United States Patent [19]

Ludwig

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[45] **Jan. 14, 1975**

[54] **PROCESS FOR GRINDING CUTTING EDGES ON BLADES**

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[21] Appl. No.: **348,210**

[52] **U.S. Cl.** ..... **51/285,** 51/81 BS, 76/89.1

[51] **Int. Cl.** **B24b 1/00**

[58] **Field of Search** ..... 76/82, 89.1; 51/285, 327, 51/81 R, 81 BS, 82 R, 82 BS, 83 R, 83 BS, 84 R, 84 BS, 80 R, 80 BS, 325, 165.72; 125/11 TP, 11 PH

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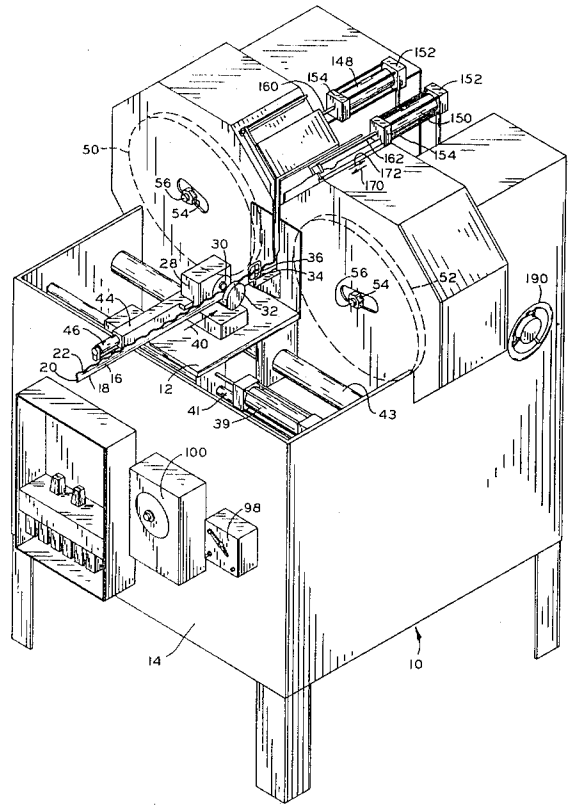
Primary Examiner—Al Lawrence Smith
Assistant Examiner—Nicholas P. Godici

[57] **ABSTRACT**

A blade is advanced by controlled increments and brought against first one and then the other of a pair of grinding wheels which are specially configured to impart an improved cutting edge configuration on the blade.

The cutting wheel consists of a convexly shaped grinding surface formed annularly on the outer periphery of the grinding wheel midway between the sides of the grinding wheel and terminating in convex valleys with additional convex grinding surfaces along the opposite edges of the grinding wheel. This profile of the grinding wheel imparts a cutting edge to the blade which is capable of greater number of honings before it loses its effectiveness. The apparatus for grinding this improved edge on the blade consists of a pair of coordinated clamping means which at all times holds the blade in clamped condition, first advancing the blade and then moving it laterally first against one and then against the other of the grinding wheels to impart the preferred cutting edge. The grinding action occurs progressively until the blade is completely ground at which time the blade is removed and the cutting wheels are redressed to the desired configuration profile.

