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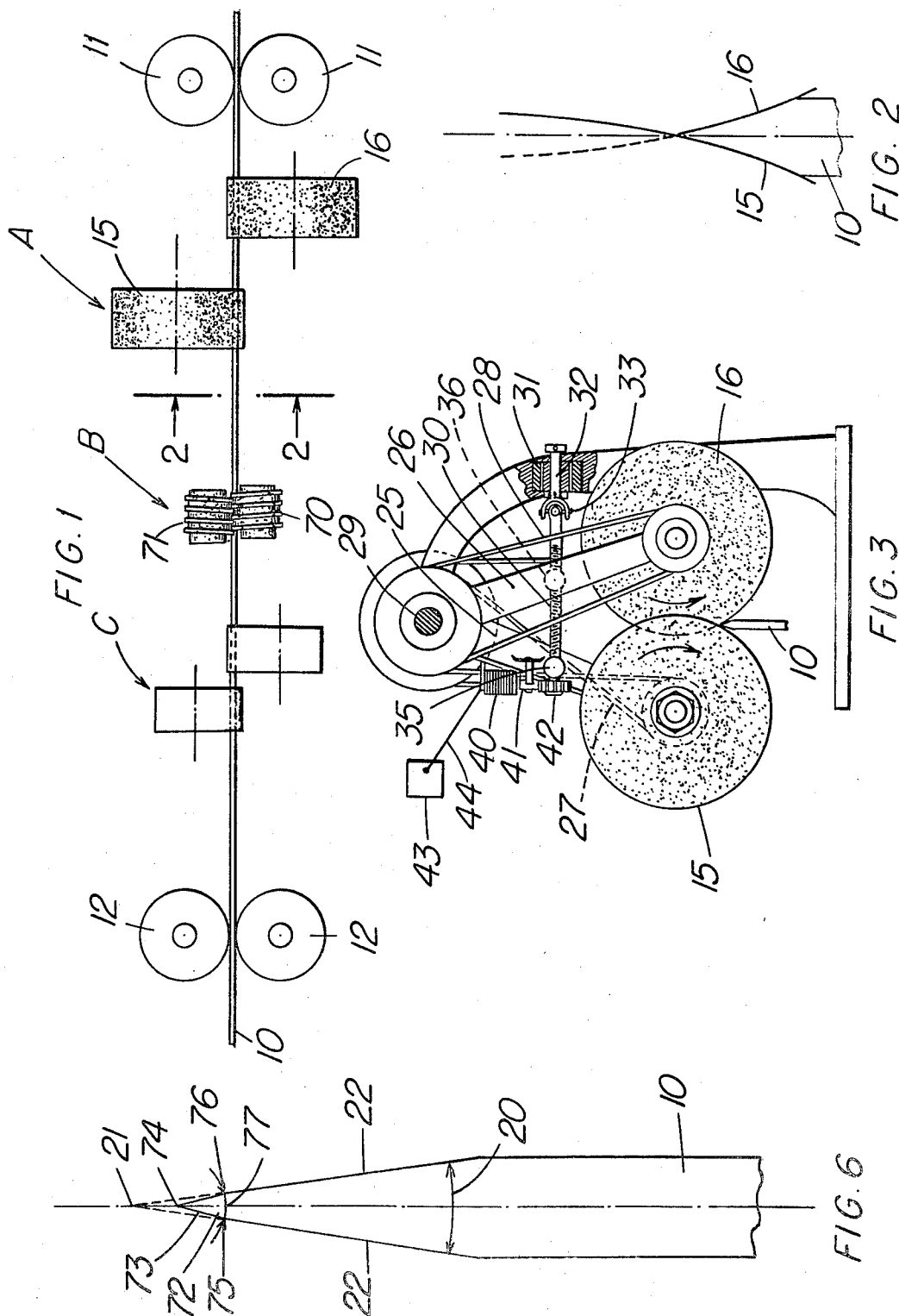
S. E. TAYLOR ET AL

