Dec. 14, 1948. H. W. BARNARD ET AL 2,456,482

KNIFE BLADE GRINDING MACHINE

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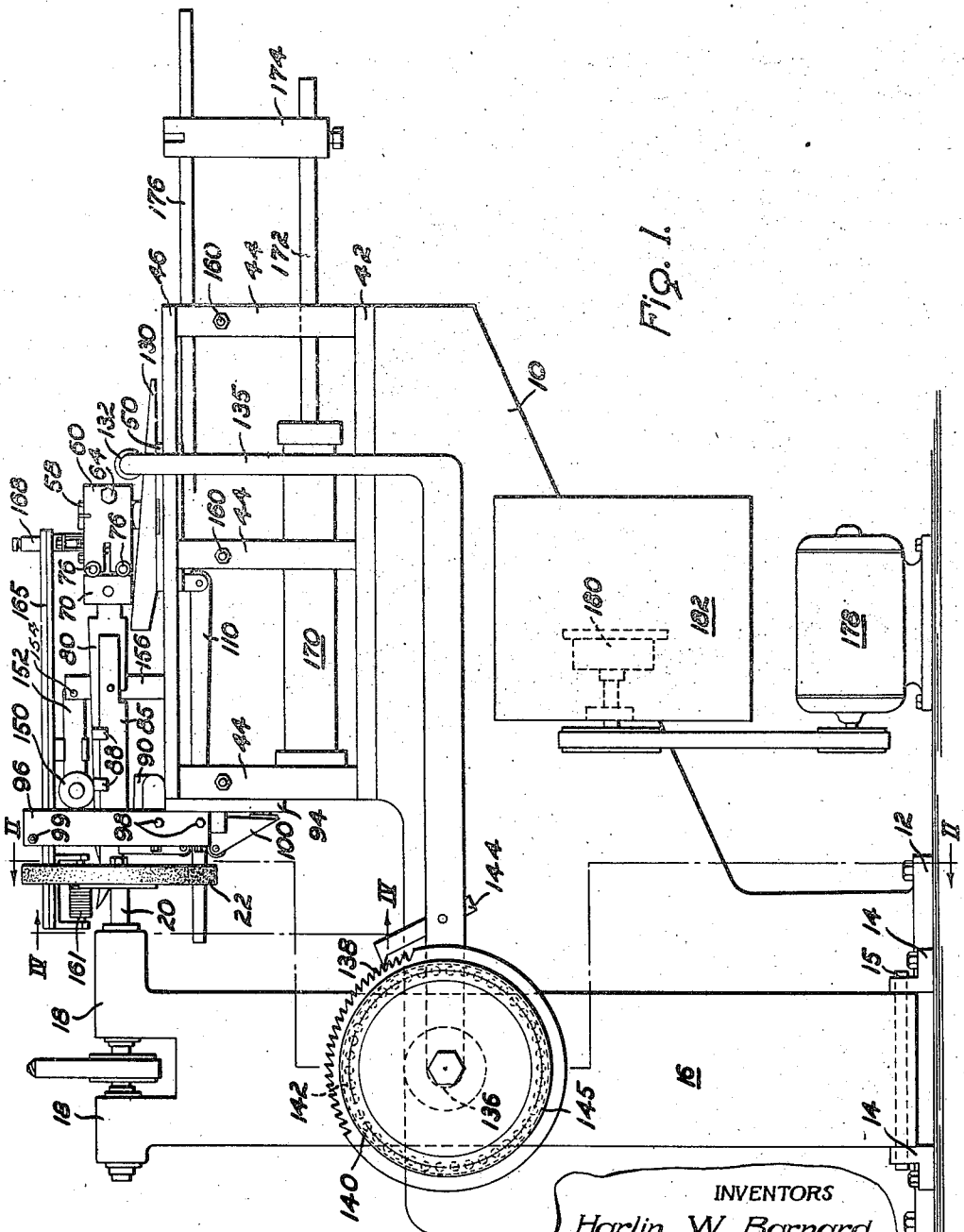


Fig. 1.

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Fig. 2.

