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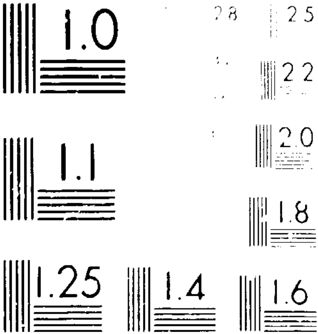
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THE MAINTENANCE OF WIDE BAND BLADES IN SAWMILLS*

by

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** Expert in wide bandsawe

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Maintenance of blades

Band blades cut more effectively if they are subjected to suitable treatment before being fitted onto the relevant sawing machines. Special tools are absolutely necessary for blade treatment. Any failure to take these precautions will result in serious production losses and unforeseen rises in costs. Blade treatment is carried out in the same way for all types of band saws. However, the maintenance of log-sawing blades entails more work and requires more time because the size of the blade is larger. In the following pages a brief description of each particular process is given as well as a list of the auxiliary tools required for each operation. In this description, the various maintenance operations are set out in the order that appears to be most suitable for the purpose; it is clear, however, that it need not be followed to the letter.

Rather, each operation should be performed after inspecting the blade, hence taking the necessary steps.

Cleaning and inspecting defects;
Eliminating cracks;
Welding or brazing the blade;
Checking blade flatness (levelling);
Straightening the back of the blade;
Tensioning;
Swage setting or spring setting of the teeth; and
Sharpening the teeth.

The work environment

All the maintenance operations should be performed in a large and well-lit workshop (Fig. 1), with enough room for the machines and blade storage. Blades that are ready or are being serviced should be stored in such a way so as not to hinder the movements of the personnel in charge of blade maintenance and prevent damage either to the workmen or to the blades. The shop should be provided with wood flooring, in order to prevent damage to blades during maintenance, making sure it is always clean and not slipery.

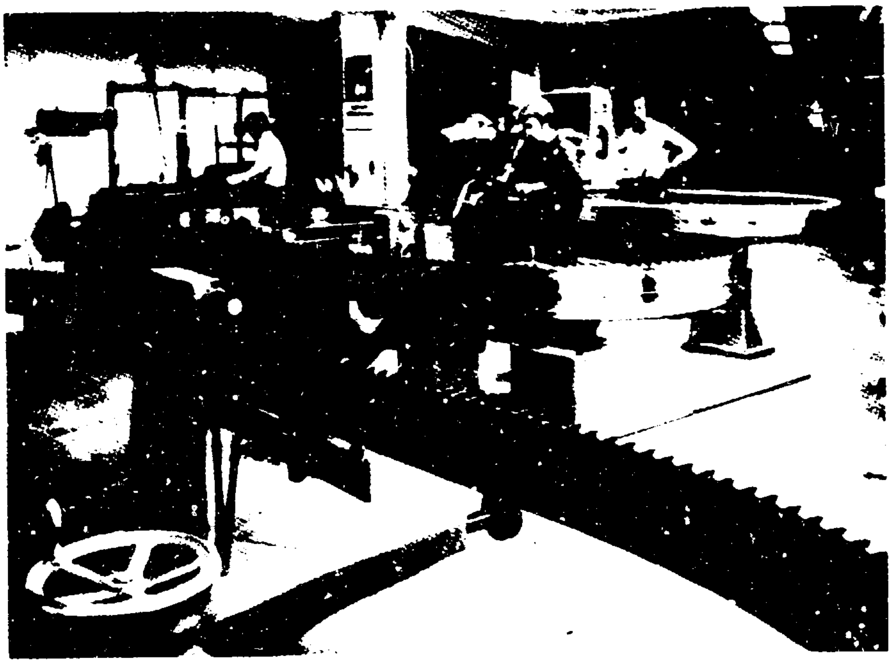

Fig. 1: The work environment

The following equipment should be included in the maintenance shop:

A) Straightening bench;

B) Sharpening machine (two types);

C) Automatic swaging devices or equipment for manual swaging or setting;

D) Brazing or welding machine with relevant tools;

E) Hand lever shears for cutting the blades;

F) Tool cabinet;

G) Blade rests.

Cleaning and inspection of defects

These operations can be best performed if they are carried out on the same bench on which the blades are straightened out and tensioned. Remove any saw dust deposits present on the blade; if it is possible, do this as soon as the blade is removed from the machine, namely, when the sawdust is still moist and can, therefore, be removed easily. Alternatively, wet the blade with crude oil and pass a steel scraper across its whole length.

Make sure, however, that no transversal scrape-marks are produced in the blade because this may eventually lead to the formation of cracks.

Clean also the tooth hollows since any chip residues present there may set on the grinder during sharpening. A medium-hard brush is recommended for this operation.

Cracks

Check whether there are any cracks in the blade, preferably through a magnifying glass. If there is only a limited number of cracks and their depth does not exceed a few millimeters, they can be eliminated through filing. One can either use a round file or grind the hollow of the tooth right down the whole length of the crack (Fig. 2).

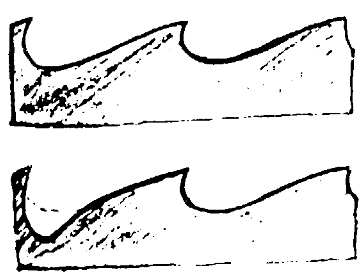

Fig. 2: Bottom of tooth after elimination of crack by means of filing.

In order to prevent isolated cracks from extending to depths exceeding 8 mm, a hole with a diameter of approximately 3 mm can be made at the end of the crack. However, if the cracks are numerous and deeper than this, the blade should be serrated anew. Longer isolated cracks can be eliminated through "stitching", as described in the section "crack welding", or through rewelding.

Brazing with heated tools

The brazing of a blade requires a considerable amount of time and, above all, utmost care. If care is not taken, this operation will have to be repeated shortly afterwards.

The brazing equipment consists of:

- Tool-heating forge or furnace
- Brazing machine
- Brazing tools (two units)
- Deoxidizing solder
- Chamferer or file chamfering device
- Scriber
- Vernier gauge
- Back square
- Hand lever shears
- Forging gun
- Weld filing rest
- Various files
- Micrometer

The blade should be marked off and cut exactly where it is to be soldered; in order to do this, use the scriber, the square and the hand lever shears. The ends of the blade should be chamfered either through a suitable machine or manually through a file and the relevant device. This operation should not result in a sharp edge; the chamfered end should instead be left with a thickness roughly equal to one tenth of the original blade thickness (Fig. 3). The length of the chamfer must be ten times the thickness.

Cleanliness is of material importance for obtaining satisfactory results. Do not touch the chamfered ends with your fingers or with objects that may foul the surfaces.

