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MICROTOME KNIFE SHARPENER

Filed Sept. 14, 1959

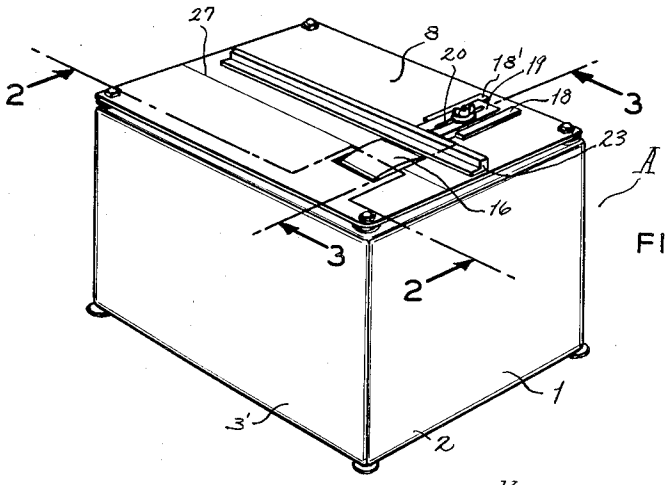


FIG. 1

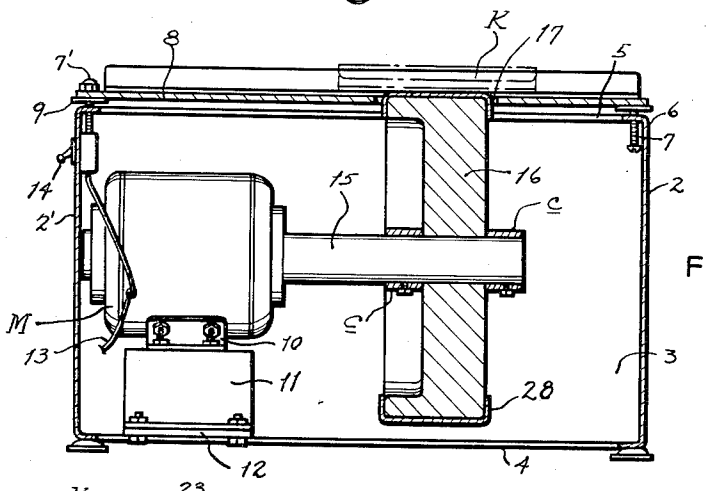


FIG. 2

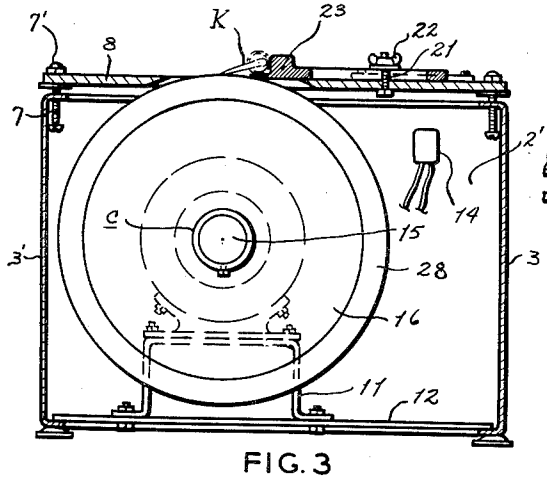


FIG. 3

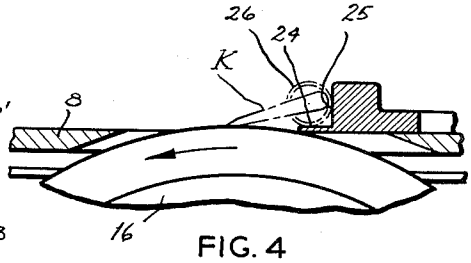


FIG. 4

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MICROTOME KNIFE SHARPENER

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This invention relates in general to sharpeners, and, more particularly, to a microtome knife sharpener.