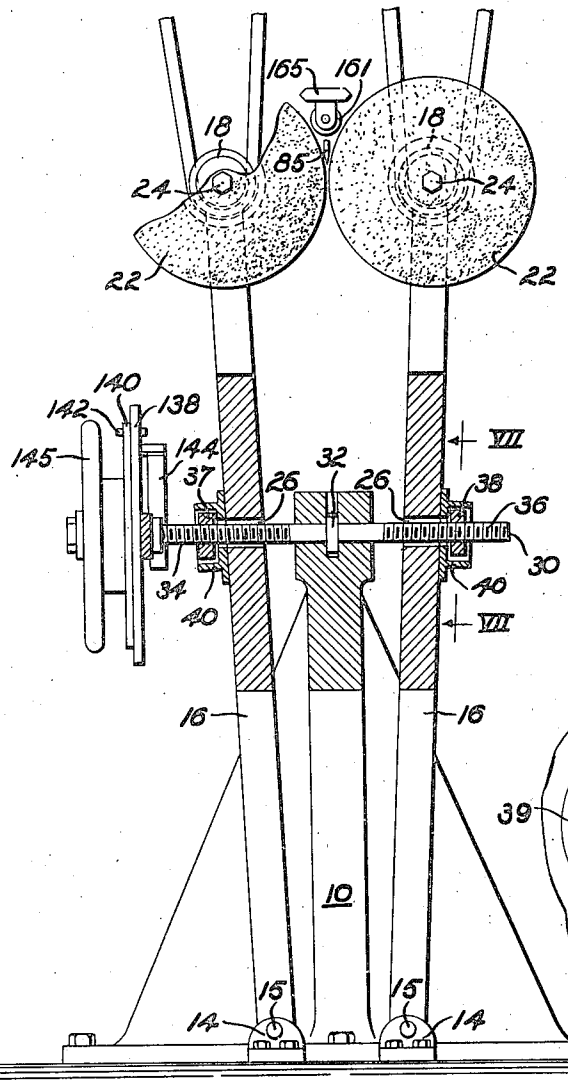


Fig. 7.

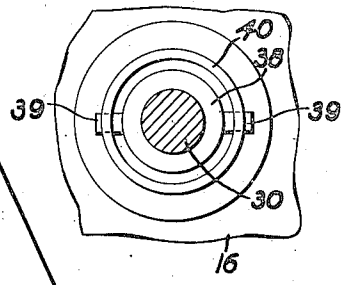


Fig. 8.

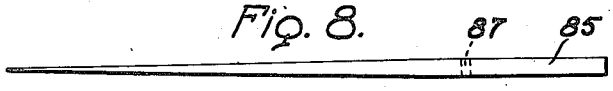
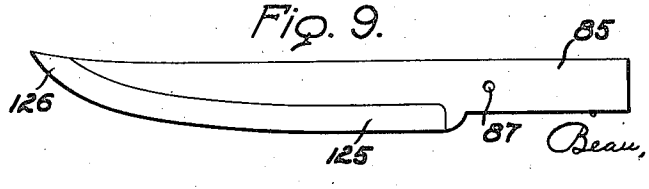


Fig. 9.



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Fig. 3.

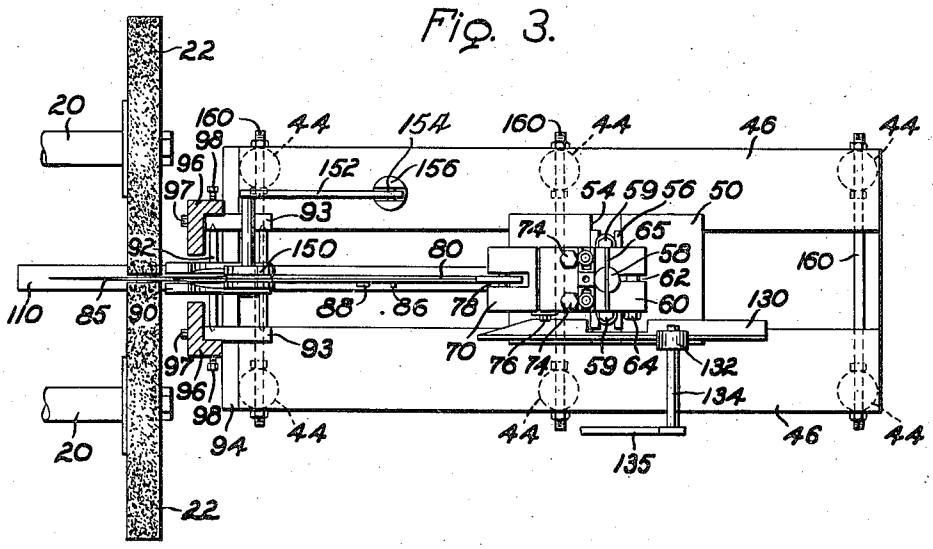
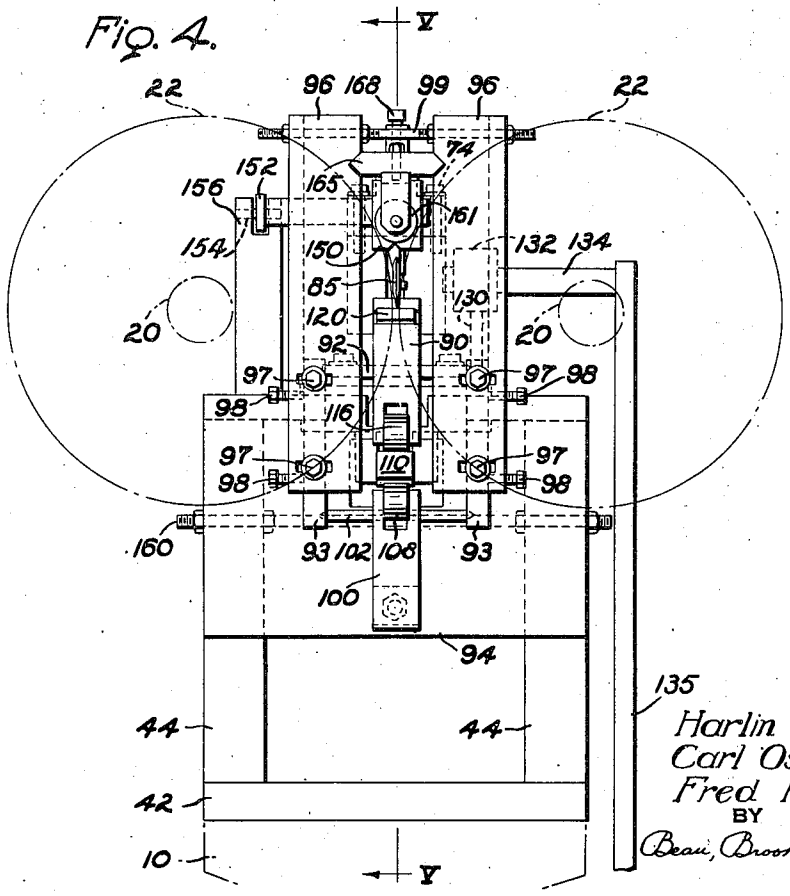