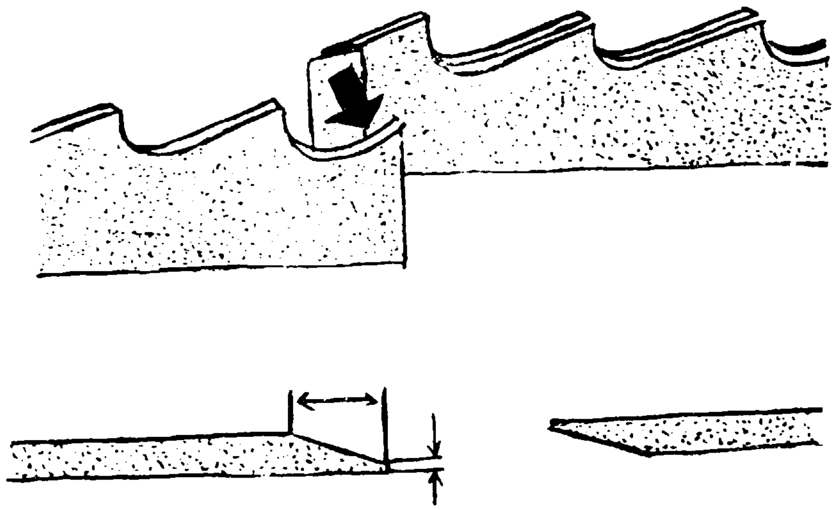

Fig. 3: Chamfering

The deoxidizer is needed in order to remove any oxide residues and to obtain a better distribution of the solder during brazing.

The best is pure borax, finely powdered and dissolved in clean water, having the consistency of a paste. This paste is then spread on the blade chamfers by means of a small piece of wood. Deoxidizer-containing solders are now also available on the market. Alternatively, diluted hydrochloric acid or a distilled water-saturated zinc chloride solution can be employed.

Place the ends into the welding machine (Fig. 4) resting them firmly against the grip, and fix them in this position by means of the set-screws. Then use a vernier gauge or another similar instrument to check whether the pitch of the tooth near the weld is positioned rightly. The solder should be cut in such a way as to exceed the width of the blade by 5 mm on each side.

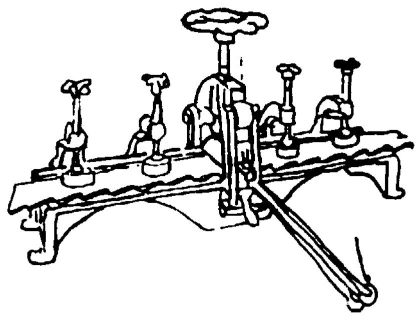

Fig.4: Welding machine with blocking device

Its width should, furthermore, exceed the overlap by 1 mm. Clean the strip of solder with emery cloth, then cover it with the deoxidizng paste. Once the strip is clean, do not touch it with your fingers. It is best to handle it through tweezers or holding it by the edges.

Lift the upper end with a screwdriver or some other similar tool and introduce the solder strip into the overlap slit, making sure it protrudes to the extent specified above. Heat the tools in order to reach a suitable temperature for brazing - usually 900°C - when the irons turn a pale cherry-red and place them on the spots to be welded, on top and under the blade; before doing this, however, remove any red-hot shavings and scale that may be present on the tools. The welding device should be adjusted in such a way that the upper surface of the bottom tool is perfectly aligned with the top of the table (or bench) and, therefore, with the lower part of the blade. Sometimes it is difficult to spot immediately the exact position in which the tool must be set. In this case, lift the overlap point slightly with a screwdriver, inserting it between the blade and the table and extracting it as soon as the desired position for the tool is found. Quickly, position also the upper tool and tighten the screw located at the centre of the brazing machine.

The clamps that are nearest to the braze should be loosened immediately so as to enable the blade to stretch uniformly without being deformed by the heat. Unless this precaution is taken, the stress which develops in the blade may well deform the weld.

Heat-resisting steel tools are recommended since scale is less likely to form on the surface of these tools during repeated heating processes; more welding operation can thus be effected before the levelled supportin surface is worn. The tools may be worn after four or five applications.

On the other hand, flatness and evenness of the supporting surfaces of the tools is essential, because this is the only way to apply pressure uniformly over the whole surface of the braze.

As soon as the tools have cooled off and recovered their original colour (black), loosen the screw at the centre of the brazing device and remove the blade. If these precautions are not taken, temper brittleness occurs in the brazed area, with the ensuing fractures.

If the tools stick to the weld, remove them with a strong hammer-blow delivered in the direction of the braze, in order to avoid the risk of reopening it. Remove any impurities that may be present on the braze with a cloth soaked in crude oil. If these instructions are followed, the braze obtained will not be too soft and will preserve its mechanical characteristics.

Flat-filing of brazes

Flat-filing can be carried out suitably on the straightening bench (on which both sides of the balde can be filed), placing the blade on top or under the bench depending on the side which requires tooling.

A good bearing surface for this operation may be supplied by a simple steel plate 35-50 cm long, 3-5 mm thick and only a few centimeters wider than the balde, which should be bent slightly so as not to strain the blade. Rest the steel plate on the bench and fix the blade onto it by means of two clamps, as shown in Figure 5.

Fig 5: Filing after brazing

Remove scale and incrustations from the brazed section of the blade, then use a file to remove the solder discharged by the chamfer and even out the thickness (roughing). Machine the brazed section in a rolling mill several times until it is flat all over, then perfect this operation with light hammer-blows.

The use of the hammer, however, (Figures 6 and 7) should be restricted to a minimum; hammers, in fact, produce "imprints" that cause the blade to vibrate and may be dangerous insofar as they can lead to crack formation.

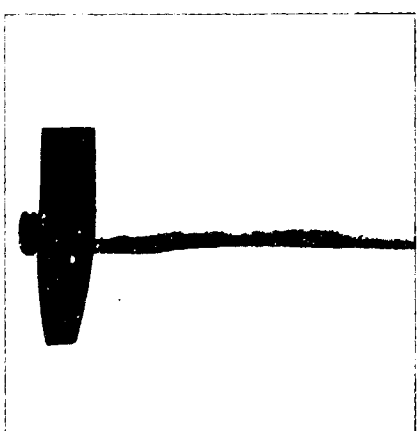

Fig. 6

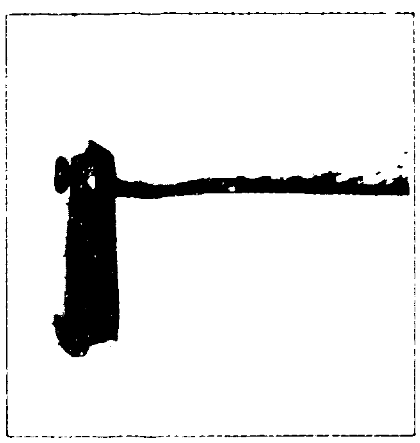

Fig.7

Hammer samples

Once the brazed section is filed, make sure its final thickness is virtually equal to that of the band.

Should dark spots, due to depressions, appear in the relevant area during the final filing operation, flatten the braze with the rolling mill rather than with the file so as not to reduce the thickness of the relevant area too much. When flattening is completed, tension the welded section, making it even with the rest of the blade. If you are not satisfied with the way the blade looks after brazing, you are well advised not to remove any visible solder residues from the blade. As long as the blade is equally thick along its whole length, these aesthetic blemishes are of no importance whatever for practical purpose. The tooth located at the height of the weld should not be flattened or set. This, however, does not mean that it should be hammered down or removed - as is often done without any good reason.

Electric brazing

Brazing by means of an electric brazing machine, is more desireable than conventional brazing, because it does not require the use of brazing tools which are hard to handle. However, it can be employed only for blades that are limited in width.

The dressing of the blade is done in the same way as in the conventional welding process.

Chamfer the ends of the blade, then fix them with the clamps of the brazing machine; the deoxidizer and the solder are applied in the way described for conventional brazing. Connect the current, in compliance with the manufacturer's instruction, and in accordance with the width of the blade, carry out both the welding and the tempering operations. The finish is effected in the same way as in brazing with heated tools.

