A SUPPLEMENT TO

GRIMSHAW ON SAWS.

CONTAINING ADDITIONAL PRACTICAL MATTER, MORE ESPECIALLY RELATING TO THE FORMS OF SAW TEETH FOR SPECIAL MATERIAL AND CONDITIONS, AND TO THE BEHAVIOR OF SAWS UNDER PARTICULAR CONDITIONS.

ONE HUNDRED AND TWENTY ILLUSTRATIONS.

BY

ROBERT GRIMSHAW,

AUTHOR OF "MODERN MILLING," "MILLER, MILLWRIGHT, AND MILL FURNISHER," ETC.

PHILADELPHIA:
E. CLAXTON & CO.,
930 MARKET STREET.
LONDON: E. & F. N. SPON, 48 CHARING CROSS.
1882.

COLLINS, PRINTER.

PREFACE TO THE SUPPLEMENT.

THE success attending the publication of "Grimshaw on Saws" has led the author to collect such material, referring more strictly to all kinds of saw blades, as has come to his hand since 1880. At all times in active correspondence with practical sawyers throughout the country, many valuable points concerning forms of teeth for special materials and conditions, and many useful hints concerning the care and management of saws, have come to his hand; which, together with descriptions of some of the most important devices patented since publishing the main work, have been incorporated in this supplement, which have been added to the original work so as to constitute a second edition.

Manufacturers who neglected to send in replies to my queries for detailed information concerning their specialties, in time for publication in the first edition, have had afforded them a second opportunity to bring these specialties before the public, and at the same time be sure that the descriptions and illustrations are absolutely correct.

To obviate unnecessary repetition, data which might probably appear under two heads have been placed, as far as possible, where the relationship is the strongest.

The index is full and complete, and the reader is advised to consult it carefully when searching for information.

The table of saw patents compiled by Mr. Wiedersheim for the original work, is supplemented by lists up to April, 1882.

The list of errata reported in the original work is larger than the author would prefer—but still it is better to give it than to allow the misprints, etc., to remain uncorrected.

The "*Cincinnati Artisan*" and the Buffalo "*Lumber World*" have kindly permitted the use of engravings, and of matter written by the author, which have appeared in those periodicals.

PHILADELPHIA, June, 1882.

SUPPLEMENT.

SPECIAL MATERIALS AND TEETH THEREFOR.

Choice of Teeth for Various Woods.—The kind of teeth and the speed of the saw should be determined by the hardness and grain of the material, its greater or less freedom from moisture, from gummy or resinous matters, and from spikes; whether frozen or not; also its size. The harder the wood the smaller and more upright should be the teeth, and the less their velocity and the rate of sawing. *Pine*, *willow*, and *alder* require large, acute, and well-pitched teeth. *Oak*, *mahogany*, and *rosewood* need perpendicular teeth, close together. *Yellow* and *pitch pines* and *larch*, being gummy and resinous, require grease to clear the blade. *California redwood* cuts like Eastern pine. Fig. 235 shows the

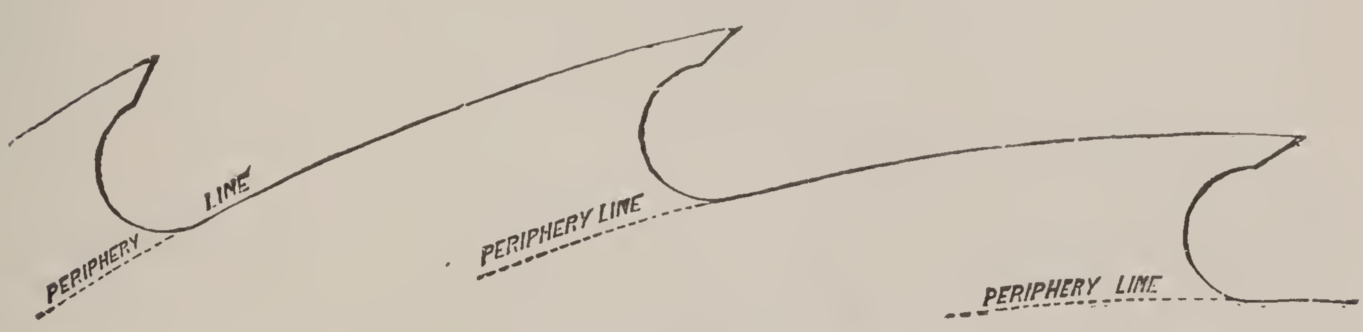


Fig. 235. For Soft Wood.

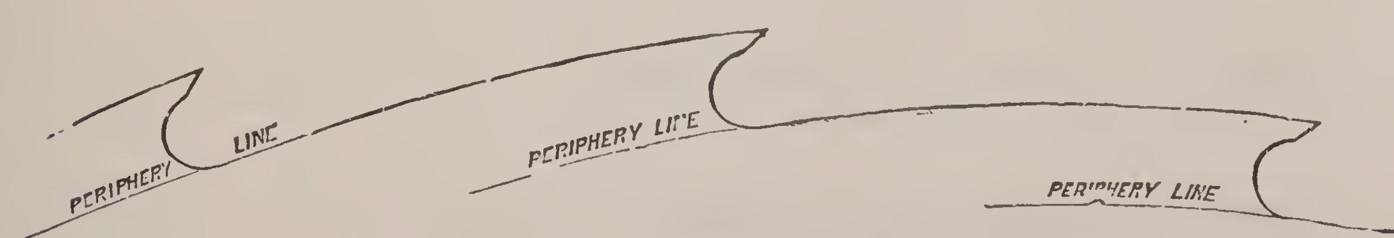


Fig. 236. For Hard Wood.

teeth for soft wood, Fig. 236 those for hard. We may say that for *pine*, *spruce*, and *hemlock*, the teeth should be cut tangent to a circle half the saw's diameter.

Cedar cuts best with a peg tooth, of fine gauge, pitch, and space. *Mahogany*, *ash*, and *English elm* are best cut with the gullet or mill tooth, of small space and nearly upright pitch.

For *maple*, *oak*, and all timber known as *hard wood*, teeth that are only swaged answer (Fig. 237). For *hard wood in warm weather*, *Norway pine* and *chestnut*, teeth part bent and part upset (Fig. 239)

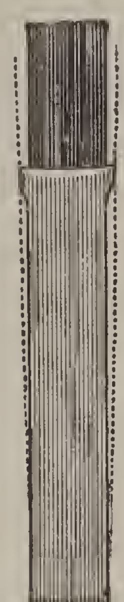


Fig. 237.

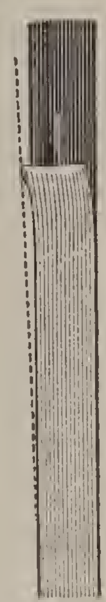


Fig. 238.

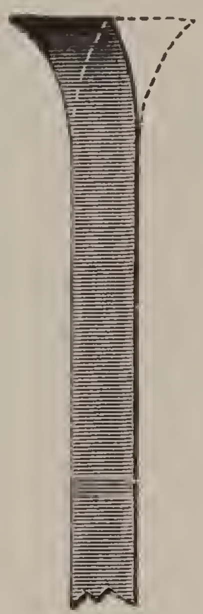


Fig. 239.

Fig. 240.

answer. For *water-soaked spruce* and *pine*, teeth bent only (Fig. 238). For *sapling pine in warm weather*, teeth bent for set, and sheared to an angle of 25° (Fig. 240). *Sapling pine in cold weather* and *second growth chestnut*, upset both sides alike (Fig. 237).

For *yellow pine*, a 56-inch circular, 6 or 7 gauge, with 32 to 36 teeth, has $3\frac{1}{2}$ to 4 inches feed, and runs 650 to 700 revolutions per minute, say 9250 to 10,000 lineal feet of rim speed. In *white pine*, Michigan sawyers use a 66 to 72-inch circular, 5 and 7 gauges, having say 50 teeth to a 66-inch saw; feed 7 to 8 inches per revolution; speed 700 to 800 revolutions per minute, or say 13,000 lineal feet of rim speed per minute; kerf $\frac{5}{16}$ inch.

Inserted Teeth for Hard Woods* should be shorter than those for soft.

Teeth for Warm and for Cold Weather.—In the New England States, where the extremes of temperature are great, it is necessary to provide for the greater brittleness of the teeth and

* "Inserted teeth" are also called "movable," "removable," "insertable," "detachable," etc.

the greater hardness of the logs, in cold than in warm weather. Reference to Fig. 241 will show the comparative pitch of teeth

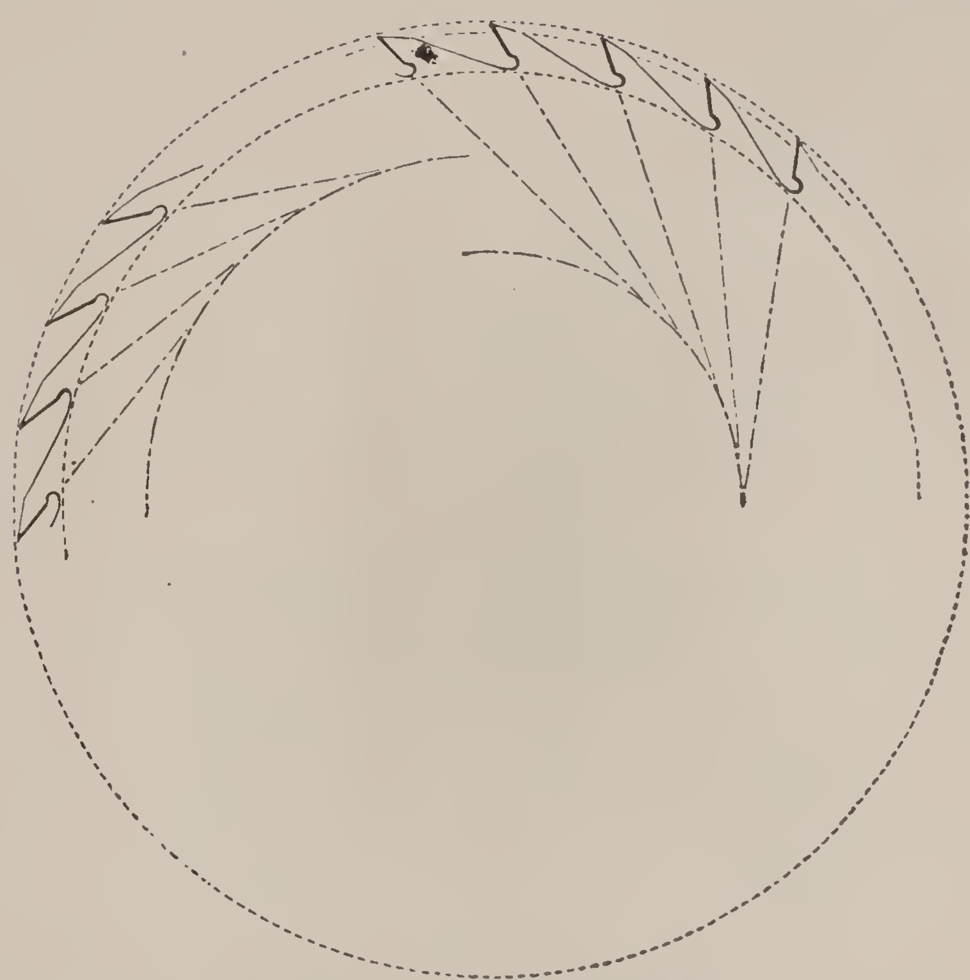


Fig. 241. Pitches for Cold and Warm Weathers.

for cold and for warm weather. The more severe the winter the stouter the teeth need be. In Fig. 241 the teeth for cold weather are $\frac{1}{2}$ pitch, those for warm being $\frac{2}{3}$.

Curious Teeth.—Fig. 242 shows a number of European special forms of teeth, selected by reason of our inability to conceive why such forms should be used. We feel little risk in predicting that they will not be widely copied by American makers.

Circular Saws for Iron. — Disston's remarks, page 45, should read: "A 44-inch saw $\frac{1}{4}$ inch thick, with peg teeth $\frac{3}{4}$ inch space is best for cutting off hot or cold iron. A high rate of speed should be used, say fifteen thousand feet rim motion per minute. These saws are made of very mild steel, not hardened or tempered. For clean cutting in cold metal highly tempered saws are used with front or cutting edge of teeth on a line with the centre, and the number of teeth corresponding, somewhat, to the amount of work to be fed on the saw at each revolution.

Such saws are run at a low speed for steel and wrought iron, say 130 to 150 feet per minute, rim motion, and should be run in a solution of soap, oil, and water. For softer metal a higher rate

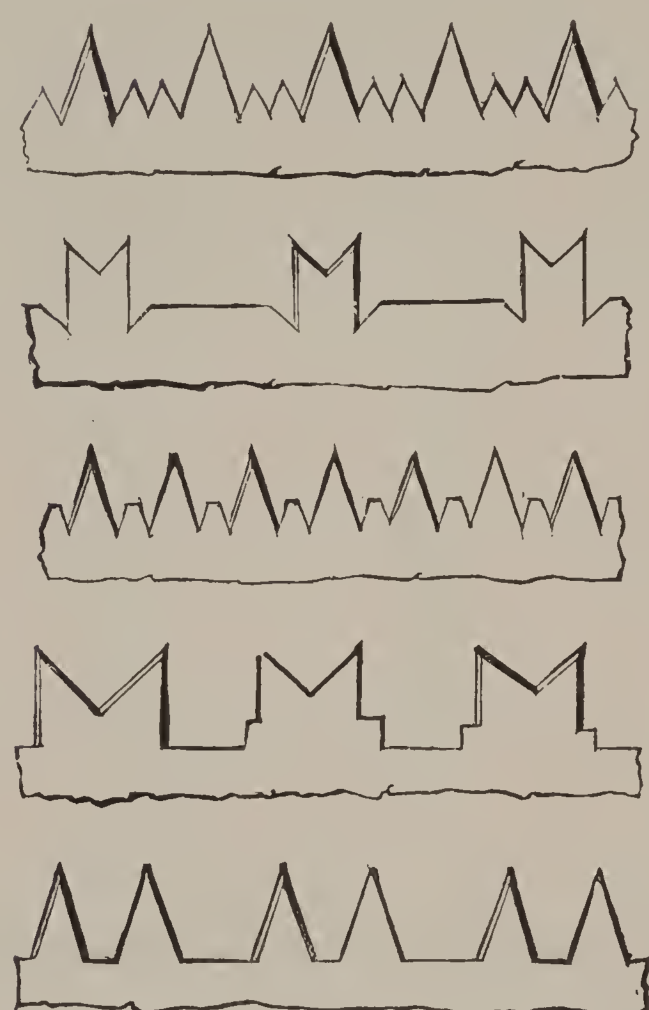


Fig. 242. Odd Forms of Teeth.

of speed is required. A large proportion of iron cutting is done by friction discs, running at a very high rate of speed, say up to 20,000 feet per minute, rim motion."

Cordesman, Egan & Co. would saw cast-iron with V-shaped teeth, "$\frac{1}{32}$ inch full," in height, 12 points to the inch, little or no set; plate 22 gauge.

For tarboard, Cordesman, Egan & Co. recommend the hand rip saw outline of teeth, $\frac{1}{16}$ inch high, 7 points per inch, plenty of set; plate 18 gauge. They say that they cut with such teeth a great deal of tarboard to make friction wheels, and get good results.

FILING.

Angles of Teeth.—Figs. 243 and 244* show the difference in the way of presenting an edge tool of a given angle to the wood.

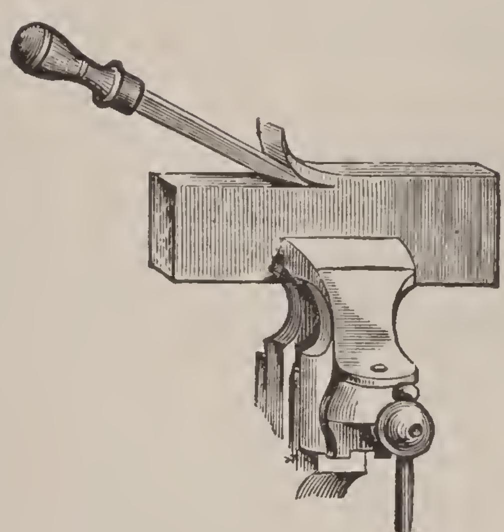


Fig. 243. Held at an Acute Angle.

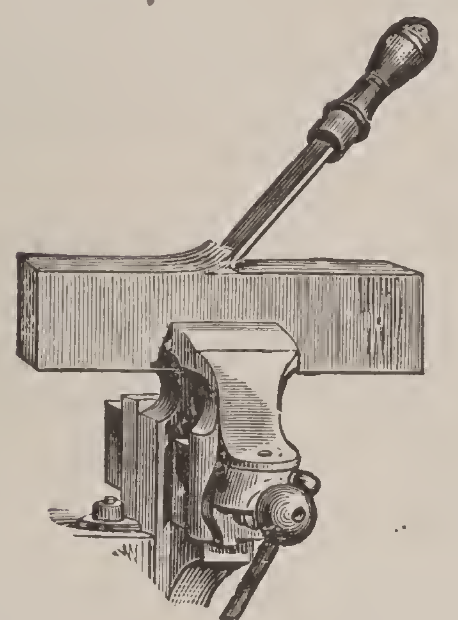


Fig. 244. Held at a less Acute Angle.

Fig. 245 shows about how deep the file should fill the tooth notches.

Fig. 245. Depths of Hand Crosscut Teeth.

In Fig. 246 the teeth are about the same height as in Fig. 245; but while the fronts do not reach the middle of the file section, the backs pass it, about averaging the wear.

Figs. 247 and 248 are of those shapes impossible to sharpen without a file of special section.

---

* By courtesy of Frey, Schechler, and Hoover.

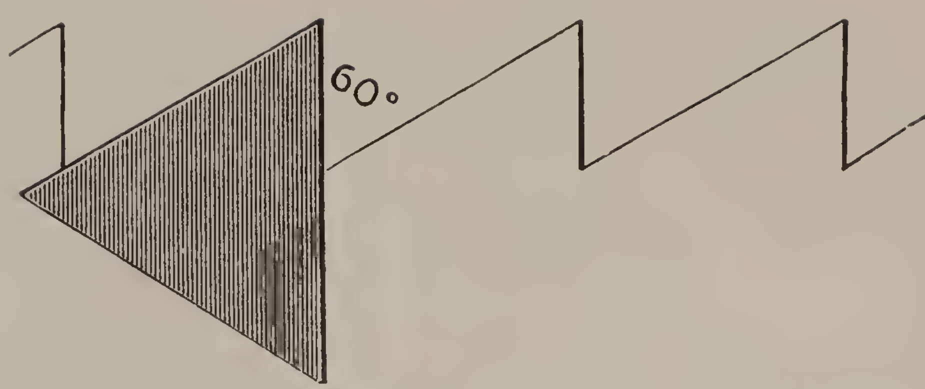


Fig. 246. Depth of Rip Saw Teeth.

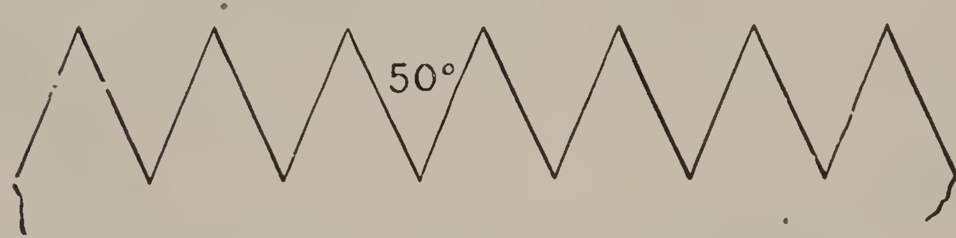


Fig. 247. Acute Angled Teeth.

The "peg" tooth (Fig. 249) permits the use of the ordinary rectangular "mill" file; but the file shown is not wide enough for the teeth to which it is applied.

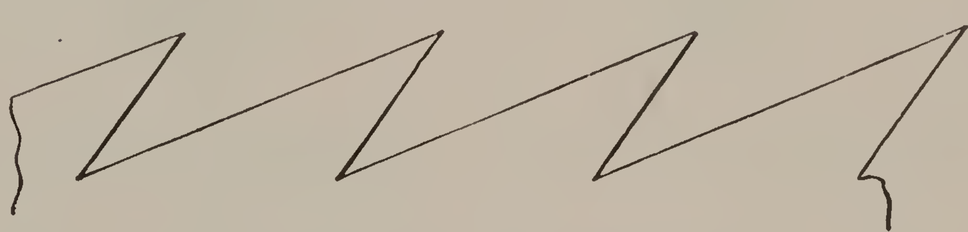


Fig. 248. Great Rake.

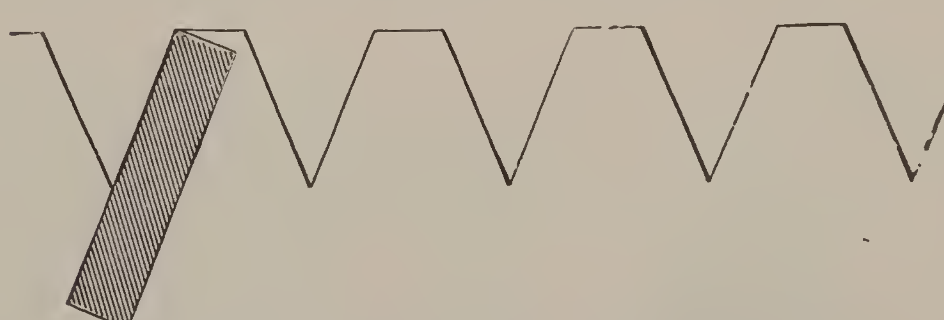


Fig. 249. Flat File on Peg Teeth.

To file "briar" and "half moon" teeth of the outlines shown in Figs. 250 and 251, it is best to have a sheet iron or zinc template to compare with.

Briar

Fig. 250.

Such M teeth as Fig. 252 (Holzapffel, 1846) would be extremely difficult to sharpen, and more liable to break than our stronger and more graceful forms, as shown by Fig. 253.

Fig. 251.

Fig. 252. M teeth of 1846.

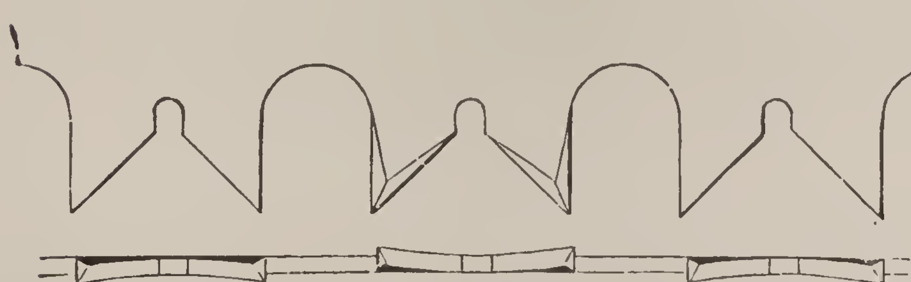


Fig. 253. Modern M teeth.

The same may be said in reference to the square throated circular saw teeth seen in Fig. 254.

Fig. 254. Square Throat.

As the fibres of a slab or plank run, as shown in Fig. 255, it will be seen from Fig. 256 that ripping teeth cut each fibre only once, while in crossing (Fig. 257) each fibre is severed twice.

Fig. 255. Fibres of a Slab.

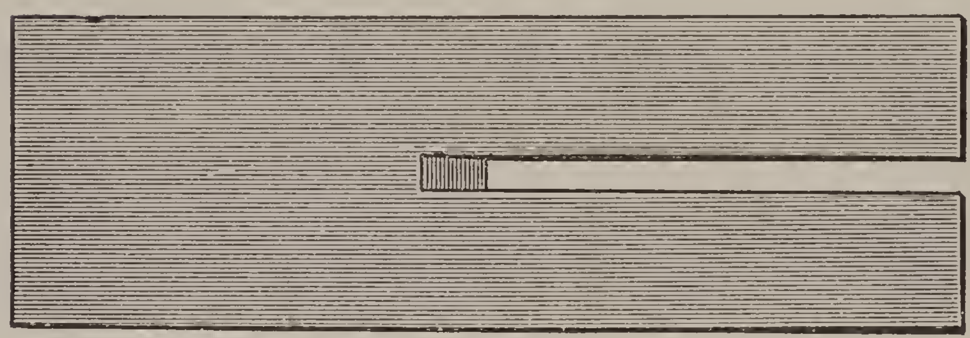


Fig. 256. Action in Ripping.

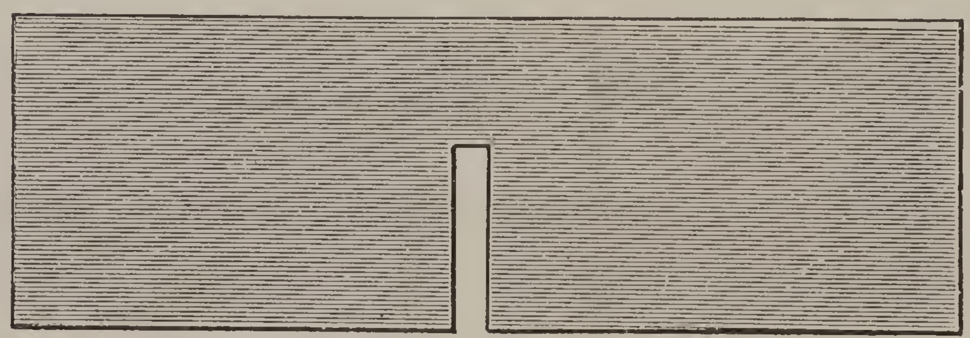


Fig. 257. Action in Crosscutting.

Cleaner Teeth.—Grandy says that cleaner teeth in crosscuts should point towards the drag or draw.

Round Gullets.—It is very desirable that the gullets be round. Grandy, in recommending round gullets for all saws, says: "I have seen a 50-inch board saw run on a cast-iron dog $1\frac{1}{2} \times 2\frac{1}{4}$ inches, breaking or cutting the dog in two, and turning some of the teeth to a right angle with the plate. I have bent them back without breaking a single tooth. This was simply because the gullet was round. The same saw had one of its teeth broken while in the cut previous to this, while the throat was square-cornered."

The Gridley Tooth.—Fig. 258 shows the ordinary spring set; Fig. 259 the spread set proper; Fig. 260 the Gridley circular saw

Fig. 258.
Spring Set.

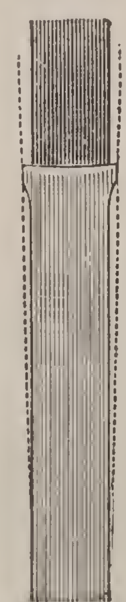


Fig. 259.
Spread Set.

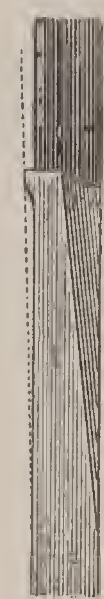


Fig. 260.
Gridley.

tooth referred to on page 60, and combining both spring and spread set. The dotted lines show the clearance.

Sheared Teeth.—"A tooth sheared or filed to a bevel of say 5° to 20° will do the work with less power (provided the tooth is strong enough otherwise to resist the tendency to spread in the cut). If a person were to take a jack-knife to cut a stick of any size, he would turn his knife to about that angle with the grain. The sheared tooth is in better shape to enter the wood than if swaged square; whereas it is often nearly impossible to saw sapling pine (such as grows in Massachusetts and Connecticut) in summer time with swaged teeth, if the teeth are bent and sheared the trouble disappears entirely. Another objection to swaged teeth is the excessive wear of the plate. But shearing must be modified to suit the kind and conditions of the timber. For instance, a spruce log will cut much easier when thawed out than when frozen; so the teeth can be sheared much more in warm weather than in cold. A 7 or 8 gauge saw will have teeth strong enough to resist the tendency to spread sidewise (or make set, as it is termed) in summer in almost any kind of wood. Then, again, logs are apt to have dirt, gravel, and sand in summer time (especially in Massachusetts and Connecticut, and on portable-mill jobs), whereas in winter time they are taken from the stump to saw pretty much free from dirt. This dirt will soon wear off the swaged set, whereas, if bent, the teeth will do much more work without filing, of course using the swage to keep the point as wide as the plate is thick. This method is almost universal in Vermont, to swage the point ½ set, bend the rest and shear 5° to 10°. In winter the sawyer will bring his saw nearly square, but still bend part and swage the rest."

Shape of File Tangs.—Files having square-shouldered tangs, shown in Fig. 261, are apt to crack in the shoulder in hardening,

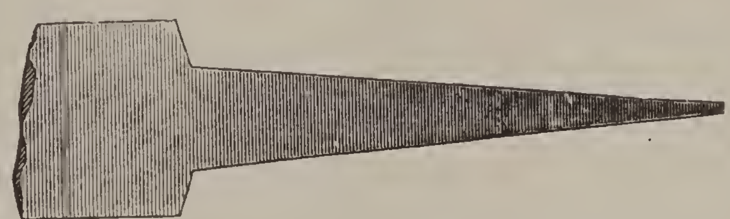


Fig. 261. Wrong.

and to break in using. The tang should have a curved shoulder, as in Fig. 262.

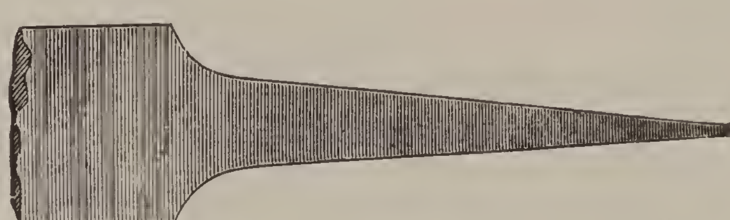


Fig. 262. Right.

Round files, instead of being drawn down as shown in Fig. 263, should be given a more parallel tang, as shown in Fig. 264, in which case they will be less liable to come out of the handles.

Fig. 263. Wrong.

Fig. 264. Right.

The Wentworth Saw Vise.*—The terrible "screeching" so frequently heard in saw filing is obviated by the convenient device illustrated in Fig. 265. There is a flexible rubber cushion

* Made by Seneca Manufacturing Co., Seneca Falls, N. Y.

or muffler between the jaws, preventing any vibration. The jaws are clamped by the cam-plate and lever shown below.

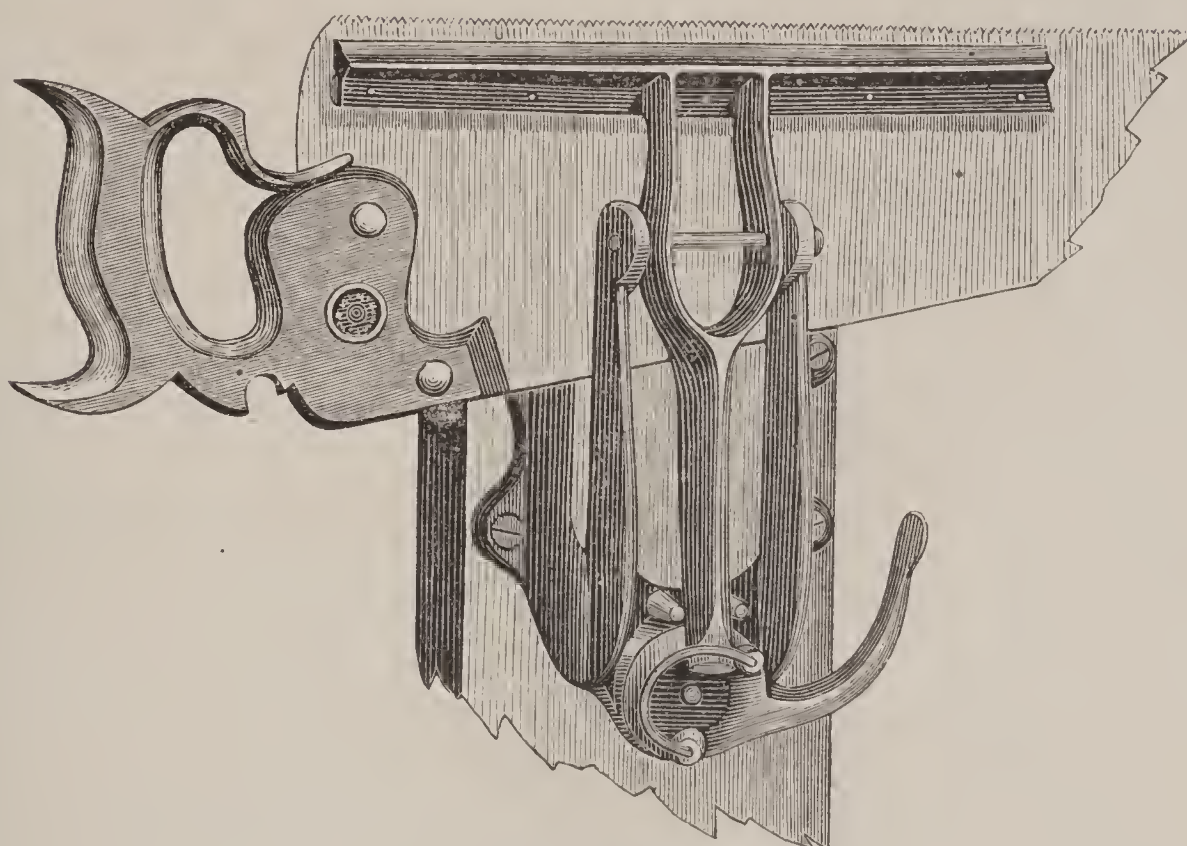


Fig. 265.

Former for Circular Saw Teeth.*—Cut a sheet zinc or other thin metal template, and fasten to the end of a wooden strip which saddles the arbor (see Fig. 266). The backs of the teeth should

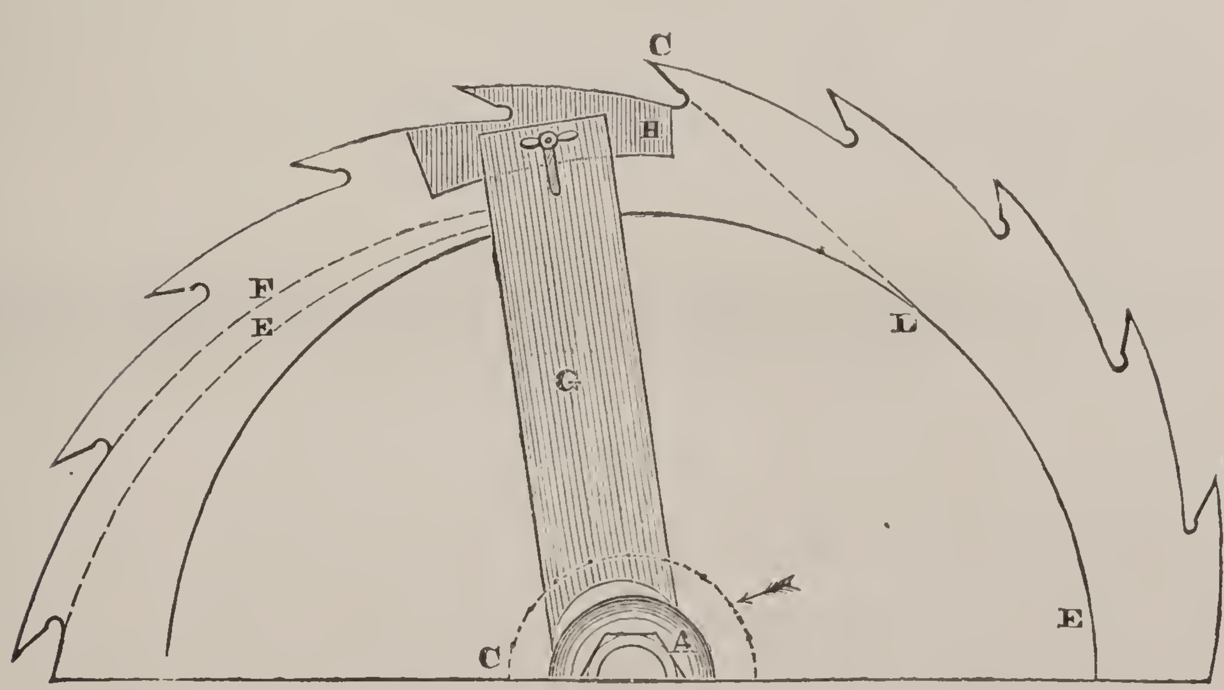


Fig. 266. Forming Circular Teeth.

* Communicated by Frey, Scheckler, and Hoover, Bucyrus.

be circular and struck from centres on the small circle C. The faces are tangent to the large circle shown.

This rule for tooth forming is simple, and the method of applying it equally so.

Parker's Vise for Circular Saws (U. S. Patent, Nos. 236, 451. January 11, 1881,) has a fixed saw and a movable saw vertically adjustable by a slot. Fig. 267.

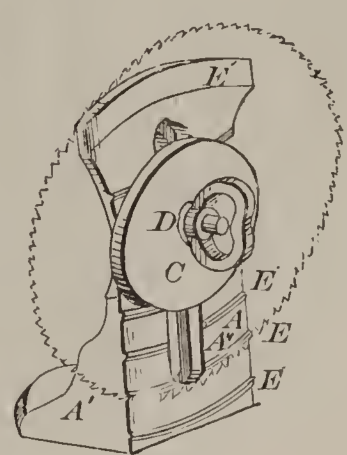


Fig. 267.

SETTING.

The Boynton combined file and set (referred to on page 126) is shown in Fig. 268, and is a very simple and handy instrument.

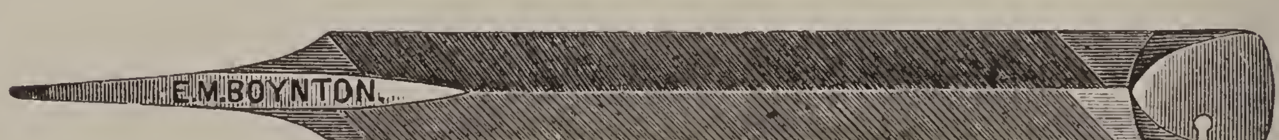


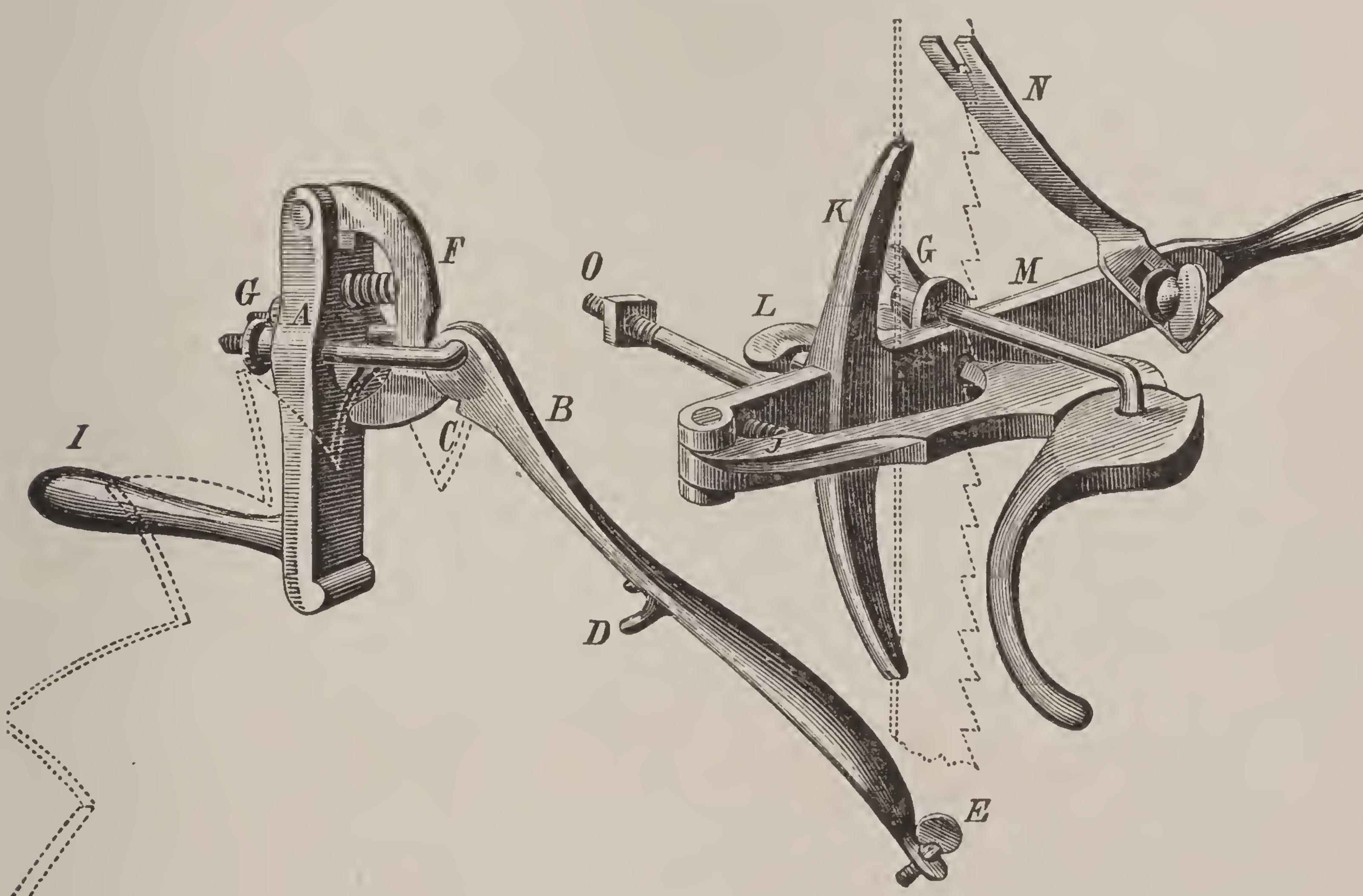
Fig. 268. Combined File and Set.

