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SAW FITTING.

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A TREATISE

ON THE

CARE OF SAWS.

A Book for Mill Managers, Superintendents, Foremen and Saw Filers.

BALDWIN, TUTHILL & BOLTON,

GRAND RAPIDS, MICHIGAN,

U. S. A.

PRICE. $2.00.

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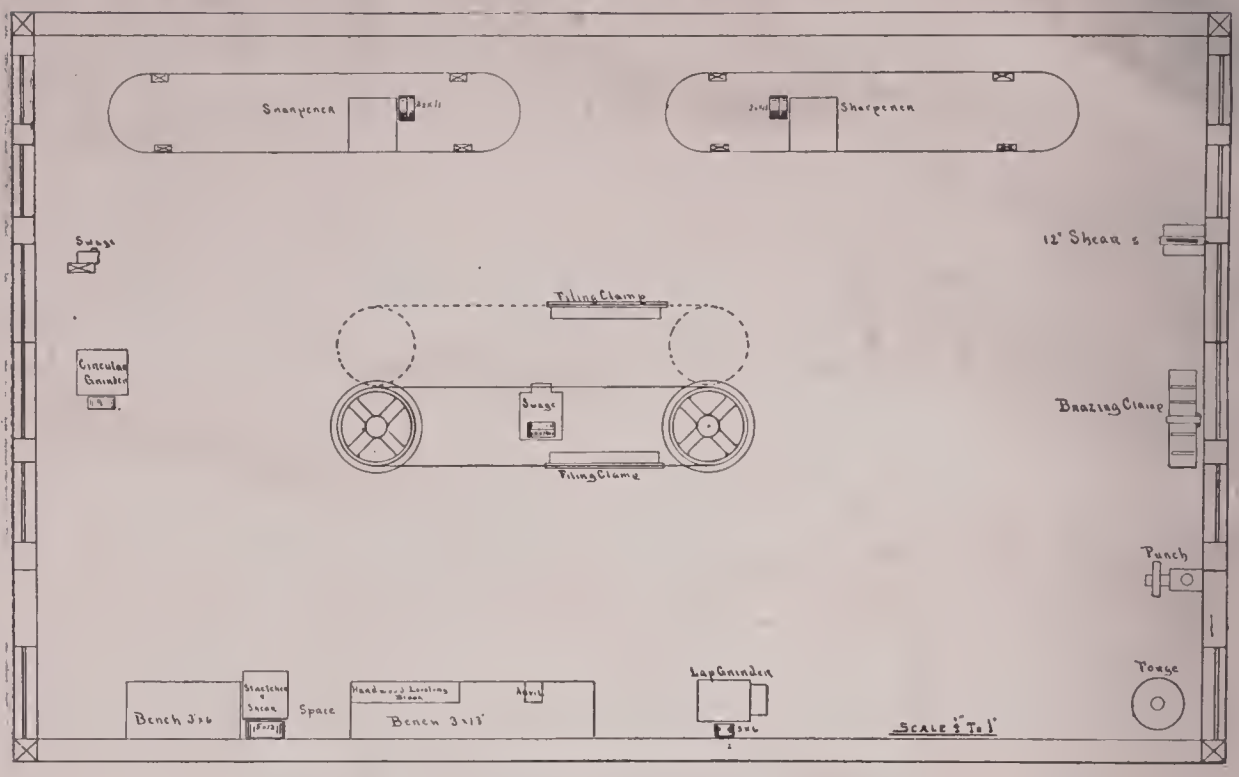
FILING ROOMS

OUGHT TO BE ABUNDANTLY LARGE, SUBSTANTIAL AND WELL LIGHTED.



PLAN FOR DOUBLE BAND MILL FILING ROOM.

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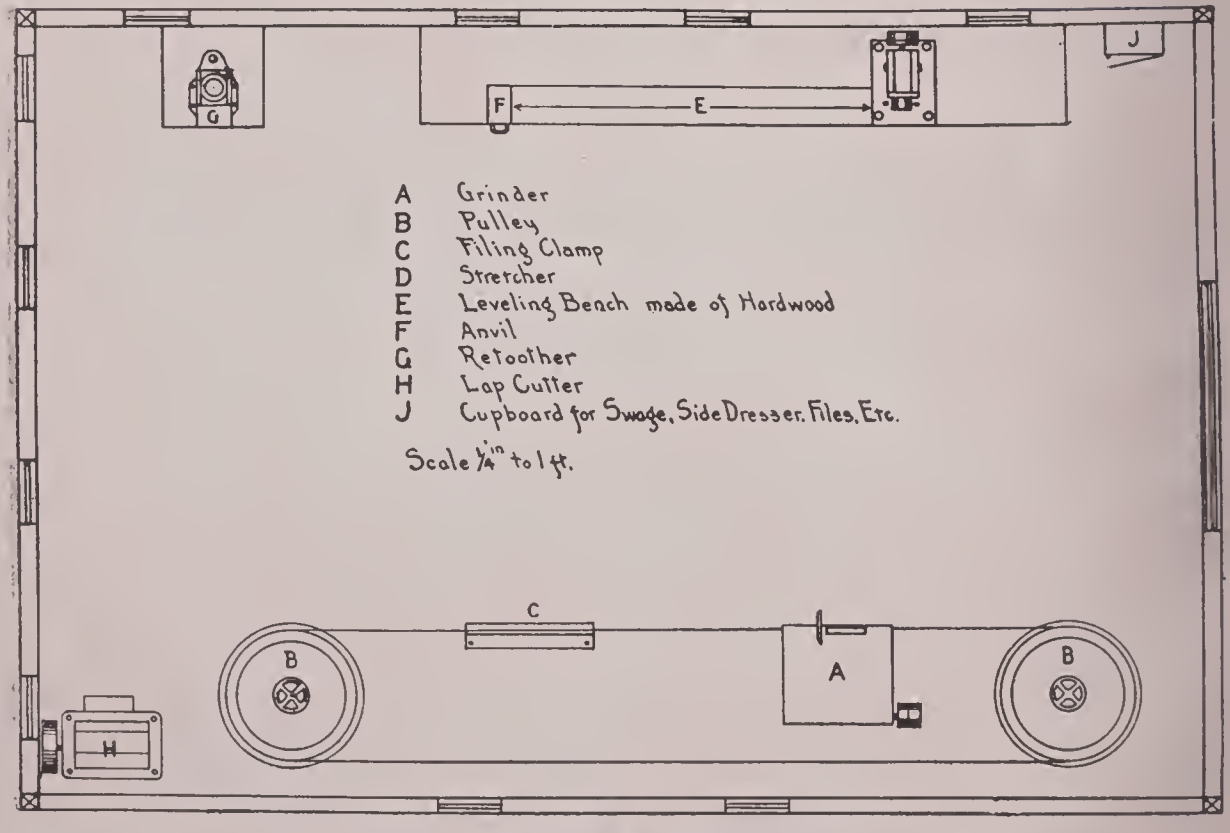

A Grinder
B Pulley
C Filing Clamp
D Stretcher
E Leveling Bench made of Hardwood
F Anvil
G Retoother
H Lap Cutter
J Cupboard for Swage, Side Dresser, Files, Etc.

Scale ¼" to 1 ft.

PLAN FOR BAND RESAW FILING ROOM.

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ECONOMICS FOR FILERS AND SAWYERS.

Saw Filers should be interested in any method, or machine or tool that is well calculated to improve or facilitate saw fitting. Their service is mental and mechanical rather than physical. Hence intelligence and skill in a filer are better recommendations than physical strength, or a disposition to hammer and file from morning till night. It is not a question of *quantity* but *quality* of work.

The quantity and quality of the lumber cut, and the steady employment of the common labor, depends largely upon the fine fitting of the saws; and the filer is therefore a profitable or a profitless man for his employer according as he fits the saws in condition to go.

Mill men and factory operators are rapidly coming to appreciate the importance of a perfect filing room equipment and are usually ready to purchase anything calculated to improve or facilitate the filer's work, if they have confidence in his ability and judgment. There are never too many good men in any calling, and with regard to saw filers, *the good filer is the one who makes his service indispensable to his employer.* Such a man can command his price.

Every saw filer should seek to become well informed—in the broadest possible manner, upon everything pertaining to his trade. The experience of no one man is universal, and hence the need of constant effort to familiarize one's self with all changing conditions in saw and mill management and operation, that as each new condition arises, one may the better meet it successfully.

The competent filer or sawyer should understand millwright work, at least to the extent that he may ascertain when faults lie in the saw, in the mill, the carriage, the track, or any portion of the plant directly under his personal supervision or operation. Defects may lie in any one of these places which, if not ascertained and remedied, will render only partially effectual the best of efforts tending to improvement in the care of saws.

The services of a filer may be invaluable at from $3.00 to $8.00 per day, or expensive at $2.00 per day. One filer may increase the cut of well manufactured lumber from two to ten thousand feet per day; another may not only lessen the average cut, but also impair the quality of the output, a double loss.

The actual results in the running of the saws depend upon the skill of the filer, and upon his having high grade, efficient saw fitting machines to work with. If the filing room is not well equipped the filer should ask for improvements, and it is his business to know what machines will afford the longest and most satisfactory service. He should familiarize himself with what the market affords for each branch of saw fitting, that his recommendation may be based upon comparative merits and actual intrinsic values, rather than on ignorance and prejudice.

As makers of saw fitting machinery we solicit the careful attention of saw filers to our various appliances. We request correspondence respecting our equipment, or respecting new designs or inventions pertaining to saw fitting. We recognize the fact that the practical daily user of a machine or tool has opportunities for discovering improvements or suggesting modifications that are rarely possible to the mechanical draughtsman or machine builder, and we are wide open to take hold of improvements or new appliances that promise to have commercial value. But as manufacturers we are bound to consider practical utility and selling qualities as prime considerations in any new device offered us, and are therefore sometimes obliged to decline devices that possess utility but no commercial value.

Saw filers seeking employment may occasionally learn something from us to their advantage regarding new mills or positions vacant, and we will always be pleased to render any service within our power to those seeking employment.

Every filer should take pride in keeping his filing room in good order, free from dirt and dust, and especially in keeping his machines clean, solidly set, in proper repair, and free from lost motion. Saw sharpeners and lap grinders are particularly liable to cutting and wear,

because of the quantity of emery dust that settles upon them. Dust pipes and exhausters are very desirable adjuncts for such machines, and it is highly important that machines using emery wheels be designed and constructed with reference to protecting the slides and journals from dust and keeping them well oiled. Keep the emery wheel head set square with saw, look out for lost motion in feed pawl, pawl slide, and emery wheel slide, and keep all boxes properly babbitted. Otherwise the operation of machines will be impaired and their life shortened. The manufacturer may use good material and endeavor to produce a machine mechanically well built, but he cannot impart brains or the ability to care for itself, to any machine.

DONT'S FOR SAW FILERS.

Don't fail to make yourself *indispensable* to your employer.

Don't fail to be progressive and on the lookout to find out and try new ideas that show decided merit in them.

Don't attempt to use poor filing room equipment. Ask for improvements.

Don't fail to keep your filing room and machines clean and in good order.

Don't recommend machines to your employer through ignorance or prejudice.

Don't fail to carefully inspect each saw as it comes off the mill.

Don't depend wholly upon sawyer to line the mill or adjust the guides.

Don't pound your saws.

Don't run dull saws.

Don't run saws with more swage than is needed for proper clearance.

Don't use poor emery wheels that glaze or fail to hold their shape.

Don't neglect to check every crack as soon as it appears.

Don't run a saw with many small edge cracks. Shear it. Make it equal to new.

Don't braze often, by avoiding the causes that make brazing necessary.

Don't burn the teeth by severe grinding or defective feeding.

Don't tolerate a rickety, poorly lighted, improperly heated filing room.

Don't run a saw with teeth of uneven length or too slim.

Don't fail to have good lights upon your work.

Don't use a poor stretcher. If your stretcher does not tension perfectly, it is a fault of construction, not a fault of the principle.

Don't fail to keep your swage dies and clamps in good order. Poor swaging and side-dressing waste and spoil quantities of lumber.

Don't use a side file in preference to a swage shaper.

Don't use a sharpener that will not feed or grind evenly.

Don't neglect to keep your emery wheels properly dressed.

Don't use a lap grinder that will not grind a square, true surface.

Don't use a retoother or shear that does not cut easily and clean, without buckling the teeth.

Don't use hammers that cut or mark your saw. Have hammers of proper weight and shape for your work.

Don't use soft brittle silver solder.

Don't use a brazing clamp that will not braze.

Don't use straight edges that are not straight.

Don't use a forge that will not heat the irons evenly.

THE SAWYER.

A good circular sawyer usually developes into a good band sawyer, although during his first few weeks of practice on the band, he is apt to not appreciate the need of care in feeding and gigging. It is usually but a question of time when by careless feeding or gigging he throws off saws or puts in some twists. The band saw requires an even steady feed, with no spurts and all the feed it will fairly stand without snaking, or dodging. Give the teeth plenty of hook for heavy feed and having plenty of hook give plenty of feed. There should be a well established ratio between the pitch, power and feed. The expert sawyer wastes no time with unnecessary carriage travel. He avoids passing the back of saw with the end of

the log. His practiced hand imparts a strong, steady feed to the very end of the cut and he reverses as the teeth leave the cut. Don't attempt to train a poorly fitted saw with the guides. These are not designed to make good the want of careful saw fitting. They are only a safeguard. The guides should fit snug up to the blade without binding it, to steady it into the cut and guard against dodging, should the feed be forced in hard or tough places. The lining metal of the guides should not be too hard. The use of extremely hardened liners in the guides may produce cracks. A hardened babbitt liner may be made by melting one part antimony to sixteen parts babbitt.

Set the guide rolls for back of saw about ¾ inch back from saw when saw is running in natural place on the wheels. These rolls should not be required to hold up the saw when in the cut but are simply a backstop for the saw in case of accident. They should run freely, so that when the saw does happen to strike them, there is nothing but the revolving friction. Don't waste time with a snaky saw. Such a saw either needs more tension, or needs an equalized tension, as a saw not open enough or with fast or loose spots will run snaky. A saw with teeth spaced too far apart or with teeth too long or slim, will also snake unless opened a good deal, in which case it is only a question of time when cracks will start in the throats.

Sawyers should be quick and energetic and the man who can hammer, file and repair, has marked qualifications over the one of lesser experience. Given good saws and the mill in good condition, the quantity and quality of the output then depend directly on the judgment and hustling qualities of the sawyer. The ideal sawyer is quick, active, strong, of temperate habits, coolheaded, fearful enough to comprehend danger and possesses quick decision to avoid it.

SAW FITTING.

The matter presented in the following pages on Saw Fitting is not an expression of opinion of a single individual, but rather the grouping together of ideas advanced by a considerable number of saw makers, saw filers and mill experts, who, as is well known, are not wholly agreed upon what constitutes the best practice in the fitting of saws. It is manifestly impossible to present directions that may be successfully applied in every instance. The quality of different saws and the conditions under which they are used are widely different. There is diversity of opinion among expert filers as regards proper tension, spacing and shape of teeth, amount of throat room, hook, method of swaging and side-dressing, and numerous other details. Where saw doctors thus disagree, it remains for each one to diagnose the case according to his own light, using intelligence and common sense largely, and then prescribe the treatment that his saw appears to need. Care, attention to details, the study of cause and effect, and the use of common sense, must characterize every successful saw filer. The filer whose work is purely experimental has no proper place in the filing room, and should abandon the profession rather than be forced out of it.

It is hoped that this treatise will present some information that may be applied with advantage, or serve as matter for consideration or investigation. It is confined almost wholly to saws used on log band or band resaw mills, but we offer to those interested in circular or gang saws a special manual treating the different classes of saws exhaustively.

It is presumed that each band saw filing room is provided according to its character and requirements, with proper sharpener, swage, shaper, stretcher, retoother, shear, filing clamp, brazing clamp, lap grinder or cutter, leveling block, anvil, hammers, straight edges, tension guages, brazing forge, with the motive power steady and uniform and the room properly lighted and of convenient size.

ERECTION OF THE FILING ROOM MACHINES.

The sharpener, lap grinder, filing clamps and stretcher must be placed with especial reference to securing a good light on the work. The first three machines should have a good light fall on the work from the front. The hammering bench and stretcher should be

placed preferably to secure north or east light on the end of bench faced when testing the saw. For log band saws the bench should be from fourteen to sixteen feet long; for band resaws from eight to ten feet long. A very convenient addition to the bench for use when the saw is on the upper brackets above bench to permit of working the inside, consists of a pair of drop leaves from four to six feet long at each end of bench, hinged to the wall or studding, to permit of being folded up or dropped down to lengthen out the bench as occasion may require. These may have a leg or support, hinged to the outer edge of under side to drop down out of the way when the shelf is not in use. The bench may be erected with the stretcher placed near the right or left hand end and anvil and leveling block in proper relative position. Avoid placing stretcher so that there will be an abrupt bend of saw downward, as this may cause the rolls to dish the saw. The saw must lie flat on bench as it feeds through the rolls in process of tensioning. Next to stretcher there may be a portable section in bench about four feet long, such that it can be lifted out when testing tension. This opening permits of bending the saw down or of testing it by its sag, which is less laborious than lifting it upward off bench. Next to this open space should be placed the leveling block from four to six feet long, and at the end of this should be the anvil. Three or more brackets placed equi-distant, about three feet above bench, supporting idle rollers of wood, or better still, a set of our special brackets above bench, and another set mounted on floor, are requisite for the convenient handling of the saw over and under the bench. The top of the lower stretcher roll should be about three feet above the floor, and if no portable section is built in the hammering bench, the leveling board may be placed close up to the stretcher with the surface of board about one-eighth of an inch below the face of the rolls, and the anvil on same level next to the leveling board. The rolls should not be allowed to run when not in use, as any unnecessary rubbing against the surface of the saw will tend to wear and impair their face. The face of the rolls and the machine itself should be kept oiled.

THE LEVELING BOARD.

The leveling board may be of iron or hardwood. If of hardwood it should be made from kilndried wood, and be not less than six inches thick by desired width and length. If an iron board is used, it should be from three to five inches thick, dressed both sides, and the operator should not neglect to turn it over from time to time, as the constant hammering on one side will cause it to become convex or raised up in the center. It is a good plan to turn it occasionally end for end, as most of the leveling is done on the toothed side of the saw which raises that side of the leveling block the most.

STRAIGHT EDGES, ANVILS AND HAMMERS.

A good outfit of saw tools is important. For log band saws a straight edge from six to ten feet long for testing the back edge of saws, one twelve inches or the width of saw for locating lumps and ridges, and a tension guage of same length, with the proper crown for guaging the tension are required. For resaws a straight edge four to six feet long and a short straight edge and a tension guage six inches long or width of saw, are required. The short straight edge should be applied very carefully along the toothed edge and back edge of saw to locate ridges. Mark only the highest spots, being careful to mark directly on the lumps. A straight edge should not be leaned or rocked, but should be applied as nearly square as possible. A round edge is advantageous and a good light indispensable.

Our Eagle Steel Faced Anvils are the best made for any kind of saw, because the face is in one solid piece of best cast steel of uniform hardest temper, perfectly welded, and warranted never to settle or change from a true surface. We furnish these anvils in about one hundred different sizes, but usually furnish for wide band saws, anvils with face 10 x 12, 10 x 14, 10 x 16, 12 x 14 or 12 x 16; and for band resaws 6 x 10, 8 x 12 or 10 x 12. A set of hammers, comprising doghead, crossface and twistface, selected with reference to the guage of saws on which they are to be used, is essential. Hammers should be bought with special regard to their weight and shape of face, both of which have much to do with their fitness for work. Hammers have both a use and an abuse. Heavy hammers, such as are commonly

used for circular saws from five to eight guage, are too heavy for bands or band resaws. Indeed the regular band saw hammers are considered by careful filers too heavy for fine work on band saws, and many use light finishing hammers, weighing not over two pounds or so, and find their use much more satisfactory. Especially is this the case where filers have a good stretcher for their work in tensioning. In such case there is very little leveling to do after the rolling, and the light hammers accomplish the work best. We furnish hammers that are hand forged of best steel, and that in shapes, finish and fitness for their work, prove entirely satisfactory. We make them specially to order to suit any requirement, if specifications and patterns are furnished. We have furnished hammers weighing from two to 10 pounds, but for general service the following meet requirements:

Circular Hammers—Weight mounted, from 3 to 5 pounds.

Band or Gang Hammers—Weight mounted, from 2 to 3½ pounds.

Light Finishing Hammers—Weight mounted, from 2 to 2½ pounds.

Band Resaw Hammers—Weight mounted, from 2 to 2½ pounds.

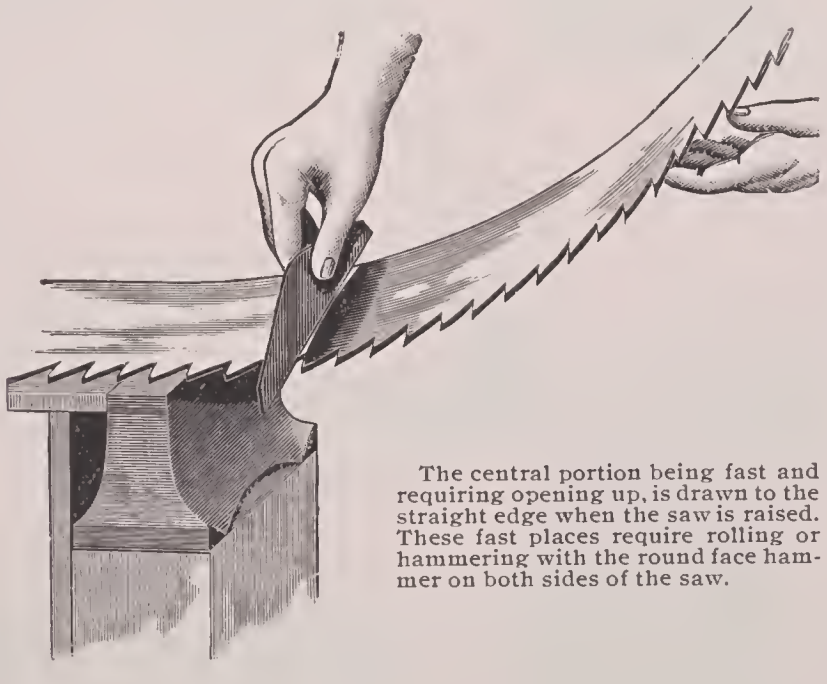
We furnish these doghead, crossface, twist face or combination.

The hammers are to be used for leveling, taking out twists, removing lumps, etc.; the saw stretcher for tensioning. If you have no stretcher, use the round face hammer for tensioning. Strike fair light blows, being careful to avoid cutting or marking the steel, for such marks crystallize and crack, especially when near the edges. In changing from heavy to light guage saws always change from heavy to light hammers.

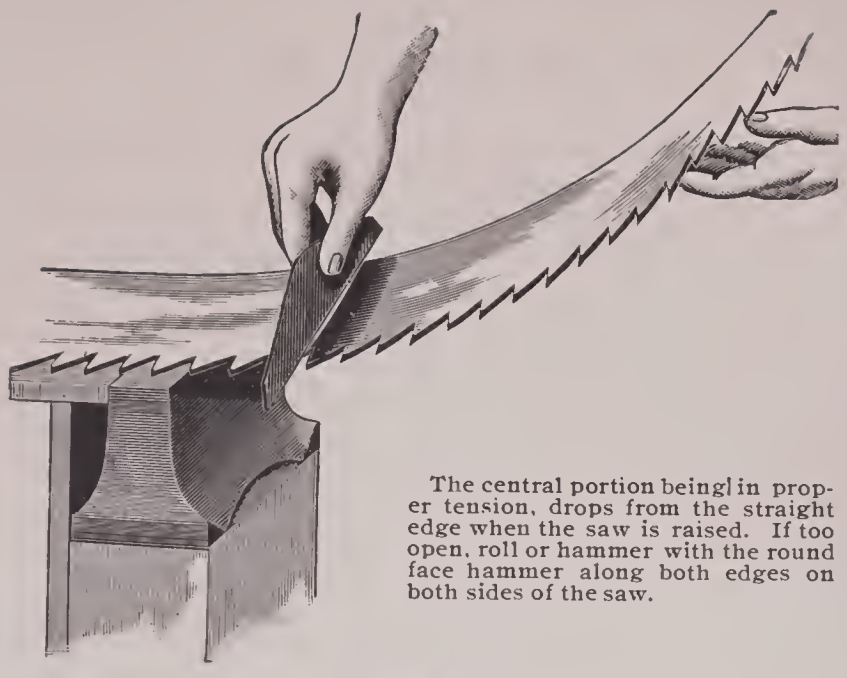
FAST, LOOSE AND STIFF PLACES.

Level your saw on leveling block, taking out lumps, or bends and twists, by hammering. Next locate the "fast," "loose" and "stiff" spots or places. This is accomplished by bending saw on upward or downward curve as shown in cuts, and making a careful examination of saw with the short straight edge applied squarely across the blade.

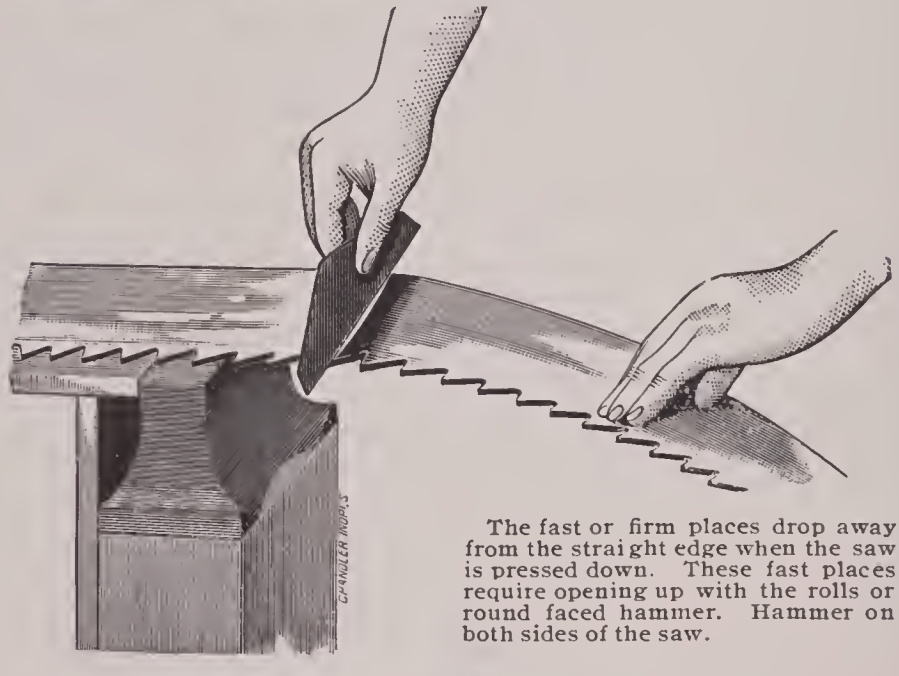
A "fast" place is one not open enough, but is convex, and stands up toward straight edge. A "stiff" place is without tension or perfectly flat, the central parts of saw conform to straight edge. See cuts.



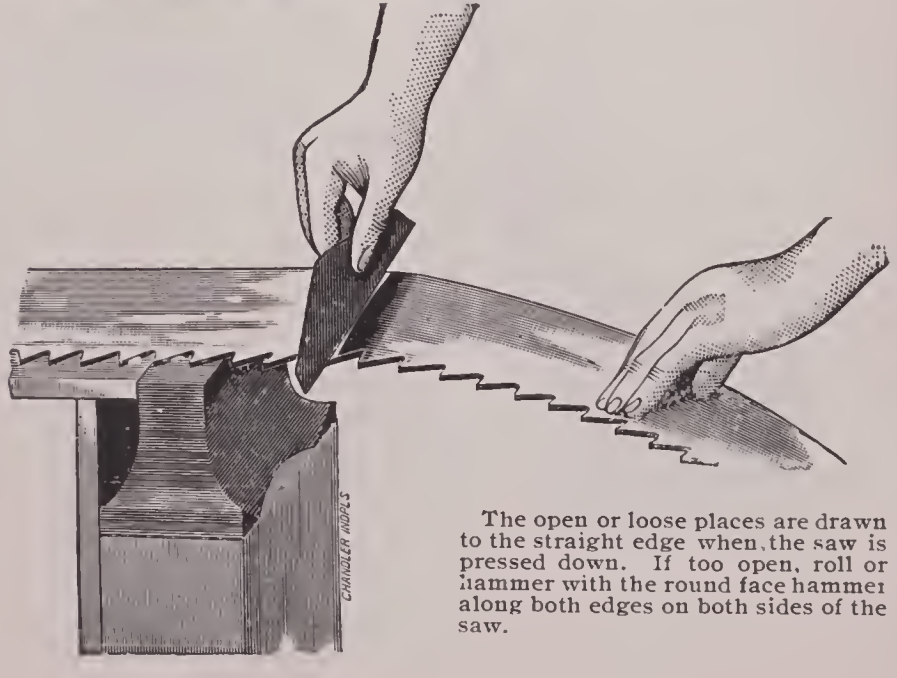
The central portion being fast and requiring opening up, is drawn to the straight edge when the saw is raised. These fast places require rolling or hammering with the round face hammer on both sides of the saw.



The central portion beingl in proper tension, drops from the straight edge when the saw is raised. If too open, roll or hammer with the round face hammer along both edges on both sides of the saw.



The fast or firm places drop away from the straight edge when the saw is pressed down. These fast places require opening up with the rolls or round faced hammer. Hammer on both sides of the saw.

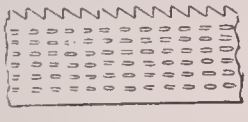


The open or loose places are drawn to the straight edge when the saw is pressed down. If too open, roll or hammer with the round face hammer along both edges on both sides of the saw.

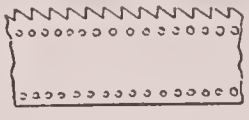
A "loose" place is too open, or is concave and saw drops away from straight edge. Such places will show the same on both sides of saw, whereas a lump will show only on one side. An experimental knowledge of these terms and their appearance in saw, may be obtained by hammering a strip of band saw, say three feet long. First make the saw flat or "stiff" by hammering down the lumps with the doghead hammer. Then test with straight edge for "fast" and "loose" places. Having located a "fast" place, you will notice that it shows on both sides of the saw similar to the manner in which a lump shows when the saw is lying flat. Remove the "fast" by use of the round face hammer working on both sides of the blade, and testing often with the short straight edge. Be careful at all times to keep the edges true. Next take out the "loose" with the same hammer until you have the piece of plate flat or "stiff" throughout. Now proceed to open or tension the saw until it shows the required amount of drop from the straight edge, which is usually about 1/16 of an inch in a 10-inch saw. The greatest opening should be in the center of the saw, decreasing gradually to within about 1½ inches from the toothed edge, and about 1 inch from the back edge, varying a little according to the work to be performed. Some run the tension as close to edges as possible.

Be careful to not get the saw too open. To insure the saw traveling on the wheels without any lateral motion, the tension must be perfectly uniform throughout the entire blade. The proper amount of tension varies according to the feed of the mill and the face of the wheel, whether perfectly flat or slightly crowned. But 1/16 to 3/32 of an inch on a saw 10 to 12 inches wide, is the amount generally used. The use of a tension guage, with one edge crowned to the amount of tension desired, is a decided aid in securing uniformity of tension. We furnish these either of a standard character or to order, crowned on any desired circle, and of any length. When testing with tension gauge place the saw on anvil as when hammering, hold the tension guage squarely across the blade at arm's length, and if the saw has been properly adjusted it will conform throughout its length to the crown of the guage. To reduce the tension of saw or stiffen the blade, hammer gently along the back and toothed edges of saw, taking care not to strike nearer than a quarter of an inch from the edge or throat. To increase the tension or "open" the saw hammer gently through the central portions of saw. See cut of Hammer Blows.

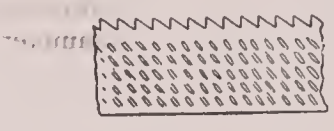
But every well equipped band filing room has a saw stretcher, and having a saw stretcher, the hammers simply prepare for and supplement its work.



Long-faced and cross-faced blows.



Blows to remove the "loose" or the "fast."



Cross-faced "twist" and long-faced "twist" blows.

TWISTS.

The removal of twists or bends in the plate is what taxes the filer's skill. The crossface and twist face hammers are to be used. A critical examination is required to locate the course and extent of twists. Find twists by taking the straight edge and running it across the saw on an angle, first one way then the other. If the lump runs one way and there is light the other way, it is a twist. Remove it by hammering the way the lump runs on the side you find it. Then turn the saw and hammer the same way on that side; mark it before turning over. To find twists the hammering bench must be perfectly level. Hammer both

sides alike. Do not hammer too heavily, for it is easier to go over it several times, than to undo heavy work. Among different causes for the formation of twists may be mentioned the case of a saw running off the wheels or breaking on the wheels; they may also be bent in taking them off or putting them on the wheels; or a twist may be rolled in the saw if the rolls do not tread perfectly or the saw does not run square with the rolls of stretcher. Bent places tend to stiffen the saw at the bend and may require some opening as well as leveling. If the bend is slight it may be removed by bending the saw by hand or by lever pressure, in the opposite direction, and it is well to set the saw through slightly, and then give it a few slight blows to make it straight. Then the bend will not recur at that place. If the saw is very badly bent or sprung, the bend may be heated with a spirit lamp until the saw fries, and then bent back. If your saw, as it lies flat on the floor, shows tendency to twist or lop over it indicates a twist. A little of this may not occasion special trouble, but when your saw twists toward a figure 8, due to a line twist running its entire length, you are in trouble. The line twist deviates but little from a parallel with the edges of saw. The man that masters a line twist is a past master in putting up a saw. In hammering to remove a twist or ridge, you must carefully trace its course and then apply your blows in line with the ridge and not transversely. Hammer down the edges and there will be little to do in the center. Twists are sometimes cross-face in one place and long-face in another place. These are bad, if overlooked, because in running the saw will dodge when they pass the cut. A long-faced twist will run in the log, and a cross-face twist will run out of the log, on a R. H. mill and transversely on a L. H. mill.

TENSION—WHAT IT IS AND HOW TO OBTAIN IT.