Welding

The progress made in welding techniques is leading to the elimination of brazing in the field of band blades. The methods now adopted instead of brazing are flash welding, which is considered better for blades that are not very wide, and MIG and TIG welding for wide ones. With the latter methods, it is also possible to "stitch" cracks.

Flash butt welding (Fig. 8)

Cut and clean the ends of the blade and fix them in the welding machine clamp. Adjust the welding current, the heading pressure and run, and the distance apart of the vice heads, following the instruction supplied by the manufacturer of the machine. When the ends come into contact with each other, the welding current runs through them, causing melting of the surfaces that are to be welded. At this stage, the heading pressure comes into play. The ends melt and cool off under pressure.

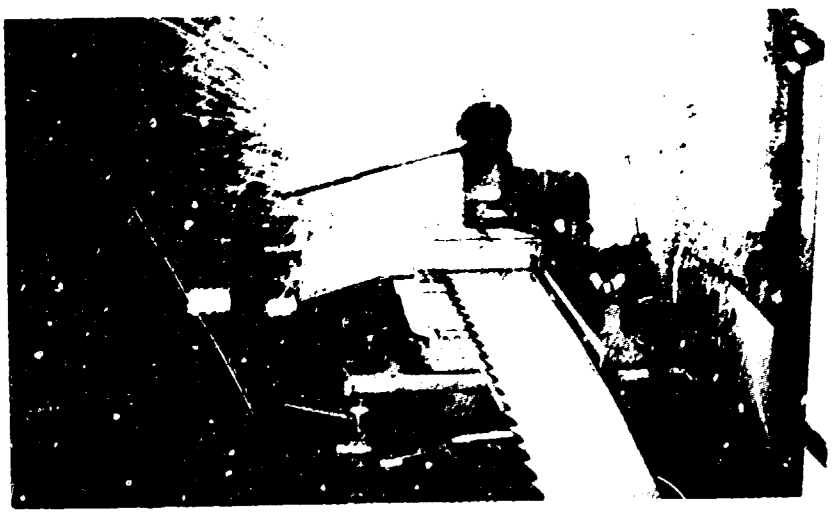

Fig. 8: Flash butt welding

In order to reduce hardness and eliminate stress, the weld is subsequently tempered through the heat of the resistance while in the clamp of the machine. Band temperature drops from the welding temperature to the tempering one (550°C to 650°C) within one to two minutes.

After welding and tempering, carefully file or grind the weld on both its sides. Grind the groove and the back of the tooth thoroughly and check the balde for flatness in the welded area.

TIG and MIG welding

The TIG and MIG methods are the most suitable for welding wide band blades. This process consists of electric arc-welding performed in a neutral Argon gas atmosphere in order to prevent the oxidation of the melted metal. In the TIG method, the welding wire is inserted into the arc separately, while in the MIG method (see figure 9) the welding wire acts also as an electrode and is, therefore, a conductor for the arc.

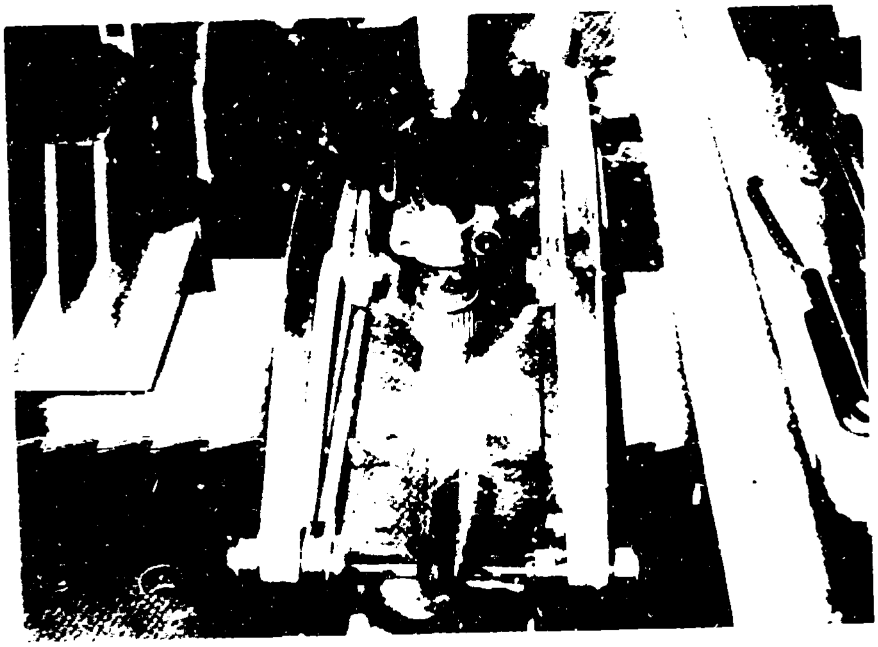

Fig. 9: Welding (MIG method)

The MIG method is more widespread and, when combined with specific devices designed to automate all the welding operations (preheating, welding and tempering), it can produce highly reliable seams and "stitching" of cracks. The results are just as good when these automatic devices are not employed, but in this case the operation must be performed by skilled personnel.

In order to effect the MIG type of welding, cut the ends that are to be joined halfway across the back of the tooth: the blade ends should be cut at right angles and carefully deburred and degreased with trichloroethylene, acetone or alcohol.

Carefully set the two ends side by side so that the back of the blade is perfectly straight, then secure them to the welding plane by means of clamps. The teeth should be set facing the operator and the blade should be laid flat on the bench.

Place two small steel off-cuts at the beginning and at the end of the weld (they should be of the same composition as the blade), in order to prevent the formation of blowholes in these areas during welding.

In order to reduce internal stress during welding, pre-heat the relevant area at approximately 400°C. In some welding machines, this is executed through an electric resistor placed inside the welding plane; in others, it is effected through a gas flame, while the temperature is checked with special chalks. Where automatic machines are employed, the pre-heating treatment is carried out by resistors and the temperature is checked by a thermostat.

The pre-heating process should be performed right before welding and should be carried on through the whole welding operation.

Use a die temper steel welding wire and, where the welding operation is carried out manually or through a special control tool, make a weld bead limited in size and as homogeneous as possible. Any difficulties that may arise here, due to the operator's lack of experience, can easily be overcome by following the advice of an experienced welder.

No such problems arise, however, when automatic welding machines are employed; simply measure the distance between the torch and the blade making sure it complies with the manufacturer's instruction, determine the desired quantity of gas, adjust the speed of the wire and the intensity of current required by setting the control knobs at the relevant values established by the manufacturer for weld thickness. then press the start push-button: the welding machine operates automatically, and perfect welds are obtained within seconds.

When the cycle is completed, stop the welding machine by pressing another push-button. Tempering can be effected with a gas flame, moving it to and fro along the weld bead until the latter as well as the adjacent area turn dark red (roughly 650°C).

Where an automatic welding machine is used, set the timer at the tempering time indicated by the manufacturer according to blade thickness, then wait until the timer has stopped. After tempering the weld, file it or grind it depending on the conditions mentioned earlier in the section on brazing.

Welding of cracks

The process used for welding cracks in the blade is similar to the one used for joining the two ends of a blade. Where the cracks do not run perpendicularly to the blade, automatic welding machines should be operated manually rather than automatically, namely, removing the torch from its support.