3,494,081

PROCESS OF FORMING A BLADE CUTTING EDGE

Filed Dec. 7, 1967

2 Sheets-Sheet 1



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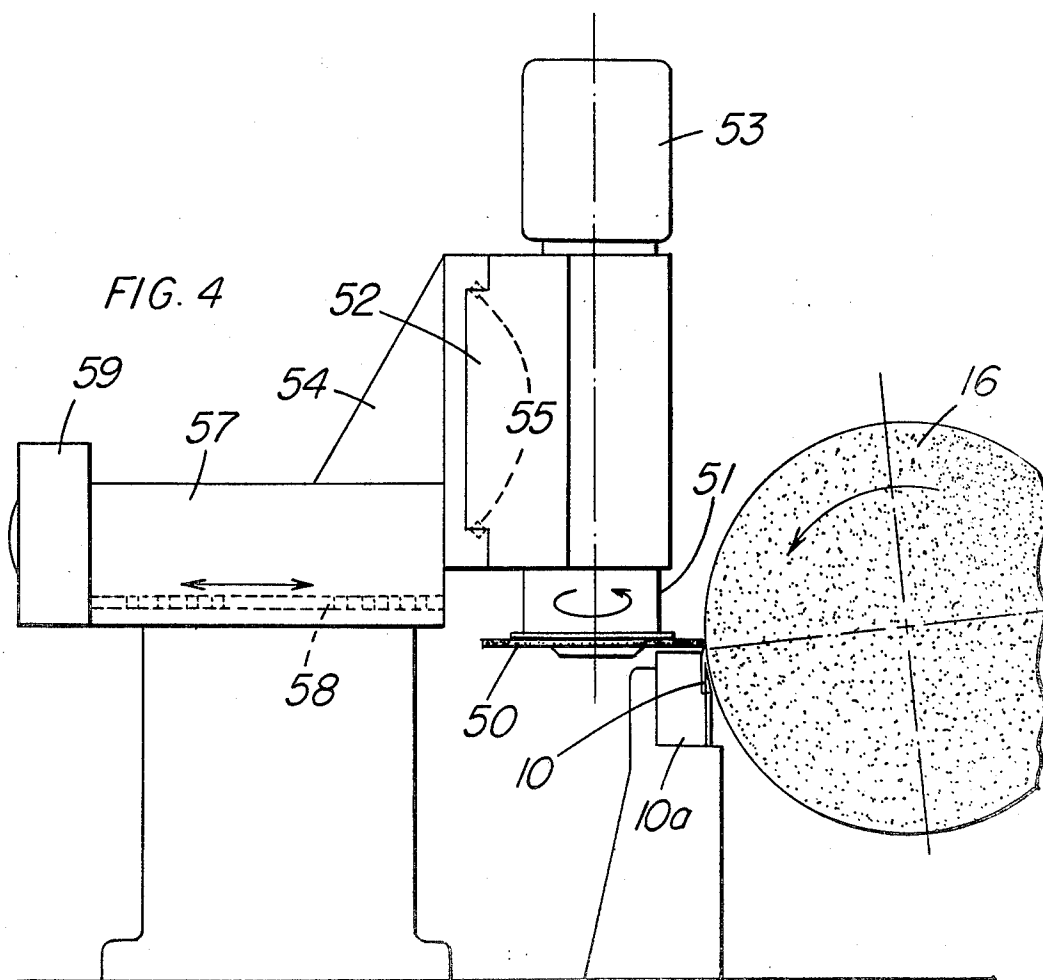
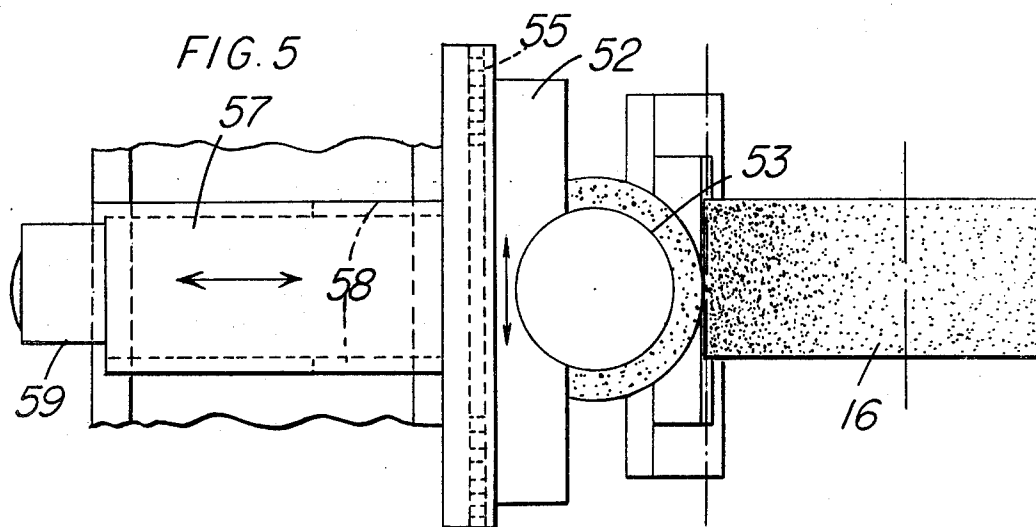
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PROCESS OF FORMING A BLADE CUTTING EDGE

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8 Claims

ABSTRACT OF THE DISCLOSURE

A process of forming a sharpened cutting edge on a continuous band strip in substantially two stages resulting in a cutting edge of two facets on each side, the process involving material removing abrading elements of particular character and arranged to produce particular included angles between the respective opposed pair of facets.

