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(54) **SHAPING APPARATUS FOR SAW SHARPENING WHEEL**

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(57) **ABSTRACT**

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A saw sharpening apparatus having an abrasive wheel for sharpening saw blades, and including a tool for shaping and dressing the abrasive wheel. The abrasive wheel shaping tool is operable to contact the peripheral surface of the abrasive wheel and shape the peripheral surface into a predetermined profile. The shaping tool is operable to move radially and axially relative to the abrasive wheel. A controller in communication with the shaping tool is programmed to urge the shaping tool against the abrasive wheel and move the shaping tool across the peripheral surface in a predetermined pattern.

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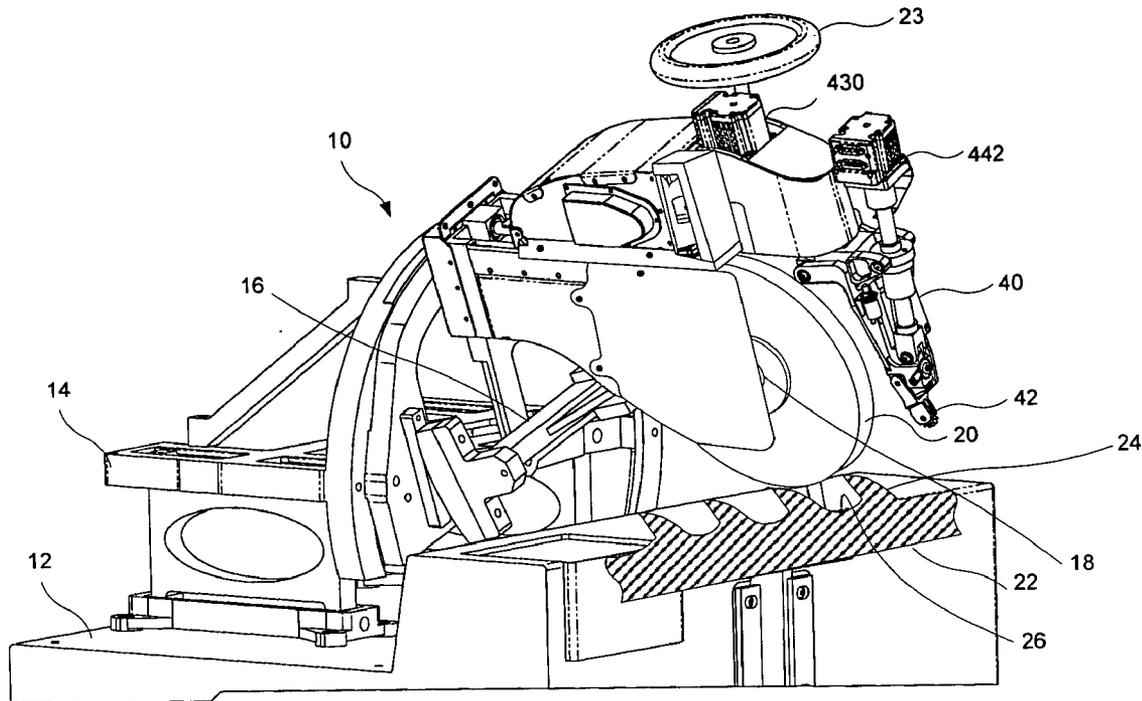
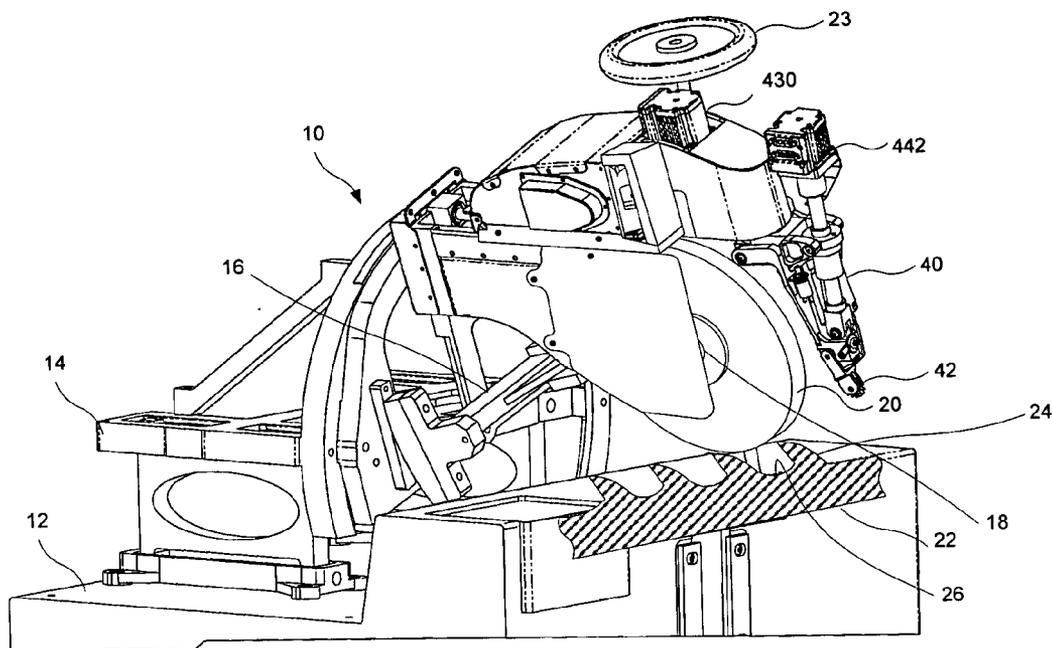