5 Claims, 14 Drawing Figures



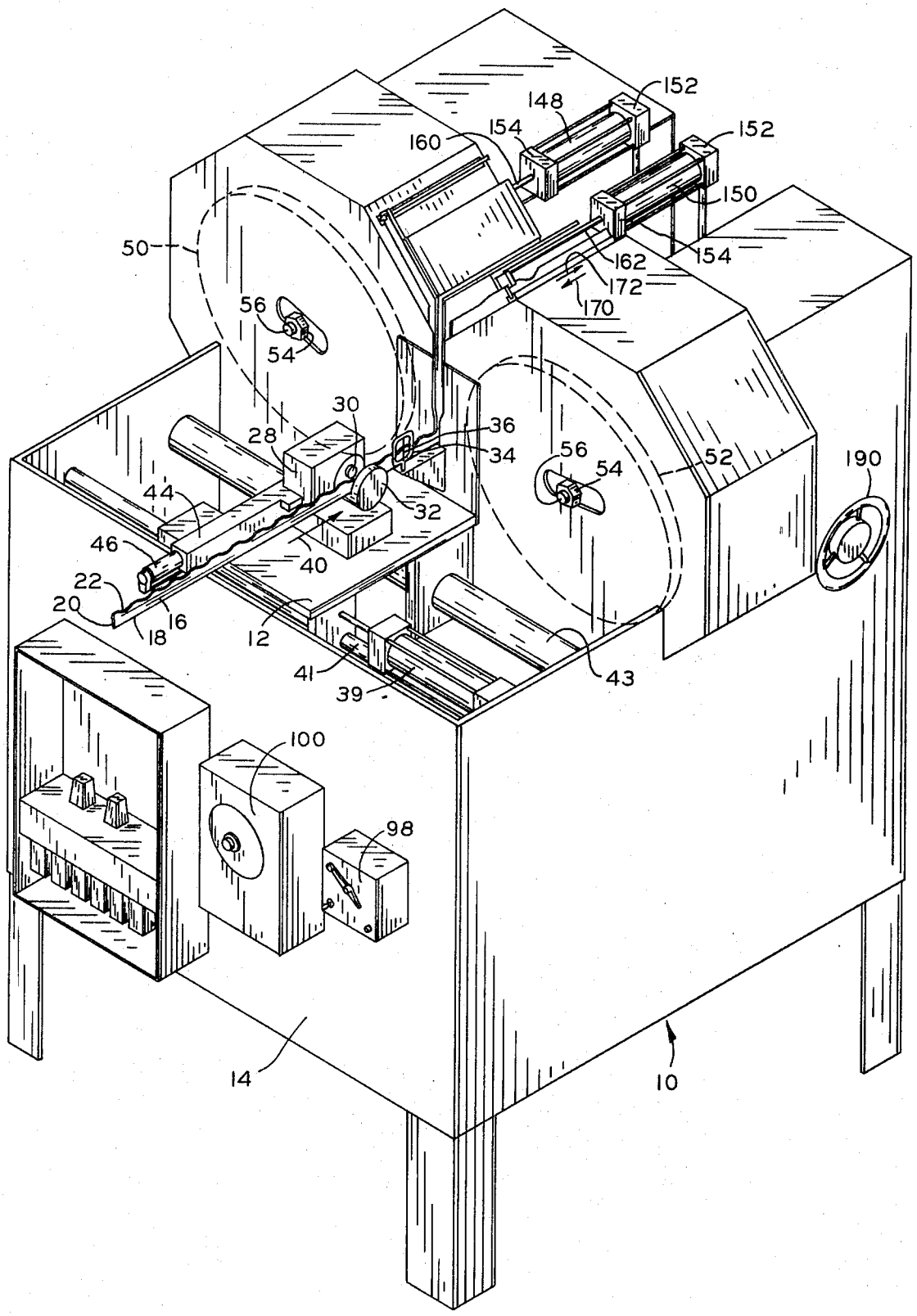

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FIG. 1

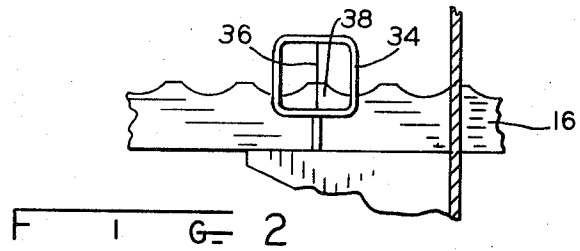


FIG 2

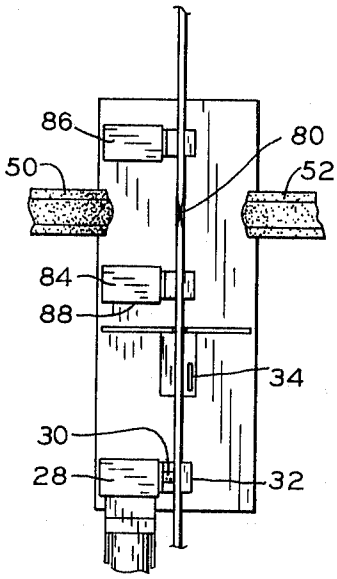


FIG 3

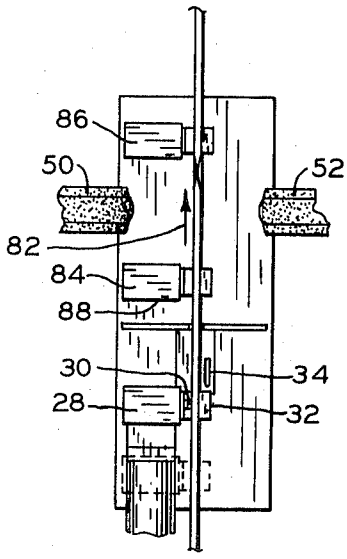


FIG 4

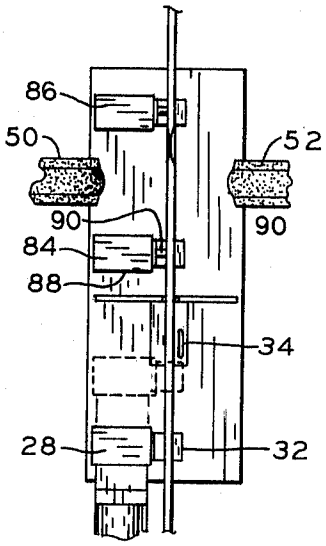


FIG 5

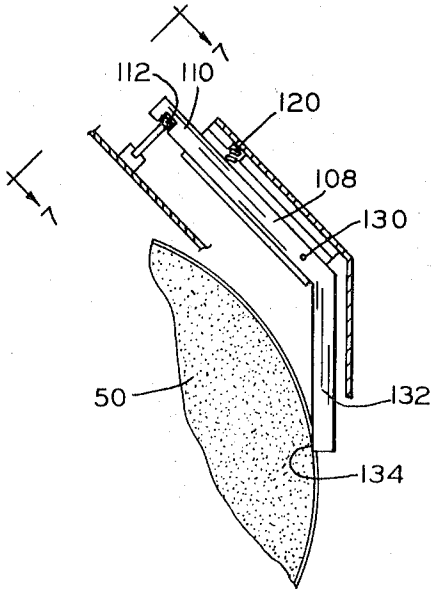


FIG 6

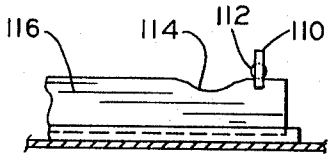


FIG 7

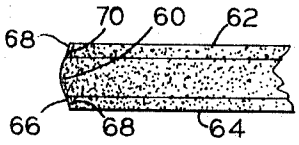


FIG 8

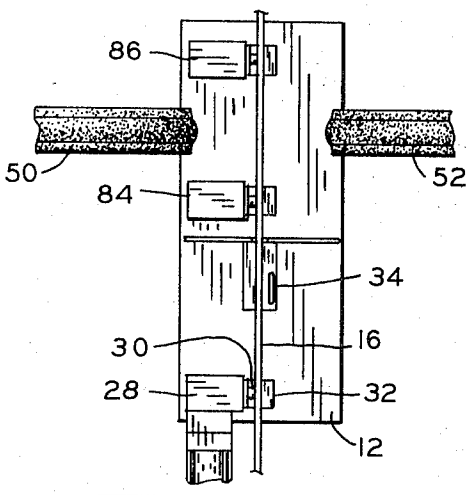


FIG. 9

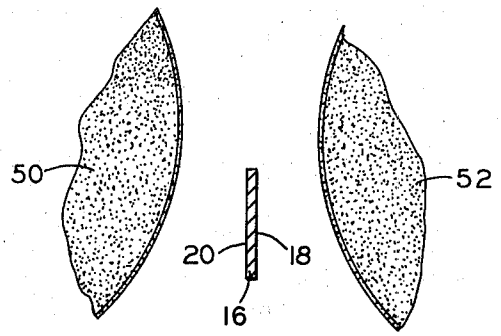


FIG. 9a

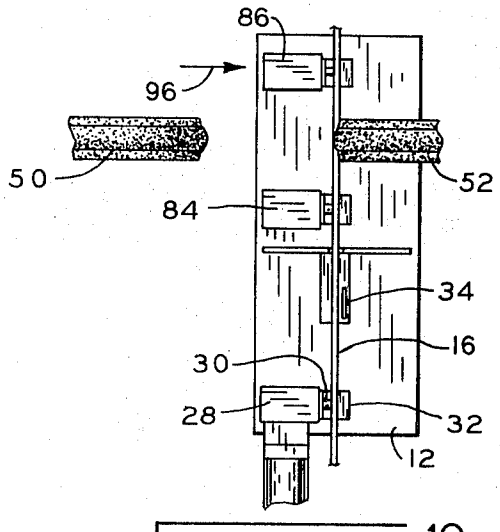


FIG. 10

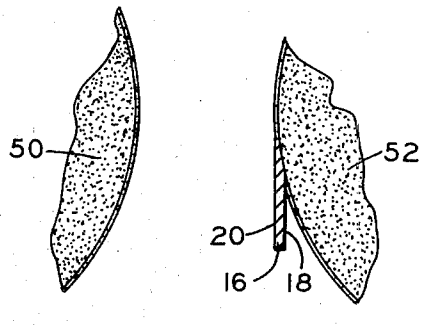


FIG. 10a

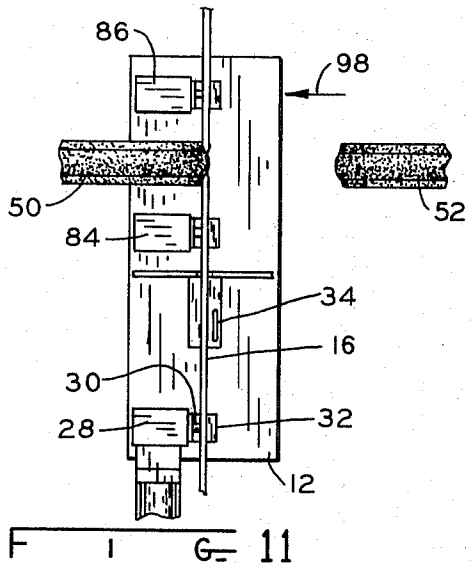


FIG. 11

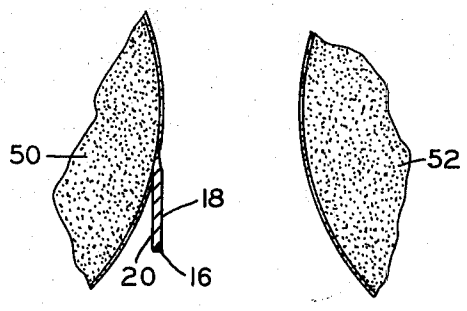


FIG. 11a

PROCESS FOR GRINDING CUTTING EDGES ON BLADES

BACKGROUND OF THE INVENTION

In my copending application Ser. No. 233,610 now U.S. Pat. No. 3,745,869, SLICING BLADE, issued July 17, 1973. I disclose a new and improved configuration