Tension in a saw is a preparation of the saw to do a specific work by compensating in advance for certain conditions known to arise during the operation of sawing. During the hardening and tempering processes, according to the thinness of the blade, it runs in various forms of bends and twists; in band saws it often deviates from a true line flatwise, edges still remaining parallel, but having run in a serpentine form. It is the work of the expert sawmaker to correct these inequalities arising during the process of manufacture. The saw is also susceptible to modifications in form arising from its use in the mill, and it is the work of the expert saw filer to currect such inequalities thus arising during use.

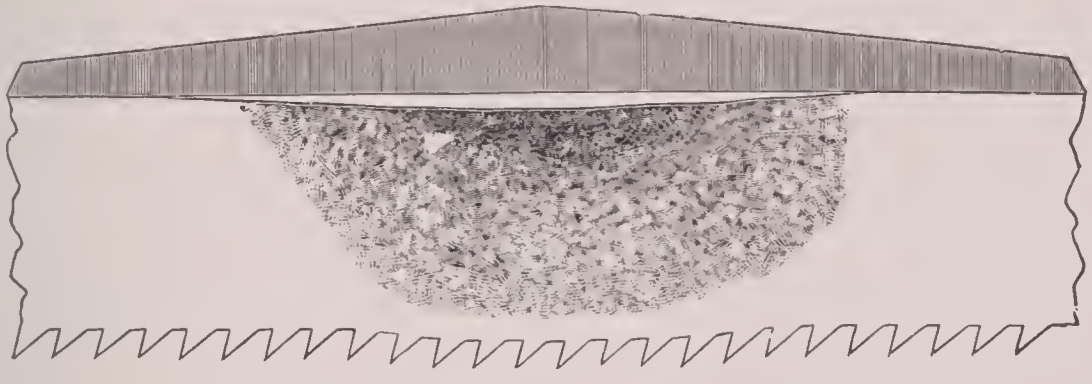
The tensioning of a band saw ought to be more easily understood and reduced to a system than the tensioning of a circular, for the reason that band saws are, for the most part run of an even width, with the same relative tension, whatever the width, while the circular saw varies with different diameters, speeds and conditions of use. In a band saw, by a constant and proper use of the straight edge and tension gauge, the drop may be regulated to a nicety. An able filer, as a result of study and investigation should arrive at a condition for the fitting of his saws.,to suit the particular band mill and the work in hand, that should continue practically uniform. A filer that is able to keep his saws in condition to accomplish uniform and satisfactory results, is entitled to and may expect good remuneration for his effort, while his employer may likewise expect a proper daily average output.

To secure the proper action of the saw teeth, the toothed edge of the saw should be the shortest or firmest. The tendency of the saw while in operation, and as a result of the processes of sharpening and swaging, is toward a "fast" condition, that is, an expansion of the edges longer than the central portions. This tendency must be constantly counteracted by the processes of hammering or rolling for tension, whereby the central portions of the saw are expanded and made longer than the edges, and the back edge made longer than the toothed edge, in various degrees. The weight or strain used on the mill, is calculated to create a frictional contact between the saw blade, which is simply a belt of steel, and the band wheels, sufficient to overcome the resistance of the lumber to the action of the saw in the cut, and this forcing apart of the wheels by the strain on the mill exerts a strain on the saw which is greatest on the toothed edge, because the remainder of the saw has been given more tension or expansion. In the process of sawing there is added to the above longitudinal strain on the saw, a lateral strain, due to the feed of the timber to the saw, and this

feed must be directly proportioned to the excess of strain in the toothed edge over the remainder of saw, or the saw will not cut to a line. The sawyer must so direct the feed that this lateral strain of the saw in the cut *shall not exceed* the longitudinal strain of the cutting edge, or in other words must vary the feed according to the size and clearness of the stock being sawed. It will also be apparent that the prevention of cracks, or the preservation of the life of the saw, must depend very largely upon the avoidance of all unnecessary strains upon the saw whether longitudinal or lateral.

A band saw running on a mechanically straight line is much more efficient than one running on an irresponsible wave line. When the saw is properly tensioned, if you apply a straight edge to the back of saw, longitudinally, the saw shows convex, and if applied to side of saw it will show flat all along the blade. Place the saw upon the mill under the strain, and it becomes a straight belt of steel, with the toothed edge so tight that it is supposed to cut to a line. It doesn't always do so, however, as many a lumber pile testifies.

The exercise of care each day and the close examination of the saw as it comes off the mill, marks the successful filer. The special work each time may be little, but it is the "stitch in time." It means an ultimate saving of time and of saws. Look for the tight spots. Make sure the tooth side is not convex. So doing, the work of fitting is reduced to a minimum unless you strike iron or stone, or have a saw pulled off the wheels.



EXPANDING THE BACK EDGE.

Band saws are bound to stretch on the toothed edge, and when so stretched are likely to crack. In testing the edges lay the saw flat on leveling bench, test the back with straight edge, and if a hollow spot is found, use the round face hammer, or the rolls, along the section thus requiring expansion, having regard to not taking out the tension, which you will do if you work along the edge without going into the body of the saw. If you use a hammer, use it so as to avoid any marks or indentations. Have the back of the saw touch the straight edge throughout, or better still, have the back full or convex. Thus the tooth edge being the shortest edge, when subjected to strain is drawn tight or straight and passes through the cut on a line, whereas, if longer than the back edge, it would tend to wave or kink, thus causing a constant vibration of the blade.

In applying the straight edge, mark only the highest spots, being careful to mark directly on these lumps. A straight edge, in testing tension, should not be rocked or leaned, but applied as nearly square as possible. A north or east light is best, and light should strike saw from but one direction.

The tension in a circular saw is like the tire on a wagon, it holds and steadies the inner portions. It is somewhat similar in the case of a band saw. The reason why the back edge may be slightly longer than the front is that the strain of the weights on mill, and the friction arising from the saw in cut, which is 50% or more, greater on the front edge than on the back, causes heat which expands the blade to a certain degree, and more on front than back. If this difference in length of the two edges is made equal to the expansion of the saw in operation, then the saw will cut to a line and with no tendency to crack. But if you get the back too long, so that the expansion of the toothed edge cannot compensate for this, then the front will crack as it cannot stretch enough. If you could examine the saw in

operation at full speed, you would find little or no tension apparent, because the heat draws the tension and makes an even strain on the full blade. Both filer and sawyer have to do with the preservation of tension. The sawyer should see that the guide is neither too tight nor too loose after each changing. The guide must be in perfect line with the carriage or feed roller. Sometimes a chip falls between the guide and the saw and wedges in so tightly that it cannot be removed until saw is brought to a standstill. Before this can be done, the saw will be in bad condition. The tension is out and it may be cracked or spoiled entirely.

COMPARATIVE ADVANTAGE OF HAMMERS AND STRETCHER.

While the use of hammers is indispensable in the proper leveling and tensioning of band saws, the use of the stretcher for the work for which it is adapted, is very superior to hammer work.

With a good stretcher, rolls properly shaped, you stretch every particle of steel affected uniformly. The roll leaves no marks upon the blade as does the hammer, which may ultimately result in crystalized spots that crack and break, require a braze, and rapidly destroy the life of the saw. Saws tensioned with the hammer are often spotted with places that have never been streched even after the saw has run for months, hence a portion of the steel must be stretched more than necessary, because of the portions not stretched at all. This condition is unlikely to exist if a stretcher is used. The stretcher is a great time saver, for an expert filer can put up a saw in from one-fourth to one-half the time required in hammer work. You can roll any section in a saw from one inch to the entire length. Commonly the filer takes a short place as a section two or three feet long, and rolls that where required. Using the stretcher the final work of leveling is reduced to a minimum. There is little use for the hammer unless the saw is kinked or twisted. But a twist cannot be taken out with the rolls or put in with the rolls, if they are in proper shape. The argument in favor of a stretcher instead of hammer for tensioning is all on the side of a good machine, but all on the side of the hammers, if a poor machine. Millmen should not buy a poor cheap stretcher when for a slightly added cost they can obtain a machine warranted of the highest superiority. The time that some filers spend in hammering their saws might be better spent in working up the points of the teeth into a better condition for cutting. They hammer unnecessarily, and point with pride to their saws, remarking that they keep them well hammered, overlooking the bright spots which shine like silver dollars the entire length of the blade. Before using the hammer, you must know where and how to use it. Then every blow struck counts and serves a purpose. It is not necessarily a mark of industry in a filer that he is continually hammering or fussing with his saws. Really good mechanics never work hard. Too much hammering takes the life out of a band saw. Never make indentations with the hammer which will bruise or crush the steel. It causes crystallization and destroys tensibility. Avoid unnecessary blows. Have a reason for every stroke of hammer and try to place it in the right spot every time. The roller is far superior to hammer work for the uses to which the roll is properly suited. There are many filers that through careful watching of their saws, and proper use of roll, rarely have occasion to use the hammer. Some filers say they have no use for a roll, preferring hammer work. This may be so in some individual cases, but the cause of such condition can be traced either to the fact that the filer is not familiar with a roll, or has used one sometime that was not properly made and ground, and consequently gave results the reverse of beneficial. However this is no disparagement of the principle but simply of the individual defective machine. When through rolling, you should carefully examine saw on leveling board, and give a finishing touch with hammer to any spots that do not show uniformity of tension.

The use of the rolls in tensioning is less likely to dish the saw than the use of the doghead hammer, if the rolls are of even diameter, track and travel together and the saw runs straight through rolls. If one roll is sharper than the other or if the saw is bent as it passes through the rolls, the saw will be apt to dish away from the flattest or broadest faced roll, and a very little dishing becomes objectionable. Too much tension in the saw will also cause the roll

to dish the saw. In machines with the upper roll an idler, if the upper roll does not travel freely, or if the saw is gummed or greasy, the upper roll may stop or slip, which will dish the saw. Hence for large, heavy guage saws, that require immense power to tension them properly, a machine with geared rolls is unquestionably the best.

USE OF A SAW STRETCHER.

The amount of needful pressure of rolls depends upon the degree of the fast or loose places and must be learned by results from actual use of the machine. After a few trials one can learn to properly estimate the pressure required to suit the work.

To remove a "fast" place find its approximate area and shape. Roll the spot, beginning at side next center of saw and apply roll at small intervals. If the "fast" is not removed, go over the surface again, rolling on lines not previously touched. If the roll does not remove the "fast" place readily, examine for a lump which may have been overlooked.

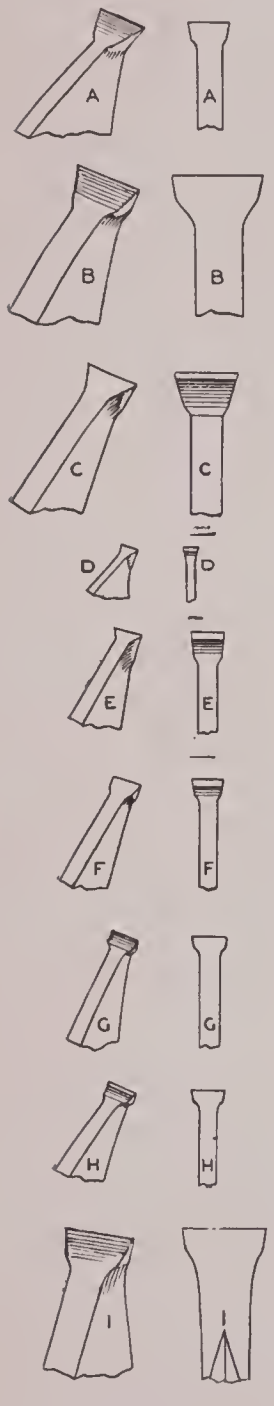
To remove loose places first test the back of saw with long straight edge. If straight or showing proper tension apply roll to both edges of saw about one inch or so from edge, and diminish pressure inward. For a loose spot with back hollowing you will apply roll only to back side of saw. Usually a slight pressure of roll will remove a loose spot. It is essential to have the toothed edge of saw tighter than any other part, and to accomplish this without materially affecting the uniformity of tension, roll the saw a little longer on the back edge. The back of saw should show a slight uniform convexity along its entire length, when tested with the long straight edge. Tilt upper wheel forward enough to make saw have as strong a pressure on wheel at back edge as at front edge. This will leave that part of the saw between the wheels with a tight toothed edge without subjecting it to that undue strain brought about by making tooth edge tightest by an all tilt movement of upper wheel. Hollow places in back of saw are caused by undue expansion of the tooth edge, due to heat from friction or too rapid feed. Apply long straight edge, and if back shows hollowing note the extent of the curvature. Roll the saw slightly over this surface up near to edge and inward toward center, diminishing the pressure inward so as to not change the tension. Having made the back true to straight edge or uniformly convex by tensioning, you can bring both edges parallel by jointing when you fit the saw. If the back is too convex roll near the toothed edge. It is an extremely nice process to determine just how close the tension shall approach to the edges of saw and especially to the edge of teeth. If the saw has too wide a strip on the toothed edge to sustain the tension, dodging is apt to result. If the tension approaches too near to edge of teeth fracture will result. Trouble is often caused by saws shifting on the wheels or running back against the rollers. This may be in the saw or in the wheels. If the saw shifts it is generally too loose on the back. A perfectly flat faced wheel requires less crown of back edge than a crowning wheel. Too much tension may cause a saw to run out or in the log.

The makers of band mills do not crown their wheels to the extent that they did some years ago and are agreed that perfectly flat wheels are the best. Crowned wheels may give excellent results if the saw is properly fitted to them, but the best modern practice favors flat wheels both for output and life of the saws. Apart from practical experience, reflection suggests that the least amount of crown there is in a band wheel, the less tension is necessary, which means less hammering and rolling and less tendency to crack. If the saw when strained and running is not straight across the full blade, but stands convex and concave with the full strain of the machine, it will always run to the concave side. This dodging may also be caused by not properly leveling the blade after tensioning with stretcher, especially if the work of the roll is imperfect. Proper tension allows the blade to lie flat on leveling board. If it does not lie thus, take straight edge and place it squarely across the saw and you can easily locate the high spots and the reason why the saw runs to one side. In some instances during the process of swaging the swage dies or clamps may turn the teeth to one side, or may swage more heavily on one side, and so cause the saw to lead off. Or the sharpener may not grind perfectly square. The emery wheel must stand

directly with the center in a straight line over the saw, or saw tooth will be ground out of square, making one side of tooth longer than the other, and causing the saw to lead to the long side of teeth.

A snaky saw either needs more tension or an equalized tension, as a saw not open enough, or with fast and loose spots, will snake. Also a saw with too long spacings or with teeth too long or too slim, will snake, unless run with extreme tension, which jeopardizes the life of saw, as a saw with too much tension will soon crack.

Whatever causes a heating of the saw in any part or place tends to bring about a dished form, and the longer the condition remains unabated, the more pronounced will the dish become. The Stretcher cannot remove lumps or dished spots. The saw must lie flat on leveling block before the stretcher can perform its work of tensioning properly. If a saw has too much tension, it tends to assume a dished form, and in such case a stretcher, unless properly used to remove the extra tension, would aggravate the trouble. But you must have a certain amount of tension in a saw in order to level it properly, as a saw without tension cannot be leveled.



Illustrations of Band, Gang, Circular and Resaw saw teeth swaged and sidedressed with Rhodes and Bolton Swages and Sidedressers, which will swage and sidedress any desired shape.

FITTING THE SAW TEETH.

Swaging, Spring Set, Sidedressing, Saw Kerf, Hook, Spacing, Gullet, Speeds, Etc.

Essentials in fine band saw fitting are an evenly, squarely set swaging, to afford proper clearance for the timber being sawed, a back taper sidedressing, and teeth perfectly spaced, properly pitched, and uniform in size. Add these essentials to saws well tensioned, and the work of the filer will be above reproach.

The practice of running a full swaged tooth in preference to any form of spring set, on all band saws capable of being swaged, is now so general that there is no occasion to advocate full swaging, unless it be to the very few filers, who either through early education, ignorance or prejudice, still use spring set. But it is evident that a swaged tooth, with each corner cutting, will do nearly twice the work in comparison with a tooth having spring set, which cuts only half of the kerf. If you are running spring set, better remove every other tooth, straighten, swage, sidedress and sharpen the teeth uniformly, and you will find your saws will cut faster, smoother and better in every way, than they previously did. Spring set is easier on the power, as each tooth does but half duty, but the output is accordingly diminished, a result not appreciated by the ordinary mill man. Some few advance the idea that a saw with set cuts cleaner than with swaging, and requires less skill and care in fitting. Neither of these propositions holds true in practice, nor are they advocated except by a few whose early education and experience has been in this one direction and whose judgment is in opposition to that of 99% of all practical filers and mill men. A band resaw, even more than a band saw, requires a swaged and finely fitted tooth, owing to the thinness of the blade and the particularly fine work that is usually desired from resaws, especially on fine woods. All up-to-date people, whether mill men or filers, are fully agreed that the swaged tooth is the only thing, and this may be readily secured with the aid of a good swage suited to the guage of the saws. That there should be any occasion for the above remarks will probably be a surprise to most filers and mill men, who are doubtless unaware that there are any filers in the United States or foreign countries using other than a full swage on bands.

SWAGING.

Swaging is the process whereby the point of tooth is spread out sufficiently to cut a kerf wider than the guage of the blade. It is variously accomplished by the aid of an upset, bar and hammer, or machine swage, hand or automatic, which will either press out or roll out the steel, making the tooth the widest at the point. On a band saw or a band resaw, the upset or swage bar is now never used, unless to touch up a few teeth, requiring a little more spread or a corner brought out, as a result of gravel or iron. A machine swage is indispensable to band or band resaw fitting, owing to the number of teeth to be fitted, ranging in number from 200 to 400 or more, according to length and spacing of saw. The swaging may be accomplished at speed of from 20 to 40 teeth per minute, according to the expertness of operator. The teeth must be sharpened alike, or must be as nearly duplicates as possible, to secure uniform results in swaging. It is obvious that a swage will act more on a blunt than on a slim tooth, and it is the business of the filer to shape the teeth with sufficient stock at point to enable the swage to act properly in throwing out the corners. Swages are made adjustable to act on teeth of all ordinary shapes, whether slim or blunt. The dies operate either by direct pressure upon the tooth, or by a rolling or eccentric draw of die toward the point of tooth. The direct pressure die subjects the fibre of the steel to the less strain, and is easier on hard, brittle saws which are liable to fracture. The dies also operate variously on top or bottom of teeth.

Each style of swaging has its advocates, but the merit of a swage is properly measured only by its efficiency in swaging without tending to fracture the steel, its wearing qualities, its simplicity and convenience of adjustment to varying styles of teeth, and its comparative cost. The severe work of a swage in working tempered steel of various degrees of hardness and sometimes showing a trace of case hardening from effect of emery wheel, and the great number of teeth that it is expected to spread out, requires that the dies shall be of special quality and temper. The steel must be of the very finest and must be tempered by an expert familiar with requirements. The purchaser of a swage should consider evident quality as more important than price, for in saw swages the best is the cheapest, no matter what the price. Filers disagree as to the comparative merit of top or face swaging, but fine results are obtained from each method. All agree that the face of tooth is the cutting side and that the corner of tooth should taper down and back from point, and face swaging tends to make this ideal shaped tooth. But the side dressing of the teeth has much to do with their cutting and clearing qualities, and a tooth swaged on top will, when side dressed, show equally well with face swaging, with the added advantage of a shorter and stronger corner, because the corner extends from front to back of tooth.

As makers of saw swages, both hand and automatic, and swaging either from the back or the face, we are in position to furnish a machine for service precisely in line with the requirements of our customers. In the majority of mills, bands, band resaws and rift gangs are quite generally swaged on the face of the tooth; circulars and gang saws are swaged on top. The comparatively low price, lightness and simplicity of the small eccentric swages, nearly all of which swage on the face, has made such style of swaging popular, the swaging being accomplished by a rolling or eccentric stroke of die on tooth. But it is our belief, as a result of long experience and practical observation, that the top swage with die operating by direct pressure, will make a stronger, better lasting corner, with less strain on the fibre of the steel, than the face swage. The top swage preserves the hook of the tooth, as there is but little grinding to do on face of tooth. The tooth when once swaged out, can be properly side dressed with swage shaper to give perfect clearance. One should swage only sufficiently to clear the saw well in the timber. There should be no friction to cause heating, but a close kerf tends to support the saw and keep it clean. Hardwoods require less set than soft woods. In most southern mills cutting yellow pine a large amount of swage is run, and the effect of this is that if the timber is pitchy the saw is more likely to gum up, while at the same time the saw must be of milder temper to stand the extra amount of swaging.

When cutting woods that will not be stained thereby, it is helpful to run a stream of water on the saw, as this tends to keep the saw and wheels free from gum, dust and pitch. It is also sometimes helpful to reduce the amount of swage, if the saw shows tendency to gum. Hardwoods, such as white maple, etc., are liable to stain, and in such cases the stream of water must be shut off. Pine, ash and maple are some of the woods most liable to gum the saw. In the matter of devices for keeping the wheels clean, the makers of band resaws seem to have looked more particularly to results than the makers of band mills.

There is perhaps no timber where a wider swage is used than in cutting the Pacific coast pine and fir, where 5 or 6 guage saws are commonly run on from ⅜ to a half inch kerf. But run your saws on a minimum kerf. It may require more careful and frequent fitting, but the saving results justify your extra effort. Some band saws cut almost $\frac{3}{16}$ that would run better on ⅛, and band saws are capable of being run on narrower swaging than is customary. You should run your saws to make lumber, not sawdust. Some of the eccentric swages in use either do not give enough swage and so require upsetting, or give too much, making a spread down face of tooth of the same width throughout, so that it tends to scrape and heat and also wear dull at point. The ideal tooth is one with face and point the widest, the corners tapering downward and backward to plate.

If the teeth are close together and there is little room to chamber the dust, top swaging is surely preferable. Swaging on the face with consequent grinding on the face tends to take out the hook which is hard to keep when the teeth are close together. Moreover, the teeth being swaged down the face less in top swaging than when swaged in front, will run with less friction and less tendency to heat. The top swaging will also last longer, as the emery wheel, dressing most on the top of tooth, does not cut away the swaging so rapidly as when grinding mainly on the face. For band saws, if the requirement is for a low priced and an essentially simple tool, the band swage operating on face of tooth, is the one to buy. If the requirement is for an automatic swage operating rapidly by direct pressure on top of tooth, and a machine that is durable and not liable to get out of repair, the Rhodes Automatic Swage is the one to buy. For gang saws the Rhodes Upper Swage has demonstrated its utility and durability by many years of successful service in numerous mills. For band resaws and rift gang saws the Bolton swage suits perfectly. For solid circulars the Rhodes upper or under swages are the best, but if a low priced machine is desired, the Hanchett swage is very satisfactory. For inserted teeth riveted in the plate the Rhodes under swage or the Hanchett swage is the machine to buy.

SIDE DRESSING—USE OF SWAGE SHAPER.

There is only one proper method to sidedress a saw tooth and that is to give the sides of teeth a taper down and back from point for perfect clearance. This may be accomplished imperfectly by use of a file side dresser, and perfectly by use of a swage shaper or pressure sidedresser, which by means of dies properly shaped, that press upon the sides of the swaging, tends to shape or mold the teeth into the desired form to the requisite amount of spread. Such a shaped tooth has the face and point the widest and it so continues as long as the tooth has sufficient spread for clearance. The proper sidedressing of the teeth is an important function in saw fitting. The ordinary side-file is insufficient in its operation for it gives no back taper to the side of tooth. The side of tooth therefore wears rounding, thus creating friction and heat, which not only makes rough lumber but also tends to impair the tension of the saw. Such a tooth is always apt to dodge or crowd to one side, whenever it strikes a hard spot or knot in the wood. For successful work you must always keep the point of tooth as keen and sharp and as much like a needle point as possible. A saw thus fitted will tend to run straight, cut easy and clean, and do good work in the hardest material. The saw tends to go where there is the least resistance, and if you want it to run straight, you must fit it to take that route. The points of the teeth must serve as the guide for the plate and if the blade is properly strained on the wheels, the points will cut to a line, if properly swaged, sharpened and sidedressed. Use a swage shaper.

HOOK IN BAND SAWS.

The more hook the greater the cutting ability of the band saw and the less motive power is required. Too much hook could not be given a saw if the question of cutting is alone considered. What makes the excessive hook detrimental or hazardous to the safety of the machine is the tendency for teeth with extreme hook to feed too rapidly. More hook can be given to the circular than to the band as the circular being round has a tendency to throw or push the stock from it somewhat irrespective of the hook. But the band saw, acting at right angles, has more of a tendency to draw the wood toward it. In the case of a band saw with no hook the action of the teeth would be not so much one of cutting as of scraping or splitting. Hardwoods require less hook than soft woods, and of the soft woods those that are stringy or fibrous require the most hook. Some of the most successful saw filers make no distinction in hook in cutting hard or soft woods, but run the same tooth with apparently equal success. In general practice, however, the hook used on saws for hardwood is from one-fourth to one-third and in rare cases one-half. As regards the efficiency of the saw in different woods, a good deal depends upon having the saw fitted with proper swage and sidedress, kept properly sharp, properly slim and throated, and the feed not too fast. Very thin band saws are run successfully in resawing the hardest woods such as kilndried oak, etc., but the teeth must be finely fitted and the stock properly fed. The action of saw teeth is identical with that of a chisel, and just as a woodworker learns to present his chisel at the right angle to the wood, to cut the best, so must the saw fitter learn at what angle his saw teeth are best calculated to cut as regards hook. There should be no such thing as scraping or tearing, through imperfect hook or dullness. A dull saw takes much more power than a sharp saw, because its operation is not clean cutting.

There is a general tendency on the part of band saw filers to run more hook in their saws. This may be done without impairing the strength of the tooth to the extent that it will chatter or vibrate in the cut, by allowing the hook to run down the face of the tooth about a quarter of an inch and then drop away from the hook line on a gradual curve, forming a nice round throat, which enables a saw to cut easy on big feed. The back of tooth must be made sufficiently full or rounding to give plenty of strength to point of tooth and you must avoid long teeth on short spacings. For a tooth with extreme hook, and for a large round gullet, a spacing of 1¾ or 2 inches is right. This long space enables you to build up the back of tooth properly, because with the greater space between the points, the backs can be kept higher without diminishing the throat room and thus more hook is secured without weakening the teeth. The amount of hook in wide band saws varies from 4 to 6½ inches in a 10-inch saw as commonly run, and is governed somewhat by the timber being sawed and the feed carried. But there are those that want still more hook than that mentioned above and their efforts in this direction have been thwarted in a measure because the construction of sharpeners has rendered it impossible to further tilt the head for extra hook, and still have the machine continue to operate successfully. In deference to this circumstance we have designed our present machines to give a possible hook of 12 inches, in 12 inches of width or 45 degrees, which is true of our 10-inch and 14-inch band sharpeners, and to give 9 inches in 12 inches on our band resaw sharpener. Moreover the construction of the machines renders their operation equally successful when head is thus set, as when set at a less extreme tilt. We can thus meet any demand for extreme hook with our Bolton band saw sharpeners. Given a saw properly tensioned and running true on the wheels when out of the cut, or running idle, but tending to run back on the wheels, as soon as it enters the log, it indicates a need of more hook and you can increase the hook up to the point where the saw runs uniform. In like manner if saw runs ahead on the wheels when in the cut it is an indication of too much hook, and you may properly consider the reduction of same.

STYLE OF THE THROAT.

The styles of the throats run are almost as various as the mills, for there are few mills that run precisely the same. The thickness of the emery wheel, the shape of its face, its

wearing qualities, the spacing of the teeth, etc., all affect to some extent the shape of the throat. The form of the cam that gives shape to the back of the tooth controls the general outline of the tooth, and the filer must look to this mainly if he wishes to change the shape of the back.

It has been customary on all sharpeners to use either a hardwood or cast iron form for shaping the throat. In such case, if you wish to change the outline of the form, you must either reshape the surface of form or put on a new form, which is a job requiring both time and skill. As a most valuable improvement upon forms for shaping the teeth, we have designed and introduced on our Bolton Sharpeners a "Universal Form," so constructed that by use of a wrench on the set screws that bear against the under surface of our form-plate, the filer can in two minutes time vary the outline of the form to produce any shaped tooth he can wish. There is no whittling or filing, or dressing or taking off and putting on of forms, but the desired result follows your effort in an instant. Every filer will see the great convenience and advantage of such a feature, which is found on no machines but ours. For further description of this feature refer to description of Bolton 14-inch Band Sharpener. Reference to the plate of saw teeth will also serve to show some varying outlines that may be produced from this form. There is practically no limit to the possibilities as regards the shapes of teeth it will produce.

SPACING AND LENGTH OF BAND SAW TEETH.

The spacing of band saw teeth as used on bands and band resaws varies from 1 to 2 inches, but the great majority run a spacing of about 1½ to 1¾ inches. There is nothing to recommend a longer spacing than the above, unless it is desired to run a long tooth with extreme hook. In such case a 2-inch spacing may be used with a throat from ¾ to 1 inch deep on a log band saw and from ⅜ to 9/16 on a band resaw, with a large rounded gullet quite similar to that run on a circular saw. Shorter teeth are usually preferred for hardwoods and frozen timber than are used for soft woods or summer sawing. Thus a ½-inch tooth is generally used for hardwoods in winter and 9/16 inch in summer, while teeth for soft woods range from ½ inch to ¾ inch, or longer.

A style of throat that is very popular in many sections, and especially among the cypress manufacturers, is the rather long throat with the base line about horizontal. It is impossible to suggest that any particular style of tooth is best adapted to any particular wood, for the reason that all shapes of teeth are apparently used with success in different woods. Expert users of Band Resaws find that for boxboard work not over 12 inches wide, a spacing of 1⅝ is satisfactory. In work demanding a minimum saw kerf and a moderate speed for saw, as in sawing picture backing, etc., a 2-inch spacing is found good. The same is true of resawing panel stock and hardwoods. Kiln dried hardwood, such as oak, hard maple, etc., tends to dull the saw very rapidly unless the feed is well regulated, and it is well to have the saw stand a fair feed instead of simply allowing it to rub the dust away. Careful feeding of the saw in kiln dried hardwoods will enable the saw to do good work in cutting considerable stock, where feeding without exercise of careful judgment may dull the saw in a few minutes.

THE WIDTH AND GUAGE OF BAND SAWS.

Among the large and progressive lumber manufacturers of the United States there has been a constant effort toward the approximation of the cutting capacity of their band mills to the work of a high-grade circular. In the following out of this plan, the width of the saws has been steadily increased so that now the band saws in common use are from 10 to 12 inches wide, and in some cases 14 inches wide, in place of the narrow 6 to 8-inch saws used a few years since. These wide band saws are commonly 14 or 15 guage. The wide saws are best calculated to stand the strain of very rapid feed, but when compared to 10-inch saws are open to the objection of increased weight and labor in handling, increased cost, and without much longer life unless handled very skillfully. Common experience

demonstrates that the life of a band saw is pretty well gone when worn down from 1½ to 2 inches, if not sooner ruined entirely. Band Resaws as now used range from 17 to 26 guage and from 2 to 9 inches wide. The lighter mills operated in woodworking establishments for resawing, use saws from 3½ to 6 inches wide and from 19 to 22 guage. In the sawmills where the introduction of the band resaws as an adjunct to the log band or circular saw, is becoming very popular, the mills are heavier, and speeded to feed from 80 to 160 feet per minute. Being subjected to hard work, the saws are 15 to 17 guage, and from 5 to 9 inches wide. The possibilities of the Band Resaw as an aid in sawmills are immense, and there is no doubt that every extensive lumber manufacturer will do well to carefully investigate its saving qualities in reduced saw kerf and labor cost and in improved excellence of product.

Band Resaw practice suggests that a ⅜-inch tooth on an 18 guage saw, a 5/16 inch on a 20 guage saw, and ¼-inch tooth on saws still thinner will work successfully. The shape of the throat must be such as to avoid any sharp angle in gullet and must afford as large a chamber as possible for sawdust. The hook carried on resaws is about the same as that used on band saws for log sawing. It will vary somewhat according to the timber, being less on hardwoods and perhaps most on cottonwood, where the hook used is often nearly ⅔. The tendency with all makers of Band Resaw Mills is to increase the strength and capacity of their mills, to use wider saws, and to approximate the work of the resaw in every way to the work of the band mill, and very satisfactory results have already been achieved in this direction. The band saw mill, whether large or small, is the mill of the present and of the future.

THE SPEED OF THE SAW.

Practice teaches that band saw teeth should have longer spacing for high speed than for low speed, and that for hardwoods the speed should be slower than for softwoods. Log band saws are now being run variously at from 7,000 to 12,000 feet per minute. As you increase the speed you decrease the feed per revolution, and as you diminish the speed you increase the feed per revolution. Speed facilitates cutting. But high speed and short spacings make fine dust, which does not pocket so readily in the throats of the teeth. The softer the wood the greater may be the speed without generating heat at points of the teeth. A saw with long spacings and a big gullet will do better on high speed than on low speed, but this is apt to be at the expense of the blade. Eight thousand to 10,000 is considered by most mill-makers and filers to be the best, with a spacing of 1½ to 1¾ for soft wood and 1⅜ or 1½ for hardwoods. In the mills where the saws are speeded above 10,000, it is found that the filers are either exceptionally expert, or the life of the saw is short, the expense for saws is large, and the path taken by the saw filers as they come and go, is well worn. The spacing must not in any case be too short so that the teeth will not properly pocket or carry out the dust. Moreover, it is extremely important to avoid short or long teeth in your saw, as manifestly a saw with teeth of a length, each doing its share of cutting, will do the best work, and in such case a saw perfectly fitted may have a longer spacing than if but part of the teeth cut. Keep your saws jointed.

One of the most extensive users of Band Resaws in the United States, resawing pine, has found 1½-inch spacing, ½ pitch, and tooth ⅜ long, the best specifications for 6-inch saws, and this spacing preferable to 1¾.

BAND RESAW FITTING.

Band Resaws require essentially the same treatment as band saws. They must be strained most near the toothed edge. Teeth must be of a length, with full swaging, evenly balanced or sidedressed, to cut to a line.

