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Description

This invention relates to a new and improved method and apparatus for rapidly sharpening knives and similar tools to create a superior cutting edge. As used herein, the term knife shall be defined to include any sort of blade such as chisels, plane edges, scissors, razor blades, and similar precision edges or cutting tools. The application is a divisional of EPA 85102761.5 (EP-A-0 154 967).

There are a wide variety of known means for sharpening knives some of which are discussed in EPA 851027599 (EP-A-0 156 230). The large number and wide variety of existing means discussed in that application for sharpening knives is testimony to the complexity and difficulty of sharpening knives in a fast, convenient, and satisfactory way that will consistently produce a sharp cutting edge. There is today in fact no known available means for the unskilled to produce rapidly and consistently razor-like cutting edges on knives.

Rapid sharpening requires a means to remove rapidly the material of composition of the knife --often a high carbon steel or a stainless steel. The rate of metal removal is related to the inherent hardness of the abrasive used, the particle size, or grit as it is commonly called, of the abrasive, the applied pressure on the knife edge, and the linear velocity of the abrasive particles across the edge being formed or sharpened. The hardest material commonly used for metal removal is diamond with a hardness of 10 on the Mohs' scale, compared to about 5.5 or so for many steel alloy knives. Other materials such as alumina, high density alpha alumina, carborundum, certain natural stones and the like also are harder than most steels and hence can be used for sharpening through abrasive action against the metal.

Creation of the finest cutting edges on the order of one tenthousandth (1/10,000) of an inch (1 inch = 2,54 cm) in width can be accomplished with these abrasive compositions, but a fine grit must be used and the velocity of the abrasive must be held below a critical limit to avoid overheating the thin and fine edge being created by the abrasive action. An abrasive system and apparatus designed to create fine edges such as that described in the copending application cited above will remove metal at a rate lower than a system where the abrasive particles are larger and moving at higher velocities.

Because creation of the finest cutting edges involves inherently a slower metal removal rate, any process designed to create such edges is not optimum for the task of initial metal removal such as where a knife is first being formed or where the blade is particularly dull. Consequently, to reduce the total elapsed time needed with a very dull knife to create a thin and fine edge of a thickness limited only by the composition of knife and its crystalline structure, one usually resorts to a series of different and time consuming grinding and sharpening operations. None of the integrated sharpening equipment existent today are satisfactory for the rapid generation of fine edges on the order of 1/10,000 inch on otherwise very dull knives.

Much prior art has been concerned with disk type sharpeners for rapid sharpening such as described in U.S. Patent No. 3,680,264. They have proved unsatisfactory because of serious control problems inherent with disks which manifest difficulties in positioning the knife accurately, in controlling the angular relationship of the knife with the disk face, and in creating excessive heating of the knife edge during sharpening. A most serious disadvantage has been the tendency of the disk to "grab" the knife when its edge is rested on the flat surface of the disk and to grind undesirable scallops or grooves along the knife edge in an uncontrolled manner. Such grabbing occurs if there is instability in the control of the angle that the knife face makes with the disk face, or inadequate means to hold the knife edge parallel to the flat surface of the disk, or poor control over the consistency of force applied to the knife edge by the disk or operator during sharpening.

A major cause of poor sharpening with disk sharpeners is poor control of knife angle relative to the rotating disk such as exemplified in prior art U.S. Patent No. 2,496,139 that actually allows the knife guide to wobble and the sharpening angle to be determined more by operator skill or by the knife width and thickness. Poor control of the knife edge parallel to disk face or poor control of the angle of knife face relative to the principal plane of a disk sharpener is unacceptable if one wishes to optimize blade edge sharpness and to avoid gouging.

To minimize such uncontrolled gouging and grabbing of knives sharpened with disks, the prior art commonly has resorted to maintaining contact of the knife edge only with the corner edge of the disk such as described in U.S. Patent No. 3,334,446 and deliberately avoiding a planar contact between the knife edge facet and the disk face perpendicular to its axis of rotation. In that patent the described disk is spring loaded to help reduce gouging and the knife is positioned on a rigid holder by means of a leaf spring pressing against the knife. A guiding means in this sharpener on one side of the disk edge limits the movement of the knife toward the disk. Even with these precautions, by deliberately avoiding planar contact with the disk face perpendicular to its axis of rotation there is only a point or limited line of contact

between the blade and abrasive during sharpening and there is a strong tendency to gouge the knife edge. The abrasive passes the knife edge in essentially one fixed direction which leaves burrs and unacceptable large serrations on the blade edge.

A common version of this approach is described in U.S. Patent No. 2,775,075 where the edge of the abrasive disk is beveled to enlarge the line of contact along that bevel of the knife edge with the abrasive. The tendency of such sharpeners to gouge knife blades is well known and at best the resulting knife edge is poorly defined and serrated. In all such sharpeners the abrasive passes the knife edge in essentially one fixed direction which creates the serrations and a sizeable burr on the knife edge.

A complex sharpener covered by U.S. Patent No. 2,519,351 contains two pair, a total of four (4) abrasive blocks, one pair of which is biased to move toward the other, that sharpens by a reciprocating rectilinear motion simultaneously both cutting edge facets of a knife. The knife is held by three sets of jaws in a positioning means designed to be free floating in lateral position between the abrasive pairs and to moderate insertion of the blade into the positioning means by engaging the sides of the knife in one or more of three (3) grooved blocks. In addition to its complexity this sharpener has the disadvantages inherent in all rectilinear motion sharpeners which leaves a serrated knife edge which cuts by tearing and has poor wear characteristics. The free floating design of the positioning means and the inherent tendency of the two cutting edge facets of the blade to jam in the grooved block makes this inapplicable in virtually any other sharpener. Because both sides of the knife or sides of its cutting edge facets are used to moderate the degree of knife insertion into the sharpener, and because of the free floating lateral motion, this prior art positioning means is inapplicable where a precise positioning of the knife edge is necessary. The degree of insertion of the knife edge and hence its position depends on the width of the knife, on the width and angle of its cutting edge facet and on the degree of manual pressure applied during insertion and movement of the knife.

U.S. Patent No. 2,751,721 describes a sharpener with a drum shaped abrasive element where the knife cutting edge facet is sharpened against annular portion of the drum surface that rotates in a plane perpendicular to the axis of rotation of the drum. The abrading force on the cutting edge is determined solely by the degree of hand pressure applied to the knife by the operator which leads to significant inconsistencies in abrading rate, poor edge formation, and gouging of the edge -- problems common to much of the prior art. Position and stability of the knife within the holder and angular control of the cutting edge facet against the abrasive surface is poor because of their dependency on the amount of pressure applied by the operator and by the profile of the several bevel faces common to the existent variety of commonly available knives.

U.S. Patent No. 2,645,063 describes a sharpener with a drum surface and a guide mechanism which provides stops that position the knife by bearing directly on the cutting edge itself. Such stops are impractical because of the constant dulling effect on the edge created by rubbing it directly across and normal to one surface of the guide. This patent and U.S. Patent No. 2,751,721 describe sharpeners that incorporate a magnet. The magnetic field does not support or guide the knife.