of blade in which there is a uniquely configured cutting edge intermediate the crest and valley of each cutting scallop. It has been found generally, that by imparting a slight cutting "corner" of the type described in the patent application that it is possible to make a "deeper" scallop so that a greater amount of material is provided for the cutting edge, enabling a greater number of honings before the cutting edge will lose its basic configuration and have to be discarded.

Obviously, each honing entails the removal of material and, to the extent that the removal of this material alters the basic configuration of the cutting edge, the blade will change its cutting characteristics and generally deteriorate in its cutting action as it loses its original cutting profile. Anything which can be done to increase the number of honings before losing the advantages of a particular cutting profile is advantageous.

The improved blade configuration which is disclosed in my copending application is achievable where the cutting edge change of curvature is not greatly pronounced; in fact, it can be barely perceptible to the naked eye and still the principal advantages of the invention may be realized.

The present invention has to do with both the apparatus and the process for producing an improved blade configuration and in order to obtain such desired blade configuration there must be used an especially configured grinding wheel having a profile which consists of a convexly-shaped-cross-section annulus disposed substantially midway between the sides of the cutting wheel and two convexly shaped but smaller radius grinding sections at the edges of the grinding wheel connected to the central section by concavities. Quite obviously, this grinding wheel configuration must be maintained by periodic dressing and the arrangement for obtaining the dressing, advancing the blade periodically and successively to preselected positions relatively to the grinding wheels, and then effecting the grinding is what the present invention is about.