Modern band resaw mills are now made with iron wheels, perfectly balanced and true, with the face made approximately flat or slightly convex, so that the tension of the saw may be readily adjusted to suit the face of the wheels. This condition met, it is requisite

that the face of wheel shall be kept perfectly clean, as any adherence of sawdust, gum, pitch or dust, if allowed to accumulate near the base of the tooth will almost certainly change the strain of the saw on the mill to an extent that will cause a fracture.

Filers are agreed that the back of saw should show slightly convex, the amount depending somewhat on the form of the wheels and whether the crossline is used. A convexity of 1/64 of an inch in 5 feet, is considered good for band resaws. The proper tensioning and fitting of resaws is a more delicate process than the similar fitting of band saws, for the resaw is not only much narrower, but also much lighter guage. Thus while the tension of a 12-inch band saw, 14 guage, may be put in so that the main strain comes not nearer than 1½ to 2 inches to the points of the teeth, yet the strain and stiffness of the wide blade serves to support and steady the teeth so that they run practically true. But, in the Band Resaw from 4 to 6 inches wide, and from 18 to 22 guage, you must depend entirely upon the up and down strain supporting the cutting edge, and must therefore tension the saw almost from edge to edge. It is well to make use of a small tension guage, which can be furnished to suit usual conditions, or can be reshaped for special work, if desired.

THE CRACKING OF BAND SAWS.

The reasons for and by natural inference the correction so far as may be of the causes that lead up to cracks or breakage, are subjects that interest sawmakers, sawmill operators and saw filers. It is frequently charged to sawmakers that fractures are generally caused mainly by poor steel, or steel of uneven temper, but the cause generally lies apart from the saw plate.

The steel used in the manufacture of band saws is among the best, toughest and most costly of any used in the woodworking industries. No manufacturer can afford to ruin his reputation by sending out saws of an inferior quality and if a saw does not do good work, it will not be amiss for the filer to first see that he has personally committed no errors of omission or commission in his saw fitting before condemning the blade. A fracture will soon occur in the best made band saw if run with uneven tension. Many saws have already been ruined by uneven tension and doubtless many more will be, as beginners are found in every band saw country, and even the more expert filers may overlook a fast place and find a crack presently as a result. The saw filer must always be observant to see that his saws have uniform tension, proper pitch to prevent crowding back on the wheels, wheels properly aligned, perfectly square or balanced swaging, perfect sidedressing, just the requisite amount of clearance to suit the wood being sawed, rounded gullets, and saws sharp with the points free from glaze or casehardening.

It is evident that band saw steel is tough steel, from the fact that 12-inch band saws, 14 guage, have been tested for tensile strength on a Riehl testing machine, and showed an average tensile strength of 150,000 pounds or over 12,000 pounds per square inch. This being true one may wonder why a band saw with only from two to four tons strain will crack so frequently. This is probably explained by the fact that the strain comes mainly on the toothed edge of the saw, which when run at a speed of 8,000 to 10,000 feet per minute, causes the slack side of the saw to vibrate materially, the amount of vibration varying under a given speed, according to the uniformity of tension of the saw blade, balance and rigidity of mill, and stability of its foundation. This vibration causes a strain that can hardly be estimated. But that it adds a strain is undisputed, and strain is greater with the greater speed for the mill. Vibration being such a factor in the causes for bad results in band saw work, it follows that particular attention should be given to the wheels and their shafts, the journals and boxes; the wheels must be round and in perfect balance and the shafts must run free in their boxes with no lost motion. Sawyers occasionally complain that their saws which have been doing good work and giving satisfaction, commence to crack and finally break. This fact is not so surprising when you consider the immense tensile strain the saw is subject to while running, and the immense number of times in a day that the saw is bent

and straightened in running over the wheels, all of which tend to cause disintegration of the saw and subsequent cracks.

It is usually the case in the mills in which the saws are speeded above 10,000 feet per minute, that the filers are very expert in fitting for such high speeds, or the life of the saw is short and the saw bill large. As between different mills there is wide difference in the saw bill, some expending double the amount that others do for new saws, owing to the frequent breakages. The tensioning of high speed saws must be very fine and even, otherwise cracks and many of them appear, long before the saw is worn down to a point where it is too narrow to stand the strain of the feed. As between different saws there is occasionally found some difference in the quality of the steel, which affects their life, notwithstanding the utmost care on the part of the maker.

It is sometimes observed that new band saws fresh from the factory, if put on the mill and run without examination, show a tendency to crack in numerous places on the back edge. This is probably due to the manufacturer having left a strip along the edge which is subjected to extreme strain under the action of heavy feed. Such saws may usually be made good by shearing off a narrow strip along the edge, retoothing, and then revising the tension. Some millmen and some filers expect that their new saws shall come to the mill in perfect condition to run. Having received new saws they immediately subject them to the most severe tests, and should they fail to meet these tests, the saw is thrown back upon the maker as worthless, and perhaps ruined. This is not just, nor is it fair to suppose that a sawmaker at a distance, unfamiliar with the special individual conditions that are so apt to characterize every mill, can always put up a saw that will be adapted to the work with no re-fitting or re-tensioning. You may suppose that the sawmakers are infallible but it is likely that they would prefer you to give them the benefit of a doubt as to this. It is a well-known fact that sawmakers turn out mainly good saws; that none are exempt from some poor ones; but their efforts deserve fair treatment, to say the least.

In high speed saws it is apt to happen that vibration is increased with speed, distortion of tension is increased by vibration and fracture of saw by both. Besides high speed and the attendant vibration being a cause for fracture, there is an added cause, the constant impact of the saw against the wheels, the constant bending and straightening, the constant tensile and torsional strain of the saw, all working in conjunction with the defects that may exist in the blade itself, either by fitting or innate defects, and it is a wonder that band saws endure so well.

Hence there are those who think that wheels speeded not over 7,000 to 8,000 feet per minute will do more and better work at less relative expense than when run at a higher speed.

There are two things to be considered in the successful operation of a mill: namely, quantity of output and quality of output. And while the quantity of output of one mill may be increased over the output of another mill, by high speed, big feed, and saw teeth shaped especially as regards long spacing, extreme hook, and large gullet to chamber the dust, yet it often happens that the mill with the lesser output manufactures its lumber so much better that it is more profitable to its operator. The mill with a "record" is not the one that has turned out under forced pressure, a large amount of poorly manufactured lumber in one hour, or a ten hours run; but rather the mill that day in and out for the season makes a good record of well-made lumber. A big one day record is a will-o'-the-wisp that beguiles millmen but does not profit them.

If the tension approaches too near the edge of teeth, fracture may result. If a saw has fast and loose spots in it, the tendency to crack is largely increased, the fast spot cracking from undue tensile strain, and the loose spot from constant buckling of surplus metal.

Avoid sharp gullets to the teeth; this concentrates the bend of the saw as it runs over the wheels too much at one point. Use as long a gullet as practicable with no sharp corners or abrupt angles.

Teeth that are too long chatter in the cut and sometimes cause fractures by throwing undue strain on the blade at the root of the teeth. Never let the saw come in contact with

the back guard wheel as case hardening is bound to ensue, from which cracks will surely result. In case saw is forced against the guard wheels and casehardened, remove the glaze at once by holding a piece of soft emery wheel against the back edge while saw is slowly running, or by draw filing.

Another cause of fracture is that the guide pins are sometimes depended on to support the saw. A saw striking or vibrating constantly against the guides is very liable to fracture. If you depend upon perfect saw fitting rather than the guide pins to support the saw you will have less actual labor in caring for saws and few, if any, cracks or breakages. If saw rattles or vibrates when placed upon the wheels in operation you must look to the tension or strain of the saw to correct this or a cracked saw will surely result. The saw may have been tensioned too much in spots. The strain placed upon the wheels is not sufficient to bring the blade true or to straighten out the portions which have been unduly expanded and these lumps strike the guides, crystallize the saw and fractures start in the center of the blade as this is the portion that usually receives the most hammering or rolling. It may seem strange that these cracks occur in the center of the blade where there is apparently the least strain or where saw is most loose, but such is the case. Uneven tension will cause cracks in the center of blade.

ADJUSTMENT AND CONSTRUCTION OF SAW GUIDES.

The guides for supporting the saw blade must be properly fitted and adjusted, and the column carrying the upper guides must stand exactly parallel with the saw blades. While the guides are a necessary adjunct to the mill, yet the saw should run practically independent of the guides. The back guide should never be used except as a measure of safety. If the column carrying the upper guide be not nicely aligned, the saw will come in contact with the upper guide either on wide or narrow lumber, as the case may be. The saw must not vibrate against the guides. Keep the wheels perfectly aligned; the crosshead carefully adjusted to see that it is free to move up and down and thus retain an even strain on the blade; the feed rolls aligned with the saw blade, and the whole machine examined to see that all parts are nicely in balance to avoid all tremble or vibration. Having the above points attended to, if the saw fails to do good work, it will be found that it is not perfectly tensioned or perfectly fitted, and the fault of this is chargeable either to a lack of a good filing room equipment, or to a lack of skill in its use on the part of the filer.

Set the guides so you can see a fair light between them and saw. The closeness of the guides to saw must depend somewhat on the fineness of the tension. If the saw is perfectly leveled, it will run on a narrower opening of guides than if it contains lumps, twists, etc. Guides are variously made of steel, hardened babbitt, wood, etc. Steel or babbitt guides are most commonly used. Wood guides are open to several objections, that if water is used on saw they are not reliable, and they are more liable to heat the saw. If the guides are set too close, the laps in band saw may strike against them and cause a crack to start at this point. It is well to dress lap a trifle thinner than the regular guage of saw.

FEEDING THE SAW.

Feed all the saw will stand and feed uniformly, according to the cut. This is a matter of judgment and education.

The matter of feed is an important item in the successful running and life of the saws. The good sawyer is the one who will get all the lumber out of a log there is in it at a rate of speed up to the capacity of the mill and not strain the machine or saw in so doing. Let the feed get away for only an instant and a fracture is almost sure to result.

There is a limit to all powers of resistance and endurance. The pressure of the feed while expanding and making fast the teeth crowds the openness of the tension to a dished form, causing the saw to come in contact with the side of the kerf, producing heat which, as is natural with steel, draws toward the point of friction, gets more dished and loose, and becomes rigid. The teeth now seek one side. It matters not how perfectly the saw may

have been adjusted in tension or in sharpness, it is powerless to resist under these conditions and is apt to crack on the edges or in the body.

Overfeeding the saw has the tendency to force the saw back on the wheels, to unduly strain it and lengthen the toothed edge, and so cause a vibratory or wavy line, and may have the effect of forcing against the back guide and working considerable injury.

EFFECT OF DULL SAWS.

A normal feed has the same effect upon a dull saw as feeding a well sharpened saw beyond its capacity. Watch springs break and yet the strain on them is comparatively light, being all in one direction, but here is the mainspring of the mill being wound and unwound thousands of times daily. There is a bending and a straightening in two directions a thousand times per minute. Were it not that saws are sometimes run when entirely too dull for good service, there would be no occasion to urge the importance of keeping the saws sharp. There are filers who think it good practice to swage very heavily right up to the limit of ductility of the steel, and then get just as many runs out of the saw as possible. Thus 14 guage saws are sometimes swaged out to 6 guage or an even ¼ inch, but such practice will hardly recommend itself unless the character of the timber requires an exceptionally wide set. Better swage to 9 or 8 guage, swage frequently and lightly each time, and a saw thus swaged and kept sharp will be the most satisfactory in its operation. The advantage of a good automatic power band swage is here suggested. For by its use, frequen swaging is made possible and easy, and the corners can be kept out full and uniform, much better than by less frequent hand swaging.

INSUFFICIENT OR IRREGULAR SET.

While it is desirable for the saving in saw kerf, to run with as little set as possible, yet there must be sufficient clearance to escape the grain or fibre of the wood, which closing at the sides and base of the teeth, produces heat, and this if in undue degree, causes expansion resulting in a wave motion, likely at any time to start small cracks at base of teeth if there are weak or casehardened spots.

RUNNING WITH TOO MUCH SWAGE.

An extreme amount of swaging increases the tensile strain upon the saw. The proper amount of swaging varies according to the timber being sawed; hardwoods requiring the least set, and soft or fibrous woods requiring more. A clearance of 4 to 5 guages is usually considered sufficient by most filers and few make a greater distinction than 1 guage of set as between hard or soft woods. It is a well known fact that many run their saws without distinction upon all classes of stock that approaches the saw, and there are mills that cut a dozen different kinds of wood almost daily, with relatively equal success. The final fitting of circular saws differs greatly in different parts of the country, according to the timber being cut and the class of the logs. Seven guage circulars are most commonly used, running on from ¼ inch to 5/32 inch set. Some of the Southern and Pacific Coast mills run 5 or 6 guage saws, and in the latter section run a set of from ⅜ inch to ½ inch. The saws in use for hardwoods vary from 8 to 11 guage and are run variously on from 3/16 inch to ¼ inch set. Gang saws in common use vary from 11 to 16 guage; log band saws from 14 to 16 guage; rift gang saws from 15 to 18 guage; band resaws from 18 to 26 guage.

RUNNING SAW UNDER TOO HEAVY STRAIN.

The tensile strain should only be enough to prevent slipping of saw on lower wheel, for no amount of strain will make an irregularly tensioned or poorly aligned saw make good lumber, but will instead bring more strain on every part of the mill and cause the saw to crack much sooner. The highest capacity and best mills now rarely exceed a strain of 5,000 pounds. The saw should be slackened after use, which will permit of the free contraction

of the blades on cooling down after work. Some claim that more saws are broken from insufficient strain than overstraining, because in the former case, the saw, by dodging is brought in violent contact with the guides, and is thus crystallized and made ready to crack.

Every filer should endeavor to have a full knowledge of the working conditions of each saw, and should examine each blade carefully as it comes off the wheels, and be careful to see that the mill is in good order, for if it vibrates or the wheels are not true, all efforts to make saws run well will fail. With so many different band mills to select from, most of them with good records, and built properly proportioned and with the metal so distributed in the machine that the saw can be strained up to the proper point without springing or distorting any part and have an ample margin of strength to stand the additional strain put on it by vibration, the buyer of a new mill may confidently expect to get good value in his purchase. It is always well, however, to make sure that the "talking points" are also "running points."

HANGING THE SAW.

Have the upper and lower wheels in line; place saw on wheels with teeth projecting in front of face of wheel; raise upper wheel, hanging proper weight on tension lever; turn the wheels slowly by hand and with the tilt lever train the saw to proper position, with teeth projecting ½-inch to ¾-inch beyond the edge of the wheel. Having saw thus properly adjusted on wheel secure the shaft in this position and do not further adjust it vertically so long as this saw is in use. As the saw becomes dull or tends to crowd back on wheels, you can counteract this by the use of the crossline lever; but a very slight adjustment of this is all that should be attempted or you will cause your saw to run in a twist. The better plan is to take saw off and resharpen or refit it, if it does not stay in place on the wheels.

All practical men are well agreed that the crossline should never be used except for lining the wheels unless in case of accident, the sawyer makes use of it to temporarily hold the saw on mill, as where a sliver or piece of bark lodges in the guides and tends to throw the saw. The use of the crossline puts your saw in a twist, and this is one of the main things to avoid.

BRAZING AND LAP CUTTING.

The lap may be prepared by the use of a Lap Grinder or a Lap Cutter. The preparation of a lap by hand is a method too tedious to be in general use, because it is difficult to file a lap by hand and do such fine, accurate work as is essential, to say nothing of the time and files required. Most important is the expense arising from the results of bad brazing, which is a considerable item where hand work is depended on.

The final result that you wish to secure is a perfect weld that becomes an integral part of the saw. The first essential is that the two joints on opposite sides of the saw shall be beveled to a perfect fit, of exact widths, with ends square, and the bevels true and of even thickness throughout. A lap thus prepared will give an almost invisible joint and the saw will be left smooth and of uniform guage. If the laps do not fit together perfectly no joint or only an imperfect joint will result in the low places. Every filer should give the greatest attention to this matter of uniform bevels.

For crosscutting the saw, a crosscutting shear is desirable, as this makes a perfectly straight, smooth, straight edge cut at one stroke, without buckling or springing the plate. Having the saw cut in two, with ends square and leveled, you will mark the width of lap on opposite sides of the saw with square and scratch awl. A ⅝ inch lap is suitable for either bands or band resaws, although some filers prefer ¾ or ⅞ for wide bands.

USE OF A LAP GRINDER.

If you prepare the lap by grinding you should use an emery wheel sufficiently coarse for the work. We recommend especially for this purpose our lap grinding wheels of 30 to 36 emery. The ordinary saw sharpening wheel of 46 to 60 emery is not suitable, being too fine. In this connection we may say, however, that some filers follow the coarse wheel with

a fine one to finish the surface after most of the steel is cut away, and some depend upon drawfiling to finish. The final grinding should be a light feed. It is necessary that the end of saw shall be level, free from lumps or bunches, and that the clamp which holds the saw on the grinder table shall clamp the saw close to the lap. The emery wheel cuts whatever lies within reach of it and cannot be depended on to press the saw down flat. Consequently, if the saw does not lie flat on the table, the bevels will not result of even thickness, and you will have thin spots that do not weld or weld imperfectly. In drawfiling use a single cut mill bastard file. If you find the lap glazed or hard spots, you may remedy this by laying a red hot iron across the surface until it has cooled, but this should rarely be necessary. Have the ends of the blade as flat as possible before drawfiling. Drawfile to a feather edge, then file the edge sharp and straight. Keep your fingers off the joints. If you drawfile, you should apply the straight edge the way of the bevel and across the saw, to be sure of a smooth, true surface, and a close joint.

USE OF A LAP CUTTER.

As between a Lap Grinder and a Lap Cutter, the latter has some points of advantage. Cutters are less expensive than emery wheels, you save files and you secure laps finely prepared—a long step toward good brazing. The Lap Cutter cuts the laps with mathematical accuracy, making a very smooth, true surface, and the cutter will force the plate firmly down upon the table. If there is any high spot, it follows that the bevels will be of even thickness and an invisible joint will result when finally brazed. In this connection it may be said that neither the cut of an emery wheel nor a cutter will follow the precise line made by scratch awl, owing to occasional variations in the thickness of the plate, although the bevels will be in effect uniform. Our Lap Cutter is a speedy machine, cutting a lap at the rate of about 1½ inches per minute when run at the recommended speed, thus cutting any Band Resaw Lap in five minutes or less, and any band saw lap in ten minutes or less. We recommend the use of good lard oil on the cutter, and plenty of it, as this prolongs the life of the cutter and insures the smoothest surface. Our cutters are of approved style and of the best material and temper and give long service.

THE PREPARATION OF THE BRAZE.

You require a powerful brazing clamp with irons for wide band saws made of 1 x 2 iron and for band resaws of ½ or ¾ x 1½ inch iron; a brazing forge with tuyeres arranged to give the irons a uniform heat their entire length; the very best quality of silver solder ¾ to 1 inch wide; commercially pure Muriatic acid or slacked lime; borax; charcoal.

Every particle of dirt or grease must be removed from the surface of the laps before brazing. This may be accomplished with a sponge dipped in muriatic acid or dilute acetic acid, or by the use of slacked lime, if it is impossible to obtain good acid.

Place the scarfed ends of saw on the Brazing Table with the back edges against the back of brazing clamp or whatever part serves as a straight edge. Have the center of lap directly over the center of irons when in position. Slip the irons in position, one over and one under the saw, and squarely across the surface of lap, and arrange the main brazing clamps so that the saw when clamped will lie in a level position, and so that final pressure can be applied quickly after the hot irons are in position.

Some authorities recommend covering the laps with a thin borax paste to serve as a flux. Such a paste may be prepared by burning some borax in a pan over a slow fire, frequently stirring it to allow all gases to escape, then pulverize as fine as possible. Put it in a glass and pour in enough clean water to make a paste, but not too thick. Apply this well to both laps. Another plan well recommended is to make the borax quite thin with water, heat it boiling hot and apply it in that condition. It thus spreads evenly over the surface and always sticks to the place. Others prefer sprinkling a little of the dry powdered borax over the joint before the hot irons are applied.

Cut a strip of silver solder, best quality, thin and flexible, the same size as lap or a bit

larger, and clean this in the same manner as the laps, being careful to remove every trace of dirt and grease. Place the solder carefully between the laps.

THE FORGE AND HEATING IRONS.

The uniform and proper heating of the irons is very important, and for this use we recommend our special brazing forge, the base of which is 8 x 16 inches, with the tuyure irons so arranged as to uniformily distribute the heat. The irons must be kept clean and free from scale, and the surfaces kept parallel and true. Heat the irons to a bright red in a charcoal, coke or bark fire. Some prefer a more intense—almost a white heat. The heating should be accomplished slowly and evenly, taking care not to burn the irons. When the irons are at the proper heat scrape all the scale from the sides to be applied to saw, and apply them centrally over and under the lap and squarely across, to avoid a twist. Apply pressure on main clamps quickly and then loosen the side clamps to relieve the strain on the body of saw. As the irons cool, tighten the main clamps from time to time. Allow the irons to remain on saw until black. This will leave sufficient temper in the saw to hold the tension when hammered and prevent the portion of the saw just brazed from becoming too hard. Do not remove the irons too soon or attempt to cool the saw with a dash of water, as this may render it brittle. The closer the scarfed ends fit, the surface of irons being true and the pressure of clamp uniform over the surface of the braze, the less solder will remain in the joint, the better it will hold, and the more invisible will it be. The operator who can make a braze that cannot be found without close examination, is a past master in the work. If the saw is a 14 guage, dress the lap to a 15 guage and you will not have any cracked brazes.

BAND SAW SHARPENING.

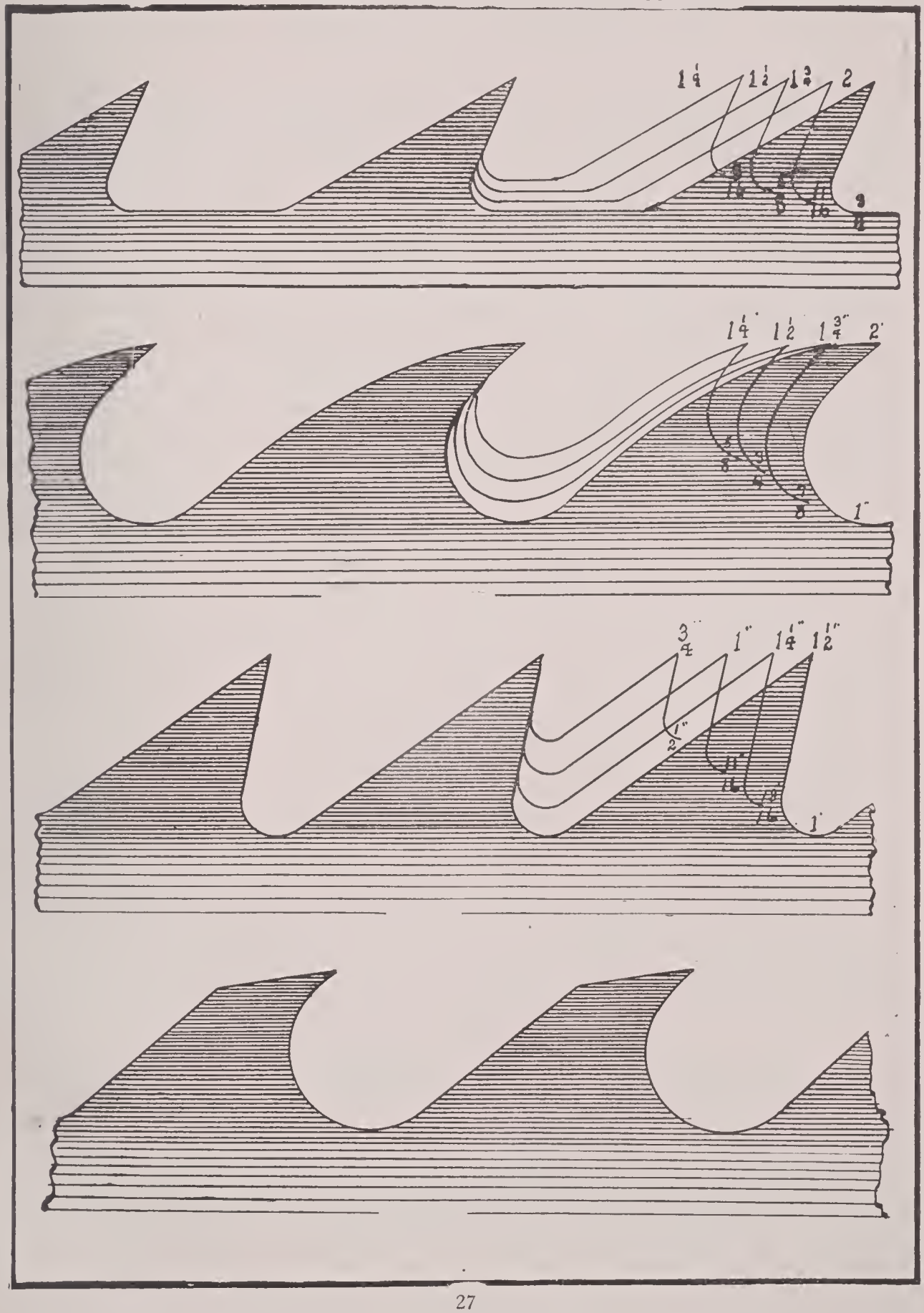
Finely sharpened teeth are essential to the best results in band saw cutting, and the comparitive merits of emery wheels and files, together with the practical details pertaining to the operation of sharpening machines, are good subjects for consideration. An automatic sharpener is an indispensable machine for band saw work, but very much depends upon the construction and adjustments of the machine itself, as to the quality of the work it performs. The rapid introduction of band and band resaw mills has called for the careful exercise of inventive genius, in the perfection of band sharpeners, as well as for the exercise of the best mechanical skill and the use of the best material in their manufacture.

In a band saw sharpener it is essential that the machine be abundantly heavy and very rigid for handling all saws within its capacity, that the feed of the saw shall be positive and uniform, that the inclination and motion of the emery wheel shall be variable to permit of any hook and any shape to the throat, that the boxes and slides shall be provided with efficient oiling devices, and kept free from dust, that the wear of the emery wheel shall be compensated by a faster speed motion, and that means be provided for withdrawing the emery dust from the machine.

The Bolton band sharpeners have been designed with the above named essentials, and others less important, well provided for. These machines are built with a slide head carrying an emery wheel operated by two forms. As the saw is pushed forward by the feed finger, the universal form raises the head to conform with back of tooth, and as the feed finger recedes, the rotating form engages and drops the head gently into the throat, allowing the emery wheel to just reach the bottom of the throat as the saw is again pushed forward. There is no possibility of grinding a depression or of casehardening the saw at base of tooth, as may occur in the operation of sharpeners on which the motion of the emery wheel is controlled by a single form. These sharpeners operate with a slow motion over the back of tooth and a relatively quick motion into the throat, whereby the greatest amount of work can be accomplished in one circuit of the saw.

A sharpener should be bolted firmly to the floor or to a substantial bench support if it is of size for band resaws, that the machine may be free from vibration. The opinion is now

[The cut illustrates some forms of teeth used on bands, gangs and band resaws. The Bolton Sharpeners are readily adapted to produce any varying style of tooth that has been found desirable. The Universal Form for producing any shaped tooth, is a feature of the greatest convenience, possessed by no other machines. The dies for Bolton Retoothers are made any shape, to suit templet submitted, so that any hook or outline of back and gullet, in regular use, will be reproduced on the saw in retoothing. When no templet is submitted, the retoothing dies are made of a standard shape which is well approved.]



general that the best method of carrying the saw to the machine is to support it upon adjustable post brackets, the machine being equipped with a front and back feed finger in preference to the method of supporting the saw on a set of adjustable pulleys, with single feed fingers.

ADJUSTMENT OF SHARPENER.

Keep the sharpener well oiled with good oil, the best for the purpose is the cheapest, but avoid getting any oil on the emery wheel. Adjust the rest for back of saw so that the feed finger will be just enough higher than bottom of throat to allow it to ride on the steel shoe and not on the saw blade. Set up the hardwood clamp tight enough to give it an easy tension on the saw, but still allow it to feed freely. Set the clamping wheel up tight, using the thumb and fingers only, thus preventing the saw from being lifted by the feed finger, especially in the case of teeth with extreme hook. Adjust the feed finger so that it will have enough travel to suit the longest spacing used. It is better that it should not be given more stroke than is sufficient to accommodate the longest spacings. Adjust the positive stop so that it comes up solid but not hard. Its use is simply to compensate for any spring that there may be in the castings. Unhook the lifting device and allow the head to come in contact with its actuating forms. Pull the belt by hand, closely watching the travel of the saw and emery wheel. You can then see what final adjustments are necessary to get the desired results. The rotating form is used to hold the emery wheel up out of the way of the feed finger, on its backward stroke, and to drop the emery wheel gently into the throat. *If a round gullet is desired*, the wheel should be held by this form a little above the bottom of throat until the saw starts forward, causing it to finish its downward travel as the saw is moving forward. *If a gullet such as the wheel naturally makes is desired*, the form should be so adjusted as to just allow the wheel to reach the bottom of the throat, as the saw is moving forward. The intelligent adjustment of this rotating form, with proper regard to its movement as related to the movement of the feed finger, will enable the operator to produce any desirable form of gullet. The *Universal Form*, so-called because its outline can be modified by set screws to a great number of varying shapes, controls the movement of the emery wheel over the back of tooth. This form may be quickly adjusted to give any desired pitch to the back of tooth, and make the line of the back straight or of any convexity desired. It is a decided improvement over the cast iron or wood forms now in use, and is invaluable for those who wish to readily change the outline of the teeth to suit all varying requirements. A form may also be applied to the machines that will produce the so-called Hazard tooth in any outline. It is obvious that as you change the outline of the universal form, you change the shape of the back of tooth accordingly. The length of the bottom of the throat is controlled by raising or lowering the idler which engages with or travels over the surface of the universal form. If this idler be drawn up, the saw will travel further before the form comes in contact with the idler and a longer throat will result; but if the idler be lowered, the contact of the form with idler will occur sooner and a shorter throat will result. In the 14 and 10-inch sharpeners, you should never adjust the main slide to compensate for the wear of the emery wheel, for in so doing you would change the length of the throat; but adjust the auxiliary slide for taking up the wear of wheel.

EMERY WHEELS FOR BAND SAWS.

As regards the proper speed for wheels of ordinary grades for saw sharpening, general practice recommends the following approximate speeds: 14 inch, at 1,300; 12 inch, at 1,500; 10 inch, at 1,800; 8 inch, at 2,400; 6 inch, at 3,000. But a speed, faster for soft wheels and slower for hard wheels, often renders a wheel otherwise condemned, entirely satisfactory.

The Bolton 14 inch sharpener will swing a 14 inch wheel at 3 speeds; the 10 inch machine a 10 inch wheel at 2 speeds; the 7 inch machine an 8 inch wheel at 1 speed, and the number of teeth sharpened per minute is about 32, when the machine is run as recommended.

A wheel of medium hardness is preferable for saw sharpening, since it will cut quicker and heat and glaze less than a hard one, although it will wear out a little sooner. A hard wheel, if run too rapidly, will produce to a greater or less extent, a casehardening which cannot be touched with a file, and from which cracks are likely to result. When the color of the steel goes beyond a blue, under the action of the emery wheel, the steel is red hot and hardens.

There is much in the selection of emery wheels of good grade, and much in keeping the wheel in condition to cut freely without undue feeding to saw. The perfect wheel will cut freely without tendency to glaze or fill up with the minute particles of dust and steel. It holds its shape without frequent dressing. Its finishing cut should leave the tooth unblued and free from bur or roughness. A saw sharpener with motion such that the emery wheel stops long in bottom of throat, is objectionable, as this is exceedingly apt to heat or caseharden the saw at base of the teeth. Then, if the gullet is not well rounded, it offers an opportunity for cracking. An 18 guage saw requires a finer graded wheel than one 14 guage or heavier, that the wheel may grind to a fine edge without blueing the points of teeth or leaving a coarse wire edge. A coarse wheel will not leave a smooth surface to the edge of the teeth, and consequently the saw will not cut so well. If the wheel is too fine for the guage of the saw to be ground, it will glaze and blue the gullet and point with the slightest grinding. A soft wheel is very objectionable, for it will wear away a trifle on each tooth, making it impossible to maintain the desired shape, and as a result the hook will be run out and there will be no uniformity between the teeth on a saw or between the different saws. Having a sharpener equipped with a number of different speeds and perhaps driven by a separate engine, it should be possible to properly speed wheels of fair quality to suit their size and the work.

The use of emery wheels with the face concaved is recommended to those that carry considerable hook in their saws, as wheels thus faced will hold their shape with less requirement for dressing than straight faced wheels. When facing an emery wheel with the dresser avoid undue pressure. If the wheel is allowed to trace the entire surface of the tooth, in grinding, its shape and that of the teeth will be better preserved. The teeth will be ground up to a sharp keen edge, every tooth alike, and the uniform width of the saw maintained. The use of a sharpener simply for face grinding or as a gumming machine, will result in having no two saws with teeth shaped alike. But if you have a sharpener that will not grind to a sharp point, and you are obliged to face with the machine and point the back with the file, see that the saw is kept properly jointed. The less that a file is used on the teeth, the better, unless for lightly pointing off a feather edge, and with a good machine and a good wheel this should be unnecessary. In general the use of an upset should be avoided, as it makes the teeth of uneven length and prevents a uniform grinding. The use of a face swage requires a greater amount of face grinding, and renders the preservation of hook more difficult, than the use of a top swage. If you use a face swage and the logs are gravelly, requiring a frequent swaging, and a consequent large amount of face grinding, you are likely to run the teeth back too fast and make them too slim, with a tendency to dodge or vibrate, and must shape the grinding to avoid this. Always keep a good sized gullet so that the dust will clear easily. The teeth should never be allowed to get short and stubby, or without the proper amount of hook, as they will do less work and take more power, and the saw has a greater tendency to bind and heat, owing to the want of sufficient room in the gullets for the saw dust to escape rapidly. If you have occasion to grind in a deep gullet, a coarse wheel may be employed, to be followed up with a fine grit wheel for finishing and pointing.

In sharpening saws, the pressure of the emery wheel should be light on the work. It is erroneous to suppose that heavy pressure produces rapid cutting; it simply results in the glazing of the wheel and the hardening or burning of the teeth, which will then crumble or fracture in the cut or when swaging. If a saw has been badly fitted and it is necessary to

remove much metal, instead of forcing the wheel as hard as possible to the plate and making it red or blue from the heat, the work should be gone over lightly a number of times.