U.S. Patent 2,841,926 discloses an apparatus according to the preamble of Claim 1, that is a combined knife sharpener and buffer having a motor-driven rotatable shaft with a grinding wheel mounted thereon in a first sharpening section and a buffing wheel mounted thereon in a second buffing section. The knife sharpening apparatus of the present invention also has two sections with a grinding wheel or disk in its first section, and is characterized by the fact that its second section comprises a sharpening member with a pair flat outer faces having abrasive particles thereon, drive means for orbitally driving said sharpening member such that each abrasive particle thereon has a separate orbital path within or parallel to the outer faces and the amplitude of said paths are essentially equal for each particle, and second sharpening section guide means opposite respective outer faces of its sharpening member.

Many of the problems associated with the rapid generation of thin fine edges on dull knives and other blades are overcome with the method and apparatus described here which include precision control of sharpening steps employing an improved disk sharpener.

The invention also provides a method of sharpening a knife having a cutting edge facet comprising placing the knife against a first inclined guide surface at a first angle in a first sharpening section of a housing with the cutting edge facet against abrasive particles on a surface of a disk mounted on a rotatable shaft, rotating the shaft to rotate the disk surface and sharpen the cutting edge facet, removing the knife from the surface of the disk the cutting edge facet being against abrasive particles on a second surface of the disk assembly mounted on the rotatable shaft, rotating the shaft to rotate the second surface of the disk assembly and further pre-sharpen the cutting edge facet, placing the knife against an inclined second guide surface in a

second section of the housing with the cutting edge facet against abrasive particles on a first face of a sharpening member, orbitally driving the sharpening member to further sharpen the cutting edge facet, removing the knife from the first face of the sharpening member, placing the knife against an inclined further guide surface in the second sharpening section with the cutting edge facet being against abrasive particles on a second face of the sharpening member with the further guide surface inclined at a mirror image angle to the second guide surface which differs from the angle of the first sharpening guide surface, and orbitally driving the sharpening member while the knife is against the further guide surface (claim 8).

The use of the knife sharpening apparatus as described here can produce quickly in hands of the inexperienced well defined and reasonably sharp edge with reduced risk of gouging, overheating, or damaging the general contour and shape of the knife edge. A very thin and finer edge can be generated quickly. Most effective use of these methods and apparatus depends critically on the control of sharpening angle in each step.

In accordance with the method of the invention the use of a disk sharpener which removes large masses of metal is followed by further sharpening with an orbiting sharpener incorporating an accurate knife guide or hold which permits rapid further metal removal for creation of a knife edge on the order of 1/10,000 inch or less in thickness (1 inch = 2,54 cm). The ultimate width of the edge is established primarily by the properties and quality of steel or other material used in the knife. The guide, preferably magnetic, used to position the knife in this orbital sharpening step commonly positions the face of the knife relative to the plane of the orbiting abrasive surface at an angle, referred to herein as the second sharpening angle, preferably larger than the first sharpening angle between the face of the knife and the plane of the abrasive disk used in the preceding disk sharpening step, referred to herein as the first sharpening angle. This will cause the orbiting abrasive to sharpen the knife cutting edge facets at a slightly greater total included angle than their existing total angle after the disk sharpener.

The combination of disk and orbital sharpening is unique because of the overall speed with which a very fine edge is formed. The disk sharpener disclosed here can quickly preform the knife edge which is then passed through the orbital sharpener to develop rapidly a razor like edge.

The invention will be more fully understood from the following description when read together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view of a combined disk sharpener and a two stage orbiting sharpener in a single apparatus constructed according to this invention.

Fig. 2 is a cross sectional elevation view taken along line 2-2 of Fig. 1 of a combined disk sharpener and a two stage orbiting sharpener in a single apparatus constructed according to this invention.

Fig. 3 is an elevation view of a further embodiment of the first sharpening section.

Fig. 4 is a cross-sectional view taken through Figure 3 along the line 4-4.

Fig. 5 is a cross sectional view of a knife with a 45° total angle at edge indicating sharpening to be made at 34° by the disk sharpener.

Fig. 6 is a cross sectional view of resultant knife with a 34° total angle at edge formed by first stage disk sharpener indicating sharpening to 40° in the next orbital sharpening step according to this invention.

Fig. 7 is a cross sectional view of a resultant knife showing the 34° and 40° angles formed along cutting edge facets formed respectively by the disk sharpening step and the first orbital sharpening step, according to this invention.

Fig. 8 is a cross sectional view of the knife cutting edge facet (high enlargement) showing the resulting 34° and 40° angles formed along the cutting edge facets and indicating a 45° total angle to be placed on the cutting edge facets by second orbiting sharpening step.

Fig. 9 is a cross sectional view of finished knife cutting edge facets with 34°, 40° and 45° angles formed on the facets as created by the disk sharpener followed by two orbiting sharpening steps according to this invention.

The apparatus as shown in Figures 1 and 2 combines a disc sharpener and an orbital sharpener into a single sharpener that can be used by the inexperienced to produce reliably and rapidly razor-sharp edges.

Base plate 22b, Figure 2, supports motor 24b, fastened to base plate 22b by screws or other means (not shown), whose left shaft 26b drives disk holder 28b on which is mounted abrasive disk 30b that rotates about 3000 RPM but at a maximum surface abrasive circumferential velocity of less than about 244 m/min (800 ft./minute) to reduce the risk of overheating the knife edge. Fan 100 mounted on shaft 26b serves to cool motor 24b. Air enters the apparatus through the annulus 102 between upper cover 104 and lower cover 106 and exhausts out a base opening 108 in the base plate 22b which is supported on rubber feet 32b.

Vertical support members 34b, 112, and 36b, Figure 12, secured to base 22b by structural adhe-

sive or screws (not shown) support upper horizontal support member 116 which in turn supports the knife guide assembly 118 through the knife guide base 120 that is fastened securely to upper horizontal support member 116 by one or more screws 122 as shown. Drive gear pulley 124 mounted on right armature shaft extension 44b, Figure 2, drives two gear pulleys 126 (one shown) synchronously by means of timing belt 128 (toothed). The armature shaft extension 44b and shafts 130 for attached gear pulleys 126, ride in sleeve bearings 132 inserted into vertical support members 112 and 36b. A more detailed description of the orbiting drive system is included in the copending patent application cited above. Two synchronously driven cranks 134 machined onto the end of shafts 130 ride within the glass filled fluorocarbon sleeve bearings 138 inserted in drive plate 136 and generate an orbital motion of drive plate 136. There are shown in Figure 2 two sets of the three (3) or more support bearings 139 held by bracket 141, horizontal support member 116, and support 36b bear slidingly on drive plate 136 to hold drive plate 136 in a vertical plane with minimum motion transverse to that plane as described in the patent application heretofore referred to. Attached to drive plate 136 by means of screw 140 is an orbiting yoke assembly 142 which has upper arms 144 on which is mounted orbiting abrasive material 146. Through this structure the orbital motion generated in drive plate 136 creates orbital motion of abrasive material 146.