Levelling

Levelling equipment includes:

- Straightening bench, provided with rests, and a slightly convex 40 kgs anvil.
- Tensioner equipped with a levelling device and an apparatus for eliminating helicoidal blade deformations (Fig.10)
- Level check ruler
- Cross face hammer

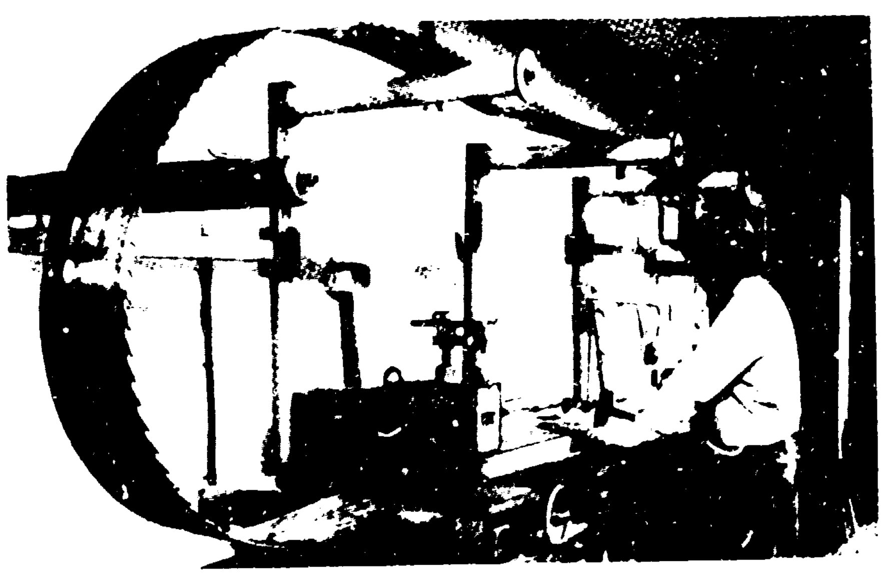

Fig. 10: Tensioner equipped with a levelling device and an apparatus for eliminating helicoidal blade deformations.

The blade should be placed on the bench with its back facing the operator and should be suspended so as to slide easily on the work table. Moreover, it should be perfectly flat when resting on the bench.

This operation should be executed in a well-lit part of the room the light source being placed at the right of the operator (unless he is left-handed) and slanting. When the control square is slightly bent forward and kept standing relative to the blade, all the control lights are screened: thus, any uneven spot on the blade is clearly visible.

Pass the square across the whole length of the blade while it is laid flat on the bench, and mark the exact position of all the buckles with the chalk. A blade may be considered flat when, resting on the work table, it is level on both its sides.

If the deformations are rather regular and continuous along the blade, flatten them through a tensioner. Turn the convex end of the blade upwards, then pass the belt through the tension rollers.

Apply only limited locking pressure to the rollers (the blade should only be pulled), and place a special roller at a given height depending on the extent of the defects you want to eliminate.

The special roller (Fig. 11) consists of a 300 to 400 mm long revolving roller having a diameter of 20 - 30 mm, placed after the tensioner, whose function is to bend the blade upwards. One or more such cycles are enough to make the blade level.

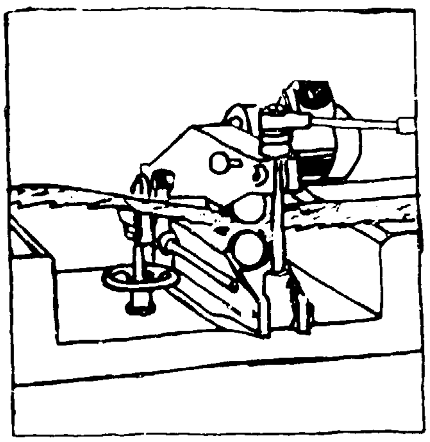

Fig.11: Revolving roller

On the other hand, when the deformations are irregular and include both upward convex sections and downward concave sections, the blade should still be levelled with the tensioner, though operating as described earlier on each single deformed section. Do not use a hammer, except in very special cases. In these cases, start hammering at the sides of the deformed area and move gradually toward the centre. As the process goes on, check the results obtained with the ruler until the required flatness is achieved.

Sometimes the blade appears corrugated when placed on the work table, if one tries to compress the bulge, another one forms immediately in an adjacent area. When a blade is in this condition, it cannot be repaired through flattening, because the defect is due to the excessive elongation of the middle section of the blade.

The defect can only be eliminated by "stretching" the edges of the blade (this process is described in the following pages). It is only after the execution of this operation that any residual bulges can be levelled out.

Sometimes blades appear to be too flexible in some of their sections, namely, they sag in the middle when the edges are lifted or compressed. This occurs when the central section is too "short", and the only way to eliminate the defect is to stretch the middle section with the tensioner and then level out any deformations still present in the blade.

Straightening

The equipment required for straightening is similar to that needed for flattening, except for the inclusion of a 1.5 m long ruler, ground at the sides, with a 60 x 3 or 60 x 4 mm square section. Place the blade on the bench with its back facing the operator and inspect the whole length of the blade. The best method is to place the control ruler on the back of the blade and inspect it through successive shifts, the extent of each shift being half the length of the ruler.

Use a piece of chalk to mark those spots where the ruler does not adhere to the back of the blade. The blade is straightened out when its back is perfectly rectilinear (Fig. 12).

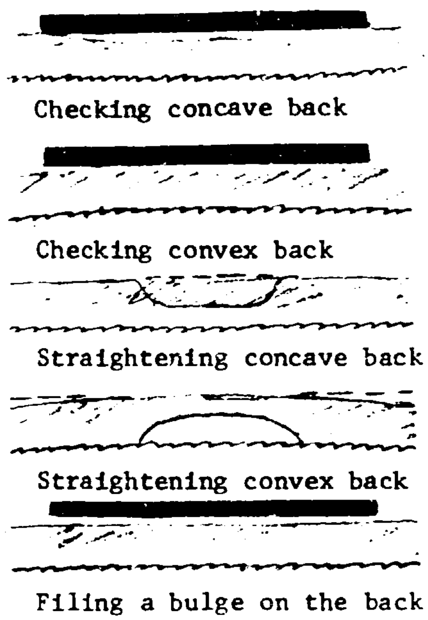

Fig. 12

When the back of the blade is uniformly concave or convex, or rather long sections of it are deformed, straighten it out by means of a tensioner.

Perform at least three runs with the tensioner, each on 1/3 of the width of the blade, close to the back if it is concave or near the teeth if it is convex. This operation should not be carried out in areas close to the edges of the blade, but at a distance of at least 10 mm.

As the blade is straightened out through tensioning, control the operation with utmost care and constantly check the results obtained. There is no point in applying too much pressure to the rollers, because this may simply lead to a similar deformation in the opposite direction. After straightening a blade that has already been tensioned, check whether its convexity has been reduced, as this occurs quite frequently; if so, restore its original convexity. (See following section.)

If the deformed sections are short, straighten them in the way described above, operating with the tensioner on each single deformed section. If the back is concave, apply the tensioner in this area; if the back is convex, perform this operation along the toothed edge.

Here, too, after straightening a blade that has already been tensioned, check whether any changes in tensioning (convexity) have taken place and, if necessary, restore its original shape.