Having a saw with teeth uniform, you should after swaging, place the saw on sharpener and grind around once to remove any feather edge resulting from swaging, then sidedress with a pressure sidedresser, and then finish sharpening. If any teeth have been bent in swaging or from other cause, straighten them. A saw will cut smoother, stand more feed, and run longer when sidedressed with pressure sidedresser, than by any other method. Constant attention to the matter of keeping the teeth exactly alike and perfectly fitted, is essential to a fine cutting saw.

CONSTRUCTION AND USE OF EMERY WHEELS.

Emery and corundum are the two abrasive substances variously used in making wheels for gumming, sharpening and grinding saws or planer knives. Corundum possesses a much smaller percentage of foreign matter than emery, and is therefore the better cutting agent. Emery is practically the same mineral in a much less pure form, being composed of corundum and the oxide of iron. Corundum is in the arts rated next to the diamond, while emery ranks much lower in the scale. It is found in commercial quantities, mainly in the Carolinas and Georgia, and is a much more expensive commodity than emery, owing mainly to the much greater cost of getting it to the market. Corundum and emery are prepared for use by crushing and then grading them according to the number of meshes there are to the inch in the wire cloth through which they are sifted. Numbers 30 to 36 are commonly used for lap grinding; 36 to 60 for saw sharpening, and it is sometimes found desirable to combine two or more numbers of emery in the same wheel.

The wheels in most common use are made by the vitrified process, by which the wheels, after being properly mixed and molded to form, are subjected to intense heat in a kiln for varying periods of time, according to their make-up and intended use. In the manufacture of such wheels it is necessary to use only the purest and best of corundum or emery, as inferior material will not withstand the high temperature.

The bond by which the particles of the wheel are held together has abrasive properties, so that every particle of the wheel cuts, and there is no waste material to clog or interfere with its work.

These wheels have a porous or open texture, insuring the freest cutting properties, and being necessarily waterproof after being subjected to such intense heat, can be subjected to the action of water, oils and other liquids without injury.

During the process of turning up and preparing the wheels for market, they are tested at a working strain about double that at which they are properly speeded while in use. They are also carefully examined and tested for soundness before being packed and shipped. It would be well if saw filers before placing a wheel upon a machine, would tap it lightly with a hammer to test its soundness, as it is possible for wheels to have a crack started while in transit, if not carefully packed or if roughly handled.

The advantage of a wire web in emery wheels as a measure of safety in case of breakage when running, is admitted by some and disputed by others. Only a small percentage of the wheels in general use are furnished with a wire web, but nearly all makers now furnish web wheels when so ordered.

WEARING QUALITIES.

An emery wheel to be perfectly satisfactory to the user, must be a fast and a free cutter; must be evenly graded and tempered throughout, and must have a reasonable amount of endurance or wear. It is important that the best and sharpest emery, or a mixture of emery with corundum, be used, and that the bond which holds the wheel together has nothing but cutting properties.

The wearing qualities depend directly upon hardness and speed. Wheels that are soft and wear away quickly or fail to hold their shape, may do good work if run faster; wheels that glaze or fill up may do good work if run slower. It is therefore desirable that emery emery grinding machines, especially those used for sharpening saws, should be provided

with two or more speeds if using large wheels, to accommodate to some extent the grade of hardness, and to maintain the rim speed of the wheel as it wears smaller.

It is of great advantage to have the Saw Fitting Machinery driven by a separate Filing Room engine of suitable size, as this enables the saw filer to regulate the speed of his machinery and affords a steady independent power, always constant and ready.

The importance of attention to the proper speed of emery wheels cannot be emphasized too much, for there are mill operators and saw filers regardless of this matter, and the results are a needlessly increased expense for wheels, injurious results to the saws arising from heating or casehardening the points or gullets of teeth, or running the hook out of the teeth, and a tendency to ascribe the bad results to defects in the machine itself rather than to improper selection and use of emery wheels on the part of the operator.

Inasmuch as emery wheels have similar ingredients, are similarly mixed and manufactured, and are carefully tested while being turned and graded, it follows that the main considerations are to select wheels of proper quality and hardness for the work and then to speed them properly. Some wheel are harder on their surface, than further in, and do not cut their best until worn down a little.

It is observed in practice that some wheels last but a few days while others last for weeks or months according to use and adaptatiou thereto; also that marked difference is sometimes found between the different wheels in a given lot, graded alike with respect to their wearing and cutting qualities and their freedom from tendency to glaze or caseharden. This again suggests the necessity for the exercise of extreme care in selection and proper speeding.

Our practical every day experience in the construction, testing, and observation of the operation of emery grinding machines not only in our own works but also in mills and factories, and our sale of wheels adapted to all kinds of requirements, gives us facilities for furnishing wheels well adapted to the various conditions of work. We make it a point to know and meet the wants of mill men, and our extensive emery wheel trade, reaching into nearly every lumbering State and Canada, suggests that we furnish good wheels at satisfactory prices.

In our sale of wheels it is our purpose to give our customers the utmost satisfaction, and if through any misunderstanding of requirements, or improper grading, a shipment of wheels proves unsatisfactory, it will be cheerfully replaced with another lot, as we consider it a matter of mutual advantage to have none but satisfactory wheels in use.

THE PROPER SPEED FOR WHEELS.

A rim speed of about 4,000 to 5,000 feet per minute is recommended by the makers of wheels. This may be increased to 5,500 if necessary but there is nothing to be gained by running it faster than this. It is possible by running a wheel at a high rate of speed to glaze it over so it will not cut, while the same wheel may cut satisfactorily if run at proper speed. Moreover, the strain on the wheel is greatly increased as the speed is increased; thus the strain on wheel at 4,000 feet, rim speed is 48 pounds per square inch; at 5000 feet, rim speed, 75 pounds; at 6,000 feet, rim speed, 108 pounds, etc.

We give below a table of speeds for saw gumming wheels with the suggestion that soft wheels may be run faster, hard wheels slower, and that the speed ought to be increased as the wheel wears smaller.

Diameter of Wheel	Rev. per minute for rim speed of 4,000 ft.	Rev. per minute for rim speed of 5,000 ft.	Rev. per minute for rim speed of 6,000 ft.
6 inch	2,546	3,183	3,820
7 inch	2,183	2,728	3,274
8 inch	1,910	2,387	2,865
10 inch	1,528	1,910	2,292
12 inch	1,273	1,592	1,910
14 inch	1,091	1,364	1,637

EMERY WHEEL DRESSER.

An emery wheel is a cutting tool composed of innumerable sharp grains of emery or corundum, which become dull by use. To sharpen the wheel, these grains must be removed and fresh grains brought to the surface. We offer a dresser for this use that will true up emery wheels while running at full speed. It is durable and as efficient as anything on the market. You should certainly have a tool of some sort for this use.

MISCELLANEOUS SUGGESTIONS ON EMERY WHEELS.

An emery wheel is a circular file; if on some particular work a wheel does not run well, it may often be made satisfactory by changing the speed.

If a wheel fills or glazes, it suggests that it is speeded too high or is too hard for the work.

Start new wheels on the slow speed cone. Endeavor to maintain the rim speed as the wheel wears down, or, in other words, increase the speed of spindle as the diameter of wheel decreases. Keep the wheels perfectly balanced and true by use of emery wheel dresser.

Keep the boxes well oiled and free from dust. Look out for heating and expansion of arbors.

Don't leave your machine running if the bearings are not well oiled, as your arbor may get hot and expand and burst the wheel.

Don't run a machine if the arbor is loose, as it will jump and not do good work, and may break the wheel.

Don't put a wheel on the floor when you take it off the machine; have a shelf to put it on. Take good care of the wheel if you want it to do good work.

Avoid heavy contact of wheels with work, as this causes a wheel to glaze and fill up much more rapidly than a light contact.

Never hack wheels, as they are liable to be broken or cracked so that they will break in use. Wheels should be run toward the operator.

The working strain is as the square of the velocity. If the revolutions be doubled the working strain will be increased four times.

Never crowd a wheel upon an arbor. Don't mount it unless an easy fit. Use good sized concaved flanges. Never mount wheels without flanges.

If wheels show softer toward center, it suggests that it has not been speeded up as it wore down, so that the rim speed has become slower, which causes the wheel to wear away faster and to appear softer.

Have your emery machines equipped with dust pipe and exhauster where possible.

Remember that wheels do no often break from inherent weakness or defects. Most accidents arising in the use of wheels are due to carelessness or ignorance.

Common causes of accidents are: Catching of work between the wheel and the rest; heating and expansion of arbors; using too small or too light flanges, and not having them properly concaved; not using any flanges, but simply screwing on a nut against the wheel; allowing arbors to become loose in the boxes from cutting and wear; running wheels on shaky machines; allowing the emery wheel to descend on the saw tooth, or feed finger to push against the wheel when in the throat.

BURTON ON BAND SAW FITTING.

The following matter has been prepared by Mr. A. J. Burton, Marionville, Pa., who has had a varied experience as a saw fitter in numerous mills, cutting a great variety of woods:

'Suppose there are a lot of new saws in the filing room to commence on. In taking the saws out of the case, be careful not to bend the plate or knock the corners off the teeth. Put saw on the hammering bench and with straight edge held lengthwise of the saw, look it over and if you find any lumps, take the light crossface hammer, say a two pound, and knock down all the lumps all the way around the saw with the long face, being careful not to hit too heavy so as to mar or cut the saw. Be sure to strike directly on the lumps and not to hit a blow except where it needs it. You may as well place the blow a quarter of a mile away as a quarter of an inch away from the lumps. Do not strike too many blows without testing the saw with straight edge. If you do you will drive the saw through and it will require time and labor to get it back. Next put the saw up on the brackets over bench and go over the inside in the same manner. Always commence on the outside of saw and always finish up on the outside or log side. A beginner is liable to do a little too much and if so he will leave the last side worked on, a little dished, and it is much better for the saw to be dished into the log than out of the log, although it should not be dished or turned over at all, but perfectly flat on both sides. After you have gone over the saw in this manner, go over again and apply the straight edge crosswise on the inside of saw. This will show you the ridges or lumps running lengthwise of the saw. Stand in front of the leveling board or anvil and with the crossface of the hammer, knock down any lumps that may be found, using care not to hit too heavy so as to make a dent in the plate. After going over the saw on the inside in this manner, put the saw down, and go over the outside in the same way. If you do this work with care you will have a saw with a straight toothed edge and a flat surface. Now take a drop level or tension guage. Use a No. 5 guage for a 7 or 8 inch saw; a No. 6 for a 9 or 10 inch saw; and a No. 8 for a 12 inch saw. Hold the guage in the right hand and put the left under the saw 2½ or 3 feet from your right hand and with chalk, mark the saw where the drop level or guage shows darkness. Then with the saw stretcher, roll the saw lightly the distance the drop level shows the saw to be stiff, and repeat until the saw conforms to the drop level from one edge to the other. The Bolton Stretcher and Shear is the latest and best up-to-date machine and if proper care is used, will never dish the saw. After thus going over the saw and making it fit the drop level all around, examine the saw on leveling board with straight edge to see if it has been dished at all. If it has, you will have to level it again with the crossface hammer, but if you have a good stretcher it will not dish the saw *unless you use too much pressure. Never allow the saw to pass through the rolls bent up or down*, unless you wish to bend your saw. You now have a saw straight and flat with a good even tension all around it. Next look at the back of saw. Use a back level 5½ feet long, 2 inches wide at each end, and 4 inches wide in the middle, made of 13 or 14 guage saw steel. Have the edge to be used concaved 1/32 inch in the entire length. Mark every place where the level does not fit the saw and roll the saw about 1½ inch from the back edge, from mark to mark, but never longer at one time than the length of the back level. If the back edge of the saw is up to a tight fit to the back level, good, but if not, look at the tension, and if you have opened the saw any, roll next time ½ inch nearer to the edge, but if the saw is stiffer, roll ½ inch nearer the center. By following this method, you can draw the back without altering the tension and with practice you can make a perfect running saw and do all the tensioning with the stretcher. Always look over the saw with drop level after you have put in the "back," to be sure you have no tight or loose spots. If the saw is too loose, roll very lightly along both edges; by so doing you will not change the back. Then equalize the tension with the stretcher and see that the saw is level, flat and straight, with good even tension and a good back. The saw is now ready to put on the

sharpener. If you follow these instructions you will have a saw that will stay on the wheels without oscillating, and that will stand heavy feed.

Before putting saw on a new or unknown mill you should examine the mill and see that the boxes are all right and that there is no lost motion. Line the face of lower wheel parallel with the V track and line top wheel with lower wheel. Put on the saw and tilt upper wheel until the saw runs ¾ of an inch off the top wheel. Be sure to do this with the tilt device. Do not use the crossline as it throws the saw in a twist so that it will rub against one guide more than the other, and probably cause it to crystallize and crack, besides causing undue wear on the face of wheels.

Always have the tension even, whatever the drop or amount of tension used may be. Do not open the saw too near the front edge as it may crack in the gullet. Do not leave the front edge too stiff or firm as the saw will snake in a hard log and go back on the wheels. Some filers leave their saws tight for 1½ inches from the toothed edge, in order to avoid cracks, but I do not think this is the best way. If a saw shows tendency to crack in front with the tension I have been using, I change the tension to a larger circle, which gives a little less tension, but I let the tension run from one edge to the other, on a perfect circle, except that I leave a ½ inch strip on the toothed edge, so that the level will show dark for ½ inch and then light from there to the back edge. For hardwood and heavy feeds, a saw requires more tension than for soft woods and light feed. Be sure to have the saw straight edgewise, for it will stand ⅓ more feed. For example, you cannot drive a bent nail in hard wood, but straighten it and you can easily drive it. The band saw is similar and with the edges straight, will cut better with less liability to dodge. Always run a little back or convexity in the back edge of saw, about 1/32 in 5 or 6 feet, and if the saw is properly put up, it will run without oscillation and present a true cutting edge, and not drive back in cut. If the wheels are crowning, open the saw a little more where it rests on the wheels.

Examine the saw as it comes off the mill and if any tight or loose spots, or any long or crossface lumps appear, take them out. By going over the saws frequently you haven't so much work to do at any one time, and you have better cutting saws with less tendency to crack.

In this manner a saw should run from six to nine months without cracks, and if cracks occur they are probably due to faults of the filer. Some times our best sawmakers make a saw that may either crack or have a tendency for the teeth to split, or that cannot be tensioned to run without making snaky lumber. In such case, as the character of the saw can usually be promptly discovered, its condition should be immediately reported to the maker. Saw makers should not be expected to send out saws to be used from three to six months and then condemned. If defects existing in saws when new from the factory are not promptly reported, the fault lies with the filer.

Don't try to lead the saw with the guides. Don't set the guides too tight. They should be set true to saw with a clearance of about the thickness of writing paper on each side. If the saw does not then run straight, it must be dished or swaged too heavy on one side, or the grinder does not grind squarely, or the track is not in line with saw, or the wheels are not in line, or the face of wheels are not flat in proper shape, or the tension is uneven in the saw. Look carefully to the fitting and tensioning of your saws at all times, but see that the mill is always in good order.

The best mills and the best sawyers meet with accidents and saws get pulled off and twisted or bent, which makes extra work for the filer, but it must be put up with. In such a case, go to work, but take it easy, and have some one help you. Take a block 8 or 10 inches deep, and with a lever or pike about 3 x 4 used as a pry, bend the saw back to place. Always apply the lever across the saw the way the bend runs. That is, if the bend is square across the saw, use the lever the same way, but if it runs at an angle from one edge to the other, this makes a twist, and you must set the block so as to press with lever directly on the ridge or twist, and in this way you can bend it back nearly as well as ever. After this, a little work with the crossface hammer, placing all blows with the long way of blow par-

allel with the lump or twist, will remove it. Never attempt to level a saw that has no tension in it, but go over it with the Stretcher and put in some tension, and you can then level your saw perfectly.

THE LIFE OF BAND SAWS.

The length of time a band saw will run is uncertain and depends much on the care in handling. If the saw is made from good steel well tempered, it will ordinarily last a long time. All sawmakers endeavor to furnish good saws, but the best of them miss it occasionally, and in such case if a saw proves defective, you should report it promptly.

If a saw is all right on receipt from the shop, and if the filer looks it over carefully, putting it in proper shape before running it on the mill, and if he looks it over every second or third time it comes off the wheels and keeps it all the time in proper shape, it will run until worn out, without a crack, and cut at the rate of 50 M per day, if it does not get pulled off the wheels or meet with an accident.

Four saws on a single band mill should run eight or nine months of the year for two years and cut twenty million feet, and if 10 inch when new, should still be 8 or 8½ inches wide. But, if accidents happen, they will not run so long. I have run four saws for five months, cutting from 50 to 55 M per day in hemlock and oak, and they haven't a crack or a blemish, except the loss of two teeth in one, which were knocked out by a stone, and they were worn down only ¼ inch. But saws cutting logs containing iron or stones, or getting pulled off and illused in the filing room, or by reckless sawyer, will last and do good work only in proportion to the care and handling they receive. Keep the tension even; the saw flat and straight lengthwise; the crown in back even; use the right amount of swage; do not allow casehardening from any cause; see that the lap is always straight; do not run too long or too slim teeth; see that the mill is in line with track and the wheels in line with each other, and success will follow.

USE OF HAMMERS.

The crossface hammer should be used only to take out long and crossfaced twists, lumps or ridges. Always place the blows on lumps or twists in the direction in which they run. Do not use the crossface hammer for tensioning. Do not hit too heavy blows and always keep the face of hammer smooth so as not to cut or mar the saw. For tensioning use a 2½ pound dog head hammer with the face as sharp as possible, but not too sharp. I get the best results from a doghead hammer, by using a wood roller, 2 inch diameter by 16 inches long, set in two pieces of 2 x 8, 10 inches long, so that it will roll and not get out of place. Place this under the saw and it will keep the saw up, so that you can find the bend or drop, and you can thus always test it the same. With the tension guage examine for stiff or loose places. Place the blows on saw where guage shows darkness till saw conforms to the guage all the way around the saw on both sides alike. If too much light shows under guage, place a few light blows on each edge, ¼ inch from the edge, and then likely there will be a little lump or a stiff place; but a few light blows will equalize it and this will prevent the saw from cracking. If a loose spot shows under one half of the guage and a tight spot under the other half, do not attempt to take out the loose first or you throw the back of saw out or in; but take out the stiff first and quite likely the loose will run into the stiff with a few light blows and be all right. If it should not do so and still continues loose, three or four blows on each side will take out the loose and not affect the back. Go over the saw in this way until the tension shows equal on both sides. Always hammer from center to edge instead of from edge to center. Do not hit a blow except where it is needed or you will make extra work on the other side of saw; but if care is taken there will be very little if any work to do on the other side. Do not use hammers too heavy for band saws. I have used all makes of hammers but consider the hammers made by Baldwin, Tuthill & Bolton to be the neatest and best. Do not use the doghead hammer on the leveling board but on anvil only. Do not place too many blows on one spot, but scatter them. This equalizes the tension more evenly and is not so liable to drive the saw through. It is a good idea to have a three pound

crossface hammer to use if the saw gets pulled off and badly bent, for the face will be larger than that of the small hammer and not so liable to fill the saw with small lumps in taking out twists, as may result if a small hammer be used. *Always use the small crossface hammer for finishing up.* Do not allow your hammers to be used on anything but saws. Take pains to detect every little lump that may show under guage, if you tension with a doghead hammer. By removing all such lumps, making the saw perfect under the guage, it will require little or no leveling, for if the tension is alike on both sides, the saw will be flat also.

CAUSES OF CRACKING.

1. Too much tension and tension too near the front edge. 2. Tension uneven with tight and loose spots which cause the saw to buckle through and crack. 3. Too hard hammer blows on the extreme edges. 4. Feeding beyond the tensibility of the saw, but this is not a direct cause. 5. Casehardening the gullet while sharpening. 6. Dished saws, or a saw that runs in or out of the log will cause it to crystalize on guide and crack. The cracking of a saw in the center is caused by using too much tension or from a lumpy, uneven condition of the plate. I have taken a saw that had 52 cracks in the center from ½ to 2½ inches long, and have stopped the cracking and by leveling and equalizing the tension, been able to run it. If a saw is hammered with care it will not crack in the center. Cracks in the back are caused by the saw running back on the wheels and becoming casehardened on the back guide, or from too much tension in the back part of saw. Saws that have been pulled off the wheels and badly bent are liable to crack. A saw is more likely to crack on the toothed edge. If it cracks in the back or center there is little excuse for the filer.

NUMBER OF POUNDS STRAIN FOR SAWS.

It is just as essential to have the right strain on the mill as it is to have the right speed. Some mills will run with less strain than others and such are the mills for me every time. We used to think that a 10-inch saw could not be run with less than 10,000 pounds strain, but I use only 3,000 pounds on my saws, and an 8-inch saw will do good work with 2,500 pounds, and a 12-inch saw with 3,700 to 4,000 pounds, although this depends somewhat on the number of the teeth and the swaging, etc. Do not use any more strain than will keep the saw from slipping on the lower wheel. This will be governed by the size of the logs to be cut. If you have too much strain, the saw will tend to crack on the edges much more, and the saws will snake for the strain will take the life of the tension out of the saw and it will make an imperfect cut for about three feet from the front end of the log. Too high speed will have the same effect. I experimented on strain in a 22-inch hemlock log, by reducing the weight until the saw stopped dead, but both wheels continuing to run as usual. The 10-inch saw stuck with a strain of 2,500 pounds. I added 500 pounds, making 3,000, and the saws ran well all summer without tendency to go back on the wheels, or to crack.

SHEARING AND RETOOTHING BAND SAWS.

If you have a saw with a number of cracks on the front edge, do not cut the saw and braze it, unless a long crack appears. Shear off the teeth or enough of the plate so that the retoothing will take out the most of the cracks, and it does not matter if the new set of teeth does not remove all the cracks, as any remaining can be punched at extreme depth of crack on each side of saw, or checked with drill. A combined Retoother and Shear is the best to use, unless you have a shear on your Stretcher or one of the combination machines that will cut lengthwise or crosswise, making a much longer cut than the ordinary retoothing shear. The dies should have a good deal of shear in order to cut easily. Keep the punch and die sharp and oil when using. I can shear a 44-foot saw with 1½-inch teeth in twelve minutes, and retooth it in thirty minutes, and when retoothed the saw will run and cut much better than one with a number of brazes in it.

In retoothing a saw always have the spacer work on the tooth to be cut; then the teeth will be evenly spaced. If the spacer works on the second or third tooth from the one you are cutting, the first tooth will be all right, but the next tooth will be a little less or more, and so the spacing will be irregular.

When tensioning and you come to a crack, tension the balance of the saw as if only that width, and if proper care is taken a crack can be checked when from 1 to 1½ inch deep so that it will wear out in time. Do not have the saw too loose at the crack. Do not be afraid of saw with center cracks if they are not over two inches long. They were caused by cross lumps or too much tension and if punched, leveled and properly tensioned, will not extend further.

Do not have a saw too loose or it will crack from vibration. Do not have it too tight or it will crack from undue strain.

THE SHAPE FOR TEETH.

The teeth should have throat room enough to receive and discharge all the dust with ease; if not, the saw will throw dust up with its return motion, and will be likely to snake and crack. In any wood, saws from 7 to 12 inches wide, and from 14 to 17 guage, should have the spacing 1½ or 1¾ inch, and the tooth ⅝ of an inch deep, with a ⅝ or ¾ inch circle on face of gullet, so that the dust will curve around easily and discharge as soon as it gets below the cut. The *hook* should be governed by the *pitch* of the back of tooth. I apply the word *hook* to the face of tooth, and the word *pitch* to the back of tooth. Now the more you raise the back of tooth so as to make it point straight down the wood, the greater pitch you have and the easier the saw will cut and the more hook you can carry. But if the back of tooth is low, you cannot carry much hook, for if you do the teeth will be too slim and will

[The cut illustrates the shapes of teeth I find to give the best results. (1) is the easiest and fastest cutting tooth I have ever used on a band saw. It has 8¾ inches hook at cutting point, on a 10-inch saw. With straight edge resting on points of teeth the line of back strikes 3/16 of an inch below the point of the next tooth. I use (2) daily in soft woods; (3) in hemlock and oak. (4) is a good tooth for hardwoods or knotty logs as it is thick on the point. (5) with longer spacing is a good tooth for white oak or other hardwoods. (6) is a good tooth for almost any kind of wood and is easily made. (7) has a different curve in gullet and is a good tooth for hemlock. (8) is slimmer and is a good tooth for soft pine.]

vibrate, causing the saw to snake in the cut. In such a case, in order to make the saw cut straight, don't diminish the hook, but raise the back, thus making the tooth stiffer, and it will not only stop the teeth from vibrating, but will also make the saw cut much easier and faster. If the back of tooth is low, do not use over four inches hook in a ten inch saw; but if the back is up so that it is nearly pointing down the cut, then use six or seven inches hook in fast feed, but use large throat.

Don't use over 8 guage swaging in a 14 guage saw in soft woods and not over 9 guage swaging in hardwood or frozen timber and not over 9 guage swaging in a 16 guage saw in soft wood and not over 11 or 10 guage in hardwoods.

A saw will not crack if the tension is even throughout the entire plate, but if put up with tight and loose spots, vibration will occur, which is ruinous to the life and operation of the saw.

THE SPEED OF BAND SAWS.

As a result of my ten years experience with band saws for log sawing, having fitted saws to cut almost all kinds of lumber that is in use or grows in Canada, the United States, Central and South America, I would recommend that saws run 10,000 feet per minute in white pine, fir, spruce, poplar, cucumber, chestnut, limewood or basswood, white wood or tulip, or other soft woods; 9,000 feet per minute in cherry, red oak, beech, birch, hemlock, North Carolina pine, yellow pine, red pine, cypress, or other similar woods; 8,000 feet per minute in maple, white oak, gum, horn beam or ironwood, ash, South American mahogany, boxwood, red cedar, satin wood, amaranth, sycamore, black walnut, North Carolina red birch, Hungarian ash, elm, and all similar hardwoods, but use a short tooth, with space 1¼ inch and not much hook; 6,000 feet per minute in rosewood, lignum vitae, Cuban mahogany, etc.

THE PROPER LOCATION OF THE FILING ROOM.

The most convenient and suitable place for a filing room is to have it detached from the mill and on a level with the mill floor, because if detached from the main frame, it will not be subject to the vibration of mill and the jar of the nigger, bullwheel, etc. A sharpener, power swage or lap grinder ought to be free from all vibration if you wish to obtain the best results. A sharpener cannot be expected to sharpen a saw to a keen, sharp edge, making all the teeth alike, if the floor on which the machine sits is vibrating and subject to the jar of the logs and the nigger. Too much attention cannot be paid to this point. For a single band mill the filing room ought to be on the carriage side of the mill detached from the mill. For a double band, it is best to have the filing room overhead, provided the mill is built strong enough to be free from vibration, and the room is sufficiently large, well lighted and cool. It is a mistake to make a filing room too small, for the machines will then be crowded and there will not be room for the filer to lay out his work. Always make the room about two to four feet longer than the length of the saws you will use, and not less than twenty-six feet wide, so that the stretcher and leveling bench can be put up crosswise of the room. Have the bench erected so that you look to the light as you work, and have it dark at your other hand and at your back.

The filing room should contain a sharpener, stretcher and shear, leveling table, 12 x 16 anvil, automatic swage, hand swage, pressure side dresser, retoother, shear, lap grinder, filing clamp, 6 x 10 engine to drive the machinery, blower forge, straight edges and tension levels. Without such an outfit, the filer cannot work to the best advantage.

BAND SAW BRAZING AND THE FITTING OF LAPS.

Make the lap ⅝-inch, using a machine as you can make a better job than with file, and much quicker. I have ground both laps on a 10-inch, 14-guage saw, in 11 minutes, with a Bolton Lap Grinder. After grinding the laps, place the saw in brazing clamp, and if you run "back" in the saw, push the saw along and set the back guides up so that when the braze is made, the back will be the same along the lap as it is in the rest of the saw. Attention to this will save time and labor in drawing out the back. Clean the lap with a clean

pine stick dipped in C. P. Muriatic acid. Use the purest acid to be had. The silver solder should be a little wider than the lap and should also be cleaned with acid. Do not use silver solder too thin as it will not flux as well as it would. 3/1000 of an inch is the best thickness, such as is furnished by Baldwin, Tuthill & Bolton. With this solder I can make a perfect braze so that when it is dressed there will only be a small streak across the saw about the size of a silk thread, and my brazes always hold well and are about as hard or stiff as any other part of the saw and will not bend when going around the saw sharpener as is so common with shop brazes. A braze that bends easily is sure to break about one inch from the lap, and you will not know the reason it gave way; but if you were to consider the number of times it has been bent and straightened, you would see that this continuous bending causes crystallization in the saw at the place where the extreme edges of the irons were applied.

You cannot make a good braze with irons too heavy for they don't clamp evenly, hold the heat too long, burn the steel and burn the life out of the solder, and frequently the braze will open up before the saw is in condition to go on the mill. Irons 1½ or 1¾ x ¾ thick are the best. Steel makes a better material for brazing irons than iron, for steel does not scale like iron and takes the heat more evenly. But if cast iron can be had it is better still. The irons should be heated slowly in a charcoal fire, as this is not so apt to burn the irons and cause them to scale, as soft coal. One of the forges designed especially for band saw brazing should be used, for it is almost fire proof and it has a long blast so that the irons can be heated their entire length without burning them. Heat the irons to a good light red, not a white heat, or the irons will scale and be smaller in some places than others, and the braze will miss. A common cherry red will not do but a light cherry red is O. K. Clean all the scale off the irons after they are hot, by scraping them across the edge of the forge. When the irons are ready, drop or pour acid on the lap until it is wet, then put on the irons square across, and clamp. Take the irons off as soon as they turn to a dark red or about the time the red turns blue. Then remove the saw from the clamp and fan it with a shingle or paper for a minute and you will see the saw taking temper again and it will not twist and curl up as it will if the irons are left until cold, as the sawmakers advise. Leaving the irons on until cold makes a soft lap.

After the braze is cold, pour on a little lard oil and rub lengthwise of the saw with a piece of No. 1 emery cloth, not sand paper, until all the black and rust are off. Clean off with a file all lumps or surplus solder that may run out, but do not file the laps. Then roll the braze, commencing in the center of saw and rolling toward both edges. Do not roll the saw except on the surface of braze where the irons were applied. Roll every half inch until you reach both edges. Then roll in the center until the saw becomes stiff for the saw is fast after being brazed. Then level with crossface hammer. Then clamp the saw lightly between the rolls, and put a block eight inches deep, under the braze, on levelling table, and put a weight on the other end of saw. Hold this down and the saw will bend over the block and be easy to dress. Use a 10 or 12-inch file, and file lengthwise of the saw and you will not leave any mark or scratch as you will if you file crosswise of the saw, and a deep scratch will cause a crack in the saw at the spot in a short time. Do not leave the lap too thick or lumpy or dress it too thin, for if you do it will not last. If you take pains to make a good braze and dress and roll it properly, it will last as long as the saw. After the lap is dressed and levelled, roll in the tension as in the rest of the saw and make the back true.

CLEANING BAND WHEELS.

Sometimes the box or pit is not made deep enough to permit a perfect escape of all saw dust, and if not the lower wheel will cause a suction in the dust box and the dust will be carried in under the saw and affect the running of the saw on the wheel. Have the dust box plenty large enough and place the dust conveyor directly under the dust as it falls from the saw when it leaves the teeth, and the trouble will be largely avoided. A little spray of water run on the saw will prevent friction on guides and in the cut, keep the saw cool and assist in keeping it clean.

The stream of water should strike the saw above the top guide, but too much water will tend to cause the saw to vibrate. A little live steam used on the upward motion of the lower wheel is a good thing for winter sawing, for it takes the frost out of the wheels and prevents the gum and dust from collecting. Some use a scraper bolted hard up to the lower wheel, but this is objectionable as the scraper tends to wear the wheel, and if the wheel is worn unevenly the dust and gum will stick all the more. The best way is to place the steel scraper close to the wheel within about 1/64th of an inch, and wear will then be avoided. Fasten a stiff hemp brush against the wheel, pressed on with a spring. This will not wear the wheels and will brush off any little bits of wood or bark that pass under the steel scraper.

HOW TO LINE BAND WHEELS WITH TRACK. ADJUSTMENT OF GUIDES.

It is taken for granted that the track is straight and level, that the edges of wheels are turned true and the lower wheel shaft perfectly level. Draw a line parallel with the track from one end to the other, Then draw a line across the track above the floor in front of band wheels and square this with the first line. Then from sticks or supports above the upper wheel, let fall two plumb lines at opposite edges of front side of upper wheel, and let these plumb lines fall directly to or at equal distances from the line already stretched across the track. Then by moving one or both ends of lower wheel shaft, square the wheel shaft with the line across the track by having the opposite edges of band wheel at exactly the same distance from the two plumb lines. Then let the cross line swing across until square with track. Adjust the top wheel in similar manner. It is better to have a band saw trained a little in rather than out of the log, but it is best to have it perfectly parallel with the track. Having the wheels properly lined, do not move the cross line again, not even to adjust the saw, but put the saw on the mill, run it slowly, and adjust with the tilt until the saw runs from 3/4 to 7/8 of an inch off the front edge of wheels.

If you hammer your saws alike, you will not have to move the tilt again for the season's sawing unless the saw gets hot or meets with an accident for the saws will all run in the same place if put up alike. Adjust guide carefully. Slack off all four guides from saw. Next set the lower log side guide up to saw, put in a sheet of writing paper between guide and saw, and then screw up guide until the paper will not fall out, but not so hard as to move the saw out of line. Then fasten the guide firmly. Then put in another piece of paper between saw and the board side guide and push the guide hard up and fasten firmly, and if right the paper will pull out tight and will leave a perfectly guided saw without too much or too little clearance. Set the top guide the same way, but be careful not to move the saw out of line when setting the guides. If a band saw is hammered and fitted right and the mill and guides are properly lined, the saw will stand a good feed and cut straight lumber.

SAW FITTING IN WOOD WORKING ESTABLISHMENTS.