Cam Power Sets.*—Fig. 269 shows a circular saw in position with the set applied. The operator stands behind the saw, the set being attached to the teeth by placing the bed die, A, on the point of tooth, so that the point will project beyond the die one-sixteenth of an inch. The cam lever, B, is then brought down

* Made by C. E. Grandy, South Barton, Orleans Co., Vt.

to the stop, C, on the cam, bending the tooth toward the latter. A four point gauge is provided on the lever, seen at D, and E is a screw to adjust the same to the amount of set desired. The die bar, F, is governed by the thumb nuts, G, on the cam links projecting through the bed. The advantage claimed for this arrangement is that the bending power is brought to bear on the tooth between the two bed bearings, so that the operator has only to bear down on the cam lever; and the more power he applies, the tighter he fastens the set to the saw. A handle is provided at I for convenience in handling.

For band or jig saws, the form of the set, as represented in Fig. 270, is changed, having a longer bed, terminating in a handle having an adjustable cam link which can be moved laterally on



Figs. 269 and 270. Grandy Cam Sets.

the beds. The die bar is the same as the circular saw set, also the cam lever, having a stop. These, together with the thumb nuts, regulate the amount of set to be given to the saw. The die bar is kept in contact with the cam by the recoil of the spring, J. Sliding laterally upon the bed is a guide bar, K, having a narrow hanging lip and grooves, and fastened in place by the thumb screw, L. The saw is placed on the set so as to leave the tooth to be set over the bed die, M. The sliding guide bar is then brought up to the back of the saw, and fastened by the thumb screw. The cam is brought down to the stop, giving as much set as desired by screwing up the thumb nut, G. A loose adjustable pawl, N, is hanged to the bed, and is used on very fine saws, to regulate the position of the teeth over the die, M, by engaging the pawl with the teeth; and as the saw is moved the pawl clicks on the teeth, every two clicks indicating the tooth to be set. The advantage of the pawl, in setting very fine saws, is that it saves the close scrutiny otherwise needed; and if the operator stops a moment, it is claimed, it shows with absolute certainty where to commence again. The set can be used with the saw on the pulley, or it can be attached to a bench by the bolt, O.

The maker claims less liability to break the saw teeth because the bend is a curve and not an angle; that a saw will hold set longer when this is used, because of the shortness of the bend; and that it is readily adjusted to different gauges of saws.

In winter the sawyer will bring his saw nearly square, but still bend part and swage the rest.

[A number of automatic machines for setting band saw teeth will be found under the head of band saws.]

SWAGING.*

Advantages of Swaged Teeth.—Swaged teeth do not "dodge" knots as do those that are spring set. Upset teeth also bear more feed than spring set do, because the cross-grained fibres that make the kerf side rough cannot touch the side of the teeth to drive them out of line.

Objections to Swaged Teeth.—An objection to swaged teeth is that they take one-fourth more power to drive than bent

* Swaging is also written "swedging," and also called "jumping," "upsetting," and "spreading."

ones in the same plate; for it is easier to split out the difference in kerf than to cut it out. In other words, it is cutting the saw-dust nearly one-fourth finer with swaged than with bent set.

Again, the swaged tooth leaves a ridge (especially in summer) on the log or board behind each swaged corner, something like half the amount of swaging, and this necessitates more set in order to clear the plate.

Sharpening with the Swage.—Some wrongly suppose that a dull saw can be sharpened with the swage. This is not the case, as the tooth becomes obtuse or "stunted," and the surplus metal must be cut away by a file. It would also make the tooth so brittle that the corners would break or "crumble," as termed by sawyers.

The "Planer Bit" Teeth (Fig. 115), p. 71, are swaged at the point.

Swage for Circulars.—Fig. 271 shows a useful swage for circular saw teeth. There is a central handle or shank with pro-

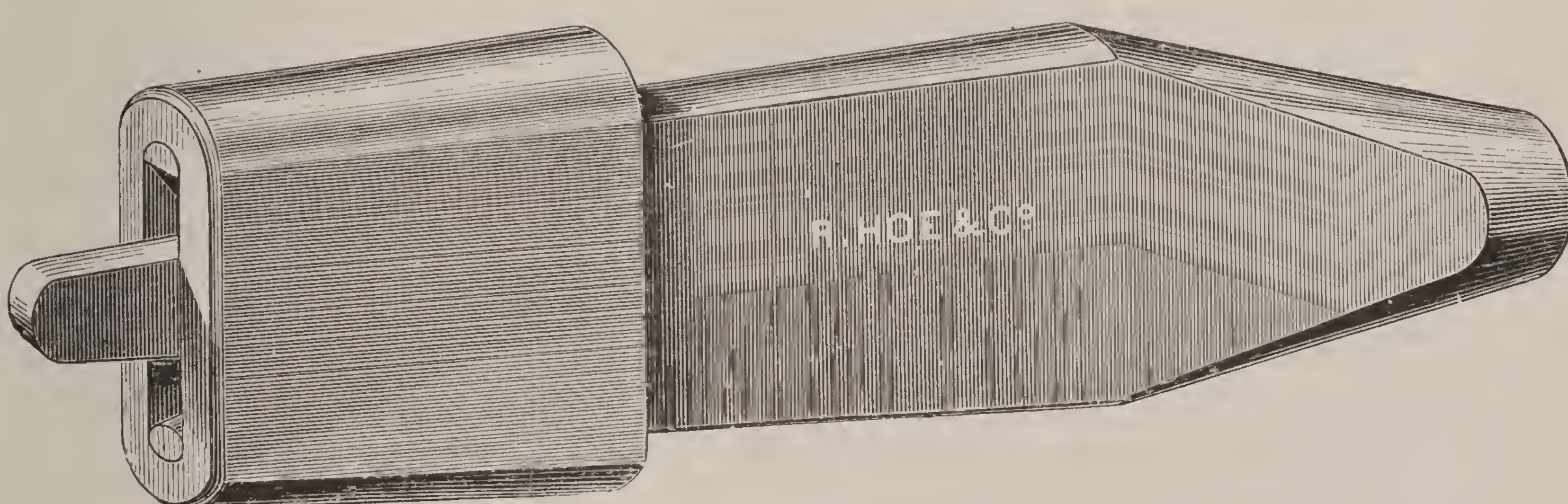


Fig. 271. Double Swage.

jecting tongue and a collar. In the upper space between the tongue and the collar, the tooth is swaged with a flat edge; while in the bottom one the operation is continued so as to give the cutting-edge a concave form.

Simonds' Saw Swage (U. S. Patent, No. 238,062. Feb. 22, 1881,) has a central tooth *a* provided with a double curve upon each of its operating faces; one curve horizontal and the other curve vertical or longitudinal. One face has longer curves than the other. In swaging teeth with this tool, the longitudinal

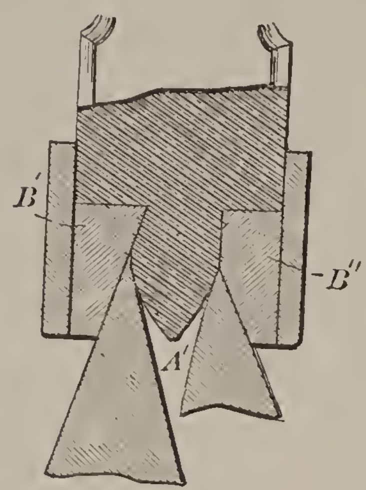


Fig. 272. Simonds' Swage.

centre of the tooth is first indented back from the edge, the tooth next spread by successive blows to right and left of the centre, and then finished or dressed up.

GUMMING.

Gumming by the Sawyers.—The stamp and die are very apt to spring the blade and are practicable only by saw makers.

A grindstone two feet in diameter, bevelled to the desired form, is good to start with.

It may be run with an eight-inch belt, two hundred turns per minute, with a half inch stream of water discharged directly into the cut. This will cut one inch and a half deep in one minute without injury to the saw.

Sharpening Gumming Cutters.—Fig. 273 shows the method of grinding gummer cutters on a grindstone or emery wheel. The

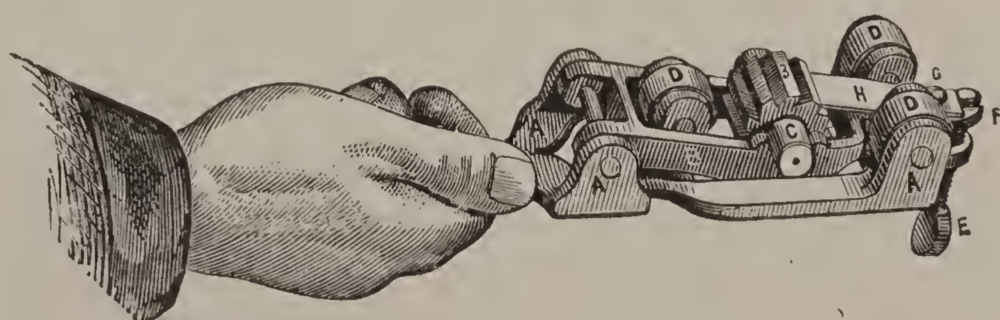


Fig. 273. Holder for Sharpening Gumming Cutters.

frame for holding the cutters is shown reversed. The rollers D, D, run on the face of the stone; the cutter C is ground one face at a time, the pawl H holding each face in position. The gauge E regulates the depth of grinding, and allows for cutters of various diameters.

Gumming Punches.—Fig. 274 shows the shape of punches for gumming gang and mulay saws, and Fig. 275 that for circulars.*

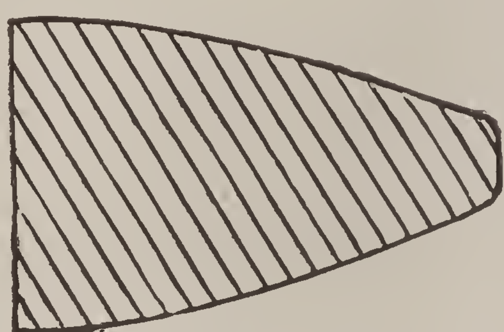


Fig. 274. Gumming Punch for Gangs and Mulays.

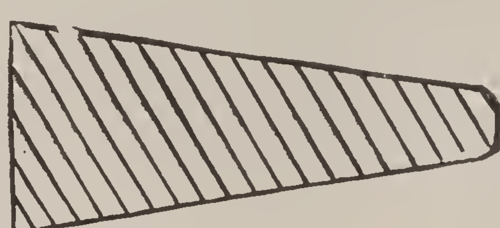


Fig. 275. Gumming Punch for Circulars.

The "Spiral Line" Method of Gulleting (see pages 132 and 137) is a misnomer. There is no spiral line at all marked on the saw—merely arcs of circles having a diameter less than that of the saw-plate.

Frey's Gummer.—Fig. 276 illustrates an emery wheel gummer and grinder, as arranged for grinding or gumming the saw without removing it from its mandrel.

This device consists in an abrading wheel of emery or corundum, fixed on a shaft, set in a flexible frame and put in rapid motion.

By means of a handle it is easily controlled by the operator, and placed at any angle necessary to the saw or article to be filed or dressed.

* Snyder Bros., Williamsport, Pa.

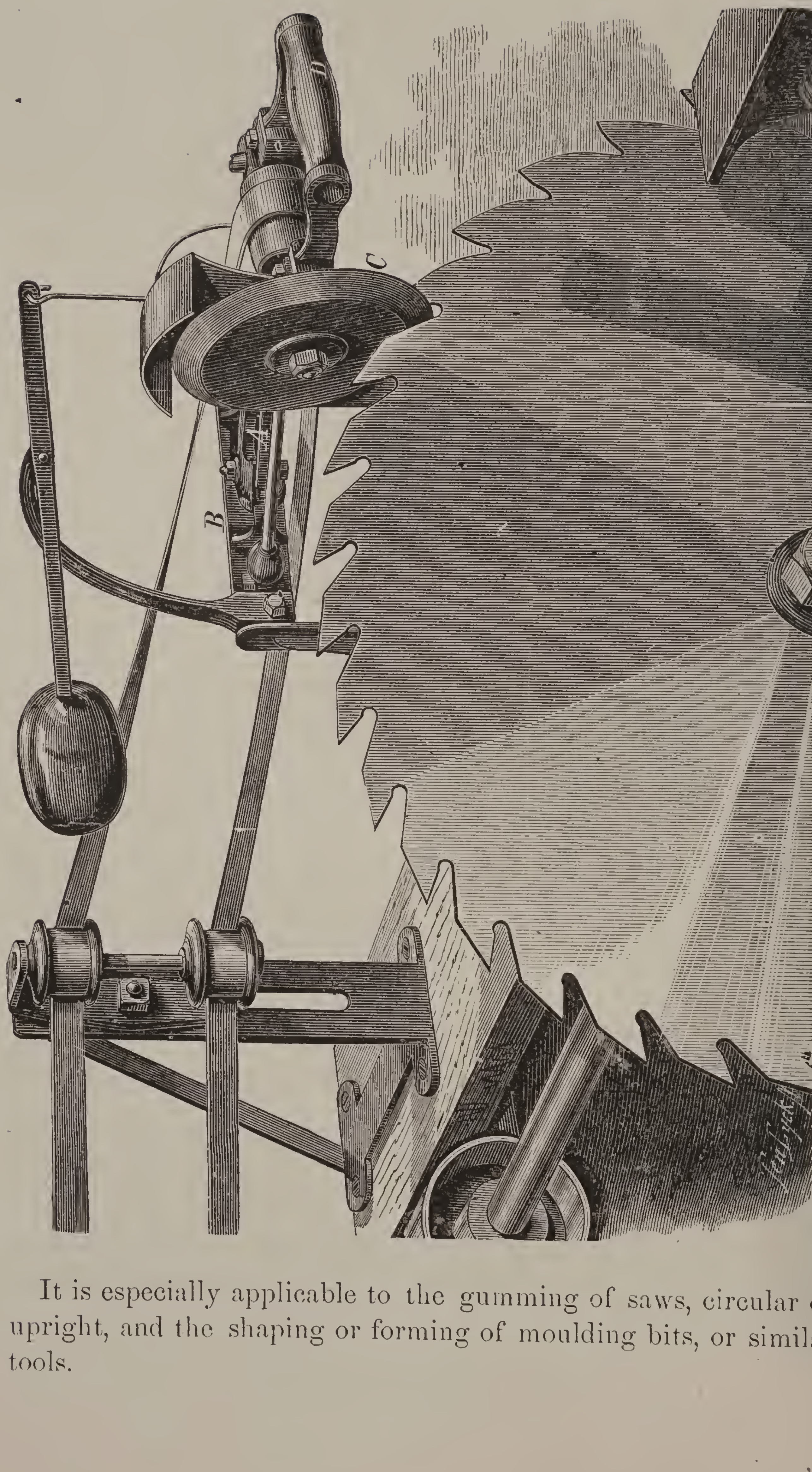


Fig. 276. Frey's Emery Wheel Gummer for Circulars.

It is especially applicable to the gumming of saws, circular or upright, and the shaping or forming of moulding bits, or similar tools.

The working portions of the machine are composed of a movable frame, A, which by a ball joint is hung on the main frame, B, so that the grinding wheel, C, has a universal movement, controllable by the handle, D. A still freer motion is afforded by a second joint on frame A, or the latter may be arranged by means of two movable slides so as to give a positive up-and-down or diagonal movement, as desired, also by two parallel rods hinged on main frame, B, by ball joints, placed on each side of flexible frame, A, and coupled to it immediately back of pulley. By this arrangement a direct parallel lateral movement is secured, and the wheel kept square to its work.

The lever and weight shown, serve to balance the frame and wheel, and make it easy for the operator to control the angle or position of the wheel.

Directions for Setting and Operating.—For a saw-mill run by a belt: Place the machine immediately behind the saw, upon a plank on the side where the teeth turn up, the shaft of the machine being directly over the saw in a line so that the emery wheel will form a right angle with it. The counter-shaft is placed on the back end of the plank, in a direct line with the driving pulley on the engine. The belt or cord is placed upon the small pulley of the machine, then around the small pulleys on the counter-shaft, turning at a right angle to the driving pulley.

The motion of the wheel should be 1500 to 2000 revolutions per minute, the lower side always turning from the operator.

The operator applies the wheel to the saw by means of the handle, when the parts so brought in contact with the emery wheel will be speedily abraded without injury to the saw.

When gumming saws, where the teeth are very blunt, do not attempt to do too much at once, but move from tooth to tooth, giving them time to cool, and then repeat the operation until the tooth is brought to the proper shape.

If the wheel is held to the saw too hard and too long, the saw is liable to blue and case-harden.

To use the machine on a direct acting-mill: The saw is generally taken off. The machine is placed on a frame or table, in such a position that it can be run from the engine or some other convenient shaft.

Mulay, drag, and crosscut saws can be dressed with equal facility.

If it is preferred to dress a circular saw on a direct acting-mill, without taking it off the mandrel, a wheel with a crank is used to rotate the emery wheel by hand. The power required would be about the same as would run a common-sized grindstone.

Shop Machine in Working Position for Dressing Mulay, Circular, or other Saws.—Fig. 277 represents the machine as

Fig. 277. Frey's Gummer and Sharpener for Straight Saws.

applied to the dressing of mulay, drag, crosscut and circular saws, when removed from their mandrels.

An iron table supports the machine, on which a horizontal counter shaft is attached, having a tight and a loose pulley, by which it can be run from any desired point, and readily started or stopped by the operator without changing his position. The table also supports the saw-holder device, as shown in the engraving.

Experience in the use of these machines has proved that it is preferable to remove the saw and place it on the machine classed "motive" or shop gummers by the manufacturers.

The universal saw-holder needs some explanation. Fig. 277 represents a drag-saw blade being ground and held between two disks on the holder, in a horizontal position. The arm which supports the disks is adjustable in all directions. For a large circular saw it is depressed and extended to the left of the operator. A conical washer which fits all sizes of holes in the saws, fastens the saw by means of a hand nut.

Frey, Scheckler & Hoover, Bucyrus, O., are the manufacturers of these machines.

Snyder's Gumming Press for Heavy Saws.—In Fig. 278 the lever A, on shaft C, bears an eccentric B, with strap D, giving

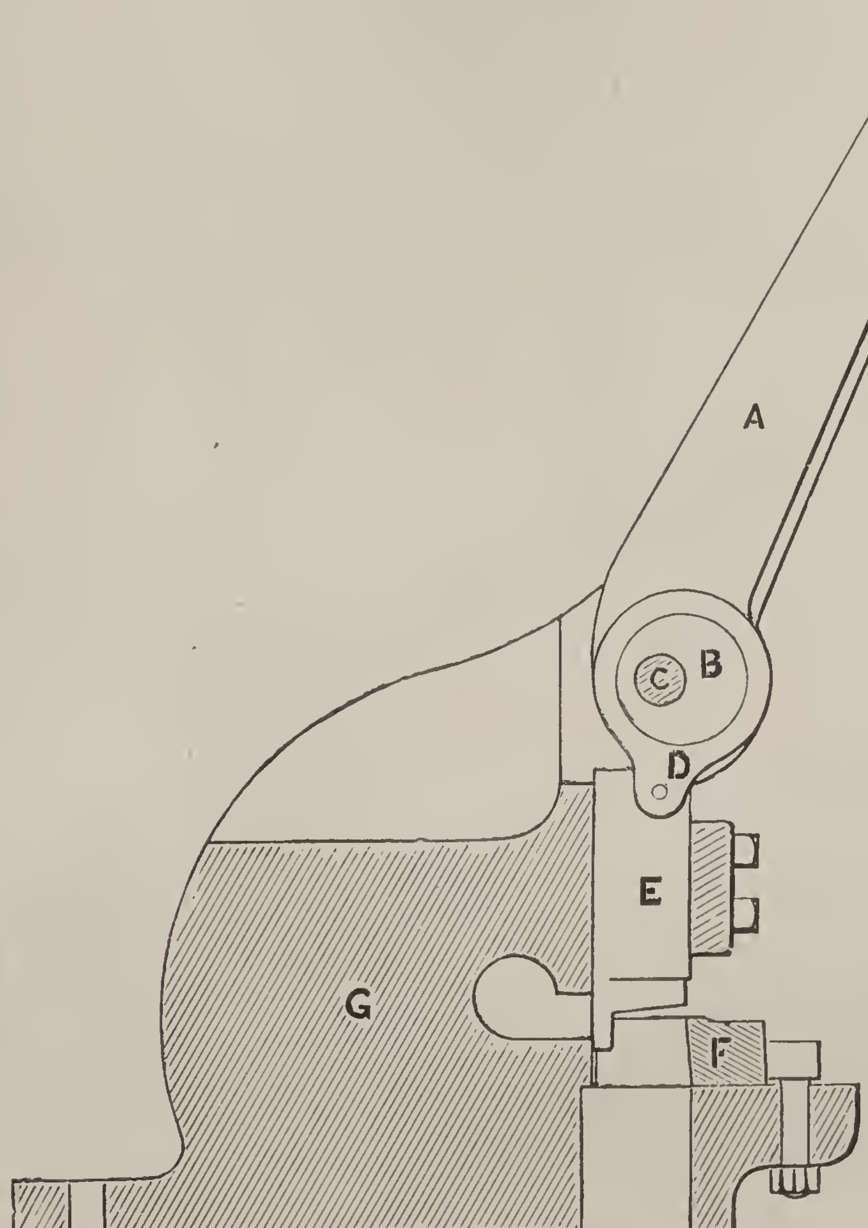


Fig. 278. Section of Snyder's Gumming Press.

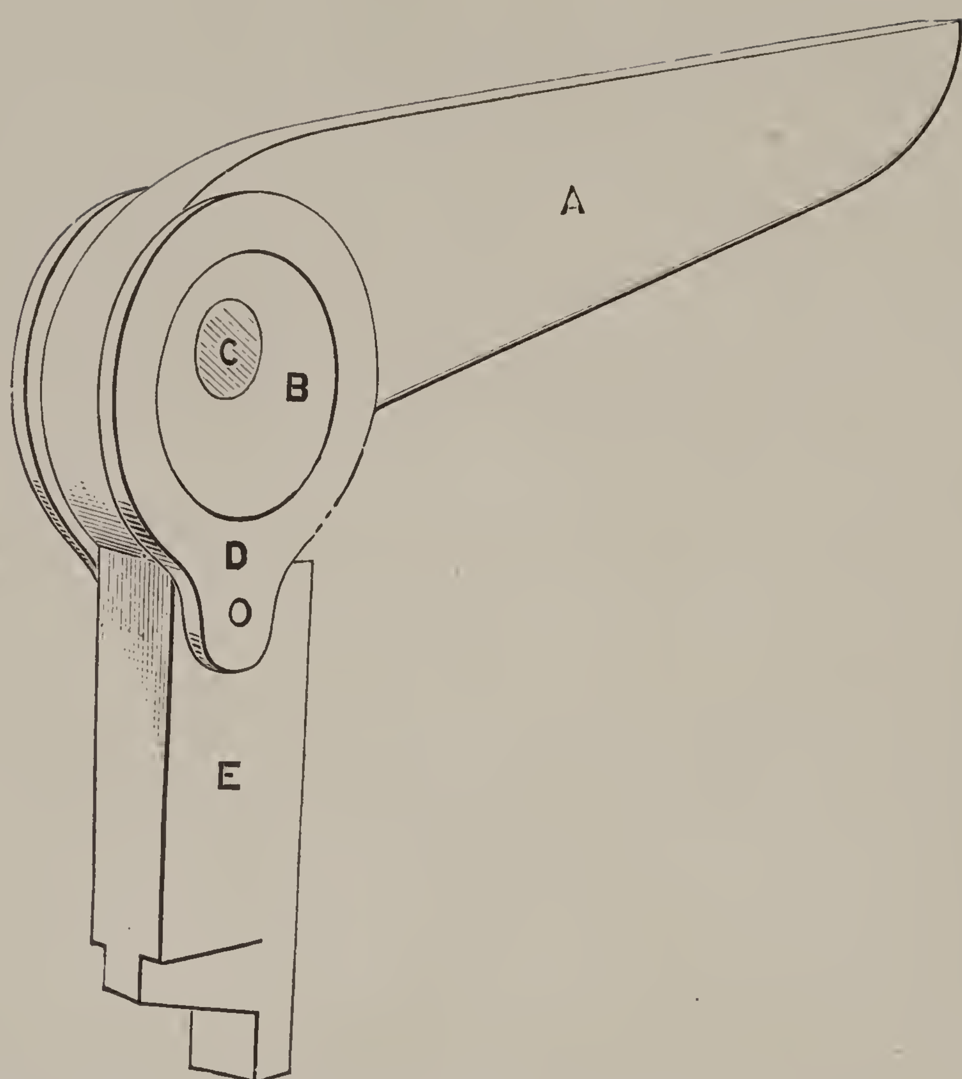


Fig. 279. Details of Snyder's Gumming Punch.

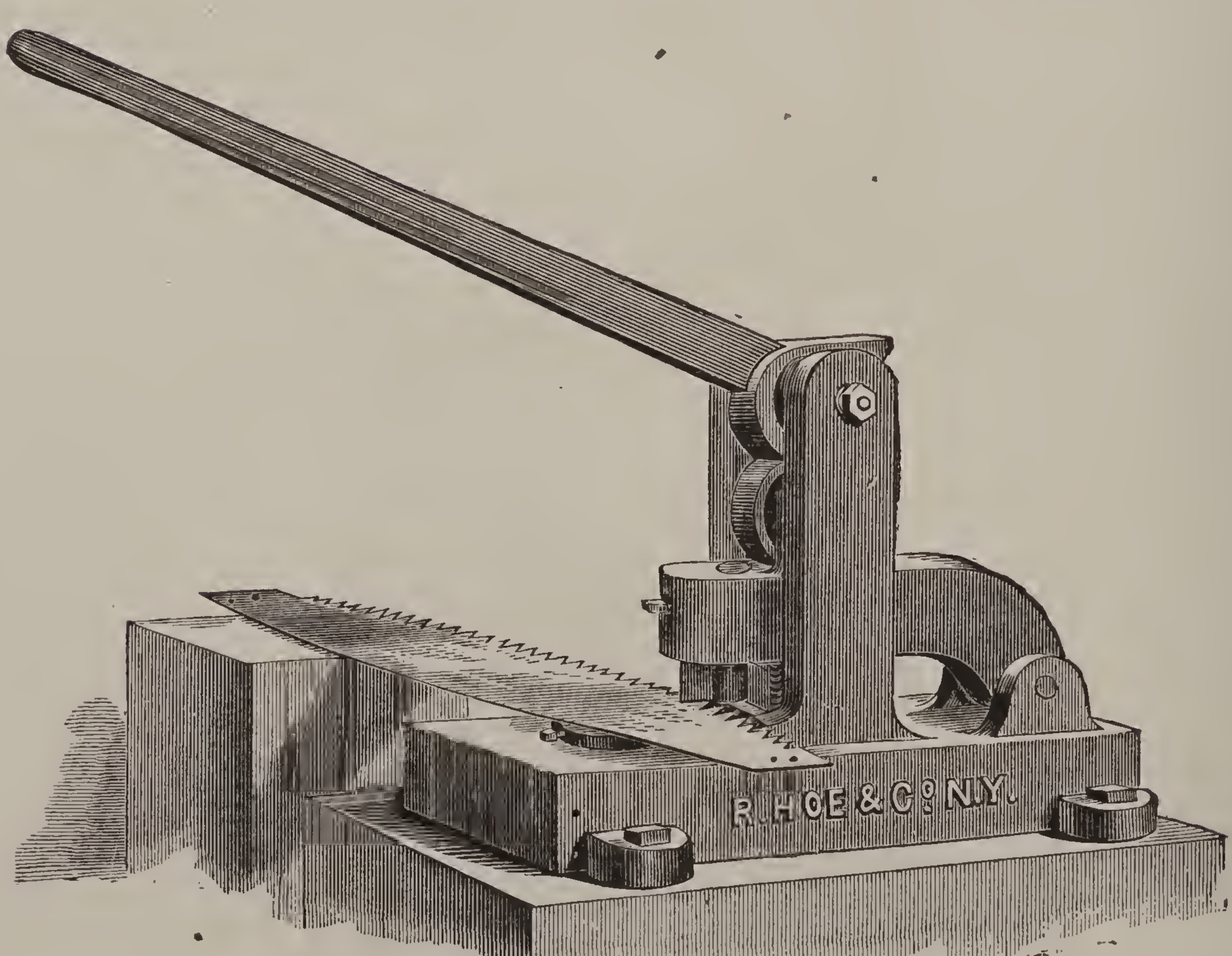


Fig. 280. Gumming Press for large Saws.

motion to the punch E. The die F is suitably adjustable with reference to the frame G. Fig. 279 shows the lever, eccentric, strap, and punch in perspective and rather more in detail.

A Gumming Press for Large Saws is shown in Fig. 280.

EMERY WHEELS.

An Emery Grinding Machine for the chisel bits of the Hoe inserted tooth circular is shown in Fig. 281. The bit is gripped

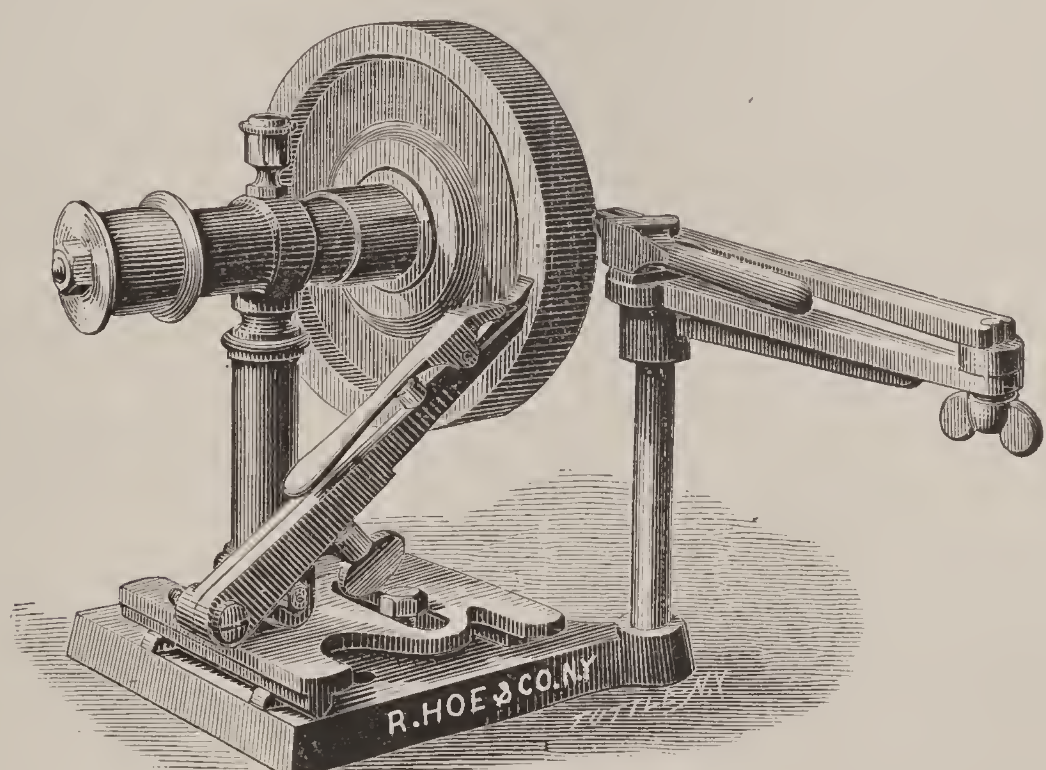


Fig. 281. Emery Wheel Bit Grinder.

by special pincers, and all are held and ground exactly alike on face, side, and back—that is all faces alike, all sides alike, and all backs alike.

The Vulcanite Emery Wheel with Solid Centre is seen in elevation and in section in Fig. 282.

The emery wheel does not stretch a saw on the edge, nor crook it as the press gummer often does. An emery wheel 12 inches in diameter should last to saw from two to four million feet of lumber. It should be run about 1800 revolutions, or 5000 to 5500 feet per minute.

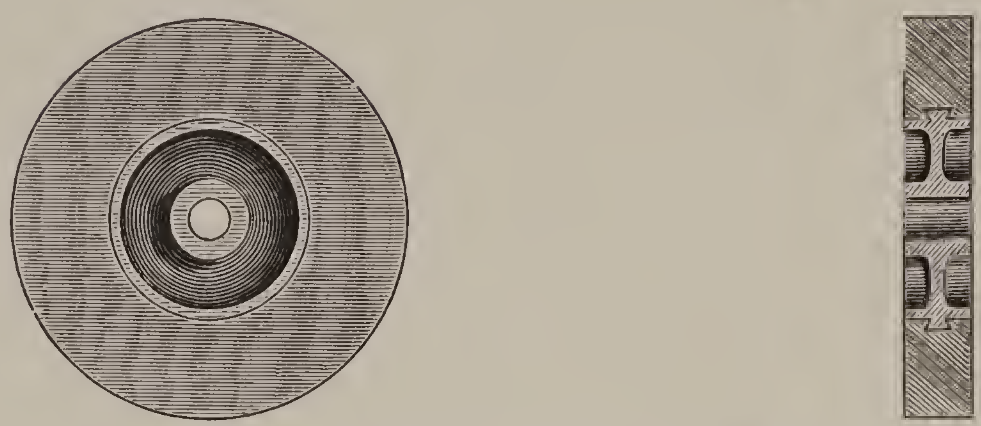


Fig. 282. Vulcanite Emery Wheel.

One emery wheel manufacturer who heads his advertisement, "Why not run your files by steam power?" aptly alludes to the emery wheel as "a rotary file that never gets dull and that runs a mile a minute."

An essential feature in the use of abrading wheels, is to touch the saw lightly and move from place to place in order to avoid heating the tooth. It is a singular fact that when the surface of a steel plate is heated by the friction of an abrading wheel, until it becomes blue, it is made hard to such an extent as to resist the best files. The hardness extends only to a very limited portion of the surface, and is easily removed by retouching it with the wheel lightly.

To Prevent Case Hardening keep the wheel moving back and forth. However, hardening a saw plate by the heat of emery wheel sharpening makes the tooth last longer, if the hardening be not excessive.

Speeds of Emery Wheels.—The following table gives the proper number of revolutions per minute for vulcanite emery wheels of different diameters:—*

Diameter.	Rev. per Min.	Diameter.	Rev. per Min.
1½ inches . .	10,000	3 inches . .	4,800
2 " . .	7,000	3½ " . .	4,100
2½ " . .	6,000	4 " . .	3,600

* N. Y. Belting and Packing Co.

Diameter.	Rev. per Min.	Diameter.	Rev. per Min.
4½ inches . .	3,400	11 inches . .	1,200
5 " . .	3,000	12 " . .	1,000
6 " . .	2,400	14 " . .	950
7 " . .	2,100	15 " . .	900
8 " . .	1,800	16 " . .	850
9 " . .	1,600	18 " . .	800
10 " . .	1,500	20 " . .	700

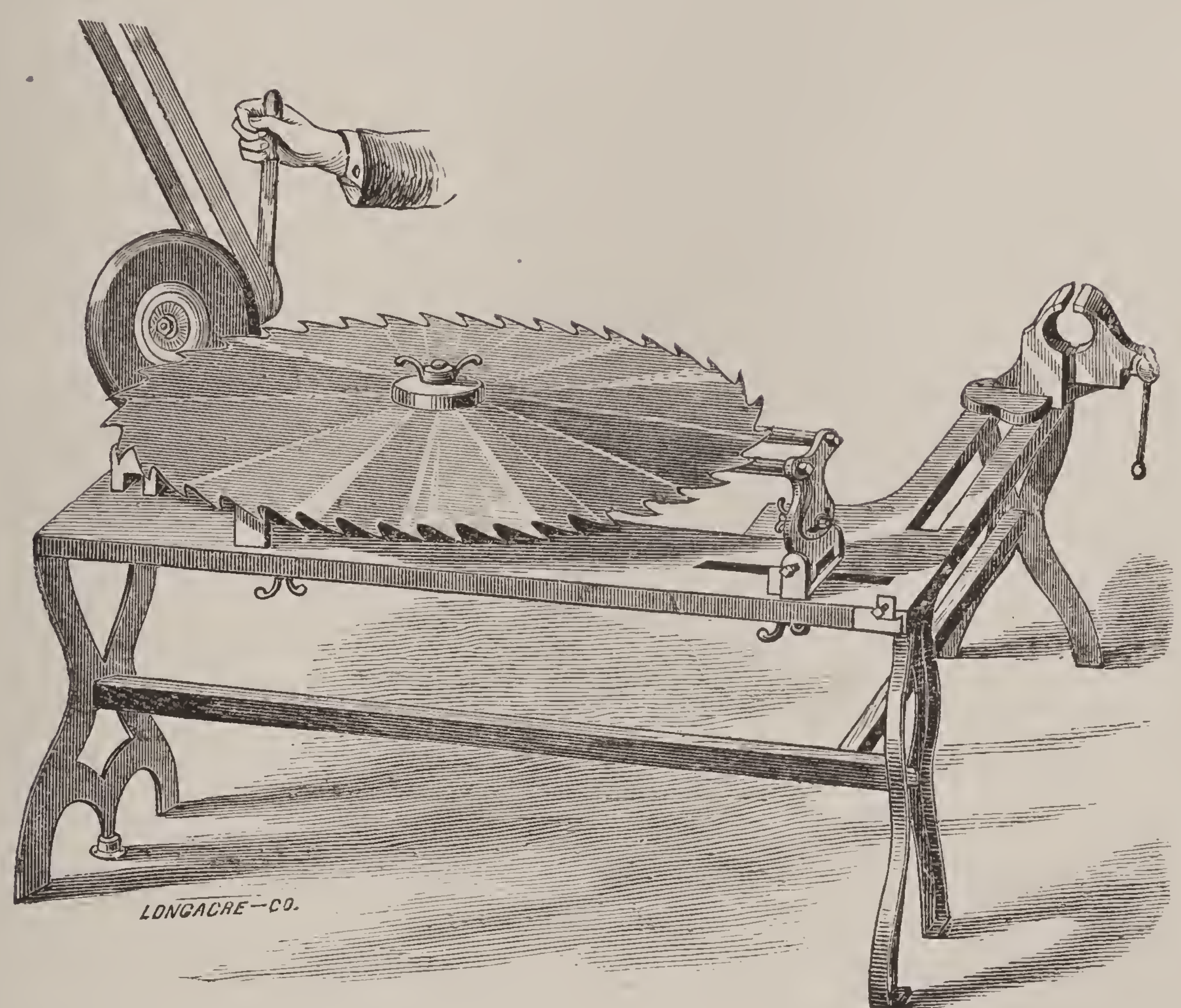


Fig. 283. Andrews' Emery Gummer.

