Aug. 30, 1960 G. A. BELL 2,950,585

APPARATUS FOR USE IN THE SHARPENING OF KNIVES, KNIFE BLADES AND THE LIKE

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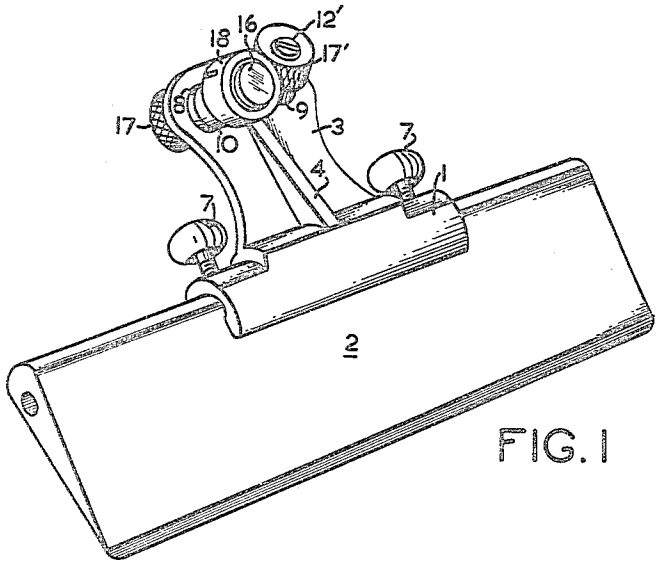


FIG. 1

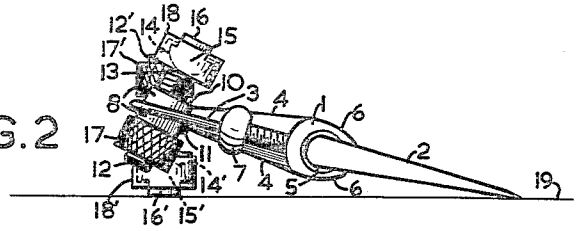


FIG. 2

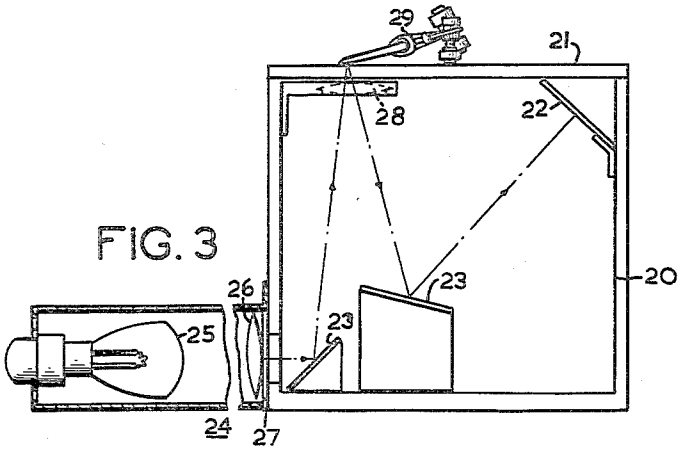


FIG. 3

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This invention relates to apparatus for use in sharpening knives, knife blades or the like on a lap or a hone, and is particularly suitable for use in sharpening of knife blades used in microtomes for the preparation of sections for histological examination.

The edge of a knife blade is formed by the intersection at an appropriate angle of two smooth surfaces of a metal, glass, sapphire, or other suitable material the surfaces being approximately flat. It is essential for the proper cutting of sections that the facets forming the cutting edge of a microtome blade should be smooth, and that the edge formed by their intersection should be straight and free from imperfections.

The method at present used in sharpening microtome blades by hand requires that the blade be fixed tightly in a split metal cylinder, known as a back, of such dimensions that the angle between the two lines at right angles to the blade and one tangential to each side of the back intersect at the desired cutting angle. The blade mounted in the back is then moved over the flat surface of a fine hone thereby removing metal from the facet in contact with the hone surface. In general the hone is of width less than the length of the microtome blade, which may be twelve inches long.