Fig. 1



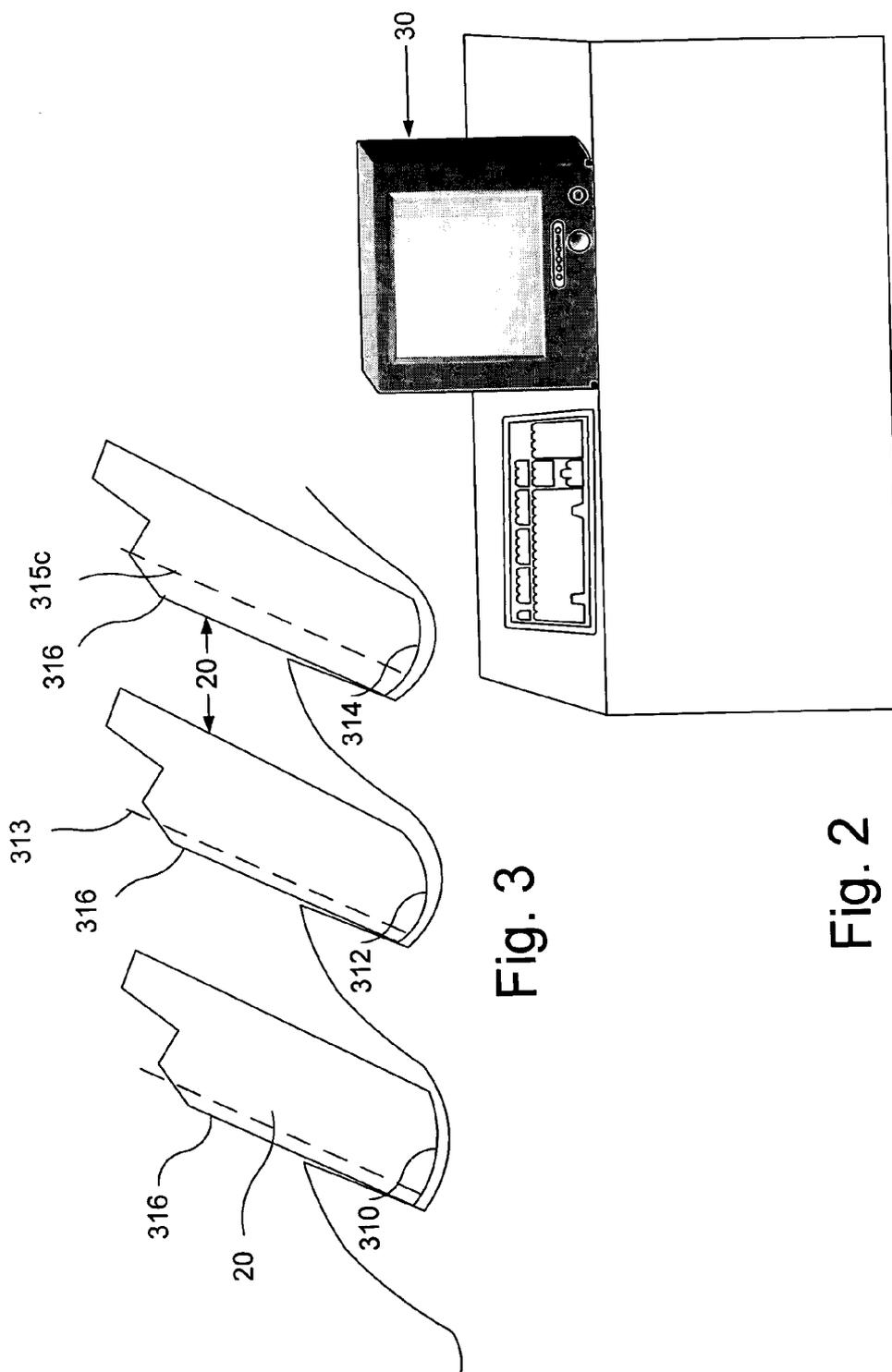


Fig. 3

Fig. 2

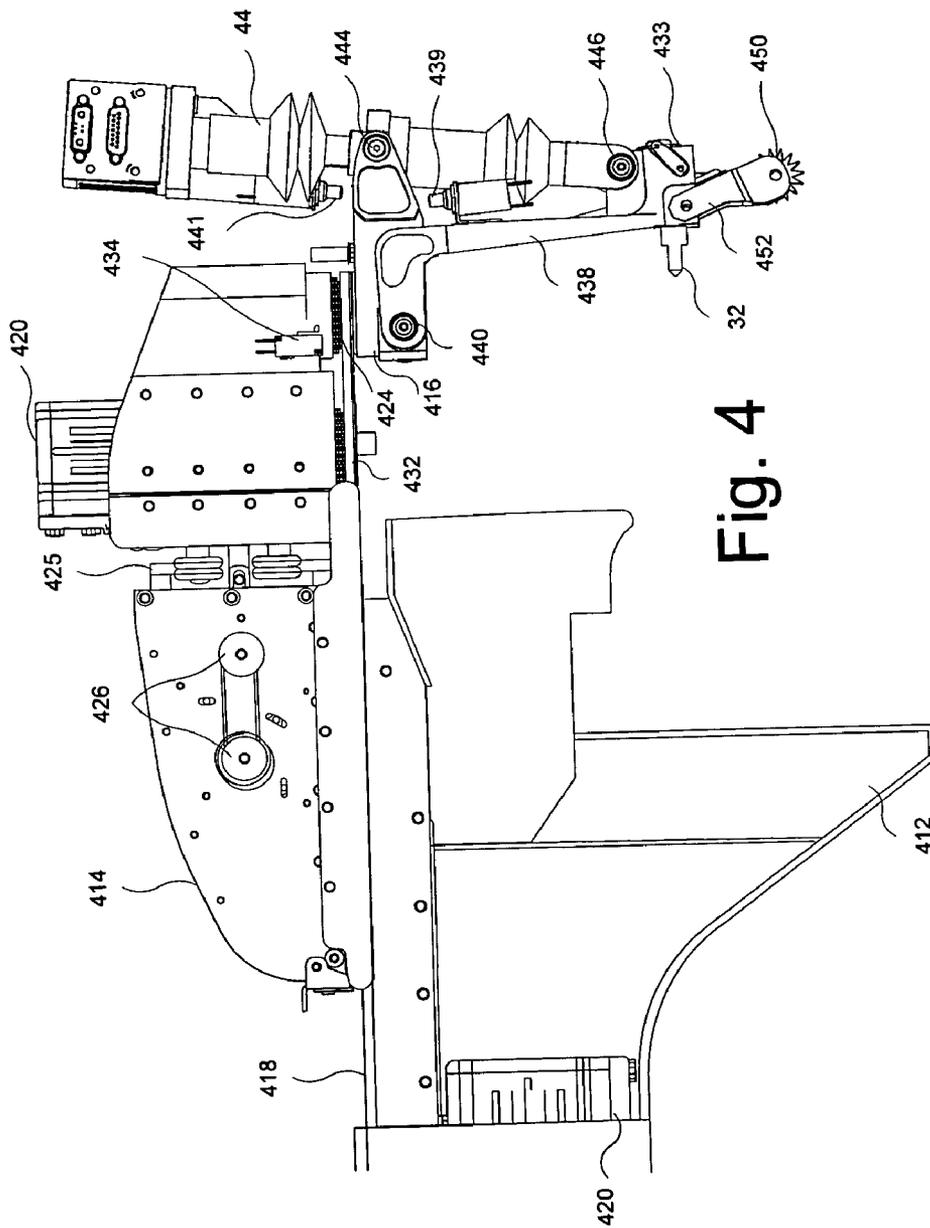


Fig. 4

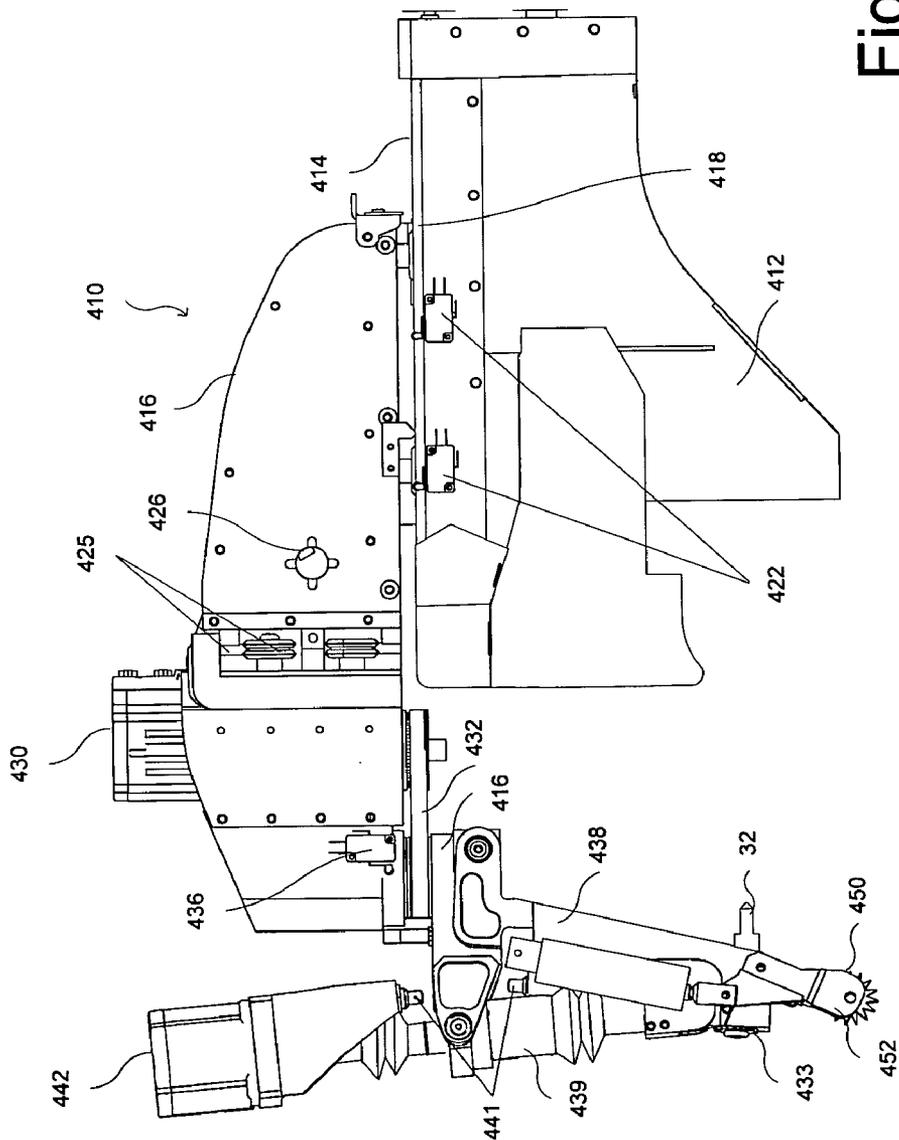


Fig. 5

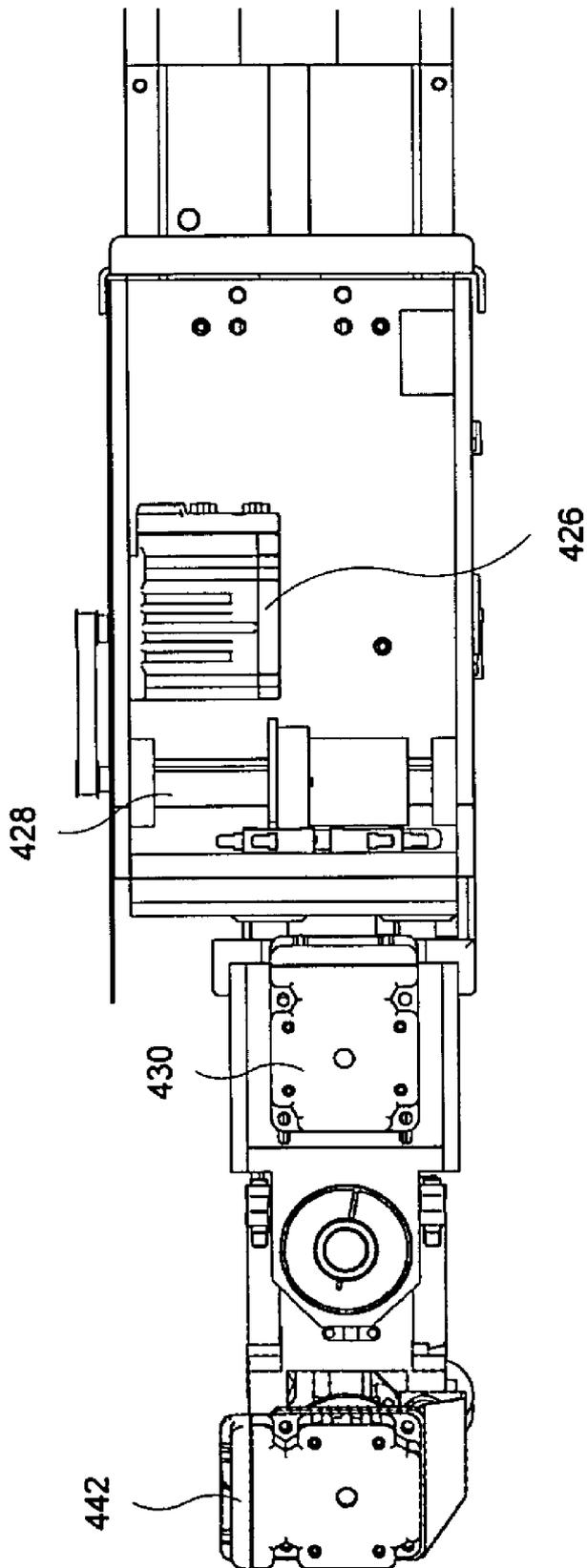


Fig. 6

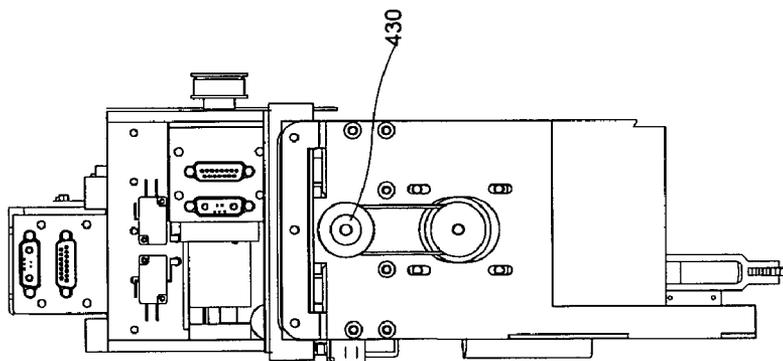


Fig. 8

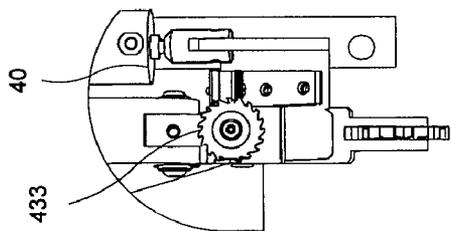


Fig. 9