The knife guide assembly 118, Figures 1 and 2, contains plastic structures 148 that support magnetic elements 150 which attract and establish a guide plane for the face of the knife. The knife guide assembly 118 also includes knife stops 152, shown in Figure 1, that serves a variety of functions as described in the application cited above. The knife guide 50b used with the abrasive disk 30b contains plastic supporting structure 154 that extends and contacts the face of enclosure 60b. It contains a magnetic element 62b to control the angle of the face of knife relative to the abrasive disk 30b. The magnetic element 62b which attracts the knife and establishes a guide plane for the face of the knife. In use the cutting edge facet of the knife placed on guide 50b rests on the stop 54b on the face of enclosure 60b. The drive cranks 134 can be an integral part of shaft 130 as described above or be a separate part affixed thereto. The motor 24b, Figure 2, must be selected such that its armature and shaft 26b, which on the right of the motor is shown as armature shaft extension 44b, has sufficient end-play to allow the necessary movement or displacement of disk 30b in direction along its axis of rotation to accommodate without reaching a travel-limit the thickest knife to be sharpened. Free end-play on the order of 1/16 inch (1 inch = 2,54 cm) has proven adequate with most knives to allow the disk 30b to be displaced to the right in Figure 2 without reaching the limit of travel permitted by the free end-play.

In this manner, when a knife is inserted between the guide 50b, Figure 2, and the rotating abrasive disk 30b so that the knife cutting edge facet rests on stops 54b, the disk 30b is displaced to the right and it is floating against the biasing force of spring 42b that applies that force to shaft extension 44b through thrust bearing 46b which force is transmitted through the motor armature to shaft 26b and to the disk 30b. Without adequate free end-play in the motor armature displacement of the disk 30b could force the motor armature against its internal stop, not shown, which is usually a thrust bearing, and the disk displacement would then be stopped, thereby generating excessively high forces on the knife by the rotating abrasive disk 30b causing gouging or other physical damage to the knife edge. The spring loading concept employed here in conjunction with the stops 54b on the face of enclosure 60b and the blade guide system provides relatively constant force on the blade edge while being sharpened and uniform sharpening action along the length of knife edge without gouging. The enclosure 60b for the disk shown on lower left is designed to provide a safety cover and structure for stops 54b but without interfering with free knife edge insertion between disk 30b and guide 50b and free contact of the cutting edge facet against the surface of disk 30b.

By combining the two types of sharpeners into a single apparatus it is possible to incorporate knife guides that optimize the sequential sharpening angles Θ in a manner that provides the unskilled with a highly sophisticated contour on the cutting edge facets and a knife of superior cutting performance. Angle Θ is determined by the plane of the guide face on which the blade rests and the plane of the moving abrasive surface, described in the patent application cited above. It was found that by using a carefully controlled and slightly larger sharpening angle in successive sharpening steps it is possible to decrease markedly the total sharpening time and insure a superior cutting edge on the blade. Although not essential it is preferable that the construction of the knife guides for the disk and subsequent orbiting abrasive sharpening steps be very similar so as to position and hold the knife in an essentially uniform manner in each sharpening position except for deliberate changes in the sharpening angle.

Many factory produced kitchen knives have, by way of example, a total cutting angle as formed by the intersection of cutting edge facets greater than 40°. Only rarely does the owner know the actual

total angle of cutting edge facets, so any practical means for sharpening must be capable of rapid and foolproof sharpening independent of and without knowledge of the initial edge angle. If it is desired to produce a razor edge, a fine grit abrasive is desirable for finishing the knife, but fine abrasives remove metal slowly. If one did know the initial total angle of the edge facets of the knife and could control the sharpening angle, it would be feasible and practical to use fine abrasive and sharpen the knife at an angle 1-2 degrees greater than the initial angle so that only little metal need by removed and only in the immediate vicinity of the edge. However, repeated resharpening would have to be done at ever increasing angles if one is to avoid need to remove large quantities of metal, and such resharpenings would ultimately result in a blunt, dull knife. The present invention addresses this problem for the first time in a manner that insures rapid sharpening of a blade to a razor sharp edge without prior knowledge of the initial angle of the cutting edge. To accomplish this, the blade is given an initial sharpening with a coarse grit disk sharpener but at a precisely determined edge angle that is less than the sharpening angles used in the orbital sharpener that uses generally a finer grit size, a lower velocity of the abrasive elements, and the unique orbital motion that produces a razor-like edge.

To illustrate the advantages of this invention in an actual sharpening case and referring to Figure 5 and assuming, by way of example, the knife to be sharpened has its cutting edge facets meeting at an initial total angle of 45°, a popular angle for kitchen knives, it is desirable first that the disk sharpener sharpen the knife to create a precisely known total angle at the knife edge as established by the two cutting edge facets. This angle should be less than the angle to be created on the facet in subsequent orbiting sharpening stages. A convenient angle of choice might be 34° by way of this example as shown in Figure 5. This sharpening step entails removal of a substantial amount of metal from the edge, a task the disk sharpener with say 100-180 grit is ideally suited to do rapidly with creation of only little burr on the edge. If by chance the initial total blade angle were less than 34°, the disk sharpener would nevertheless generate a 34° angle on the blade. The resulting blade edge shown in Figure 6 with a 34° total included angle then can be sharpened to a razor edge in either a one step or multiple step orbital sharpener. The use of two orbital sharpener steps following disk sharpening makes is possible to use first a faster-working coarser grit followed by a finer grit to leave a smoother edge.

Illustrating with a two step orbital sharpener, first the knife of Figure 6 with a 34° total angle is sharpened to a 40° total angle which can be done rapidly with an orbiting abrasive of about 180 grit. This step need entail removal of only a small amount of metal near the edge of the cutting edge facets as seen in Figure 6, compared to the amount of metal removed in the preceding disk sharpener operation. The resulting blade Figure 7 has a 34° total angle along the rear of the cutting edge facet and a 40° total angle nearer to the cutting edge itself. In the final orbital sharpening step we can for example use a finer abrasive of say about 600-1500 grit, to recreate the original 45° angle adjacent to the very cutting edge as seen in Figure 8 (enlarged) by removal of only very little additional metal. Because this series of sharpening steps is incorporated in a single apparatus, it is possible for the manufacturer to incorporate precision knife guides that sharpen in each successive step with a slightly greater angle so that only the disk sharpener has the burden of removing substantial quantities of metal. The orbiting sharpener has to remove only relatively smaller amounts of metal while placing a fine edge on the knife. Each sharpening step is employed to do what it can do best and the overall result for the inexperienced is rapid formation of a knife with a fine, razor-like edge. The resulting knife edge of this example shown in Fig. 9 and highly enlarged compared to the scale of starting blade of Figure 6 has three micro bevels along each cutting edge facet 70 that form total angles of 34°, 40°, and 45° respective as one views the knife cutting edge facets at positions progressively closer to the cutting edge. Because that length along the cutting edge facet that is beveled at 45° is very small, usually less than 0.030 inches, it can be sharpened rapidly with the fine grit orbital sharpener leaving essentially no burr on the edge. Any final micro-burr on the blade edge can be readily removed by pushing the knife edge over and in sliding contact with the knife stops 152 of Figure 1 before the blade edge facet is abraded by the orbiting abrasive 146. For resharpening a knife once sharpened as described the orbital positions designed to create the 40° and 45° total angles will usually regenerate quickly a fine superior edge without recourse to the disk sharpening stage, and only after a series of resharpenings or hard use would it be necessary to use the lower angle disk sharpener again.