OBJECTS OF THE INVENTION

It is an object of the present invention to produce a cutting blade having all of the advantages which are set forth in my copending application Ser. No. 233,610 now U.S. Pat. No. 3745869 and particularly the advantage which inheres in the maintenance of a highly effective cutting edge which can undergo a substantial number of honings without altering the basic cutting qualities of that edge.

Another object of the present invention is to achieve the described cutting edge with a pair of grinding wheels each having a special profile capable of producing the described configuration for the cutting edge on the blade.

It is another object of the present invention to provide an automatic and continuous process wherein the blade is automatically and accurately ground to a given improved configuration and following which the blade is released and the replacement blade inserted.

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It is a related object of the invention that the foregoing process be accomplished in a relatively quick, efficient and accurate manner so that the high quality of the cutting edge can be readily duplicated from one blade to the next to assure its consistent quality.

An overall object of the present invention is to provide a process and apparatus for practicing that process which will produce a preferred blade configuration and which incorporates a specially constructed grinding wheel having a central annular convex grinding surface and two spaced convex grinding surfaces of smaller diameter are disposed at each of the edges of the grinding wheel and connected with the central grinding surface by concave sections.

Other objects and features of the present invention will become apparent from a description which proceeds with reference to the accompanying drawings wherein a selected example embodiment of the invention is chosen to illustrate the invention.

DRAWINGS

FIG. 1 is an isometric view of the apparatus for effecting a grinding of the blade, the blade being shown in partial view;

FIG. 2 is an enlarged fragmentary detail view of the sighting mechanism for locating the blade in the clamping fixture at its correct position;

FIGS. 3, 4 and 5 are progressive detail views showing the blade being advanced after a section thereof has been ground to a particular configuration; the intermediate stage illustrated in FIG. 4 illustrates how the clamping member advances the blade to a new cutting position; FIG. 5 illustrates the clamping mechanism after advancing the blade with the dotted line position of the clamping means indicating the intermediate position and the full line position illustrating the clamping mechanism which is maintained until a successive grinding operation occurs;

FIG. 6 is an enlarged schematic detail view of the lever for dressing the grinding wheel following the complete grinding of each blade;

FIG. 7 illustrates the specially ground cam surface for a cam follower on the dressing arm of FIG. 6 and which causes the dressing arm to describe a certain prescribed movement whereby the dressing at the bend of the lever will reconfigure the grinding wheel to the profile corresponding to the cam surface of FIG. 7;

FIG. 8 is an enlarged detail view of the profile configuration of the grinding wheel and which it will be noted corresponds to the profile of the cam surface in FIG. 7;

FIGS. 9–9*a*, 10–10*a*, and 11–11*a* are progressive detail views showing in top view and side elevation view the progressive steps in first clamping, FIGS. 9, 9*a*, and biasing the blade to the right (FIGS. 10, 10*a*) to effect grinding at one side of the blade and then laterally displacing the blade in an opposite direction to effect grinding on the opposite side of the blade, FIGS. 11, 11*a*.

SPECIFIC WORKING EXAMPLE OF THE INVENTION

Referring to FIG. 1 apparatus designated generally

by reference numeral **10** has the usual bed **12**, and control panel **14**, the purpose of which is to grind cutting edges on a blade **16**.

Blade **16** at the time that it is fed into the apparatus consists of two parallel flat sides **18** and **20** and a series of regularly spaced notches **22** of concave shape disposed at regular intervals along the length of the blade **16**.

Blade **16** is held by a clamping fixture **28** having a reciprocable clamping member **30** and backing **32**. Blade **16** is initially positioned at its proper starting position by means of a sighting member **34** having a hairline **36** which accurately locates the blade initially in the manner indicated in FIG. **2** wherein the hairline **36** is intended to bisect crest **38** of blade **16**.