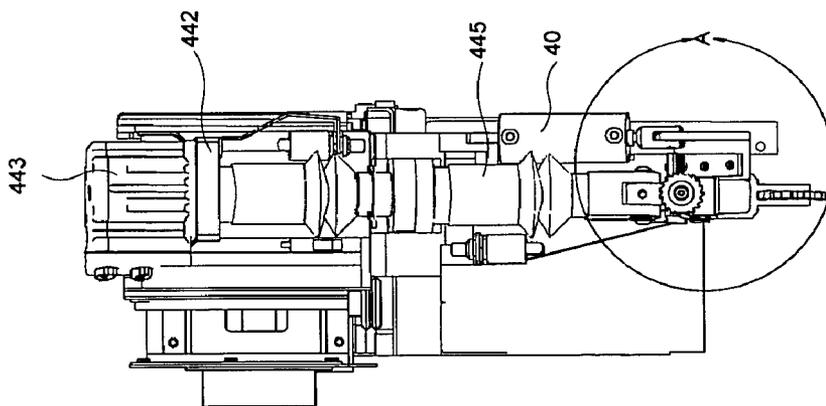


Fig. 7

SHAPING APPARATUS FOR SAW SHARPENING WHEEL

[0001] This invention relates to industrial saws used to cut lumber, and in particular to abrasive wheels used to shape and sharpen the teeth on saw blades.

[0002] In sawmills lumber is sawn from logs by large band saws and circular saws. The saws are designed to cut at high production rates, and can only maintain high production rates if properly maintained. Proper saw operation and efficient cutting of specific types of wood require the correct saw tooth shape. Experienced saw filers have favorite profiles that they prefer for specific types of saws or wood, and which they try to accurately reproduce time after time. Some variation inevitably occurs from time to time. To further complicate matters, different saw filers within one sawmill can inadvertently produce variations on a specific profile. These unwanted variations in profiles can lead to variations in product quality and production rates.