Comparing saw practice in large sawmills with that in small sawmills and woodworking plants, it is noticeable that there is a radical difference in the character of the fitting and the equipment for the work. For while the up-to-date sawmill operator recognizes that a good filer and a good filing room equipment are alike desirable, the small mill man and factory operator is less disposed to be critical or exacting in these respects. But saw fitting as a fine mechanical employment, is relatively just as desirable and advantageous to the operator of small saws, as to the lumber manufacturer, and perhaps more so, because the small saws have to do with the preparation of the finished product. It is a well demonstrated fact that every mill or factory, whether devoted to the manufacture of lumber, shingles, staves, heading, veneers, etc., or to the production of boxes, furniture, sash, doors and blinds, or to general planing, turning and wood finishing connected with any line of manufacture, will find the use of finely fitted saws a prime essential in successful work.

Spring set and hand filing have no more place in a factory than in a sawmill, except on such saws as are used for crosscutting, or which, from the fine character of the teeth, cannot be swaged successfully. A *full swaged tooth* is the only tooth to run on any kind of a rip saw. A saw well rounded, with teeth swaged and properly sidedressed, and with proper pitch and clearance for the dust, is a combination unsurpassed.

Edgers, bolters, lath and shingle saws, barrel, stave and veneer saws, solid and segment rip and resaws, run with a swaged tooth, will do more and better work, than if fitted by hand with spring set. It may be claimed that the hand filing and setting are simpler and require less skill on the part of the filer, than the use of an emery sharpening machine and a saw swage, and this is measurably true; but no one will argue that there is a profit in crude, inferior saw fitting or that the factory saw filers are not disposed to progress and improve the character of their work. If a higher grade of work is demanded there will be found plenty of men to meet the advanced requirements and any man of fair ability can do so, if given proper tools to work with. A few factory operators have considered that any kind of a roustabout could fit their saws well enough, and have considered a cheap man and a bastard file to be a complete filing room outfit. Some have furnished an upset and swaging hammer, a bench grinder and a piece of T rail for an anvil. And some, still more progressive and quick to see the advantage arising from the use of finely fitted saws, have furnished rooms of proper size, well lighted and equipped with sharpener, swage, hammering outfit, knife grinder, and other tools adapted to the various requirements.

A good saw fitting equipment, well suited to general woodworking plants, may be obtained for a small outlay, and it will save its cost several times a year over inferior tools, or an absence of tools.

FACTORY SAWS.

The use of an upset swage or bar and hammer on small circular saws can never be so satisfactory or efficient as the use of a machine swage, for the reason that the hand tools do not maintain the uniform length or shape of the teeth, and on saws hard or brittle are more liable to cause a fracture of the tooth or a crumbling of the corners. The use of the upset shortens the tooth, gets the saw out of round, and requires a great amount of gumming. The machine swage draws out or prolongs the tooth, preserves the hook, affords a sharp, keen point that requires little dressing with file or emery wheel, and improves rather than impairs the quality of the steel at the point. It is rapid and uniform in operation, swaging from 10 to 20 teeth per minute, as usually operated, and only requires that the teeth shall be approximately alike, having the same hook on the face and pitch on the back. To secure this the use of some kind of a saw gummer is necessary, but a hand gummer may be used just as successfully as an automatic machine, and a combined hand rip and cutoff circular saw gummer is the kind most suitable for all-around factory requirements. Hand filing should be avoided so far as possible, as it tends to change the shape of the teeth, affecting their uniformity, shortens the teeth and reduces the size of the throat or chamber for dust. The hand gummer requires little mechanical skill in its operation and is very readily changed to suit the different sizes and kinds of saws.

There are conditions of excellence that must exist in the machines on which saws are to run, always requisite to the successful operation of the saw, however well fitted; and it is presupposed that every saw arbor is level, and in line with the table or carriage, and runs without end play or lost motion in the boxes, and that the mandrel hole in the saw fits the arbor. Small saws require less frequent and fine hammering than the large rip saws used in saw mills, and any man equipped with a small and inexpensive outfit of hammering tools, can perform the hammering satisfactorily after a little practice and study of methods. Otherwise if the saws do not run true without heating, they should be sent to a saw shop or hammered by a competent man.

Keep your saws jointed so that every tooth touches the jointer, and you will have a round saw with each tooth performing its portion of the cutting. If you use a spring set, having no machine swage and sidedresser, have your saw-set fit the teeth and spring the

tooth with a slight twist which will leave the face of the tooth out a trifle more than the body of the tooth and make the saw less liable to timber bind. Use just enough set to clear the saw. File the teeth square on face or straight with arbor, but the use of an emery wheel is much better for it keeps a round throat and leaves a harder and a longer lasting edge. Dress the backs or tops of teeth a trifle fleming so as to give the outside corner a little lead. Fit the teeth so that they will be uniform in size and shape. Keep the hook line between ½ and ⅔ distant from center of saw. A saw thus fitted will run well in any ordinary ripping, but if you are cutting cross-grained stock a small amount of flem in face of tooth will be a benefit. Should the corners become a trifle rounded, joint lightly with a file jointer, as often as may be necessary and understand that fine work from the saw depends mainly on fine fitting. Maintain short teeth, round saws and round throats.

For pitch pine, basswood, or any wooly or crossgrained wood, it is best to put more bevel or flem on the backs. All rip saw teeth should be filed square on the front for any kind of work. An increase in the amount of hook in a saw up to a limit, tends to make it cut easier, but if the teeth have too much hook, their strength will be diminished, and they may break or dodge and lead out of line. If you diminish the hook beyond a limit, the saw will take more power, stand less feed, dull more quickly and its operation becomes one of tearing or scraping, rather than of cutting. Avoid the filing of square gullets in your saw as cracks are particularly liable to start if the saw is dull or weather frosty. Keep the teeth sharp by frequent dressing. A few minutes spent on a saw each day will pay in saving power and labor, to say nothing of the increased quantity and quality of the output. A saw is just like a razor or a plane, it must be kept sharp all the time to do good work. If you run an extreme hook, the back of the tooth must be strengthened to a well rounded form, but avoid getting the backs higher than the points, or the gullet too small to chamber the dust. If the teeth loose any of the proper amount of hook or gullet, the saw will be harder to keep in order, will require more power, and will produce inferior lumber. The length of the tooth, the spacing and the size of the gullet depend directly upon the amount of feed. For light feed a short tooth is preferable as it will cut the smoothest lumber, but as the feed is increased the length of the tooth and the size of the gullet must be correspondingly increased to properly care for the dust.

FACTORY SAW FITTING.

The stock should be fed to the saw so that the teeth will take a deep, full cut, rather than a light scraping one, as they will stand up to the work with less tendency to dull. It is sometimes observed in sawing kilndried hardwoods that the saw is dulled in a short time, and this fact can usually be traced to improper feeding, assuming that the saw was in the first place properly fitted.

The fitting of cutoff saws differs from the fitting of rip saws only in the shape and manner of filing the teeth.

Coarse cutoffs should have the pitch line about one inch from the center for hard woods and not over two inches from center for soft woods. File the tooth a trifle more fleming on the bottom than on the top and use more flem on soft than on hard woods. It is unnecessary to twist the point of cutoff saws in setting, but set the teeth square over. Fine cutoffs for smooth work do not need any hook or any pitch to the teeth, unless you wish to do more rapid work, in which case it is well to give some little pitch. For fine cutoffs use one of the saw sets specially manufactured for such purpose.

Small band saws and jig saws require to be filed but the one way, square on both top and bottom, the set making the necessary bevel. Special care must be taken to remove all bends, twists and lumps; also see that the braze is dressed to a uniform thickness with the rest of the saw. Keep the band saws well jointed and be careful in filing brazed teeth to avoid forming a hollow place in the saw at that point.

In all saw work, no matter how small the machines on which the saws are run, they must be in good repair, boxes running cool, etc., otherwise the best fitted saws will not be able to do good work.

THE HAMMERING OF SMALL CIRCULAR SAWS.

Small circulars rarely are given or require any such amount of careful treatment with respect to leveling and tensioning, as the large saws in sawmills. Space does not here permit us to treat this subject in detail, as in a manual devoted wholly to saw hammering. We refer the reader to one of the Manuals on Saw Hammering priced in connection with Saw Tools. But any circular saw, no matter how small, requires for fine work that it be leveled, free from twists or lumps, with the tension uniform. By uniform tension is meant that the tension or expansion of the steel, shall show uniform at any distance from the center, all around the saw, when the straight edge is applied, although the degree of this tension will vary at different distances from the center, being little or nothing at center and rim and more through the body of saw, according to the diameter, speed, guage and feed. Thus the saw, when properly tensioned, will run true and steady, free from vibration, the centrifugal strain being properly compensated by the process of hammering. Every filing room should be equipped with the proper tools for hammering, and if the filer in charge is not familiar with the principles of hammering, he should learn the process.

CIRCULAR SAW TEETH.

Assuming the hook in circular rip saws to be normal when tangent to a circle whose diameter is one-half that of the saw, it is matter of common observation that this standard is often departed from. The wear on the teeth will sometimes give an intimation of the degree of hook required, but as this is influenced by the clearance of the back of tooth, this feature must be taken into account. If the wear is greater on the under or throat edge of the tooth it may be given more hook, but if the wear is greater on top, either reduce the back or lessen the hook, as required. In soft woods more hook can be carried than in hardwoods, and of the soft woods those that are stringy or fibrous require the most hook. The hook or pitch of the teeth in circular crosscut saws may be assumed to be normal when the front and back of the tooth make the same angle with a line from the point of tooth to center of saw. This is often designated a "peg" tooth. For smooth cutting this style of tooth is popular among furniture makers. For the general run of cutting off saws the pitch of the tooth is not given the consideration usually bestowed on rip saw teeth. Cut-off saws may not require so much care in this respect as rip saws, yet it is evident that it would be profitable if more care were bestowed upon them, for the reason that there is a far greater number of crosscut saws cracked or broken before being worn out, than of the rip saws. Other causes besides the shape of the tooth on a cut-off saw cut figure, as for example the angle at which the tooth enters the lumber varies materially according to the part of the saw that is doing the cutting. Cut-off saws are run both above and below the saw-table, cutting on the top or bottom of the saw. Or, the cutting may be done on a line just above or just below the arbor. When fine teeth are employed, dust chambers can be employed to advantage. They relieve the saw and assist in keeping it cool. A combination of cutting and cleaning teeth is a help in some cases.

The size and number of the teeth in circular saws are governed largely by the guage of the saw. This being fixed upon, the dressing of the teeth is the next most vital matter contributing to the saw's work. As regards the work of the saw for different woods there is much that depends upon having saw fitted with the proper amount of set or swaging, having the teeth kept sharp and properly slim and throated, and the feed not too fast. The flem on the teeth may properly vary for different woods. Under proper care, 19-guage resaws are cutting hard maple, and 16-guage segment resaws easily cut kiln dried oak wide, being run steadily on such lumber. The varying of the setting and filing will accomplish much. In sawing pine, if the lumber is wet and green, increase the set and file slightly more bevel on the teeth. For smooth cutting it is necessary that every detail of the machine be in perfect condition and the saw in thorough repair. It should be perfectly round, every tooth set and filed alike, and the set specially arranged. In rip saws the set may be carried more than usual down the front of the tooth. Side jointing is required, and after this is done the clear-

ance on the side must be accurately extended to the cutting edge. This last is an essential feature which is overlooked by many. Sawing with the grain adds to the smoothness of the cutting and to the ease with which the labor is done, hence there is an advantage in using larger saws and cutting on top.

While there are other considerations which affect the saw's work, the one which is closest to hand, is in most instances perfection or lack of perfection in the dressing of the teeth. This requires time, labor, skill, and a proper filing room equipment for the several classes of saws to be fitted. It is a very short sighted policy on the part of any mill or factory manager to refuse the small expense that would enable his saw filer to have machines and tools that would enable him to accomplish his work practically correct, save his time by perhaps one-half, and afford saws that could be kept at all times sharp and well fitted, affording a greater sawed product and a vastly better sawed product. It is coming to be noticed that mill men are taking a greater pride in the quality of the work turned out, and they are aware that the quality of the sawing can be raised and maintained at a higher standard by allowing a reasonable amount of time for dressing the saws, and by affording a proper equipment of tools for the filer's use.

The finishing touches may be given with a file unless the work and quality of the emery wheel is practically perfect. The quality of emery wheels being somewhat variable, it follows that the teeth are not always left in the best condition for going on the arbor, direct from the sharpening machine. The vibration of the emery wheel or of the machine when loosely or lightly constructed, often removes from the tooth its fine cutting edge and leaves it a bit dull. Then, too, the emery wheel may be fed to the saw so as to blue or burn some of the teeth in spots. If there is any pressure of the emery wheel as it passes over the top of tooth in leaving the tooth, it will drop and leave the point dulled. For the above reasons, the filer should point the saw teeth with a file, if his examination of the saw as it comes from the emery wheel shows that this is necessary. On the other hand many filers are so expert in the use of emery wheels and so particular in their selection of wheels of the right fineness and hardness for their work, that they commonly finish the saw with emery wheel, and very rarely touch the point with a file.

Clever saw filers will always be on the lookout for modifications in their fitting that may be better calculated to suit their individual requirements. The conditions in no two mills are precisely the same, and while there is commonly a considerable uniformity of work in the mills as regards the care of saws, yet an apt filer will often discover special methods of fitting that improve his own results, which would perhaps not work with equal success in other places. The difficultness of laying down rules that would suit every case is manifest and our discussion of these phases of work is calculated mainly to review principles generally known, and perhaps to arouse or stimulate a desire for improvement in the minds of saw fitters. As an illustration of changed conditions, the case may be cited of several sawyers who tried in vain to make headway in resawing cottonwood with a 44-inch resaw. One filer concluded there were too many teeth in the saw. Upon removing alternate teeth, it was found that very good work could be accomplished and coarse toothed saws became the rule. The seat of the trouble was lack of power, which was not suspected, and the coarse toothed saws being recommended to a neighboring mill, were tried there unsuccessfully, owing to the saw being too light for the work it had to do.

Swaged teeth on circular rip saws are always preferable to the use of teeth sprung. Such swaged saws should have fewer teeth and larger throat room as each tooth has two cutting points. We offer swages of capacity for swaging circular rip saws of all sizes from 6 inches up to 72 and from any guage from 4 to 24, and there is no reason why any filer should be unable to properly and perfectly swage his small saws, except it be the lack of proper tools for the work.

When you place a new saw on the arbor see that it is just a fit, not too tight or too loose, and that the mandrel collars are clean. See that the nut on the arbor is an easy fit, so that it will be squarely seated against the collar when tightened. You can put a mark on the

collars and this together with the mark or brand on the saw will enable you to always replace them in the same relative position. Such points may be considered trifles but trifles make perfection. Hang and carefully test and true up the saw by lining the collars with thin paper where necessary, until saw runs true within one hundredth part of an inch. The saw must be jointed perfectly round. The proper dressing of the teeth is a vital matter. The least amount of swaging or spring set which can be run successfully is the best to use. This proposition is true whether the consideration be the smoothness of cut, saving of lumber, easing the labor of the saw or lessening the power consumed in driving the saw.

If a spring set is used, it should be placed at the point of tooth only—not extended into the plate below the base of tooth. The latter practice has ruined many a saw. Swaging on circular resaws is more successful but requires more work and skill than the use of spring set, and too many resawyers are apt to prefer to run saws in the manner that will occasion them the least labor and also to run them long after they are in fair condition to run. As regards the proper filing or sharpening of the teeth, a number of considerations enter into this discussion. The lumber to be resawed and its condition; the guage, number of teeth, and condition of the saw, and the resaw machine itself all have bearing upon the proper fitting of saws.

The saws being in perfect running order the machine itself next commands attention. The feed rolls as usually made, wear more rapidly in the lower than in the upper journals and do not have a uniform bearing on the lumber; this point should be sharply looked after, as the correct lining of the feed rolls and their perfect action is essential. The action of the reverse and stop motion of the feed rolls is also important. It must be positive and free from lost motion, an instant's delay in reversing at a critical moment often working damage.

A variable feed controlled by a conveniently placed lever, is a positive advantage which is appreciated by all using thin saws. When entering a hard knot or a shaky place in the board, a variable feed is a necessity. When not on the machine a makeshift is employed by using the stop motion, and by alternately throwing the feed rolls into and out of gear, jerking the board along a little at a time. This loses time and is imperfect at best. In other instances where the feed might be properly increased it cannot be done, thus causing a loss in output. A disc friction meets the requirements in this direction. The guide pins should be set just to clear the saw near the base of the teeth. There is danger of breaking the saw in resawing short stuff, if the material leaves the rolls before the forward end passes the rear of the saw so that the taker-away can grasp the end of the board. As the board leaves the rolls it is liable to swing, throwing it across the front of the saw. A trough formed by setting up a board on each side of the saw may be employed, to hold the lumber in line. For handling short blocks, six rolls, 20 inches or more in length, two boards with a cleat along the bottom and at the back edge of each, will serve nicely. The short pieces are set between and all passed through the rolls at once, thus in some instances saving stock which would otherwise go to the scrap pile. Thinner guage saws may be used. Greater output per hour may be secured. Smoother sawing may be done. Such results demand machines of the best construction solidly set on heavy independent foundations, saws speeded at a faster rate, increased feed and perfect feed works, teeth or saws better fitted, and with plenty of steady power.

It is a well known fact that as between different mills, there is a vast difference in both the quantity resawed per hour and the quality of finish of the resawed stock. The results arise mainly from the difference in the expert fitting of the saws and the expert handling of the machine itself. If the stock shows rough and snaky, with every revolution of the saw manifest, it is evident that there is chance for improvement in the fitting of the saw and it suggests the need of better saw tools or a better saw filer, or both.

The importance of finely resawed product is not to be underestimated. For whatever purpose the lumber may subsequently be used, its fitness for this use is largely determined by its condition as it comes from the saw. A perfectly resawed stock greatly facilitates the subsequent processes through which it may pass in being turned into a finished product and

the time and labor bestowed upon it by other operatives depends to a degree upon the skill and ability of the resawyer and the work of his machine and saw. If the lumber comes out smooth and uniform in thickness the product may be finished up to standard excellence, but if it is irregular, corrugated and wavy, no operator, no matter how expert, can turn out perfect product, except by an undue expenditure of labor.

PLANER KNIVES.

Planer knives must be perfectly balanced, duplicates in every respect, for smooth dressing. The uniformity must extend to width, thickness, bevels, and slots, otherwise vibration must ensue, which is detrimental to good results according to its degree. The equipment for knife grinding will comprise a proportional balancing scale, and a good automatic knife grinder. The emery wheel should be selected with special reference to its work and the speed at which it is to run on the machine. Good grinding requires proper fineness, hardness and speed, of wheel. See that the face of knife as well as the knife bar is perfectly clean and free from chips, gum or dust before bolting down. Tighten to an easy degree but do not strain on bolts more than necessary to bring knife tight to bar; when knife is about half ground it is well to stop machine and slacken bolts that hold knife, except one, then immediately tighten and finish grinding and you will never have crooked knives. The use of water prevents to some extent the injurious effects arising from wheels unsuited to the work or improperly speeded. If your wheel is hard, do not crowd it, as it only becomes clogged and is liable to overheat the knife and make it soft on the edge. The proportional balance enables the operator to balance the knives end ways, at the same time balancing the total weight, and as a result, having each knife in the set balanced against the others, both as a whole and in parts, smoothness of running and freedom from vibration result.

BRAZING NARROW BAND SAWS.

The life of a narrow band saw depends considerably upon the manner in which it is brazed. If the saw is heated too hot the steel becomes burnt and will quickly break apart upon one side or the other of the joint. If not heated hot enough the brass may not be melted or it may not make a good contact with the blade. In either case the braze will be a poor one and will quickly come apart. One method of brazing is by the use of tongs. The saw is first beveled down and clamped at a few inches at each side of the joint, a piece of brass being placed between the ends of the saw; some fine wire is twisted tightly around the joint, holding both the saw and the brass in place. A pair of heavy tongs is then heated red hot and pressed upon the joint, which has been previously cleaned with acid and dusted with powdered borax. As soon as the brass is seen to run, the tongs are quickly removed and a pair of cold pliers applied to the joint, forcing the ends of the saw closely together and cooling the saw at the same instant, fast enough to give it a slight degree of temper. Another method is by use of the blow pipe lamp. This is either a large wick, burning kerosene, the blaze being forced by a blow pipe used with the mouth against the edge of the saw, or an automatic bellows arrangement is sometimes supplied with a lamp to be operated with the foot. By the blow pipe method the flame is applied to the edge of the saw, heating the metal gradually from one side to the other and avoiding local hot and cold spots. Another method is brazing in the forge fire. The saw is clamped in an iron frame, and if desired the joint can be wound with iron wire as above described. It is then transferred to the forge and held over a clear coal fire until the brass is seen to melt. To prevent the temper from being removed from the saw on each side of the joint, pieces of wet rag may be wound around the blade to protect it at the points mentioned. A little device which gives much better results than the rag winding is known in some shops as the "hole in the casting." This tool consists merely of a piece of iron, either cast or wrought, 12 or 14 inches square, with a hole about 1 inch diameter in the middle of the plate. The forge fire being nicely fixed, the plate is laid on top and pressed down so that no flame escapes around

the edges thereof. The fire should be drawn very gently, and a very hot blowpipe flame will be observed to go up through the hole. Saws can be brazed very nicely with this apparatus as a source of heat. Particular attention should be given to the brass used in brazing band saws. It should not be hard nor should it be too soft. A variety known as "yellow brass" is particularly desirable for brazing. Band saw manufacturers frequently supply a kind of granulated brass, which is very handy for brazing, as little or much can be placed upon a saw blade, rendering it unnecessary to cut the required portion off a large piece. Brazing cannot be well done unless good borax be provided. Keep the borax when finely pulverized in a tight tin box, using a spoon for placing it upon the saw. When it is desirable to fasten the saw blade together without the use of clamps recourse must be had to iron binding wire. Copper wire is not so good as the iron because the brass unites more readily therewith at the instant of fusion. Very fine wire should be used; nothing larger than No. 28 or 30 should be procured for this purpose. In filing up the ends of a broken saw care should be taken to match the teeth exactly. To do this, cut off the blades squarely at the end of a tooth, then count back two or three teeth, as necessary, and start the bevel from that point. Serve the other end of the saw in precisely the same manner, and there will be no question but what the joint will come together so as to match the saw teeth exactly after the brazing is finished. Aside from good brazing, the running qualities of a narrow band saw depend greatly upon the manner in which the joint is dressed after brazing. First straighten up the back edge of the saw, after which the saw may be laid flat upon a board or an iron support, and the joint dressed down carefully with a mill file. Then turn the saw the other side up and dress that side in the same manner. Dress each side a little at a time, and take care not to gouge out holes, which after the other side is finished leave the saw too thin in places and too thick in others. A little care in this respect will enable the filer to dress the saw so it will be straight and of even thickness in all parts of the braze.

CIRCULAR SAWS FOR LUMBER MANUFACTURE.

The conditions governing the operation of large circular saws used in the manufacture of lumber from the log, are exceedingly various, and there is a wide difference between an experimental and an expert knowledge of their care.

It is highly important that you have a good mill, for one with weak or defective parts will be very likely to waste much of the power, and contribute toward inferior lumber manufacture. You also require good saws.

The mill and the saws demand constant care to keep them in the best condition for sawing. The filer or sawyer who is a competent millwright and is thus enabled to watch and judge of the mill and know that it is right and see that it is kept right, is unlikely to be baffled by knotty problems in saw fitting or tensioning, because with the preliminary conditions properly met, the care of the saws becomes more simple.

The conditions of a mill that should directly interest a saw filer, and to which he should give constant attention, are the track, the carriage, the husk, the arbor, the collars, the guides, the power, the speed, the feed, the number of teeth, the hook, the gullets, the kind and quality of the lumber cut, and finally the proper tensioning and fitting in the mill filing room.

Know that the machinery as well as the saws are in good order.

See that the track is level and straight, the carriage substantial, free from end play and the set works positive; the saw mandrel absolutely level, fitting as tightly in the boxes as it will without heating, and with but little end play, the mill lined true with the track; the collars perfectly true, and the power steady and abundant.

The fast collar on the mandrel should be turned flat from the outer edge about ¾ of an inch towards the center, then concaved slightly to the shaft. The loose collar should be flat or but very slightly concaved. This will insure the collars pressing the saw firmly at

their rims, thus maintaining the saw flat and straight on the log side. To ascertain if the collars are defective, place the saw on the mandrel and tighten up the collars by hand. Then test saw with straight edge, and if found correct, tighten up the collars with a wrench and test again with straight edge to see if the face of the saw has been altered. If changed, it suggests that the trouble lies in the collars, and this must be remedied.

The mandrel should fit center of hole snugly but enter freely, and each pin should have a bearing. The saw should slip close up to the fast collar. Sometimes the arbor being a trifle large near the collar, the saw when forced up to its place by the nut, is made full on the log side.

It is difficult to make two saws hang just alike on the same mandrel, or the same saw to hang exactly alike on different mandrels. The slightest difference in turning up the collars of the mandrel or in the finish of the saw near the mandrel hole will cause a perceptible difference in the hanging, so that it is often necessary to adjust the saw by packing between the collars with writing paper.

In hanging a new saw it is best to fit it on, screw it up between the collars, and then examine it carefully on the front or log side, and see if the face is flat.

Never attempt to run a saw that is dishing on the log side, as it will be sure to draw toward the log.

If the collars are not true and cause the saw to stand full or dish either way, this condition may be remedied by the use of rings cut about same size as the collars. These rings should be cut out of firm writing paper, oiled, and applied to one or both collars as required.

If the saw is dished on the log side place one or more rings against the loose collar until the saw when clamped up by collar stands in proper position.

If the saw is too crowning on the log side, reverse the position or application of the rings, placing more paper against the fast collar.

If necessary to do any filing at the center of lug pin holes, see that no bur is left on the edges.

Set the spread wheel flush with the saw and a half inch clear of the teeth.

Adjust the mandrel so as to give the saw a slight lead into the log.

Adjust the guide pins clear of the teeth, and close enough to touch the plate at some point in its revolution. This should be done while the saw is in motion.

It is especially important that the mandrel bearing next to saw shall run cool, as heating will heat the center of saw and cause it to lead or dodge. Never have anything to cause friction at either center or rim of saw that can be avoided. If saw warms at or near the center it should have more lead into the log; if it warms near the teeth it should be led out of the log. If the mandrel and guide pins are properly adjusted and the saw does not run straight, you should examine thoroughly to ascertain the trouble. The fault may lie in insufficient power to maintain uniform speed, in which case the remedy is to reduce speed to the velocity that can be maintained, and hammer the saw stiff. A high speed saw requires special hammering.

A saw should never be taken from the arbor very hot at the eye, and then placed in a leaning position, as it is liable to dish. In such case it is better to run the saw slowly out of the cut until cooled down.

SETTING THE HUSK.

A prime requisite in mill construction is a solid, firm foundation. Heavy seasoned timbers should be used for husk stringers, leveled and so placed that they cannot possibly change from their position. Then fasten down the husk frame firmly by heavy through bolts, for a slight change will make a great difference in the running of the saw and may necessitate frequent relining and leveling.

LINING THE SAW WITH CARRIAGE.

A principal cause of trouble in the running of circular saws is in the lining of the saws, which if not properly done, will cause the saw to heat and snake. A saw should be lined almost straight with the track, leading into the log no more than is necessary to keep it in

the cut, prevent it heating at the center, or scratching the lumber when the carriage is reversing. In practice, the amount of lead varies from 1/64 to 1/8 of an in inch in 20 feet, according to the diameter of the saw. Change the line of direction of the saw to give the lead desired by sluing the mandrel in the proper direction. Before attempting to line a saw you must see that all end play is taken out of the mandrel, that the track is straight, level and solid, the carriage free from lateral motion, and the saw plumb and flat on the log side. Then move up the carriage until the head block is on a line with the front edge of saw. Fasten a pointed stick firmly upon the head block with the point lightly against the saw. Move the carriage until the point is opposite the back edge and if necessary slue the mandrel until the point clears the saw from 1/64 to 1/32 of an inch.

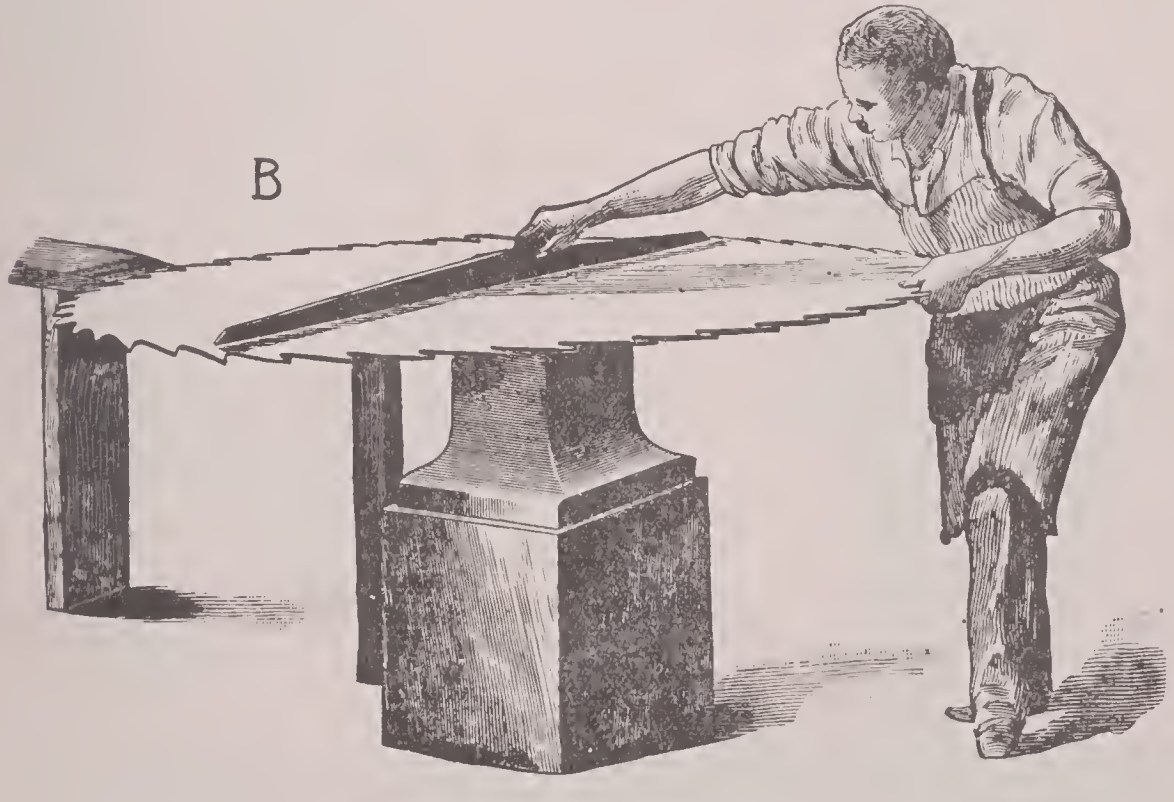
Or fasten a square edged stick or board firmly upon the head block so that the end of the stick will be 1/8 of an inch from the saw when opposite its center. Then run the carriage back until the stick is 15 to 18 feet from the saw. Then stretch a line from the back of the saw to the stick and you can give accurately any lead desired.

Or a tapering board with a hole at the large end, and a nail or screw at the small end, may be fitted on the stem of the mandrel and screwed up tight between the collars. Measure from the head block to the nail head in the end of board, then turn the mandrel half over by pulling on the belt, run the head block to the new position and measure again, setting the mandrel to give the required lead.

After testing the saw as above, by turning the saw slightly to a new position, and measuring again, any imperfection in the saw itself will be shown. The saw arbor should not be run absolutely rigid, but may be allowed 1/64 of an inch end play or thereabouts.

DEFINITIONS OF CIRCULAR SAW TERMS. (REFER TO CUTS.)

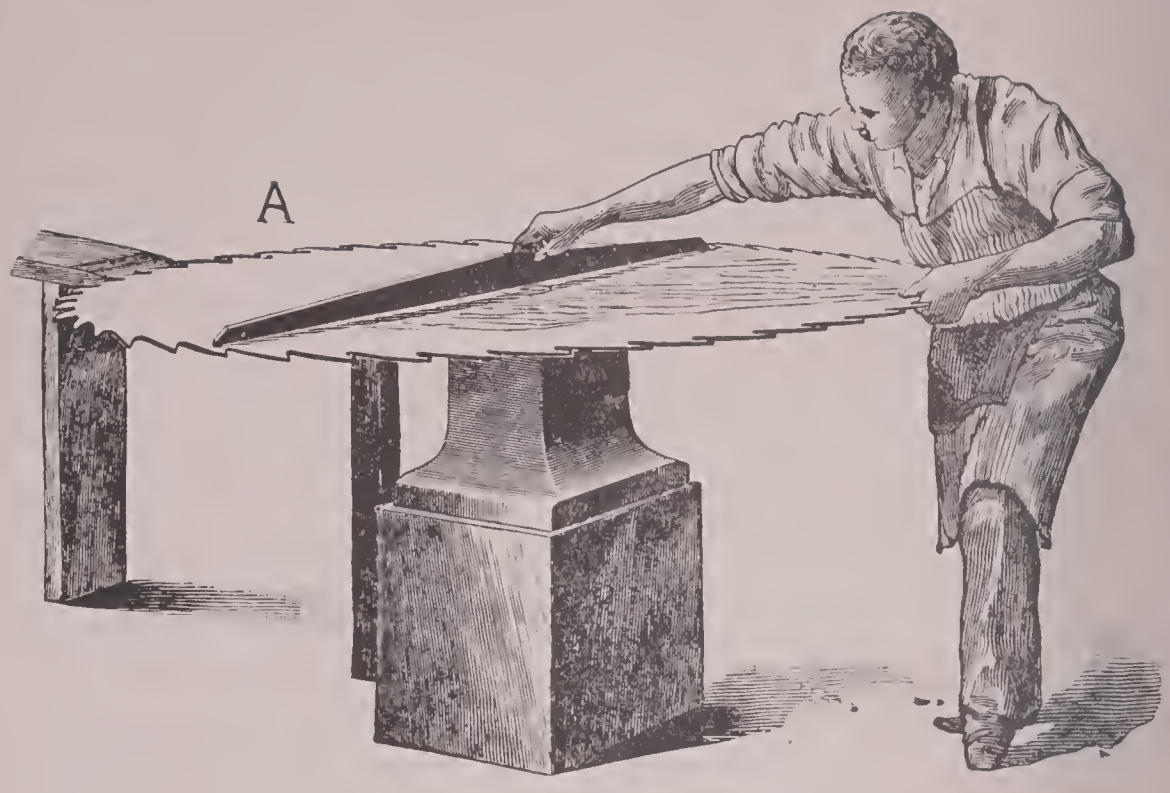
A "stiff" or "tight" place is one that conforms to straight edge, showing no drop due to expansion or tension. (Fig. B).