Fig. 4.



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Fig. 6.

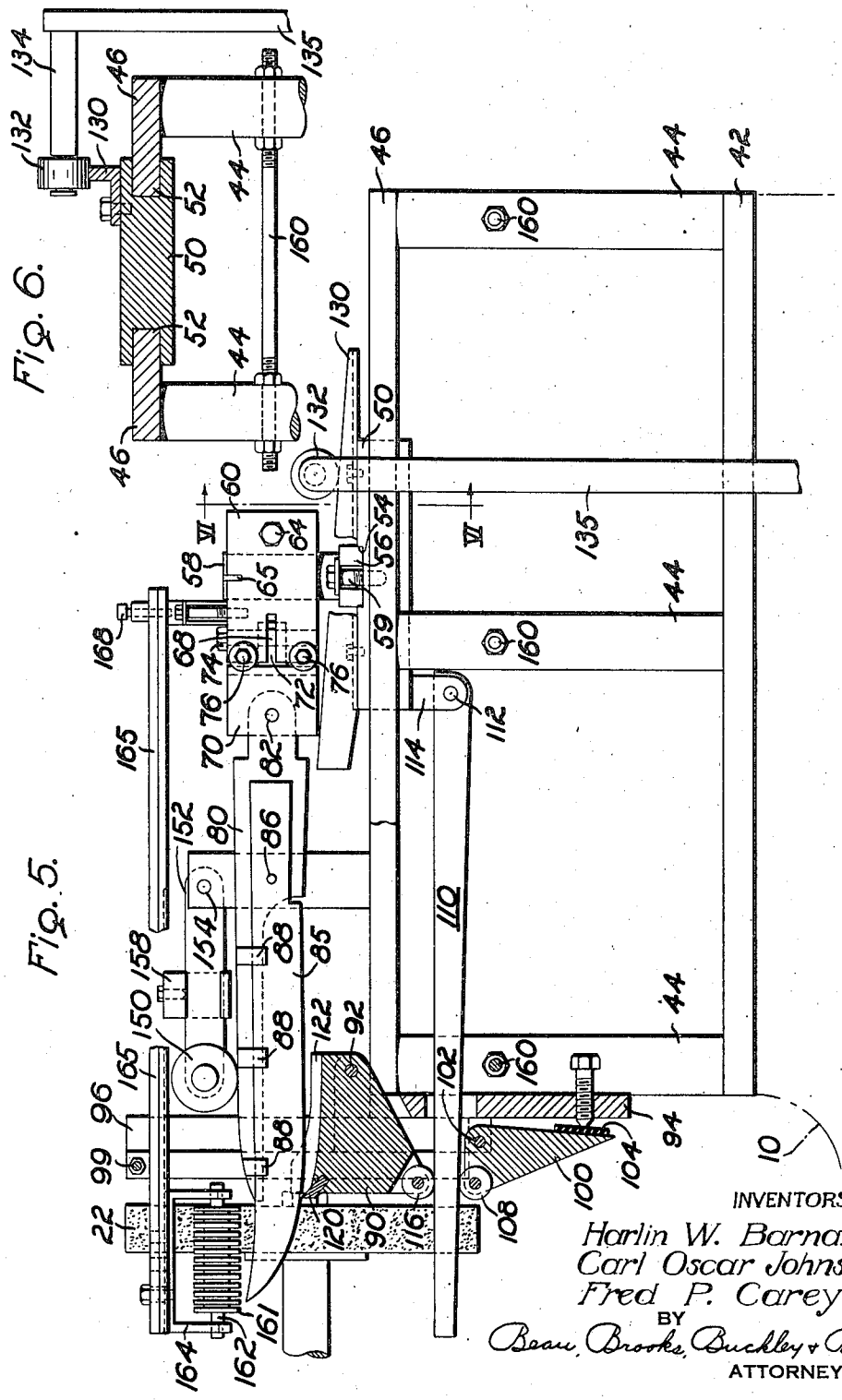


Fig. 5.

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KNIFE BLADE GRINDING MACHINE

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Application March 15, 1946, Serial No. 654,590

6 Claims. (Cl. 51—85)

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This invention relates to the manufacture of cutlery, and more particularly to an improved machine for concave-grinding knife blades of curved or any other profile and tapering sectional form.

One of the objects of the invention is to provide a machine upon which a knife blade blank may be mounted, whereupon the machine operation may be initiated and grinding of the knife cutting edge throughout the successive stages thereof will be performed automatically and without operator attention.

Another object of the invention is to provide a knife blade grinding machine of the character described which is particularly suited to the grinding of knives having edges of curving profile. Another object of the invention is to provide an improved machine of the character described which is particularly adapted to cutting edge grinding of knife blades which are of tapering sectional dimension lengthwise of the blade.

Another object of the invention is to provide a machine for the purposes hereinabove referred to, which machine embodies improved means for compensating for edge wear of the grinding wheels of the machine. Another object of the invention is to provide an improved machine for concave or hollow-grinding of knife blade blanks.

Other objects and advantages of the invention will appear in the specification hereinafter.

In the drawings:

Fig. 1 is a side elevation of a grinding machine embodying the invention;

Fig. 2 is a section taken along line II—II of Fig. 1;

Fig. 3 is a fragmentary top plan of the knife blade mounting and grinding mechanism of Fig. 1;

Fig. 4 is a view, on an enlarged scale, taken along line IV—IV of Fig. 1;

Fig. 5 is a section taken along line V—V of Fig. 4;

Fig. 6 is a section taken along line VI—VI of Fig. 5;

Fig. 7 is a fragmentary section, on an enlarged scale, along line VII—VII of Fig. 2;

Fig. 8 is a top edge view of a knife blade blank of the type which is particularly adapted to be ground in a machine of the invention; and

Fig. 9 is a side elevation of the blade blank of Fig. 8 subsequent to grinding the knife edge thereof in accord with the invention.

The invention is illustrated in the drawing in conjunction with a machine including a central