[0003] One important aspect of the saw tooth shape is the side profile of each saw tooth and the adjacent gullets. As discussed above, specific tooth and gullet profiles vary from application to application, and from user to user, but must be reproduced accurately to maintain optimal efficiency. As a saw is used and the teeth of the saw are worn down, the cutting edges of the saw are dulled and the profiles of the teeth and gullets are changed, reducing the efficiency of the blade. When it has been determined that a saw blade requires maintenance, it is taken off line and replaced with a fresh blade while the worn blade is sent to the saw shop for maintenance and sharpening.

[0004] A necessary step in the maintenance of the worn blade is the reshaping of each tooth on the blade to the desired profile. The teeth are restored to the desired profile using a rotating abrasive wheel that is inserted between adjacent teeth to profile the lower edge of the tooth and the adjacent gullet. The abrasive wheel is specifically shaped, usually using a carbide abrasive wheel, to grind each tooth and adjacent gullet into the desired profile. The abrasive wheel also wears as it is used, however, and must be periodically reshaped as it is worn away. In current practice the abrasive wheel is removed from its shaft on the profiling machine, and mounted in a chuck that rotates the abrasive wheel as an operator moves a cutter into contact with the abrasive wheel. The periphery of the wheel is cut to the desired shape, or at least close to the desired shape depending on the skill of the operator. The surface of the abrasive wheel is then dressed to remove embedded material from the surface, and the wheel is returned to service. While adequate as now practiced, this method can result in unwanted variations in the profile, the removal of excessive material from the wheel periphery, and an out of round shape of the abrasive wheel. Removal of excessive material can unnecessarily reduce the life of the abrasive wheel. An out of round shape can reduce the efficiency of the sharpening process since only a portion of the abrasive periphery is in contact with the blade. An out of round shape can also lead to uneven wear of the abrasive wheel as portions of the periphery are worn out of shape more quickly than other portions. Another undesirable aspect of current practice is that the abrasive wheel must be removed from the sharpener to be refurbished.

[0005] For each of these reasons an improved apparatus for shaping abrasive sharpening wheels is needed.

SUMMARY OF THE INVENTION

[0006] The present invention addresses the shortcomings of the prior art by providing saw sharpening apparatus having a driven abrasive wheel with a peripheral surface, an apparatus for supporting a saw blade in a predetermined position relative to the saw blade, and an apparatus for advancing the saw blade into engagement with the abrasive wheel to sharpen the saw blade. An abrasive wheel shaping tool is mounted on the saw sharpening apparatus and operable to contact the peripheral surface of the abrasive wheel and shape the peripheral surface into a predetermined profile. The shaping tool is operable to move radially and axially relative to the abrasive wheel. A controller is in communication with the shaping tool and programmed to urge the shaping tool against the abrasive wheel and move the shaping tool across the peripheral surface in a predetermined pattern. The shaping tool is preferably mounted on a pivotable member. A first servo assembly is connected to the pivotable member and operable to move the shaping tool radially. A second servo assembly is connected to the pivotable member and operable to move the shaping tool axially relative to the abrasive wheel. In preferred embodiments the shaping tool is movable radially and transversely simultaneously relative to the abrasive wheel peripheral surface responsive to at least one signal from the controller.

[0007] These and other features of the invention will now be described by reference to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is a perspective view of a preferred embodiment of the invention.

[0009] FIG. 2 is a perspective view of the embodiment shown in FIG. 1 with a band saw blade mounted for sharpening.

[0010] FIG. 3 is a side elevational view of different tooth and gullet profiles and showing the corresponding peripheral shapes of an abrasive sharpening wheel.

[0011] FIG. 4 is a left side elevational view of the embodiment shown in FIG. 1.

[0012] FIG. 5 is a right side elevational view of the embodiment shown in FIG. 1.

[0013] FIG. 6 is a top plan view of the embodiment shown in FIG. 1.

[0014] FIG. 7 is a front elevational view of the embodiment shown in FIG. 1.

[0015] FIG. 8 is a rear elevational view of the embodiment shown in FIG. 1.