A knife sharpened as just described has a significantly superior cutting quality compared to knives sharpened by more conventional means. A knife sharpened according to this example will have three distinct micro bevels on the cutting edge facet as shown in Figure 9. Superior cutting qualities of a cutting edge facet with multiple micro bevels are attributable to the fact that the decreas-

ing bevel angles toward the rear of the cutting edge facet offers angular relieve immediately behind the edge that allows the material being cut to tend to move away from or to bear less firmly on the rear portion of the cutting edge facet. A knife with appropriate micro cutting edge facets as created by this invention can remove readily a very fine shaving of material from the surface of a material as contrast to a greater tendency of a knife to split the surface and dig below the surface if the cutting edge facets are planar as a result of being sharpened only at a single angle.

One can see from the foregoing the uniqueness of combining the new improved disk sharpener with the orbiting sharpener in a single apparatus. Even a very dull knife can be sharpened rapidly by the inexperienced and the resulting knife edge is razor sharp on the order of 1/10,000 inch wide.

Figures 3 and 4 show an alternative form of the first sharpening section using a split disk arrangement. The double disk design has proven particularly effective to permit the operator to sharpen conveniently both cutting edge facets of a knife from the same side of the sharpener. In this arrangement two disks 30d, 30d are secured and positioned back to back on a driven shaft 26d and held apart against stops in their rest positions by a biasing mechanism, such as spring 100, located between the two disks forcing the disks apart. Travel of each disk along the shaft axis is limited in one direction by the stop or pin 101 located on the shaft and in the other direction by the position of the second disk or the biasing mechanism. The permissible travel of each disk against the biasing mechanism and toward the opposite disk must be sufficient to avoid the possibility of the disk reaching its limit of travel against the biasing mechanism at any time while the knife being sharpened is displacing the disk against the biasing mechanism. The disks secured to the stops can slide independently on their common shaft while each is forced to rotate at the shaft speed by a pin 101 fastened to or through the shaft, that engages within a slotted portion 102 of the hub of each disk. That pin 101 also can serve as a stop to control position of the disks in this rest position. Other means of driving the disks at shaft speed while allowing the disks to slide on the shaft will be obvious to those skilled in mechanical arts. Abrasive mounted on the outside faces of each disk 30d, 30d rotating on the shaft 26d is pressed against the knife cutting-edge facet during sharpening by a force determined by the spring or other biasing means. For a given knife and type abrasive, the rate of metal removal during sharpening depends on the biasing force and on the size and speed of the abrasive particles.

Although not illustrated in Figure 3, it is to be understood that the stops as shown in EPA 85102761.5 (EP-A-0 154 967) may be extended sufficiently toward the disks to prevent the knife blade from being inserted too far and to provide support for the vertical facet. These stops thus would limit the degree of insertion of the knife and limit the displacement of the disk against the spring.

The invention may also be used by mounting any suitable number of disks on each shaft to achieve different types of abrading action such as coarse and fine or any intermediate treatments.

Claims

1. A knife sharpening apparatus comprising a housing base (22b) a first section and a second section in said housing, a motor-driven rotatable shaft (26b) in said first section, a disk (30b) mounted on said motor-driven rotatable shaft, abrasive particles on a planar surface of said disk, and a guide (50b) on said housing base opposite said surface of said disk, characterized by the fact that said second section comprises a sharpening member (144) with a pair of flat outer faces (146) having abrasive particles thereon, drive means (134, 136) for orbitally driving said sharpening member such that each abrasive particle thereon has a separate orbital path within or parallel to the outer faces and the amplitude of said paths are essentially equal for each particle, and second sharpening section guide means (118) opposite respective outer faces of its sharpening member.

2. Apparatus according to claim 1, wherein the guide means (50b) for the disk has a guide surface at an angle to said disk, and the second sharpening section guide means have guide surfaces (148) at mirror image angles to each other with said mirror image angles differing from the guide surface angle of the first sharpening section.

3. Apparatus according to claim 1 or 2, which includes a second disc (30d) mounted on the rotatable shaft (26d), both of said discs being slidably mounted on said shaft and each having a back face and a front face perpendicularly to said shaft, said back faces of said disks being disposed toward each other and said front faces being disposed remote from each other, resilient means (100) between said back faces and reacting against said discs for urging said front faces away from each other, stop means on said shaft for limiting the sliding

motion of said disk assemblies imparted by said resilient means, a slot (102) in each of said discs terminating short of said back faces leaving a wall portion, said stop means comprising a pin (101) mounted to said shaft and located in each of said slots whereby said pins function to halt the motion of said disks when contacted by said wall portions and to prevent relative rotation of said disks with respect to said shaft for causing said disks to rotate with said shaft, and abrasive means on said front faces.

4. Apparatus according to any one of claims 1 to 3, which includes a third sharpening section (Figs. 1 and 2), a sharpening member (144) in said third sharpening section, and third sharpening section sharpening member having a pair of flat outer faces (146) with abrasive particles mounted thereon, drive means (134, 136) for orbitally driving said third sharpening section sharpening member, guide means (148) for each of said third sharpening section sharpening member outer faces at mirror image angles to each other, and said mirror image angles of said third sharpening section guide means being different than the guide surface angles of the first sharpening and second sharpening sections.

5. Apparatus of claim 4, wherein the guide surface angles of the third sharpening section are greater than the guide surface angles of the second sharpening section which in turn is greater than said guide surface angle (50b) of the first sharpening section.

6. Apparatus according to claim 5, wherein the drive means for orbitally driving the sharpening member of each of the second and third sharpening sections imparts an orbital velocity to each of its particles of no greater than 244 m/min (800 feet/minute).

7. Apparatus according to any one of the preceding claims, wherein said abrasive particles are diamond particles with generally flat surfaces.

8. A method of sharpening a knife having a cutting edge facet by means of an apparatus according to any one of claims 1-7 comprising the steps of placing the knife against a first inclined guide surface at a first angle in a first sharpening section of a housing with the cutting edge facet against abrasive particles on a surface of a disk mounted on a rotatable shaft, rotating the shaft to rotate the disk surface and sharpen the cutting edge facet, removing the knife from the surface of the disk, the cutting edge facet being against abrasive particles on a second surface of the disk assembly mounted on the rotatable shaft, rotating the shaft to rotate the second surface of the disk assembly and further pre-sharpen the cutting edge facet, placing the knife against an inclined second guide surface in a second section of the housing with the cutting edge facet against abrasive particles on a first face of a sharpening member, orbitally driving the sharpening member to further sharpen the cutting edge facet, removing the knife from the first face of the sharpening member, placing the knife against an inclined further guide surface in the second sharpening section with the cutting edge facet being against abrasive particles on a second face of the sharpening member with the further guide surface inclined at a mirror image angle to the second guide surface which differs from the angle of the first sharpening guide surface, and orbitally driving the sharpening member while the knife is against the further guide surface.