After the blade **16** is clamped in place by hydraulically displacing clamping member **30**, the entire fixture is moved in the direction of arrow **40** (FIG. **1**) by means of a hydraulic cylinder **44** having a piston **46**. Following each grinding which occurs at opposite sides **18, 20** of the blade **16**, the cylinder **44** is operated and the piston **46** in conjunction with clamping member **30** will advance the blade **16** by the prescribed amount so that the grinding operations occurs serially and at the desired locations.

Referring to FIG. **1**, the bed **12** rides on two spaced guides **41** and **43** and piston **39** is usable for moving the bed **12** back and forth on such guides.

A pair of grinding wheels designated by reference numerals **50** and **52** are mounted for rotational movement on a fixed axis of rotation and are clamped in place by means of nuts **54** threadedly received on bolts **56**. Each grinding wheel **50, 52** is configured in a special manner which is evident from considering FIG. **8**. The convexly profiled annularly shaped central grinding surface **60** is located substantially midway between sides **62** and **64** of each grinding wheel and smaller diameter convexly shaped grinding surface **66** and **68** are disposed contiguously with side **62, 64** with concave sections **69** and **70** joining the central and laterally offset grinding surfaces **60, 66** and **68**.

Referring to FIGS. **3, 4** and **5**, after the blade **16** has been ground in the manner indicated by reference numeral **80** it is advanced by the clamping and indexing fixture **28** in the direction of the arrow **82** and grinding is then repeated at the next location by first clamping the blade with lateral grinding fixtures **84** and **86** each consisting of a cylinder **88**, piston **90** and backing **92**. There are two such fixtures **84, 86**, one on each side of grinding wheels **50, 52**. Referring to FIGS. **9–9*a***, **10–10*a*** and **11–11*a***, the clamping fixtures **84, 86** first bias the blade rightwardly in the direction indicated by reference numeral **96** (FIG. **10**) bringing side **18** blade against wheel **52** and after this side is ground, the fixtures reverse bringing the blade in the direction of the arrow **98** (FIG. **11**) and causing the opposite side **20** of the blade to be ground by wheel **50**.

The blade is thus ground to have a profile with a desired cutting edge configuration determined by the profile of the grinding wheels **50, 52**. The resulting blade configuration, is the one shown in FIG. **12** in which, there is indicated (in an exaggerated manner), a cutting edge which reverses in curvature commencing from the root to the crest at each location where grinding is effected.

It should be further noted, that it is possible to obtain a greater depth of root in order to have a greater quantity of material available for successive honings so that in spite of the inevitable material removal, there will nevertheless be maintained a cutting edge which does not lose its original cutting value and therefore, has a greater wearlife. That is the overall purpose of constructing a blade in this manner.

Referring to the lateral clamping elements **84** and **86**, these clamping fixtures are timed with the clamping fixture **28** so that one or the other is always in clamping relationship with the blade. Hence before one clamping fixture releases, the other is brought into operative position against the blade.

As indicated in FIG. **1**, the apparatus is started through a switch box **98** and a counter **100** which determines the number of grindings which need be performed to produce a cutting edge throughout the entire length of the blade **16**. It should be understood that for the purpose of illustration a single pair of grinding wheels have been shown but more than one pair of wheels are possible to use depending upon design considerations.

After the blade has traversed throughout its length and all edge portions thereof have been sharpened (as indicated in the foregoing manner), each grinding wheel is dressed by means of a grinding lever **108** (FIG. **6**). The grinding lever **108** has a first arm **110** with a cam follower **112** which bears against a cam surface **114** on cam block **116**. A compressed spring **120** urges the cam follower **112** against the cam surface **114** which corresponds to the profile intended to be maintained on the surface of the grinding wheel. The lever is mounted on a pivot pin **130** and the depending arm **132** having a diamond tip **134** is caused to trace across the face of the grinding wheel (FIG. **8**) following each complete blade grinding. For this purpose, there are two hydraulic cylinders **148, 150** which are mounted on the apparatus through pillow blocks **152, 154**. Pressure responsive pistons **160** and **162** cause the lever **108** to move first in the direction of the arrow **170** (FIG. **1**) and then **172** and in so doing, the movement of the lever together with the cam **112** and cam surface **114** will cause the diamond tip **134** to trace the same configuration as **114** on the working surface of the associated grinding wheel. It should be noted that the distance "X" in FIG. **6** from the cam to the pivot **130** is the same as the distance from **130** to the diamond tipped surface at **134** so that the tracing produced by diamond, will refinish the surface of the grinding wheel to maintain the original grinding surface acting on successive blades.