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frame 10 having a base portion 12 adapted to be bolted firmly to the factory floor so as to provide a steady base for the machine while in operation. The base portion 12 includes paired bearing blocks 14—14 at opposite sides of the central frame portion 10; the bearing blocks 14 carrying pins 15—15 (Figs. 1–2) which pivotally mount the lower ends of corresponding beams 16—16 which are disposed to extend vertically from the base plate in substantially parallel relation at opposite sides of the central frame portion 10.

At their upper ends the beams 16—16 are formed with bearing block portions 18—18 which rotatably mount corresponding stub shafts 20—20 which in turn have keyed thereon corresponding grinding wheels 22—22; it being understood that the drive shafts 20—20 are suitable collared for positional maintenance thereof, and that the grinding wheels 22—22 are keyed to the shafts 20—20 and detachably locked thereon by any suitable means such as the screwthread and nut arrangements indicated at 24.

Intermediately of their vertical lengths the beams 16—16 are apertured as indicated at 26 to freely accommodate therethrough a cross shaft 30 (Fig. 2); the cross shaft 30 being rotatably mounted in the central frame member 10 and positionally locked thereon against displacements in axial directions as by means of a collar 32. The opposite ends of the cross shaft 30 are oppositely threaded as indicated at 34—36, and the threaded portions thereof are engaged by correspondingly threaded nuts 37—38 which are carried by horizontally disposed pins 39—39 (Fig. 7) so as to freely pivot relative to a mounting bracket 40 which is bolted in each case to the corresponding beam 16. Thus, it will be understood that the hinge pins 15—15 and the cross shaft 30 cooperate to control the positions of the beams 16—16 relative to the frame 10, and that the grinding wheels 22—22 are thereby mounted to rotate in rim-to-rim relation; the distance between the rims of the grinding wheels being adjustable simply in response to rotations of the cross shaft 30. For example, rotation of the cross shaft 30 in one direction will draw the beams 16—16 together while rotation of the cross shaft 30 in the opposite direction will drive the beams further apart; the movements of the beams being at all times centralized relative to the frame portion 10 and therefore symmetrical relative to the central vertical plane of the machine frame. Means for rotating the cross shaft 30 to obtain necessary adjustments of the

gap between the grinding wheels incidental to performance of blade grinding operations will be explained hereinafter.