SURGICAL SAWS.

There are few industries which evince yearly more advancement or offer more new mechanical devices, with special adaptations, than does the manufacture of surgical instruments.

Specialists, performing special operations, constantly feel the want of instruments which shall perform, in the most satisfactory manner, delicate operations.

The consumer becomes the inventor, and the number of new instruments put upon the market yearly is limited only by the advance in special branches of surgery.

As these instruments are used where delay from breakage would often prove fatal, the very best material is chosen for their manufacture.

Goodwillie's Oral Saw.—Fig. 284 is a special saw for operations in the mouth, the bend of the bow permitting freedom of action, but stiff enough to prevent the saw from springing.

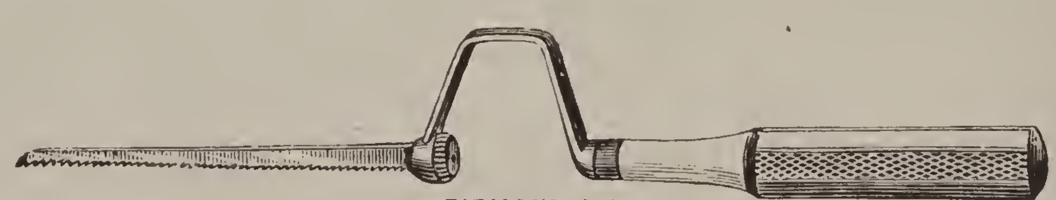


Fig. 284. Goodwillie's Oral Saw.

Amputating Saws.—Figs. 285 and 286 are different forms of amputating saws. The teeth of these saws cut only on the downward stroke, and are without any set. Where used for heavy operations, they are made very stiff and strong. The smaller saw is used in lighter operations and in positions where the larger instrument would be impracticable.

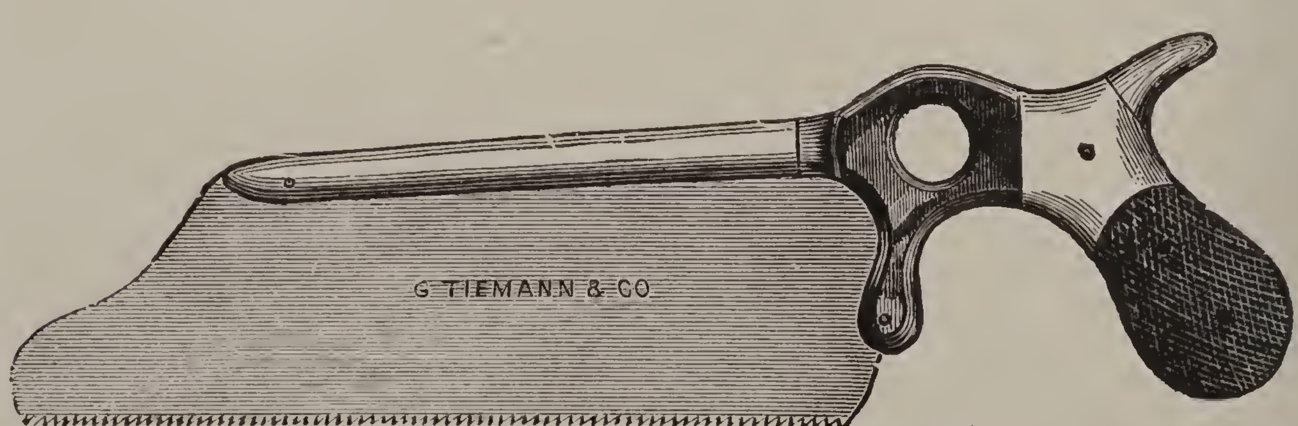


Fig. 285. Pfarre's Amputating Saw.

Fig. 286. Light Amputating Saw.

Szymanowski's Bone Exsecting Saw.—Fig. 287 shows bone exsecting saw, improved by Tiemann & Co. The novel fea-

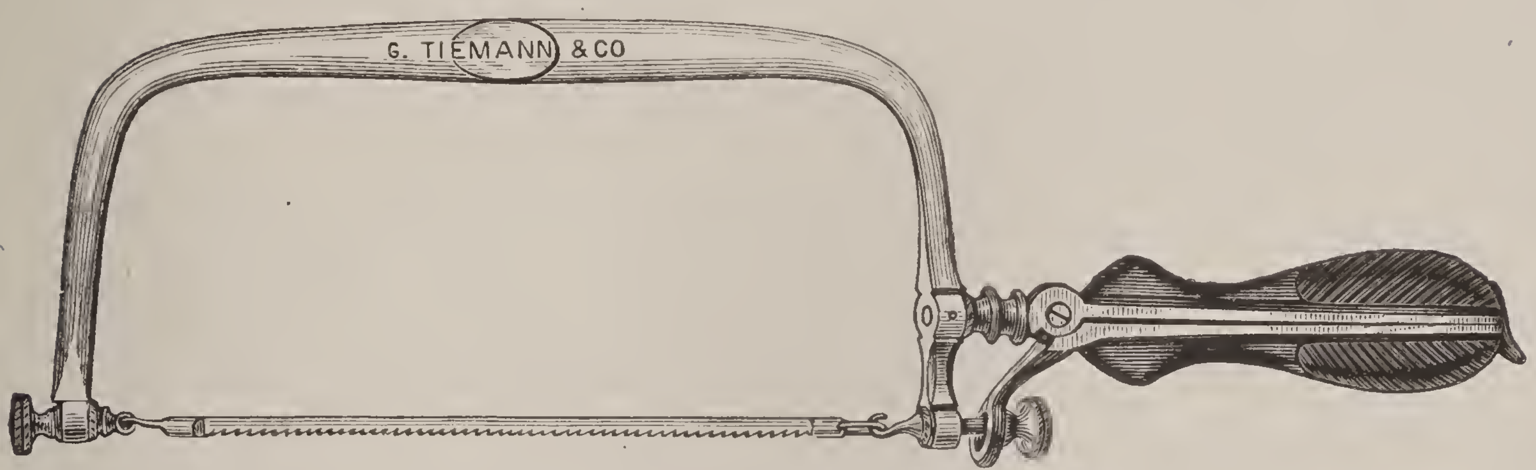


Fig. 287. Szymanowski's Exsector.

ture of this saw is that the blade can be rotated by means of the wheel below the handle. This saw has special advantages in some operations.

Bone Saws for Operations of the Skull.—Fig. 288 represents a bow saw, with two blades, for capital operations. By

Fig. 288. Bow Saw with two blades, for Capital Operations.

means of the screw beneath the handle the blade may be strained to any degree of tightness.

ONE-HAND SAWS.

Superiority of American Saws.—I never saw any but an American hand-saw that could be bent into a hoop, point to heel, and which would then spring back straight and true, like the old-time (Toledo) sword blades. And one of our factories submits all of its first-class hand-saws to this test before sending them out. I never heard of any but an American crosscut by which two men have cut off a sound 12″ gum log in *seven* seconds by the watch. To be sure, there was a real live emperor looking on, but all the sawyers from France to Fond-du-Lac could not have performed that feat with any but an American saw.

The Steel Bucksaw Frame, p. 50, is claimed never to warp nor lose its elasticity, to be unaffected by weather, stand more rough usage than a wood frame, and be less trouble. If I could set an M tooth buck-saw blade in one of these all steel self-strained spring frames, I would not trade that combination for a dozen such affairs as saw makers are obliged to make for country store-keepers to hang up on sale.

A Detachable Bladed Compass Saw,* shown in Fig. 289, takes up very little room, when taken apart; and blades of any desired coarseness of teeth may be used. It will be noticed that

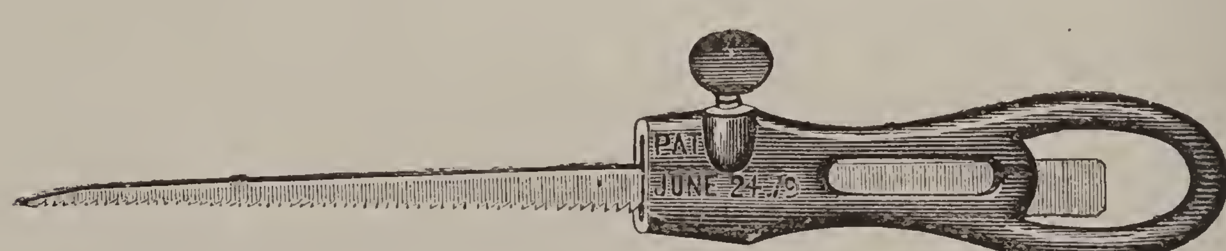


Fig. 289. McNiece's Detachable Compass Saw.

the binding screw grips the back of the blade instead of the side, as is usually the case with such tools. Mr. McNiece will furnish blades for this saw with teeth pointing towards the butt,

* Made by Wm. McNiece, 525 Cherry Street, Philadelphia.

so as to have the desirable "pull cut" recommended on page 17 (see Figs. 10 and 11).

An Egyptian Pull Cut Saw is shown in Fig. 290.

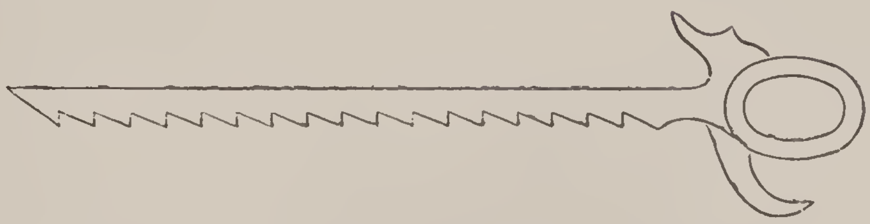


Fig. 290. Ancient Egyptian Saw.

Pruning Saws.—Referring to the pruning saw (Figs. 33 and 34, p. 32), we would prefer giving "pull-cut" teeth or M teeth, to the crosscut teeth shown in the illustrations.

A Sensible Pruning Saw, which they use out in California, has teeth pointing toward the handle, and find that it will trim off a shoot neatly where a push-cut blade would tear all before it; and when it comes to stouter limbs the weight of the body can be put on it.

The Butcher's or Meat Saw (Fig. 291) has a straight blade strained by a screw in a somewhat elastic back frame or bow. It

Fig. 291. Butcher's Saw.

has no set, as the tough, hard character of the bone requires none; and clearance is not very necessary where the walls of the cut are so thoroughly lubricated by grease.

Table and Compass Saws should be thinner at the back than on the cutting edge, to prevent pinching.

"Crosscut" Sawdust is granular, but "rip" sawdust should be in the form of chips.

How to Choose a Saw and Keep it in Order.—"In selecting a saw it is best to get one with a name on it that has some 'reputation.' If a man desires to purchase a first-class watch, he selects a maker who has attained a reputation. This remark applies in the choice of a saw or any other tool. The first point to be observed in the selection of a handsaw is to see that it 'hangs' right. Grasp it by the handle and hold it in position for working. Then try if the handle fits the hand properly. These are points of great importance for comfort and utility. A handle ought to be symmetrical and the lines as perfect as any drawing. Many handles are made out of green wood; they soon shrink and become loose, the screws standing above the wood. Handle wood should be seasoned three years before using. An unseasoned handle is apt to warp and throw out of truth. The next thing in order is to try the blade by springing it. Then see that it bends regularly and even from point to butt in proportion as the width and gauge of the saw vary. If the blade is too heavy in comparison with the teeth, the saw will never give satisfaction, because it will require more labor to use it. The thinner you can get a thin saw the better. It makes less kerf, and takes less muscle to direct it. This principle applies to a well-ground saw. There is less suction and friction on a narrow, true saw than on a wide one. You will get a smaller portion of saw blade, but will save hundreds of dollars' worth of manual labor at a very little loss of width of blade.

"See that it is well set and sharpened and has a good crowning breast; and get a proper light to strike on it; you can then see if there is any imperfection in grinding or hammering. 'We should invariably make a cut before purchasing a saw, even if we had to carry a board to the hardware store.'

"Handsaws should be set on a stake or small anvil with one blow of the hammer. A high-tempered saw takes three or four blows of the hammer, as they are apt to break by attempting to set with only one blow. This is a severe test, and no tooth ought to break afterward in setting, nor will it if the mechanic adopts the proper method. The saw that is easily set and filed is easily made dull.

"We have frequent complaints about hard saws, but they are not as hard as we would make them if we dared; but we should never be able to introduce a harder saw until the mechanic is educated to a more correct method of setting his saw. The principal point is that too many try to get part of the body out of the plate, when the whole of the set must be got out of the tooth—setting below the root of the tooth distorts and strains the saw-plate. This may cause a full-tempered cast-steel blade to crack, and eventually break at this spot; but it is always an injury, even if it does not break or crack."

Hardening Saw Points.—A Canadian patent of N. Wharton is for hardening the points of the teeth of a mill saw more than their base and the blade. As the teeth ultimately wear away by filing, we cannot see where the advantage of leaving the bases soft comes in.

Round Saw Back.—A patent was taken out on a round bar for a tenon saw back, the blade not being gained into the bar, but touching it along its entire length.

Making very Small Straight Blades.—Where it is required to make very fine teeth, as for small scroll saws, hack saws made from watch spring or "hoop-skirt wire," the teeth may be made regular in space, depth, and pitch, and the work greatly facilitated by the use of a guide, seen in Fig. 292. This is simply a steel rod

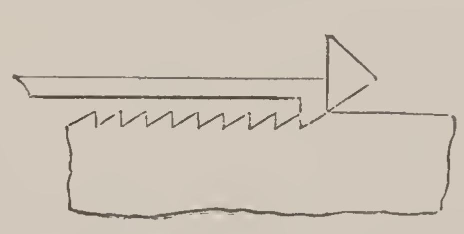


Fig. 292. Making Small Straight Blades.

with the end upset and filed to fit the required tooth outline. The first notch being made (that at the point) the guide is applied therein and the file used against it, moving the guide on one space as each new tooth is made.

Lengths, Sizes, and Spaces of Unstrained, Unguided Saws.—(Class 4) expressed metrically, and corresponding to table on page 30.

		Length, Cm.	Thickness. Inches.	Thickness. Millim.	Points per dec'meter = 3.937 inches.
Taper	Hand,	66.04	.042	1.0668	20 to 48
	Rip,	71.12 to 76.20	.049	1.2446	12 to 20 Heel. 24 to 32 Point.
	Panel,	35.56 to 60.96	.028 to .035	.7012 to .8890	32 to 48
	Compass,*	25.40 to 50.80	.065	1.7510	......
	Keyhole,*	17.78 to 22.86	.032	.8128	......
Backed	Tenon,	15.24 to 45.72	.028 to .035	.7012 to .8890	44 to 60
	Miter,	50.80 to 76.20	.035 to .042	.8890 to 1.0688	40 to 44

Barthelme's Reaming Saw (U. S. Patent, No. 239,698. April 5, 1881).—There are three kinds of tapering teeth, *b*, *e*, *g*, placed in line. Teeth *b* having inclined cutting edges *a*, teeth *e* having oppositely inclined cutting edges *d*, and teeth *g* having flat edges *f*, the operation of the saw is to produce a triangular groove.

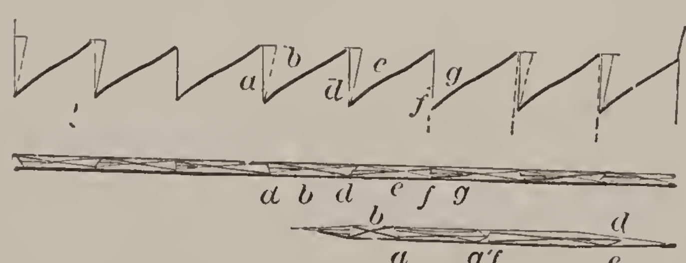


Fig. 293.

* For curved sawing.

CROSSCUT.

The Crosscut Saw.—The ordinary crosscut saw, among the most primitive and most generally used implements, is one of the advance couriers of civilization. It penetrates the forest almost with rifle and axe, and far in advance of the surveyor's chain, and once it enters a country it stays there. It remains a useful member of society, despite its crudity. It is its very simplicity that has caused it to be so tenacious of its position among needful implements. It requires no foundations, no motor, no special preparation. Where the axe leaves a tree, there the crosscut takes it; and from the newly fallen log upon the virgin shores, to the busy ship-yard that succeeds the primeval forest, the crosscut is never hung up. And yet it is an aggravating, fatiguing, slow-working affair.

Disadvantages of the Crosscut.—In the first place, it requires great muscular exertion from the weakest muscles of the body. In the second, it not only develops one side of the body at the expense of the other, but by unnecessarily fatiguing one side without giving it any reserve member, it lessens the capacity of the operator, already working at a disadvantage, with weak muscles, to do heavy work. In the third place, in most positions, where the log lies upon the ground, the position of the sawyer is uncomfortable, unhealthy, and still further lessens his capacity for work. In the fourth place, the operator must often clear away a space in the brush and snow for room to work in.

In this country especially there have been many improvements made in the crosscut, as in all sawing implements. The heavy bow-frame of sapling sprung into an arc, still used by the cross sawyer in Europe, has no place here. The curved edge of the blade has been brought from the top to the bottom or cutting edge, in order that as the saw wears away the middle (as it naturally does) the wear of the blade may be taken up, and still leave it a capable tool. In the third place, the shape of the teeth has been very carefully chosen to suit various requirements. Crosscutting has become a regular cutting, and not a mere abrasion. The M tooth has been employed to give the best cutting edge with the best facility for sharpening. Perforations have been introduced along the line of the gullets to lessen the time, labor, and expense of filing, while insuring that the teeth remain at the proper distance and size, and perhaps cooling the blade. The gullets are made deeper in the centre of the edge than at the ends, for the same purpose that the cutting edge itself has been made convex. The handle has become a convenient affair by which the tool may be firmly grasped and guided, and modifications have been introduced by which one man may do very heavy crosscutting. But with all these improvements the crosscut wears a man out, makes him lop-sided, and uses only the muscles of his arms and shoulders. The disadvantages have led to the rapid introduction of the "riding drag saw," of which an illustration is given, Fig. 27, page 29.

Taper Gauge.—The crosscut, more than any other saw, requires to be tapering in gauge, as shown in Fig. 294; the back *a*

Fig. 294. Section Showing Taper.

being thinner than the edge *b*. Where there is not enough taper, enough set must be given to effect the same result.

Belly.—The crosscut blade is always made wider in the middle than at the ends (frequently twice as wide), and this extra width is generally put on the cutting side—to counteract the rocking tendency of the sawyer, and to allow for the extra wear that the middle of the saw gets. Very often there is a section of fine teeth at each end of a crosscut, to start with; and some makers put deeper gullets in the central portion, to give more dust room, and save time, files, and gumming. (See Fig. 295.)

Fig. 295. Swelled Blade, with Graduated Gullets.

Perforated Crosscuts.—Out in the backwoods, among snow and underbrush, where emery wheel gumming machines are not get-at-able or usable, perforations in crosscuts are special blessings to sawyers. But perforated blades are not at all recommended for gummy timber.

A correspondent writes: "As to perforated teeth, I am entirely at loggerheads. A very little is saved in gumming, but the liability of breaking out in the cut is so great that it destroys their usefulness. I have seen a perforated tooth saw with four or five teeth gone right in succession. This was done by first breaking off one tooth in a hard cut in an oak log in winter.

"The theory of allowing for fluttering by perforations does not hold good at all. I have seen these saws flutter and roll the same as any saw worn at the edge."

The Varieties of Crosscut Teeth are legion—hook, crook, double hook, double crook, V's, M's, W's, and all their variations and combinations, with cleaners or plows in every possible alternation; and each or all of these in infinite difference of acuteness, set, rake, and cross-angle.

Fig. 296 shows in full size an arrangement of teeth of crosscuts very popular in some quarters. The scorers or cutters are single teeth with alternate fleam to left and right. The cleaners or plows are of course shorter than the cutters; they are double, and have no fleam. We approve of the idea of giving no fleam to cleaner teeth, but highly object to the square-shaped gullets between the teeth, and also to the notches in the plows. These should have rounded outlines, which are easier to make and leave a stronger plate.

Of the crosscuts made by the American Saw Company, and illustrated on pages 43 to 47 inclusive, the Premium is the most sold and the Champion next.

The "Climax" Crosscut, page 40, has cutting teeth in combination with clearing teeth, placed *face to face*, and not *back to back*, as is the usual manner.

The Lightning Crosscut.—Among its advantages, not enumerated in the first edition, may be mentioned the fact that teeth

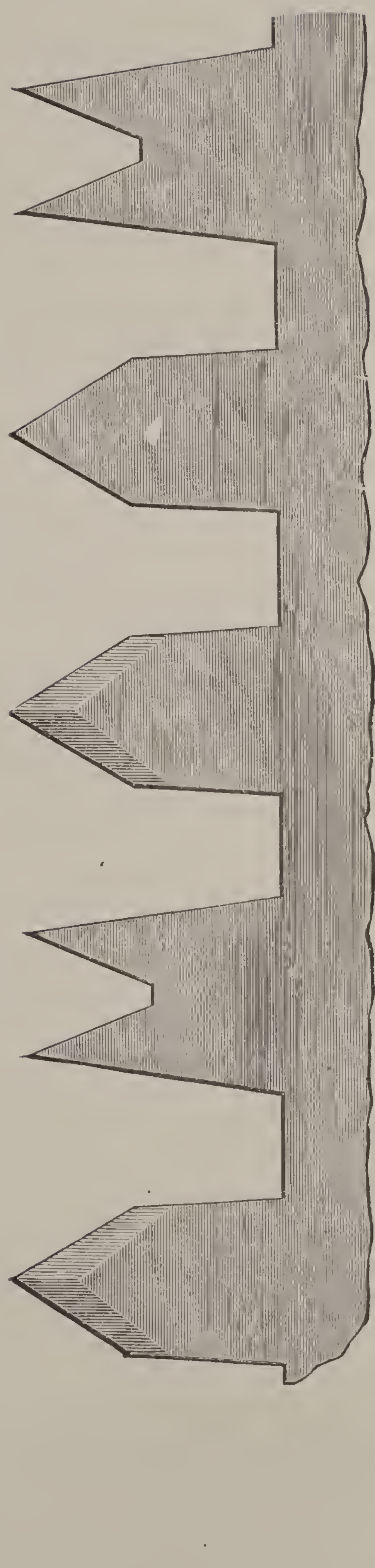


Fig. 296. Crosscut.

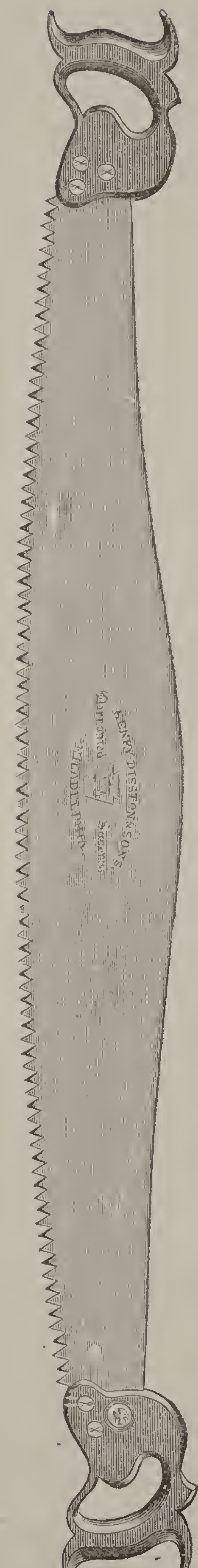


Fig. 297.
Double Skew Taper Blade.

of uniform length are easier to sharpen than where the clearers are shorter than the cutters; and as the teeth are double and the gullets arch-shaped, they may be gummed deeper than V-toothed blades—thus saving expense and frequent repairs.

The New American Crosscut was recently brought out to accommodate the tendency towards more *cutting* teeth.

Fig. 297 shows a form of two-man crosscut, which has convex cutting edge and a double curved taper on the back, corresponding somewhat to the "skew bevel" hand saws of the same eminent makers. In this saw, as toothed in the cut, the teeth are plain Vs, set and fleamed alternately to left and right; but of course any style of tooth will go with this style of plate; the cut being given only to show the outline of the blade.

Handles for Crosscuts.—The log crosscut in some parts of Europe has a stout straining bow of wood, for some purpose to the writer unknown. Possibly saw makers there cannot make their saws stiff enough to keep straight, even with a stout man at each end. Our American manufacturers are especially strong on convenient crosscut handles, readily and firmly attached to the blades, and of a comfortable shape.

Peace's Crosscut Handle (U. S. Patent, No. 238,960, March 15, 1881, Fig. 299) has two adjustable curved plates B B'; B

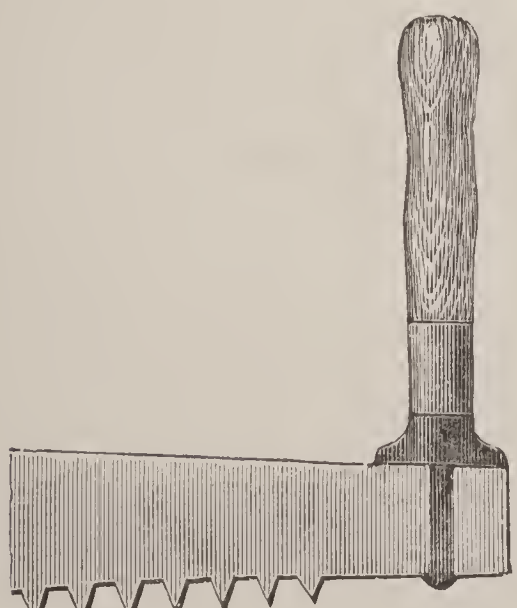


Fig. 298. Crosscut Handle.

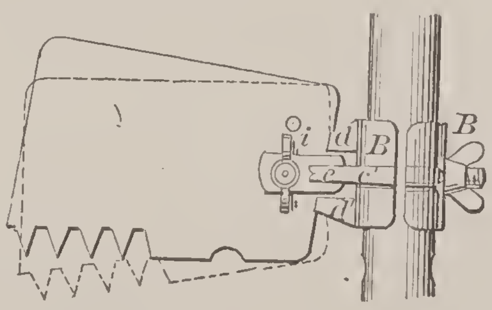


Fig. 299. Peace's Crosscut Handle.

having four projecting arms c c', d d', one arm being shorter than the others, and all so arranged that by a bolt and thumb nut i, the handle may be secured on the plane of the saw blade or at an angle thereto, without being moved therefrom.

Emerson's Crosscut (U. S. Patent, No. 239,156, March 22, 1881) has sections B, having scoring teeth b b' in pairs, one pair, b, set to one side of the blade and the other pair, b', set to the opposite side. There are also sections c, having scoring teeth c and c' with graduated slots or spaces deepest in the centre of the saw. (See Fig. 300.)

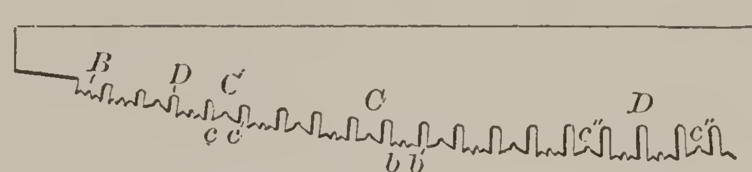


Fig. 300. Emerson's Crosscut.

Boynton's Curving Crosscut Saw (U.S. Patent, No. 239,710, April 5, 1881) has its edges formed with reversed curves or swells, these curves being arranged on each edge of the saw so as to permit its breadth and thickness to be diminished to lessen its friction surface and allow a less set to the teeth without impairing the strength of the saw or rendering liable to buckle. We have no knowledge of these saws having been used. (See Fig. 301.)

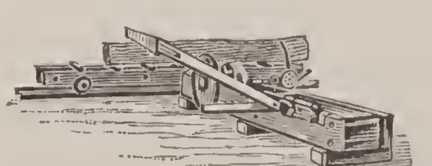
Fig. 301. Boynton's Curving Crosscut.

DRAG AND PIT SAWS.

Pit Saws.—A long time ago, when many ships were built of wood, and their heavy sides were laboriously framed of carefully sawed timbers, "pit-sawing" was much in vogue, and was also a common method of getting out straight boards and planks from the round or squared logs. The pit sawyers had a long taper blade (Fig. 302), a "pit" or "whip" saw, having a handle at each end, and the "top sawyer" and "bottom sawyer" pulling one in, the other above, the saw pit, made alternate bows, and slowly worked their way through the log's length. Sometimes these saws were held in a rectangular straining frame, which did not make the upstroke any the easier. This straining frame was the precursor of the "gate" or "sash" of the present day.

Double Cutting Butting Saws (Fig. 303) are now coming more into use, and still in many cases called "drag" saws, although they cut on the thrust as well as on the drag stroke.

Depth of Drag Saw Cut.—The cut of the drag saw may be deepened by weighting the blade; a sliding weight being supplied, with a set screw to hold it in any desired place to give the desired leverage.



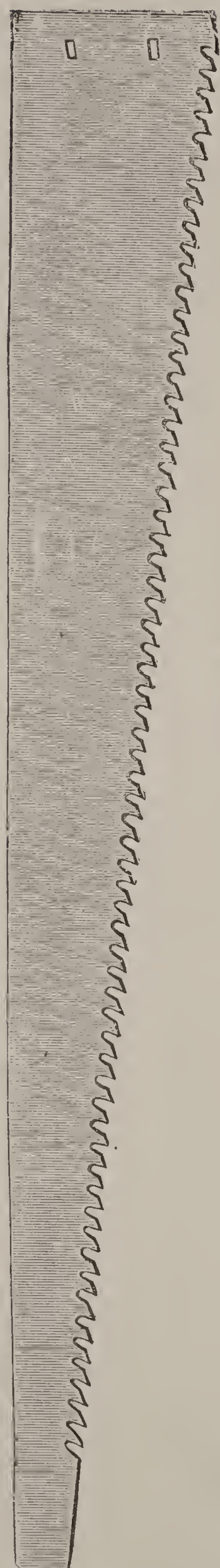


Fig. 302.
Pit Saw Blade.

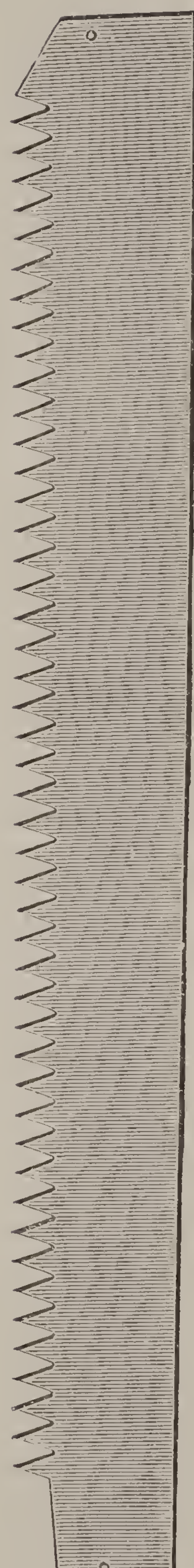


Fig. 303.
Double Acting Butting Saw.

THE JIG SAW.

Jig Saws.—Henry L. Beach, Jig Saw Maker, Montrose, Pa., states that strained jig saw blades "are made all lengths and all widths from $\frac{1}{8}$ to $\frac{3}{4}$ wide, and from 13 to 18 inches long. Nearly all the saws used in my machines are 18, 19, and 20 gauge. Those $\frac{3}{16}''$ wide should have 8 points; $\frac{1}{4}''$, 7 points; $\frac{3}{8}''$, 5 points; $\frac{1}{2}''$, $4\frac{3}{4}$ points to the inch, and run with as little set as possible for smooth work. For heavy sawing I often use saws 16 inches

Fig. 304. Fret Saw Work.

long, one inch wide at the upper end, $\frac{3}{4}$ or $\frac{5}{8}$ at the lower end, with three teeth to the inch. I consider the taper saw a good thing for heavier classes of work, but for ordinary sawing the

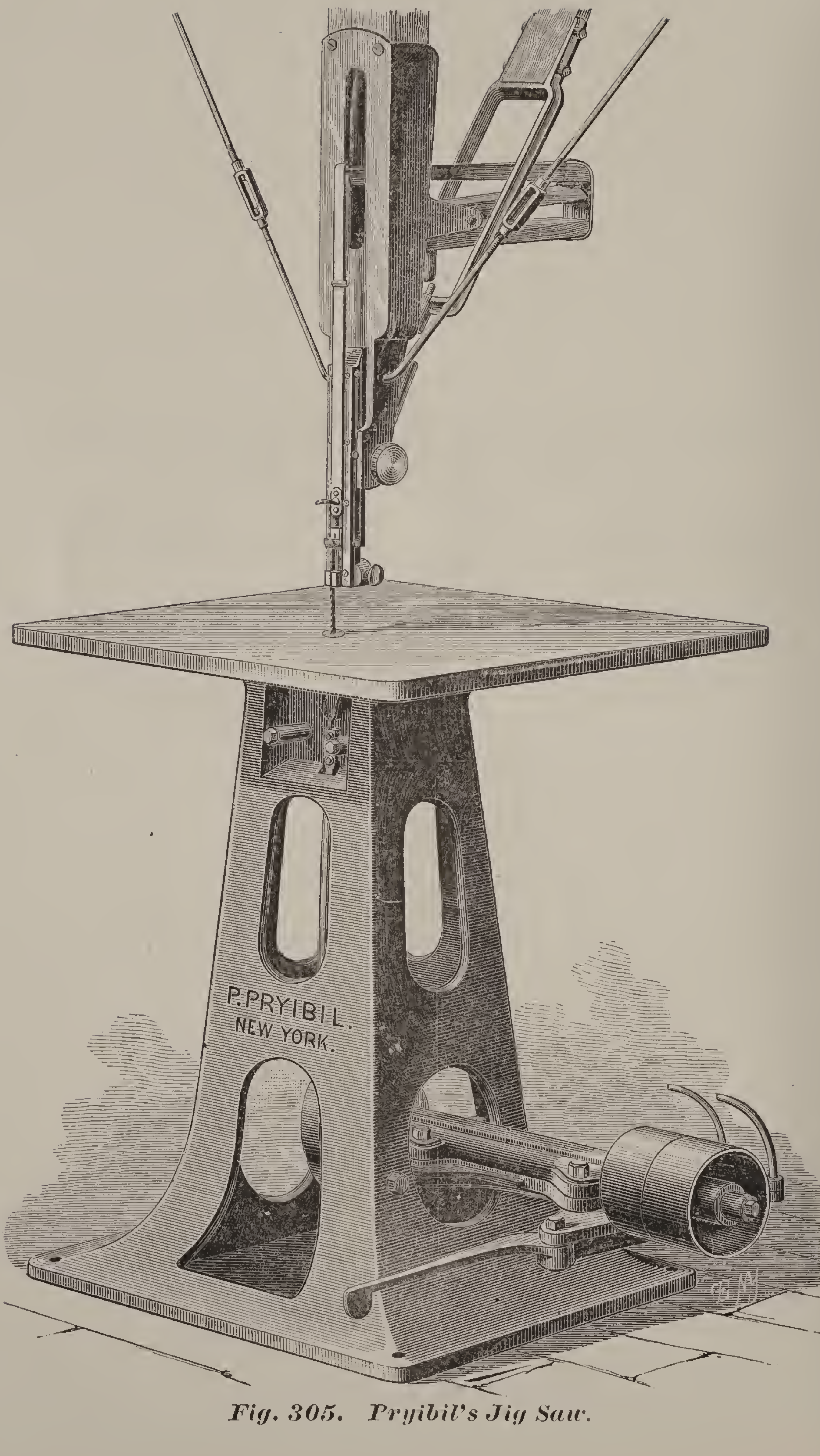
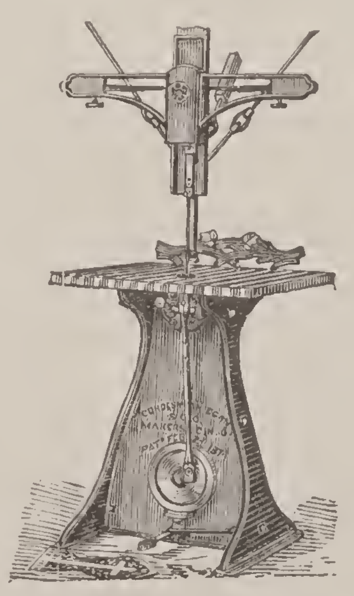


Fig. 305. Pryibil's Jig Saw.

straight saw is the best. Some sawyers use bevelled backs, saws ground thin on the back and left thick on the front. These require no set and work smooth. The objection is that the feathering weakens the blade too much. Have never seen any round saws; they must, however, prove a failure so far as doing smooth work and making smooth corners, which is desirable. The best stroke is $5\frac{1}{4}$ inches for all kinds of work, and the speed should be 850 to 900; 1000 to 1400 speed is often advertised to be the best, and in machines giving little or no strain a high speed is desirable, but it is death to the machine. 850 speed with 50 lbs. strain will do more work, do it better, and the machine will stand it."

Strained vs. Unstrained Scroll Saws.—"Saws not strained by a spring above the table become convex on the back edge and can be used only on thin, light work, while strained jig saws are actually at use at present upon 'piano desk work,' and are producing more work than the gate-saw, which has always been thought to be the only one which could be advantageously used for the purpose."—P. Pryibil.



THE MULAY.

The Mulay has an unstrained blade, driven from below and guided at the top in ways, and by reason of the absence of the heavy straining frame, capable of high speed and great output. It cuts, of course, on the pull stroke only. For log sawing it is used, principally in the Western States of America, in places where there is but small water power and but a limited amount of sawing. For scroll sawing its use has extended both east and west from Cincinnati, where it is said to have been first used for this purpose. The only advantage the sash has over the mulay is, that a saw so wretchedly filed that it would be impossible to run it through a log as a mulay, can be pulled through a log when strained in a frame. But it will not, however, make straight lumber even when thus strained. As a log mulay should make about 300 to 350 strokes per minute, all the moving parts (especially the reciprocating parts) should be as light as possible.

Snyder's Mulay.—In one of the best forms known to us (Snyder's), the lower end of the blade is held in a cross-head running between guides, and the connection between the saw and cross-head is a ball-and-socket joint, so that the blade can be easily adjusted to run in line with the carriage, and also be given the proper rake. The upper guide, which is lifted by the blade itself, needs to be specially light, and is made of wood. As it is lifted by the blade and friction tends to buckle the blade no less than weight does, it should fit very loosely. But as the cross-head ordinarily employed would, if it had a loose fit, permit the blade to move from its proper adjustment in the centre line of the carriage, a new mode of guiding has been devised. The entire machine is seen in Fig. 306.