Besides straightening the back of the blade, check whether the ring is deformed. Spiral deformations are quite frequent and are due to accidental "seizure" or deflection of the blade during cutting. In order to check spiral deformation, suspend the blade from a support and measure its lateral deviation. Spiral deformations are eliminated on the straightening bench. Diagonal hammering is still adopted. However, there is another method that is certainly more practical and causes less damage to the blades. It consists of a special tool fitted on the tensioner before the rollers, which is designed to lift the blade by the sides applying considerable force. In this case, the tensioner's only function is to pull the blade.

Crowning (tensioning)

As pointed out earlier, the supporting surface of the fly-wheels is convex. Hence, the blade must also be convex if it is to adhere to the fly-wheels in its whole length (figure 16).

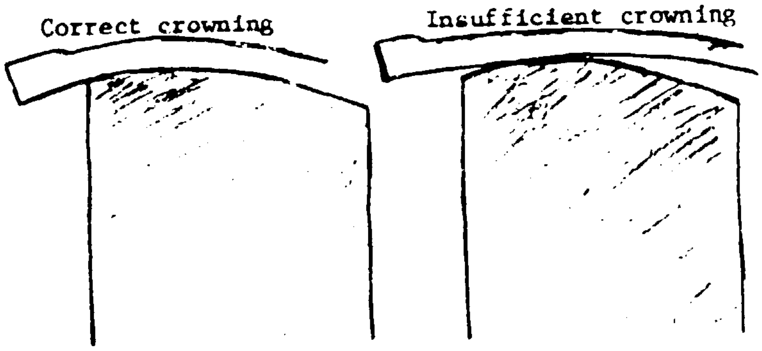

Fig. 13: Crowning examples

When there is too much or too little crowning, the blade slides sideways over the fly-wheels and this results in imperfect sawing.

Moreover, deep cracks may be produced causing blade damage which cannot be repaired. Crowning requires much care and patience from the toolmaker, as well as good vocational training. Crowning equipment includes a work bench, a tensioner, a control ruler (same as the one used for levelling) and a **round (tensioning)hammer.**

In order to effect this operation, stretch the blade fibres through several tensioning cycles, diminishing the extent of the stretch as you move from the middle toward the edges. Before starting the operation, make sure the blade has been suitably flattened and straightened. With the chalk, mark the areas where the tensioner must pass (from 3 to 9 depending on the width of the band). Then operate the tensioner, starting from the weld and finishing at the same spot where the cycle was started. This process should not involve the welded area, which is to be machined at a later stage. Do not apply too much pressure: light runs are preferable. First perfect the middle section, then progress toward the edges. The pressure should drop regularly with each pair of runs and should be equal for each run of the same pair. The runs should be carried out at a distance of at least 10 mm from the edges.

Should further crowning be required, after the regular tensioning runs, repeat the whole operation on the other side of the blade, reducing the pressure by half and intercalating the new runs with the previous ones. In order to increase the convexity of the blade, go over the middle section a few times; perform the same operation near the edges if you need to reduce blade convexity. Crowning is checked by means of the ruler, placing it across the width of the blade: proper crowning is obtained when, upon bending a section of the blade, the light reflected by its surface appears to be fading as it extends from the middle of the blade to the edges. The opposite effect should be obtained when bending the blade the other way and inspecting it from the outer side of the recess thus formed. In order to check whether the crowning operation has been performed evenly, make sure the blade is perfectly flat on the work bench (Fig. 14). No exact value can be given for crowning. The operator, however, will be able to establish, through his own experience, the right value for a given machine.

Fig.14: Checking evenness of crowning operation.

The average values of the beam of light as a function of the blade width are supplied hereunder:

Blade width mm	Beam of light mm (camber at the centre of the arc)
80	0.2
100	0.3
150	0.6
200	0.9
260	1.3
310	1.6

It is also possible to suggest the rough number of tensioning runs as a function of blade width:

3 runs for 60 - 80 mm wide blades;
5 runs for 100 - 130 mm wide blades;
7 runs for 140 - 205 mm wide blades;
9 runs for 230 - 310 mm wide blades.

Check blade crowning frequently and restore its original condition just as often, referring to the relevant value of crowning will thus not have to be done through heavy runs which damage and deform the blade, and the latter will always be in perfect condition.

Hot crowning (Hot tensioning)

Hot crowning is an alternative method to roll crowning. Operate as follows: heat the edges rapidly (300 - 400°C) by means of a welding flame; the ensuing compressive stress causes the edges to contract, hence the crowning.

The hot-crowning process can be repeated many times without damaging the steel, as long as the tempering temperature is not exceeded. The average speed of run should be roughly 1 m/min. This crowning process is not recommended without having previous experience in the field.

Spring setting or swage setting

The main goal of the setting or heading process is to reduce the lateral friction of the blade against the cut material and help the blade to penetrate into the cut. The value of both of these processes is closely related to the quality and degree of dryness of the wood that is to be cut.

Generally speaking, this value is greater for soft (fibrous or fresh) wood and less for hard (or compact, seasoned or frozen) wood.

As to the choice between the two methods, practical experience indicates that a greater amount of material can be processed through swage than through spring setting. Thus, where both high quality and volume are required, it is better to use blades with swage-set teeth only: this, however, requires skilled blade-setting operators.

Spring setting

This method should be adopted only when the blades are used to process dirty lumber, which often contains foreign matter. The setting process requires the use of a shovel or of a mechanical setter. If operating with a shovel, a 1.5 m long special vice is employed to clamp, in various points, the blade which requires setting. This type of vice is needed also where swaging is done by a manually operated machine. This process will be discussed in the next section.

Bend the teeth before sharpening: the bend should be made as near the top land of each tooth as possible, not at the root. Usually, the teeth have to be set in turn to the right and to the left.

If the blade is used to cut soft wood, one can leave one tooth erect every four set ones, in order to obtain a straighter cut.

When using a shovel, such as the one shown in figure 15, to bend the teeth, make sure the width of the slot is accurate relative to the thickness of the tooth and the gripping edge is suitable for obtaining the required setting value.

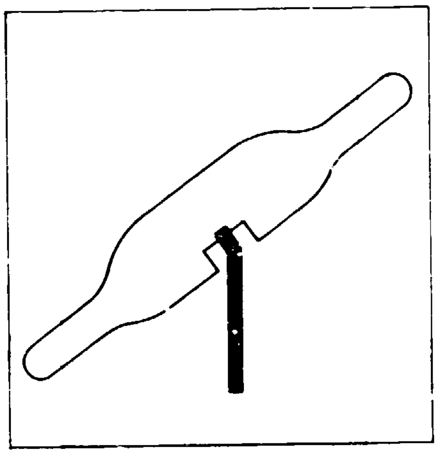

Fig. 15: Shovel used for bending teeth

On the other hand, if operating with a mechanical setter, one has to make sure the small hammers are adjusted properly so that only the top lands of the teeth are bent. Check if the bend is equal on both sides.

Tooth setting is checked by measuring the bending value through a ten-centesimal micrometer such as the one shown in figure 16.