The machine frame portion 10 mounts a bracket for supporting the blade blank holding and reciprocating mechanism of the machine; the work mounting bracket comprising a frame-like structure including a bottom plate 42; paired posts 44 and parallel top rails 46—46 which are fixed to the top ends of corresponding posts 44 to be supported horizontally thereby in spaced parallel relation so as to define therebetween a slideway centered upon the central vertical plane of the machine referred to hereinabove. A cross head designated 50 of block metal form is mounted upon the slide rails 46—46 so as to be vertically positioned thereby while being free to reciprocate longitudinally of the slideway; the cross head 50 being laterally recessed at 52—52 (Fig. 6) for sliding engagement with the inner edges of the slide rails 46. The cross head 50 is formed in its upper face with a transversely directed groove 54 into which is bolted an inverted T-shaped bracket 56; the bracket 56 having a central vertically extending cylindrical post portion 58, and having its lower arms slotted to receive screws 59 for bolting the bracket to the cross head at a laterally adjusted position thereon. The post 58 carries a block 60 which is vertically bored to slip-fit upon the post 58 and split as at 62 (Fig. 3) and fitted with a clamping screw 64, whereby the block 60 may be adjusted vertically as well as rotationally relative to the post 58, and then locked by the screw 64 in any desired adjusted position. Preferably, a key 65 is employed to lock the block 60 against rotation relative to the post 58.

The front end of the block 60 is horizontally bored to receive in slip-fitting relation the stub shaft portion 68 of a knife blade holder block 70; the block 60 being slotted as indicated at 72 and clamping bolts 74—74 being furnished to permit the holder block 70 to be clamped into the head block 60 in any adjusted position. Set screws 76—76 are provided in conjunction with the blocks 60—70 to provide for fine adjustments of the block 70. The block 70 is vertically slotted at 78 in its forward end to receive therein the rear end of a knife blade blank holder 80. The blade holder 80 being pivotally connected to the block 70 by means of a pin 82 (Fig. 5). The holder 80 is illustrated in the drawing to be mounting a knife blade blank 85 by means of a pivot pin 86 extending from the holder and slip-fitted through an aperture 87 in the blade blank handle, in cooperation with overhanging flange devices 88 extending from the blade holder 80 across the top edge of the blade blank. The blade blank 85 is disposed upon the holder 80 so that the knife edge portion of the blade blank is directed downwardly, while its tip end is directed into the gap between the grinding wheels.

To support the blade blank upwardly against the flanges 88 a guide device 90 is provided in the form of a block of metal pivoted by means of a cross pin 92 upon a pair of lugs 93—93 which are integral with a face plate 94 fixed to the work bracket structure. Thus, the guide block 90 is arranged to rock about the transverse horizontal axis of the pin 92 for a purpose which will be explained hereinafter.

A pair of parallel posts 96—96 are bolted to the front ends of the lugs 93—93 by means of screws 97 (Fig. 4) and set screws 98 are provided on the posts 96 to assist in adjustments of the bottom ends of the posts relative to the knife blade guide block 90. Thus, the posts extend vertically and straddle the knife guide block 90 and are interconnected at their upper ends by means of a cross bolt 99 and lock nuts, whereby fine adjustments of the posts 96—96 relative to the position of the blade blank may be effected.

A crank member 100 is pivotally mounted by means of a pin 102 carried crosswise of the lugs 93—93 of the face plate structure, and at its lower end the crank 100 carries a cushion block 104 for abutting engagement against the extending end portion of a set screw 106 which is threaded through the face plate 94 for absorbing vibrations and thereby smoothing out the grinding operation. At its upper end the crank 100 carries a roller 108 which provides vertical support for the forward end of a cam bar 110; the rear end of the cam bar being pivotally connected at 112 to a lug 114 extending integrally from the cross head 50. The upper face of the cam bar 110 bears against a roller 116 which is carried at the lower end of the knife blade guide block 90, whereby the crank 100 and the cam bar 110 cooperate to control the rocking position of the knife blade block 90.

At its upper forward edge the blade holder block 90 mounts a lip piece 120 which is preferably formed of extremely hard material such as the alloy commercially known as tungsten carbide or some other suitable material; and the lip piece 120 is so disposed as to present an edge portion thereof for line contact with the knife edge portion of the blade blank 85 when mounted in the holder. The guide block 90 is centrally grooved and thus formed with a recess 122 which sweeps downwardly and rearwardly parallel to the longitudinal extent of the knife blade blank so as to avoid any interference between the body portion of the block 90 and the knife blade blank as the cross head 50 reciprocates to slide the blade blank back and forth through the grinding zone between the wheels 22—22.