Heretofore, various types of generally conventional sharpeners have been utilized for the purpose of sharpening microtome knives, such as utilized in hospitals, laboratories, and clinics, for sectioning of prepared tissue and other materials for diagnostic and analytical purposes. However, none of these sharpening devices have proved in actual practice to operate in a highly efficient manner to produce an even, sharpened edge on the microtome knife so that any area of the knife edge will cut uniformly. All such sharpening devices currently used require that the wheel be constantly subjected to a cooling agent, primarily water, for dissipation of the heat developed by the friction of the knife upon the sharpening wheel and to disperse the suspended abrasives. The application of the coolant is accomplished by mounting of the wheel within a vessel containing such coolant, as water, so that a portion of the wheel is constantly immersed therein. Because of the continuous subjection of the wheel to the coolant, it has been substantially impossible to maintain an even coating of abrasive thereon so that the knife is brought into direct contact with the wheel periphery resulting, in some instances, in severe damage to the edge, and in many cases rendering the same unusable. Another type consists of a flat glass disc on which water is dripped and acts as a coolant and dispersing medium for abrasive powders. With this type, the disc rotates about a vertical axis and the knife edge is presented to the wheel face rather than the periphery. An unsatisfactory effort to overcome this marked defect has been attempted, and that is the practice of suspending the abrasives in the cooling agent within which the wheel rotates, so that the latter will tend to pick up abrasives upon each rotation. But this method has proved unreliable, and, at best, has caused the sharpening operations to require considerable periods of time. Furthermore, the use of such free flowing coolants, as water, customarily results in splashing and splattering of the water and suspended abrasive, which condition is wholly undesirable within a scientific laboratory. Additionally, sharpening wheels as made primarily from glass and stone inherently develop or contain certain surface defects, pits, or irregularities, wherein particles of the abrasive tend to become permanently fixed so that the sharpening wheels never attain a truly "clean" state whereby upon application of further abrasives a laminating or piling-up effect is caused in those portions, thereby conducing to the unevenness of the abrasive coating, and further, preventing uniformity of abrasive size, since the adhering particles may be of different mesh than the later applied abrasives, and with the wearing-away of the latter the former will be exposed and, hence, operate simultaneously with the surrounding particles, which condition is productive of uneven sharpening.

Therefore, it is an object of the present invention to provide a microtome knife sharpening device which does not require the constant application of an extraneous, free-flowing cooling agent, and which device is so constructed as to effect high heat-conductivity for reliable dissipation of heat developed during operation.

It is a further object of the present invention to provide a microtome knife sharpener which incorporates a highly polished, circumferential, operating face, which permits of even distribution thereon of an abrasive and

which may be readily and entirely cleaned for receiving additional, removable abrasive coatings which thereby present a uniform layer at all times to the knife.

It is a further object of the present invention to provide a microtome knife sharpener which is highly efficient in operation, being capable of effecting the sharpening operation in minimum time; which may be easily operated and does not cause splattering or splashing; which is durable in operation; and which may be most economically produced.

These and other detailed objects are obtained by the structures illustrated in the accompanying drawing, in which—

FIGURE 1 is a perspective view of a microtome knife sharpener constructed in accordance with and embodying the present invention.

FIGURE 2 is a vertical transverse section taken on the line 2—2 of FIGURE 1.

FIGURE 3 is a vertical transverse section taken on the line 3—3 of FIGURE 1.

FIGURE 4 is an enlarged detail illustrating the contact between the wheel and the knife to be sharpened thereby.

Referring now by reference characters to the drawing, A designates a microtome knife sharpener incorporating a rectangular housing 1 having end walls 2, 2', side walls 3, 3', a bottom wall 4, and being open in its upper portion as at 5 except for an inturned marginal flange 6. Extending through threaded openings in flange 6 at the corners of housing 1 are screws 7, the upper ends thereof passing through aligned openings in a top closure plate 8, and being engaged by cap nuts 7'. Provided upon each screw 7 between flange 6 and plate 8 is an adjusting collar 9, upon selected operation of which the disposition of top plate 8 with respect to housing 1 may be altered for purposes presently appearing. Thus, for example, collars 9 on an adjacent pair of screws 7 may be adjusted relatively to the remaining collars so as to cause the top plate to be horizontally inclined, or, manifestly, all collars 9 may be regulated for raising or lowering of said plate 8 within the range provided by the available length of screw 7.