Fig. 307 shows the old and the new way of guidance. In the old plan, where the cross-head and guides were at right angles to the width of the blade (see B, B), a very little looseness of fit gave considerable disalignment. But, by clamping the blade D between wooden pieces C, parallel with its width, and putting the ways fore and aft, as at E, E, considerable play may be allowed in

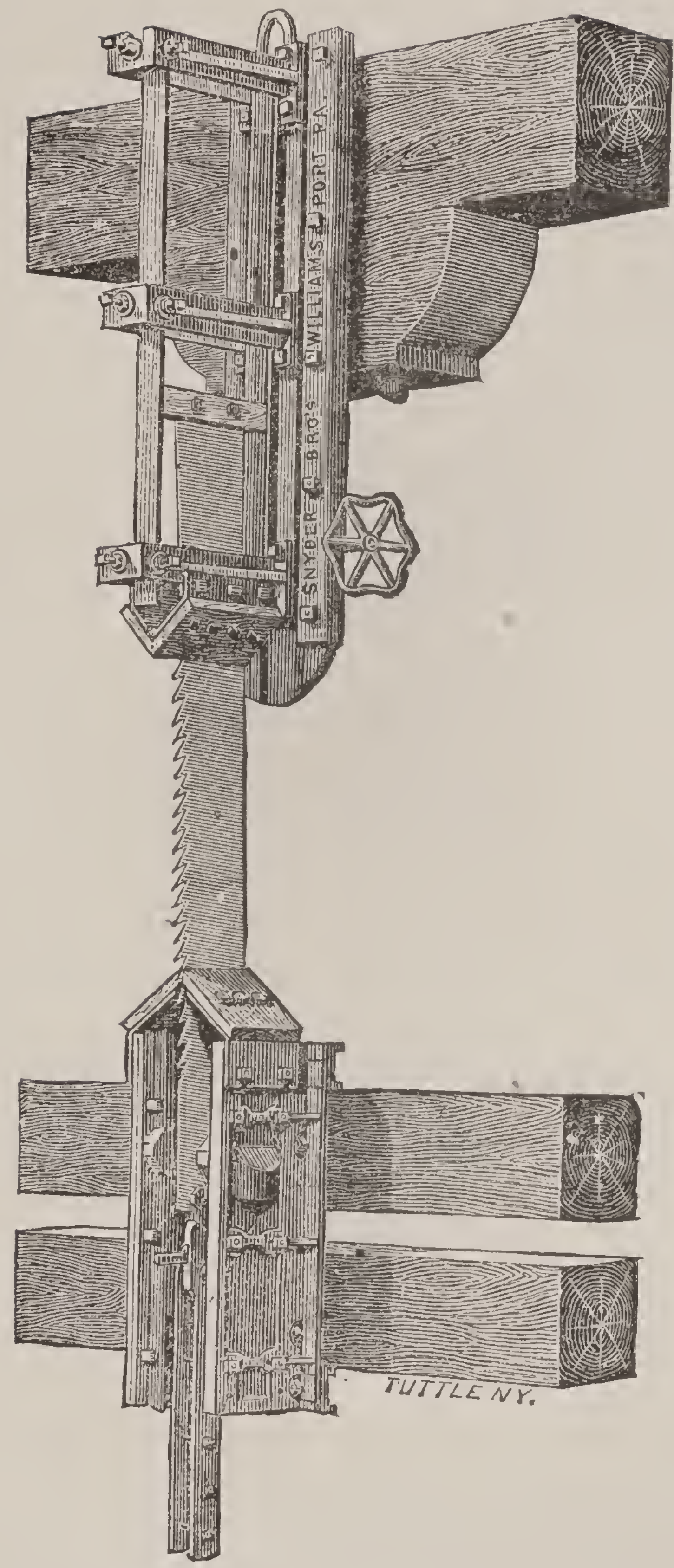


Fig. 306. Snyder's Mulay Guide.

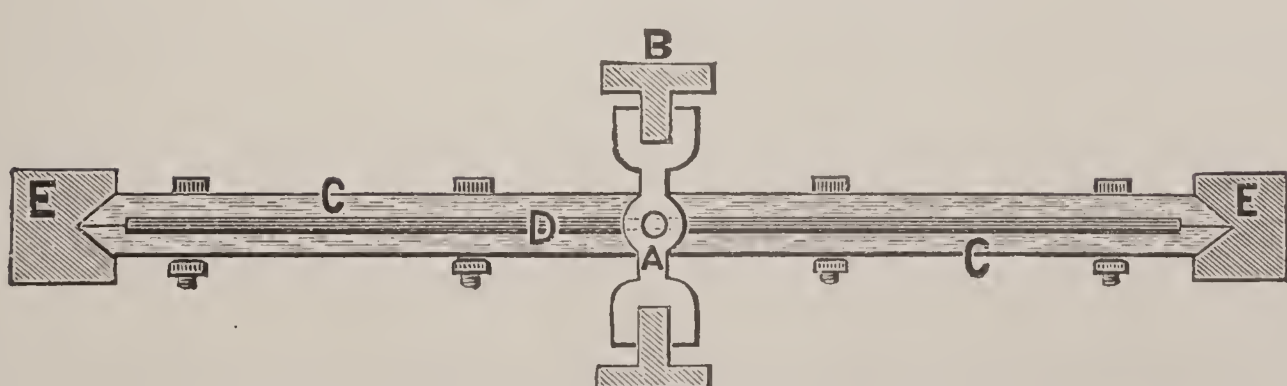


Fig. 307. Comparison of Mulay Guides.

the guides without the blade getting out of the centre of the kerf line. Diagonal boards (Fig. 307) help guide the blade, and are adjusted so as to just clear the log and help to guide it above. They are adjusted by a rack and pinion, and hand-wheel.

For log sawing the blade is generally 10″ to 12″ wide, and $\frac{1}{4}$″ thick as a maximum, $\frac{1}{9}$″ as a minimum; the most common gauge being No. 7, or about $\frac{3}{16}$″. The stroke for a 7-foot mulay is generally 28″.

Andrews' Mulay Fastening is shown in Fig. 308. A is the blade, B the permanently attached clamp, C the movable strap

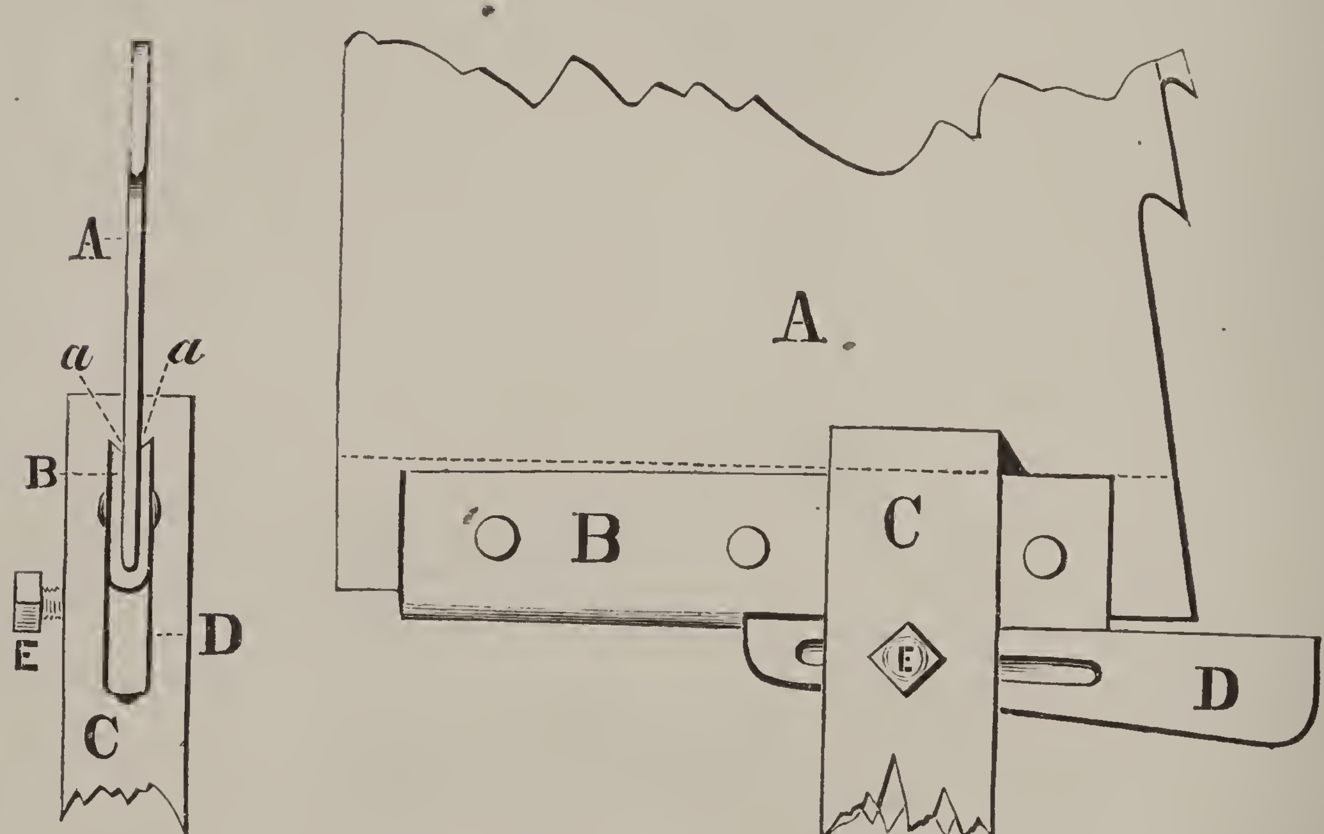


Fig. 308. Andrews' Mulay Fastening.

and bolt, D the wedge, and E the holding bolt. It will be seen that as the saw plate wears away, C can be run backwards; and that all desired adjustments can be readily made. The strap C holds to the clamp by the hooks *a a*.

Mulay Saws on the Pacific Coast.—Mulays are very little used on the Pacific coast. As far as we can learn, none are in use on Puget Sound, and only a few in Mendocino and Humboldt, the great red-wood districts of California. There they are employed in a few mills only to take the slabs off the largest logs to reduce their size.

Some of these mulays are wider at the top than at the heel. These are thought by some to cut better and make a lighter saw than the straight blades, and to have more strength at the top where it is needed.

"**Mulays for Log Sawing** are but little used, except in mills where there is but a limited amount of sawing."—[J. A. FAY & Co.]

THE SASH.

The Object of the Frame or Sash is to secure guidance in right lines, and to enable the use of a thin and narrow blade.

The Single Sash is sometimes used where it is desired simply to rip a log to show its quality at the heart.

The Two-Bladed Sash serves to square a log in two passes. It is much used for this purpose in France.

Gang Mill Sawing Machines are used in America only in the large lumber districts. They are known as *round* or *flat*, according as the logs they slit have or have not been previously squared on two sides.

Round Gangs are more economical of timber than flat; the boards being afterwards "edged" square by small circulars.

The Strain upon a gang sash is often 5 to 6 tons per blade.

Straining Sash Gangs.—The mode of hanging the blades is deserving of special attention. Improved American usage (such, for instance, as that of E. Andrews, of Williamsport) is, in this respect, far superior to foreign. It is well known that, with proper straining, very thin saws can be run; while it is difficult to make even a thick saw work well when not properly strained. When blades are strained by holes and tug-pins, it is necessary to punch or drill the first hole near the cutting edge, so that that part may receive the most strain. As the saw wears away, another hole is made, of course at some little distance from the first, thus preventing the blade being strained in line with blank space between the holes.

Mistakes in punching or in drilling often cause the saw to be given to͗o much or too little overhang, in either of which cases it will work badly. By the use of the horse and stirrups, shown on page 23, and herewith, the holes are made at the factory, and never changed; the saws being plated with straps at each end, and the rake given simply by moving it more or less in either direction through the top stirrup. Fig. 309 shows a strap; Fig.

Fig. 309.

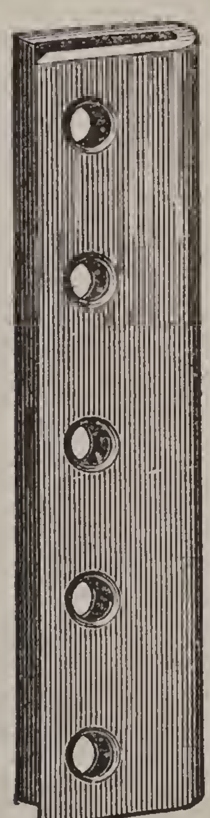


Fig. 310.

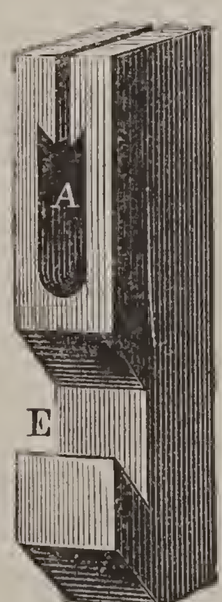


Fig. 311.

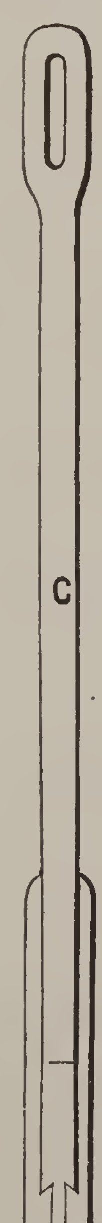
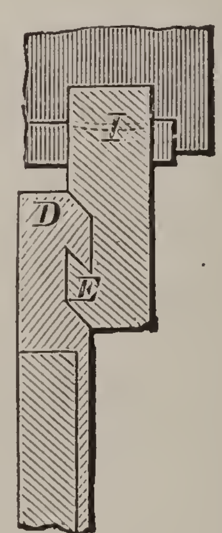


Fig. 312.



Andrews' Sash Fastenings.

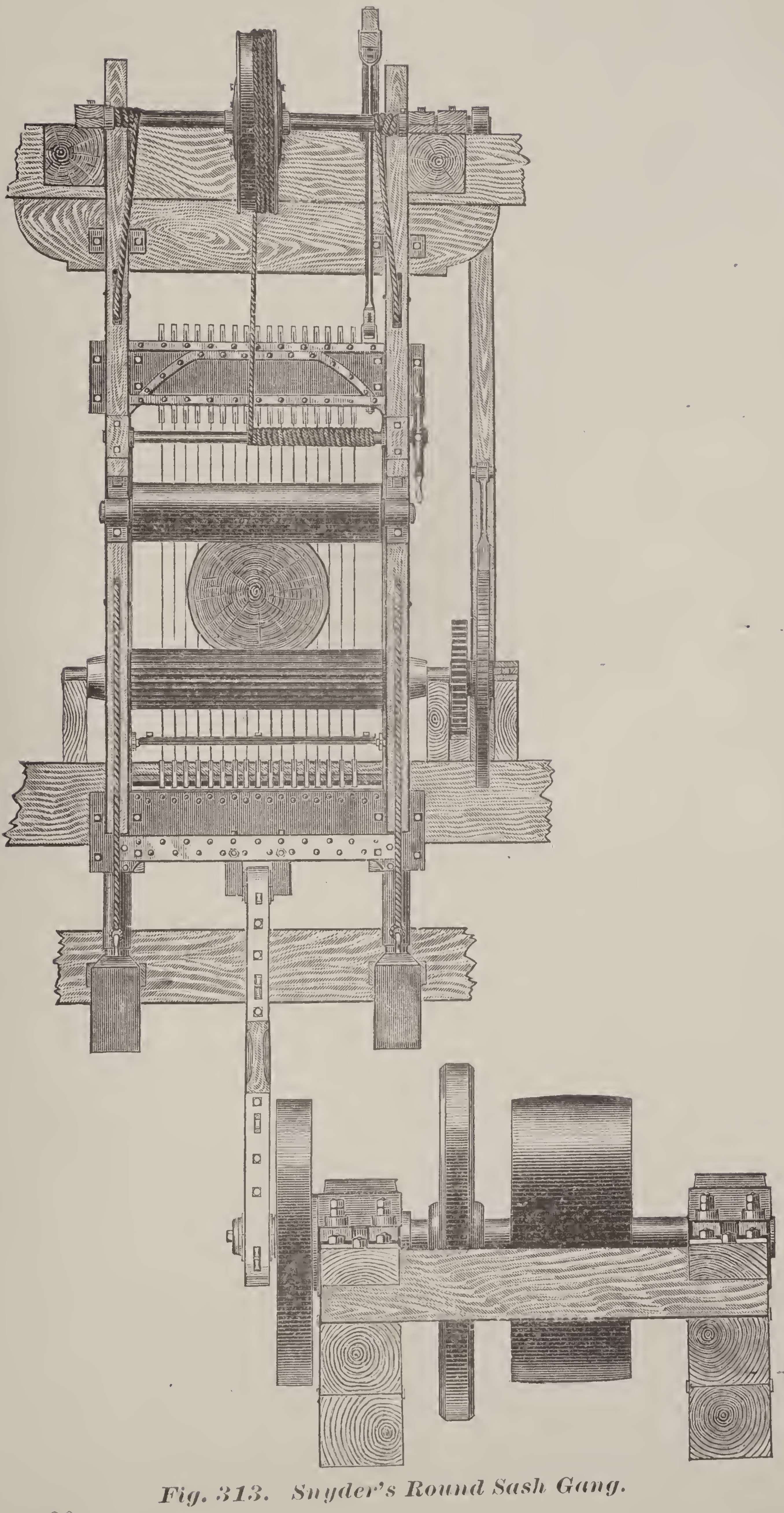


Fig. 313. Snyder's Round Sash Gang.

310 the bottom hook; Fig. 311 the top stirrup on a smaller scale; Fig. 312 is the hook attachment for the lower end of the blade to the lower girt. As the blade wears away, the strain line may be moved back by moving the hooks along the straps. This arrangement permits instant changes in the rake, to accommodate either hard or soft wood. In fitting a gate for these hooks, all that is necessary is to drill three holes through the bottom girt of the gate and attach a flat piece of iron. This holds the hooks in place on removing the saw, and prevents them from falling when the saw is removed. One set of hooks answers for any number of blades. The lips of the hooks and of the stirrups are made on a circle to prevent straining at the corners where the blade is given rake or overhang. Some sawyers of experience find thin saws to work best when part of the desired rake is given by packing the top bar of the gate, to bring the strain more nearly on a line with the bottom of the saw teeth. This invention has been thoroughly tested, and proved to be all that is claimed for it.

"Rake" for Reciprocating Blades.—It is desirable that the straight line which passes through the tooth points be inclined forward, or "raked," to let the cant advance when the blade rides. (See Fig. 314.) This rake should be so regulated that the blade

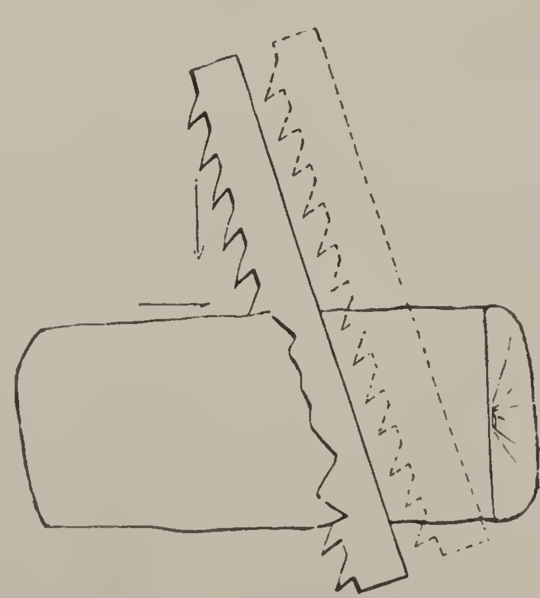
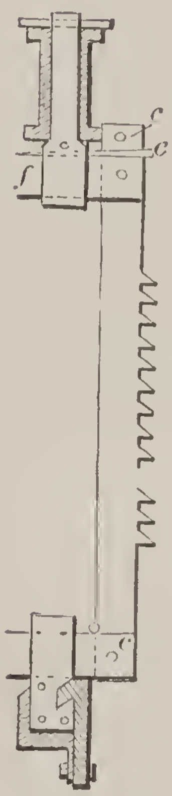


Fig. 314. Exaggerated Rake.

in descending shall not pass, during part of the stroke, through the kerf already made—as this would lessen the capacity of the machine.

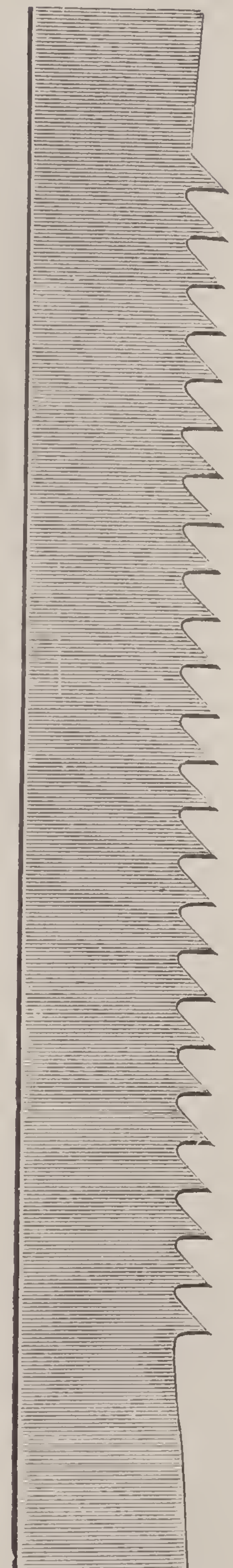
Snyder Bros.' Rule for Rake is "give $\frac{1}{16}''$ more than the feed in the same length. Say feed $\frac{1}{2}''$, crank $12''$, the saw should have a rake of $\frac{9}{32}''$ to the foot."

Fig. 315.



Hubbard's Sectional Mill Web.

Fig. 316.

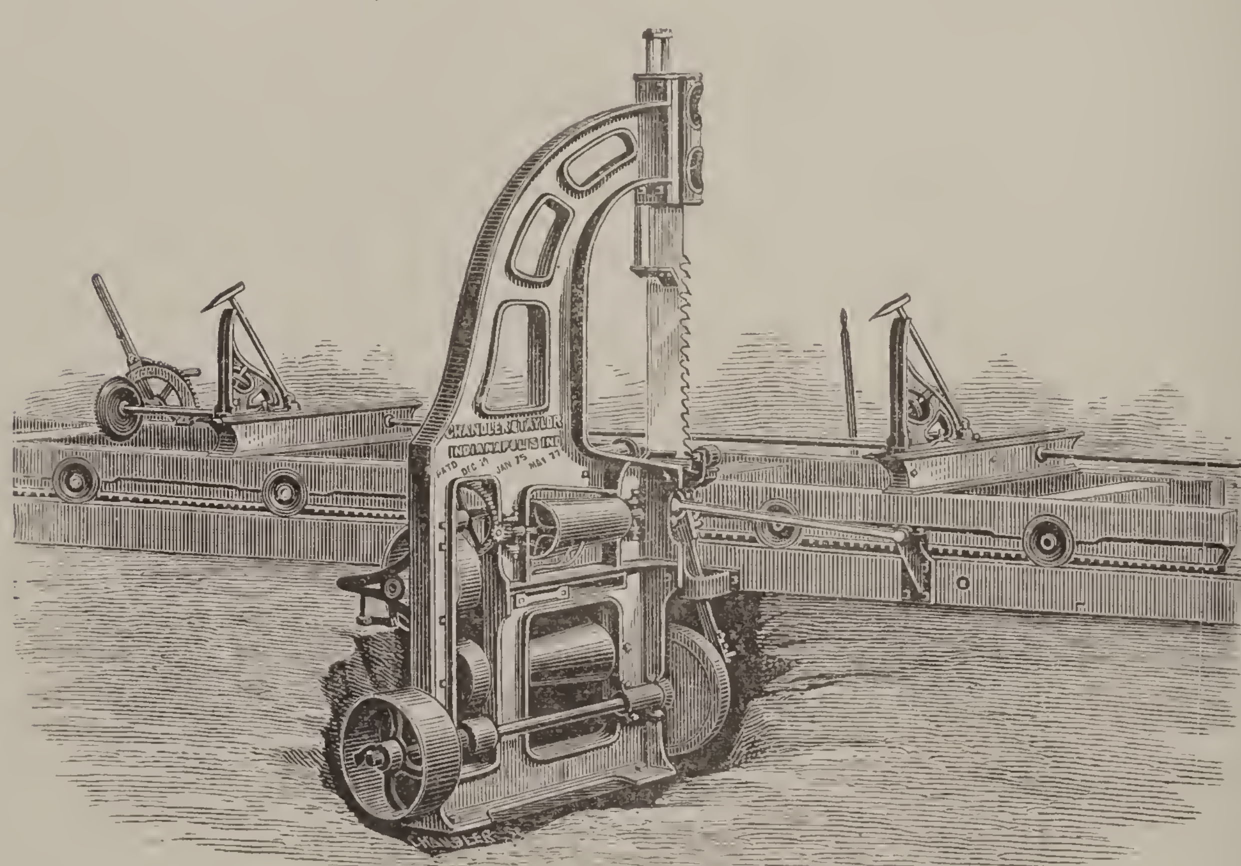


Usual Type of Mill Saw Blade.

Hubbard's Sectional Saw (U. S. Reissued Patent, No. 9657. April 12, 1881) consists of longitudinal sections—the front section, which is the saw proper, having teeth, and the other sections being blank, and of a thickness equal to or less than that of the front section. Sections are so connected as to permit of independent longitudinal expansion.

Double Cutting Sash Saw.—The strained sash saw originally cut on one stroke only; not cutting on the return. There are now horizontal strained saws which cut both ways; and one or two vertical machines which do the same thing imperfectly.

Double Cutting Mill Saws with single cutting teeth, one half pointing one way, and the other in the opposite direction, have been patented by T. Davis.



Overhung Mulay.

Statistics of Mill Saws. (Worssam.)

TIMBER FRAMES.

Size of Frame.	Space, Pitch, and Depth of Tooth (gullet).								Length of Saw.	Width of Saw from the back of the point to tooth.		Gauge of Saw.		Length of Stroke.	No. of down strokes per minute.	Average No. of horse power for each frame.
	Soft Wood.				Hard Wood.											
	Space.	Pitch.		Depth.	Space.	Pitch.		Depth.		Top.	Bottom.	Soft Wood.	Hard Wood.			
		Face.	Top.			Face.	Top.							inch.		
12″	$\frac{3}{4}$″	80″	32″	$\frac{5}{8}-\frac{3}{4}$″	$\frac{5}{8}$″	90″	32″	$\frac{1}{2}-\frac{5}{8}$″	3–1$\frac{3}{4}$″	4 or 3$\frac{1}{2}$″	3$\frac{5}{8}$ or 3$\frac{1}{8}$″	16	16	13	235	4
18	$\frac{3}{4}$	"	"	$\frac{5}{8}-\frac{3}{4}$	$\frac{5}{8}$	"	"	$\frac{1}{2}-\frac{5}{8}$	4– $\frac{3}{4}$	4$\frac{1}{2}$ or 4	4$\frac{1}{8}$ or 3$\frac{5}{8}$	16	16	16	190	6
24	$\frac{3}{4}$	"	"	$\frac{5}{8}-\frac{3}{4}$	$\frac{3}{4}$	"	"	$\frac{1}{2}-\frac{5}{8}$	5–2	5	4$\frac{1}{2}$	15	15	19	160	7
30	$\frac{7}{8}$	"	"	$\frac{3}{4}$	$\frac{3}{4}$	"	"	$\frac{5}{8}$	6–10	5$\frac{1}{2}$	5	15	14	22	140	8
36	$\frac{7}{8}$–1″	"	"	$\frac{3}{4}$	$\frac{3}{4}$	"	"	$\frac{5}{8}-\frac{3}{4}$	6–10	6	5$\frac{1}{2}$	14	14	25	125	9
42	$\frac{7}{8}$–1	"	"	$\frac{3}{4}-\frac{7}{8}$	$\frac{3}{4}$	"	"	$\frac{5}{8}-\frac{3}{4}$	7–4	6$\frac{1}{2}$	6	14	14	28	110	10
48	1–1$\frac{7}{8}$	"	"	$\frac{7}{8}$–1	$\frac{7}{8}$–1	"	"	$\frac{3}{4}-\frac{7}{8}$	8	7	6$\frac{1}{2}$	14	13	31	100	11
54	1–1$\frac{7}{8}$	"	"	$\frac{7}{8}$–1	$\frac{7}{8}$–1	"	"	$\frac{3}{4}-\frac{7}{8}$	8–9	7$\frac{1}{2}$	7	14	13	34	90	12

DEAL FRAMES.

Size of Frame.	Soft Wood Space.	Soft Wood Pitch Face.	Soft Wood Pitch Top.	Soft Wood Depth.	Hard Wood Space.	Hard Wood Pitch Face.	Hard Wood Pitch Top.	Hard Wood Depth.	Length of Saw.	Width Top.	Width Bottom.	Gauge Soft Wood.	Gauge Hard Wood.	Length of Stroke.	No. of down strokes per minute.	Average No. of horse power for each frame.
11″	$\frac{5}{8}$″	80″	32″	$\frac{1}{2}-\frac{5}{8}$″	$\frac{5}{8}$″	90″	32″	$\frac{1}{2}$″	3– $\frac{3}{4}$″	3$\frac{1}{4}$″	3″	17	17	12$\frac{1}{2}$	245	3
14	$\frac{5}{8}$	"	"	$\frac{1}{2}-\frac{5}{8}$	$\frac{5}{8}$	"	"	$\frac{1}{2}$	3–4$\frac{3}{4}$	3$\frac{1}{2}$	3$\frac{1}{4}$	17	17	14	215	4
18	$\frac{5}{8}$	"	"	$\frac{1}{2}-\frac{5}{8}$	$\frac{5}{8}$	"	"	$\frac{1}{2}$	3–9$\frac{3}{4}$	3$\frac{3}{4}$	3$\frac{3}{8}$	16	16	16	190	5
20	$\frac{5}{8}$	"	"	$\frac{1}{2}-\frac{5}{8}$	$\frac{5}{8}$	"	"	$\frac{1}{2}$	4–1$\frac{3}{4}$	3$\frac{3}{4}$	3$\frac{3}{8}$	16	16	17	180	5$\frac{1}{2}$
22	$\frac{5}{8}$	"	"	$\frac{1}{2}-\frac{5}{8}$	$\frac{5}{8}$	"	"	$\frac{1}{2}$	4–4$\frac{3}{4}$	3$\frac{3}{4}$	3$\frac{3}{8}$	16	16	18	170	6
24	$\frac{3}{4}-\frac{7}{8}$″	"	"	$\frac{5}{8}-\frac{3}{4}$	$\frac{5}{8}-\frac{3}{4}$	"	"	$\frac{1}{2}$	4–5$\frac{3}{4}$	4	3$\frac{5}{8}$	16	15	19	160	6$\frac{1}{2}$
26	$\frac{3}{4}-\frac{7}{8}$	"	"	$\frac{5}{8}-\frac{3}{4}$	$\frac{5}{8}-\frac{3}{4}$	"	"	$\frac{1}{2}$	4–8$\frac{3}{4}$	4	3$\frac{5}{8}$	15	15	20	150	7
Planking Frame.	$\frac{3}{4}-\frac{7}{8}$	"	"	$\frac{5}{8}-\frac{3}{4}$	$\frac{5}{8}-\frac{3}{4}$	"	"	$\frac{1}{2}$	5–6$\frac{3}{4}$	4	3$\frac{5}{8}$	15	14	22	140	8$\frac{1}{2}$

EXPLANATORY REMARKS.

Frames.—The depth of timber to be sawn governs the size of frame: thus a 12″ frame is to cut 12″ deep.

Space.—The space is the distance from tooth to tooth, measured at the points.

Pitch.—The pitch is the inclination of the tooth-face up which the shaving ascends, and is measured with the tops of backs of the teeth, in degrees, from a line passing through the points.

Gauge.—The gauge referred to above is generally known as Stub's *Birmingham Wire Gauge.*

Stroke.—The stroke should be equal to depth of material to be sawn, but in practice the tabulated dimensions are found sufficient.

Gauge of Saw.—In converting deals into thin stuff the gauges of saws must be somewhat modified; thus, over 7 cuts all blades should be 1 gauge thinner, 10 cuts 2 gauges, 13 cuts 3 gauges.

CIRCULAR.

Thickness of Plates.—Circulars are used thinner in Wisconsin than in Michigan. For instance, 60-inch disks are used as thin as 10 gauge (0.134 inch), having teeth $2\frac{1}{2}$ inches apart. The Wisconsin timber may be a trifle softer than the Michigan (being more like Norway pine); but our informant considers the sawyers more skilful. The gauge demanded depends upon the kind of timber and its general condition, but more upon the amount of care displayed in the management. Generally, the thicker the saw the more you can force matters and have it run straight. For general sawing in New England, 7 or 8 gauge straight is recommended as about as thin as practicable, for board saws 46 to 60 inches in diameter.

Rim Tapering.—Referring to the modern American system of rim tapering, Mr. C. E. Grandy says: "I have obtained the best results from 7-gauge straight, and do not fancy using wedges for saws. In every case of rim taper, I notice that the sawyer has to use enough set to clear the centre, or his plate would warm. If this be so, of what use is it to have the three gauges ground off at the edge? In sawing thin boards only, or resawing with a thick spreader, this is all right, as there is a saving of kerf* and greater stiffness of the saw obtained by the rim taper."

Number of Teeth for Circulars.—The same sawyer says: "I have settled on forty teeth in common board saws, say from forty-four to fifty-four inches in diameter. Too many teeth consume too much power. If there be too few, they are not strong enough to stand the average work."

Dished Circulars.—A distinction must be made between a "dished circular," made with a permanently and intentionally dished plate, and a "dishing" circular, intended to be flat but having got "rim-bound."

---

* Kerf is sometimes called "scarf," and also written "carf."

The dished circular was designed in 1806, by Trotter, for the purpose of curved and bevel sawing.

The temper of a concave saw, in our opinion, ought to be a good and as high as any ordinary circular doing the same nature of work. The custom has been to leave the saw much softer, to avoid breaking in the hands of the saw-maker; but a soft saw will not hold the set when cutting hard wood heading. The disk is made to a true circle, and in diameter corresponding to the heads it is to circle, providing the heads are cut square on their periphery, as cheese-box heads are made. To make a seventeen-inch cheese-box, use a saw dished to a circle of seventeen inches; and for a seventeen-inch flour-barrel head, with bevel, use a saw dished to a circle of twenty-four inches. The same saw may be used for making various sizes of heading having bevelled edges, by changing the angle of the axis of the head in relation to that of the saw. In that case the bevel on the heading is also changed or altered to suit the saw. In a small head they are sharper, and in a large head stunted. Concave saws, sawing bevelled heading, must be filed as a ripping saw, or square across the tooth.

Cutting Action of Circular Saw.—Fig. 317, photo-engraved from a full-sized sketch, shows the action of a 60-inch saw cutting in a 20-inch cant. As shown by the photo-reduction of the actual-sized drawing, the radius of the saw is 30 inches, thickness (or light) of the cant 20 inches, radius of collar 4 inches, radius of arbor $1\frac{1}{2}$ inch. The cut shows 10 successive positions of the saw disk, in passing through the log. The 10 arcs of circles are drawn with radii of 30 inches, 3 inches apart. Each arc is exactly a quadrant or 90°. Each of these arcs touches the base line or line of centres at a point 30 inches from its centre. The centres being 3 inches apart, the distances between the arcs, showing the position of the rim upon the line of centres, are each exactly 3 inches. Running verticals from the successive positions of the centre, 3 inches apart, all these verticals are 3 inches apart. Running a horizontal line along the points of tangency, parallel to the line of centres and perpendicular to the verticals from the successive positions of the centres, it will be seen that the distances between the points of tangency, measured upon this line of tangents, are the same as

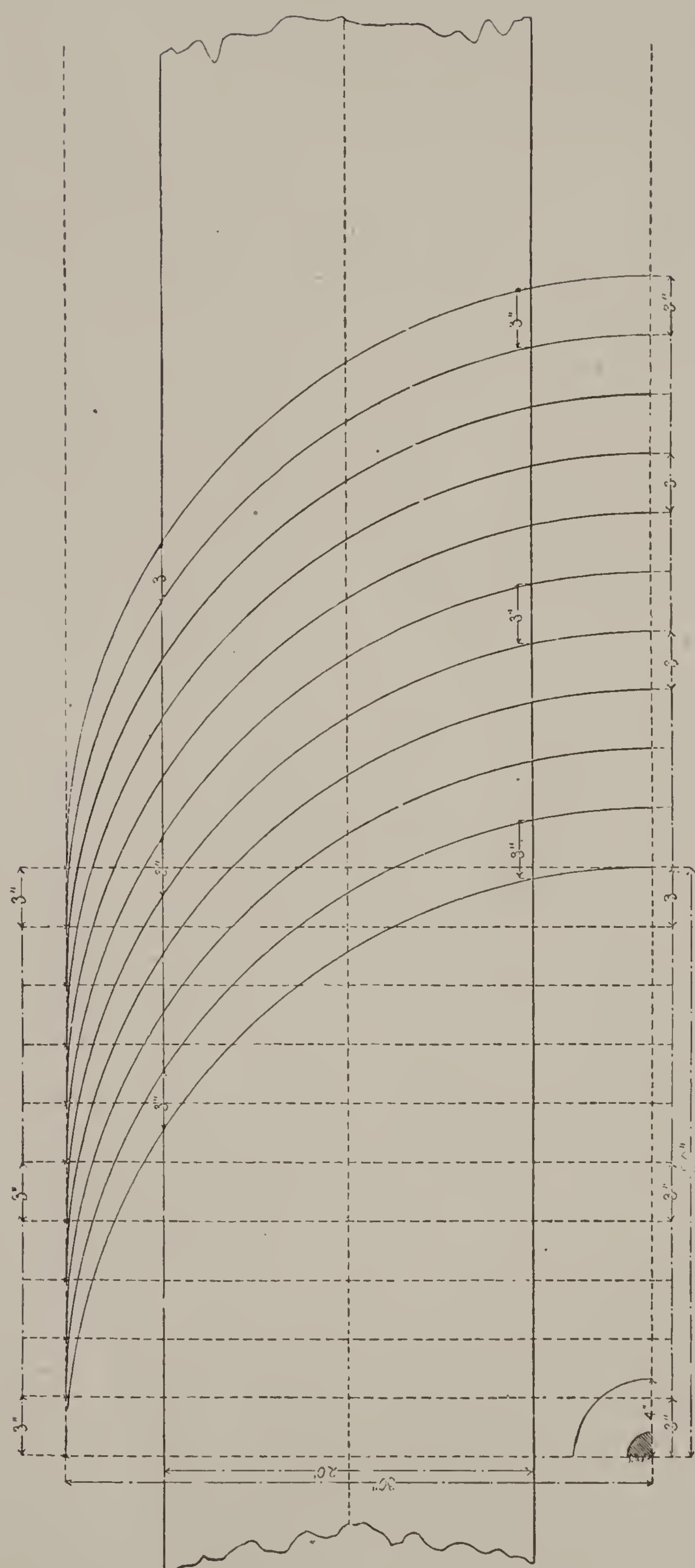


Fig. 317. Cutting Action of Circular Saw.

those between the centres, the same as between the successive positions of the rim upon the line of centres, and the same as the distance between the verticals. The sides of the cant are parallel to each other, to the line of centres, and to the line of tangents. The distances between the verticals from the successive positions of the centres, are, if measured upon the top edge of the cant, or upon the bottom edge of the same cant, the same as measured upon the line of centres, or upon the line of tangents, or anywhere else—just 3 inches. The distance between the curves showing successive positions of the saw rim upon the top edge of the cant, is just the same as the distances between the centres, between the verticals, and between the points of tangency—namely, just 3 inches. The distance between the curves showing the successive positions of the rim upon the bottom edge of the cant is the same as that between the centres, between the points of tangency, between the verticals, and between the successive positions of the rim, measured upon the line of centres—namely, 3 inches. The horizontal distance between the successive positions of the rim, measured along *any* line parallel to the line of centres, the line of tangency, the top edge of the cant, and the bottom edge of the cant, is just 3 inches. It cannot be made to measure more, nor less. It can be proved geometrically, and it can be measured by any one having 30 inches of string to draw sharp circles, and a 2 foot rule to draw and measure the straight lines.