The lip piece 120 and the guide block 90 and its supporting devices are so constructed and arranged as to support the knife blade blank at all times so that the portion of the blade blank edge being ground at any phase of the grinding operation is disposed substantially exactly at the elevation of the plane of the axes of the grinding wheels 22—22. As illustrated in Figs. 3–5, the upper edge of the lip piece 120 is disposed as closely as practicable to the faces of the grinding wheels 22—22, and therefore this blade blank edge guide arrangement approaches as nearly as possible the ideal of a guide support disposed between the grinding wheels and in the plane of the axes thereof.

Thus, it will be appreciated that as the cross head 50 is caused to reciprocate upon the slide rails 46—46 while the grinding wheels are rotating, the knife blade blank 85 will be thereby carried to reciprocate longitudinally through the grinding zone between the wheels with the body of the blade blank disposed above the elevation of the plane of the wheel axes. Throughout the operation the knife edge portion of the blade blank is guided by the lip piece 120 to be at all times substantially at the elevation of the grinding wheel axes, and therefore the grinding wheels 22—22 will operate to simultaneously concave grind the corresponding sides of the blade blank 85 throughout the extent of longitudinal movement of the blade blank relative to the grinding wheels. Means for causing the work holding cross head to reciprocate for feeding the knife

blade blank relative to the grinding wheels will be discussed hereinafter.

It is a feature of the invention that the machine thereof is particularly suited to grind knife blades which are of tapering form in edge view; that is, of gradually increasing thickness from tip to handle portion, as illustrated in Fig. 8. It will be appreciated that if such tapered form knife blanks were to be passed longitudinally between grinding wheels while maintaining the bottom knife edge portion at a constant elevation relative to the plane of the axes of the grinding wheels, the depth of the grinding at each side of the blade would increase progressively from the blade tip to the handle portion. Thus, the finished blade would not be of progressively increased stiffness from the tip end toward the handle end thereof, as was intended. In the case of the present invention however, the cam bar 110 is constructed and arranged to function automatically to lift the lip piece end of the guide block 90 as the blade bank moves into and through the grinding zone in correct relation to the rate of taper of the blade blank so that the depth of grinding as illustrated at 125 in Fig. 9 at opposite sides of the blade blank will in the case of the present invention be either uniform throughout the entire pass of the blade through the grinding zone, or otherwise as may be preferred.

Another feature of the invention is that the edge or line support for the knife blade blank which is provided by the lip device 120 permits the grinding of the blade blank at opposite sides thereof to be extended completely through the tip of the blade blank as indicated at 126 in Fig. 9. This is because the lip piece 120 operates at all times to maintain the cutting edge portion of the blade blank centered within the grinding zone between the wheels 22—22.

Another feature of the invention resides in the arrangement for adjustment of the holder block 60 relative to the cross head 50, whereby the block 60 may be simply lowered slightly from time to time relative to the cross head to compensate for uneven wearing of the working faces of the grinding wheels under normal operating conditions, thereby lengthening the operative periods between grinding wheel redressings. Due to the fact that the portions of the grinding wheels which are nearest to the blade holder mechanism are called upon to do more work than are the portions of the grinding wheels further away from the work holder, the wheels will be found to have become worn off subsequent to grinding a number of blades so that the plan view profile lines of the wheel are divergent instead of parallel as when the wheel faces are initially dressed. To compensate for such uneven wear of the grinding wheels the holder block 60 is simply adjusted downwardly upon the cross head post 58 so that the handle end of the mounted blade blank is moved down while the lip 120 of the blade guide maintains the tip end of the blank at its original elevation. This slightly inclines the attitude of the line of the knife edge being ground, and thereby enables the grinding wheels to continue to grind off the blade sides in a direction substantially perpendicular to the profile of the knife edge.

Incidental to each pass of the knife blade blank through the grinding zone between the wheels 22—22 metal is removed from each side of the blank, thereby reducing it toward the knife edge form desired. The invention includes an

arrangement for reducing the width of the gap between the grinding wheels to compensate for such removal of metal by providing the crosshead 50 with an inclined cam track 130 and a roller 132 arranged to ride upon the track. The roller carries a shaft 134 which is integral with a crank arm 135, and the crank arm 135 pivotally mounts at 136 (Fig. 1) upon the cross bolt 30. Thus, it will be understood that for each forward and backward movement of the work holder relative to the grinding wheels the crank arm 135 will oscillate about the axis of the bolt 30. A ratchet wheel 138 is rotatably mounted upon the bolt 30 to lie against an index wheel 140 which is keyed to the bolt 30. A pin and aperture arrangement as indicated at 142 is provided to permit the wheels 138—140 to be detachably locked together in any indexed position as desired. The crank arm 135 carries a ratchet pawl 144 for engagement with the ratchet wheel 138 in one direction of movement of the crank 135; whereby it will be understood that for each reciprocation of the blade blank holder the cross screw 30 will be slightly rotated so as to draw the grinding wheels 22—22 further together, thereby compensating for the blade blank metal removed during the preceding pass through the grinding wheels. A hand wheel 145 is also keyed to the screw 30 for manual adjustments of the grinding zone gap independently of the ratchet-pawl mechanism. The ratchet teeth of the wheel 138 are terminated as shown so that when the grinding wheels 22 reach a predetermined position of minimum clearance therebetween the pawl will ride upon the wheel periphery and halt the grinding wheel feeding operation.