Presented within housing 1 is a prime mover or motor M secured upon a mounting 10 which is supported on a bracket 11, bolted to base plate 12 extending transversely between the lower inturned edges of walls 3, 3'. Motor M is connected to a source of power external of housing 1 as by leads indicated at 13; there being an operating switch 14 connected to motor M and positioned for convenient presentation of its toggle arm upon the outer surface of end wall 2'. Motor M comprises a drive shaft 15 having mounted, as by spaced collars c, on its outer end a balanced wheel 16, constructed of aluminum or other materials, to be discussed below more fully, the upper portion of which extends upwardly through the open, upper end 5 of housing 1 and through a slot-like opening 17 formed in closure plate 8; said opening 17 being slightly greater than the thickness of wheel 16.

Secured or otherwise fixed on the upper surface of closure plate 8 is a pair of spaced apart guide members 18, 18' cooperating to form a way for a slide 19 which is centrally slotted, as at 20, for extension therethrough of a screw 21 rigid in plate 8 and having a retaining wing nut 22 threaded on its upper projecting end so that upon loosening of wing nut 22 slide 19 is freed for movement relatively between members 18, 18' and upon tightening of said nut 22 said slide 19 will be maintained in selected position. Guide members 18, 18' are presented so as to define the path of movement of slide 19 along an axis substantially tangentially aligned with, or parallel to the tangent of, the upper portion of wheel 16 extending through opening 17.

Mounted on the end of slide 19, perpendicular thereto, and proximate wheel 16, is an elongated microtome knife holder 23 extending almost from end to end of closure plate 8. Said holder 23 is of a generally stepped configuration having a lower step or knife support ledge 24 planarwise parallel to closure plate 8, and a riser-like abutment 25. As the thickness of wheel 16 is less than the length of microtome knives to be serviced by machine A, a microtome knife must, perforce, be moved by the operator along support ledge 24 for presenting the entire edge portion of the knife to wheel 16. In the drawing, K indicates a microtome knife being provided with the conventional back 26 which may be retained upon the knife during sharpening.

Indented or otherwise inscribed upon the upper surface of closure plate 8 spaced from knife holder 23 and axially parallel therewith is a guide line 27 so related to sharpening wheel 16 as to be aligned with the remote terminus of the "flat" curve (to be described) at the extreme projecting portion thereof. Thus, knife holder 23 will be adjustedly disposed so that the edge of a knife to be sharpened, and supported thereon, will be in alignment with guide line 27 by which condition proper address of the knife K to wheel 16 is certain.

Provided circumferentially about the entire peripheral surface of wheel 16 is a wheel facing or cover 28 fabricated of relatively thin sheet-forming material, of uniform thickness, being secured to the wheel in any suitable manner, and having its exterior, knife-confronting face, highly polished to a mirror or near mirror finish for presenting a consistently smooth surface, free of any surface defects or irregularities, and having thus a minimum coefficient of friction. The most important property of wheel 16 together with its facing or cover 28 is that the same have a high heat conductivity for heat-exchange or thermal conductivity, depending upon the unit of measurement for the particular material. Thus, for the purposes of the present invention it has been found that wheels constructed of the following materials have the desired characteristics: aluminum or aluminum alloy, such as an alloy comprising 98.9% aluminum, .4% silica, and .7% magnesium (with a hardness of approximately 73 Brinell scale), or of copper, or copper alloys; hard woods, such as, mahogany, maple, oak; and plastics, such as, phenol-formaldehydes, phenol-furfurals, thermosetting resin-rubber compounds, melamine formaldehydes, various phenolic plastics, tetrafluoroethylenes, and polypropylenes. The facings or covers 28 may be of the same material as that of the wheel or may be constructed from any other of the above specified materials. It is not requisite that wheel 16 and its cover 28 be formed from the same material. Thus, a wheel 16 fabricated of aluminum could have applied thereon a facing 28 formed of copper, wood, gold, plastic, etc. It is critical that the facings or covers 28 of the wheel 16 have the capability of providing a highly polished surface or mirror finish for purposes presently appearing, and that such facings together with the wheels further have the property of high heat or thermal conductivity. With respect to materials of construction for facing or cover 28, it as been found desirable that those of metallic character have a heat of conductivity within the range of .450–1.0. Thus, within this range will be found cast aluminum, alloys thereof, copper, alloys thereof, pure gold, and alloys thereof. With respect to other materials which are measured in terms of thermal conductivity, such as, the hardwoods and the plastics, such should have a thermal conductivity within the range of .3 to 1.3, and this would include mahogany, maple, oak, and the plastic materials, as above stated. In passing, it should be recognized that wheel 16 might be formed without a facing or covering 28 such as being made entirely of wood, or the like, but in any event must possess the capability of providing a mirror finish and having a minimum thermal conductivity of .3 or a minimum heat conductivity of .4, and a Brinell hardness within the range of 50 to 250.