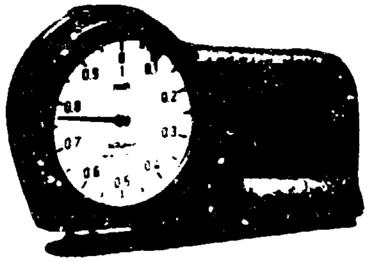

Fig. 16: Ten-centesimal micrometer

Swage setting

The main advantages afforded by swage setting are better cutting quality, and harder tooth top lands, which means longer life for the cutting edge.

The equipment required includes: a hand-operated swaging machine, a vice and blade-supporting stands, or an automatic swaging machine (which does not require a vice); a lateral tooth equalizer (hand-operated) or a grinding machine to even out the sides of the teeth and a micrometer.

Before carrying out this operation, clean the blade and the profiles of the teeth carefully through superficial sharpening. Then lubricate the top lands that require heading by means of a piece of chalk soaked in oil or a pastel (of the type used to write on wooden boards).

If the process is carried out with a manual swager, place the blade onto the stands (usually, the same that are employed with the sharpening machine) and introduce it into the vice (the latter should be rather long and included in the stand-sharpener unit) (see figure 17).

Fig.17

The swaging process is illustrated clearly in figure 18. As the cam of the swaging machine performs a 120° rotation, it compresses frontally as shown in Figure. 19.

The swager should be introduced into a tooth and suitably adjusted (for the first time) according to the shape of the tooth. In particular, carefully adjust anvil C, which is placed opposite the cam, on the back of the tooth: it should adhere perfectly to the back surface of the tooth (Fig.20) in case it does not, the results obtained will be less than perfect (Fig.21).

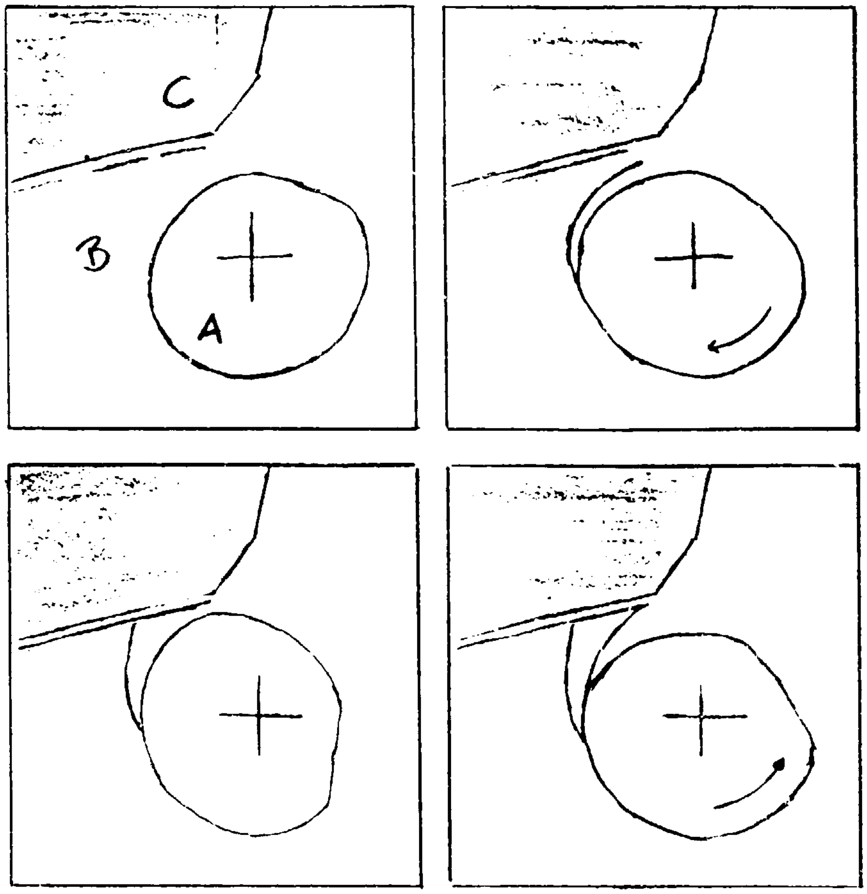

Fig.18: Swaging process

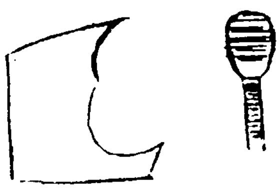

Fig. 19: Frontal compression

After the adjustment, perform some tests, swaging a few teeth; depending on the degree of swaging desired, each tooth can be slightly flattened with one or two blows.

The swaging may be short or long, as shown in figure 22.

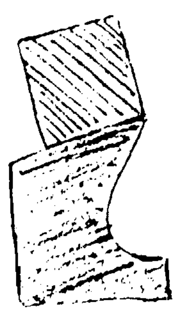

Fig. 20.

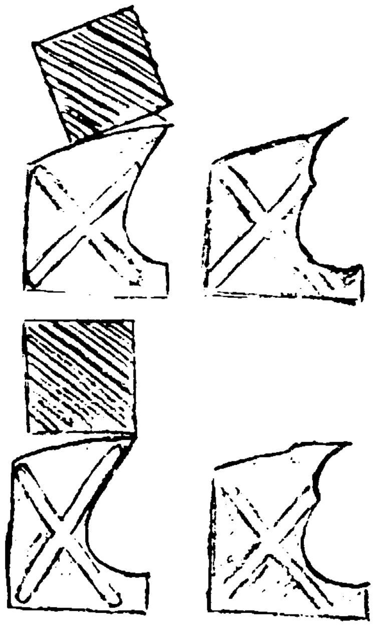

Fig. 21

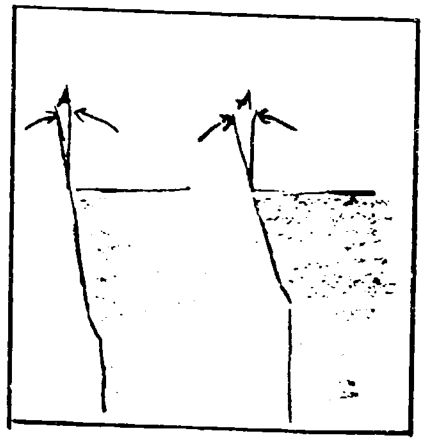

Fig. 22:
Narrow and
wide swaging.

The advantage of long swagings is that the teeth can be sharpened a greater number of times, while short ones offer less side friction during cutting. The former operation requires a cam with a larger diameter. Swaging machines must be adjusted in the same way: once they are preset, these machines operate automatically (see fig. 23).