To maintain the blade blank in proper position and attitude within the grinding zone between the wheels 22—22 we provide a grooved roller 150 carried at the free end of an arm 152 which is pivoted at 154 to a post 156 carried by one of the slide rails 46. A weight 158 is slidably mounted upon the arm 152 for adjustments longitudinally thereof so as to regulate the downward pressure exerted against the top edge of the blade blank holder; and the groove in the roller 150 provides a lateral guide for the top edge of the blade blank and thereby prevents passage of a blade blank through the grinding zone in an axially twisted condition.

The work support bracket preferably includes tie rods 160 extending between the paired post members 44-44 adjacent the upper ends thereof so that the crosshead 50 will be firmly supported in properly guided relation. Adjustment means embodied in the crosshead and workholder connection devices permits the machine to be initially set up for extremely accurate axial alignments of the crosshead and the work holder carriage relative to the grinding wheel axes so that perfectly uniform and accurate grinding results at opposite sides of the blades may be obtained.

A grinding wheel dressing mechanism is conveniently carried upon the posts 96—96 and power-driven by the cross head 50 for periodically redressing the working faces of the grinding wheels 22-22. For this purpose the redressing mechanism is illustrated to comprise a dressing hob 161 which may be of any standard form and which is shown herein to comprise a plurality of hard metal discs carried upon a mandrel 162. The mandrel is mounted by means of a bracket 164 upon a slide bar 165 which extends along the vertical central plane of the machine. The slide bar 165 is V-shaped at its side edges and is

thereby mounted in splined relation within complementary shaped grooves in the side walls of the posts 96—96. At its rear end the slide bar 165 is detachably connected as at 168 to the holder block 60; that it will be understood that as the cross head 50 reciprocates on the slide rails 46 with the redressing mechanism in operative position the latter will be caused to reciprocate within the space between and above the grinding wheels 22-22 and to bear thereagainst while the latter are rotating so as to redress the perimetral faces of the grinding wheels into mutually parallel condition, and central to the vertical central plane of the machine.

To actuate the cross head 50 to reciprocate upon the slide rails 46—46, it is contemplated that any suitable manual or powered gear means may be employed. However, by way of example an actuating mechanism is illustrated herein to comprise a hydraulic cylinder 170 and a piston rod 172 carrying a latch bar 174 which is adapted to be swung into locked position with a strut 176 which extends rearwardly from the cross head 50. The hydraulic pressure supply system is illustrated to include an electric motor 178 which is geared to a pump 180 disposed in communication with an oil reservoir 182; and it will be understood that suitable conduit devices and self-reversing control valve mechanism will be provided for operation at the end of each stroke of the work holder, whereby to provide constantly reciprocating movements of the work holder such as to cause the mounted blade blank to pass back and forth between the grinding wheels as long as the master valve of the hydraulic control system is open.

Thus, it will be appreciated that the invention provides a knife blade grinding machine which is featured by embodiment of universally adjustable work holding means in a machine comprising a central base support; paired grinding wheels arranged symmetrically relative to the vertical central plane of the base and symmetrically adjustable thereto; a work holding carriage centered upon the vertical central plane of the base and thereby accurately aligned relative to the grinding gap; power means for reciprocating the work holder to cause the mounted blade blank to pass through the grinding zone; improved blade tip guide means supporting the knife edge profile of the blade blank at substantially the plane of the grinding wheel axes at all phases of the blade reciprocating operation; and improved means for guiding and adjusting the work relative to the grinding zone to compensate for wearing of the grinding wheel surfaces and to provide any desired pattern of grinding such as to uniform depth throughout the entire extent of the blade, and whereby the grinding operation is at all times directed substantially perpendicular to the knife edge profile. It is of course a further special feature of the machine that blades of any profile shapes may be ground thereon without need for special cams or guides, because of the action of the guide rocker 120.