Owing to the advancing movement of the cant, the scratches made by the teeth of the saw are not exactly circles, but they follow the same rule, as regards their distances apart, as do the circular arcs showing the successive positions of the saw rim.

In other words, the saw scratches are the same distance apart measured along the top edge or the bottom edge of the cant.

If they were not, it would be necessary for the *top edge of the cant to be different in length from the bottom*, or for the cant to be fed in upon an arc of the circle so as to give less feed to the top edge than to the bottom.

In making a drawing on this subject, do not be misled by the parallel curves appearing to meet at the top.

This photo-engraving of the full-sized sketch may be relied upon as settling beyond all controversy the fact that *the tooth scratches made by the circular saw are the same distance apart at the top as upon the bottom of the log.*

"Virginia Rail Fence."—Sometimes a circular gets a notion of running crooked in the edge, even while cold, although not sprung, and when standing seemingly true and both sides alike. In this case it is too large at the rim, and tends to wrinkle, although not enough to show when standing; but the additional stretch, caused by centrifugal force under motion, causes further rim expansion, and dishes the plate on one diameter to one side, and exactly the reverse on the diameter at right angles. This trouble is apt to occur with inserted tooth saws, simply by overstraining the edge by riveting or by too close a fit of the teeth. Dirty or greasy dust or rust in the groove of the teeth, will cause the same trouble.

Trembling or Fluttering at the edge is caused by lack of balance, one side being gummed or filed more than another. An ounce of steel on one side of a saw running at 800 or 900 revolutions per minute, will cause this trouble. See that the teeth are all alike as to size, or, at least there is as much metal on one side of the saw as on the other, counting from any diameter. To cure fluttering, mount the saw on an arbor on two steel straight edges, and file the teeth on the heavy side until it balances. To prevent, use a sheet metal template.

Sawdust Packing.—Sawdust packs in the side of the log and board, sometimes on account of the shape of the gullet. If the tooth be nearly straight, from three-fourths of an inch from the point to the bottom of the tooth next behind, there will be less trouble from this.

Another cause is frozen or slightly thawed sawdust that strikes the side of the log or board, and sticks to it long enough to crowd in between the plate and timber. This occurs when the timber is thawing out slightly, and in this case a little extra set will help the matter.

A "Bull's Eye" is sometimes caused by getting a piece of slab down between the saw and the frame, and the question is whether or not to run out the stock before sending the saw to be hammered.

Grandy says: "This will depend on how close a workman you are. By giving the saw more set than usual, and reducing the feed, you may run and do fair work, but at the expense of power and good mechanical principles. A better way would be to take a block of hard wood endwise to the grain, and lay the saw flat on the block, bulged side up; take a two pound or three pound hammer, and, by heavy blows, force it down. Lay a piece of thick pasteboard on the saw to receive the blows, and prevent stretching the plate, for if you do this by light blows, you make the matter worse. Try with a straight edge after each blow."

Cats' Tails.—The sawyer is often troubled in cutting sapling pine in the summer, by what are called in Vermont "cats' tails," or the inside bark slipping off and rolling in beside the plate, heating the saw. This may be remedied by filing the tooth considerably, shearing say 20°; that is, about the same as for bolting or cutting off. Shearing is not recommended when the logs are frozen, unless the saw is of unusual thickness.

Crowding the Log.—It sometimes happens that the circular saw crowds the log, and gets warm. Although it seems true when cold, and pains have been taken to file and set both sides alike, it seems impossible to make it run well unless it be given more set on the log side. This is a common trouble with inexperienced sawyers, and the remedy a foolish one, in fact, "getting Satan in to drive out Satan," as the doctors say. If the saw be true the trouble is, that it ranged out of the log; or else the collars, although they may have been right once, are not right from having accumulated rust and dirt on the face of the collar, near the centre. This causes the disk to become crowning on the log side. To remedy this, take an old file, break it off so as to form a scraper or turning tool, fix a solid rest, take out the check pins, and run the arbor quite slowly; hold the tool firmly, and turn off the rust, and, perhaps, a little of the iron, according to the condition of the collar. Use a gauge to test with, and leave the collar a little concave. Clean off the loose collar also, and then if the disk be true and ranged parallel with the line of motion of the carriage, it will probably run straight without the necessity of giving one side more set than the other, or filing one side more shearing than the other, both of which are makeshifts or botches.

Hammering.—In the matter of hammering, if the smith could stand at the brake, and saw 100,000 feet of lumber, after hammering each saw, he could learn more in one year than otherwise in ten.

Temper of Circulars.—Disstons say that a circular saw cannot be too hard (but a handsaw should have a "Damascus temper").

Nonhammered Saws.—Mr. C. E. Grandy, South Barton, Vt., says: "I have such a saw 52″ press tempered to run 900 revolutions, to feed 2 inches in maple often running 30 M feet. The saw took the shape of a tea saucer; returned it to the maker, repressed it, rehammered it, sawed 100 M feet. It took the shape of a worm rail fence most of the time. Then I sent it to another manufacturer, had it hammered to run 800; we sawed 1,000,000 with it; it wore to 49″, and is doing good work now."

The Brooke Removable Teeth (Fig. 318) have claimed for them the following advantages over others of the same class: large throat, hence greater clearance; greater amount of metal to wear away; capability of being swaged; adaptability to very thin plates; interchangeability with the "new" in the same disk.

We give beneath the thinnest disks used with the "Brooke" and the "new" teeth of the American Saw Company.

Nos.	Gauges.	Thickness in inches.	Thickness in mm.
1	4 to 10	.238 to .134	6.05 to 3.30
2	7 to 12	.18 to .109	4.57 to 2.77
3	10 to 18	.134 to .049	3.30 to 1.24
4	12 to 20	.109 to .035	2.77 to 0.89

For hard wood the "*short new*" *removable tooth* No. 1 or 2, is recommended by the makers; and the Brooke teeth may be temporarily replaced by it in the same disks.

To the Operator using "Brooke" Inserted Teeth.—"When changing the bits or teeth, be careful not to drive or expand the rivet so much as to strain the saw plate, nor to head it too much. Place the bit and spring together, and then put the heel of the spring as

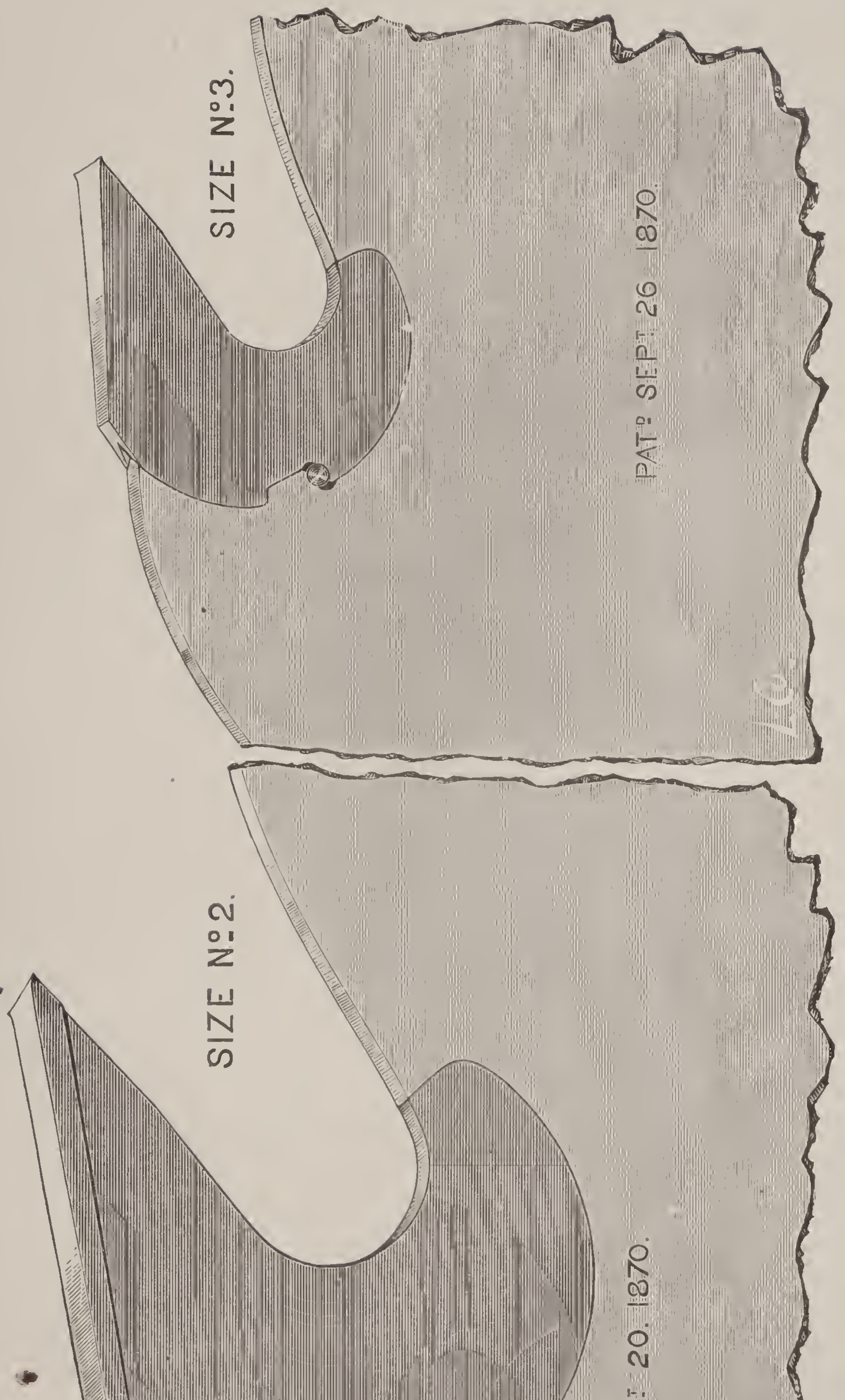


Fig. 318. "Brooke" Teeth, Full Size.

close in its corner as possible, with the point of the plate entered into the groove of the bit, keeping the lower part of the bit with the adjoining part of the spring just clear from the plate sideways, until both are turned into the groove so far that they will drop over the lug into their place. A swage may be used on the point if necessary to bring them to place, and the small end or pin of the wrench to draw the spring down before inserting the rivet. The rivet should be driven or expanded only enough to set the spring firmly in the bottom part. If it is found that the spring does not hold the bit tight enough when the rivet is in, do not try to tighten it by driving the rivet more, but with a light hammer give one or two blows on the side of the spring near the inner or throat edge about opposite the lug and rivet, holding a sledge on the opposite side. This will expand the spring on that edge so that it will press more firmly on the bit. The hand screw-press, with wrench, is used for forcing out the rivet, and makes the changing of bits quick and easy.

"After the bits are in, the first thing is to round and joint off the teeth, and put the saw in working order. If any of the bits are found to stand more on one side than the other, file off the full side. Do not attempt to bend or spring them over, as there is plenty of spread on the point to allow of their being jointed off on the side. Be careful to have the front of the bit the widest.

"One set of these bits should last twenty-eight to thirty days of ten hours each. They have done so where both hard and soft timber were sawed."

New Lumberman's Clipper.—Fig. 319 shows the "Lumberman's Clipper" tooth as at present made. It will be seen to differ

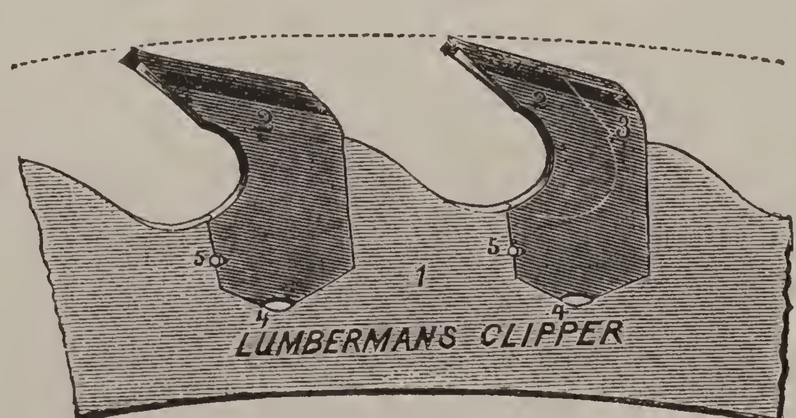


Fig. 319.

from that illustrated on page 77, which has square bottoms to the teeth.

Greatest Number of Teeth in a Disk.—The "Brooke No. 1" may be placed at 4″ apart. The "new" teeth may be placed at the following distances:—

Nos.	"Regular."	"Short."
1	$4\frac{1}{2}$	$4\frac{1}{4}$
2	$3\frac{1}{2}$	$3\frac{1}{4}$
3	2	—
4	—	1″

Inserted Toothed Circulars seem especially popular in California, Wisconsin, Michigan, and Ohio, and for yellow pine in the Southern States.

Economy in using Inserted Teeth Circulars.—Messrs. R. Hoe & Co., N. Y., write under date of May 10, 1881: "The prices of 54″ and 56″ saws are as follows:—

One 54″ solid circular, list . . .	$105 00	
less 40 per cent. . .	42 00	
	$63 00	
boxing	2 40	$65 40
One 56″ solid circular, list . . .	$125 00	
less 40 per cent. . .	50 00	
	$75 00	
boxing	2 60	77 60
One 54″ chisel tooth, list . . .	$160 00	
less 10 per cent . .	16 00	
	$144 00	
boxing	2 40	146 40
One 56″ chisel tooth, list . . .	$180 00	
less 10 per cent. . .	18 00	
	$162 00	
boxing	2 60	164 60

The prices of chisel tooth saws include the regular number of bits and shanks given with each saw.

"The estimate referred to in your letter, 'cost of inserted teeth to cut 1,000,000 feet of lumber about $35,' is a fair one, though some of our customers have written that they cut with one set of bits in a 56″ to 60″ saw 95,000, 100,000, and even 120,000 feet of lumber."

Inserted Teeth.—C. E. Grandy writes: "In the matter of inserted toothed saws, I have used about every style made. Here, again, is too fine a theory for the average sawyer or even saw-maker to carry out.

"Where keys as rivets are used, they are almost certain to buckle the edge of the saw. If the saw-maker succeeds in getting the right tension on the edge, the sawyer by the time he puts on a new set, or even puts in a few teeth, he is sure to spring the saw.

"It is proverbial in New England that one is 'leaning up against the side of a mill like an inserted tooth saw.' You will find one in most every mill, but they are superannuated, awaiting further orders.

"The style of turning in on a circle gave the best results where the tooth is held like a circular. In one of which I know the manufacturers did not get the tension right the first or second time. Trying the third time they put in a new set of teeth; their teeth evidently did not fit tight, so they left the eye of the right tension and ran the saw successfully until this set was worn out.

"The first set being found I put them in, then the old story of the Virginia rail fence was repeated. I took the teeth out and ground the shanks narrower which received the strain, and I used this set of teeth successfully.

"The theory that the plate of an inserted tooth saw is not destroyed by gumming is correct; but the texture of an inserted toothed saw is as costly as that of a solid tooth. My experience is that 1,000,000 feet sawed will necessitate *new teeth*, that is, where the power is good enough to carry 2 to 4″ feed. If one will think this out he will see why where one is successful another is not. As to perforated teeth, I am entirely at loggerheads with them.

"A very little is removed in gumming, but the liability of breaking out in the cut is so great that it destroys their usefulness. I have seen a perforated, inserted tooth saw with four or five teeth in succession broken out. This was done by first breaking off one tooth in a hard cut of oak log.

"The theory of allowing for expansion by perforation does not hold good at all. I have seen these saws flutter and roll the same as any saw warm at the edge."

The Pitch Circle.—Misleading directions are often given concerning the laying out of the face or cutting edge of circular saw teeth. It is frequently stated that the front face should be the tangent of a circle "one-fourth the saw's diameter," if ripping hard wood, or "one-fifth," if soft, when in reality, three-fourths is meant in the first case, and four-fifths in the second. Fig. 320

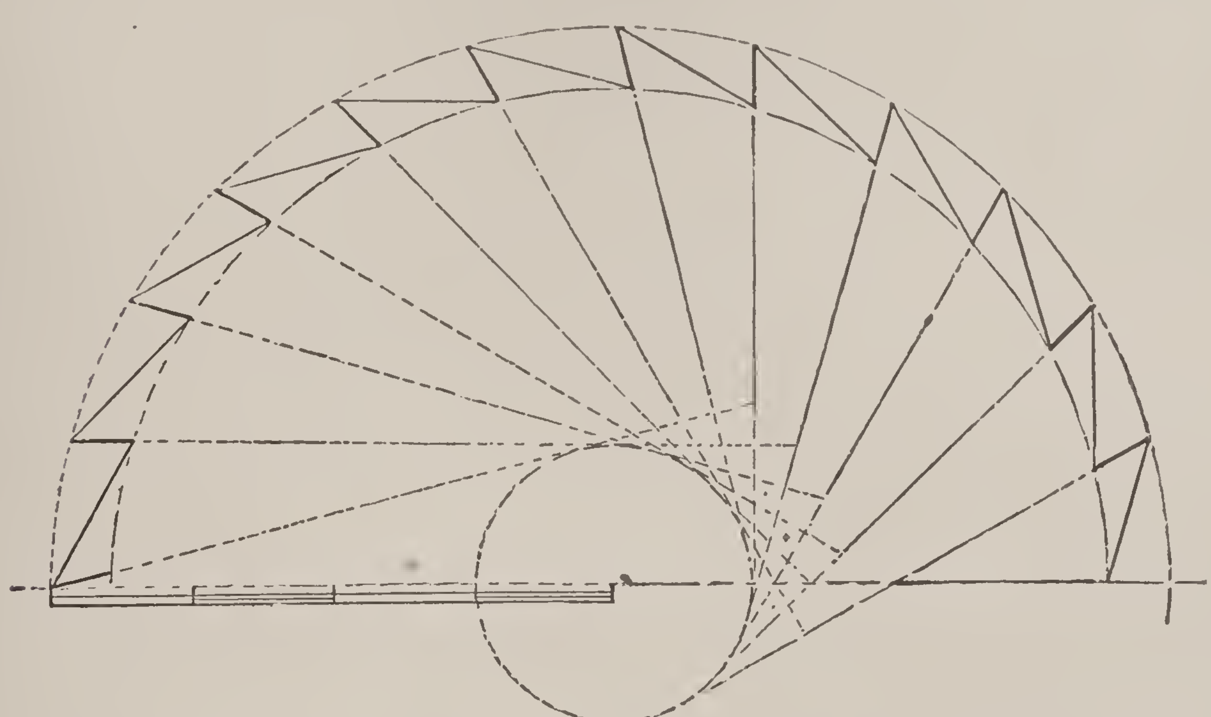


Fig. 320. Showing Tangent Circle 1-4 Saw Diameter.

shows teeth laid out to tangents of a circle one-fourth the disk diameter. It will be seen that this is not a suitable tooth for hard wood.

The Latest "Smallest Circular Saw in the World."—On page 62, Fig. 90, was shown in actual size what was then believed to be the smallest circular saw in the world; its use being to make the slits in gold pens. But a still smaller one has been found, used for the same purpose by Mr. John Holland of Cincinnati,

Fig. 321. Smallest Circular Saw in the World.

and given in full size in Fig. 321. It is run from 2500 to 4000 revolutions per minute.

Making Small Circulars for Screw Nicking.—At the works of the Union Screw Works, Cleveland, Ohio (one of the best organized factories we have ever inspected), the small circulars for nicking screw heads are made in a machine designed by the superintendent, Mr. W. H. Bidwell. The blanks are punched out of sheet steel, of size and thickness varying with the screws to be nicked. They are then strung on a mandrel, say 50 on each, and tightly bolted up. Three mandrels are put in a machine which has three shaper heads, each bearing a tool having one edge vertical, and the end ground to 60°. These tools, being mounted with their straight sides a little off the radial line of the disks, travel together, each cutting at one pass one tooth in each of the disks on its mandrel. An index wheel on each mandrel automatically causes partial rotation of the disks at each cut, and insures desired number of teeth, evenly spaced.

Speed of Circular Saws for Barrel and Shingle Work.—John Greenwood & Co., Rochester, N. Y., say: "We can add very little to the valuable information contained in 'Grimshaw on Saws,' except, perhaps, in relation to the gauges given for concave saws on page 67. For barrel-head work, the gauge, if it is the English standard, is three gauges too light. A 7-inch saw should not be more than 15 G., 14 is what we generally use for 7 and 8-inch saws. For 10 inch, 11 and 12 G. We run these saws over 5000 revolutions per minute, and 40-inch shingle saws, 60 teeth screwed to cast-iron stiffening collars, 1300 revolutions. Your tables of speed are rather lower, say 10 per cent., than the rule in our line of trade. We find our customers increase on our figures considerably sometimes. One we know of is running a 42-inch shingle saw in heading 1500 revolutions per minute."

Speeds of Circulars.—The statement that there is a fixed and invariable rule for speeds of saws of given diameter, needs more than a little qualification, as disks of the same diameter take different speeds according to gauge, quality, temper, teeth, timber to be cut, etc.

Concave Saws.—"The temper of a concave saw, in our opinion, ought to be as good and as high as in any ordinary circular doing the same nature of work. The custom has been to leave them much softer to avoid breaking in the hands of the sawmaker, but a soft saw will not hold the set when cutting hard wood heading. The disk is made to a true circle, and in size corresponding with the diameter of the heads they are to circle, providing the heads are cut square on their periphery, as cheese-box heads are made. If we want to make a 17-inch cheese-box head, we use a saw dished to a circle of 17 inches, and for a flour barrel head 17 inches in diameter with bevel, we use a saw dished to a circle of 24 inches. The same saw may be used for making various sizes of heading having bevelled edges by changing the angle of the axis of the head in relation to that of the saw. In that case the bevel on the heading is also changed or altered to suit the saw; in a small head they are sharper and in a large head stunted. Concave saws sawing bevelled heading must be filed like ripping saws, square across the tooth."

Sectional Grooving Saw.—Fig. 322 shows a form of sectional grooving saw in which the action is gradual throughout the width of the cut. As seen by the engravings, it consists of six sections, all alike, and each having four teeth. These six sections, being put on one mandrel, are so arranged that the teeth take up nearly the circumference. In cutting with them, one section cuts out a kerf one-sixth the diameter of the groove intended to be made, and the next one cuts alongside of the kerf that the first one made, etc. By this means the action is much smoother than if there were but one section, each end cutting full kerf width. This saw is made by Goodell & Waters of Philadelphia.

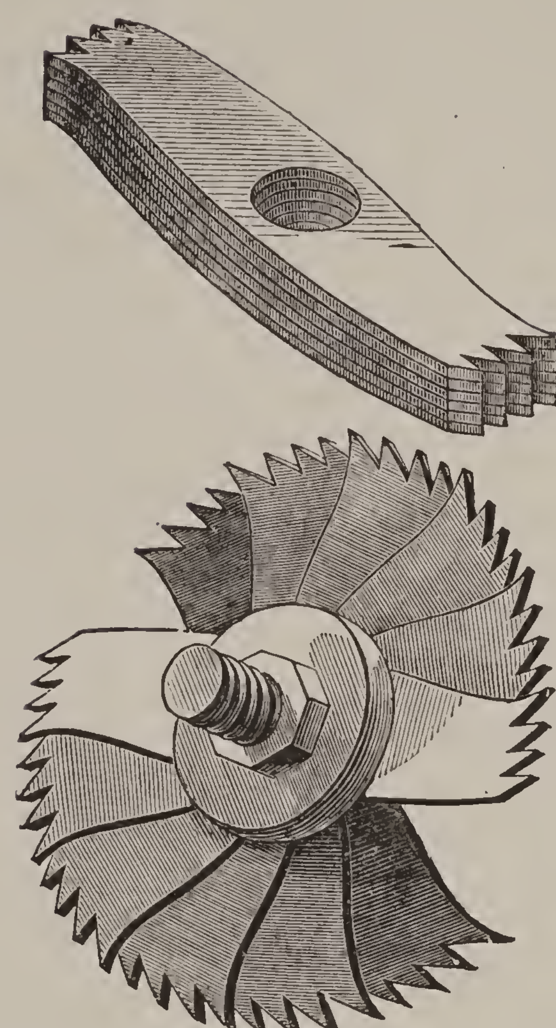


Fig. 322. Sectional Grooving Saw.

Adjustable Veneer Saws.—By making the holes in a veneer saw segment oblong radially, the segment is rendered more easily adjustable.

An Adjustable Dished Circular, patented by S. B. Wells, in 1854, had an angular incision cut from the edge to the centre, or, in other words, a section was cut from the disk, which was then sprung by means of washers and rings to the desired curvature. It was designed for cutting barrel staves, wheel felloes, etc., and intended to be run somewhat slower than the ordinary circular.

Kringer's Insertable Saw Tooth.—In U. S. Patent, No. 248,761, October 25, 1881, Fig. 323, the saw plate *A* has a socket *B* (provided with a shouldered portion *H*, having a depression *I*), and is also provided with a depression *L*. The saw tooth or bit proper has an oblong, rounded V-shaped projection *J*.

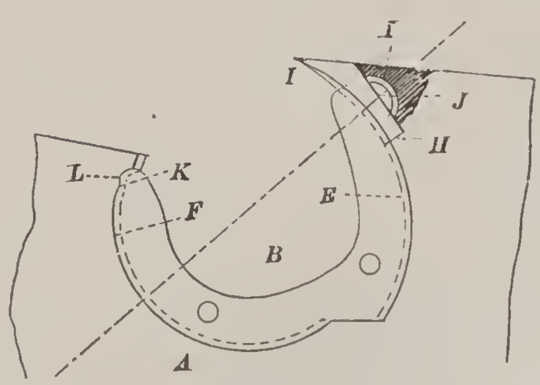


Fig. 323. Kringer Tooth.

Hubbard's Relayed Saw Tooth (U. S. Patent, No. 245,831, August 16, 1881) is for a relayed saw tooth consisting of a body part, having a bevelled edge which extends above the throat, and a hood or removable part bevelled to fit the bevel of the tooth and projecting into the throat below the bevel. The removable part has also a heel projecting into the recess in the throat.

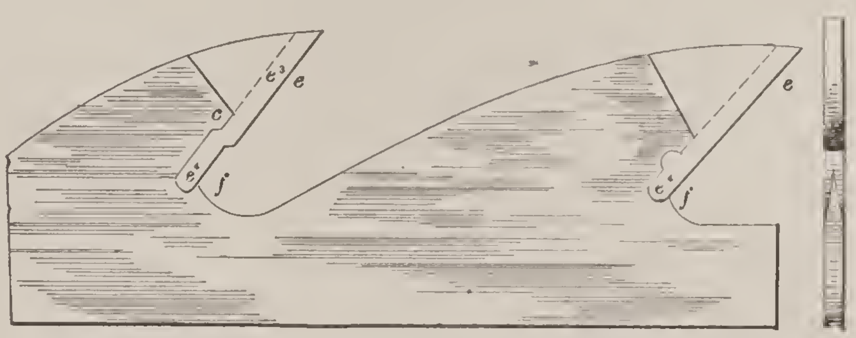


Fig. 324. Hubbard Relayed Tooth.

Mulford's Insertable Saw Tooth (U. S. Patent, No. 236,690, January 18, 1881) is shown in Fig. 325.

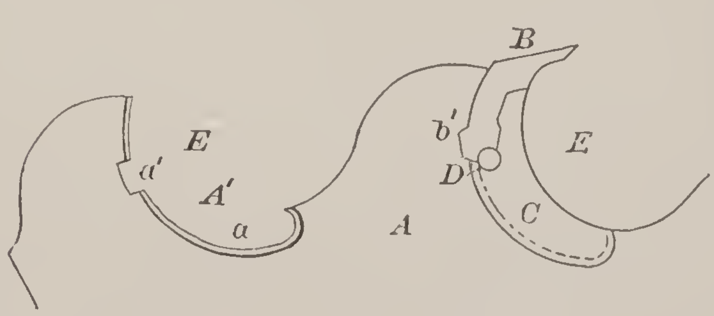


Fig. 325. Mulford Tooth.

Douglas' Insertable Saw Tooth (U. S. Patent, No. 236,876, January 25, 1881, Fig. 326) has a projection on one side longest in the run of the cut of the tooth from the point backward, on which there is a flat surface parallel with the face of the saw.

Fig. 326. Douglas Tooth.

Hill's Insertable Saw Tooth (U. S. Patent, No. 239,098, March 22, 1881).—The blade *A* has throats or gullets *C*, and its teeth are recessed entirely above the gullets. Those portions of the detachable tooth *B*, which are in the same recess, are of the same thickness of the blade and have a double curved shape.

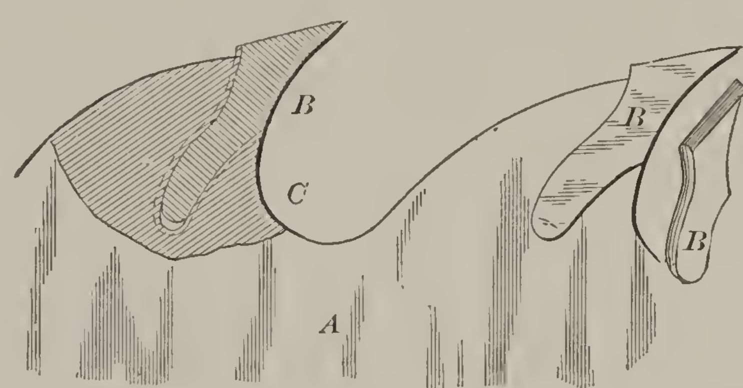


Fig. 327. Hill Tooth.

Atkins' Detachable Saw Tooth (U. S. Patent, No. 246,703, September 6, 1881) has, in combination with an insertable saw tooth having suitable projection, strong locking jaws, forming a recess in the saw plate.

Fig. 328. Atkins Tooth.

Simonds' Loose Circular Saw (U. S. Patent, No. 237,617, February 8, 1881), shown in Fig. 329, is loose with reference to its diameter and also with reference to its radii; but with reference to its diameter, more loose at the eye than any other part.

Fig. 329. Simonds' Loose Circular.

Osgood's Side Cutting Circular (U. S. Patent, No. 238,521, March 8, 1881) has side cutting teeth *a a*, and chisel cutting teeth *f f*, the latter being curved as shown in Fig. 330, to under

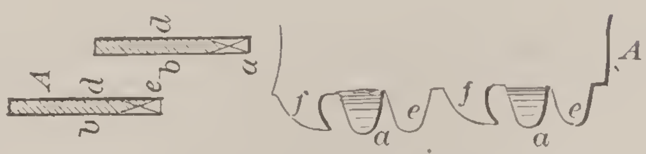


Fig. 330. Osgood Side Cutting Circular.

cut or to plane out the wood between scores made by the teeth *a a*, the scorers being shorter than the cutters.

Northway's Planing Saw (U. S. Patent, No. 245,090, August 2, 1881).—There are sawing teeth *B* and planing blades *C C*, cut

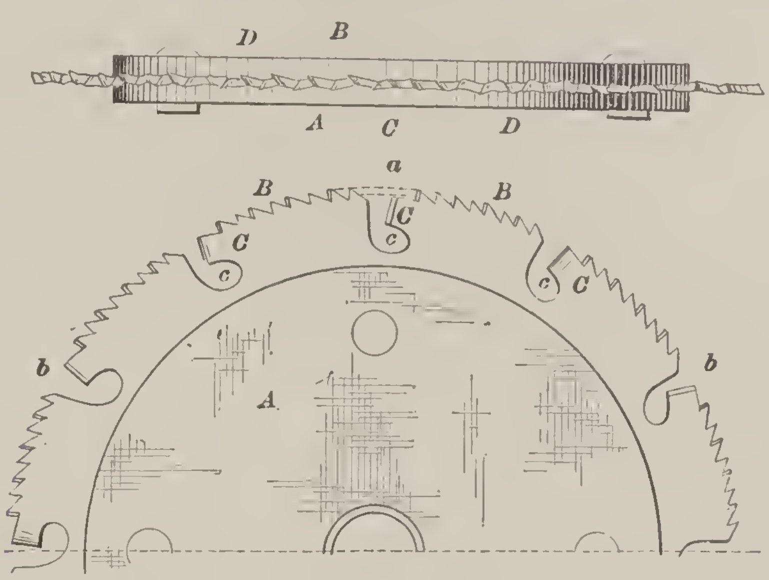


Fig. 331. Northway Planer.

into the working edge of the saw. The points of the teeth *B* extend radially beyond the points of the planing teeth *C C*. The edges of the planing teeth extend laterally alternately in opposite directions, further than the whole remaining portions of the blade. The planing teeth *C* have throats *c* to receive the chips.

McDonald's Saw Arbor (U. S. Patent, No. 243,076, January 21, 1881).—There is an attached collar *c*, having a flat face and round edge *a*, the saw resting against the flat face.

Figs. 332 and 333. McDonald Arbor.

Bennett's Hand Circular Saw (U. S. Patent, No. 239,703, April 6, 1881) has a circular saw projecting below the edge of the plate on which it is mounted, and receiving its motion from one or more friction wheels, which move along the surface of the board to be cut.

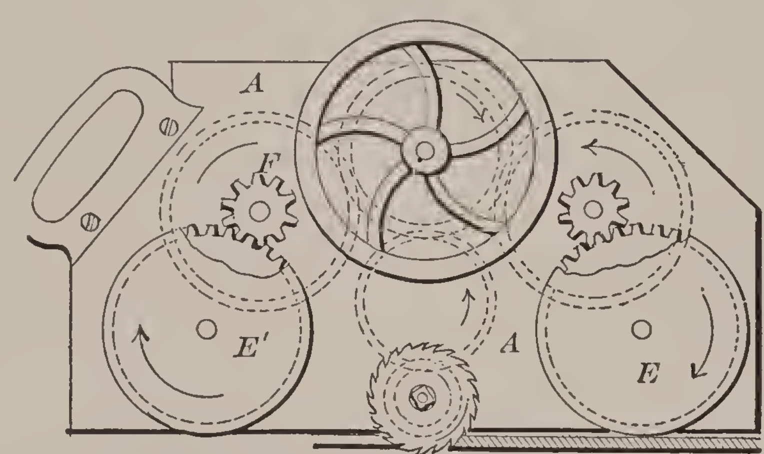


Fig. 334. Bennett Hand Circular.

Suggestions for Making Saw Mandrels, *with special reference to Facing the Saw Collars.*—"First. Special care should be taken to have good drilled centres in the shaft, and when the shaft is turned to see that the mandrel is tight in the lathe centres. Second. Do not chamber out the face of the saw flanges or collars, but finish them so as to give a full bearing on the saw. Third. The face of the loose collar should be perfectly flat; be sure that it is not concaved or full at the centre. Fourth. The face of the fast collar, which is shrunk on or made part of the mandrel, should be faced or made a trifle concaved, so that by laying a perfect straight-edge across it and looking through towards a strong light, daylight will be barely discernible. The last cut should be made with a very fine-edged sharp tool. All cast collars should be of very soft iron and carefully annealed so that they will not contain hard spots. Fifth. The greatest care should be used in fitting the lug or steady pins. They should be made of steel, very carefully turned and fitted, so as not to require force in driving. After they are in, the face of the collar should be very carefully examined with a straight-edge to ascertain if driving them has not raised and swelled the metal of the collar around them, and if so, it must be very carefully chipped or filed off level with the face of the collar. The above applies to circular saws for saw-mills only. For resawing or for bench saws both collars should be turned concaving."—JAMES E. EMERSON.

Packing Circular Saws.—A custom followed universally in Europe, but not at all in America, is "packing" circular saws with pieces of hard wood, such as mahogany, under the saw table on either side, and lying immediately parallel and close to the disk, which it serves to guide and prevent from wavering. In many cases the packing contains a gasket of felt or similar material, well charged with oil, and serving to lessen not only the friction of the disk against the packing, but that in the cut itself. Mr. Samuel Worssam, in 1853, designed and made a packing by loose blocks on each side of the saw, each fitted with adjustable packing pieces. Abbey, of Paris, "packs" with four adjustable screws above the saw table, their points terminating in hard wood and touching the disk at opposite points. Good packing enables the running of a thinner saw.

Packing Collars with Paper.—Saw makers recommend this, but it is at best a makeshift for a short time. A saw ought not to be forced into position. When it does not run true it should be hammered.

Range.—The saw should be given little, if any, range into the cut. In theory, it should be exactly parallel; but to offset the tendency to throw off on the side cut of a log, it may be ranged in such a line that the saw would strike the head-blocks fifty or sixty feet off, assuming that they are half an inch from the saw. This range in summer time may be reduced to one-half; that is, to one-fourth inch in fifty feet.

The Hinkley Saw Guide.*—Fig. 335 shows a convenient guide for circulars. The arms are fitted in a bored cylinder, and

* Reliance Saw Works, Milwaukee, Wis.

may be turned back out of the way when changing saws, and dropped into position again precisely as before, without touching or altering the adjustment. The lateral adjustment is effected by

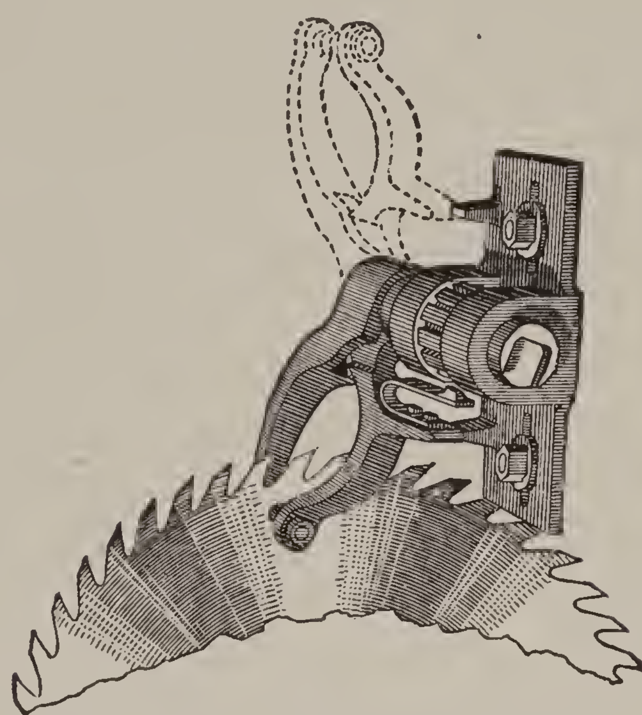


Fig. 335. Hinkley's Guide.

a worm and wheel which moves both arms together backward and forward in the bored cylinder without altering the distance between the saw pins. The worm is attached to a rod and hand wheel convenient to the sawyers, either before or behind the disk, to permit adjustment while in motion without danger. The space between the saw pins is regulated by a bolt on the front end of the guide. This device answers for either right or left-hand mills.

The Use of Water on Circular Saws.—Water, properly applied, is to be recommended, being a good lubricant, and cooling in its effects. It may be used in such small quantities as not to be detected. It should not show on the saw nor be perceptible in the dust. It is employed in some mills in such a manner as to have it fly all over the place. Used in this latter way, it is very objectionable.