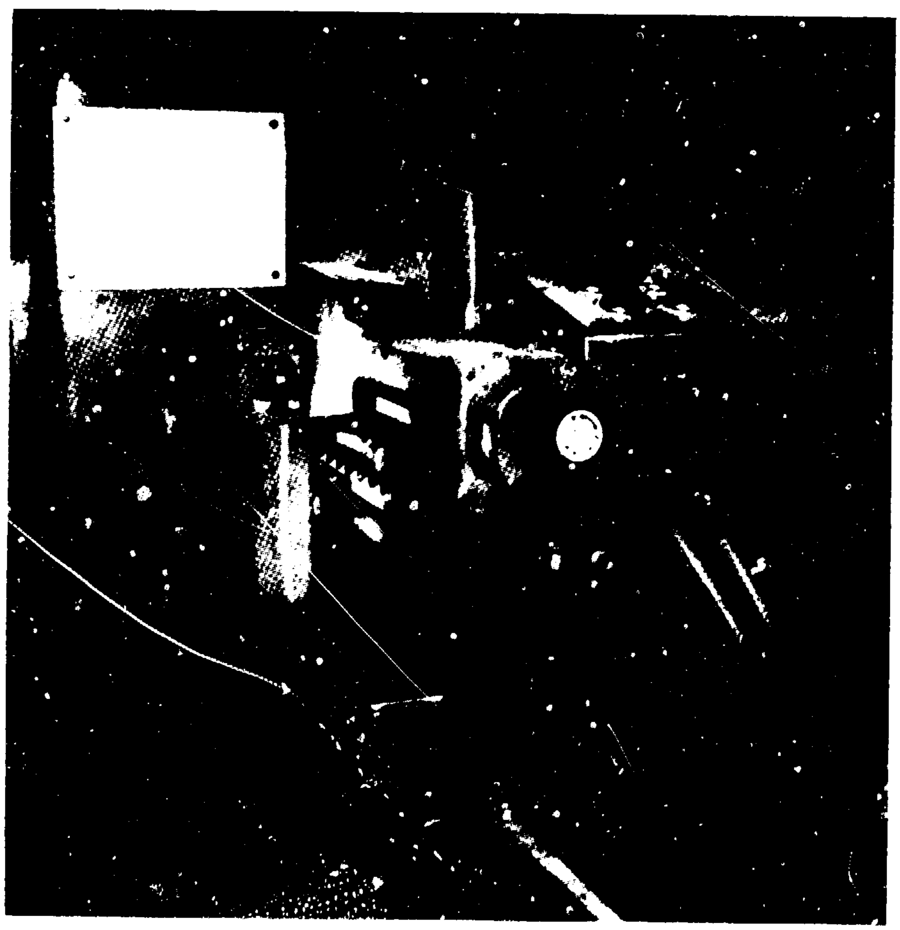

Fig. 23:
Swaging machine

After the swaging operation, the sides of the teeth should be evened out: this can be done with a manual equalizer or with an automatic grinding machine. In the former case, use the stands and the vice employed for the manual swaging operation.

In order to adjust the equalizer, place it on top of a tooth. Depending on the desired type of swaging (long or short), adjust the bevel edge of the swaging jaws (Fig. 24).

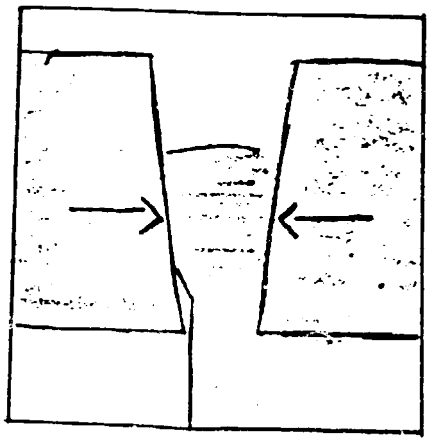

Fig. 24: Adjustment of bevel edge of swaging jaws.

Morever, adjust the stroke of the lever so as to obtain the right thickness of the top land of the tooth. Make a few tests on some of the teeth and make sure the shape is symmetrical and the thickness is correct: perform these checks with a micrometer (Fig. 25).

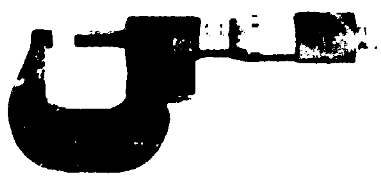

Fig. 25: Micrometer

If the operation is carried out with an automatic grinding machine, connect the latter in parallel with the sharpening machine in order to be able to use the same blade-supporting stands. Sometimes it is possible to connect the grinding machine to the sharpener by means of a universal joint, and synchronize the two operations so as to perform them simultaneously.

Adjust the inclination or the position of the grinders according to the desired type of swaging (short or long), and check symmetry and thickness in the same way as for the hand-operated equalizing tool.

Irregular swaging may result if:

- The cam of the swaging machine is worn;
- The anvil of the swaging machine is worn asymmetrically;
- Some teeth are damaged and have not been repaired completely by the pre-swaging sharpening operation;
- The grinder used for the pre-swaging sharpening operation was not well trued-up with the thickness of the blade;
- There are marks left by a previous swaging operation.

At the end of the operation, the standard swaging values should be the following:

- For blades designed to cut very soft wood (e.g. poplar): 0.5 - 0.7 mm each side;
- For blades designed to cut soft wood (e.g. Norway spruce): 0.4 - 0.6 mm each side;
- For blades designed to cut hardwood (e.g. oak or frozen wood): 0.3 - 0.45 mm each side.

Subsequently perform the sharpening operation, which (the first times only) should be carried out without grinding the front of the tooth:the reason for this is that the cutting edge, hardened through the flattening process, can be utilized fully. However, after two or three regrinding operations, the face of the tooth should also be sharpened.

Sharpening

The only tool required is a good sharpening machine (Fig.26). The state of the machine is of paramount importance: in particular, make sure the grinding wheel bearings, the gears and the wheelhead guides are not slack.

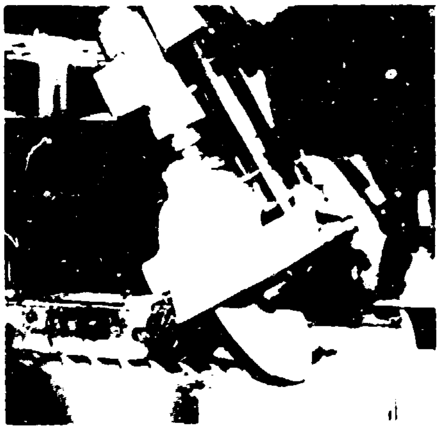

Fig. 26:
Sharpening machine

A good exhaust fan can prove very effective in limiting the damage produced by the grinding powder. It is best to employ sharpeners that are suitable for sharpening tooth profiles of various shapes and sizes.

Make sure you are employing the right grinding wheel. It should sharpen without burning; it should, therefore, not be too hard. 60 M5 or similar types are the most suitable ones. The thickness of the wheel should be roughly one third of the pitch of the tooth, as shown in figure 27 .

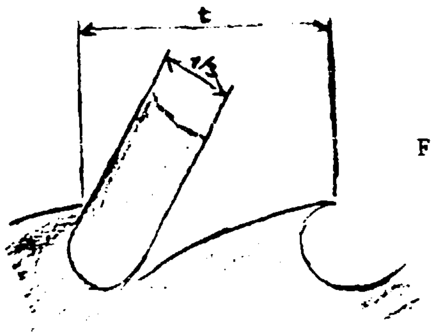

Fig. 27: Illustration of correct grinding wheel size.

It is worth noting that a great number of the cracks produced during machining occur in burnt areas due to the employment of unsuitable grinding wheels. Although they are not visible to the naked eye, these burns lead to the decarbonization of the steel and to the formation of many microcracks (figure 28). Burning often results in shorter cutting edge life.

Fig. 28: Microcrack

The grinding wheel should be dressed frequently in order to restore the cutting edges and remove any resin deposits that may damage them; while restoring the wheel, check also the roundness and the profile of the cutting edge.

The sharpener should be set very carefully.

Gear adjustment should be done in accordance with the exact reproduction of the tooth profile. Make sure the axis of the grinding wheel is trued up with the thickness of the blade (see figure 29), the feed pawl is shaped suitably (figure 30) and the wheel is perpendicular to the blade.