[0016] FIG. 9 is an enlarged partial front view at A in FIG. 7.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] Referring now to FIGS. 1 and 2, a saw sharpener is shown generally at 10, and includes a base 12 and a top unit 14. Top unit 14 includes a pivoting arm 16 that is movable between an upper and a lower position as described in greater detail below. A belt-driven drive spindle 18 and abrasive sharpening wheel 20 are mounted on arm 16. Saw

sharpening 10 operates by moving arm 16 and the rotating abrasive wheel 20 downward to engage and grind the toothed edge of a saw blade 22. (See FIG. 2). Arm 16 is operated automatically in the embodiment illustrated (an Armstrong #4 BSS machine), but could also be operated manually in other embodiments. As a tooth 24 and gullet 26 are advanced into position, arm 16 and the rotating abrasive wheel 20 are lowered into contact with the blade. The lowered position of the abrasive wheel 20 is preset using hand wheel 23 to accommodate blades of different heights and different degrees of wear.

[0018] Referring to FIG. 3, abrasive wheel 20 regrinds the tooth 24 and gullet 26 into the desired shape. Shapes can vary as shown in FIG. 3. Shapes 310 and 312 in FIG. 3 are the same shape except that the radius is reduced from 1" in 310 to $1\frac{3}{16}$ " in 312. Shapes 312 and 314 are the same except that in 312 the center line for the radius is $\frac{1}{16}$ " from surface 316, while in 314 the centerline for the radius is $\frac{3}{16}$ " from surface 316. These are but a few of the possible variations in the tooth and gullet profiles that can be achieved with the invention, and are intended to illustrate rather than limit the invention to any particular profile.

[0019] As shown in FIG. 3, the perimeter of abrasive wheel 20 can be shaped differently to grind different tooth and gullet shapes into the saw blade. In the prior art, the shaping of the abrasive wheel has been done by removing the abrasive wheel from arm 16, mounting abrasive wheel 16 in a separate spindle, and manually shaping the wheel to a desired profile. As discussed above, that method of shaping the abrasive wheel leads to undesirable variations in the saw profile, specifically in the shape of the teeth and gullets in the saw blades sharpened with the abrasive wheel.

[0020] The present invention overcomes the drawbacks of the prior art by providing a saw blade dresser that includes a controller that can be programmed to repeatedly provide any desired tooth and gullet profile, and do so even as the abrasive wheel is worn down. This represents a significant advance over the prior art, and provides significant productivity gains over the prior art methods.

[0021] Referring to FIG.'s 4-6, one preferred embodiment of the invention will be described. A wheel shaping apparatus is shown generally at 410, and includes a support frame 412, an infeed carriage 414, and a shaping arm 416. Infeed carriage 414 is driven longitudinally along infeed guide rails 418 by infeed drive servo motor 420. Limit switches 422 limit the travel of infeed carriage plate 414. Infeed carriage 414 is positioned laterally along lateral guide and roller assembly 425 by cross feed servo motor 430.

[0022] Shaping arm 416 is pivotally mounted on infeed carriage 414 at 424. The rotation of shaping arm 416 around pivot 424 is controlled by theta servo motor 430 via belt and pulley 432. The rotation of shaping arm 416 is limited by theta limit switches 434 and 436. Cutter arm 438 is mounted on shaping arm 416 at pivot 440. Radius axis servo motor 442 is connected to shaping arm 416 at pivot 444 and to cutter arm 438 at pivot 446. Radius axis servo motor 442 is operable to move cutter 32 toward and away from the abrasive sharpening wheel 20 during the shaping operation. The travel of cutter arm 438 is limited by limit switches 439 and 441. Cutter 32 is mounted on the lower portion of cutter arm 438, and includes a diamond cutting tip 33. Cutting tip 33 is preferably replaceable apart from the body of cutter 32,

but the invention is not limited in that manner. Cutter 32 is mounted for rotation within a journal (not shown), and includes a toothed wheel 433 on the end opposite the cutting tip 33. Toothed wheel 433 is rotated to rotate the cutter 32 to provide even wear on the diamond cutting tip 33. Toothed wheel 433 is rotated by disc 454 mounted on a pivoting frame 452 as it is periodically cycled as described below. Referring to FIG.'s 4 and 5, a star wheel 450 is mounted on a pivoting frame 452. Frame 452 is pivoted by the actuator 454 to move the star wheel 450 into contact with abrasive wheel 20 as described below.

[0023] Referring to FIG. 2, controller 30 is a microprocessor—driven device such as a personal computer. Controller 30 includes a memory module that stores in electronic form predetermined abrasive wheel profiles that have been selected by the user. Controller 30 is in communication with the servo motors to control the movement of diamond-tipped cutter 32 into engagement with the abrasive shaping wheel 20 to shape the wheel into the desired profile. Cross feed servo assembly 426 operates to move cutter 32 across the peripheral surface, i.e. axially with respect to the abrasive wheel 20. R-axis servo assembly 442 operates to move the cutter 32 radially with respect to abrasive wheel 20. Theta axis servo assembly 430 operates to rotate the tip of cutter 32 to maintain it in a perpendicular orientation to the abrasive wheel at the point of contact of cutter 32. Doing so properly orients the tip 34 of cutter 32 to the portion of the surface being shaped at a particular instant.