A SAW STIFF WITH NO TENSION.

A "fast" place is one that stands up to the straight edge or shows convex.

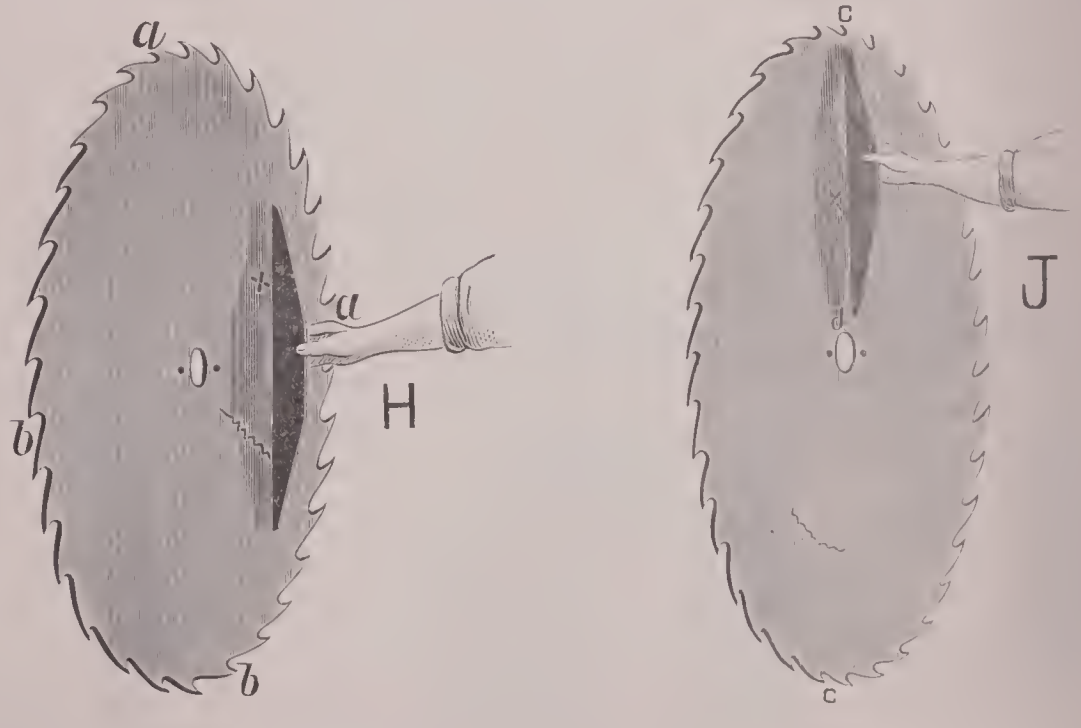
A "loose" place is one that drops from the straight edge or shows concave. (Fig. A).



A SAW LOOSE OR OPENED FOR TENSION.

A "dished" saw is one that will not lie flat when saw rests on anvil, but shows a bulge or distortion of the saw plate.

A "lump" is a spot or place that stands up on one side of saw only. (Figs. H and J).



TESTING FOR LUMPS, RIDGES OR TWISTS.

A "ridge" or "twist" is an extended lump.

"Leveling" a saw consists in reducing all lumps, ridges, twists and similar distortions. "Tensioning" consists in expanding certain parts of the saw plate to a greater extent than others, to withstand the centrifugal strain of the speed, and the resistance of the timber being sawed. The amount or degree of the tension is indicated by the drop of the saw from the straight edge, when applied across the diameter of the saw or from eye to rim.

To remove a tight place hammer directly on the parts that do not drop from the straight edge, but you should hammer on both sides of saw alike so as not to spring the saw.

To remove a loose place, that is a place too open or having too much tension, apply round face blows between the loose spot and the rim, so as to allow the extra amount of tension at that point to run out at the rim.

Bright spots upon a saw are generally tight spots or lumps, and are apt to run in ridges extending toward the center. Such places should be knocked down by hammering on anvil on the pad or end grain block as later described.

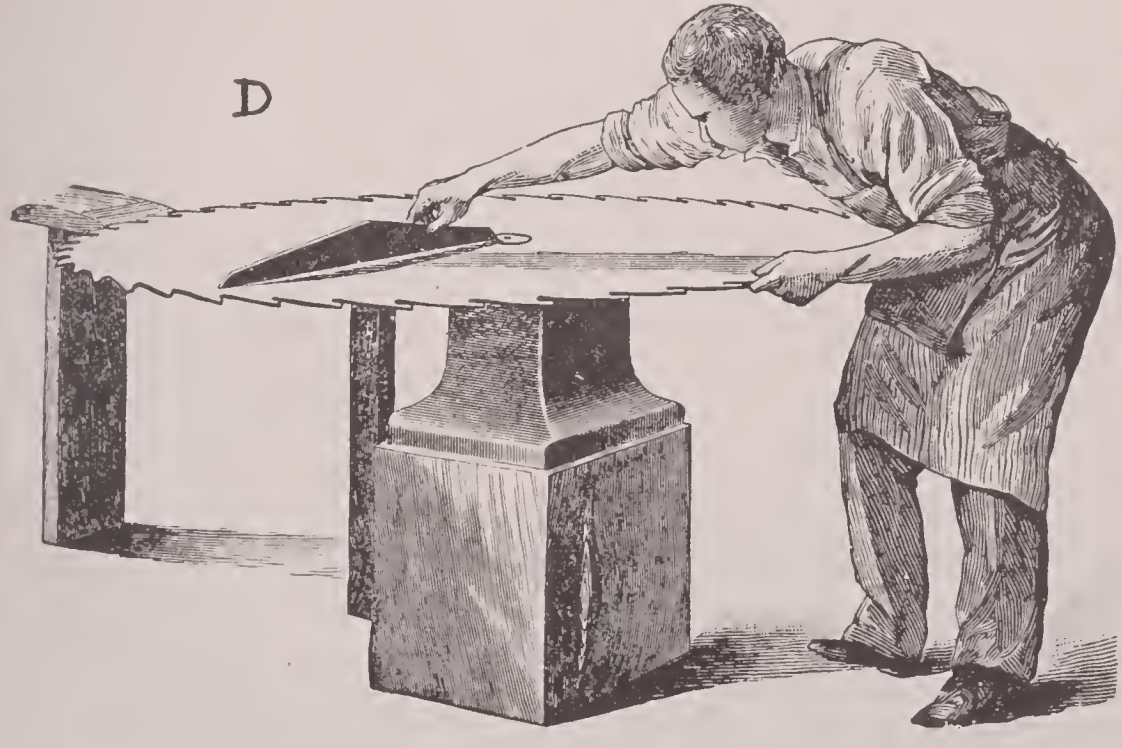
Mark loose places with loop marks, on both sides of the saw. Mark tight spots by loop marks and cross marks.

A lump will show a bulge on one side and a drop on the other side. It should be marked with a (X). A ridge or twist will stand up to the straight edge when the latter is applied lengthwise, and will show a lump or ridge if applied crosswise. Mark with — — —.

HAMMERING TOOLS. CIRCULAR SAW FILING ROOM REQUIREMENTS.

The equipment of machines and tools necessary to the proper tensioning and fitting of circular saws is variable according to the size, number and variety of saws to be fitted. A large sawmill requires a larger and more expensive outfit than a small mill or a woodworking establishment, but the requirements are essentially similar in kind and vary only in degree.

In a mill where large circular saws are to be cared for, the filing room equipment should include an automatic sharpener for the large rip saws, a hand or automatic sharpener for the small rip and cut-off saws, a machine swage, an upset swage or a swage bar and hammer, a file sidedresser, or a swage shaper, a hammering bench, a fitting up bench, a steel faced anvil with face 6 x 10, 8 x 12 or larger, a doghead and crossface hammer weighing from 3½ to 5 pounds each, a long straightedge equal in length to the diameter of the largest saws, for testing the openness of the entire saw, a straight edge of half this length, reaching from center to rim, for testing the drop of the tension (Fig. D), and for locating lumps, ridges and twists, and a short 12 to 15 inch straight edge for finding small lumps that may be overlooked in the preliminary processes of leveling.



TESTING THE "DROP" OR DEGREE OF TENSION.

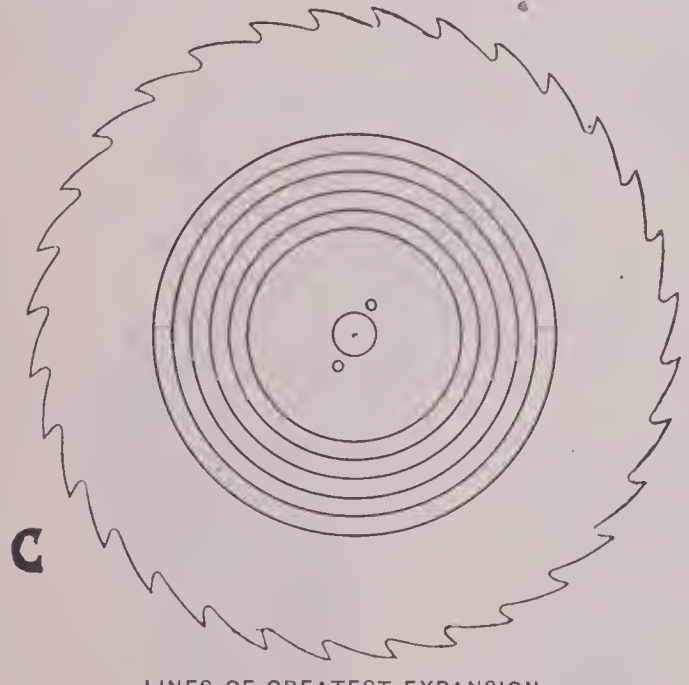
The test of the saw with straight edges, is the most reliable, and every beginner in hammering should make it a study to *read* and *understand* his saw by his straight edge tests. But the straight edge test of the saw when on the mandrel will not be reliable unless the mandrel and collars are perfectly true.

The heavy hammers mentioned above may be supplemented with a pair of light hammers weighing three pounds or less for fine work on high speed saws or for use on light guage saws. Some make use of a twist face hammer and consider it a desirable part of a hammerer's outfit.

It is extremely important that the face of the hammers and the force of the blow shall be such as to avoid cutting or unduly marking the surface of the saw. None but expert hammerers should use heavy blows, for it is easier to add to than to reduce the effect of your blows. First know where the blows are required and then place them to count. Let the blows be light but solid, striking the saw fair, with saw firm on anvil. The hammering process consists in leveling or straightening the saw, removing lumps, bunches, ridges, twists and every form of distortion, preliminary to a proper distribution of the tension or expansion. But a saw without some tension cannot be leveled, and in such a case, the first thing to do is to hammer the saw on concentric circles a few inches apart over a section of the saw lying between the center and rim (Fig. C). Use the crossface or twist face hammers in leveling; the doghead in tensioning.

TENSION.

If you revolve an object attached to a cord, about the hand, it will be observed that on slow revolution the cord is slack and the pulling force on the hand scarcely noticeable; but if you increase the speed of the revolution, the cord becomes tense and the pull at the end greater, due to the centrifugal force or tendency to fly from the center, until at some limit, the cord breaks. Each molecule of steel at a distance from the center of the saw may be compared to the object attached to the cord, only in this case these molecules are revolving about the center of the saw as a fixed point, with radial lines in the saw plate representing the cord in the illustration. The centrifugal force or tendency to fly from the center, increases with the square of the velocity, that is as you increase the speed of the saw two times, you increase the centrifugal strain four times. If the plate of a saw were perfectly flat and devoid of tension, it would when speeded up and subjected to the cutting strain, finally reach a condition where the strain of the centrifugal force would exceed the cohesion of the molecules of the saw, and the plate would crack or burst. Hence it becomes necessary for the sawmaker and saw fitter to expand or stretch the body of the saw plate to overcome the effect of speed, so that the saw though loose and vibratory when motionless, will when at its maximum speed run perfectly stiff and rigid. It is therefore evident that there is a direct relation between the degree and location of tension and the speed, and that a saw put up to run 450 revolutions per minute will require less tension than one to run from 600 to 900. The expansion by hammering should be directly in line with the centrifugal force, through the middle portions, until the circumference is approached where the expansion gradually diminishes, leaving a rim or "tire" to hold the saw stiff and



LINES OF GREATEST EXPANSION.

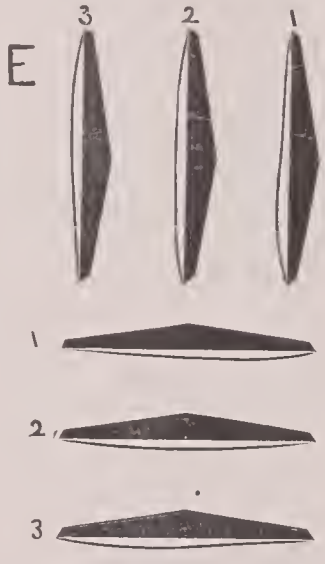
rigid when at work. If the tension, speed, feed and fitting of the teeth are properly harmonized, the saw will run firm and steady whether in or out of the cut, other conditions peculiar to the mill itself being correct.

UNIFORMITY OF TENSION.

Uniformity of tension means that the tension or expansion of the plate is uniform on the circumference of any circle described from the center of the saw all around this circle. The expansion at varying distances from the center will be variable to suit the speed, guage, and the cutting strain on the teeth due to the character of the timber being sawed. There is in each saw what may be called a line or section of maximum tension located not far either way from a circle about midway between center and rim, and diminishing alike either way from this line. This main line or section of greatest tension is the neutral point where the strain of the centrifugal force and speed is balanced by the opening for tension.

If you hammer on circles without the line of greatest tension it will let out the tension, but if you hammer nearer the center of saw it will tend to open or expand the saw still more. If you hammer directly on this line it will have a tendency to run the tension nearer the rim. It will be manifest from this and Fig. E, 1, 2, 3, that the relative location of the greatest amount of hammering for tension must be varied to adapt the saw to high, medium or low speeds.

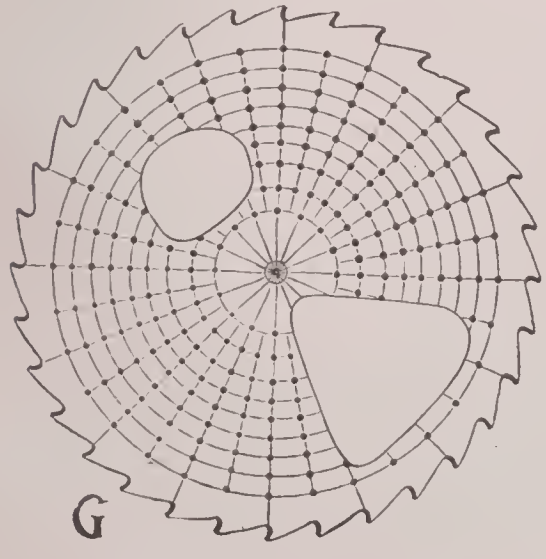
The only absolute test of this degree of tension and the location of a uniform maximum tension line, is by the application of straight edge from center to rim of saw. The vibration of a saw when shaken or the spring of a saw when pulled through by hand, tells much to the expert, but to the amateur it is not a reliable test. Fig. E, 1, 2, 3, is intended to indicate in somewhat exaggerated form, the comparative location of greatest tension in a high, medium and low speed saw, as measured by a straight edge test from center to rim.



RELATIVE FORMS OF TENSION INDICATED BY STRAIGHT EDGE TEST.

A saw in proper condition will do good work, but there are numerous causes for the letting down of the tension or various forms of distortion, which require frequent examination and treatment to counteract. Overfeeding, undue variations in speed, heating in the cut, sudden cooling, teeth improperly fitted, all contribute in various degrees to impair results.

EQUALIZED TENSION.



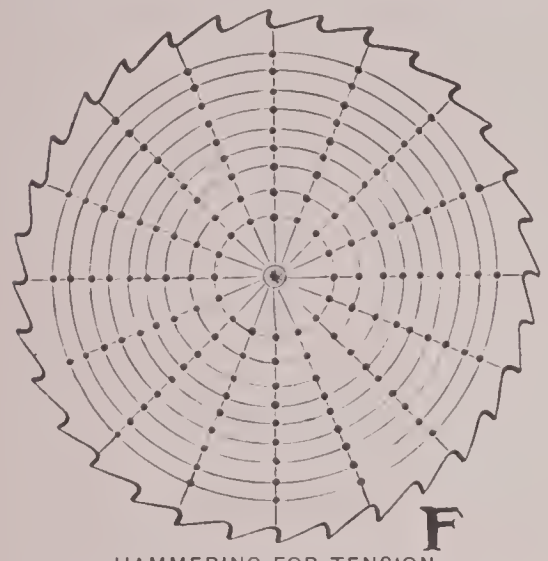
TENSION FAIRLY CORRECT IN SPOTS.

It is of the greatest importance that the tension shall be carefully equalized; that there shall not be alternate tight and loose spots, for if such is the case, the saw will not run well. The meaning of this will appear manifest when it is remarked that one part of the saw might be tensioned for 800, another for 700, another for 600, etc., or in other words adapted to such varying speeds, but not uniformly adapted to any one speed. Fig. G.

LOCATION OF TENSION.

At the eye of the saw there is no centrifugal force and there is consequently no tension required. There is no occasion to hammer a saw for tension under the collar. The greatest expansion in a saw for ordinary work and speed should show midway between the center and rim. If a high speed saw this drop may show greatest a little nearer the rim according to circumstances. Having once gotten a saw in proper tension for your mill, keep it that way by frequent light work with the hammer, for it is easier to keep a saw up in order by frequent slight treatment, than to allow it to run down and then be compelled to give it a thorough systematic revising. Moreover the life of a saw is preserved by keeping it always in good order. Nothing destroys the life of a saw faster than the strains arising from undue and neglected distortion.

A saw may be weak and limber on the rim, due to the center being too stiff, in which case it needs expanding in the center, to prevent it from heating and snaking. The remedy is to hammer the saw on concentric circles, about three inches apart, striking blows about two inches apart all around. Fig. F. Hammer both sides of saw approximately alike. To test the degree of the expansion, stand the saw up on edge, and give it a shake to see which portion of the saw vibrates. If the center still shows stiff and the rim vibrates, or if by giving the center of the saw a pull, it does not readily spring, but stands firm, a greater amount of expansion is required, and you must repeat the hammering on added lines, until the right amount of looseness at center and the right amount of stiffness at rim results.



F

HAMMERING FOR TENSION.

Avoid doing too much work on one side, or the saw will become dished, and you cannot then test the tension with certainty. If you get one side fuller or in such condition that it stands up higher to the straight edge than the other, it indicates a dished form, in which case you must mark the highest places and reduce them until the saw shows uniformly alike on both sides.

TENSION TOO NEAR THE CENTER.

A saw may be too loose or open in the center, in which case it is likely to heat in the center and run out in slabbing or run in after the center of log is passed. Such a saw requires a suitable expansion of the rim or a letting out of the tension, by hammering on circles from two to three inches from teeth if put up for very high speed or at four to five inches from rim if put up for moderate speed, and if a slow speed saw the blows may be applied still nearer to center. But these blows should be lightly struck to avoid letting out too much of the tension.

TENSION TOO NEAR THE EDGE.

If a saw has its maximum tension too near the edge, the tension will be likely to be impaired or let out, by reason of the saw heating on the rim, thus causing the saw to snake. To remedy this reduce the tension by hammering at about one inch from the roots of the teeth, and then revise the tension through the middle portions of the saw.

DEGREE OF THE TENSION.

The degree of the tension or expansion of a saw must depend upon the size of the saw, the guage of the plate, the speed at which it is to run, and the amount of the feed.

Temper has much to do with the proper expansion of saws.

A soft saw will expand more than a hard one from centrifugal force and such being the case it will stand more expansion in the process of hammering.

Small circular saws used for ripping and crosscutting are rarely given much tension, and are commonly run very nearly stiff or flat throughout. In similar manner, among the small circular log mills, the question of hammering a saw is given little consideration, and it is common practice to run the saw as long as it will cut at all, regardless of the quality of the lumber or the quautity cut, until a traveling saw hammerer puts the saw again in shape for work. But the modern sawmill operator who runs a mill and cuts lumber for profits, and whose profits depend directly upon the quantity and quality of the output, requires a saw to run at a high speed, stand big feed, and cut true lines, and is ready to pay a capable man to make it do so. These high speed fast feed saws vary from 6 to 8 guage, run from 700 to 900, and stand from 8 to 20 inches of feed, cutting from 60 to 100M feet per day of good merchantable lumber. There is always ample power to make the saw leave the cut at practically the same velocity as it enters it.

Saws thus operated must be fitted right, and demand more careful manipulation than those subjected to lesser requirements. An expert filer will take the saw and condition it to whatever speed, or feed or timber confronts him.

But there is nothing peculiar or exclusive in the fitting of saws for fast mills. The same principles that apply in one saw or in one mill apply in the other, and the results depend simply upon the degree of the skill and adaptation displayed.

There are no inflexible rules to go by in hammering a circular saw. The filer must first ascertain *where the saw needs hammering*, giving proper consideration to the conditions of its operation and then hammer to meet the conditions or improve the conditions if not right. Hammer right up to the roots of the teeth or right up to the eye if the saw requires it. No part of the saw should be sacred ground.

Neither the theory nor the practice of saw hammering is in any sense exclusive, although there are a few who are vastly more expert than the many, as in any employment. But saw hammering is simply the application of common sense to the needs of a saw, and one only needs to understand the condition of the saw and its use, the usual methods followed to accomplish desired results, and apply these ideas in practice, to make saws run satisfactorily.

Now whether a sawyer or filer desires to master the process of hammering, there are general principles that should be understood, in order to talk intelligently about the subject or explain to others the conditions that demand consideration or improvement. And there are occasions in every mill or factory, no expert hammerer being employed, where the application of a few well directed blows will level or tension a saw so that its operation will be decidedly improved.

One must have a good idea of what constitutes a saw properly "put up". This will vary according to the guage, speed and feed. A small heavy guage, slow speed saw will be stiff or show very little tension. A 7 guage log saw from 56 to 72 inches diameter, running at a speed of 700 to 800 will show considerable tension, will not stand straight, but remains dished when in repose, and requires a considerable pull to force the center back and forth. A thin high speed saw will require more tension than a similarly speeded heavy guage plate. The average log saw for ordinary speeds should be put up sufficiently loose or open through the center, so that when standing up and given a quick shake, the center will vibrate more than the rim, and when leaning over, the center will drop through. The amount of this dish or tension will measure up variously. A saw in perfect tension will show as in Fig. A, to greater or less extent, according to the speed and feed for which it has been tensioned. The long straight edge when applied across the saw touches only on the edges, but shows a gradual drop of the saw away from the guage as you leave the edges. A saw that has lost its tension will appear as in Fig. B, in which the tension or drop of the saw has in part or wholly disappeared. When testing for tension be sure to have the straight edge held at right angles to that part of the board or bench from which the saw is being raised with the left hand, and the opposite edge, while the straight edge is held and pressed down with the right hand. Do not lean or tip the straight edge unduly when testing a saw. When the saw is in proper tension the straight edge applied from eye to rim will show as in Fig. D,

indicating that the center of the saw is stiff, and if a short straight edge was pressed directly over the center it would show the saw to be approximately flat across the collar bearing. It is rarely necessary to hammer the portion of the saw under the collars.

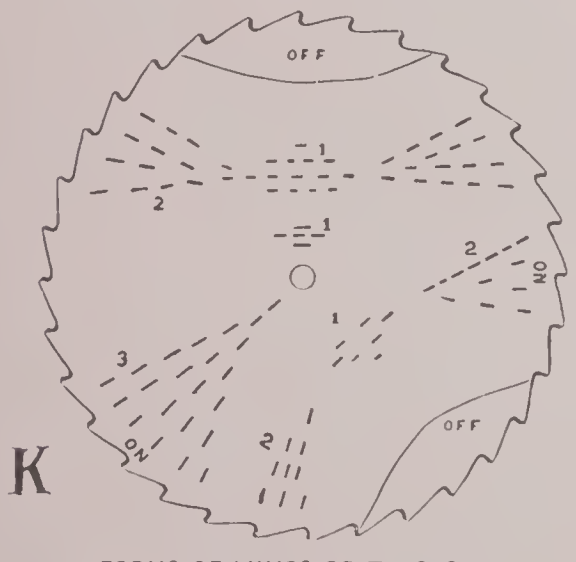
The drop of the middle portions of the saw hammered for tension should show uniform all the way around. If the drop is not uniform, those parts that do not drop perfectly must be marked and equalized by hammering. To test the tension of a saw let the center rest on anvil. Raise the edge with the left hand and apply the straight edge on radial lines all around the saw. The straight edge will touch the saw at center and rim. If a slow speed saw the middle portions between center and rim will drop away but little, but the higher the speed, and the thinner the guage, the more will be the drop.

In the case of circulars 7 to 8 guage, 60 inch, speeded for 700 to 800, a good test for tension is to apply a 5 foot straight edge across the saw, tipping it a foot from perpendicular. The eye should drop through. Or with saws across anvil slightly raised, the eye follows up to the straight edge the same as the rim, and in the entire length of straight edge, three points touch straight edge, the two on rim and the eye, but the eye touches the lightest. A saw thus put up will generally give good service in either hard or soft woods, north or south.

LUMPS, BENDS, RIDGES, TWISTS, ETC.

Hammering to remove lumps or ridges must always be done on the high side of the saw or on that part of the saw which stands up to the straight edge. Lumps or ridges on the edges may be found by examining that part of the saw with the center resting on anvil. Lumps in the body of the saw may be found by examining that part of the saw, with the saw standing perpendicularly upon the floor, marking the direction and extent on the high side with a piece of chalk, Fig. H-J, K.

If the lumps are to be taken out upon the anvil it is well to pad it with a thin piece of leather or with a couple of thicknesses of heavy wrapping paper. Allowance must be made for the tension, when removing lumps, as every blow struck tends to stretch the part hammered, and if the tension is altered it requires considerable exercise of skill and care to restore it. Some filers use a slightly oval wooden block for knocking down lumps, for in hammering upon this the tension will not be affected. The object to be attained in knocking down the lumps is simply to straighten the plate without expanding the metal. Adapt the blows to suit the guage and temper of the saw, for thin or soft plates require lighter blows than heavy hard plates.



FORMS OF LUMPS OR TWISTS.

Lumps are apt to extend into ridges, and should be knocked down with the crosspene hammer, letting the pene follow the direction and extent of the lump, as indicated by the straight edge examination and chalk marks. Round lumps may be reduced by the use of the doghead hammer or with the crosspene, by changing the hammer over after each blow, so that the strokes cross each other. Put the blows in exactly the right spots, directly upon the lump or ridge, and nowhere else. Test the entire surface of the saw with straight edge, rolling the saw about and marking the lumps with a (X) and the ridges with a (— — —) in the direction in which they run. Knock down the big lumps or ridges and oftentimes the little ones will disappear during the process. Practice alone makes perfect in either leveling or tensioning a saw, and this alone can make one familiar with the force or number of blows requisite to reduce any fast spot. There are numerous forms of bends and twists, the direction and extent of which will be found in testing to be exceedingly various. These will show as high and low sections on application of the straight edge,

and may show numerously quite close together, and even right up to the base of the teeth. When on the rim they will cause the saw to rattle and heat in the guide. These places must be tested by the application of the straight edge in every direction. At one position the saw will show full or stand up to the straight edge, while in a transverse position it will show hollowing (Fig. K). Always attempt to keep the center and rim true. In opening a twisted saw always hammer nearer the center and rim than on a straight saw. Sometimes the expansion of a twisted saw right down to the eye, will stiffen it and improve its condition materially. Sometimes the saw may show a good condition of tension and still be lumpy or full of small twists on the rim, giving it a sort of corrugated appearance. In such case the saw must have very careful treatment on the rim to bring it practically straight and true.

After a saw is level and free or open all around, tension to suit the speed, striking about equally hard blows on both sides. These blows should be struck on diametrical lines and on circles from two to three inches apart through the middle portions of the blade. Fig. F. The closeness to rim or center at which the greatest amount of force is expended must depend upon the conditions affecting the operation of each saw.

It is very important that you properly distribute the blows for if you hammer too much at one spot a loose spot or lump may result that will be difficult to take out, or if unnoticed will burn a blue spot on the saw in the cut.

If a saw standing on the floor is shaken and the center and rim both vibrate, it needs a little more hammering on lines nearest the rim. A skilled hammerer will stand the saw on floor, taking hold of the top edge, and by giving the saw a sudden shake, if the center vibrates and the edges stand stiff, he knows it to be open toward the center. He will also tip the saw over and see if it falls away from the straight edge sufficiently.

When you get the saw fairly flat or level, if the tension appears to be in properly, put saw on the mandrel and if fitted for the speed, it will then run stiff and rigid and stand up to its work. Observe the motion of saw when running up to high speed on the mandrel. If it runs wavy or shaky, and heats on the rim while at work, it is put up for low speed, and the body of the saw needs opening a little. If it leads in or out of the log, heats or appears weak in the center, it is put up for too high speed, and should be stiffened by a little hammering on the rim. If a saw runs steady out of the log, it is the fault of the hanging, lining, fitting or management, if it does not run steady in the log.

In cases where it is necessary to go over the saw more than once for tension, it is best to avoid placing the new series of blows on the same circles already hammered, but rather on lines between those already operated upon.

TREATMENT OF BLUE SPOTS IN A SAW.

A blue spot in a saw is caused by the existence of a lump at the spot which is heated and blued by constant friction in the cut. If it shows in the form of a round lump it may be reduced by use of the doghead hammer; but if it extends in the form of a ridge, the long faced hammer marks will be required. Such ridges usually extend from center toward rim. In hammering it is well to put the saw through slightly at the spot so as to require a little treatment on the reverse side, for if the blue spot is hammered down only just flat, it may reappear whenever the saw gets hot.

CRACKING OR BREAKING OF SAWS AT COLLAR LINE.

The occasional cracking or breaking of saws at the collar line is due to the fact that the saws have been put up for a certain speed, but owing to various causes, such as insufficient boiler, engine or belt power, the proper speed for the saw is not maintained in the cut or the sawyer does not properly control his steam feed, and forces the log unduly to the saw, and as a result the saw runs in or out of the log (most generally out) so that the log forms a sort of wedge between the saw and the headblocks, eventually cracking or breaking the saw at or near the collar line by forcing it over this rigid point. If the feed is not properly

diminished when the speed of the saw is reduced from any cause, the saw will be almost certainly crowded out just as if the tension was not properly adjusted for the usual speed at which the saw is calculated to run.

Cracks throughout the body of the plate are generally caused by improper tension or feeding beyond the endurance of the blade. Cracks at the rim are for the most part due to improper fitting of the teeth or angular filing in the gullets. As soon as a crack is discovered it should be immediately checked by drilling a ⅜-inch hole at end of each crack, and if the crack is over ten inches long it may be well to drill a hole in the center also. Then ream each side and put in a hot rivit, but don't strain the saw in so doing.

SELECTION OF SAWS.

It is just as essential to have saws of good quality as it is to have a good mill, and in ordering saws, the kind of work to be done, the amount of power at hand to drive the saw, the skill of the saw filer and the character of the saw fitting equipment must all be taken into account.

THE GUAGE OF SAWS.

For mills of ordinary capacity, doing general work, circular saws, 7 guage straight, or 7 guage at center and 8 on the rim, are recommended. In valuable timber and with skilled sawyer and filer, 8 x 9 guage or even 8 x 10 guage saws are used with success. The use of saws thinner than 8 x 10 guage for log sawing will in most instances result in disappointment for more than ordinary skill is required to handle thin saws and the lumber saved by the reduced thickness of the saw and kerf is more than offset by the waste from bad cuts arising from inexpert sawing. The cheapest saw with respect to the guage is one that will stand up to its work in all kinds of timber without any favoring. More teeth are necessary in a thin saw than in a thick one.

The greater the speed and feed used, the heavier must be the guage of the saw to stand up to the work expected from it, and consequently in most of the large and fast mills, where the saving of time and the quantity of the daily output is more important than the saving of saw dust, saws of 6 or 7 guage are principally used.

THE NUMBER OF TEETH.

A high speed fast steam feed saw requires the greatest number of teeth that can be conveniently included, for the saw having a maximum quantity of work to do, requires more teeth with which to do it, in order that the strain may be evenly distributed. The number of the teeth will therefore depend not only on the thickness of the saw, but also on the kind of timber sawed, and the speed and feed of the mill. 12 teeth to the inch of feed in hardwood and 10 teeth to the inch of feed in soft wood is considered good in general practice, although fast mills may crowd a saw down to 6 or 8 teeth to the inch of feed. Thus a 60 inch saw 6 or 7 guage should have from 80 to 90 teeth for fast work, but if the power is limited a reduction in the number of teeth will better adapt the saw to the power at hand for use.

The more teeth in a saw the smoother it will cut and the less set it will run with. Also the more hook the better and the smoother the lumber will be. The greater the feed the greater the hook required.

In addition to the regular specifications necessary to give in ordering saws the purchaser should always give full details regarding the number of revolutions per minute, greatest feed at each revolution of the saw, kind of lumber to be sawed, and all details that will assist the sawmaker to adapt the saw to individual conditions of use.

THE SPEED OF CIRCULAR SAWS.

The experience of many of the best sawyers and filers in the country recommends a speed of from 9 to 10 thousand feet per minute as a medium rim speed for circular saws, and

the following table of revolutions per minute for the various sizes of saws is based on a 10,000 feet rim speed.