The setting for the grinding wheels is provided by means of a setting wheel **190** (FIG. **1**).

OPERATION OF THE DEVICE

In operation, the blade **16** is mounted in place within the apparatus and after suitable adjustments with the setting wheel **190**, the operation then commences. The apparatus is switched on from the switchbox **98** and a preselected setting is provided for the counter **100** which signals the end of each blade processing. Initially, the blade is positioned accurately relative to the grinding wheels **50, 52** by means of the sight **34** having hairline **36** which initially is intended to bisect one of the crests in the manner indicated in FIG. **2**.

Thereafter, the machine commences operation and continues to perform grinding at the location of each scallop and valley of the blade such operation continu-

ing intermittently until all portions of the blade edge are sharpened.

The blade advances in increments according to the operation of the clamping fixture **28** which grips the blade and advances it as indicated in FIGS. **3, 4** and **5** by first protracting the piston **30** and clamping the blade between the end of the piston **30** and backing **32** (FIG. **3**), advancing the blade as indicated from the dotted line position (FIG. **4**) to the full line position and then releasing and retracting from the dotted line position to the full line position (compare FIGS. **4** and **5**). Before the clamping fixture releases in FIG. **4** the clamping fixtures **84** and **86** are energized to engage opposite sides of the blade and displace the blade first to the right (FIG. **10**) to effect grinding at one side of the blade and then to the left (FIG. **11**) to grind the left-hand side of the blade (FIG. **11**).

Owing to the particular configuration of the grinding faces on grinding wheel **50, 52** the blade edges take on a particular configuration which is quite advantageous in that successive honings can be made of the blade edge without loss of the original cutting value of the blade.

After the blade has been entirely honed, this is sensed by the counter **100** and the cylinder **148, 150** are then actuated to move the arm **110** back and forth so that the follower **112** traces across the cam surface **114** and the diamond tipped end **134** of lever **132** is caused to trace a new profile on the surface of the wheel which corresponds to the cam surface profile **114.** Thus following each grinding operation of an entire blade, each grinding wheel is redressed in the described manner.

Although the present invention has been illustrated and described in connection with the single example embodiment it will be understood that this is illustrative of the invention and is by no means restrictive thereof. It is reasonably to be expected that those skilled in this art can make numerous revisions and adaptations of the invention and it is intended that such revisions and adaptations will be included within the scope of the following claims as equivalents of the invention.

What I claim is:

1. A process for grinding cutting edges on blades comprising the steps of: clamping the blade at selected locations along the length thereof, grinding a cutting edge by holding the blade in a longitudinally fixed position while laterally displacing the blade against first one and then the other of two rotating grinding wheels one on each side of said blade and each profiled to have centrally disposed convexly shaped annular grinding surfaces of major dimension, a convex grinding surface of smaller dimension disposed immediately adjacent said central surface one on each side thereof, bringing the major and smaller dimension convex grinding surfaces against the surfaces of the blade at first one blade side and then the other blade side to effect a series of profiled cutting scallops with crest and valley sections and reversely directed cutting surfaces between each crest and each valley of the blade, and periodically longitudinally advancing successive blade sections for grinding action.

2. The process in accordance with claim **1** including the step of dressing each grinding wheel with a hard tipped lever having a cam follower and cam which is configured to be of the same dimension as the grinding wheel dimension intended to be maintained.

3. The process in accordance with claim **1** including the step of continuously maintaining the blade under gripping action by gripping means for laterally displacing the blade against one or the other of the grinding wheels and with a further gripping means for advancing the blade section for successive grinding action.

4. The process in accordance with claim **1** including the step of adjusting the location of the blade relatively to the grinding wheel in advance of the first grinding.

5. The process in accordance with claim **1** wherein each grinding wheel is continuously rotatable on a fixed axis of rotation and the blade is brought laterally thereagainst to effect the grinding action thereon.

* * * * *