[0024] Turning to FIG.'s 5-9 the servo systems will be described in greater detail. FIG. 7 is a front elevational view of one embodiment of the invention. R-axis servo assembly 442 is a precision positioning device that includes servo motor 443 and jack screw 445 encased in a flexible cover. As motor 443 is operated jack screw 445 is turned a prescribed number of turns moving cutter 32 toward or away from abrasive wheel 20 a prescribed distance. Theta axis servo assembly 430 operates pulley and belt assembly 432 to rotate cutter arm 438 through an arc of about 180° to permit cutter 32 to engage abrasive wheel 20 at any angle at any point across the peripheral surface of abrasive wheel 20.

[0025] The operation of the invention will now be described. Once the abrasive wheel 20 has become worn and its peripheral surface is no longer in the desired profile, an operator activates controller 30. Controller 30 prompts the operator to select the desired profile from those stored in memory, or to enter a desired profile. Once the operator has selected the desired profile, controller 30 accesses the memory and loads the programming instructions for the selected profile. The desired profile of the abrasive wheel is selected and controller 30 is instructed by the operator to initiate the reshaping of the abrasive wheel. Controller 30 signals infeed carriage servo assembly 420 to properly position the assembly longitudinally along infeed guide rails 418. Controller 30 then signals cross feed servo motor 426 to position infeed carriage 418 laterally along lateral guide and roller assembly 425. The controller then positions cutter 32 in a predetermined starting position, after which the operator signals controller 30 to begin. Controller 30 then implements the programming instructions for the selected profile, and signals servo assemblies 430 and 442 to move cutter 32 in an arc across the peripheral surface of abrasive wheel 20 to achieve the desired profile. In one preferred embodiment, cutter 32 is repeatedly engaged with the abra-

sive wheel, removing a small amount of material each time until the desired profile is achieved with the minimum total amount of material removed from the abrasive wheel. In between successive passes, the R-axis servo 442 moves the cutter 32 a predetermined distance closer to the axis of rotation of the abrasive wheel. After a predetermined number of passes, or alternatively after the operator has determined that the desired profile has been achieved, controller 30 activates cylinder 40 to urge star wheel 42 against the rotating abrasive wheel 20 to remove embedded material from the surface. When the abrasive wheel has been sufficiently dressed star wheel 42 is retracted, and controller 30 returns the apparatus to its ready position. The cycling of cylinder 40 engages disc 454 with toothed wheel 433 and rotates cutter 32 to provide even wear on cutting tip 33. The saw sharpener is now ready to receive and sharpen the next blade.

[0026] While the invention has been described with reference to the preferred embodiments described above, those of skill in the art will recognize that numerous changes in arrangement and detail can be made without departing from the scope of the following claims.

What is claimed is:

1. In a saw sharpening apparatus having a driven abrasive wheel with a peripheral surface, an apparatus for supporting a saw blade in a predetermined position relative to the saw blade, an apparatus for advancing the saw blade into engagement with the abrasive wheel, and the abrasive wheel operable to sharpen the saw blade, the improvement comprising:

an abrasive wheel shaping tool mounted on the saw sharpening apparatus and operable to contact the

peripheral surface of the abrasive wheel and shape the peripheral surface into a predetermined profile;

the shaping tool operable to move radially and axially relative to the abrasive wheel; and,

a controller in communication with the shaping tool and programmed to urge the shaping tool against the abrasive wheel and move the shaping tool across the peripheral surface in a predetermined pattern.

2. A saw sharpening apparatus according to claim 1 further comprising:

the shaping tool comprising a pivotable arm and a cutting tool mounted on the pivotable arm;

a first servo assembly connected to the pivotable member and operable to move the shaping tool radially relative to the abrasive wheel; and,

a second servo assembly connected to the pivotable member and operable to move the shaping tool axially relative to the abrasive wheel.

3. A saw sharpening apparatus according to claim 2 further comprising the shaping tool being movable radially and transversely relative to the abrasive wheel peripheral surface simultaneously responsive to at least one signal from the controller.

4. A saw sharpening apparatus according to claim 2 further comprising the shaping tool being movable axially in an arc.

5. A saw sharpening apparatus according to claim 4 further comprising the pivotable arm being connected to the second servo assembly and movable through an arc.

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