One serious disadvantage of this method is the non-parallelism of the cutting edge of the blade with the line of contact between the back and the surface of the hone, which results in the production of an edge with a variable cutting angle. Another disadvantage is that it is not possible to vary at will the value of the cutting angle. Because the hone is of less width than the length of the microtome blade more work will be done on the central zone of each facet and concave facets and a curved edge result.

The object of the invention is to provide apparatus for use in the hand sharpening of knife blades and the like, particularly microtome blades, which does not have these disadvantages.

According to this invention apparatus for use in the hand sharpening of knife blades and the like comprises a blade holder and means including a pad of abrasive resistant material whereby when the pad and blade edge are placed on a flat abrading surface the lower facet of the knife blade aligns itself in contact with the surface.

Also according to this invention apparatus for use in the hand sharpening of knife blades and the like comprises a blade holder, a tongue extending rearwardly of the blade holder, a pad of abrasive resistant material, a self-aligning bearing for the pad, and means carried by said tongue for adjustably securing the pad at a desired distance from the tongue in a direction which makes an angle of or near 90° with respect to a plane drawn through the tongue and blade.

The blade holder should be used with a lapping plate of sufficient size to take the whole length of the blade. The surface of the usual lapping plate is chequered by two sets of parallel grooves at right angles to each other,

the purpose of the grooves being to prevent the accumulation of debris on the surface and to stop the formation of a "wire edge." With such a plate, while the blade is worked over the plate with a circular movement, care must be taken to avoid bringing the edge parallel with either set of grooves, since if the edge does become aligned with the grooves is will be seriously damaged. According to this invention, therefore, a lapping plate suitable for use with the blade holder is provided with either a spiral groove or a plurality of a circular grooves in its surface. A suitable size of plate is one 14 inches in diameter with ½ inch pitch for the grooves.

When re-sharpening a knife that has previously been sharpened using the apparatus of this invention it is desirable that the holder be set so that the blade is presented to the lapping plate at the same angle as used in the preceding sharpening, or at a slightly greater angle. While this can be done using a piece of plate glass, it can be done much more conveniently by using a special setting box which has been developed for use with the blade. Accordingly this invention also comprehends a setting box for setting blades in the blade holder comprising a flat transparent plate, a light source having a distinctive marking, means for projecting the light from the source onto the underside of the flat transparent plate, and means for bringing the light reflected from the upper surface of the plate to a focus on a screen.

Reference will now be made to the accompanying drawings in which—

Figure 1 is a perspective view of apparatus according to the invention in which a microtome blade has been secured.

Figure 2 is a side elevation of the apparatus with a microtome blade secured therein and positioned on a lapping plate.

Figure 3 is a diagrammatic sectional drawing of a setting box useful in setting the facets of a knife to a desired angle.

The apparatus comprises a blade holder **1** in which a blade to be sharpened, such as the microtome blade **2** may be secured. A tongue **3** extends rearwardly from the blade holder, that is in a direction away from the blade, and is provided with strengthening ribs **4**. The tongue **3** may be formed integrally with the blade holder **1**, as shown in the drawings, or the two parts may be made separate from each other and be secured together by screws or other suitable fasteners. so as to enable different types of blade holders to be used. The blade holder shown in the drawings is designed to be used with a very common form of microtome blade which is wedge-shaped in section. The knife-blade is slid into the groove **5** until the apparatus is positioned about halfway along the blade, and the blade is then forced against the tapered jaws **6** of the groove **5** by the knurled-head screws **7**.

Bosses **8**, **9** are provided on each side of the medial line of the blade holder, with their faces **10**, **11** making an angle with the surfaces of the tongue **3**, the angle made by face **10** being opposite to that made by face **11**.