9. A method according to claim 8, including a third sharpening section in the sharpener having guide surfaces at mirror image angles different from the mirror image angles of the second sharpening section for directing the knife edge against a second orbitally driven sharpening member having abrasive particles on its exposed surfaces, including the steps of removing the knife from the second sharpening section, placing the knife against one of the third sharpening section guide surfaces with the knife against the second sharpening member, orbitally driving the second sharpening member to impart an orbital motion to the second sharpening member, removing the knife from the first guide surface of the second honing section, placing the knife against a further guide surface of the third sharpening section with the knife edge against the second sharpening member, orbitally driving the second sharpening member, and the orbital driving of both the first and second sharpening members imparting an orbital velocity to each of their abrasive particles of no greater than 244m/min (800 feet/minute).

10. A method according to claim 9, wherein the guide surface angle is increased from the first to the second to the third sharpening sections.

Patentansprüche

1. Ein Messerschleifgerät bestehend aus einem Gehäusesockel (22b), einem ersten und einem zweiten Teil in dem Gehäuse, einer motorbetriebenen, rotierbaren Drehwelle (26b) in dem ersten Teil, einer auf der motorbetriebenen, rotierbaren Drehwelle befestigten Scheibe (30b), Schleifpartikeln auf einer flachen Fläche der Scheibe und einem Führungsteil (50b) auf dem Gehäusesockel gegenüber der Scheibenfläche, dadurch gekennzeichnet, daß der zweite Teil eine Schleifeinheit (144) mit einem Paar von flachen Außenflächen (146) aufweist, auf denen sich Schleifpartikel befinden, mit einer Antriebsvorrichtung (134, 136) zum Orbitalantrieb der Schleifeinheit, sodaß jede der dort befindlichen Schleifpartikel eine separate Umlaufbahn innerhalb von oder parallel zu den Außenflächen hat und wobei die Amplitude der jeweiligen Bahnen für jede Partikel im wesentlichen gleich ist, und mit Führungsvorrichtungen (118) des zweiten Schleifteils, die gegenüber den entsprechenden Außenflächen ihrer Schleifeinheit angeordnet sind.

2. Eine Vorrichtung gemäß Anspruch 1, wobei das Führungsteil (50b) für die Scheibe eine Führungsfläche in einem gewissen Winkel zu der Scheibe aufweist, und die Führungsvorrichtungen des zweiten Schleifteils Führungsflächen (148) haben, die Spiegelbildwinkel zueinander haben, wobei die Spiegelbildwinkel sich von dem Führungsflächenwinkel des ersten Schleifteils unterscheiden.

3. Eine Vorrichtung gemäß Anspruch 1 oder 2, mit einer zweiten, auf der rotierbaren Drehwelle (26d) befestigten Scheibe (30d), wobei beide Scheiben verschiebbar auf der Drehwelle angebracht sind und jede eine Hinterseite und eine Vorderseite hat, die sich senkrecht zur Drehwelle erstrecken, wobei die Hinterseiten der Scheiben einander zugewandt sind und die Vorderseiten voneinander abgewandt angeordnet sind, mit einer elastischen Vorrichtung (100) zwischen den Hinterseiten, die auf die Scheiben zum Auseinanderdrücken der Vorderseiten einwirkt, mit einer Anschlagsvorrichtung auf der Drehwelle zur Begrenzung der Gleitbewegung der Scheibenanordnungen, die durch die elastische Vorrichtung verursacht wird, mit einem Schlitz (102) in jeder Scheibe, der sich bis kurz vor die Hinterseite erstreckt, wobei dort eine Wandungstärke aufrechterhalten bleibt, und die Anschlagsvorrichtung einen Stift (101) aufweist, der auf der Welle montiert ist und in jedem der Schlitze angeordnet ist, wobei die Stifte dazu dienen, die Gleitbewegung der Scheibe zu stoppen, wenn sie mit den Wandungstärken in Anschlag kommen, und um eine relative Drehung der Scheiben gegenüber der Welle zu vermeiden, sodaß die Scheiben mit der Welle rotieren, und einer Schleifvorrichtung auf den Vorderseiten.

4. Eine Vorrichtung gemäß einem der Ansprüche 1 bis 3, mit einem dritten Schleifteil (Figuren 1 und 2) und einer Schleifeinheit (144) in diesem dritten Schleifteil, wobei die Schleifeinheit des dritten Schleifteils ein Paar flache Außenflächen (146) mit darauf angebrachten Schleifpartikeln aufweist, mit einer Antriebsvorrichtung (134, 136) zum Orbitalantrieb der Schleifeinheit des dritten Schleifteils, mit einer Führungsvorrichtung (148), die jeder Außenfläche der Schleifeinheit des dritten Schleifteils zugeordnet sind und die Spiegelbildwinkel zueinander haben, wobei die Spiegelbildwinkel der Führungvorrichtung des dritten Schleifteils sich von den Führungsflächenwinkeln des ersten und des zweiten Schleifteils unterscheiden.

5. Eine Vorrichtung gemäß Anspruch 4, wobei die Führungsflächenwinkel des dritten Schleifteils größer sind, als die Führungsflächenwinkel des zweiten Schleifteils, welche wiederum größer sind, als der Führungsflächenwinkel (50b) des ersten Schleifteils.

6. Eine Vorrichtung gemäß Anspruch 5, wobei die Antriebsvorrichtung zum Orbitalantrieb der jeweiligen Schleifeinheit des zweiten und des dritten Schleifteils jeden seiner Schleifpartikel mit einer orbitalen Geschwindigkeit antreibt, die nicht größer als 244 m/min (800 Fuß/Min) ist.

7. Eine Vorrichtung gemäß einem der vorhergehenden Ansprüche, wobei die Schleifpartikel Diamantpartikel sind, die im wesentlichen flache Oberfläche aufweisen.

8. Ein Verfahren zum Schleifen eines Messers mit einer Facette auf der Schneide, mittels einer Vorrichtung gemaß einem der Ansprüche 1 bis 7, bestehend aus den folgenden Schritten:
   Anbringen des Messers gegen eine erste, zu einem ersten Winkel geneigte Führungsfläche in einem ersten Schleifteil eines Gehäuses, mit der Facette der Schneide gegen Schleifpartikel an einer Oberfläche einer auf einer Drehwelle montierten Scheibe, Drehen der Welle, um die Scheibenoberfläche zu rotieren und somit die Facette auf der Schneide zu schärfen, Entfer-

nen des Messers von der Oberfläche der Scheibe, wobei sich die Facette auf der Schneide gegen Schleifpartikel an einer zweiten Oberfläche der auf der Drehwelle montierten Scheibenvorrichtung befindet, Drehen der Welle, um die zweite Scheibenoberfläche der Scheibenvorrichtung zu rotieren und die Facette auf der Schneide weiter vorzuschärfen, Anbringen des Messers gegen eine zweite, geneigte Führungsfläche in einem zweiten Schleifteil des Gehäuses, mit der Facette der Schneide gegen Schleifpartikel an einer ersten Oberfläche einer Schleifeinheit, Antreiben der Schleifeinheit in einer orbitalen Bewegung, um die Facette der Schneide weiter zu schärfen, Entfernen des Messers von der ersten Oberfläche der Schleifeinheit, Anbringen des Messers gegen eine weitere, geneigte Führungsfläche im zweiten Schleifteil, mit der Facette der Schneide gegen Schleifpartikel an einer zweiten Oberfläche der Schleifeinheit, wobei die weitere Führungsfläche zu einem Spiegelbildwinkel gegenüber der zweiten Führungsfläche geneigt ist, wobei dieser Winkel sich vom Winkel der ersten Schleifführungsfläche unterscheidet, Antreiben der Schleifeinheit in einer orbitalen Bewegung, mit dem Messer gegen die weitere Führungsfläche.