BACKGROUND OF THE INVENTION

Thin safety razor blades have commonly and for many years been processed in an initially continuous strip form including the operation of forming the cutting edge by grinding, honing and stropping. Depending upon the particular type of blade the thickness is in the range from about .0015 to about .015 of an inch and because of the thinness and flexibility of the strip, problems have been encountered, particularly with strips in the lower range of thickness, in supporting the strip adequately and in maintaining the necessary accurate relationship between the strip and the grinding or other edge forming element.

There have been proposals for sharpening the edge by processes resulting in a two-facet shape, that is an edge having what might be termed a primary facet at the extreme cutting edge and extending back a fraction of a thousandth of an inch, and a secondary facet extending back from the primary facet to the main body, the secondary facets on the opposed sides forming an included angle materially smaller than the included angle between the opposed pair of edge or primary facets. Insofar as known, such prior two-facet shapes and relations and the character of the forming processes failed to result in blade edges having the desired sharpness and smooth edge and have not achieved commercial success.

The common commercial apparatus and process for forming the sharpened blade edges have varied as to details but in general it has been of a character resulting in a three-facet shape. The process involves three major operations comprising a first coarse grind employing grinding wheels of 180 grit or coarser, the opposed faces forming an included angle of about 12°. This is followed by a rough hone operation performed by wheels of about 400 grit leaving a zone extending back from the edge having an included angle of about 16°, and then a final hone operation employing an 800 grit wheel or drum leaving a very narrow facet at the extreme edge with an included angle larger than the other two of about 20°. The grit or grain designation as employed herein is in accordance with the commonly accepted designations and specifications of The Grinding Wheel Manufacturers Assoc. of the United States and Canada referred to in for example Mechanical Engineers Handbook by Marks, page 694, Fifth Edition (1951). In general the higher the number the finer the grain size.

In the above described type of operation, heretofore considered necessary to obtain removal of the gross stock, the sharp abrasive particles of the coarse grind result in extremely rough surfaces including a rough and irregular apex and the rough hones are therefore called upon to smooth down definite irregularities which they

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are unable fully to accomplish leaving nicks and weak edges which the final hone is unable to rectify.

Furthermore, it has been difficult to control the rough hone. It is necessary to provide honing wheel in-feed adjustment of substantial amount to compensate for wheel wear, this in-feed having been performed periodically resulting in an undesirable cyclic condition and unstable operation.

SUMMARY OF THE INVENTION

It has been found in accordance with the present invention that an improved cutting edge can be formed by the selection of particular types or characters of edge forming wheels and blade angles resulting in a two-facet blade edge.

In this process the original rough grind operation is eliminated and the initial operation which may be termed a "fine grind" is designated to form an included angle in the range of about 12° to 18°. The fine grind wheel is a wheel no coarser than 400 grit and preferably a wheel of 600 grit. There is combined with the initial fine grind a "point of work" diamond dressing which aids in maintaining accuracy. This point of work dressing is accomplished by a small wheel the surface of which is impregnated with diamond particles, the wheel being mounted on a shaft perpendicular to the grinding wheel spindle and traversing the face of the grinding wheel near the point of work. The grinding wheel is slowly fed forward and the dressing wheel removes a minute amount from the circumference thus maintaining the periphery of the grinding wheel in constant relation with the work strip edge and resulting in a substantially smooth facet.

The "fine grind" step is followed by a honing operation in which the ultimate or primary facet at the blade edge is produced, this having an included angle in the range of about 18° to 22°. Since in this case the honing operation follows a grinding operation employing a fine grit wheel the honing elements have less work to do and less irregularities to reduce and the ultimate edge is smoother and more free of nicks or weak areas.