In the sharpening of microtome knives it is vital that the cutting edge portion thereof be disposed flatwise upon the wheel in order to attain substantial uniformity in such edge. Without such flat presentation, the resulting edge will be irregular and hence inadequate in cutting sections of uniform thickness, and obviously unfit for providing that degree of thinness in sections so vital for innumerable analyses. It has been found that a wheel having a diameter of at least eight inches will provide in its circumference a curve of such angle as to be substantially coincident in extent with the edge portion of microtome knives and substantially coincident with its chord so as to provide what might be termed a "flat" curve, and thereby assure the critical engagement with the knife over the necessary surface thereof for attaining the requisite sharpened edge. Consequently, it is the combined diameter of wheel 16 and facing 28 which will control in this instance. Thus, FIGURE 4 of the drawing illustrates this contact between the facing 28 of wheel 16 and the edge of knife K.

The angle of the bevel of the cutting edge on knife K may through the operation of machine A be of any desired degree, with the relationship between closure plate 8 and wheel 16 being determinative, as by the selected positioning of closure plate 8 through operation of collars 9. Thus, as closure plate 8, together with knife holder 23 thereon, is relatively raised, a reduced portion of wheel 16 will project thereabove, through opening 17, so that a somewhat steep bevel may be obtained, while conversely upon lowering of closure plate 8 a relatively shallow bevel will result. But, regardless of such adjusting the flatwise engagement between wheel 16 and knife K will be maintained. It will be observed that the adjustability of knife holder 23 through operation of slide 19 will permit machine A to accommodate microtome knives of varying sizes.

The sharpening operation is easily accomplished by use of machine A, as the user after having adjusted knife holder 23 with respect to guide line 27 for the particular knife being serviced, and positioned closure plate 8 for the desired degree of bevel, need only slide knife K along step 24 so as to present one surface of the edge portion to wheel 16, and then to turn knife K over to present the opposite surface of the cutting edge for sharpening.

Thus, with the outer face of covering 28 being ground and polished to a mirror or new mirror finish for presenting a smooth, even surface, and wheel 16 being rotated in a direction away from knife K, as indicated by the arrow in FIGURE 4, abrasives of multi-faceted crystalline character, such as, aluminum oxide, diamond dust, or the like, are then applied on said covering. Said abrasives are preferably maintained or suspended in a "stick" of a waxy-like well-known carrier or vehicle, so that the "stick" end is thus rubbed across the rotating cover for applying a coating of the abrasive; which latter for use with the present device should have a minimum hardness of 8 or more Moh scale, and with a micron size within the range of .5 to 8. Understandably, the finer the abrasive, the greater should be the speed or rotation of wheel 16 which is adapted for operation between 1250 and 1800 revolutions per minute. It is recognized that variable speed controls (not shown) may be provided with motor M so as to allow for selection of the speed of rotation indicated by the size of the abrasives between the stated limits. By lightly applying the abrasives to the wheel cover 28 in the manner stated, a coating will be developed which is thereon subjected to a non-aqueous dispersing agent as contained within an absorbent pad, which latter is manually moved contactingly about the abrasive coating for assuring uniformity of thickness and evenness of distribution thereof. The abrasive coating on the wheel then takes on the character of a relatively thin paste-like