9. Ein Verfahren gemäß Anspruch 8, einschließlich eines dritten Schleifteils in der Schleifvorrichtung mit Führungsflächen mit Spiegelbildwinkeln, die sich von den Spiegelbildwinkeln des zweiten Schleifteils unterscheiden zum Ausrichten der Schneide gegen eine zweite Schleifeinheit mit Orbitalantrieb und mit Schleifpartikeln auf ihren Oberflächen, einschließlich der folgenden Schritte:
Entfernen des Messers von dem zweiten Schleifteil, Anbringen des Messers gegen eine der Führungsflächen des dritten Schleifteils mit dem Messer gegen die zweite Schleifeinheit, Orbitalantreiben der zweiten Schleifeinheit zur Übertragung einer Orbitalbewegung auf die zweite Schleifeinheit, Entfernen des Messers von der ersten Führungsfläche des zweiten Ziehschleifteils, Anbringen des Messers gegen eine weitere Führungsfläche des dritten Schleifteils mit der Schneide gegen die zweite Schleifeinheit, Orbitalantrieb der zweiten Schleifeinheit, wobei der Orbitalantrieb sowohl der ersten, als auch der zweiten Schleifeinheit eine Orbitalgeschwindigkeit auf jeden Schleifpartikel bei nicht mehr als 244 m/min (800 Fuß/Min) überträgt.

10. Ein Verfahren gemäß Anspruch 9, wobei der Führungsflächenwinkel von dem ersten zum zweiten und zum dritten Schleifteil vergrößert wird.

Revendications

1. Appareil pour aiguiser les couteaux comprenant une base de boîtier (22b), une première section et une seconde section dans ledit boîtier, un arbre tournant (26b) motorisé dans la première section, un disque (30b) monté sur ledit arbre tournant motorisé, des particules abrasives sur une surface plane dudit disque, et un guide (50b) sur ladite base de boîtier en face de ladite surface dudit disque, caractérisé en ce que ladite seconde section comprend un organe d'aiguisage (144) muni de deux faces extérieures plates (146) revêtues de particules abrasives, des moyens d'entraînement (134, 136) pour entraîner orbitalement ledit organe d'aiguisage de façon que chaque particule abrasive située sur cette organe ait un trajet orbital séparé dans ou parallèlement aux faces extérieures et l'amplitude desdits trajets est sensiblement égale pour chaque particule, et la seconde section d'aiguisage comprend des moyens de guidage (118) en vis-à-vis des faces extérieures respectives de son organe d'aiguisage.

2. Appareil selon la revendication 1, dans lequel les moyens de guidage (50b) pour le disque ont une surface de guidage faisant un angle avec ledit disque, et les moyens de guidage de la seconde section d'aiguisage ont des surfaces de guidage (148) faisant des angles en images de miroir l'une par rapport à l'autre, lesdits angles en images de miroir étant différents de l'angle formé par la surface de guidage de la première section d'aiguisage.

3. Appareil selon la revendication 1 ou 2, qui comprend un second disque (30d) monté sur l'arbre tournant (26d), lesdits deux disques étant montés coulissants sur ledit arbre et chacun présentant une face arrière et une face avant perpendiculaire audit arbre, lesdites faces arrière desdits disques étant disposées en regard l'une de l'autre et lesdites faces avant étant disposées en opposition l'une à l'autre, des moyens élastiques (100) entre lesdites faces arrière et qui réagissent entre lesdits disques pour repousser lesdites faces avant à l'écart l'une de l'autre, des moyens d'arrêt sur ledit arbre pour limiter le mouvement de coulissement dudit ensemble de disque imprimé par les moyens élastiques, une fente (102) dans chacun desdites disques se terminant en deçà desdites faces arrière en laissant une

partie de paroi, lesdits moyens d'arrêt comprenant une goupille (101) montée sur ledit arbre et située dans chacune desdites fentes moyennant quoi lesdites goupilles agissent pour retenir le mouvement desdits disques lorsqu'elles sont accrochées par lesdites parties de paroi et pour empêcher la rotation relative desdits disques par rapport audit arbre afin de faire tourner lesdits disques avec lesdits arbres, et des moyens abrasifs sur lesdites faces avant.

4. Appareil selon l'une quelconque des revendications 1 à 3, qui comprend une troisième section d'aiguisage (figures 1 et 2), un organe d'aiguisage (144) dans ladite troisième section d'aiguisage, et l'organe d'aiguisage de la troisième section d'aiguisage présentant deux faces extérieures plates (146) recouvertes de particules abrasives, des moyens d'entraînement (134, 136) pour entraîner orbitalement ledit organe d'aiguisage de la troisième section d'aiguisage, des moyens de guidage (148) pour chacune des faces extérieures de l'organe d'aiguisage de la troisième section d'aiguisage formant des angles en images de miroir l'un par rapport à l'autre, et lesdits angles en images de miroir desdits moyens de guidage de la troisième section d'aiguisage étant différents des angles formés par les surfaces de guidage des première et seconde sections d'aiguisage.

5. Appareil selon la revendication 4, dans lequel les angles formés par les surfaces de guidage de la troisième section d'aiguisage sont supérieurs aux angles formés par les surfaces de guidage de la seconde section d'aiguisage qui à leur tour sont supérieurs aux angles (50b) formés par les surfaces de guidage de la première section d'aiguisage.

6. Appareil selon la revendication 5, dans lequel les moyens d'entraînement pour entraîner orbitalement l'organe d'aiguisage de chacune des seconde et troisième sections d'aiguisage impriment une vitesse orbitale à chacune de ses particules qui n'est pas supérieurs à 244 m/min (800 pieds par minutes).

7. Appareil selon l'une quelconque des revendications précédentes, dans lequel lesdites particules abrasives sont des particules de diamant ayant des surfaces généralement plates.