A threaded rod **12** is screwed into the boss **8** and carries at its upper end a steel block **13** having an internal hemispherical seat **14**. The spherical surface of a steel hemisphere **15** engages with the seat **14** thus forming a self-aligning bearing. To the flat upper surface of the hemisphere **15** is secured a small, preferably optically, flat pad **16** of abrasive resistant material such as tungsten carbide or Stellite. The free end of the rod **12** is slotted to take a screwdriver blade, and a locknut **17** is provided. A cover **18** may be provided over the junction of the body **13** and hemisphere **15** to reduce the likelihood of abrasive particles reaching the hemispherical bearing surfaces. A similar arrangement ex-

tending approximately in the opposite direction is screwed into the boss **9** and similar components have been given the same numbers primed.

The apparatus is used with a flat hone or, preferably, a lapping plate. In both cases the hone or lap should be of such a size that the whole length of the knife blade is in contact with the hone or lap. The lap will, of course, be charged with abrasive particles in the usual way. The surface of portion of a lap is indicated in Fig. 2 by the line **19**. In use the knife blade is firmly secured in the blade holder by the screws **7** and jaws **6**, the tongue **3** in effect forming an extension of the blade away from the cutting edge. The assembly is placed on the flat hone or lap with the cutting edge and one pad **16'** in contact therewith, and the threaded rod **12'** adjusted until the cutting facet of the blade makes contact with the hone or lap over substantially its whole surface (unless a new facet having a different angle is to be produced). This lower cutting facet orients itself to a position of equilibrium, and the pad **16'** on its self-aligning bearing aligns itself in contact with the hone or lap surface. The blade is then worked over the hone or lap. The device is reversed to work the other cutting facet, the pad **16'** then being brought into contact with the surface of the hone or lap.

The apparatus enables correct presentation of the blade to the surface of the lapping plate (or hone) to be obtained, and working the blade over the plate produces an accurate flat surface of high quality on the cutting facets of the blade. The angle of each facet may be varied as required over a wide angle (12° to 20° in a typical case) by adjustment of the threaded rods or screws **12, 12'**. By placing the knife blade, mounted in the blade holder, on a piece of flat glass and adjusting the threaded rods until the interference bands are observed between the glass plate and the knife facet and the pad the existing facet angle may be reproduced.

A setting box by which the blade may be set accurately and easily is shown in Figure 3. A box **20** is provided with a ¼ inch plate glass top **21**, a ground glass screen **22** at the rear upper edge, mirrors **23** and a light source indicated generally by **24** at the lower front edge of the box. The light source includes a lamp **25**, a condenser **26** of say 3 inch focal length, and a transparent plate **27** marked with some distinctive marking, for example a cross. A lens **28** is provided in contact with the plate glass and is of such a focal length as to focus the cross on plate **27**, after reflection by the upper surface of the plate glass, on to the screen **22**. The knife blade in its holder is shown diagrammatically at **29**. If the blade facet is not wholly in contact with the plate glass two images of the cross will appear on the ground glass screen, one by the reflection from the upper plate glass surface and the other by reflection from the blade facet. The appropriate adjusting screws is adjusted until the images coincide, when the lock-nuts **17** or **17'** as the case may be is tightened. This adjustment will give the same bevel angle for the facets as that provided by the previous lapping. Alternatively, after setting the adjusting screws can be advanced one half turn before locking, thereby increasing the bevel angle slightly, and a new very narrow facet will then be produced when the blade is lapped so that a new cutting edge is obtained by removing very little metal.

A suitable lubricant, known as "white mixture" used in the lapping is as follows:

	Millilitres
Mineral white spirit	400
Water	1,000
Ethyl (or power) alcohol	1,000
Turkey red oil	45

This is a non-permanent emulsion and should be shaken each time before using.

A suitable abrasive is well graded aluminium oxide of maximum particle size 4 micron.