The McDonough Hollow Arbor (Fig. 336), an important patent, concerning which there has been much litigation, is based upon the idea of taking water through the mandrel of a circular and having it escape at the collar on both sides of the saw while in motion, the centrifugal force distributing it equally all over the disk, thus lubricating the saw and keeping it and the journal cool. A jet of water is also discharged beneath the guides to cool that circle of the disk.

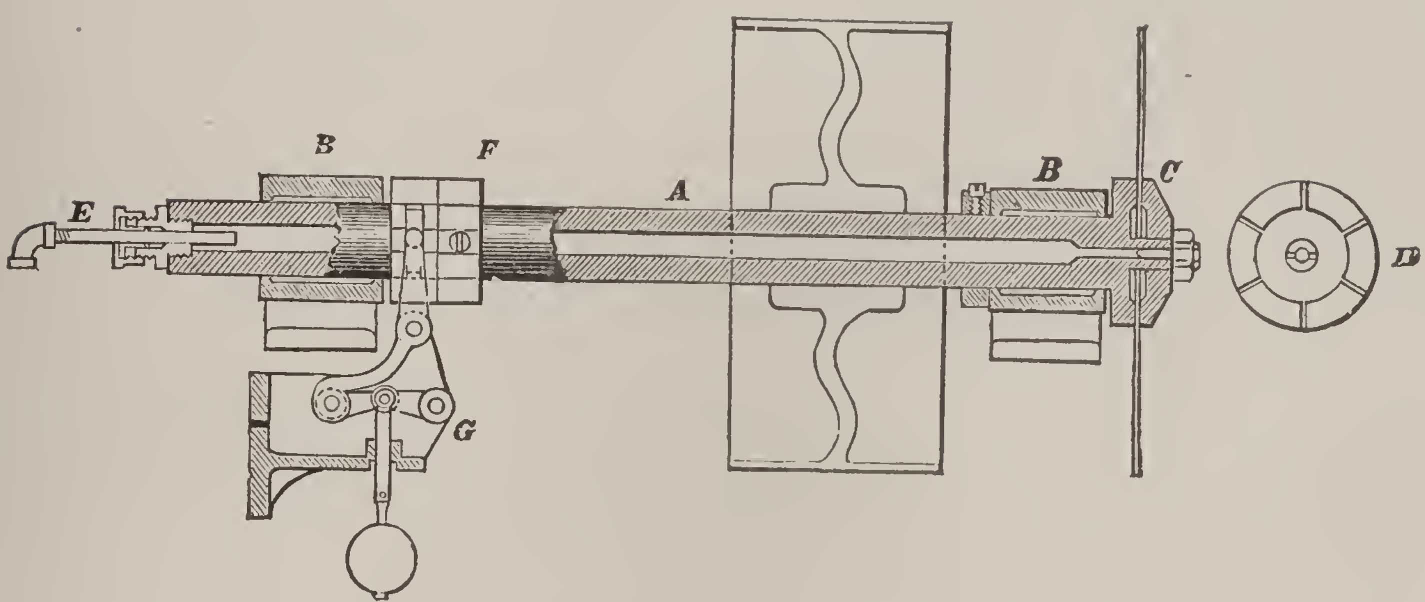


Fig. 336. McDonough's Hollow Arbor.

We understand that the patent has been decided in favor of Mr. F. McDonough, of Eau Claire, and we quote almost verbatim from the circular of the manufacturers, the Reliance Works, Milwaukee, Wis.

"Referring to the cut: *A* is the hollow arbor and pulley; *B B* are the arbor boxes; *C* the saw and collars; *D* the face of collar, showing the small creases through which the water is ejected to lubricate the saw; *E* is the pipe and stuffing-box for the admission of water into the arbor; *F* the tight collar or shoulder on the arbor; *G* is the weighted saw relief and collar, which can be attached conveniently to the husk.

"One patent covers a hollow arbor with water passing in at the tail end, and coming out between the saw collars, vent being given at this point by forming small creases in the face of both collars, so that water is ejected on both sides of the saw, and also by means of small outlets acting as lubricators for the boxes. The great value claimed for this over the solid arbor is—

"First. That fifteen per cent. more lumber can be cut, for full feed can be carried on all kinds of logs, no time being lost in waiting for the saw to cool off.

"Second. The same amount of lumber can be cut with ten per cent. less power, because a much thinner saw can be run, and with much less friction, as the plate is lubricated with water where it rubs on the log.

"Third. It will save ten per cent. in saw scarf, on account of using a thinner saw. The saw can be heavier at the eye, where strength and stiffness are required, and, if necessary, it can be of the same thickness as the scarf.

"Fourth. A great saving in repairs and expense of running, for, if the log rubs on the centre of the saw, it will not affect it, and the arbor will run with one-quarter the amount of oil.

"With this device there is an equal expansion of arbor and plate, avoiding all danger of warping, as the water is run through the *centre* of the arbor, and distributed equally on both sides of the centre of the saw, whence, by centrifugal force, it is evenly distributed over the entire surface of the plate, which is not the case where the water is applied to one side of the saw by means of a pipe.

"Old arbors may be bored to apply this principle."

The McDonough Saw Relief.—The object of this device is to allow lateral motion to the arbor. There is often a tendency for a log to crowd and bind the saw, which, if held perfectly rigid, would heat and probably break. In such case the relief, by allowing end play to the arbor, relieves the centre of the saw from pressure, and the blade, adjusting itself in line with the cut, passes through the log without trouble or damage, and the guide, by holding the cutting edge of the saw firmly in place, insures lumber of even thickness. When there is no crowding of the log, the saw and arbor run perfectly free, as there is no pressure whatever given by the relief, but the moment binding and crowding occur, then it acts instantly and surely.

Opening Wheel.—To lessen the friction of a ripping circular saw in the kerf and to increase the rate of feed, wedges were once driven into the cut, close behind the disk, to separate the several surfaces, but at times this caused splitting of the cant, and to obviate this, G. L. Molesworth devised in 1856 a self-acting revolving wedge, so placed as to separate the two parts and be revolved by its own friction against the sides of the kerf. This wheel,

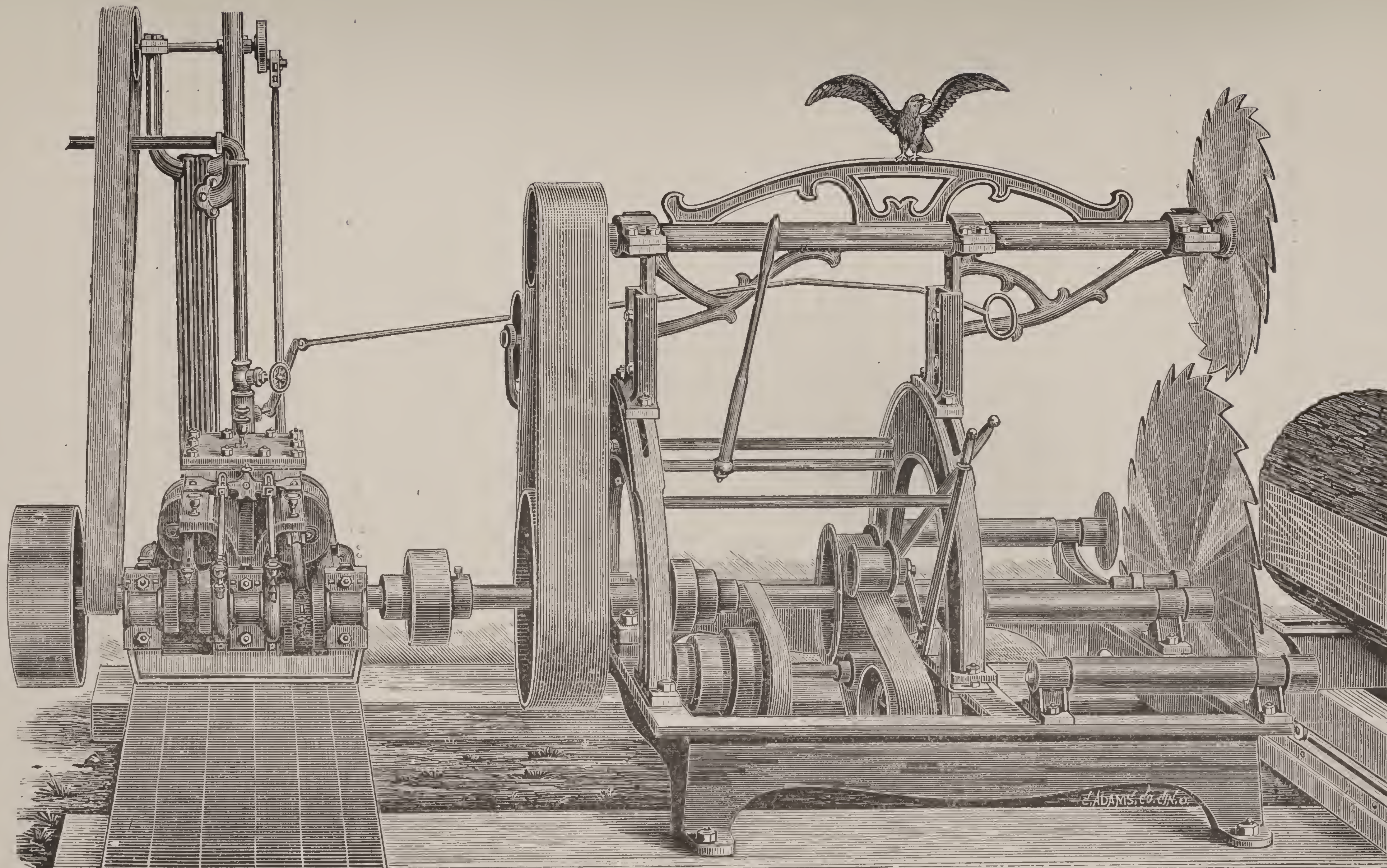


Fig. 337. Double Circular Mill,—Direct Driven.

which now has very general application, exerts a uniform pressure in relieving the saw, and adapts itself to irregular as well as straight sawing.

Direct Driven Circulars.—Fig. 337 shows the double circular saw-mill of Frey, Schechler & Hoover, Bucyrus, Ohio, driven direct from a high-speed engine of special design.

"Three High" Circular Saw.—We illustrate herewith, by courtesy of Tatum, Bowen & Co., San Francisco, in front and side

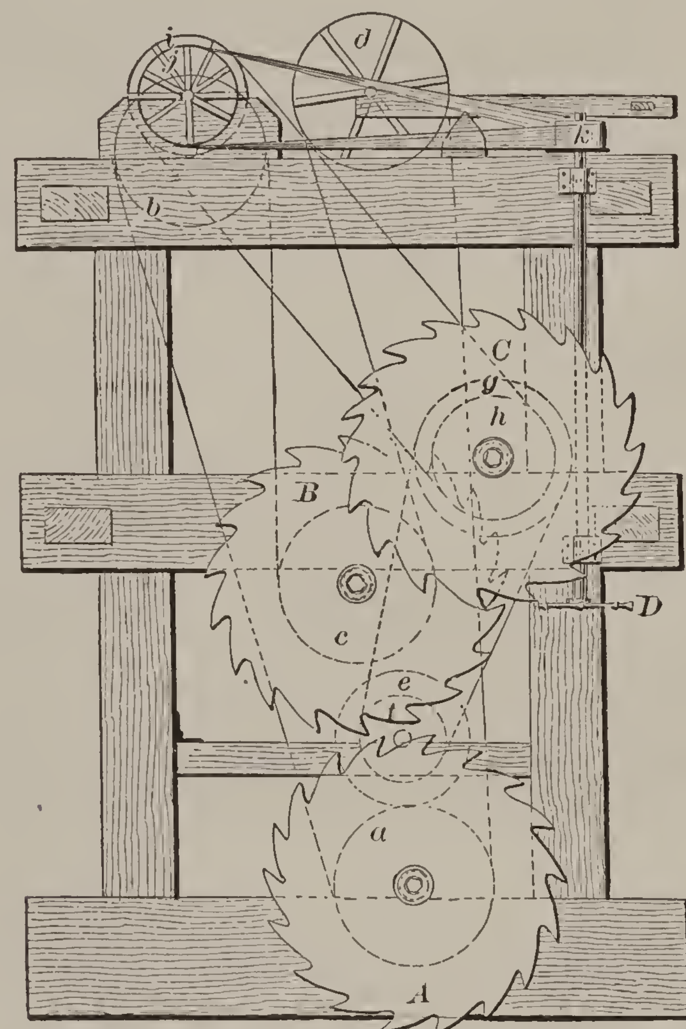


Fig. 338. "Three High" Circular Saw.

elevation, the machine used in California to cut logs ten feet in diameter, and referred to on page 56.

The invention consists in so arranging a gang of saws on the frame, and providing a small horizontal saw to follow or precede the gang, that the small saw will rabbet out a place to allow the end of the arbor or collar of the centre saw to pass. There are three vertical circular saws, arranged on the frame in the usual way for double circular saws, except that the upper one is extended beyond the vertical plane of the lower saws. There is also a vertical spindle, the lower end of which is provided with a small

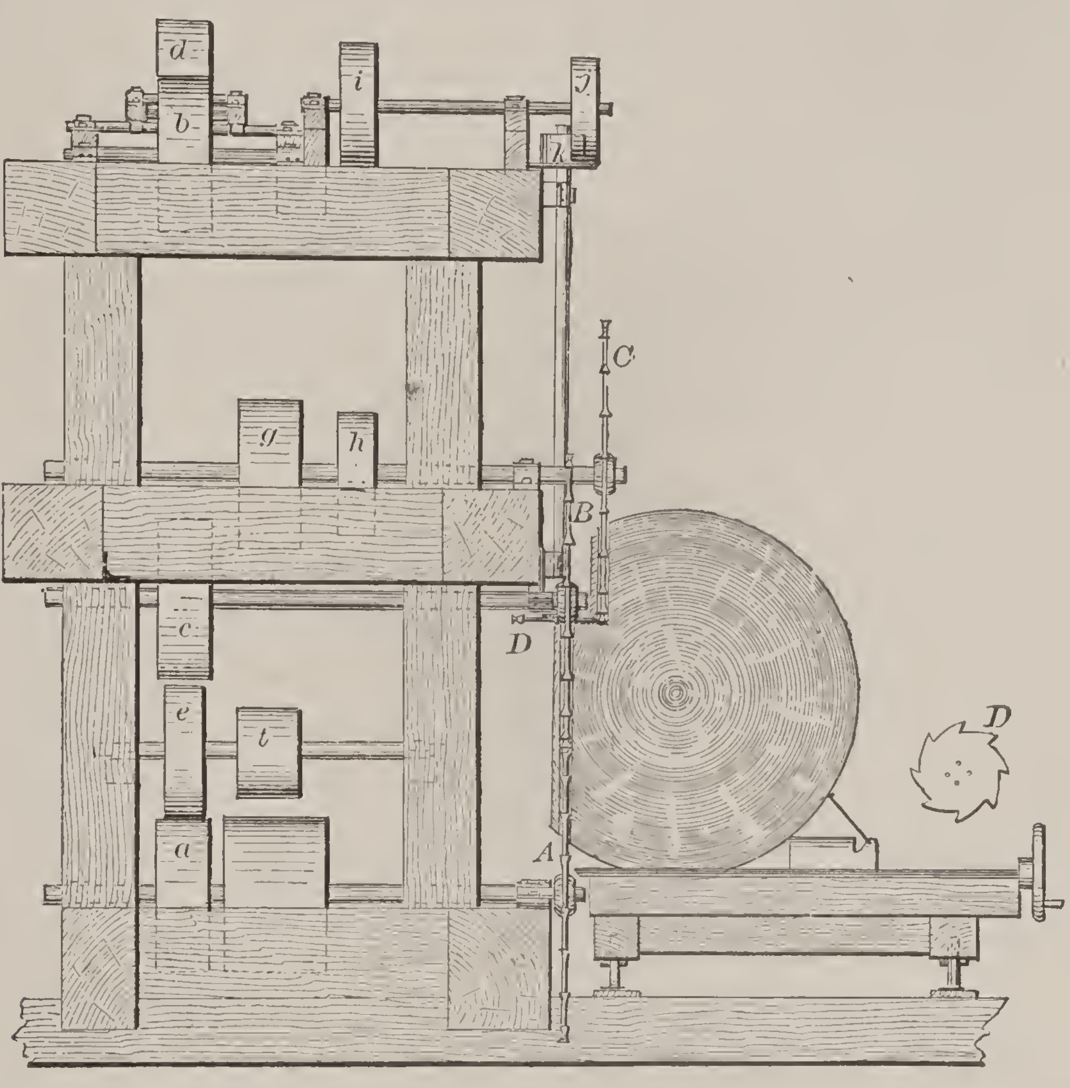


Fig. 339. "Three High" Circular Saw.

horizontal saw which precedes or follows the gang on the plane with the cutting edge of the top saw, on the collar or arbor of the middle or vertical saw. This, when in operation, rabbets out a longitudinal piece along the edge or joint. The upper saw thus cuts a board down from the upper part, while the two lower saws of the gang cut their width. The relative position of the gang is such that the upper face of the log is just as much in advance of the lower log face as the upper saw is in advance of the lower saw, and the distance between the vertical planes of the upper and lower saws is equal to the thickness of the lower saw divided by two and added to the thickness of the board or cut, the projection of the arbor or collar of the middle saw, and the clearance. The clearance may be operated without affecting the operation and perfect working of the gang. When the greatest depth is obtained, the lower cut or board will be the greater, and the upper one the lesser in width. In operating with such a saw-mill, at first the lower saws of the gang slab one side of the log, and the upper saw is not engaged; but as the set advances the upper saw cuts but little depth, and the horizontal saw following or preceding cuts lengthwise, and a small angular piece of the log is taken off with wane top.

Pitch of Circular Saw Teeth.—"The under side should stand at an angle of 45° to the plane of the cut, as this is the dividing line between a scraping and a direct downward cut. Of course this changes as to height of cut in circular saws."

Broken Teeth.—When a tooth is broken out of a circular saw, it often chops or breaks the timber badly. In fact, when the logs are frozen hard, it is almost impossible to run. To send the saw off to be cut down would seriously lessen its value by decreasing its size. The trouble may be remedied in another manner. As the tooth next behind the one broken has double work to do, it will spread off to one side more than to another, if bent for set, thus causing the extra mark on the timber. Shorten this tooth, whether spring or spread for set, so as to divide the cut. If bent for set, file the tooth next behind the one broken square across the blade, swage it out to full set, both sides alike. The saw will then cut as nicely as before, and will make but little mark on the lumber. If the saw be swaged for set, file the tooth on the top so as to divide the cut, and reduce the set a little in this tooth, using great care not to file it too much.

Sheared Teeth.—A tooth "sheared" or filed to a bevel of say 5° to 20° will do the work with less power (provided the tooth is strong enough otherwise to resist the tendency to spread in the cut). If a person were to take a jack-knife to cut a stick of any size, he would turn his knife to about that angle with the grain. A "sheared" tooth is in better shape to enter the wood than if swaged square. In Vermont, they swage the point about one-half the set and bend the rest, and shear 5° to 10°.

Rounding.—By holding an old file firmly to the edge of the saw when at full speed, marking the teeth on the points, then filing off the backs until the marking disappears, looking closely so as not to file a particle more than to the line, the saw may be rounded perfectly. The saw should be rounded on the arbor on which it runs when at work, although this is very seldom done. One sawyer says that he has seen a saw, which seemed perfectly round on the filing mandrel, show $\frac{1}{32}$ inch out when changed to working arbor. This is enough out to make the saw run badly in some timber.

Jointer for Circular Saws.—Fig. 340 shows an emery grinding machine for circular saws,* which, after gulleting the teeth, facing and backing them, with the emery wheel shown in the

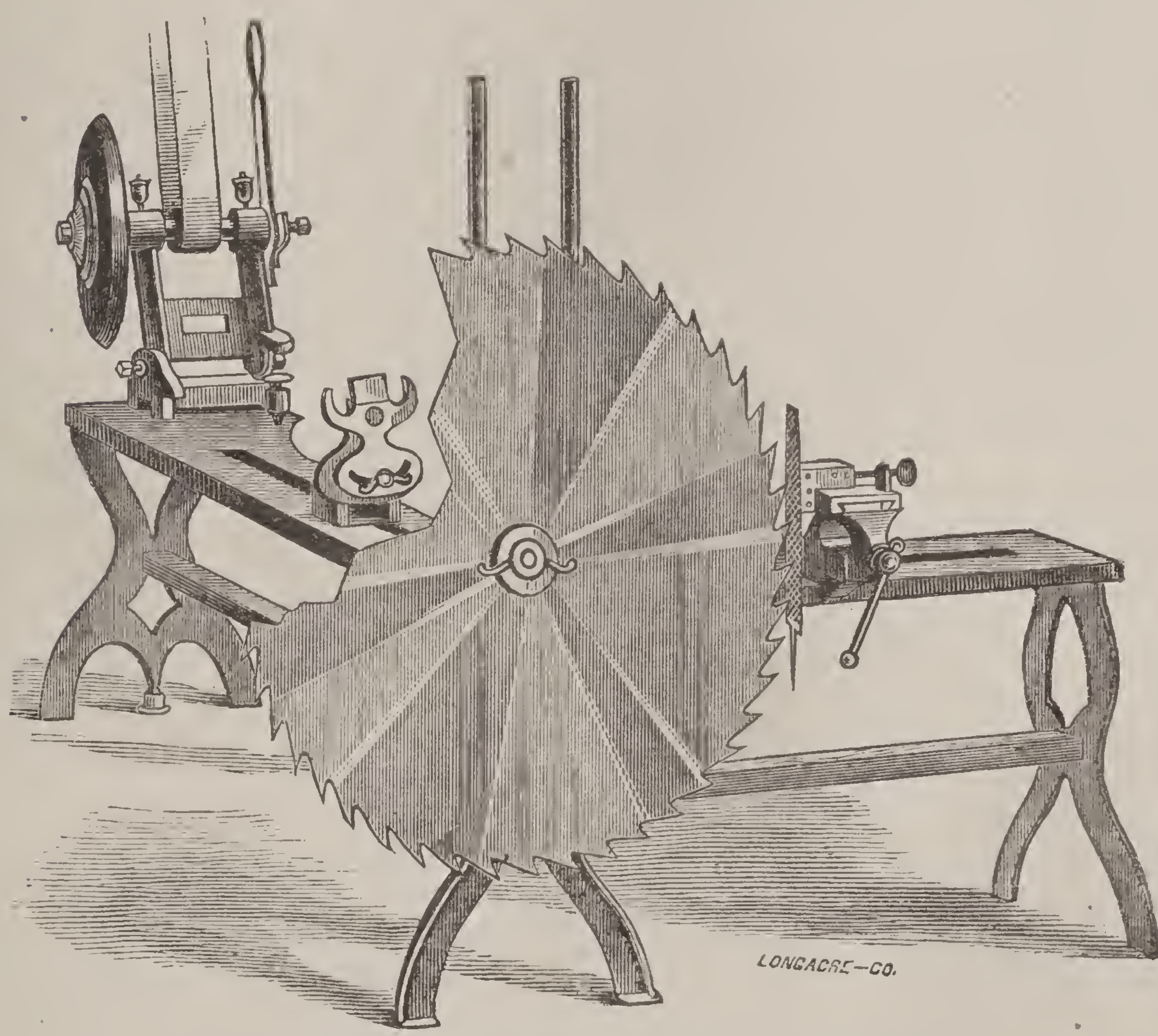


Fig. 340. Jointer and Emery Gummer.

swinging rest to the left of the cut, will "joint" them on an ordinary flat file held in the vise at the right: thus insuring that all the teeth are of the same length; or, rather, that the tips are all in the same circle, concentric with the mandrel.

* E. Andrews, Williamsport, Pa.

M Toothed Circular.—Boynton makes an M tooth circular saw which we suppose he designs to be reversible, being finished on both sides and turned on the mandrel when one set of teeth grows dull. This may or may not be an advantage for small disks. It is intended for both ripping and crossing.

The Spiral Saw.—A special class of saw, of which we know but one variety, is Armstrong's spiral saw used for making dovetails. In action it comes in between the band and the circular segment saws. The segments are clamped in a spiral groove in a holder having eccentric rotation. Those making the first cut have a straight edge; those at the last of the cut have their cutting edge at right angle to the plate; the intermediate ones grading between these extremes. As the cutting flange of each segment is worn away by filing, it is moved on one space towards the unflanged end.

The Rim Saw is a connecting link between the circular and the band saw; being simply a flat ring—not a belt—toothed upon

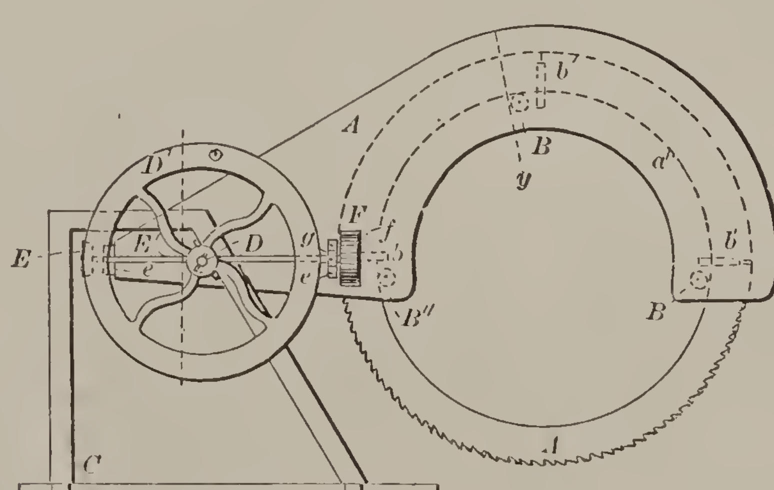


Fig. 341. Rim Saw.

its outer edge. It is fed by friction rollers. Fig. 341 shows one (U. S. Patent, 252,268) driven by suitable mechanism.

Amesbury's Spiral Band Saw File.*—This machine is fastened to an ordinary bench. The saw is hung over it (if the work is not done while the saw is in place). The file is in two sections—one stationary, the other movable in the direction of the axis. The stationary section carries the feeder and a thin segmental file, which

* G. W. Amesbury & Co., Philadelphia.

latter files only the throats and faces. The movable section carries a thick bevelled file variable for varying grades of teeth. It rotates on a higher plane and files the tooth-backs, also taking the burr from the points. The thumb-screw *D* varies the height of this section to suit the grade of teeth and to change the pressure. The thin face and throat file is cut only on its face and corner. The filing head runs in an oblong bearing so that it can move to allow for high teeth. There is an adjustable pressure spring *E*, which holds it to the work; and there is another spring under the head, keeping it to the tooth face—thus giving the high teeth the most pressure and bringing them down to the general level. The saw is held in a clamping jaw with the back resting against the gauge *F*, which is adjustable to any saw width by the screw *C*, and can be set at any angle. The clamping jaw is operated by a cam on the hub of the gear, and opens and closes as the machine is feeding or filing. This jaw acts like a vise upon the saw when the files are in contact with the teeth, and releases it when in contact with the feeder.

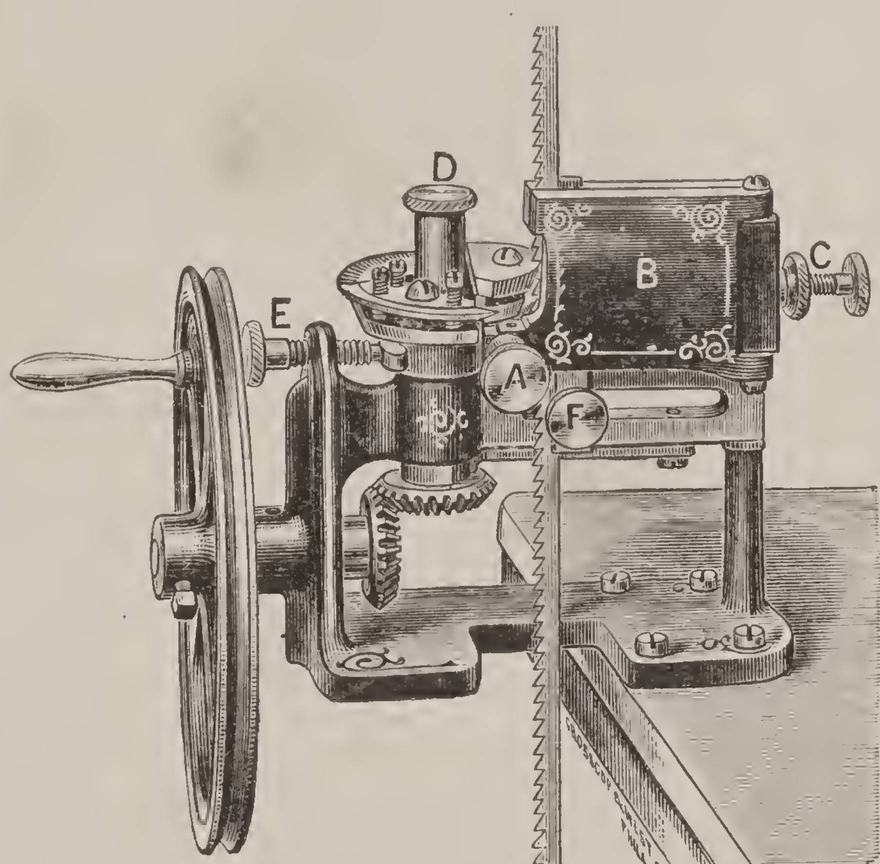


Fig. 342. Amesbury Band Saw File.

The machine has a capacity for saws $\frac{1}{16}$ to 2 inches wide, and from the finest tooth to two teeth to the inch. It is driven by hand or power, as desired, and is claimed to file saws of 500 to 1800 teeth in 30 to 90 minutes.

BAND SAWS.

Early Band Sawing Machines.—A band sawing machine was patented in France in 1815 by Toroude, and another in England in 1845 by Thouard. But it was not until 1855 that the machine was rendered practical and efficient; this by Perin of Paris. Parienté followed at once with an English patent, and in 1856 Exall and Barbour took out one. In 1866 Wilson patented a combined band and jig, the object of which was to cut the outside curves with the constantly running band, using the jig for the inside cutting.

The Original Newberry Band Saw of 1808 (see p. 83) had in some cases no teeth, being a blade for splitting skins.

A Reciprocating Band Saw was patented in England in 1879 by Adam Knox of Glasgow. The blades are horizontal, and reciprocated either on the rim of segmental levers or on pulleys. The machinery proposed is very complicated.

A Multiple Band Saw was patented in England in 1876 by Johnstone.

Circular vs. Band.—One point in which the circular has the advantage over the band is that the former has much the faster feed and will turn out a greater quantity of work. No doubt the circular will be very largely used until lumber becomes so valuable that sawyers find it economical to save lumber which they are now wasting in sawdust. This is now occurring in valuable lumber, such as black walnut, mahogany, and various classes of imported woods, and where these are being sawed into thin material, the band log saw is especially called for. Fay & Co. in their large band saw use a No. 18 gauge blade, which takes out about $\frac{1}{16}'''$ kerf.

Band vs. Mulay.—We quote below the opinion of a prominent New York manufacturer of wood-working machinery, concerning the Band Saw vs. the Mulay and Circular: "The circular does say one-third more work than the band, but with greater waste; its kerf for large saws (cutting 24″ to 30″ wide) being as much as or even more than $\frac{3}{16}$″; while the band saw on the same saw would not take more than about $\frac{3}{32}$″. The band resawing machine will therefore effect a large saving in costly timber and in making thin stuff where the kerf is a large percentage of the whole. Properly handled, a band resawing machine will cut as thin as $\frac{1}{8}$″ 24″ wide, making a kerf $\frac{1}{16}$″ full. Segmental circular saws riveted to and backed by large plates can be made to do equally well, but they are then unfit for anything but taking off a thin piece which can be sprung out by the plate without binding or heating the saw.

"The mulay will not do more than about one-third as much work as the band saw, and will make a kerf of from about $\frac{1}{32}$″ to say $\frac{1}{8}$″.

"The band saw labors under the disadvantage that there are at present but few men in the country who thoroughly understand setting up and using it. But even when properly handled it cannot successfully compete with the circular saw for log sawing, although superior to the mulay, which it excels both in speed and economy, this for the reason that in such work speed more than economy of timber is sought."

One Disadvantage of Circular and Band Saws is that although the cutting is continuous the feed is intermittent, and in board work the log must have several passes if wide. In this the gang sash has the advantage of all others—the cant passing through but once.

Band Saws for Bevelled Work.—Cabinet-makers and chair-makers are among those who require large quantities of *bevel* sawing and need band saws, having once availed themselves of the dished circular.

Thin Band Saw Blades stand better than thick ones, owing to their superior pliability.

"**Band Saws for Metal Cutting** should be rigidly held, and have a lineal velocity of 250 feet per minute. The teeth should be finely spaced and of 60° crosscut shape."

Band Log Sawing.—From a personal letter to the author from Mr. J. R. Hoffman, dated December 26, 1879, we make the following excerpts: "The main obstacle that I met with in starting the band saw for log sawing was in obtaining the saw blade. I tried for fifteen years to persuade some manufacturers to make a saw, and after the first introduction of the small band saw in this country, I returned to the charge and exhausted the patience of a great many saw manufacturers by my importunities, and should have continued to harass them until the present time had not a firm in France taken the order and furnished us with saws. During the French and German war we succeeded in getting a few saws made in this country in short pieces, and since that some manufacturers have succeeded very well in their manufacture. Still we prefer imported stock.

"There is no romance about this thing; it is intensely practical. No starving wife or ill-fed children with quivering lip and transparent skin sat at the low hearth-stone while it was being worked out. They knew nothing of it. I wanted it. Like the boy with the gopher, 'I had to have it.' I could not afford to waste so much lumber. I set to work and made it. I wanted to use it and have used it to some purpose; if others cannot see the advantages, more the pity—for them."

Bevel of Band Saw Joints.—In joining band saw blades, one rule for the amount of bevel is to give a bevel on each side of the joint as long as the distance between two teeth.

Brazing Band Saw Blades.—"Muriatic acid," also called "hydrochloric" and "chlorohydric" acid, is used as a flux. The joint should be finished by filing lengthwise of the blade.

Files for Band Saws should have their edges rounded, as shown in Fig. 345, to give rounded gullets and avoid cracks.

Rounding Band Saw Gullets.—A rat-tail file may be used to round band-saw gullets, where rounded three-cornered files are not obtainable.

A Serrated Steel Disk for Band Saw Sharpening was shown at the Paris Exposition of 1878, by Martinier, the inventor. The machine in which it ran gave an automatic feed to the blade.

An Inclined Blade Band Saw for bevel sawing is shown in Fig. 343.

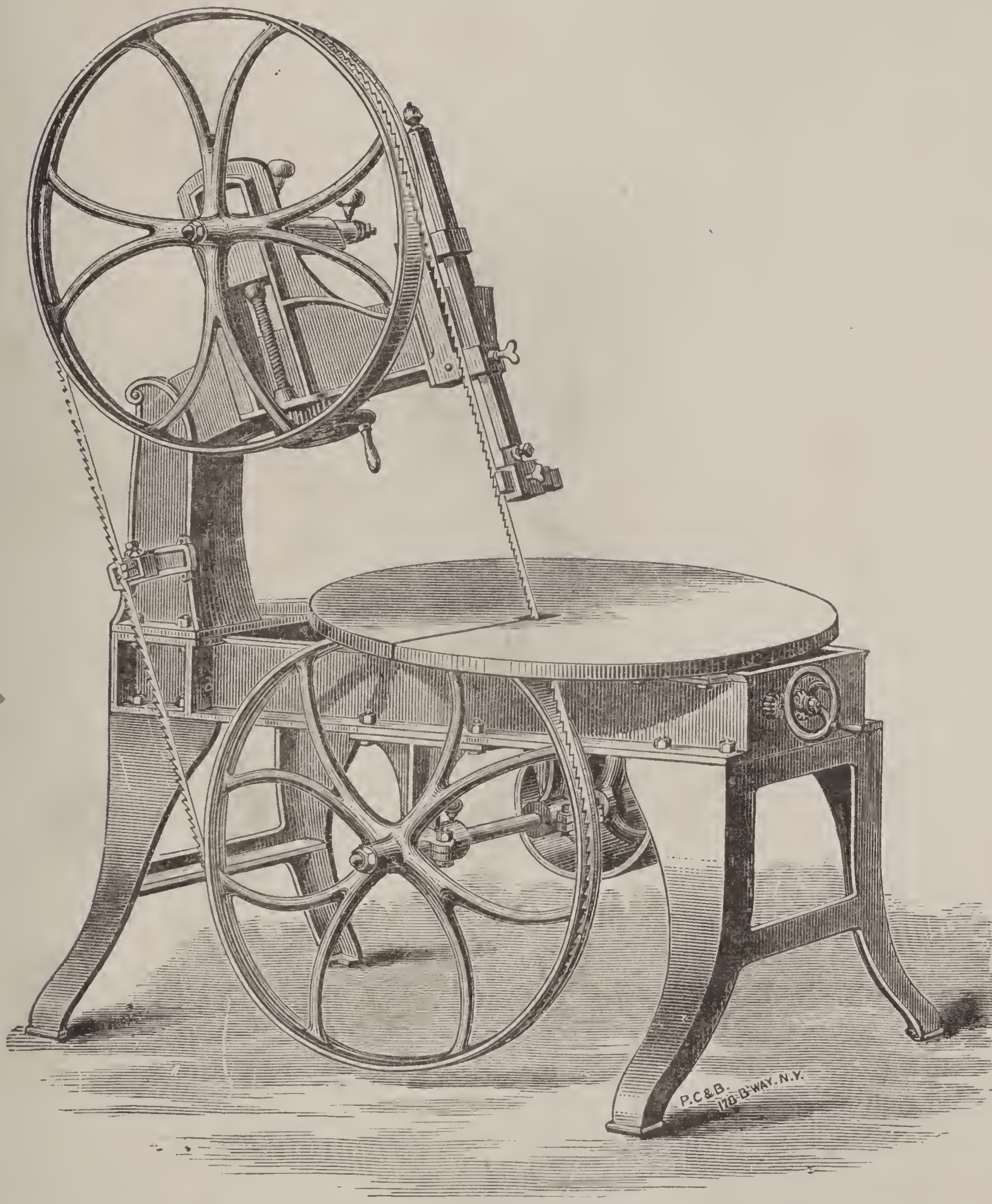


Fig. 343. Pryibil's Inclined Blade Band Saw.

A Band-Saw Guide, shown at Paris in 1878 by Quétel Trémois, consisted of three hollow brass blocks filled with oil and perforated on one side, which were pressed against the blade in such a manner as to both steady and lubricate it.

Pryibil's Band Saw Guide, shown in Fig. 344, consists of two steel blocks adjustable by means of a screw to any thickness of

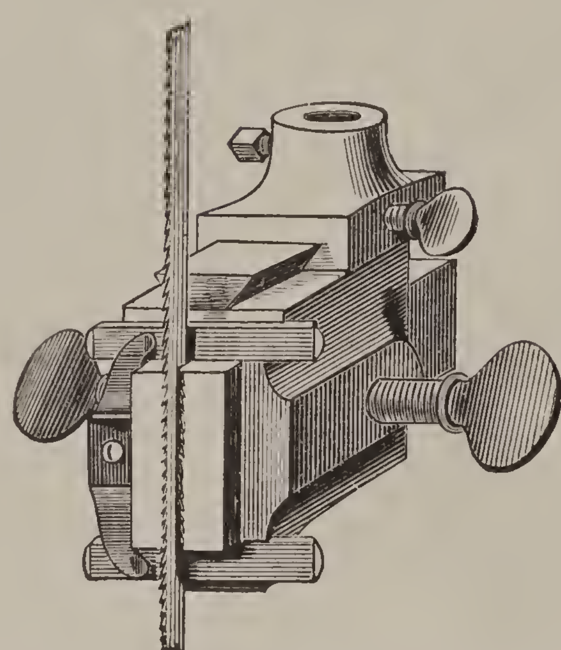


Fig. 344. Pryibil's Band Saw Guide.

blade, and in depth from $\frac{1}{16}$ to $1\frac{1}{4}$ inches. The back of the blade runs against two hardened steel slips which are adjustable lengthwise to change the line of contact when grooving commences. It is adjustable on the guide-post at any height, to suit any height of stuff; of course being kept as near as possible to the top of the stuff sawed.