Inches Diameter.	Revolutions per Minute.	Inches Diameter.	Revolutions per Minute.
8	4600	40	980
10	3920	44	890
12	3260	48	815
16	2450	52	750
20	1960	56	700
24	1630	60	640
28	1400	64	600
32	1225	68	560
36	1080	72	530

The above speeds may be found too fast for an old or rickety mill, and in such case should be lessened accordingly. Keep the belts neatly laced and straight and look to everything that will prevent or lessen vibration. If power is lacking reduce the feed that the motion may be kept more nearly uniform. But in such case it is better and cheaper to increase the power for there is no profit in a mill handicapped by lack of power.

Attention to proper speeding and maintenance is one of the most important elements contributing to successful saw operation. If the speed of the saw is too high it cannot be made to do good work, and is besides very liable to damage or accident. Too high speed will generate heat in the saw, make it limber, and it will only run and do good work on light feed, while the teeth are in perfect order, with keen, sharp corners, etc. As soon as such conditions are departed from, the saw will snake or dodge upon contact with the least obstacle. Then too, a speed not uniform or too low, a slowing down in the cut, from lack of power or overfeeding, is likewise objectionable and is attended with ill effects upon the saw and the lumber, although a saw may be hammered to withstand a low or variable speed to some extent.

Saws used on light portable mills are commonly speeded about 450 revolutions per minute, and those run on high speed fast steam feed mills, from 600 to 900 revolutions per minute.

THE PROPER FITTING OF THE TEETH.

The most perfect saw is one that will cut the easiest, the smoothest and the most in a given time, with the least expenditure of power. When the teeth are presented to the timber with just the right hook and pitch on the back, they will cut the kerf out in shavings and not scrape it into fine dust. But this does not mean that all of the dust will be cut into long shavings, for all timber is not sufficiently tough to hold together.

A light set, teeth short as possible, with plenty of dust room, all the hook they will stand, and there will be no trouble even in the hardest frozen maple.

In the care of saw teeth, proper attention must be given to hook, swaging, sidedressing, shape of the gullet and sharpening, and these details are exclusively within the province of the saw filer.

Fast feed saws usually have the hook line about half way between center and rim. Saws subjected to light feed will stand more hook and a slimmer tooth. Soft woods require more hook than hardwoods.

Use as much hook as possible up to the point where the strength of the tooth is not impaired, for plenty of hook facilitates cutting and is easier on the power. A saw with too little hook acts on a tearing or scraping fashion rather than a cut, and greatly taxes the power. But the hook affects the strength of the tooth. Too much hook, while easing the labor of cutting, reduces the strength of the tooth, making it liable to break out or dodge and lead out of line; too little hook unduly adds to the burden of sawing. The greater the

feed the larger should be the gullet and the lower the back of the tooth to give easy clearance and room for the dust. But you must avoid teeth too thin on the point or they will crumble on edge and lose corners. Teeth to run in frozen timber must have the back raised up or strengthened more than is required for summer sawing. But never allow the backs to get higher than the points or the hook to become too extreme.

A saw properly balanced from the standpoint of fitting must be perfectly round, must have teeth of equal size and shape and round gullets of equal depth, and must be swaged and sidedressed uniformly, or one portion of the saw will be heavier than another, causing it to leap and tremble, and make bad cuts. There is no excuse for running a *dull* saw, one dull not only on the extreme point, but also on the cutting edges of the tooth under the point. The points of the saw teeth are the only parts of the saw that should properly come in contact with the lumber, and require the most careful swaging and sidedressing.

THE SWAGING, FILING AND SIDEDRESSING.

The teeth of all saws wear narrowest at the extreme points, subsequently they must be kept spread, so they will be the widest at the very points of the teeth, otherwise the saws will not work successfully.

The points of saw teeth are variously fitted with full swage, spring set, or half swage and half set, and there are doubtless conditions where any one of the three forms may prove

1. FULL SWAGE. 2. HALF SET AND SWAGE. 3. SPRING SET.

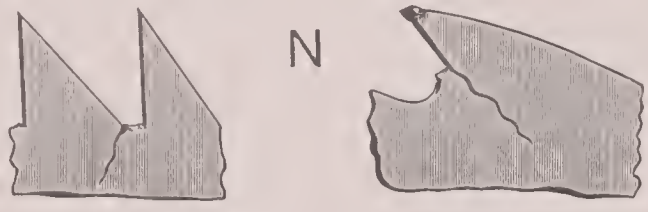
preferable to either of the others. But in general practice the full swaged tooth is considered the *only thing to run*. Fig. M illustrates these three forms for clearance. 1 shows the full swaging which is in all mills of any capacity accomplished by the use of an eccentric or direct pressure machine swage, although some use an upset or bar and hammer for the purpose.

Soft woods require more swage or set than hardwoods. A saw swaged full on both corners will do the fastest cutting and make the smoothest lumber, but requires the most power. It is not possible to always spread the points of the teeth exactly alike when swaging, but they may be readily reduced to uniform width and bevels by use of our File Sidedresser or by the use of Swage Shaper for circular saws. This insures smooth cutting and strong full corners that are not liable to break off in hard cuts. 2 shows a tooth fitted with half swage and half set, but neither this nor 3, which is fitted with spring set, are in general use except in mills poorly equipped with saw fitting appliances or on small factory saws having teeth too small or fine to be fitted otherwise than by hand filing and setting. In the case of a tooth fitted with spring set, the corner should be sprung close to the point, and may be filed slightly beveling on the under side and square on top, though most saw fitters prefer to file the face of tooth perfectly square, and bevel the back if any bevel at all is used. They consider that all splitting saw teeth should be perfectly square on the front and that it is absurd to bevel the front of a ripping tooth on any kind of saw, even a hand saw.

The object sought in beveling the tooth on the face is to have it present a full sharp edge on the outside. But this bevel must be very slight if used, for if filed with more bevel on one side than the other it will cause the saw to lead out or into the log. There is little to recommend the use of spring set unless it be to save power, or to save time, files and emery wheels, but this will be done at the expense of the quantity and quality of the output, except in case of saws where the use of a swaged tooth is clearly impossible.

The swaging can best be accomplished by the use of a Rhodes Upper or Under Swage, for large log saws, and a Bolton Resaw Swage for small circulars. (See page 14 for illustrations of swaging.) There are thousands of these machines in use, and there is absolutely no question regarding their efficiency or durability, and peculiar adaptation to swaging tempered saw steel. To secure uniform work from any kind of swage, it is necessary to keep the teeth of proper shape and thickness at the point and to swage sufficiently often. If the tooth is too slim it will be impossible to secure the requisite amount of spread or strength of tooth; if too blunt the swaging may be too heavy and may also strain the steel so much as to cause a fracture. It is therefore best for those that use a machine swage to swage every second, third or fourth time, as may seem desirable, and so keep the corners always out full, but without exerting an undue strain on the fibre of the steel. Do not attempt to run or swage or set a saw, if frosted, without first taking out the frost.

Teeth on all saws should be kept as near a uniform shape and spacing as possible, in order to keep the saw in proper balance and condition. Keep the saws round so that each tooth will do its proportional share of the work, or if a reciprocating saw, keep the cutting points jointed on a straight line. If a saw has long and short teeth, the long teeth will be subjected to the most strain, which may cause the saw to leave its line, heat, and give bad results generally. One cause of cracking lies in the saw getting out of round. The ends of some teeth crumble off and those next succeeding take all the strain. There are convenient and simple methods for keeping a saw properly jointed and there is no excuse for running saws out of round.



CRACKS FROM ANGULAR FILING.

Never file any saw with too sharp or acute angles under the teeth, but file on circular lines so far as possible as all saws are apt to crack from sharp corners. Fig. N illustrates some forms of sharp angular filing from which cracks may result.

FILING.

The greatest wear of a saw is on the under edge of the teeth and the wear under the point is in proportion to the amount or the extent of the feed. Thus if a tooth at each revolution takes out ⅛ of an inch, it will tend to become dull for ⅛ of an inch below the point, or more or less as you diminish the feed. File to a point but not to a thin wire edge. Do nearly all the filing on the under side of the teeth, and see that they are well spread at the point. File square and have the corners project alike on both sides of the saw. Do not try to run dull saws, for a few minutes spent with file or emery wheel will save ten-fold the amount of time and labor consumed in forcing a dull saw, besides making a saving in the power consumed and a heavy percentage of difference in the quantity and the quality of the lumber cut or resawed. It is just as essential to keep a saw sharp, as a razor or a plane, and a sharp saw requires less set, takes less power, cuts cleaner and smoother, and is in every way superior to one not in good order.

If you use an emery wheel in sharpening, which should be the case on all saws having a gullet of sufficient size to permit the use of emery wheel, avoid the erroneous notion that an emery wheel gums rapidly by being forced upon the work. Such action only tends to heat the saw red hot, causing it to glaze or caseharden, so that the file will not touch the steel in pointing, besides rendering the plate liable to crack or the points to crumble. Then,

too, undue gumming or heating of the plate on the rim, causes expansion to such an extent that the plate may buckle or run unevenly, and render hammering immediately necessary. The avoidance of ill effects is better than their cure.

Most filers consider it desirable to point their saws with the file, after sharpening with the emery wheel, to remove any bur or feather edge, and any glazed or hard spots that may have been formed, as by so doing the points of teeth stand better and it will prevent the starting of cracks at glazed spots.

GENERAL OBSERVATIONS ON CIRCULAR SAWS.

If a saw is properly adjusted and everything about the machine right, it should run cool or nearly so.

If the saw heats at the center, it is usually either the fault of the mandrel heating or the collars not being properly turned, or the carriage being out of line, or the saw being run with too little set.

If the saw heats at the rim it may arise from leading too much into the log, causing it to bear too hard against the outside guide, or the backs of the teeth may be too high, or the saw may be trying to cut more than it will chamber.

If a saw is run at a higher rate of speed than that for which it is adjusted, it will be too large on the rim and will run in and out or "snaky." On the contrary, if the speed for which it is adjusted is not kept up, it will be too large in the center and is disposed to dish or run out of the log.

If a saw inclines to run out of the log, give it a little lead, and if tight on the rim increase the motion to expand the rim.

If it inclines into the log, lead out by filing the points of the teeth or adjusting the mandrel.

If it runs in and out, lead into the log, file the points of the teeth to lead out, and if necessary reduce the set of the teeth. This will cause the saw to warm a little and expand.

If it heats at the center while the mandrel runs cool, line into the log a trifle and increase the set. If it heats at the rim and not at the center, line out of the log a trifle.

As the saw enlarges on the rim by wear, lead out a trifle to expand the center and equalize the tension of the rim.

The track must be solid, level and straight.

The carriage trucks must be free from end play, and the set works accurate and positive.

The saw arbor must be abundantly heavy, level, with very little end play, and the saw must hang plumb.

The saw must have an easy, close fit on the mandrel and lug pins have a good fair bearing.

The tight collar should be slightly concaved; the loose collar flat.

The saw should stand straight on the log side, when the collars are screwed up and the saw running at the required speed.

The saw must be in line with carriage and lead a trifle into the log.

The saw must be in perfect round or balance.

The gullets must be properly shaped and sufficiently large to chamber the dust.

The backs of teeth must not be higher than the points.

The teeth must be filed or sharpened perfectly square on face and back.

The swaging must be sufficient for perfect clearance, and should be evenly balanced.

The guides must be perfectly adjusted when the saw is standing still or lightly running.

The saw must have sufficient teeth for the amount of feed.

The saw must be properly thick for the character of the work.

The teeth must have proper pitch for fast, free cutting.

The mandrel and carriage must each be free from spring.

The mandrel must not be allowed to heat in the bearings.

The saw must be kept sharp, and not run when dull.

The teeth must be sidedressed to make the extreme point and face of the tooth the widest with a proper taper or clearance down and back from point.

The spread of the swaging must be sufficient to properly clear the blade of the saw to prevent friction.

The speed ought to be uniform both in and out of the cut.

Do not lead the saw with the guide pins, but by slueing the mandrel or proper filing.

Reduce the set or spread of the swaging if you wish the saw to run warmer at center.

Increase the set or spread of the swaging if the saw runs too warm at center.

Increase the gullet or lower the back if the saw heats on the rim.

Increase the motion if the saw is too tight on the rim. Keep it cool in the center.

Don't set the guide pins too close or the saw will heat at the rim and run snaky. Keep the saw free from gum by proper swaging and the use of water, or the rim will heat from undue friction.

Keep your swage and saw sharpener constantly in good order. Fair, evenly balanced swaging, taper side dressing and perfect sharpening, are essentials to a fine cutting saw.

Keep all gum and saw dust off the tracks.

Don't use over $^{3}/_{32}$ set equally divided on the saw.

Do not attempt to straighten a saw until it shows about the right amount of tension for your work. Straighten on a padded anvil or a block of wood. None but sawmakers or expert hammerers attempt to level a saw on the bare anvil.

In testing a dished saw lean it over until it shows as nearly straight as possible, and then test with straight edge. Otherwise you will not be able to locate the lumps.

Heavy blows must be carefully avoided, and blows unduly hard near the eye have a greater tendency to dish the saw than if placed near the rim.

You may get your saw too open for your speed, in which case you have only to reduce the amount of the expansion by blows around the rim, as previously described.

The use of the sharpener, and the constant strain on the saw near the rim will presently enlarge it here and so render necessary the expansion of the central portions until it is necessary in hammering to go right down to the eye.

A saw with the tension too near to the eye is not likely to slab well. A saw when put up for its speed will cut well in any kind of timber and without special adjustments of the guide for various woods.

A saw used for work in frozen timber needs more tension than for summer work.

With many small mills it is a common fault that the power is insufficient for the load and the speed of the saw is therefore far from uniform. The motion is up when the saw enters the log and is down when it leaves the log. The next cut starts before the saw had recovered its normal motion. If then the saw runs out, you get a thin board, or if it runs in, a thick one. If saw heats on rim but does not snake you have too much lead; if it warms on the eye there is not enough lead. Saws that are laid over or dished out will warm on the eye; if dished in, will warm on the rim. If motion is steady in any cut, and the saw snakes, the saw is not open enough. When saw is too open you get thick and thin boards.

Saws should run at high speed to accomplish the best results. Short, slim teeth can be run on lighter cuts. High speed saws will stand heavier feed in proportion to the length of the teeth than low speed. Long teeth will not hold corners well.

The use of water on circular saws is helpful in keeping the saw cool and free from gumming. The piping may be so arranged that if the water is required at any particular part of saw it may be there applied. Water is also used successfully running into the journals of the saw shaft. A small rather than a large stream will do the work, and a tiny jet is often all that is needed.

CAUSES FOR HEATING ON THE RIM.

Saw not open enough in the body for the speed.
Accumulation of gum or pitch on the teeth.
Teeth without sufficient swaging or set.
Backs of the teeth too high for clearance.
Gullets too small to chamber the dust.
Guide pins set too close to the saw.

CAUSES OF HEATING AT THE CENTER.

Saw too open in the body or center for the speed.
Teeth without sufficient swaging or set.
Mandrel running hot.
Saw lined too much out of the log.
Saw dished too much into or out of the log.
Speed insufficient to expand the rim.
The remedies for above should suggest themselves.

Use large collars not less than 8 inch diameter for a 60 inch saw. It is said that for every 1½ inch you add to the size of your collar you can take 1 guage off the thickness of your saw. A 10 guage 60 inch saw with 9 inch collars will do as good work and as much of it as an 8 guage saw on a 6 inch collar. The collars should have from ⅝ to ¾ inch bearing surface on the saw, the balance turned out clear; the collars should be of good tool steel, for loose collars made of cast iron are not stiff enough, as the center is liable to be squeezed in by the nut and the saw is not properly clamped.

The guides should be as near to the cut as possible and rigid, with as little opening as possible, although the sawyer must regulate the guides according to the condition of the saw. Cow's horn makes one of the best and most durable guide pins known. The guides should be within about 1 inch of the throats of the teeth.

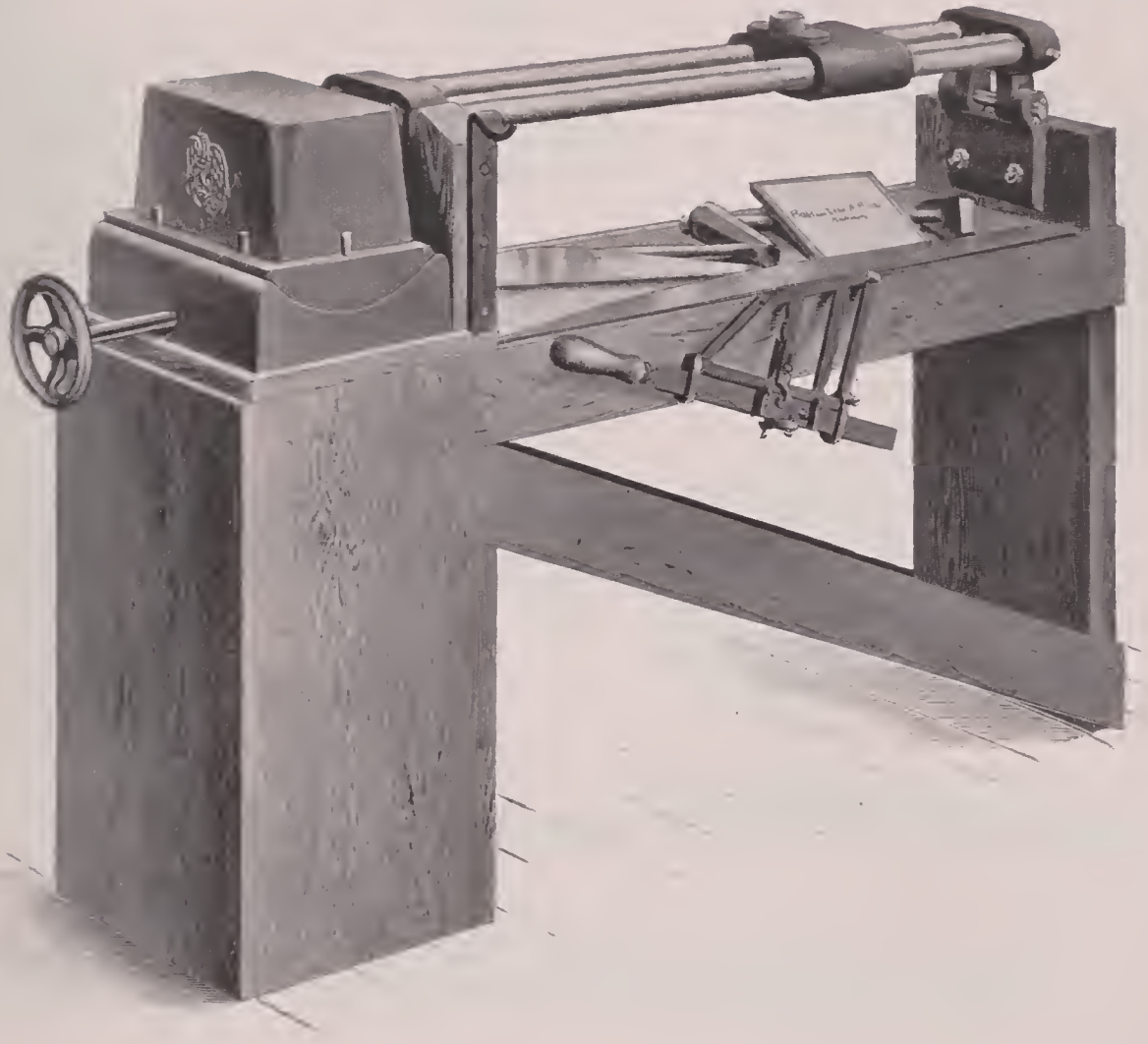
Small, light mills having too many teeth in the saw for a full swaging, should run half swage and half set.

TWO HUNDRED PAGE CATALOGUE.

Our 200 page catalogue of Saw Fitting Appliances will be mailed free on request.

The book contains illustrations and descriptions of our entire line of 60 or more machines for the care of saws.

We illustrate a few of these machines and tools in the following pages.



BOLTON CIRCULAR SAW HAMMERING BENCH, NO. 80.

SAW TOOLS.

PRICE LIST OF SAW TOOLS.

(NO FILING ROOM COMPLETE WITHOUT AN OUTFIT.)

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(See cut and description. Instructions Books, by mail postpaid, on receipt of price.)

B. T. & B.'s Book on Bands, Gangs, Circulars and Resaws $2.00
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Any two for $3 50 or the three for $5.00.

BEST HAND FORGED STEEL SAW HAMMERS.

Finely ground and polished; mounted with handle; made to order any style; in weight from one to ten pounds. Regular styles are *doghead, crossface, twist face, combination* and *swaging* hammers.

Circular, Band or Gang Saw Hammers—Doghead and Crossface ..... per pair, $5.00
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Single hammers of any style furnished as follows:

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3½ lb. at 2.75	6 lb. at 4.00	8 lb. at 5.00
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BEST STEEL STRAIGHT EDGES AND TENSION GUAGES.

Straight Edges, from 4 to 120 inches long, 10 cts. per inch, or $1.00 per foot.
Tension Guages, 6-inch, 75 cts.; 8-inch, $1.00; 10-inch, $1.25; 12-inch, $1.50.
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Surfaced both sides. Made to order any thickness or face.

12 x 48 x 3 at $25.00 12 x 60 x 3 at $30.00 12 x 72 x 3 at $35.00

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EAGLE STEEL FACED SAW ANVILS—WARRANTED.

The best to buy because face is in one piece of best cast steel, of uniform, hardest temper, perfectly welded, and warranted never to settle or change from a true surface.

We can furnish over one hundred different sizes, but sizes listed are those most used.

Face, 8 x 5	Height, 5½	Weight abont	60	pounds.	Per pound, 12 cents.
" 10 x 6	" 5½	"	86	"	" 12 "
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" 10 x 14	" 8	"	300	"	Price, $35.00
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" 10 x 16	" 8	"	360	"	" 43.00
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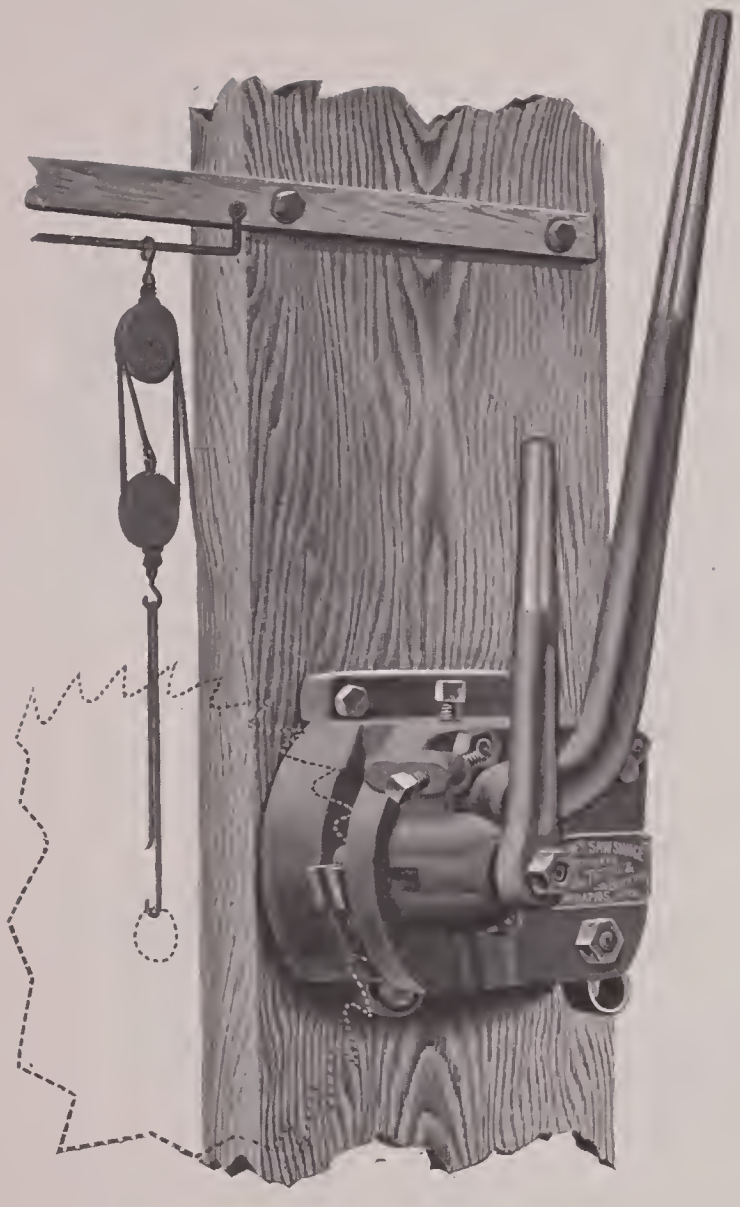
Crescent Saw Gunmer 25.00
Wright's Non-Friction Band Saw Gnide (for saws 1/16 to 1-inch wide) 10.00
Brazing Tongs for Bands 1½-inch or under 2.00

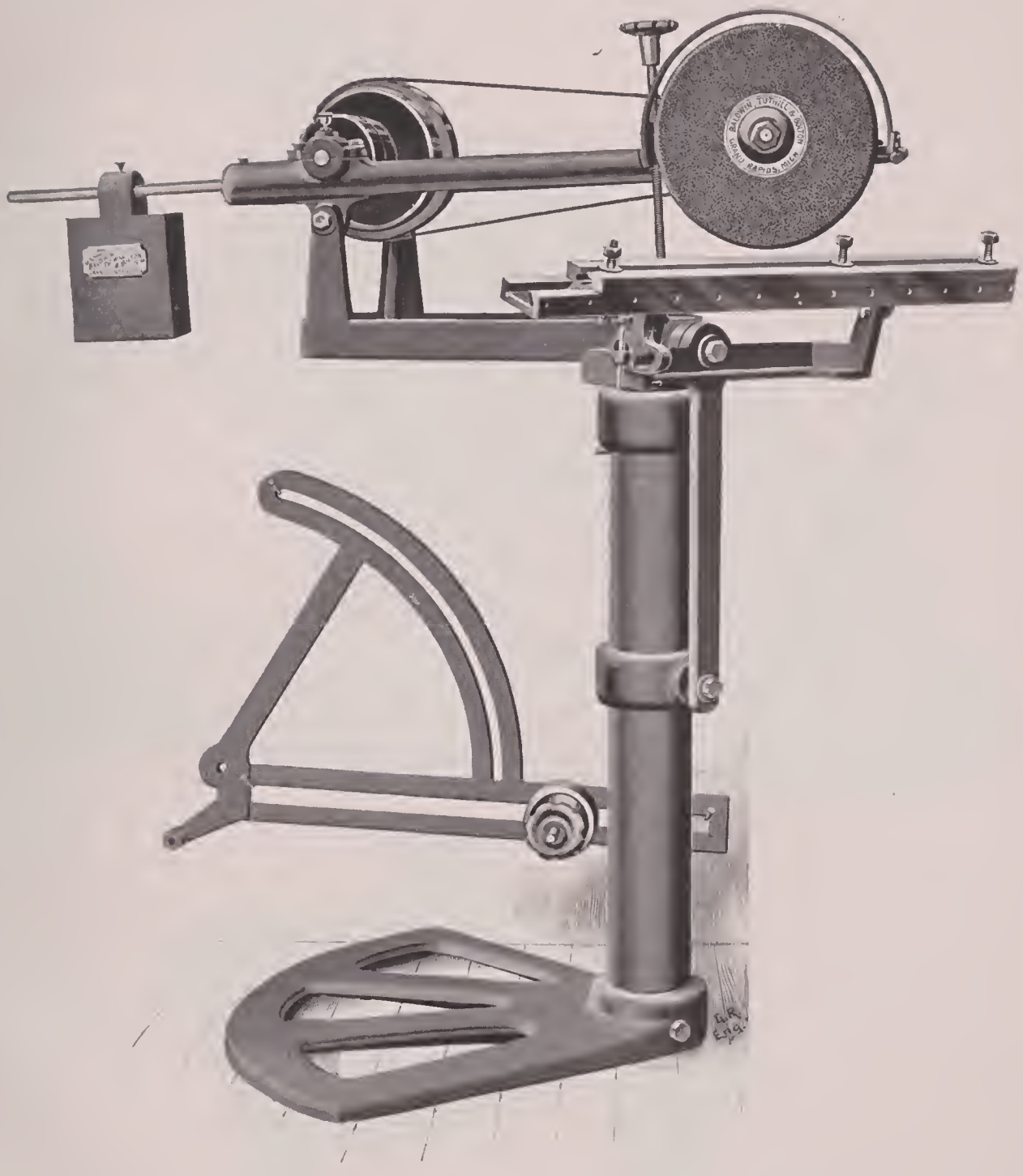


SWAGE IN OPERATION.

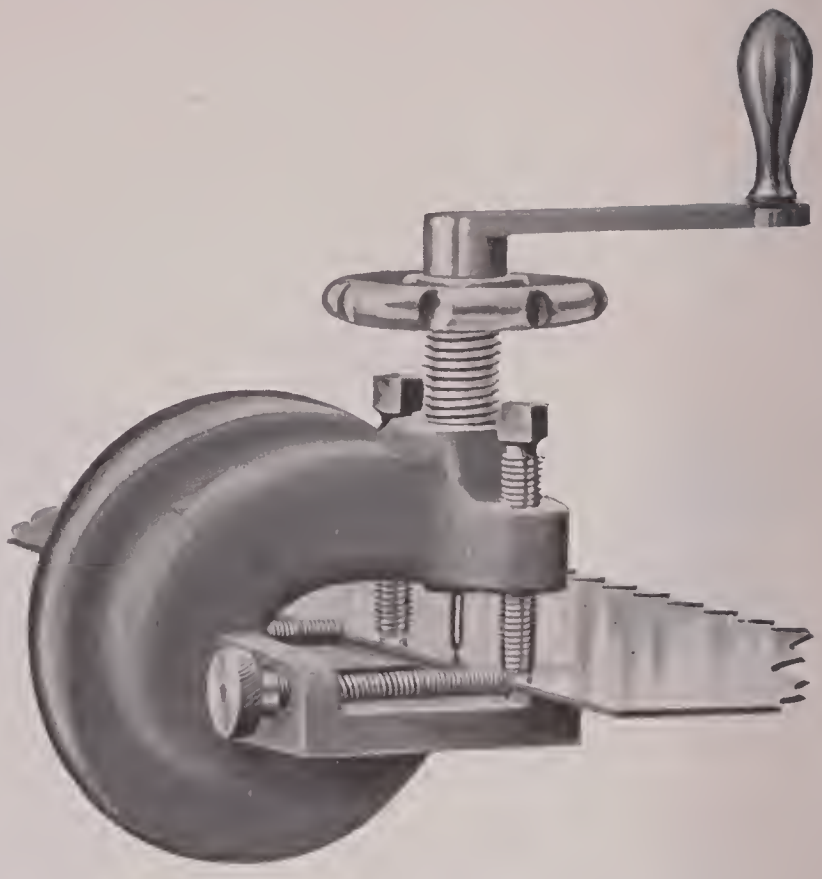
SECTIONAL VIEW.

RHODES UPPER CIRCULAR OR GANG SAW SWAGE.

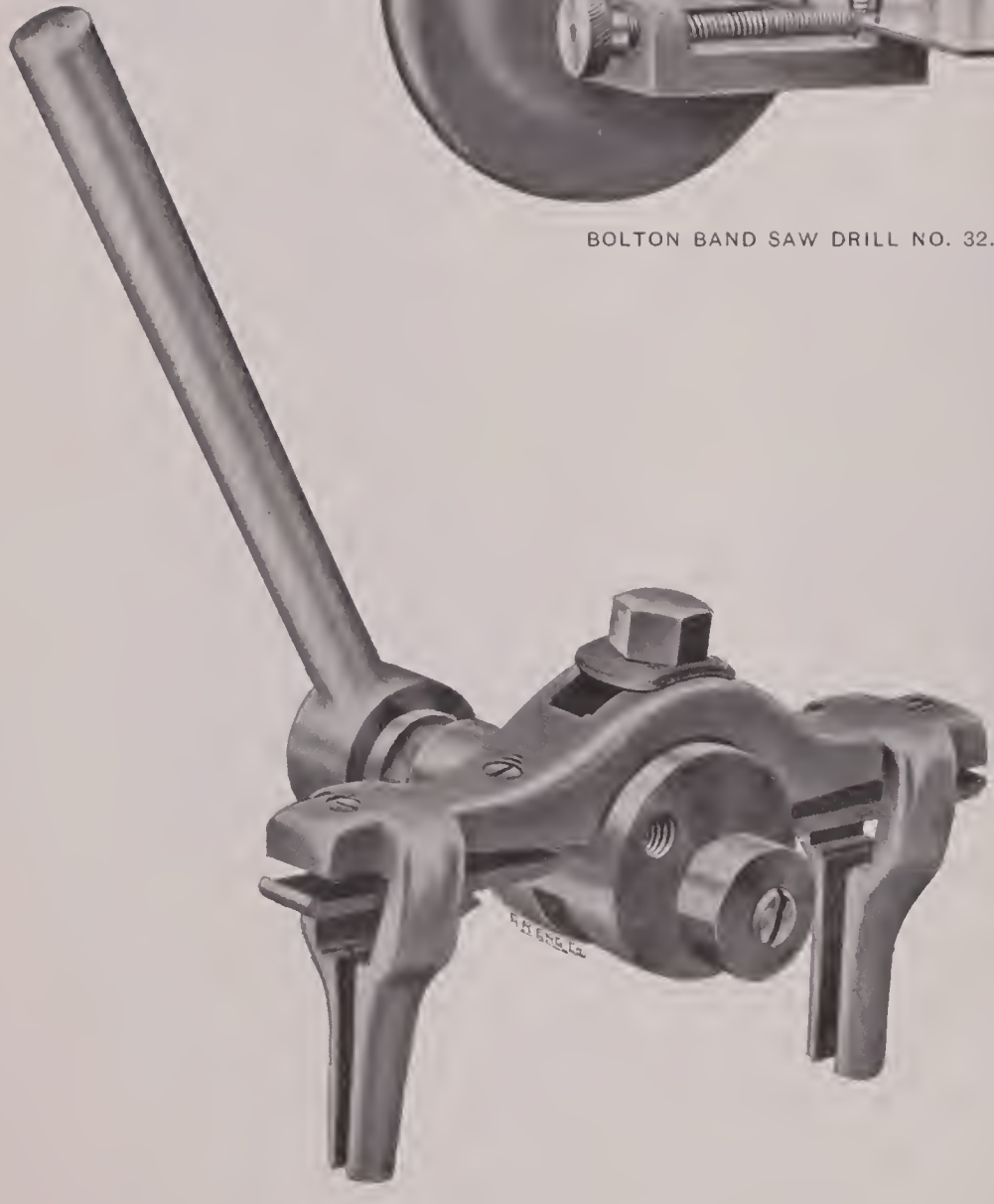
(For solid Saws or Chisel Bits, 5 guage or lighter.)