The invention accordingly comprises a novel process employing different techniques and an association of steps and edge forming elements and comprises further the resulting razor blade of improved character which has demonstrated shaving superiority over blades produced by former methods. Also the process results in marked increase in machine efficiency and reduction in scrap. This latter advantage ensues from the inherent conditions that each time the advance of the work strip is stopped in the machine the length in the machine is scrapped. The machine for the processing in accordance with the present invention has fewer stations and accordingly the lengths which are necessarily scrapped occasionally are shorter. Furthermore with a shortened machine with fewer stations requiring attention the number of times that the need for shut downs occurs is reduced.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic plan view showing in general the various primary elements employed in the processing of a continuous blade strip in accordance with the invention;

FIG. 2 is a view taken on the section 2—2 of FIG. 1 showing the relation of the grinding wheels and the blade strip in a considerably enlarged scale over FIG. 1;

FIG. 3 is a view in elevation showing the mountings for the grinding wheels and a means for forwardly feeding them to compensate for wear;

FIG. 4 is a view in elevation but somewhat diagrammatic showing a means for dressing a grinding wheel to maintain the proper relation to the blade strip;

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FIG. 5 is a top plan view of the mechanism of FIG. 4; and

FIG. 6 is a cross section of the blade strip on an enlarged scale showing the progress of the edge forming in the successive steps of the fine grind and the honing operations, the figure indicating the facets formed.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

The features of the blade shape are particularly indicated in FIG. 6 and will be further pointed out in the description immediately to follow of the apparatus and method for forming the cutting edge. As indicated in FIG. 1 a strip 10 of steel, or other material capable of being shaped to a sharp edge, having the usual thickness in the range of about .0015 to .015 of an inch, is fed from a suitable supply source such as a coil (not shown) by appropriate power feed means such as an initial pair of opposed rolls 11 and the final opposed rolls 12 all of which rolls may be positively driven in timed relation.

The strip proceeds from the rolls 11 through the fine grind station A then through the honing station B followed by a stropping station C and is drawn on past feed rolls 12 to a suitable take-up means where it normally is accumulated in a coil.

At station A the top edge is subjected to the fine grind operation of a pair of grinding wheels 15 and 16 as illustrated more fully in the enlarged view of FIG. 2. The grinding wheels 15 and 16 are of relatively fine grain with a grit or fineness designation of a grain size not larger than about 400 grit wheel and comprising preferably of wheel of 600 grit.

In this operation the secondary taper or facet formation indicated by the angle 20 in FIG. 6 is formed, the taper portion extending up to the temporary edge 21 forming side facets 22. The wheels are set with respect to each other and the blade strip 10 to produce an included angle 20 in the range of about 12° to 18° and preferably in the narrower range of 14° to 18° and particularly about 14°. This relation is accurately maintained and the means for accomplishing such accuracy comprises an important feature of the present invention. The two wheels 15 and 16 are constantly or periodically fed forwardly at a very slow rate, but the exact relation of the peripheral grinding face of each wheel is maintained at a fixed relation with respect to the blade strip 10 by means of a point of work small dressing wheel. The means for forwardly feeding the supports for the grinding wheels 15 and 16 may be of standard type common in razor blade sharpening machines such as that disclosed in the patent to Tarbox 1,370,381 reference being had particularly to FIGS. 3 and 4 of that patent. For convenience, however, the general arrangement is shown in FIG. 3 hereof, the illustration being here limited to a pair of grinding wheels operating on the upper edge of the blade strip but it will be understood that the means for grinding and the other operations may be duplicated for forming a cutting edge on the lower edge of the strip as in the above noted patent.

Referring to FIG. 3 the grinding wheels 15 and 16 are supported on swinging arms 25 and 26 respectively and are driven in the directions indicated by arrows by belts 27 and 28 respectively, the belts being driven by pulleys on the shaft 29 from which the swinging arms 25 and 26 are suspended. The strip 10 is shown supported in a suitable guide 10a. Interconnecting the arms 25 and 26 is a rod 30 rotatively supported in the frame portion 31 at 32 but restrained against axial movement. The rod 30 has a suitable universal joint therein as indicated at 33 and has oppositely screw threaded connections with the arms 25 and 26 as indicated at 35 and 36 respectively. Various means may be provided for controlling and operating the rod 30 to advance the wheels 15 and 16 as

needed. One such means is disclosed in the patent to Tarbox referred to above. This comprises as disclosed in the patent an electro-magnet 40 mounted on arm 25 having a latch 41 adapted when the magnet is energized to engage ratchet wheel 42 mounted on the end of rod 30 and rotate the rod through a small angle. The energization of the magnet may be from various sources. In the present machine it has been found that a practical arrangement comprises the employment of a timer such as indicated at 43 having an electrical connection 44 to the magnet 40. The timer is set in operation when the main machine is in operation. The amount of forward adjustment of the wheels will depend upon various factors. As a representative example grinding wheels 15 and 16 have a diameter of 12 inches and a width of 5½ inches. Mechanism is provided for constantly dressing the peripheral surface of each wheel as will be described below. The timer is actuated every seventeen seconds and the mechanical arrangement and relations are such that each actuation causes the wheels to be in-fed fifty millionths of an inch.