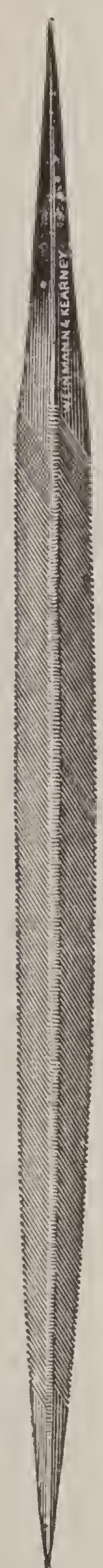
The Band Saw Filing Apparatus, shown in Fig. 346,* consists of a frame bearing two wheels over which the band is placed —their distance apart being adjustable. Between them is a filing vise or clamp 20″ long, worked by three eccentrics and a handle. The vise may be used for jig as well as for band saw blades.

Pryibil's Band Saw Setter (Fig. 347).—"The hand wheel spindle carries a crank operating through a connecting rod upon two vertical slides, one on each side of the saw. These slides are provided with adjustable cam faces (front adjusting screw shown at *a*) acting through friction rolls upon the setting levers. This adjustment after being once set never needs to be altered except to take up wear. Adjustments for different gauges of saws are made by means of the screw *b*. The saw is guided between the faces *c* and *d*; the teeth bearing against the faces *c* of the hinged frame

* Made by P. Pryibil, 461 W. 40th St., New York.

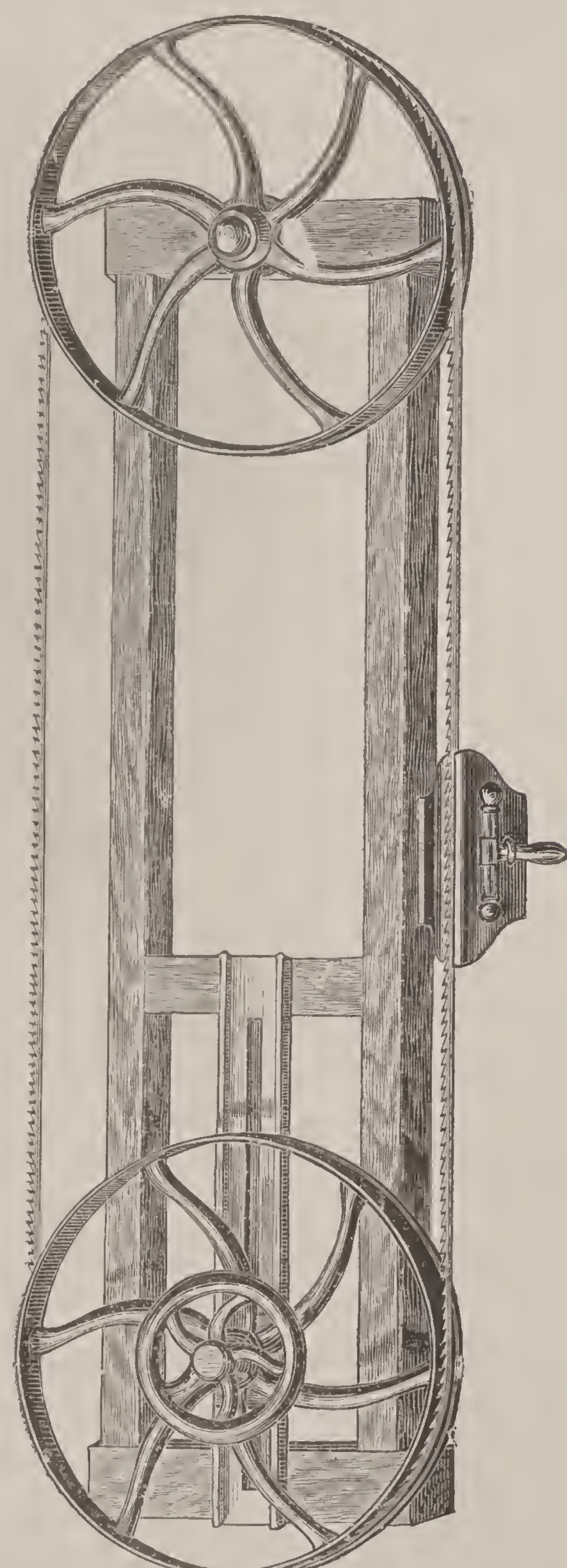
c′ vertically adjustable through the thumb-screw *e*, the back bearing on the faces *d* attached to the rods *f*, and forced upward by the

Fig. 345.



Band Saw File.

Fig. 346.



Pryibil's Band Saw Filing Frame.

springs *g*, the tension of which is regulated by a thumb-screw (not shown) acting on the yoke *h*. Through the hinged frame *c′* the height of the saw relatively to the setting tools is governed and thereby the set regulated, variations in width of saw affecting only the faces *d*, and therefore not the set. The band is fed two teeth per stroke by the pawl *i* connected by a spring to the lever *k*, taking its motion from the connecting-rod above men-

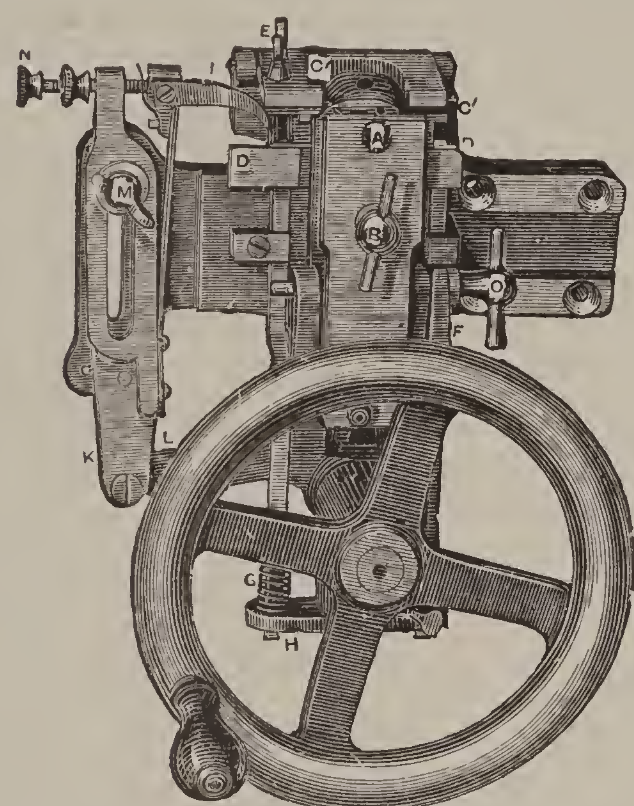


Fig. 347. Pryibil's Band Saw Setter.

tioned through the link *b*. The stroke of the pawl is regulated by moving the fulcrum *m* of the lever *k* in the slot. By means of the adjusting screw *n* the teeth of the saw are, after other adjustments have been made, brought opposite the setting tools."

Atlantic Works' Band Saw Setting Machine and Filing Frame (Fig. 348).—The filing frame is of iron pipe with suitable cast connections and cross pieces. Attached to it is a sliding carriage bearing an oscillating set hammer. The feed is automatic, and adjustable to any tooth pitch. Two teeth should be fed forward at each stroke of the set hammer. The saw is strained and passes between two steel blocks or anvils. The teeth are brought to the proper height on the anvils by putting under the saw a strip of metal thicker than the blade. The stroke of each hammer is regulated by a set screw.

Setting Band Saw Teeth.—"Band saw teeth should be set by sudden blows given from the inside of the curve, so that the blade has no tendency to destroy the tire covering nor to run unsteadily."

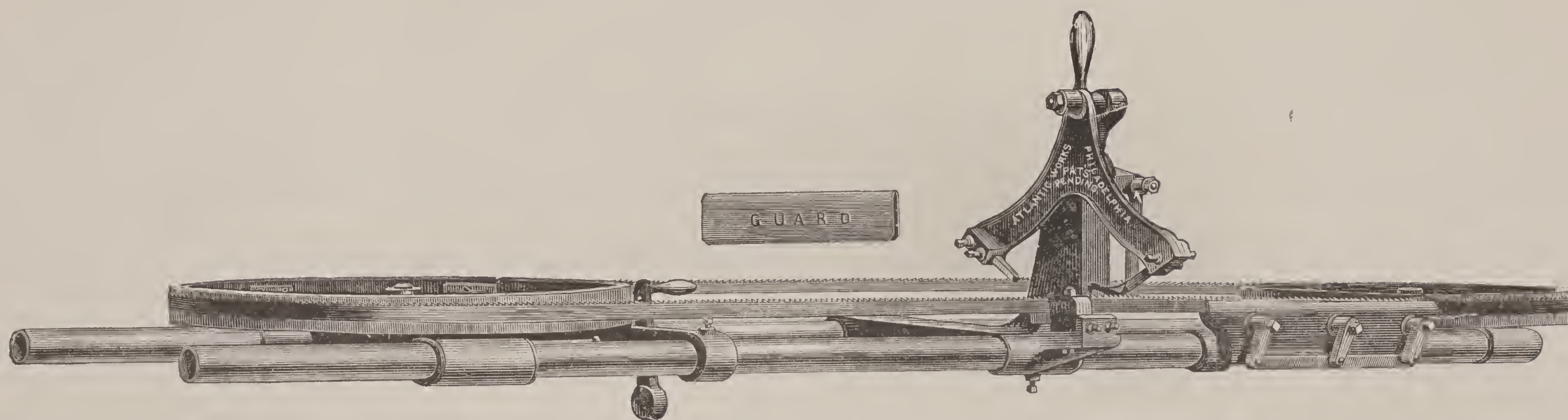


Fig. 348. Atlantic Works Band Saw Filing and Setting Frame.

Howe's Band Filing and Setting Machine.*—This machine runs by power and is automatic. It uses an ordinary file. The pulley wheel below gives a rising and falling motion to the rim frame bearing the file, while the saw is passed along one tooth at a time by suitable feed gear, difficult to describe without a lettered cut, but which may be studied out in Fig. 349.

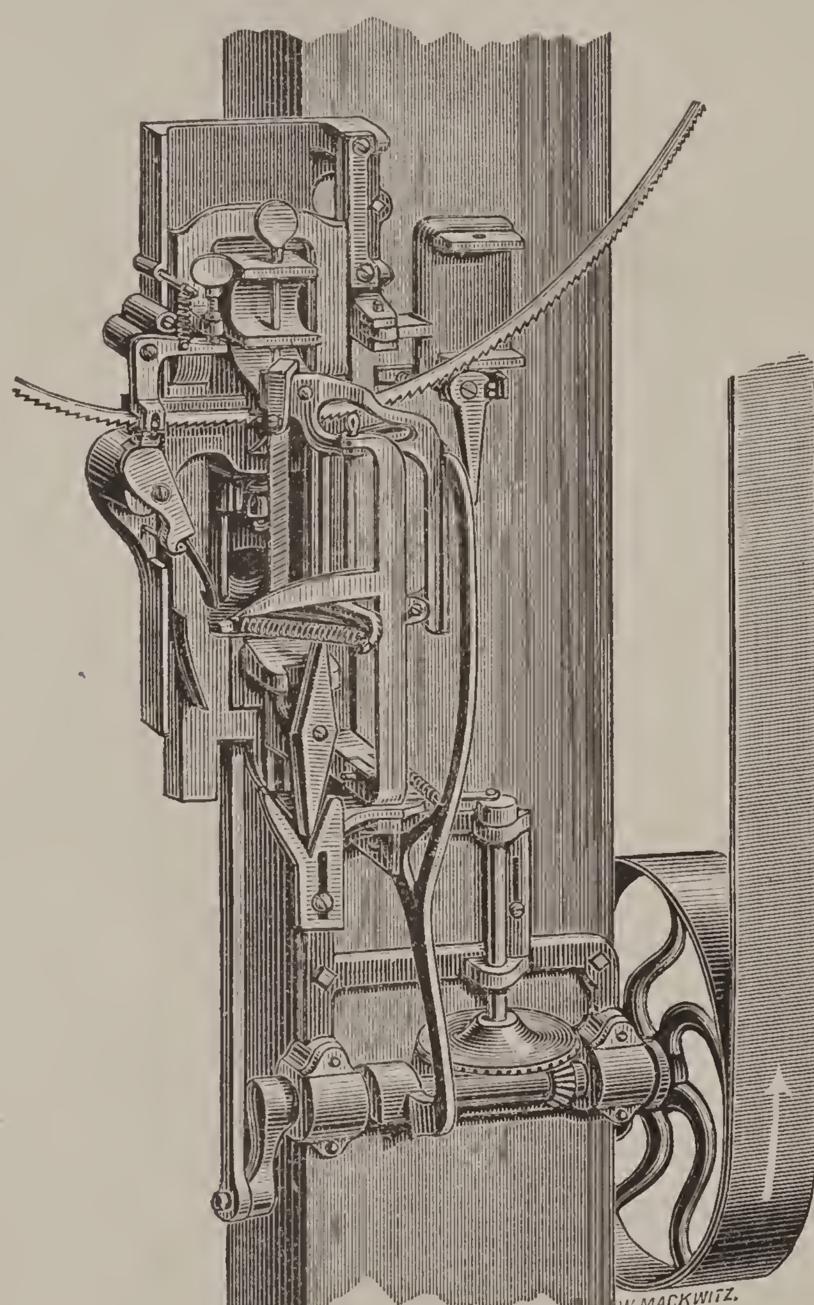


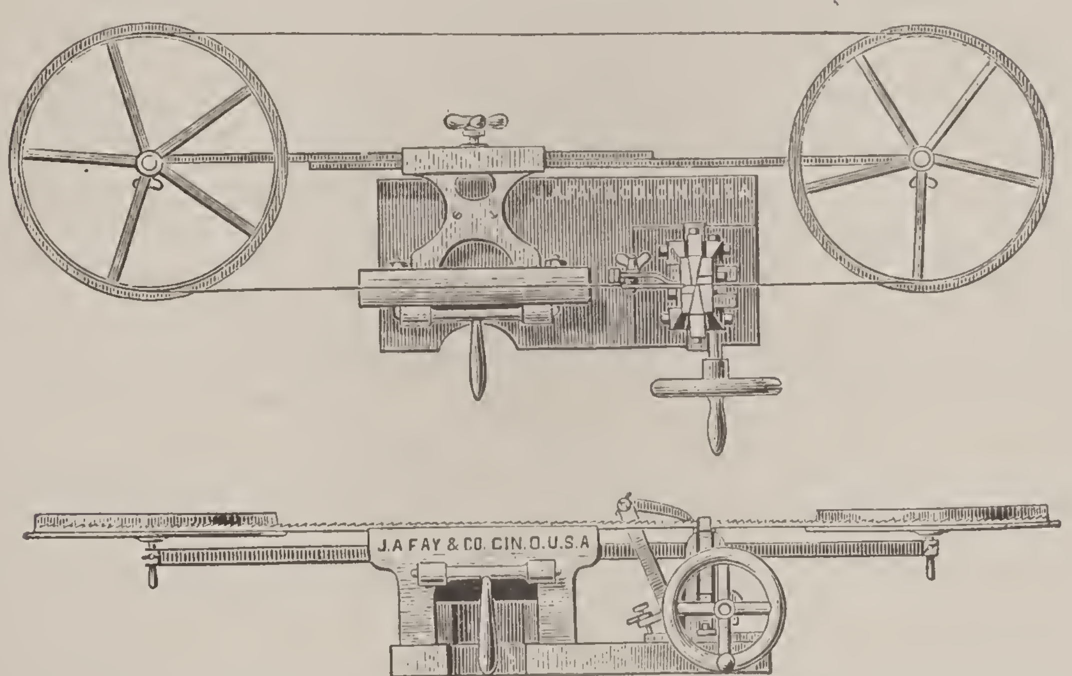
Fig. 349. Howe's Band Saw Filing and Setting Machine.

The inventor states that the machine is $17\frac{1}{2}$ inches high, and 14 inches wide, weighing 50 lbs. "It is run at 75 rotations per minute; files and sets saws $\frac{3}{16}''$ to $12\frac{1}{2}''$ wide, any number of teeth and any length of blade. As regards the power required, no definite tests have been made; but a $1''$ belt on a $10''$ pulley (only so

* M. Stewart & Bros., 1218 Mallinckrodt St., St. Louis, Mo.

tight that it can be put on with ease without being in motion) will run it; or it can be worked with a crank of 8″ sweep by a ten-year old boy with very little effort. A larger machine is building at the date of writing (April 16, 1882), to file and set saws up to 6″ wide."

The Band Saw Setting Machine shown in Figs. 350 and 351 in top and side view, has proper pulleys and tension device to sus-



Figs. 350 and 351. Band Saw Setting Machine.

tain the saw and keep it at a proper tension while being filed and set. For filing there is a suitable vise. The setting is accomplished by two hammers driven by a cam on a shaft revolving on a hand wheel.

MISCELLANEOUS.

Scandinavian Floors.—The chamber floors found in the northern parts of Sweden and Norway are laid with boards cut from the tree without being sawn parallel, and consequently retaining all the taper of the tree. The edges of the boards are tongued and grooved, and the joiners who cut the tongues and grooves, work in pairs, one pulling and the other propelling the tool that does the work. In consequence of the boards tapering, they are laid with a broad and narrow end meeting alternately, and thus a dovetail is effected along the whole length of the boards, and a very curious appearance is the result.—*Timber Trades Journal.*

The First Saw-Mills in England.—The old practice in making boards was to split up the log with wedges, and, inconvenient as the practice was, it was no easy matter to persuade the world that the thing could be done in any better way. Saw-mills were first used in Europe in the fifteenth century, but so late as 1555, an English ambassador, having seen a saw-mill in France, thought it a novelty which deserved particular description. It is amusing to note how the aversion to labor-saving machinery has always agitated England. The first saw-mill was established by a Dutchman, in 1663; but the public outcry against the new-fangled machine was so violent, that the proprietor was forced to decamp with greater expedition than ever did Dutchman before. The evil was thus kept out of England for several years, or rather generations, but in 1768, an unlucky timber merchant, hoping that after so long a time the public would be less watchful of its own interests, made a rash attempt to construct another mill. The guardians of the public welfare, however, were on the alert, and a conscientious mob at once collected, and pulled the mill to pieces. —*The Iron Age.*

Correcting Unequal Tension in Circular Saws.—U. S. Patent, No. 237,915, to Geo. F. Simonds (February 15, 1881), is for a method of correcting unequal tension in circulars by clamping them between heated disks held in formers of ordinary temperature; the formers also clamping the saw around the outside of the disk. In the cut, *A A* are formers and *B B* heated disks.

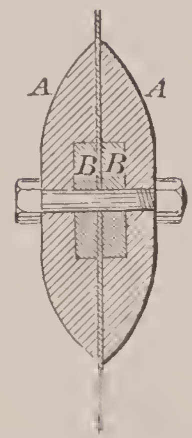


Fig. 352.

Adjusting the Tension of Circular Saws: Simonds' Method.—U. S. Patent, No. 239,863 (April 5, 1881) is for passing a graduated gauge between the straight edge and the bent saw.

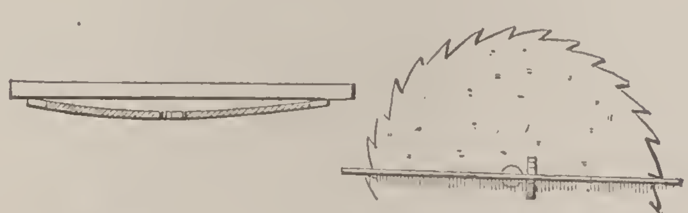


Fig. 353. Adjusting Tension.

Quick Saw Making.—November 11, 1875, Emerson, Ford & Co. (now Emerson, Smith & Co.), of Beaver Falls, Pa., made a 40-tooth solid saw 60 inches in diameter, gauges 5 and 6 inches in 7 hours 45 minutes of work. The anvil work, flattening, smithing, hammering, and blocking took 4 hours 55 minutes, there being given 12,764 hammer strokes. The smithing took 8523 of these blows. The drilling, toothing, grinding, hardening, tempering, and cooling took 2 hours 50 minutes.

Mending a Broken Arbor.—"I will tell you how I mended a broken saw arbor with only blacksmith's tools. It is a circular wood-saw. The screw on the saw end, 1″ diameter, broke off at the shoulder, which latter, being but $1\frac{1}{4}$″ diameter, I considered would weaken it too much to drill and tap in a screw large enough to be safe; besides, trouble, time, and expense of sending to shop. So I squared ends, and centred nicely, and drilled $\frac{1}{2}$″ hole in each piece 1″, and joined them with a dowel. I roughened the dowel a little with a screw-die to make brass flow well, and wound the neck with fine iron wire to hold melted brass and make sure of a strong job. Drilled vent-holes near ends of dowel, then put it in the fire and brazed the joint, and it proves an entire success. It has since been accidentally subjected to a most violent test, so that I believe it now just as strong as before broken."—C. G. OSGOOD, Foristell, St. Charles County, Mo.

An Old Saw Anvil.—Fig. 354 shows a relic exhibited at the Centennial Exhibition, Philadelphia, 1876, by Mr. E. Andrews, saw maker, of Williamsport, Pa. It is interesting to note the continuance of a handicraft for so long in one family.

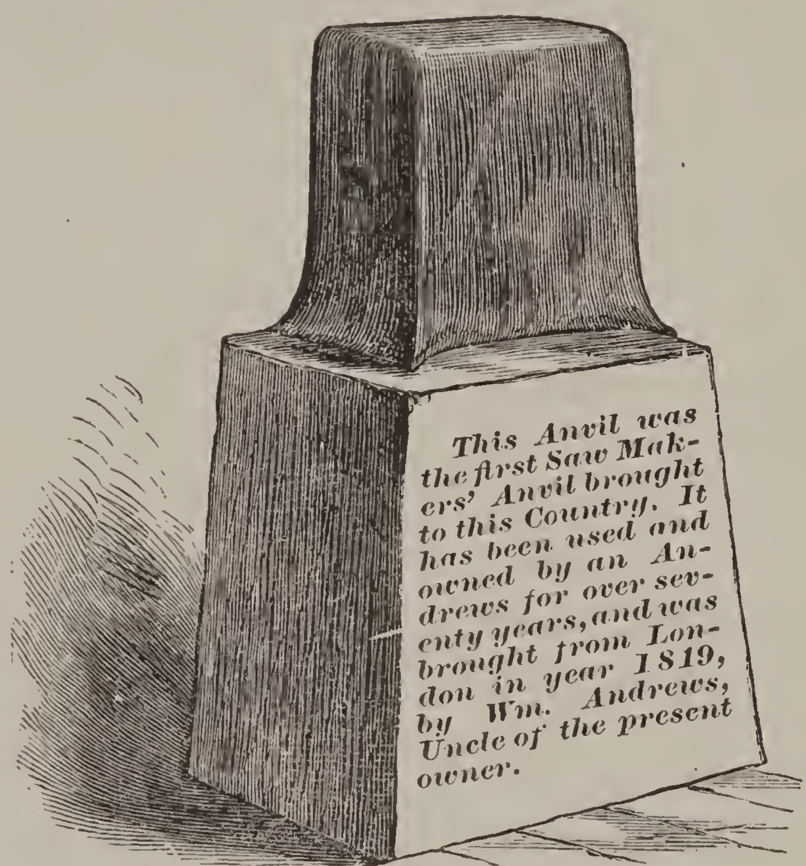


Fig. 354.

Sawed Veneers.—Sawed veneers preserve the natural color and grain of the wood better than sliced.

Materials having a Granular Nature must be divided by sawing, while those which are fibrous can be divided by direct cutting. Wood partaking of both granular and fibrous nature, is divided by sawing or cutting, as the grain may determine.

In Sawing Stone the edge of the blade is rounding and used with a rocking motion, so as to make it "take in" deeply first in one place then in another, rather than uniformly all along the cut.

Shingle Saws should be tapering to 14 gauge.

A Decimal Gauge for Sheet Metal and Wire.—Gauges, or notched plates for measuring thicknesses of metal sheets and wire, were at first of local origin and innumerable variety. One of the Birmingham gauges (the Stubs) has been most carefully perpetuated. In America one was introduced by Brown & Sharpe, to correct some discrepant proportions in this last, by establishing a regular proportion of the 39 successive steps between 0000 and 36. Starting at 0.46 inch for 0000, each gauge is 10.9478 per cent. less than the preceding one; giving 0.005 inch for No. 36, which is 35 of the Birmingham.

The great use of the gauge to-day is for purposes of estimate—calculating the value of given superficies or lengths in weight of material, or *vice versâ;* and any notation or division of parts facilitating this would be an advantage. The proposed Decimal Gauge, which we owe to the eminent engineer, Mr. Robert Briggs, is based on the successive reduction of an assumed unit of dimension, by $\frac{1}{10}$; or, what is the same thing, successive increase by $\frac{1}{9}$. The centimetre = 0.3937079 inch, is zero.

Table I. gives a comparison of the Decimal, the Birmingham, and the American gauges. The diagram shows the irregularities of the Birmingham and its comparison with the other two.

The solid volume of a sheet one metre square and one millimetre thick, is a cubic decimetre, or a litre, or a kilogram of water. The weight of a plate of any gauge is simply found from the specific gravity of the material. Thus as the specific gravity of iron is 7.7, a square metre of iron, one mm. thick, weighs 7.7 kilograms; and if a centimetre thick, 77.7 kilograms, etc.

This gauge will give a scale of proportionate dimensions for all practical sizes and thicknesses of that metal, and diameter of wire. The scale is capable of indefinite extension at either end. It gives a numerical proportion easily remembered and readily used in computation. In sheet metal, especially where it is a constant requirement to estimate for weights, it would be a great advantage after having laboriously calculated the weight of a vessel, tank, boiler, or caldron, for some assumed thickness, to be able to increase or lessen the weight without figuring anew. To weigh 10 per cent. less, then a gauge off the thickness does it.

Table I.

Comparison of Decimal, Birmingham, & American Wire Gauges.

Dimensions in English Inches with Corresponding Dimensions for Decimal Gauge in Centimetres.

No. of Gauge.	Decimal Gauge. Centimetres.	Decimal Gauge. Inches.	Birmingham Gauge. Inches.	Amer. Gauge. Inches.
0000 = — 3	1·3717	0·5401	0·454	0·46
000 = — 2	1·2346	0·4861	0·425	0·4096
00 = — 1	1·1111	0·4375	0·38	0·3649
0 = 0	1·	0·3937	0·34	0·3249
1	0·9	0·3543	0·3	0·2893
2	0·81	0·3189	0·284	0·2576
3	0·729	0·2870	0·259	0·2942
4	0·6561	0·2583	0 238	0·2043
5	0·5905	0·2324	0·22	0·1819
6	0·5314	0·2092	0·203	0·1620
7	0·4883	0·1883	0·18	0·1443
8	0.4305	0·1695	0·165	0·1285
9	0·3874	0·1525	0·148	0·1144
10	0·3487	0·1373	0·134	0·1019
11	0·3138	0·1236	0·12	0·09074
12	0·2824	0·1112	0·109	0·08081
13	0·2542	0·10008	0·095	0·07196
14	0·2288	0·09007	0·083	0·06408
15	0·2059	0·08106	0·072	0·05707
16	0·1853	0·07296	0·065	0·05082
17	0·1668	0·06566	0·058	0·04526
18	0·1501	0·05909	0·049	0·04030
19	0·1351	0·05318	0·042	0·03589
20	0·1216	0·04787	0·035	0·03196
21	0·1094	0·04307	0·032	0·02846
22	0·09848	0·03877	0·028	0·02535
23	0·08863	0·03489	0·025	0·02257
24	0·07977	0·03140	0·02	0·02010
25	0·07179	0·02864	0·018	0·01790
26	0·06461	0·02544	0·016	0·01594
27	0·05815	0·02289	0·014	0·01419
28	0·05233	0·02060	0·013	0·01264
29	0·04710	0·01854	0·012	0·01126
30	0·04239	0·01669	0·010	0·01003
31	0·03815	0·01502	0·009	0·008928
32	0·03434	0·01351	0·008	0·007950
33	0·03090	0·01217	0·007	0·007080
34	0·02781	0·01095	0·005	0·006304
35	0·02503	0·009856	0·004	0·005614
36	0·02253	0·008870		0·005000
37	0·02028	0·007983		0·004453
38	0·01825	0·007185		0·003965
39	0·01642	0·006466		0·003531
40	0·01478	0·005819		0·003144

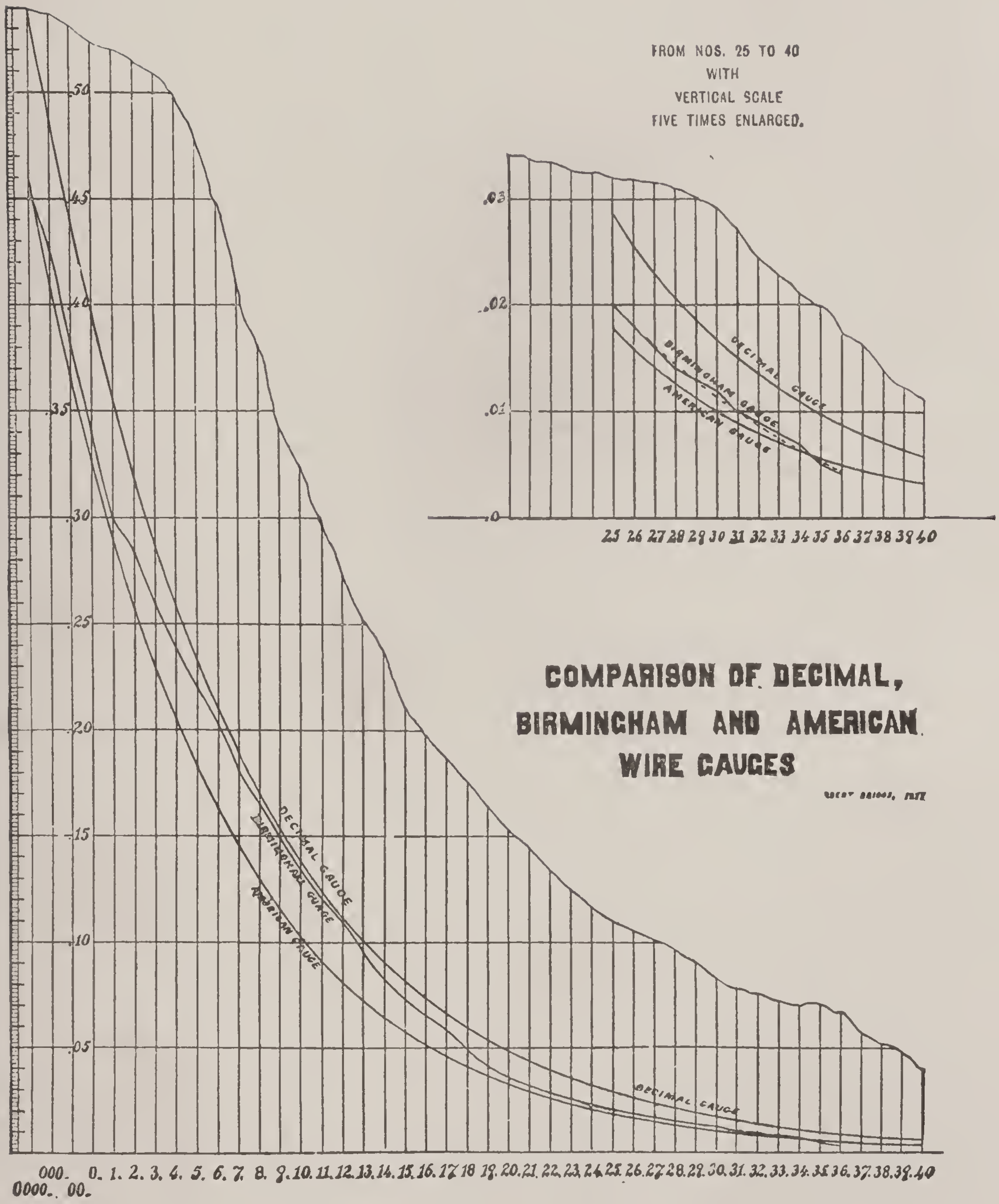

FROM NOS. 25 TO 40
WITH
VERTICAL SCALE
FIVE TIMES ENLARGED.
.03
.02
.01
.0
DECIMAL GAUGE
BIRMINGHAM GAUGE
AMERICAN GAUGE
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
COMPARISON OF DECIMAL,
BIRMINGHAM AND AMERICAN
WIRE GAUGES
.50
.45
.40
.35
.30
.25
.20
.15
.10
.05
DECIMAL GAUGE
BIRMINGHAM GAUGE
AMERICAN GAUGE
DECIMAL GAUGE
000. 0. 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40
0000. 00.

Table II.

Weight of One Square Foot of Sheet Metal, or One Foot in Length of Wire, of Thicknesses or Diameters given by the Decimal Gauge; English Units.

No. of Gauge.	Thickness or Diameter.	One square foot of sheet metal.				One foot in length of wire.			
		Iron, pounds.	Steel, pounds.	Copper, pounds.	Brass, pounds.	Iron, pounds.	Steel, pounds.	Copper, pounds.	Brass, pounds.
—3	0·5401	21·8277	22·0460	24 4650	23·1148	0·76359	0·77926	0·88290	0·85052
—2	0·4861	19·6449	19·8413	22·0185	20·8033	0·61851	0·63120	0·71515	0·68892
—1	0·4375	17·6804	17·8572	19·8167	18·7230	0·50099	0·51127	0·57927	0·55803
0	0·3937	15·9124	16·0715	17·8350	16·8507	0·40580	0·41413	0·46921	0·44300
1	0·3543	14·3211	14·4643	16·0515	15·1656	0·32870	0·33545	0·38006	0·35883
2	0·3189	12·8890	13·0178	14·4463	13·6490	0·26624	0·27171	0·30785	0·29066
3	0·2870	11·6001	11·7161	13·0017	12·2841	0·21566	0·22009	0·24936	0·23543
4	0·2583	10·4401	10·5445	11·7015	11·0557	0·17468	0·17827	0·20198	0·19070
5	0·2324	9·3961	9·4901	10·5313	9·9501	0·14150	0·14440	0·16360	0·15446
6	0·2092	8·4565	8·5411	9·4782	8·9551	0·11461	0·11696	0·13252	0·12512
7	0·1883	7·6108	7·6869	8·5304	8·0596	0·09283	0·09474	0·10734	0·10134
8	0·1695	6·8498	6·9182	7·6774	7·2536	0·07520	0·07674	0·08695	0·08209
9	0·1525	6·1648	6·2264	6·9096	6 5283	0·06091	0·06216	0·07043	0·06649
10	0·1373	5·5483	5·6037	6·2187	5·8755	0·04934	0·05035	0·05705	0·05386
11	0·1236	4·9935	5·0434	5·5967	5·2879	0·03996	0·04078	0·04621	0·04363
12	0·1112	4·4941	4·5400	5·0371	4·7591	0·03237	0·03303	0·03743	0·03534
13	0·10008	4·0447	4·0851	4·5334	4·2832	0·02622	0·02676	0·03032	0·02862
14	0·09007	3·6402	3·6760	4·0801	3·8549	0·02124	0·02167	0·02456	0·02318
15	0·08106	3·2762	3·3090	3·6721	3·4694	0·01720	0·01756	0·01989	0·01878
16	0·07296	2·9486	2·9781	3·3048	3·1225	0·01393	0·01422	0·01611	0·01521
17	0·06566	2·6537	2·6822	2·9744	2·8102	0·01129	0·01152	0·01305	0·01232
18	0·05909	2·3884	2·4123	2·6769	2·5292	0·009142	0·009330	0·01057	0·009980
19	0·05318	2·1495	2·1710	2·4092	2·2763	0·007405	0·007557	0·008562	0·008084
20	0·04787	1·9346	1·9539	2·1683	2·0487	0·005998	0·006121	0·006935	0·006548
21	0·04307	1·7411	1·7585	1·9515	1·8438	0·004858	0·004958	0·005618	0·005304
22	0·03877	1·5670	1·5827	1·7563	1·6594	0 003935	0·004016	0·004550	0·004296
23	0·03489	1·4103	1·4244	1·5807	1·4935	0·003188	0·003253	0·003686	0 003480
24	0·03140	1·2693	1·2820	1·4226	1·3441	0·002582	0·002635	0·002985	0·002819
25	0·02864	1·1423	1·1537	1·2804	1·2097	0·002091	0·002134	0·002418	0·002283
26	0·02544	1·0281	1·0384	1·1523	1·0887	0·001694	0·001729	0·001959	0·001849
27	0·02289	0·9253	0·9346	1·0371	0·9799	0·001372	0·001400	0·001587	0·001498
28	0·02060	0·8328	0·8411	0·9334	0·8819	0·001111	0·001134	0·001285	0·001213
29	0·01854	0·7495	0·7570	0·8401	0 7937	0·0009003	0·0009188	0·001041	0·0009828
30	0·01669	0·6745	0·6812	0·7560	0·7143	0·0007292	0·0007442	0·0008432	0·0007961
31	0·01502	0·6071	0·6132	0 6804	0·6429	0·0005907	0·0006028	0·0006830	0·0006448
32	0·01351	0·5464	0 5519	0·6124	0·5786	0·0004785	0·0004883	0·0005532	0·0005223
33	0·01217	0·4917	0·4966	0·5512	0·5207	0·0003876	0·0003955	0·0004481	0·0004231
34	0·01095	0·4426	0·4470	0·4960	0·4687	0·0003139	0·0003204	0·0003630	0·0003427
35	0·009856	0·3983	0·4023	0 4464	0·4218	0·0002543	0·0002595	0·0002940	0·0002776
36	0·008870	0·3585	0·3621	0·4018	0·3796	0·0002060	0·0002102	0·0002381	0·0002248
37	0·007983	0·3226	0·3258	0·3616	0 3417	0·0001668	0·0001702	0·0001929	0·0001821
38	0·007185	0.2904	0·2933	0·3255	0·3075	0·0001351	0·0001379	0·0001562	0·0001475
39	0·006466	0·2613	0·2639	0·2929	0·2767	0·0001095	0·0001117	0·0001266	0·0001195
40	0·005819	0·2352	0·2376	0·2636	0·2491	0·00008866	0·00009048	0·0001025	0·00009678
Specific Gravity.		7·769	7·847	8·708	8·228	7·6893	7·847	8·891	8·394
Weight per cu. ft.[1]		485	489·85	543·6	513·6	480	489·85	555	524
Weight per cu. in.		0·28067	0·28348	0·3146	0 2972	0·2807	0·2836	0·3212	0·3033
Weight 1 ft. long, 1 in. round.		2·6453	2·6717	2·95 [illegible]	2·8012	2·6180	2·6717	3·0283	2·8580

[1] These figures for weight per cubic foot were adopted from Trautwine.

Table III.

Weight of One Square Metre of Sheet Metal, or One Metre in Length of Wire, of Thicknesses or Diameters given by the Decimal Gauge; Metric Units.