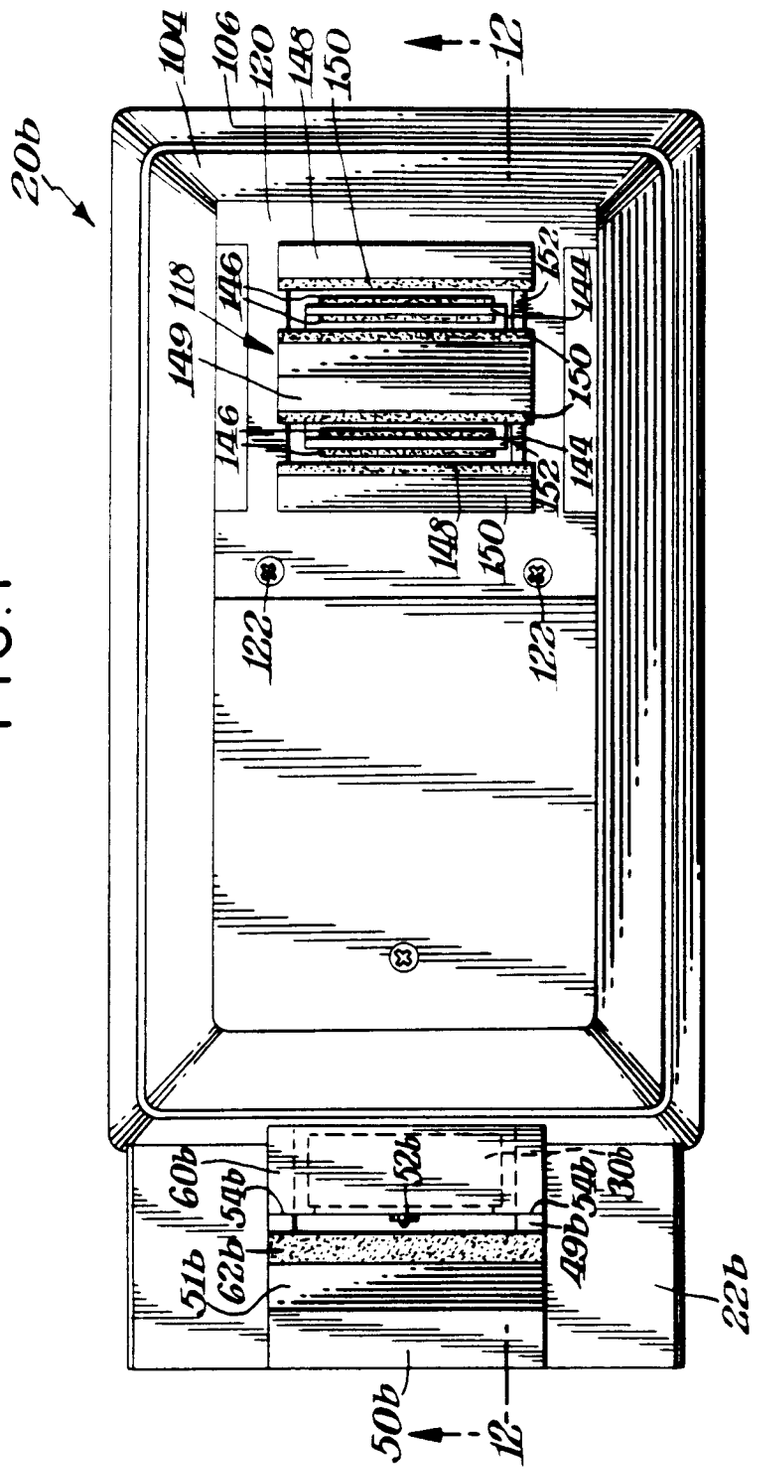
8. Procédé pour aiguiser un couteau ayant une facette de bord de coupe au moyen d'un appareil selon l'une quelconque des revendications 1-7, comprenant les étapes consistant à placer le couteau contre une première surface de guidage inclinée faisant un premier angle dans une première section d'aiguisage d'un boîtier de façon que la facette du bord de coupe porte contre les particules abrasives sur une surface d'un disque monté sur un arbre tournant, mettre en rotation l'arbre pour faire tourner la surface de disque et aiguiser la facette du bord de coupe, retirer le couteau de la surface du disque, la facette du bord de coupe portant contre des particules abrasives d'une seconde surface de l'ensemble de disque monté sur l'arbre tournant, mettre en rotation l'arbre pour faire tourner la seconde surface de l'ensemble de disque et continuer de pré-aiguiser la facette du bord de coupe, placer le couteau contre une seconde surface de guidage inclinée dans une seconde section du boîtier, la facette du bord de coupe portant contre des particules abrasives d'une première face d'un organe d'aiguisage, entraîner orbitalement l'organe d'aiguisage pour continuer d'aiguiser la facette du bord de coupe, retirer la couteau de la première face de l'organe d'aiguisage, placer le couteau contre une autre surface de guidage inclinée dans la section d'aiguisage, la facette du bord de coupe portant contre des particules abrasives d'une seconde face de l'organe d'aiguisage, l'autre surface de guidage étant inclinée selon un angle en image de miroir par rapport à la seconde surface de guidage qui diffère de l'angle de la première surface de guidage d'aiguisage, et à entraîner orbitalement l'organe d'aiguisage pendant que le couteau porte contre l'autre surface de guidage.

9. Procédé selon la revendication 8, comprenant une troisième section d'aiguisage dans l'aiguiseur présentant des surfaces de guidage disposées selon des angles en images de miroir différents des angles en images de miroir de la seconde section d'aiguisage afin de diriger le bord du couteau contre un second organe d'aiguisage entraîné orbitalement présentant des particules abrasives sur ses surfaces découvertes, comprenant les étapes consistant à retirer le couteau de la seconde section d'aiguisage, placer le couteau contre une des surfaces de guidage de la troisième section d'aiguisage, le bord du couteau portant contre le second organe d'aiguisage, entraîner orbitalement le second organe d'aiguisage pour imprimer un mouvement orbital au second organe d'aiguisage, retirer le couteau de la première surface de guidage de la seconde section d'aiguisage, placer le couteau contre une autre surface de guidage d'une troisième section

d'aiguisage, le bord du couteau portant contre le second organe d'aiguisage, entraîner orbitalement le second organe d'aiguisage, et entraîner orbitalement à la fois le premier et le second organe d'aiguisage pour imprimer une vitesse orbitale à chacune de leurs particules abrasives qui ne dépasse pas 244 m/min (800 pieds par minutes).

10. Procédé selon la revendication 9, dans lequel l'angle formé par la surface de guidage s'accroît de la première à la seconde et de la seconde à la troisième section d'aiguisage.