It will also be appreciated that although only one form of the invention has been shown and described in detail it will be apparent to those skilled in the art that the invention is not so limited but that various changes may be made therein without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In a knife blade grinding machine, a base, a pair of beams movably fastened to said base and each mounting a grinding wheel whereby said grinding wheels are disposed in edge-to-edge relation for grinding a knife blade therebetween and relatively movable to regulate the grinding gap therebetween, a cross head slidably mounted upon said base for reciprocation in the direction of the grinding gap between said wheels, means for pivotally mounting a blade blank at its handle end portion on said cross head, a knife blade guide pivotally mounted upon said base and having an edge portion slidably engaging under the tip end portion of said knife blank, said guide edge being disposed closely adjacent said grinding wheels and said mechanism being so constructed and arranged as to dispose the knife edge portion of said blade blank between said grinding wheels at approximately the elevation of the plane of the grinding wheel axes throughout all phases of the blade blank movement through said grinding gap, means for relatively moving said grinding wheels to regulate the gap therebetween in response to reciprocations of said crosshead, and means for automatically tilting the longitudinal attitude of said blade blank as it reciprocates through said grinding gap.

2. In a knife grinding machine, a base, a pair of grinding wheels mounted on said base by horizontal bearings whereby said grinding wheels are disposed in edge-to-edge relation for grinding a knife blade therebetween, a cross head slidably mounted upon said base for reciprocation in the direction of the grinding gap between said wheels, a blade blank holder pivoted to said cross head for mounting a blade blank adjacent its handle end portion relative to said cross head, a knife blade guide mounted upon said base and having an edge portion slidably engaging under the tip end portion of said knife blank, said guide edge being disposed closely adjacent said grinding wheels and said mechanism being so constructed and arranged as to dispose the knife edge portion of said blade blank between said grinding wheels at approximately the elevation of the plane of the grinding wheel axes, and means for vertically adjusting the handle end portion upon said cross head for tilting the knife blade longitudinally to compensate for uneven wearing of said grinding wheels.

3. In a knife blade grinding machine, a base, a pair of grinding wheels mounted upon said base whereby said grinding wheels are disposed in edge-to-edge relation defining a grinding gap for grinding a knife blade therebetween, a cross head slidably mounted upon said base for reciprocation in the direction of the grinding gap between said wheels, means for pivotally mounting a blade blank at its handle end portion on said cross head, a knife blade guide pivotally mounted upon said base and having an edge portion thereof slidably engaging under the tip end portion of said knife blank, said guide being disposed closely adjacent said grinding wheels and said mechanism being so constructed and arranged as to dispose the knife edge portion of said blade blank between said grinding wheels at approximately the elevation of the plane of the grinding wheel axes throughout all phases of the blade blank movement through said grinding gap, and cam means carried by said cross head for reciprocation therewith and operable upon said guide to rock the latter to alternately raise and lower said blade blank as it passes through said grinding gap.

4. In a knife grinding machine, a base, a pair of bearings fastened to said base and each

mounting a grinding wheel whereby said grinding wheels are disposed in edge-to-edge relation for grinding a knife blade therebetween, a cross head slidably mounted upon said base for reciprocation in the direction of the grinding gap between said wheels, means for connecting a blade blank at its handle end portion to said cross head, a knife blade guide pivotally mounting upon said base and having an edge portion slidably engaging against the knife edge portion of said knife blank, said guide edge being disposed closely adjacent said grinding wheels and said mechanism being so constructed and arranged as to dispose the knife edge portion of said blade blank between said grinding wheels at approximately the position of their closest relative proximity throughout all phases of the blade blank movement through said grinding zone, and means connected to said cross head and bearing against said guide to rock the latter incidental to back and forth feeding movements of said blade blank relative to the grinding wheels.

5. In a knife blade grinding machine, a base, a pair of grinding wheels carried by said base whereby said grinding wheels are disposed in edge-to-edge relation for grinding a knife blade therebetween, a carriage slidably mounted upon said base for reciprocation in the direction of the grinding gap between said wheels, means for mounting a blade blank upon said carriage, a knife blade guide pivotally mounted upon said base and having an edge portion slidably engaging against the knife edge portion of said knife blank as the latter reciprocates through the grinding gap, and means responsive to reciprocation of said carriage to rock said guide so as to tilt the longitudinal attitude of said blank incidental to feeding movements thereof relative to the grinding gap.

6. In a knife blade grinding machine, a base, a pair of beams pivotally fastened to said base and each mounting a grinding wheel whereby

said grinding wheels are disposed in edge-to-edge relation for grinding a knife blade therebetween, a screw interconnecting said beams and adapted to be adjusted to regulate the grinding gap between said wheels, a cross head slidably mounted upon said base for reciprocation in the direction of the grinding gap between said wheels, means for mounting a blade blank upon said cross head, blade guide means constructed and arranged as to dispose the knife edge portion of said blade blank between said grinding wheels at approximately the elevation of the plane of the grinding wheel axes, means responsive to reciprocation of said cross head to actuate said screw whereby to automatically lessen said grinding gap as the knife blade is progressively ground down, and means responsive to reciprocation of said cross head to alternately raise and lower said blade guide means as the knife blade passes back and forth through said grinding gap.

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