No. of Gauge.	Thickness or Diameter. Centimetres.	One square metre of sheet metal.				One metre in length of round wire.			
		Iron, kilos.	Steel, kilos.	Copper, kilos.	Brass, kilos.	Iron, kilos.	Steel, kilos.	Copper, kilos.	Brass, kilos.
—3	1·3717	106·576	107·643	119·453	112·860	1·13637	1·04373	1·31391	1·24054
—2	1·2346	95·9185	96·8777	107·508	101·574	0·92046	0·93935	1 06427	1·00484
—1	1·1111	86·3267	87·1900	96·7568	91·4170	0·74557	0 76088	0·86206	0·81392
0	1·	77·6940	78·4707	87·0811	82·2753	0·60391	0·61631	0·69827	0·65928
1	0·9	69·9246	70·6238	78·3730	74·0478	0·48917	0·49921	0·56560	0·53401
2	0·81	62·9321	63·5614	70·5357	66·6430	0·39623	0·40436	0·45813	0·43255
3	0·729	56·6389	57·2053	63·4821	59·9787	0·32094	0·32753	0·37109	0·35037
4	0·6561	50·9750	51·4847	57·1339	53·9808	0·25997	0·26530	0·30058	0·28380
5	0·5905	45·8775	46·3463	51·4205	48·5827	0·21057	0·21489	0·24347	0·22988
6	0·5314	41·2898	41·7027	46·2784	43·7244	0·17056	0·17406	0 19721	0·18620
7	0·4883	37·1618	37·5334	41·6506	39 3520	0·13816	0·14099	0·15974	0·15082
8	0 4305	33·4447	34·7891	37·4855	35·4168	0·11191	0·11420	0·12939	0·12216
9	0·3874	30·1002	30·4012	33·7370	31·8751	0·090644	0·092504	0·10481	0·098953
10	0·3487	27·0901	27·3610	30·3633	28·6876	0·073422	0·074929	0·084894	0·080152
11	0·3138	24·3810	24·6248	27·3270	25 8188	0·059472	0·060692	0·068764	0·064923
12	0·2824	21·9429	22·1623	24·5945	23·2369	0·048172	0·049161	0·055699	0·052588
13	0·2542	19·7486	19·9461	22·1349	20·9132	0·039019	0·039820	0·045116	0·042596
14	0·2288	17·7737	17·9514	19·9214	18·8219	0·031606	0·032254	0·036544	0·034503
15	0·2059	15·9963	16·1563	17·9293	16·9397	0·025601	0·026126	0·029601	0·027947
16	0·1853	14·3967	14·5407	16·1364	15·2457	0·020736	0·021162	0·023977	0·022637
17	0·1668	12·9570	13·0866	14·5228	13·7211	0·016797	0·017141	0·019421	0·018336
18	0.1560	11·6613	11·1779	13·0705	12·3490	0·013605	0·013885	0·015731	0·014852
19	0·1351	10·4952	10·6002	11·7634	11·1141	0·011020	0·011246	0 012742	0·012031
20	0·1216	9·4457	9·5402	10·5871	10·0026	0·008926	0·009110	0·010321	0·009745
21	0·1094	8·5011	8·5861	9·5284	9·0022	0·007230	0·007374	0·008360	0·007893
22	0·09848	7·6510	7·7277	8·5756	8·1020	0·005857	0·005977	0·006772	0·006393
23	0·08863	6·8859	6·7548	7·7180	7·2918	0·004744	0·005379	0·005485	0·005179
24	0·07977	6·1973	6·2593	6·9462	6·5626	0·003843	0·004841	0·004443	0·004195
25	0·07179	5·5776	5·6336	6·2516	5·9064	0·003112	0·003176	0·003599	0·003398
26	0·06461	5·0199	5·0700	5·6264	5·3157	0·002521	0·002573	0·002915	0·002752
27	0·05815	4·5179	4·5631	5·0638	4·7842	0·002042	0·002084	0·002361	0 002229
28	0·05233	4·0661	4·1068	4·5574	4·3058	0·001654	0·001688	0·001912	0·001806
29	0·04710	3·6595	3·6961	4·1017	3·8752	0 001340	0·001367	0·001549	0·001463
30	0·04239	3 2936	3·3265	3·6915	3·4877	0·001085	0·0011075	0·001255	0·001185
31	0·03815	2·9642	2·9938	3·3223	3·1389	0·0008790	0·0008971	0·0010164	0·0009596
32	0·03434	2·6678	2·6945	2·9901	2·8251	0 0007120	0·0007266	0·0008233	0·0007773
33	0·03090	2·4010	2·4250	2·6911	2·5425	0·0005767	0·0005886	0 0006669	0·0006296
34	0·02781	2·1609	2·1825	2·4220	2·2883	0·0004204	0·0004767	0·0005402	0 0005100
35	0·02503	1·9448	1·9642	2·1798	2·0595	0·0003784	0·0003862	0·0004375	0·0004131
36	0·02253	1·7504	1·7679	1·9618	1·8535	0·0003065	0·0003128	0·0003544	0·0003346
37	0·02028	1·5753	1·5911	1·7656	1·6682	0 0002483	0·0002534	0·0002871	0·0002710
38	0·01825	1·4178	1·4320	1 5891	1·5013	0 0002011	0·0002052	0·0002325	0·0002195
39	0·01642	1·2760	1·2888	1·4302	1·3512	0·0001629	0·0001662	0·0001883	0·0001778
40	0·01478	1·1484	1·1599	1·2871	1·2161	0 0001319	0·0001346	0·0001526	0·0001440
Specific Gravity.		7·769	7·847	8·708	8·228[1]	7·6893	7·847	8·891	8·394[1]

[1] Value of specific gravity of brass sheets or wire dependent on the composition of brass.

*Stubs' Birmingham Wire Gauge expressed Metrically and in Decimal and Vulgar Inch Fractions.**

Gauge.	Inches.	Inches.	Millimetres.	Gauge.	Inches.	Inches.	Millimetres.
1	..	.3	7.62	14	....	.083	2.1082
2	..	.284	7.2136	15	....	.072	1.8288
3	..	.259	6.5786	16	....	.065	1.7510
4	$\frac{1}{4}$ —	.238	6.0452	17	....	.058	1.4732
5	$\frac{7}{32}$	.22	5.588	18	....	.049	1.2446
6	$\frac{3}{16}$ +	.203	5.1562	19	....	.042	1.0668
7	$\frac{3}{16}$ —	.18	4.572	20	....	.035	.8890
8	$\frac{5}{32}$	.165	4.291	21	....	.032	.8128
9	$\frac{5}{32}$ —	.148	3.7592	22	....	.028	.7012
10	$\frac{1}{8}$ +	.134	3.3036	23	....	.025	.6350
11	$\frac{1}{8}$ —	.12	3.048	24	....	.022	.5588
12	$\frac{1}{8}$ —	.109	2.7686	25	....	.02	.5080
13	$\frac{3}{32}$	.095	2.4130	26	....	.018	.4572

Table of Revolutions per Minute for Various Rim Speeds.

Diameter Inches	Rim Speed, Feet per minute.				
	9,000	**10,000**	**11,000**	**12,000**	**13,000**
8	4297.12	4774.62	5252.	5732.50	6207.
10	3437.70	3819.70	4201.60	4586.	4965.60
12	2864.75	3183.08	3501.33	3821.66	4138.
14	2455.50	2728.35	3001.14	3275.71	3546.85
16	2148.56	2387.31	2626.	2866.25	3103.50
18	1905.94	2122.05	2334.22	2547.77	2578.66
20	1718.85	1909.85	2100.80	2293.	2482.80
22	1562.59	1736.22	1909.81	2084.54	2257.09
24	1432.37	1591.54	1750.66	1910.08	2069.
26	1322.19	1469.11	1616.	1763.84	1909.84
28	1227.75	1364.17	1500.57	1637.85	1773.09
30	1145.90	1273.23	1400.53	1528.66	1655.20
32	1074.28	1193.65	1313.	1433.12	1551.75
34	1011.08	1123.44	1235.76	1348.82	1460.47
36	954.91	1061.92	1167.11	1273.88	1379.33
38	904.65	1005.18	1105.68	1206.84	1306.73
40	859.42	954.92	1050.40	1146.50	1241.40
42	818.5	909.45	1000.38	1091 90	1182.28
44	781.29	868.11	954.90	1042.27	1128.54
46	747.32	830.36	913.39	996.95	1079.47
48	716.19	795.77	875.33	955.41	1034.50
50	697.54	763.94	840.32	917.20	993.12
52	661.09	734.55	808.00	881.92	954.92
54	636.61	707.35	778.07	849.25	919.55
56	613.87	682.68	750 28	818.92	886.71
58	592.70	658.56	724.41	790.68	856.13
60	572.86	636.61	700.26	764.43	827.60
62	554.46	616.08	677.67	739.67	800.90
64	537.14	596.51	656.50	716.56	775.87
66	520.86	578.74	636.60	694.84	752.36
68	505.54	561.72	617.88	674.41	730.23
70	491.10	545.67	600.22	655.14	709.37
72	477.45	530.51	583.55	636.94	689.66
74	464.55	516.17	567.78	619 72	671.02

* See p. 144.

Table of Lineal Velocity of Belts or of Band Saws (given in feet per minute), on Pulleys of given Diameters, at Various Speeds.

Diam. Pulley.	Revolutions per Minute.					
	300	350	400	450	500	600
30 in.	2356	2749	3142	3534	3927	4712
32 "	2513	2932	3351	3770	4189	5026
34 "	2670	3115	3560	4005	4451	5341
36 "	2827	3298	3770	4241	4712	5654
38 "	2984	3482	3979	4477	4974	5969
40 "	3141	3665	4189	4712	5236	6283
42 "	3298	3848	4398	4948	5498	6597
44 "	3455	4031	4607	5184	5760	6911
46 "	3612	4215	4817	5419	6021	7226
48 "	3770	4398	5027	5655	6283	..
50 "	3927	4581	5236	5890	6545	..
52 "	4084	4765	5445	6126	6807	..
54 "	4241	4948	5655	6362	7069	..
56 "	4398	5131	5864	6591	7330	..
58 "	4555	5314	6074	6833	7692	..
60 "	4712	5497	6283	7069	7854	..

Rule.—To find lineal velocity of a band saw or a belt in feet per minute—multiply diameter in inches by $\frac{3.1416}{12} = .2618$ and by the number of revolutions per minute.

Rule.—To find the number of revolutions per minute of circular saws, pulleys, or wheels of various diameters corresponding to a given rim speed. Multiply the diameter in inches by 3.1416 and divide the product into twelve times the rim speed in feet, or divide the diameter in inches into 3.82 times the rim speed.

Less accurately; divide 11 times the diameter in inches into 42 times the rim speed in feet.

Diameter and Thickness of American Concave Saws, expressed Metrically (corresponding to Table on page 67).

Diameter, mm.	Thickness, mm.
152.39	1.2446
177.19	1.2446
208.19	......
253.99	1.7510
304.79	1.8288
355.59	......
406.39	2.1082
457.19	2.4130
507.99	......

Diameters and Thickness of American Circular Saws, with Size of Mandrel Holes, expressed Metrically (corresponding with Table on page 56).

Diameters, cm.	Gauge.	Mandrel Hole, mm.
10.16	19	19.04972
12.70	19	"
15.40	18	"
17.78	18	"
20.32	18	22.22479
22.86	17	"
25.40	16	25.39977
30.48	15	"
35.56	14	47.6045
40.64	14	"
45.72	13	31.74971
50.80	13	33.32
55.88	12	"
60.96	11	24.91
66.04	11	"
71.12	10	38.08
76.20	10	"
81.28	10	41.26
86.36	9	"
91.44	9	"
96.52	8	"
101.60	8	50.79
106.68	8	"
111.76	7	"
116.84	6	"
121.92	6	"
127.	6	"
132.08	5	"
137.16	5	"
142.24	5	"
147.31	5	"
152.39	5	"
158.48	4	"
162.55	4	"
168.67	4	"
173.72	4	"
178.79	3	"
183.57	3	"

Richards' Speed Table for Circular Saws. (Expressed Metrically by R. G.)

Diameter.		Revolutions per Minute.	Peripheral Velocity.	
Inches.	Centimetres.		Metres per minute.	Feet per minute.
36	91.44	1500	4300	14100
30	76.20	1800	4300	14100
25	63.50	2100	4150	13700
20	50.80	2400	3800	12500
15	38.10	2700	3225	10600
10	25.40	3000	2125	7000

Circumference of Wheels, Pulleys, or Circular Saws. (Original.) Diameters being given in Inches and Centimetres, and Circumferences being given in Feet and Metres.

Diameter, inches.	Circumference in feet.	Circum. in metres.	Diam. centimetres.
8	1.9344	.6848	20.32
10	2.6181	.7975	25.40
12	3.1416	.9570	30.48
14	3.6652	1.1178	35.60
16	4.1888	1.2760	40.64
18	4.6124	1.4356	45.72
20	5.2360	1.5951	50.80
22	5.7596	1.7546	55.88
24	6.2832	1.9141	60.96
26	6.8068	2.0736	66.04
28	7.3304	2.2331	71.12
30	7.8540	2.3926	76.20
32	8.3776	2.5521	81.28
34	8.9012	2.7117	86.36
36	9.4248	2.8712	91.44
38	9.484	3.0304	96.51
40	10.472	3.1899	101.59
42	10.9956	3.3497	106.68
44	11.5192	3.5092	111.76
46	12.0428	3.6687	116.84
48	12.5664	3.8282	121.92
50	13.09	3.9878	127.00
52	13.6136	4.1473	132.08
54	14.1372	4.3068	137.16
56	14.6608	4.4663	142.24
58	15.1844	4.6258	147.32
60	15.708	4.7853	152.40
62	16.2316	4.9448	157.48
64	16.7552	5.1043	162.56
66	17.2788	5.2638	167.64
68	17.8024	5.4234	172.72
70	18.3260	5.5829	177.80
72	18.8496	5.7424	182.88
74	19.3742	5.9019	187.96

The Circumference or Periphery of a Saw.—Multiply its diameter by 3.1416, or more roughly by $3\frac{1}{7}$ (that is, multiply by 22 and divide by 7).

Circumference in Feet.—Multiply the diameter in inches by .2618; or multiply the diameter in inches by 11 and divide by 42.

Rim Speed in miles per minute is found by multiplying the diameter in inches by the number of revolutions per minute and dividing by 20168.

Table of Rotation Speed for Circular Saws to give a rim speed of 9420 *feet*= 2871 *metres per minute. Diameters expressed Metrically and in Inches.*

Diameter, Inches.	Diameter, cm.	Revolutions per minute.	Diameter, Inches.	Diameter, cm.	Revolutions per minute.
8	20.32	4500	42	106.68	870
10	25.40	3600	44	111.76	840
12	30.48	3000	46	116.84	800
14	35.60	2585	48	121.92	750
16	40.64	2222	50	127.00	725
18	45.72	2000	52	132.08	700
20	50.80	1800	54	137.16	675
22	55.88	1636	56	142.24	650
24	60.96	1500	58	147.32	625
26	66.04	1384	60	152.40	600
28	71.12	1285	62	157.48	575
30	76.20	1200	64	162.56	550
32	81.28	1125	66	167.64	545
34	86.36	1058	68	172.72	529
36	91.44	1000	70	177.80	514
38	96.51	950	72	182.88	500
40	101.59	900			

One metre equals 39.37043 inches, 3.28087 feet, 1.09362 yards.
One inch equals 2.53995 centimetres.
One foot equals 0.3048 metre.
One square inch equals 6.45148 square centimetres.
One square foot equals .0092901 square metre.
One square yard equals 0.836112 square metre.

Dark-red color indicates about 700° Cent., equals 1292° Fahr.; cherry red, 1652° Fahr.; white heat, 2372° Fahr.

List of Saw Patents up to April, 1882.

Drag Saw,	M. P. Hall,	Jan. 13, 1880,	223,504
Saw,	A. A. Burr,	Mar. 23, 1880,	225,795
Scroll Saw,	D. F. Sutton,	Mar. 30, 1880,	226,130
Drag Saw,	J. Augspurger,	Apr. 20, 1880,	226,590
	J. A. Cluxton,	Apr. 20, 1880,	226,718
Endless Chain Saw,	E. Nunan,	Apr. 20, 1880,	226,774
Drag Saw,	J. K. Hutchins,	May 4, 1880,	227,110
Circular Saw,	J. K. Lockwood,	May 11, 1880,	reissue 9197
Saw,	E. Morris,	May 18, 1880,	227,815
	C. Suisse,	July 6, 1880,	229,772
Drag,	J. Carothers,	June 22, 1880,	229.091
	M. B. Swindell,	June 29, 1880,	229,488
	C. S. Dean,	July 13, 1880,	229,975
	N. L. Brown,	Aug. 24, 1880,	231,474
	J. Oldham,	Oct. 5, 1880,	233,008
Drag Mach.	J. J. Thomas & N. F. Mills,	Oct. 12, 1880,	233,126
Drag,	J. M. Da Costa.	Oct. 19, 1880,	233,403
Saw Teeth,	G. F. Woolston,	Mar. 11, 1851,	7,979
	N. Barlow,	Apr. 10, 1855,	12,664
	I Mason,	Sept. 11, 1860,	29,982
	I. S. Brown,	Jan. 8, 1861,	31,073
	L. B. Southwark	July 9, 1861,	32,796
	J. E. Emerson,	Sept. 12. 1865,	49,868
	E. Colson,	May 4. 1869,	89,559
	"	Nov. 9, 1869,	96,674
	P. Cook,	Feb. 23, 1869,	87,092
	J. Newton,	Aug. 24, 1869,	94,022
	U. B. Noyes,	Oct. 5, 1869,	95,602
	I. & T. Bird, Jr.,	Dec. 27, 1870,	110,430
	G. H. Hiles,	May 17, 1870,	103,045
	C. V. Littlepage,	July 12, 1870,	105.345
	J. E. Emerson,	Apr. 29, 1873,	138,236
	" "	Sept. 16, 1873,	142,781
	U. P. Miller,	Aug. 26, 1873,	142,258
Saw Teeth Bl'k,	J. E. Emerson,	Sept. 16, 1873,	142,780
	" "	Nov. 8, 1870,	108,990
Circular,	N. Johnson,	May 21, 1872,	127,061
Construction of	W. A. Wilson,	Mar. 22, 1859,	23.330
Detachable,	G. J. Hogan,	Apr. 26, 1870,	102,400
Insertable,	W. H. Ivens,	May 9, 1871,	114,685
	N. Johnson,	Dec. 24, 1872,	134,290
	H. G. Powell,	Aug. 20, 1872,	130,659
	J. W. Strange,	Aug. 13, 1867,	67 682
Removable,	J. Crookes,	Aug. 5, 1873,	141,427
Saw Tooth,	J. E. Emerson,	May 26, 1874,	151,321
	J. R. Luce,	May 26, 1874,	151,407
	M J. Rahilly,	Jan. 20, 1874,	146,708
B'd Saw Teeth,	A. Hatch,	Mar. 31, 1874,	149,120
Saw Teeth,	W. P Hale,	Apr. 13, 1875,	162,061
Saw Teeth Circ.	A. F. Dimond,	Dec. 28, 1875,	171,604
Insertable,	E. Smith,	Apr. 28, 1875,	162,319
Saw Teeth,	A. Boynton,	Aug. 15, 1876,	180,986
Insertable,	C. Adams,	May 16, 1876,	157,446
	H. Disston,	May 16, 1876,	177,481
	T. S. Disston,	May 30, 1876,	178 123
	E. C. Keys,	Aug. 1, 1876.	180,429
	E. T. Leppert,	June 6, 1876,	178.450
	T. S. Disston,	Apr. 3, 1877,	189,199
Saw Tooth,	N. W. Spaulding	June 19, 1877,	192,099
	" "	June 19, 1777,	192,090
	C. Adams,	June 11, 1878,	204,697
	W. E. Brooks,	June 18, 1878,	205,042
	J. R. Luce,	Dec. 17, 1878,	211,029
	W. P. Miller,	Dec. 17, 1878,	211,035
Saw Tooth, Insertable,	J. R. Berry,	Aug. 13, 1878,	207,003
	S. J. Randall & J. O'Brien,	Feb. 12, 1878,	200,219
	F. Schley,	Nov. 5, 1878,	209,627
	J. Ohlen,	Nov. 11, 1879,	221,602
	N. Johnson,	Jan. 7, 1879,	211.097
Inserted,	R. H. Osgood,	Dec. 2, 1879,	222,304
Saw,	C. H. Douglas,	Jan. 25, 1881,	236,876
	C. N. Hubbard,	Apr. 12, 1881,	reissue, 9,657
	C. R. Marvin,	June 14, 1881,	242,951
	E. Osgood,	Mar. 8, 1881,	238,521
	J. Ashenfelter,	Aug. 2, 1881,	245,114
	G. H. Northway,	Aug. 2, 1881,	245,090
	H. Van Bibber,	Aug. 9, 1881,	245,588
	S. Toles,	Nov. 1, 1881,	249,119
	H. Westphal,	Dec 20, 1881,	251,149
Saw Tooth,	E. J. Hill,	Mar. 22, 1881,	239,098
	E. C. Mulford,	Jan. 18, 1881,	236,690
	E. S. Snyder,	May 3, 1881,	241,082
	C. N. Hubbard,	Aug. 16, 1881,	245,831
Detach.	E. C. Atkins,	Sept. 6, 1881,	246,703
Insert.	A. Krieger,	Oct. 25. 1881,	248,761
Back,	J. R. Woodrough	Jan. 17, 1882,	252,571
Circular,	G. F. & D. Simonds & A. A. Marshall	Feb. 8, 1881,	237,617
Compress,	C. Bush,	Jan. 10, 1882,	252,179
Crosscut,	E. M. Boynton,	Feb. 14, 1882,	253,671
	" "	Apr. 5, 1881,	239,710
	J. E. Emerson,	Mar. 22, 1881,	239,156
Drag,	J. M. De Coster,	Oct. 19, 1880,	233,403
	J. P. Fosdyck,	Oct. 26, 1880,	236,610
	J. Augspurger,	Nov. 2, 1880,	233,907
	S. Clemens,	June 14, 1881,	242,885
	E. Strobl,	June 14, 1881,	243,004
	M. L. Nichols,	Oct. 11, 1881,	248,200
	S. Males,	Dec. 6, 1881,	250,557
Drag for Cutting Snags,	J. W. Swales,	May 17, 1881,	241,749
Fire w'd Drag,	W. Warmoth,	Aug. 23, 1881,	246,253
Hand,	J. R. Woodrough	Jan. 17, 1882,	252,570
Saw, Hand,	L. Lawson,	Oct. 11, 1881,	248,045
Circular,	A. A. Bennett,	Apr. 5, 1881,	239,703
Jig,	C. P. Warwick,	June 21, 1881,	243.092
Reaming,	L. Barthelmes,	Apr. 5, 1881,	239,698
Scroll,	W. Jones,	Jan. 4, 1881,	236,163
	F. Schaefle,	Feb. 15, 1881,	237,912
Swing,	J. Connell & V. Dengler,	Feb. 14, 1882,	253,513
Swinging,	W. F. Rothenberg,	Apr. 19, 1881,	240,339
Sawing Mach.	S. W. Brown,	Oct. 26, 1880,	233.597
	A. F. Morris,	Nov. 30, 1880,	234,886
	F. J. Crump,	Apr. 26, 1881,	240,667
	L S. Edleblute,	June 21, 1881,	243,114
	E. R. Hill,	July 5, 1881,	243,896
	J. Angspurger,	Aug. 30, 1881,	246,448
	L. D. Noblett,	Aug. 30, 1881,	246.540
	D. Berry,	Nov. 29, 1881,	250,191
	C. W. Trautman	May 10, 1881,	241,449
	A. Euston,	Feb. 28, 1882,	254,202
Sawing Mach. Band,	L. F. Ketler,	Jan. 10, 1882,	250,043
Circular,	H. J. Colburn,	Dec. 6, 1881,	250,425
	" "	Dec. 13, 1881,	250,712

Sawing Circ.	C. S. Beath,	July 5, 1881,	243,835
	D. O. Strifler,	July 12, 1881,	244,335
Crosscut,	W. H. Smith,	Jan. 17, 1882,	250,043
	J. M. Turner,	Feb. 15, 1881,	237,930
Cut. down stand. timb'r,	J. Angspurger,	Aug. 30, 1881,	246,447
Drag,	L. M. Comstock,	Oct. 26, 1880,	233,731
	L. H. & J. E. Gibbs	May 24, 1881,	241,960
	T. J. Henaberg,	Apr. 26, 1881,	240,515
	J. W. McKee,	Jan. 4, 1881,	236,236
Sawing Mach. Drag,	N. McAdams, Jr.	July 12, 1881,	244,278
	S. B. & E. Allen,	Aug. 16, 1881,	245,693
	E. L. & J. A. Dunham,	Aug. 16, 1881,	245,800
	G. B. Durkee,	Nov. 29, 1881,	250,136
	D. H. Ball,	Dec. 27, 1881,	251,504
Saw'g Groov. & Plan'g Mach.	G. M. & N. Fay,	Mar. 15, 1881,	238,875
Sawing Mach. Hand,	N. W. Giles,	Apr. 19, 1881,	240,316
	N. M. Lawrence,	May 3, 1881,	241,031
	M. Kurtzeman,	Sept. 13, 1881,	247,069
Heading Stave Spoke,	G. W. Wilson,	July 5, 1881,	243,745
Sawing kindl'g w'd, Mach. for,	J. H. Brown,	Feb. 1, 1881,	237,161
Sawing kindl'g w'd, Mach. for,	N. A. Allen,	Oct. 25, 1881,	248,686
Saw'g Mach. log	C. B. Halstead & J. A. Carpenter,	Jan. 3, 1882,	251,872
Sawing Mach., Port. Rail.	J. McKinney,	Jan. 28, 1882,	243,595
Rim,	O. F. Sillcot,	Jan. 10, 1882,	252,268
Saw'g & Rout'g Mach.	S. M. Bragg,	Feb. 8, 1881,	237,475
Sawing Mach.	N. D. Herschell,	Oct. 26, 1880,	233,752
Scroll & Circ.	A. Showalter,	Feb. 14, 1882,	253,777
Sawing Mach. Shingle,	O. C. Hanson,	Dec. 7, 1880,	235,233
	D. Lane,	Feb. 1, 1881,	237,294
	N. H. Perkins,	Jan. 11, 1881,	236,620
	H. F. Snyder,	Apr. 12, 1881,	240,048
Tenon,	N. H. Clayton,	Nov. 2, 1880,	233,981
Wood,	N. H. Mellott,	May 24, 1881,	242,016
	C. F. Needham,	Apr. 19, 1881,	240,050
Saw Mill,	C. A. Hege,	June 28, 1881,	243,556
Band,	C. Meiners,	Aug. 30, 1881,	246,330
Saw Mill Circ.	C. J. L. Meyer,	Jan. 24, 1882,	252,689
Saw Mill Circ.	J. Campbell,	Feb. 28, 1882,	254,110
Gang,	J. M. Story,	Dec. 21, 1880,	235,824
	G. W. Nichols,	May 17, 1881,	241,699
Portable,	W. N. Whipple,	Sept. 27, 1881,	247,726
Reciprocating,	G. Gowen & A. Williams,	May 24, 1881,	241,857
	T. S. Wilkin,	Jan. 25, 1881,	236,968
Steam,	A. J. Emlaw,	Aug. 30, 1881,	246,380

The above comprises all United States Patents in the class of Saws from October 19th, 1880, to March 7th, 1882, inclusive.

Compiled by

JOHN A. WIEDERSHEIM,

Solicitor of Patents,

No. 110 S. Fourth St., Philadelphia, Pa.

Through whom copies of specifications, drawings, and claims may be ordered and obtained.

ALPHABETICAL SUBJECT INDEX

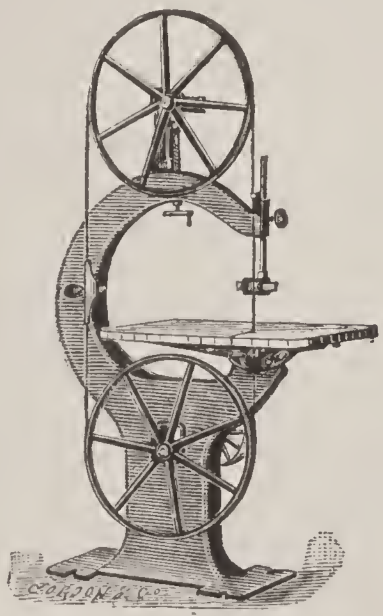
TO

SUPPLEMENT TO GRIMSHAW ON SAWS.

PATENT
Wood-Working Machinery,

FOR

Planing Mills, Sash and Door Work, Furniture, Chair, and Bracket Factories, Car Shops, and General Wood Workers, etc.,



OF THE

LATEST AND MOST-IMPROVED DESIGN.

MANUFACTURED BY

CORDESMAN, EGAN & CO.,

Nos. 234, 236, 238, 240, 242, 244, 246, 248 & 250 W. FRONT STREET,

CINCINNATI, O., U. S. A.

PERIN BAND SAW BLADES.

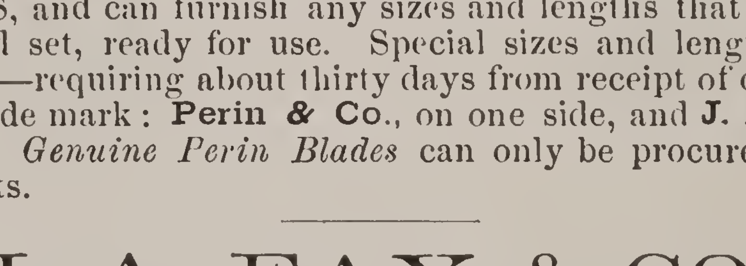
"KNOW ALL MEN BY THESE PRESENTS: *That we,* **PERIN, PANHARD & CO.,** *of* **Paris, France,** *have this day withdrawn the agency for the sale of our* **Band Saw Blades** *from Messrs. London, Orton & Berry, successors to Messrs. Richards, London & Kelley, Phila., and appoint Messrs.*

J. A. FAY & CO.,

of **Cincinnati, O., U. S. A.,** *to be our sole and exclusive agents for the entire States and territories of the United States of America, with full power to prosecute all infringements and illegal abuse of our trade mark. Made in Paris, France, Jan.* 1, 1878"

Witness,
W. TARAZIN,

PERIN, PANHARD & CO.,
Successors to Perin & Co.



As will be seen from the above announcement, we have been appointed sole and exclusive agents for the United States of the celebrated PERIN BAND SAW BLADES, and can furnish any sizes and lengths that may be required, joined, filed, and set, ready for use. Special sizes and lengths, not in stock, will be imported—requiring about thirty days from receipt of order. All blades will bear the trade mark: **Perin & Co.**, on one side, and **J. A. Fay & Co.** on the other side. *Genuine Perin Blades* can only be procured from us or our authorized agents.

J. A. FAY & CO.,

MANUFACTURERS OF

BAND SAWING MACHINERY,

VIZ.:

Band Log-Sawing Machines for Logs.
Band Re sawing Machines for Lumber.
Band Scroll-Saws for all kinds of Straight and Curve-Cutting required in Car and Railroad Shops, Carriage, Wagon, Sash and Door, Cabinet and Agricultural Implement Works, etc etc.

ILLUSTRATIONS AND PRICES SUPPLIED ON APPLICATION.

J. A. FAY & CO.,

W. H. DOANE, President.
D. L. LYON, Secretary.

Cor. John & Front Streets, CINCINNATI, O.

LANE & BODLEY CO., Manufacturers of Sawing Machinery,

Illustrated Catalogue and Prices furnished on application.

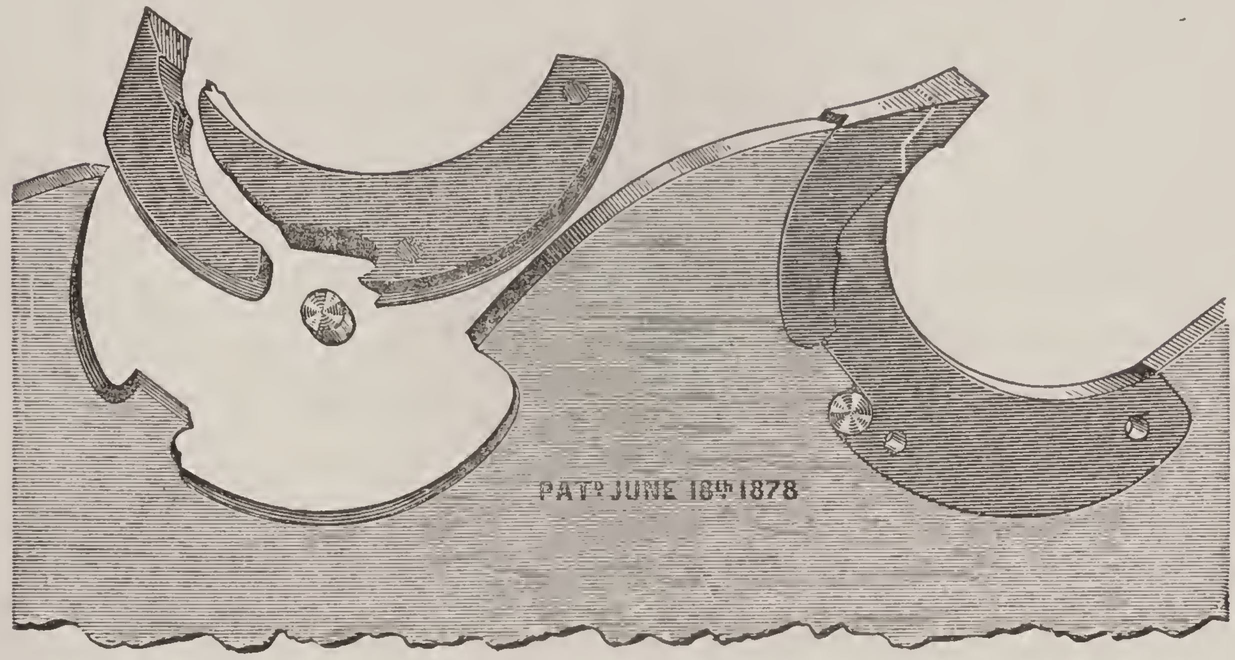
CINCINNATI, OHIO.

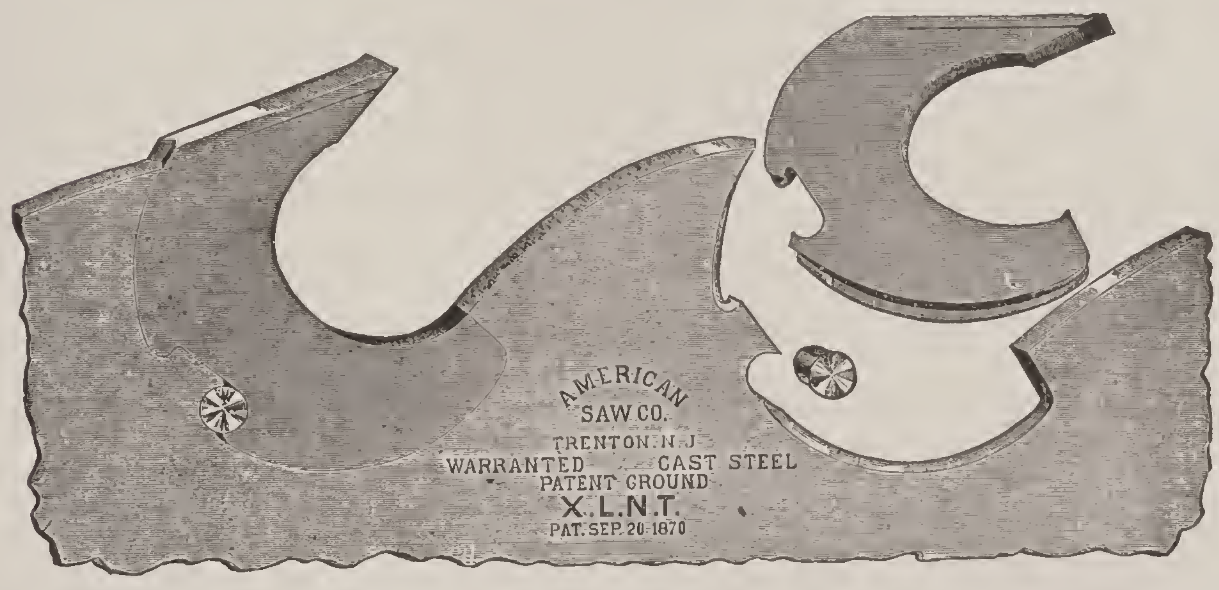
American Saw Company,

TRENTON, N. J.,

MANUFACTURERS OF

INSERTED TOOTHED CIRCULAR SAWS.





ALSO

PERFORATED CROSS CUT SAWS,

AND

SOLID SAWS OF ALL KINDS.

SEND FOR DESCRIPTIVE PAMPHLET.

IN PREPARATION.

Grimshaw on Sawing Machinery.

HISTORY, CLASSIFICATION AND COMPARISON, CONSTRUCTION, INSTALLATION AND USE OF AMERICAN AND EUROPEAN

SAWING MACHINERY OF ALL KINDS.

By ROBERT GRIMSHAW.

A SEQUEL TO THE AUTHOR'S WORK ON SAWS,

Being mainly drawn from the writer's long-collected personal notes, and from official data, obtained as member of the Jury of Awards on Wood Working Machinery at the Paris Exposition of 1878.

PARTIAL TABLE OF CONTENTS.

HISTORY OF SAWING MACHINERY — CLASSIFICATION (into Drag; Mulay (scroll and log); Jig Scroll; Single Frame (overhung, vertical gate); Gang Sash; Reciprocating Chain, Band, and Cylinder Saws; "Woodpecker"; Solid, Segmental, Inserted Toothed, and Side-Cutting Circulars; Wabble Circular; Convex and Concave Cutting Chain Saws; Dished and Spiral Saws; Solid Segmental, and Insertable Toothed Cylinder Saws; Perpendicular, Inclined, and Horizontal Band Saws); COMPARISON; CONSTRUCTION; Wood, Iron, and Compound FRAMES; DESCRIPTIONS of various Machines, with Dimensions, Speeds, Capacities, and Power Required; VARIOUS OPERATIONS (Felling, Butting, Slabbing, Squaring, Ripping, Cross Cutting, and Edging; Lath, Shingle, and Picket Making; Grooving; Tenoning; Scroll Sawing; DESIDERATA in Sawing Machines; INSTRUCTIONS for Ordering; CAUTIONS in Buying. SITE OF SAW MILLS; PLANNING AND CONSTRUCTION of Building; GENERATION OF POWER (Water Wheels, Engines, and Boilers); TRANSMISSION (Shafting, Pulleys, Hangers, Couplings, Gears, Pulleys and Belts, Friction Pulleys. Wire Ropes, Journals, Bearings, and Lubrication). Waste by various widths of Kerf; Tables of Log Measurements for logs 10 to 20 feet long, and 12″ to 96″ diameter; Lumber Grading; Gauges and other Tables. Manufacture, Choice, Care, and Use of Blades; Filing; Gumming; Swaging; Setting. List of U. S. Patents on Sawing Machinery from 1790 to 1882. Hauling, Dogging, and Rossing the Logs. Insurance on Saw Mills. Cremating Sawdust and Slabs; making Compressed Fuel from Sawdust and Pitch. Distribution of the Timber Supply in the United States, Canada, and Europe; Characteristics of the various American and Foreign Woods.

The above work has been carefully prepared from the best AMERICAN and EUROPEAN practice, and is believed to be the most complete as to details and practical information ever issued. It is so arranged and so thoroughly indexed that any subject can be readily found; and is up to date.

This work will be handsomely printed on heavy paper, and well bound in cloth; and will contain over two hundred illustrations, many of them full page. It will be a large quarto, so as to show the cuts in their full size.

Price to subscribers is fixed at **TEN DOLLARS**, and will be advanced after publication.

ROBERT GRIMSHAW,

930 Market Street, Philadelphia.