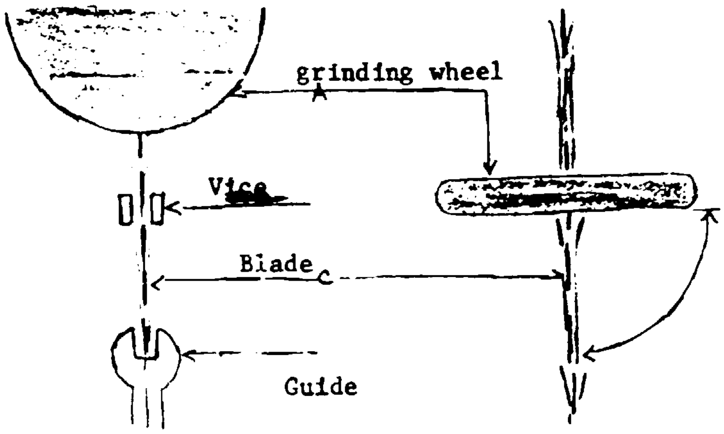

Fig. 29: Positioning of grinding wheel

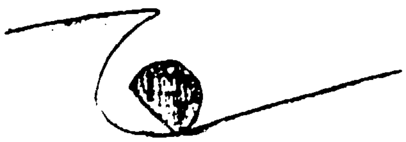

Fig. 30: Profile of feed pawl.

Sharpening is performed automatically; however, make sure the runs are light enough so as not to burn the cutting edge and the tooth fillet. Should the pitch of the teeth not be equal throughout the blade, uniform the pitch by means of the double pawl.

The latter should be used, furthermore, with machines whose gears are subject to backlash.

When new blades are sharpened, make sure that the residues produced during cutting are removed from the whole profile of the tooth; this is required in order to prevent crack formation.

Finally, bear in mind that the blades should be sharpened as soon as this appears to be necessary: they should never be kept operating on the sawing machine too long because this may cause serious damage as well as a negative effect both on the quality and quantity of the sawn lumber.

Stellite

Special blades have recently been devised for cutting those types of wood which cause severe wear - eg. makoré, sipo, teak, etc. The top lands of the teeth of these blades are hardfaced with stellite, a non-ferrous chrome-and cobalt-containing alloy. These types of wood include mineral particles (generally, siliceous ones) that tend to concentrate in the middle area. Often the blade breaks down after a single cut and must be replaced. This results in loss of time and, therefore, of production. The stellite coating process is performed as follows: the teeth are compressed (figure 31) and a drop of stellite is welded in the resulting niche (figure 32), thus filling it up to the top land of the tooth.

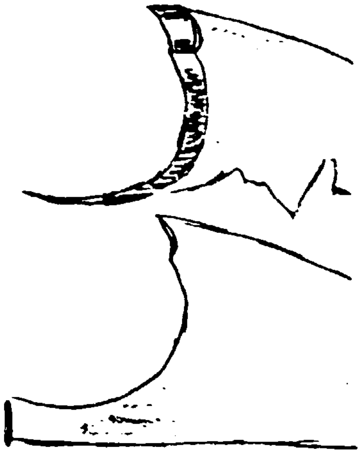

Fig. 31

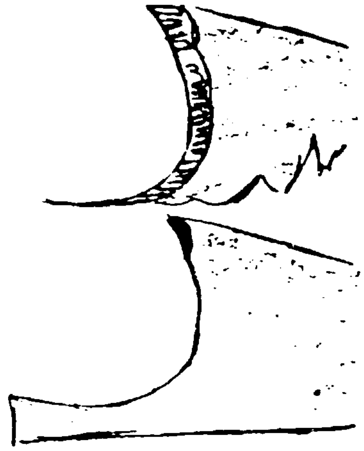

Fig. 32

Subsequently, the teeth are finished by grinding their sides with an automatic grinding machine. The teeth are then sharpened in the usual way with a standard grinding wheel.

Another process, which aims at eliminating the swaging operation, is currently being developed. The idea underlying this new process is that of automating the operation and doing away with the manual one which requires highly skilled labour and entails a considerable loss of time.

Stellite is available in various degrees of hardness. Hardness number 12 is the most suitable for band blades.

Stellite is supplied and utilized in the form of a rod with a diameter of 2.5 - 3.2 mm; thus, any drops obtained are large enough to cover the whole top land of a tooth.

As stellite is applied, the underlying steel hardens, hence the top lands must be subsequently flame-tempered up to roughly 450° C.

In order to make this operation easier, the blade is suspended so that the top lands of the teeth are turned upwards and point in the direction of the welds (see figure 33).

Moreover, the blade should be able to slide smoothly up and down (it is best to suspend the blade from rollers).

The costs required for stellite hard-facing are very low if one considers how much longer the blade will last, and that each stellited tooth can be reground approximately ten times. Blades whose thickness is less than 1.1 mm should not be stellited.

The blade should be replaced three to four times a day, in spite of the considerable cutting life of "stellited" blades. This may be useful in order to limit the frequency of certain operations, such as tensioning and straightening.

Fig. 33: Blade held in such a way that teeth are pointing upward in the direction of the welding.

Most important of all is that only high-grade blades be stellited. A common steel blade, in fact, buckles too easily and is likely to crack. Stellite is applied by means of a standard oxy-acetylene welding device, with a blowpipe having a capacity of 100 litres/hour and a 0.9 mm diameter nozzle.

The gas should be kept at very low pressure and the oxygen-acetylene mixture should be controlled so that the length of the flame be roughly three times greater than the length of the internal white flame.

The white flame should reach the edges of the teeth just under the back of the recess formed through compression. At the same time, the end of the stellite rod should be directed toward the centre and slightly above the bottom land of the recess (figure 34).

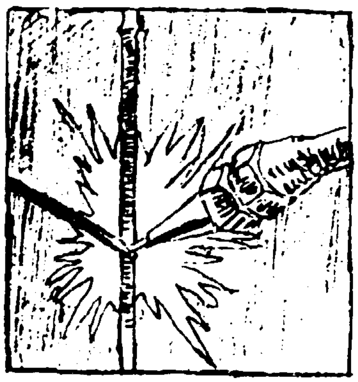

Fig. 34: Positioning stellite rod.

Thus heated, the wire protects the top land of the tooth and prevents burning. When the tooth turns light-red, the tip of the flame should be directed against the stellite wire and should be kept in this position until a drop falls into the notch. The flame should be removed gradually in order to avoid sudden cooling.

Two operations are of the utmost importance:

a) heating the steel of the tooth until it reaches the required temperature; and

b) forming a suitably large stellite drop.

If the temperature of the steel is too low, the stellite clots in the hollow top land of the tooth instead of expanding. If the temperature is too high, the steel melts, ruining the top land completely.

Moreover, the steel and the stellite form an alloy which impairs the basic characteristics of stellite itself.

Exceedingly large stellite drops result in an unnecessary waste of stellite and in increased grinding time. On the other hand, if the drops are too small, they are not able to cover the whole surface of the top land of the tooth.

The operation described above is more similar to brazing than with welding. All the various stages must be executed in rapid succession in order to prevent the oxidization of the steel surface. Any worker with some welding experience can gain, within very few hours, the practical knowledge needed in order to master the stelliting technique.

Obviously, he will acquire this knowledge by practising with unserviceable blades.