The point of work wheel dressing means is shown somewhat diagrammatically but with sufficient detail for an understanding thereof in FIGS. 4 and 5. The showing is with respect to only one of the wheels such as the wheel 16 but it will be understood that a similar mechanism is applied to the other wheel. The dressing wheel 50, which may be of metal with diamond particles adhering to the periphery, is mounted on a spindle 51 carried in a head 52 and rotated by a motor 53. The motor also has a suitable drive connection for reciprocating the spindle head 52 on the bracket support 54. Guideways for this purpose are indicated at 55 but the details of the drive connection are omitted as they may vary and are of no importance. Means may also be provided for advancing the dressing wheel 50 for initial setting and to compensate for wear although normally such wear would be very slight and accordingly after initial setting the adjustment need be only intermittent and of small amount. In this regard the bracket 54 is mounted on the slide 57 adapted to be reciprocated on ways 58. A motor 59 has a micro-screw connection of suitable character (not shown) with the slide 57 for making the desired adjustment of the dressing wheel relative to the grinding wheel 16.

From the grinding wheels 15, 16 the blade strip continues on to the honing station B where are located the opposed honing wheels 70 and 71. The honing wheels are preferably of the intermeshing spiral type such as are disclosed in the patents to Hill 2,281,975 and Delafontaine 2,709,874 and will include suitable means for adjustment laterally of the blade strip. Normally it will be sufficient to provide means for manual adjustment at infrequent intervals. The honing wheels are designed to remove only a small amount of metal from the extreme edge forming the wedge shaped portion 72 having the primary edge facets 73, the wedge shaped portion being indicated by the triangular shape outlined by the edge 74 and the points indicated at approximately 75 and 76. The setting of the honing wheels is adjusted to provide an included angle 77 in the range of about 18° to 22° and preferably about 20°. The width of the facets 73 are dependent principally upon the angle 20 derived in the fine grind operation. In general, however, the width of the facets 73 will be in the range of .0003 to .001 of an inch.

The honing wheels 70, 71 should have a fineness or grit size of about 800 and preferably at least not substantially coarser than 800 grit.

Because of the relatively fine grit wheels employed in the initial grind at station A, the area at and adjacent the extreme edge indicated at 21 in FIG. 6 contains only relatively small grain marks or irregularities and the final hone is required to remove only a small amount of metal leaving a smooth regular ultimate edge 74. Because the dimensions involved particularly around the ultimate edge are so minute the showing in FIG. 6, it will be ap-

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preciated, is made substantially out of proportion for purposes of illustration and clarity.

The blade strip continues from the honing station on through the stropping station C which applies the final finish to the areas immediately adjacent the edge without any material change in the shape. The stropping operation at C is normally performed in the manner and by means common in razor blade sharpening machines and the details thereof need not be concerned in connection with the present invention.

The foregoing description refers specifically to a razor blade strip, but it will be understood the operations and the principles of the invention are applicable to the formation of a sharpened edge on a strip of hard material designed for other purposes, providing the basic thickness of the stock to be sharpened does not exceed a certain amount of about .015 of an inch.

We claim:

1. A process of forming a cutting edge on a continuous band strip comprising advancing the strip past abrading elements arranged and operated to form an initial secondary inclined facet on each side of an edge of the strip, the included angle of the facet being in the range of 12° to 18°, the said abrading elements being of relatively fine grain no coarser than 400 grit, further advancing the strip past honing elements arranged and operated to form a primary facet on each side of the strip extending to and forming the ultimate edge, the included angle of the primary facets being greater than that of the secondary facets.

2. A process in accordance with claim 1 in which the included angle of the primary facets is in the range of 18° to 22°.

3. A process in accordance with claim 1 in which the included angle of the primary facets is about 20°.

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4. A process in accordance with claim 1 in which the abrading elements are about 600 grit.

5. A process in accordance with claim 1 in which the included angle of the secondary facets is about 14°.

6. A process in accordance with claim 1 in which the band strip has a thickness less than .015 of an inch.

7. A process of forming a cutting edge on a continuous band strip comprising advancing continuously the strip past abrading elements arranged and operated to form an initial secondary inclined facet on each side of an edge of the strip, the included angle of the facets being in the range of 12° to 18°, the appropriate relation of the abrading elements with relation to the strip edge being maintained by slowly feeding forward the abrading elements and constantly traversing the forward faces of the abrading elements by a dressing element the said dressing element reciprocating in a fixed path parallel to the direction of advance of the strip.

8. A process in accordance with claim 7 in which the edge is further operated on by honing elements to form small primary facets defining the ultimate cutting edge.

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