layer, having the desired viscosity for adherence to the wheel surface and for promoting desired sharpening results. The dispersing agent is desirably a low-volatile liquid, as selected from combinations of range, distillate, and residual oils, glycols, and glycol derivatives, both with and without wetting agents, all of which are well known in the art. The abrasive coating will thus be evenly distributed so that at all times the microtome knife being sharpened will maintain contact with the abrasives and, hence, not be brought into friction-producing, damaging contact with the bare face of cover **28** through any abrasive-barren zones. Such heat as may be generated through the engagement between knife K and the abrasives will readily be dissipated through the inherent properties of the materials of construction of wheel **16** and cover **28** as shown hereabove, and, accordingly, no extraneous cooling agent need be applied during the sharpening action.

Thus, by obviating the use of a free-flowing liquid cooling agent, the present invention assures an even distribution of abrasives, avoidance of splattering, and with the sharpening action being effected in a reliable and relatively rapid manner, no longer necessitating the services of a highly skilled operator. In actual practice, it has been found that at least three microtome knives may be sharpened before any additional application of abrasives is required. So, considerable economy in time may be effected through the usage of the present invention.

The utilization of the mirrored-surface cover or jacket **28** prevents the permanent adherence thereto of any abrasives so that all such applied abrasives are readily removable after sharpening operation, as by the exercise of simple, conventional cleansing actions whereby the cover surface is returned to its clear, polished state. A new abrasive may thus be used for each of succeeding operations without danger of any undesirable mixture or union with a previously applied abrasive. With the sharpening wheels heretofore used, such as, of iron, glass, stone, and the like, the surface-cleaning operations were never capable of entirely freeing the peripheral surface of such wheels of previously applied abrasives due to the pitting and other irregularities consistently found in such wheels. So the subsequently applied abrasives would consistently and necessarily be intermingled with other, previously applied abrasives, so that the sharpening results would be indefinite and unreliable. Furthermore, the adherence of previously applied layers of abrasives would reduce materially any heat transfer capabilities of the grinding wheels so the knife being sharpened would be subjected to a relatively marked increase in heat with its attendant undesirable results.

Thus, as shown hereinabove, the present device presents a wholly new and completely effective departure from previously known structures in providing a mirrored surface to a sharpening wheel for microtome knives which will permit the firm adherence thereon of suitable abrasives and yet allow the same to be entirely removed subsequent to operation. The present device does not require the utilization of any cooling agent and hence is competent to operate for longer periods and in a highly efficient manner. Furthermore, the present invention may be most economically produced; is operated at extremely low cost, and in this day of scarcity of highly skilled technicians, does not require the services of such type individuals, but may be used by individuals after most limited instruction.

It should be understood that changes and modifications in the formation, construction, arrangement, and combination of the several parts of the microtome knife sharpener may be made and substituted for those herein shown and described without departing from the nature and principle of my invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. A machine for sharpening microtome knives comprising a casing, a wheel provided in said casing, said wheel having a peripheral face, means for effecting rotation of said wheel, microtome knife guide and support means provided on said casing for presentation to the peripheral face of said wheel of the edge of a microtome knife to be sharpened, said wheel rotation means being adapted to rotate the wheel in a direction away from the edge of a presented knife, a continuous facing member of uniform thickness mounted on the peripheral face of said wheel and being co-extensive therewith and being completely supported thereby, said wheel and said facing member being each constructed of material having substantially high heat conductivity so as to adapt the said machine during usage for rapid thermal transfer and to render said machine thereby independent of extrinsic cooling means; said facing member being resistant to pitting and development of surface irregularities, the outer surface of said facing member being polished to a substantially mirror finish for providing adhesive characteristics for repeated accommodation thereon of various size abrasives without pit formation.

2. A machine for sharpening microtome knives as defined in claim 1 and further characterized by the wheel being constructed of material having a minimum heat conductivity of .4 and a Brinell hardness within the range of 50 to 250, and the facing member being constructed of material having a heat conductivity within the range of .45 to 1.

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