BOLTON 72-INCH HAND RIP AND CUT-OFF GUMMER, NO. 75.



BOLTON BAND SAW DRILL NO. 32.



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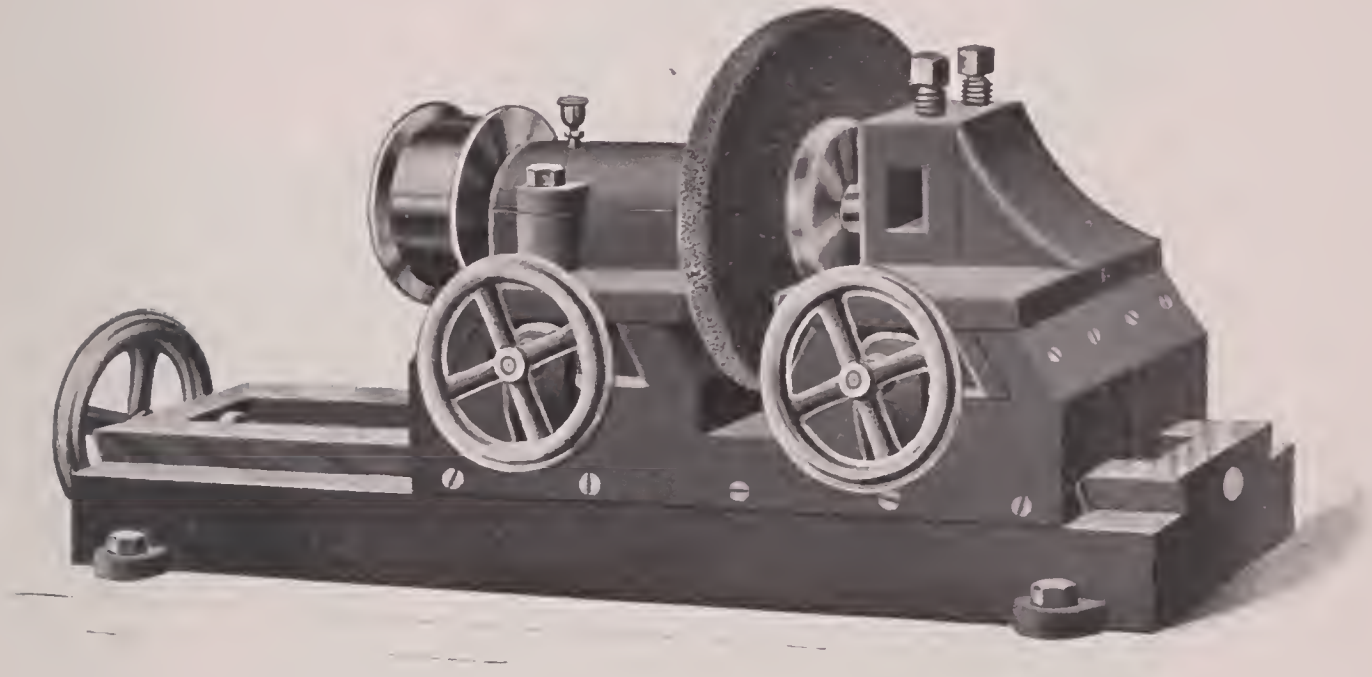
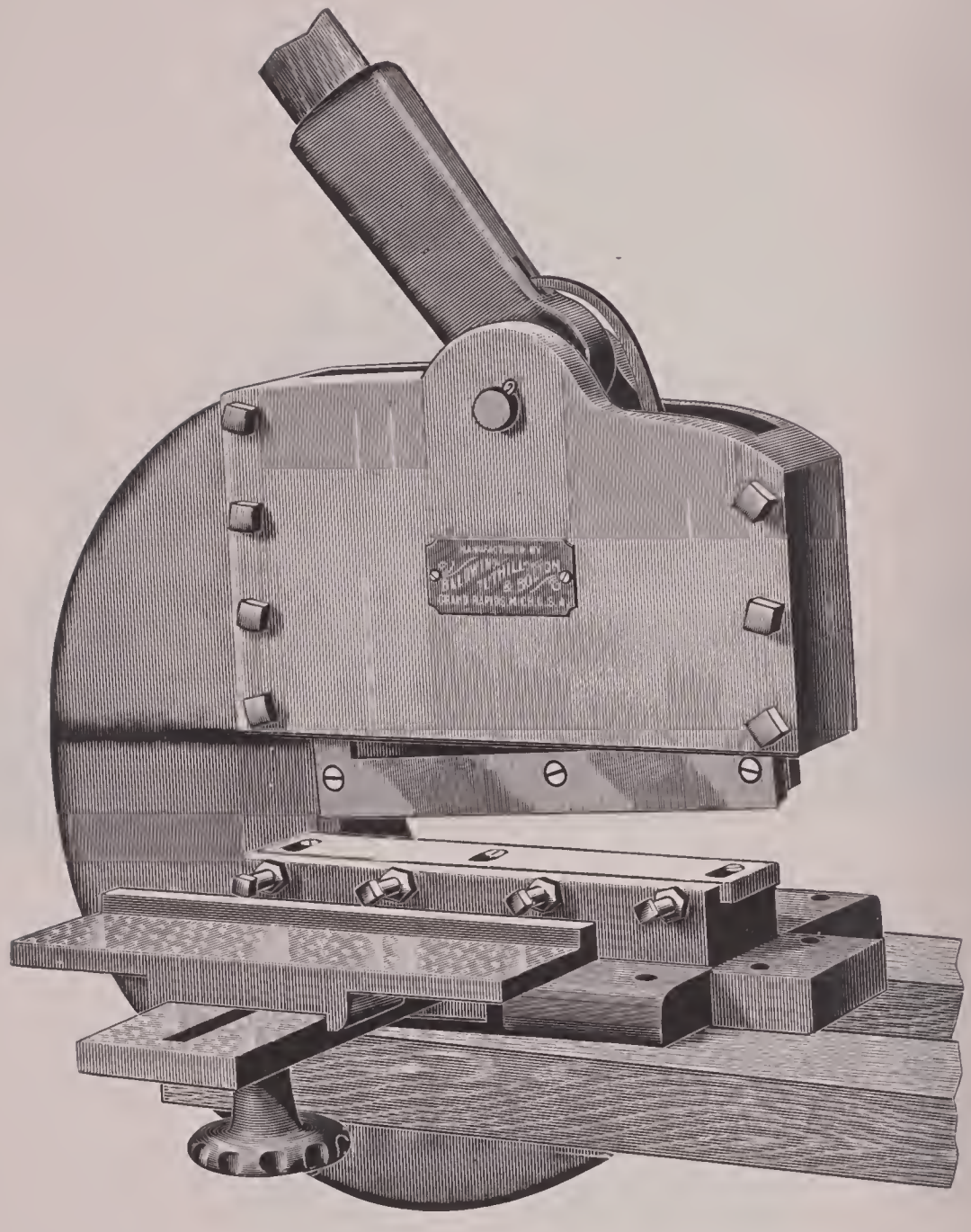
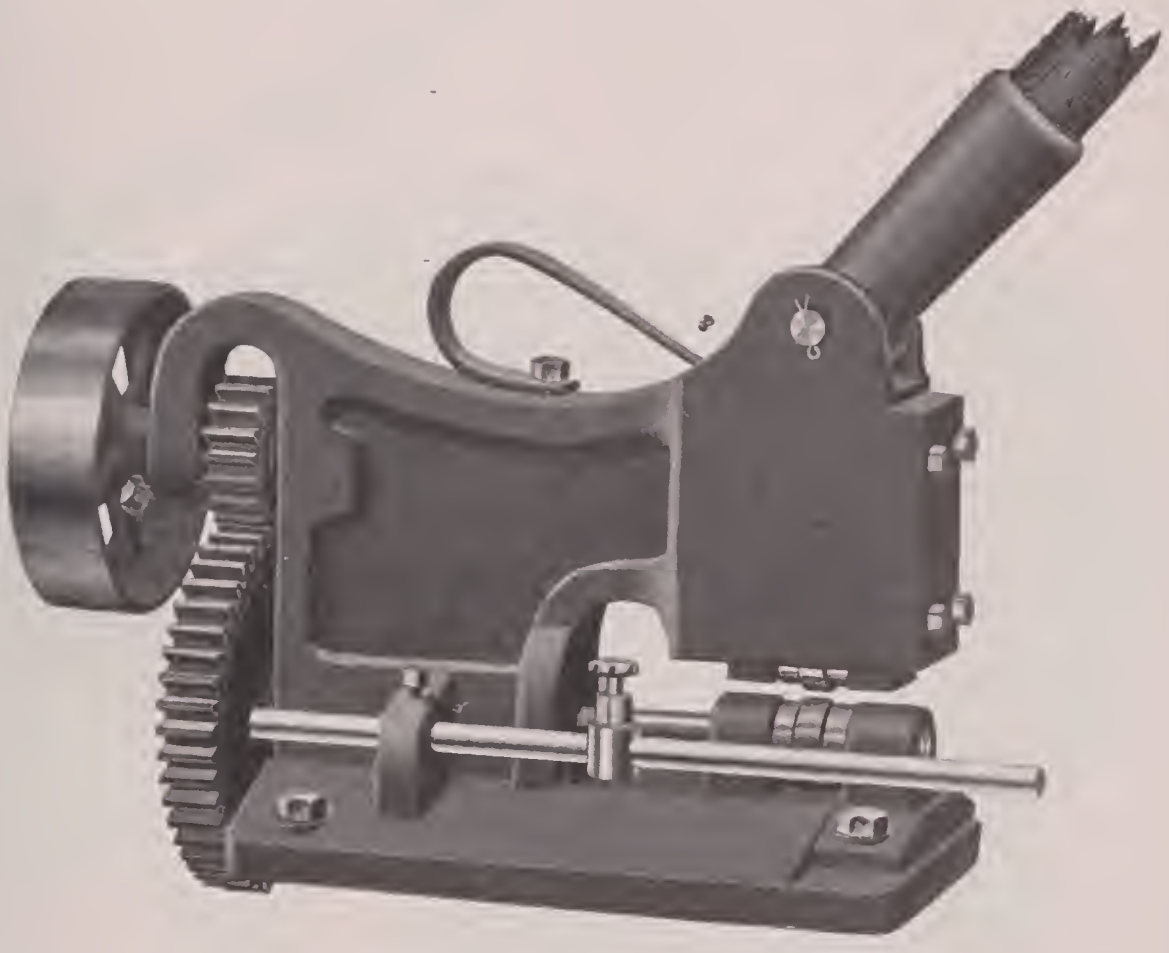


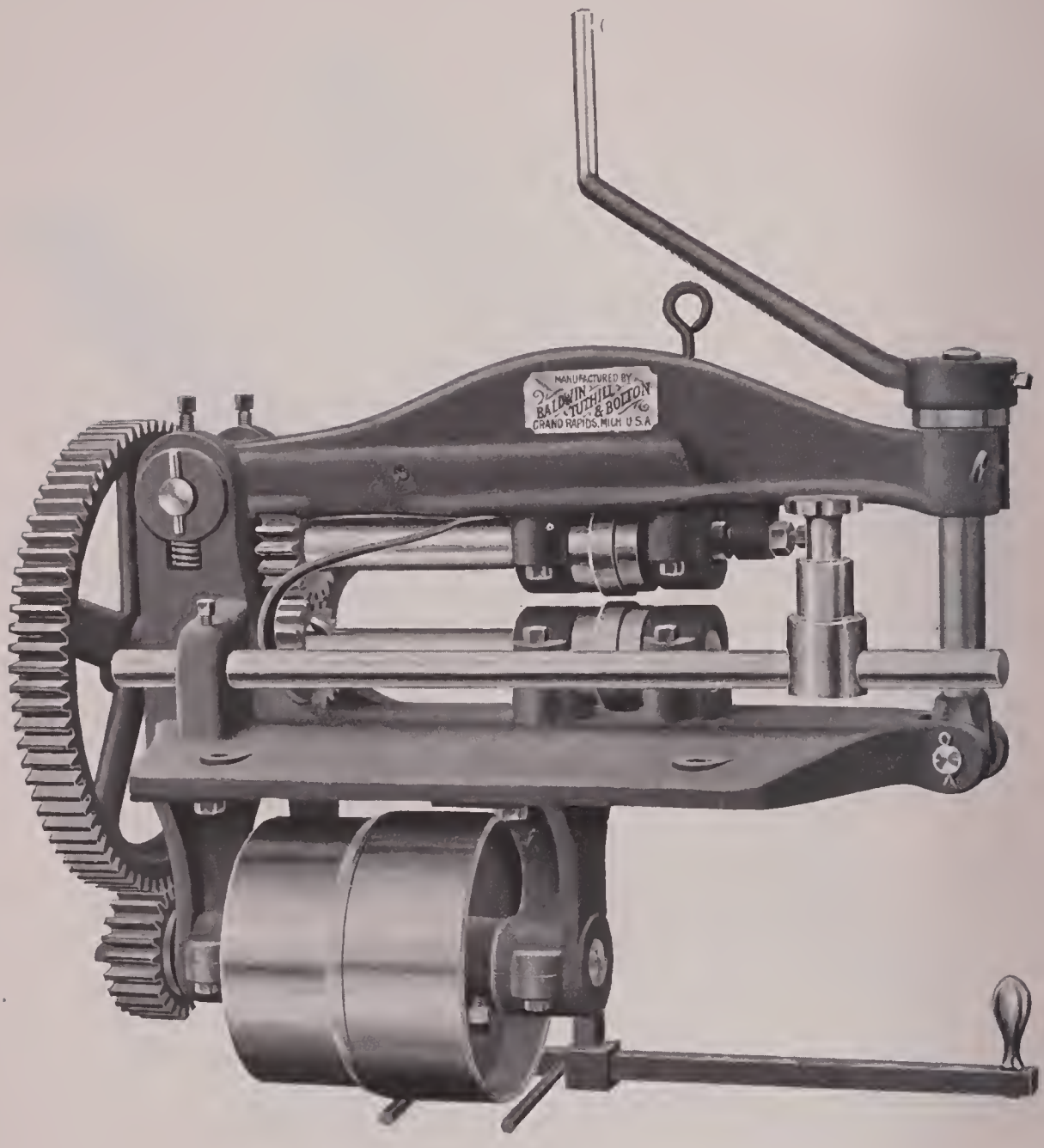
THE BOLTON BAND WHEEL GRINDER WITH TOOL ATTACHMENT NO. 27.



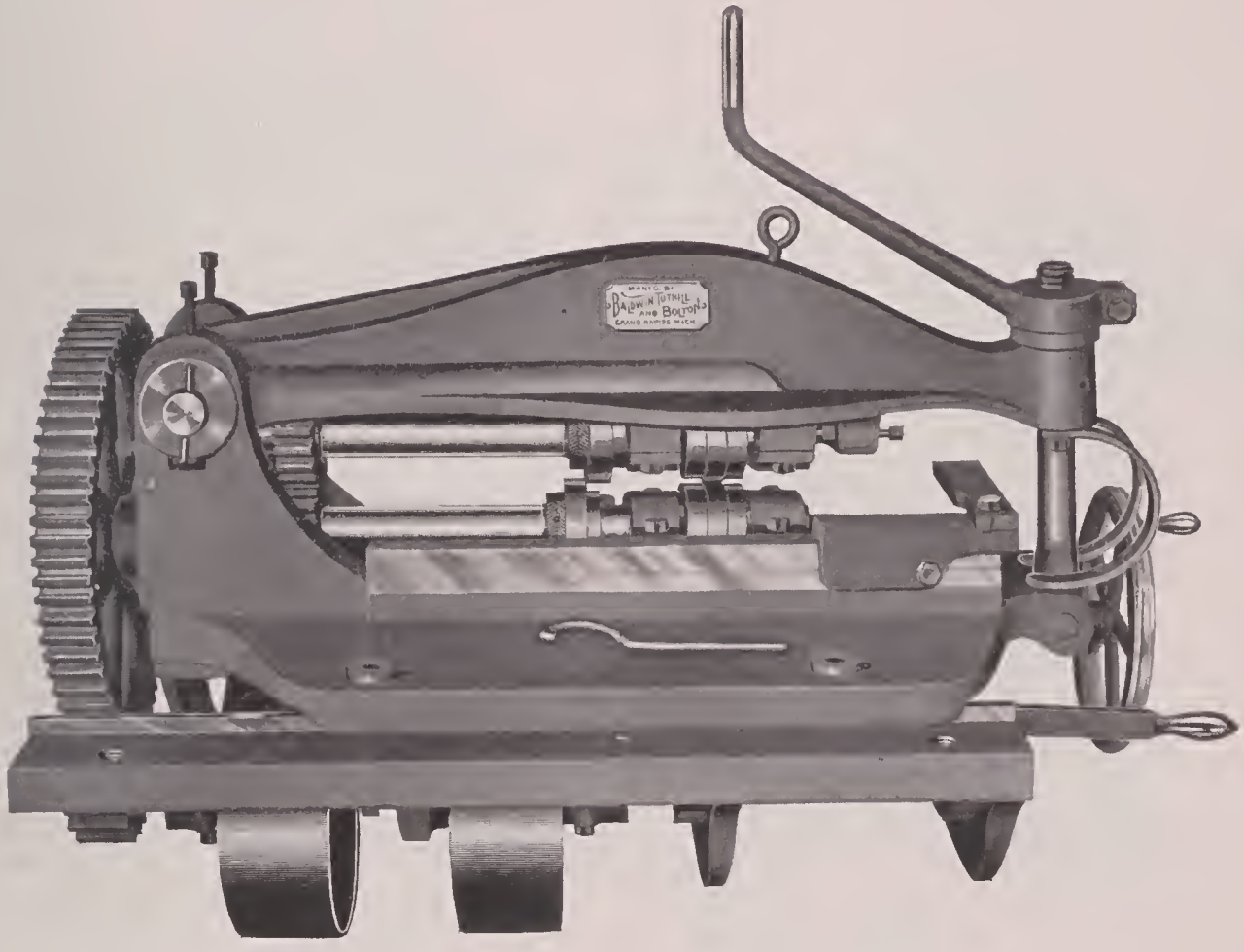
BOLTON 12-INCH SHEARING AND CROSSCUTTING MACHINE, NO. 15.



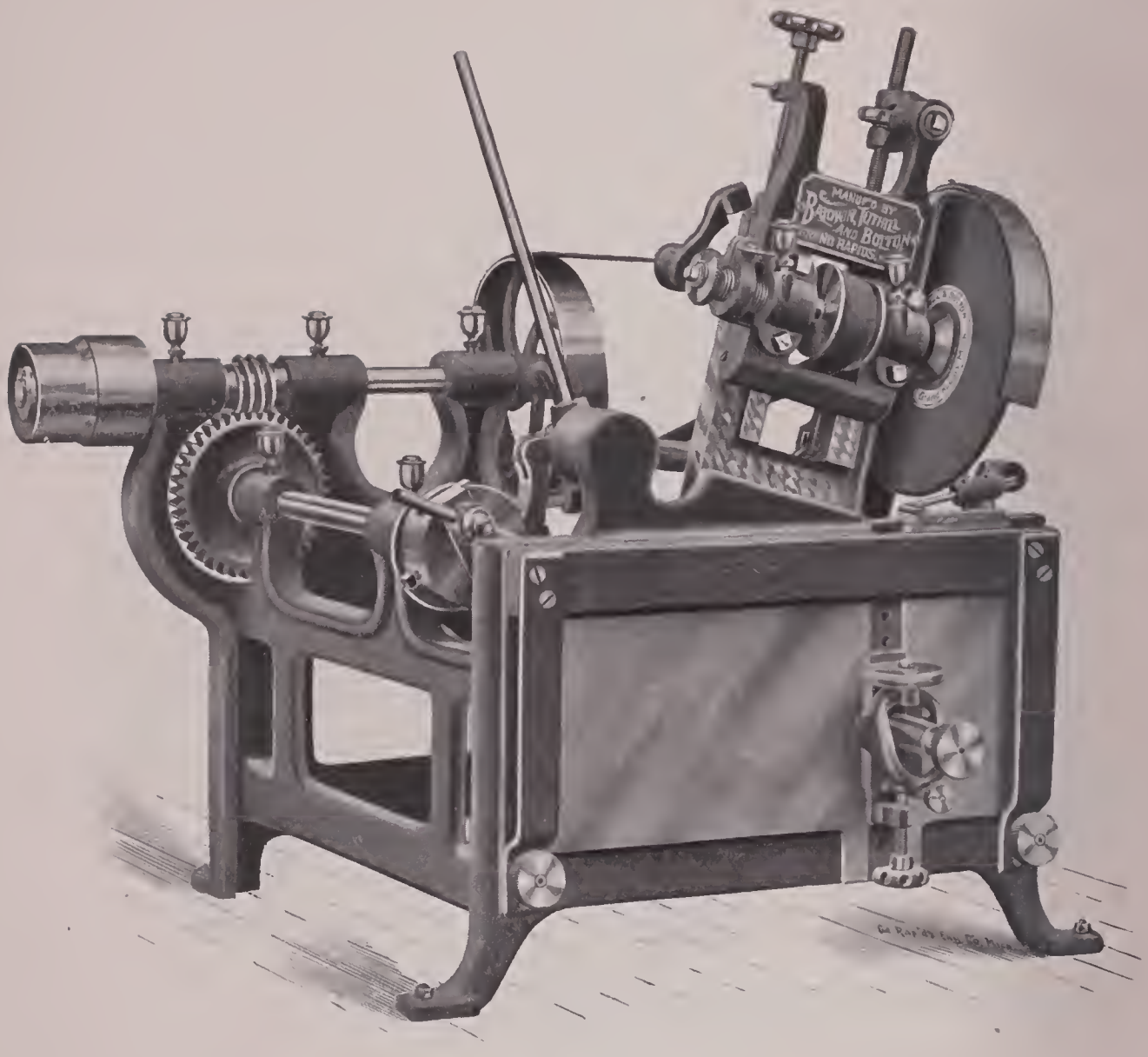
BOLTON BAND RESAW STRETCHER NO. 9.



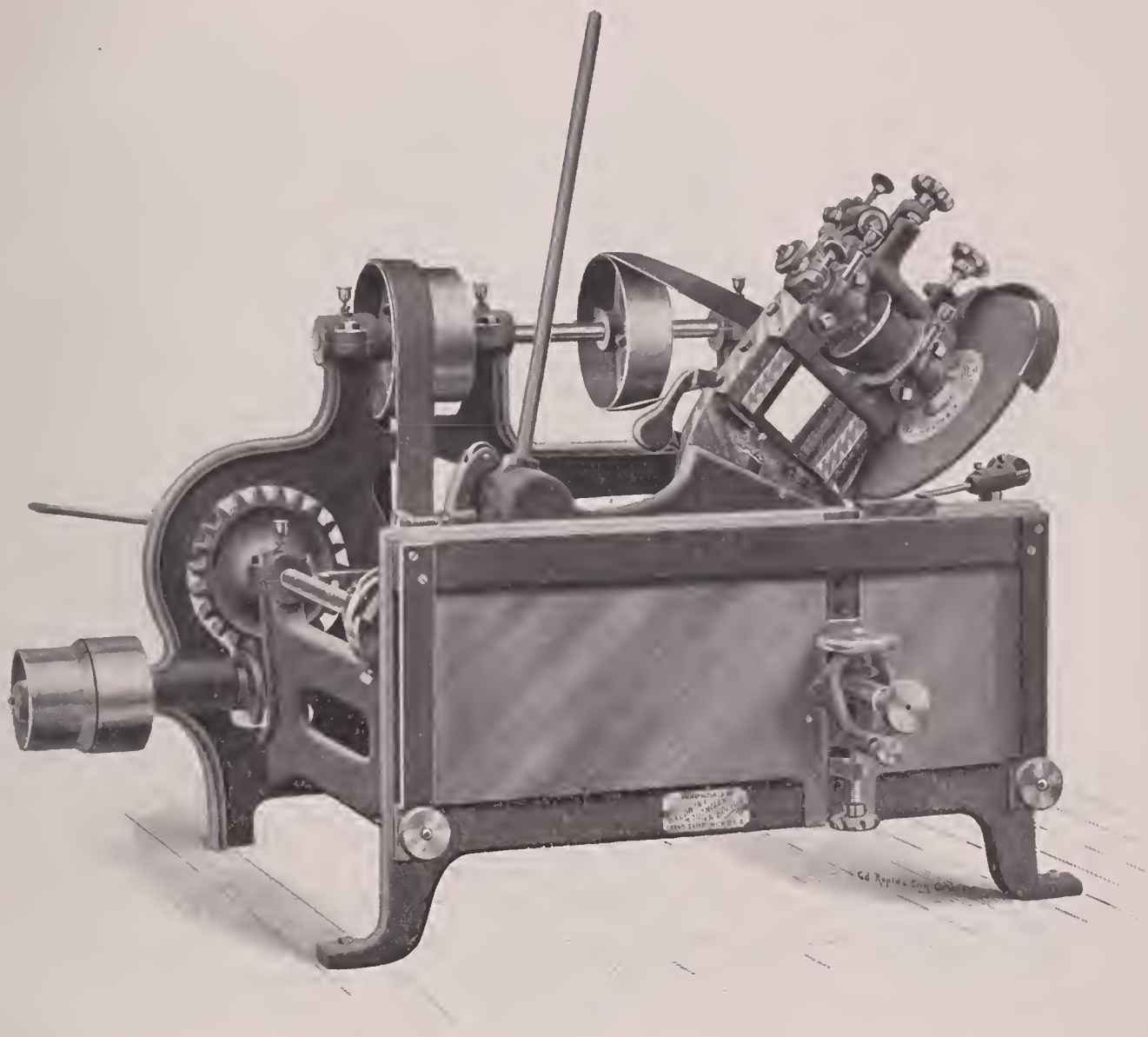
BOLTON LARGE BAND RESAW STRETCHER, NO. 8.



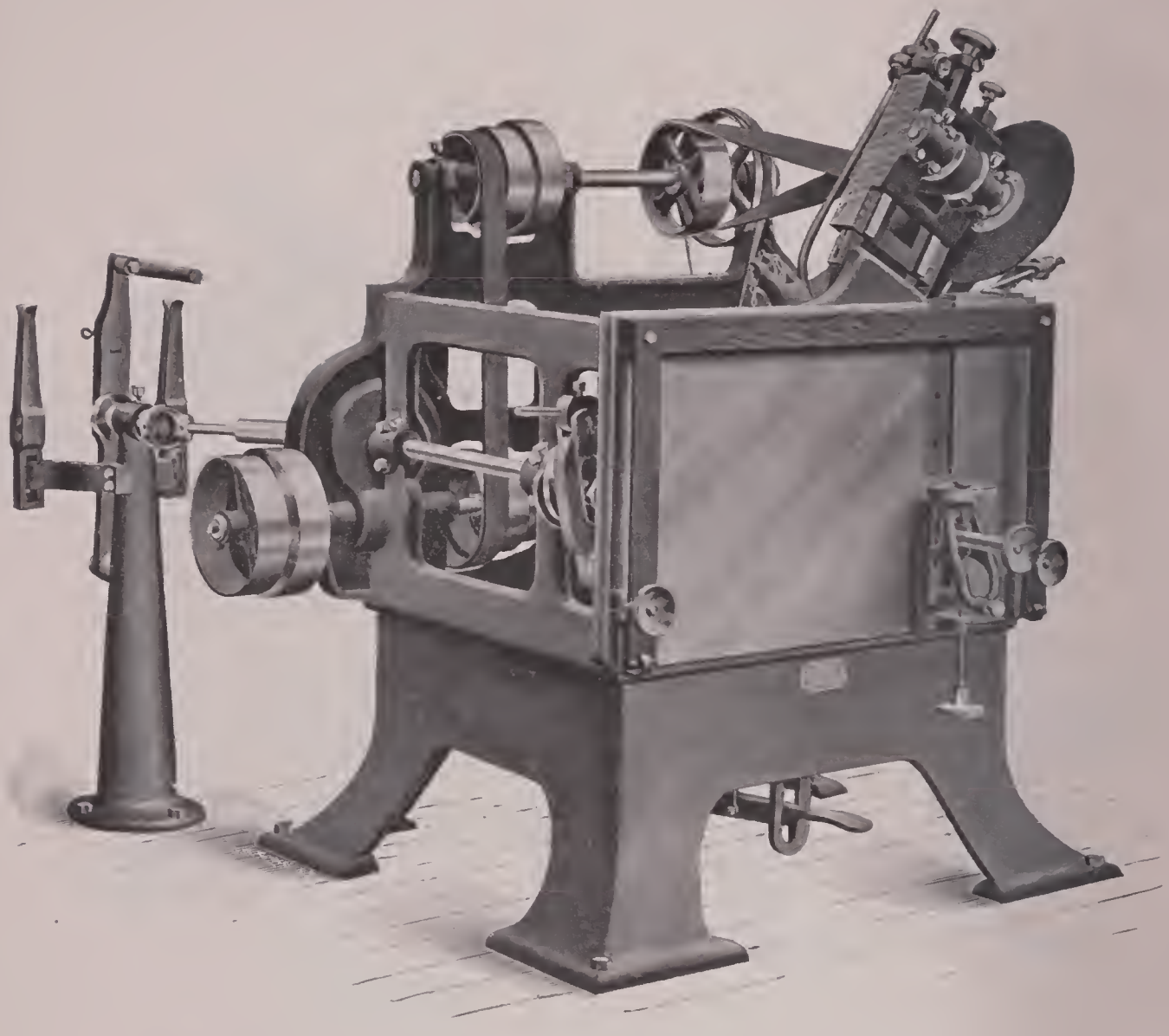
BOLTON MOVABLE 12-INCH STRETCHER AND SHEAR, NO. 5.



BOLTON 7-INCH BAND RESAW SHARPENER NO. 3, R. H. OR L. H.



BOLTON 10-INCH BAND SAW SHARPENER NO. 2, R. H. OR L. H.



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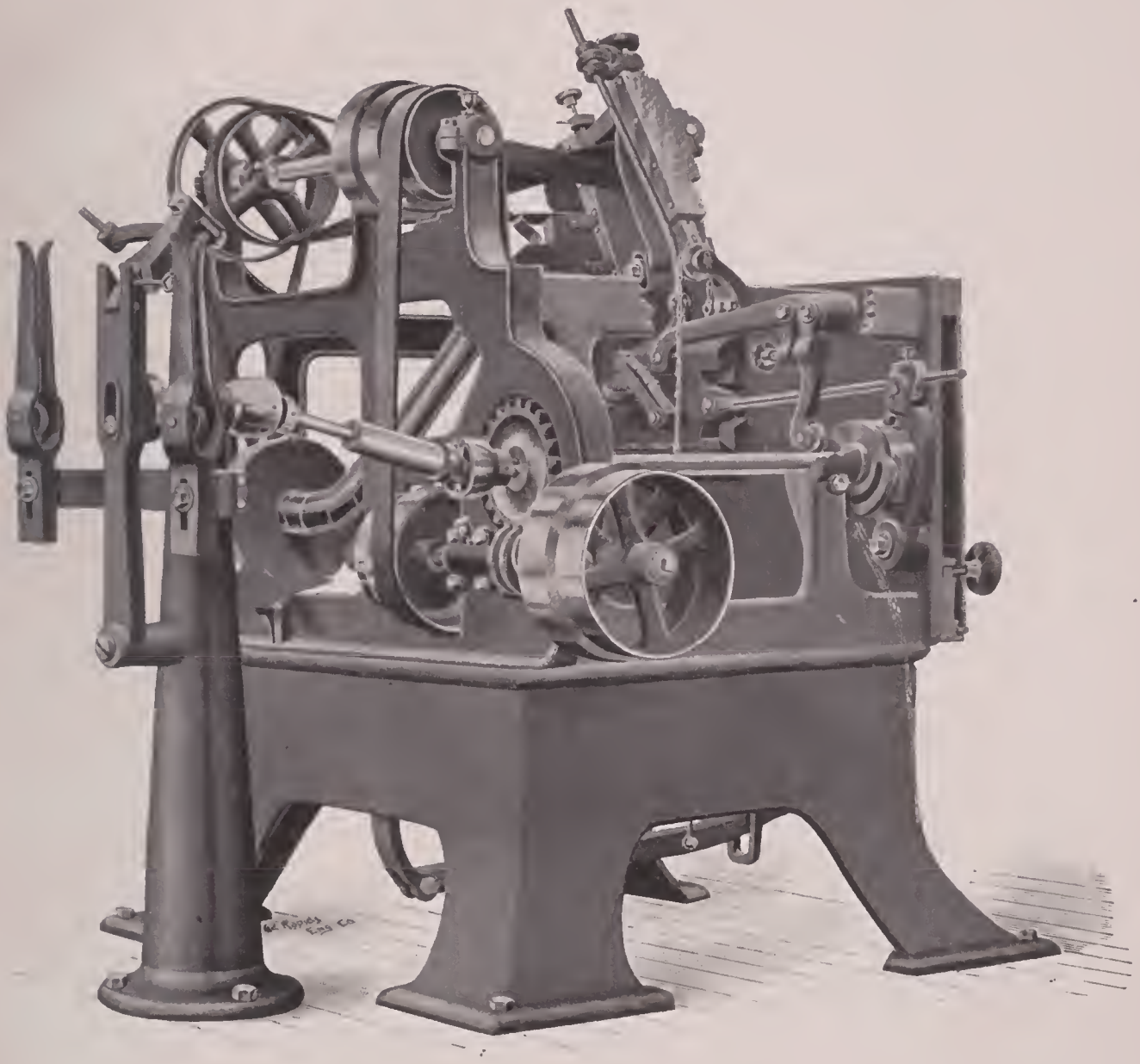
FRONT VIEW.



BOLTON 14-INCH BAND SAW SHARPENER NO. 1. R. H. OR L. H.
BACK VIEW.

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