FIG. 1


20b
104
106
120
148
150
12
118
146
149
152
144
122
60b
54b
62b
51b
52b
49b
30b
22b
50b

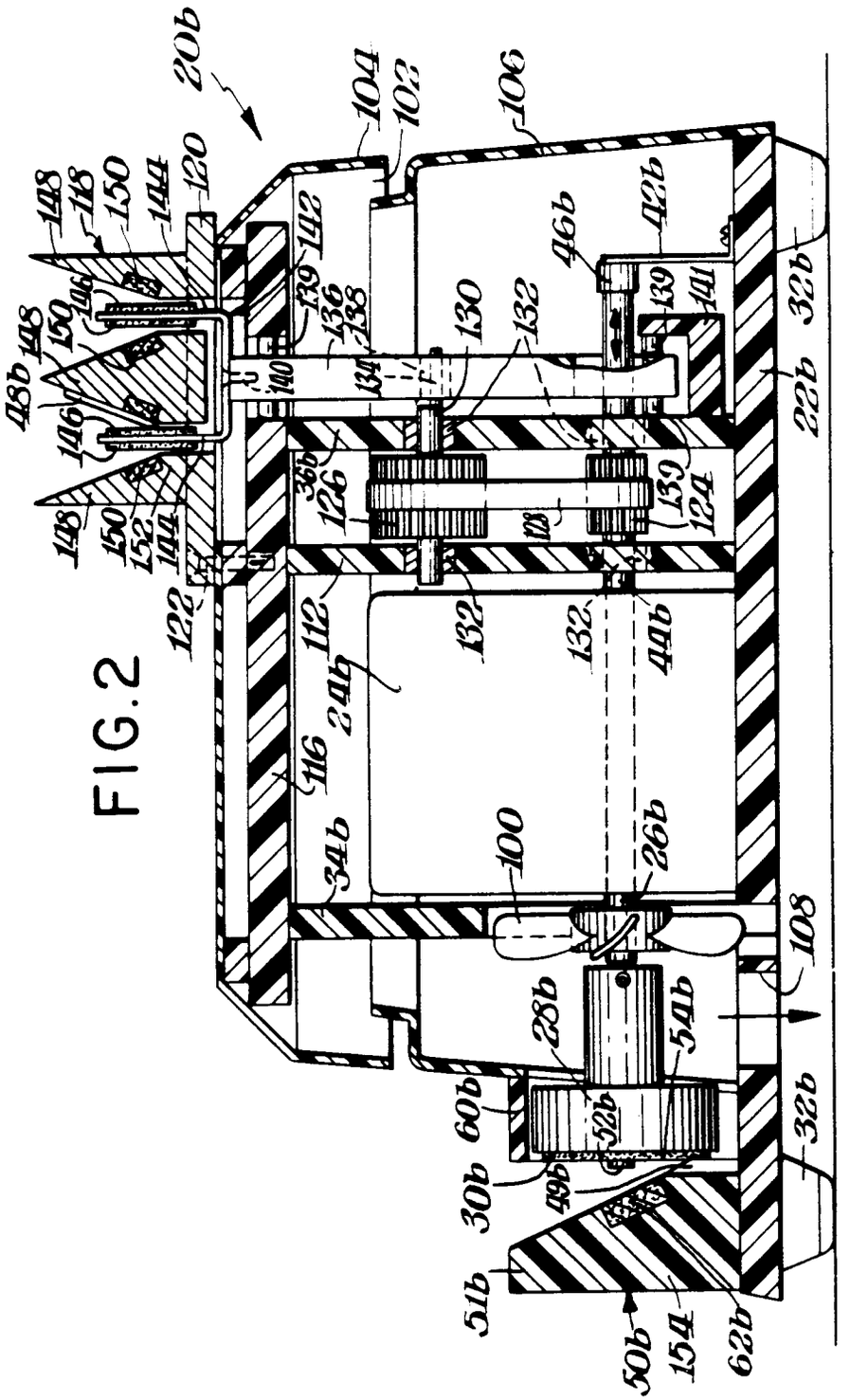

20b
104
102
106
148
118
150
144
120
142
46b
42b
32b
48b
146
136
138
130
132
140
22b
126
124
122
112
24b
44b
116
34b
100
26b
108
28b
54b
60b
52b
30b
49b
32b
51b
50b
154
62b

FIG.2

FIG.3

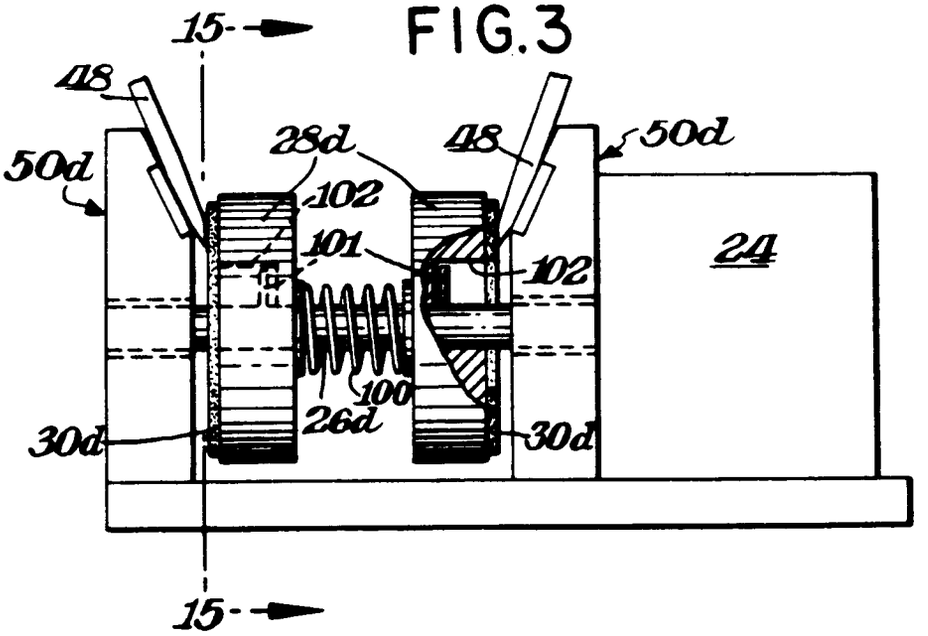

15
48
50d
28d
102
101
48
50d
24
102
100
26d
30d
30d
15

FIG.4

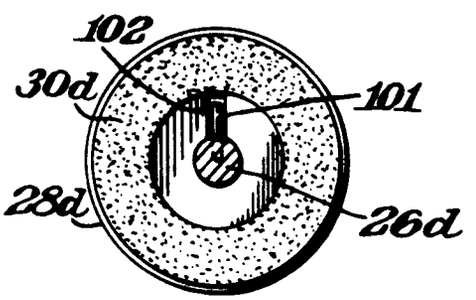

102
30d
101
28d
26d

FIG.5

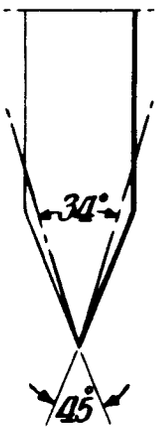


FIG.6

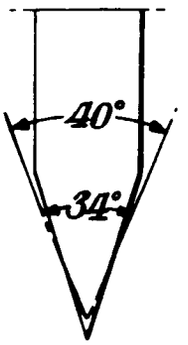


FIG.7

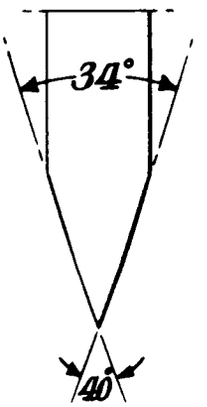


FIG.8

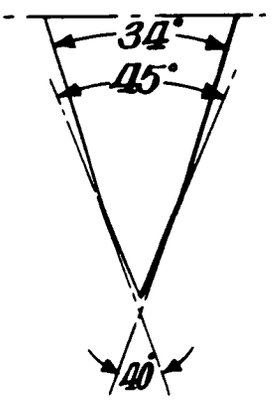


FIG.9