The preferred procedure for sharpening a microtome blade is as follows. The equipment is set up in a room free from corrosive fumes and reasonably free from dust and dirt. The lapping plate is carefully set up in a dish to which water can be supplied and which has drainage channels. The surface of the lapping plate is wiped carefully with soft cloth and inspected for damage. If not already done the ends of the cutting edge should be radiused by means of a suitable abrasive stone. The bearing pads on the knife holder should be checked for free movement in their seatings, and if there is any tendency to stick the caps **18** should be removed, the hemispheres and seatings cleaned with a light petroleum fraction, and repacked with a grease resistant to water and to petroleum fractions. The knife is then secured in the holder as previously described. For the first time of lapping the adjusting screws **12, 12'** are set to give the smallest practical cutting angle, as by placing the blade and holder on a flat surface and adjusting the screws to give a clearance of $\frac{1}{32}$ to $\frac{1}{16}$ inch between the flat surface and the back cylindrical section of the holder. For subsequent lapping the setting box of Figure 3 may be used.

The lapping plate is now flushed with the light petroleum fraction to remove any foreign matter. A teaspoon of abrasive is placed in a 4 ounce jar which is then filled with lubricant and then well shaken. About one fluid ounce of abrasive mixture is then poured onto the lapping plate and spread evenly over it as by a disc of hardened steel. The knife and holder are placed on the plate and lapping commenced, working over the full area of the plate. During lapping the knife and holder should be held lightly in contact with the plate, just sufficient to keep the bearing pad in contact with the plate and the main pressure along the cutting edge of the knife. The point of application of the pressure must be inside the triangle formed by the ends of the knife and the bearing pad to prevent the ends of the knife from rocking and damaging the plate. Too great a pressure along the cutting edge will result in the edge bending and so forming a wire edge.

Lapping is continued, adding more abrasive mixture when necessary and keeping the plate lubricated with white mixture. If any burrs develop on the plate lapping should be stopped immediately and the burrs carefully removed by rubbing over the burrs with an abrasive stone that has previously been lapped flat. When it is estimated that the damaged edge of the blade has been removed the edge is examined under a microscope (power about 100×). At this stage the edge will be serrated, due to the action of the loose abrasive, and the cutting facets will present a slightly matt appearance. If there are no gaps or breakdown of undesirable size the lapping is finished on a charged plate. To do this the plate is flushed with the petroleum fraction, the abrasive mixture is applied, and the abrasive worked into the lapping plate by the hardened flat steel disc which pushes the tiny grains of abrasive into the soft surface of the lapping plate. After about two minutes work with the steel disc the plate is scrubbed with a nail brush and a suitable detergent, and then flushed with water until the plate appears quite clean in the grooves and on the surface. The plate is then flushed with alcohol to remove excess water. A small amount of white mixture is now poured onto the plate and spread with the steel disc (this disc having first been cleaned to remove any loose abrasive). The knife is now lapped with a circular stroke for 1 to 2 minutes on each facet, and finally with a straight stroke only and with the cutting edge trailing for about 12 strokes, each facet alternately, with very light pressure.

When, due to repeated use and re-sharpening, the bevel angle becomes excessive the holder should be set to give the smallest practical cutting angle and the knife lapped using loose abrasive until a complete facet has

been formed at the new bevel angle. Of course a final lapping with a charged plate will then be given.

The lapping plate is preferably of leaded bronze which has the advantage over cast iron that it does not corrode readily in the presence of air and water and is of the correct hardness to hold the abrasive particles commonly used. Lapping plates generally used for the lapping of flat surfaces have a rectangular pattern of straight grooves cut in their lapping surface. Thin objects such as the cutting facet of a knife blade may easily become aligned with a straight groove with consequent serious damage to the lapping plate and knife. To remove this hazard lapping plates used in this invention are preferably made with a plurality of concentric circular grooves or one or more spiral grooves in the lapping surface. A suitable pitch for the grooves is one half inch and a suitable width one sixteenth inch.

It has been found that microtome blades sharpened on a lapping plate with the aid of the apparatus of this invention have a very superior finish, while the time required to effect sharpening is reduced, very materially in most cases. In one large hospital laboratory the time for preparing microtome knife blades has been reduced from approximately four man days per week to three man hours by adopting the method and apparatus of the present invention.

It is known that the greater the width of the facets forming the cutting edge the greater the time required for sharpening a blade, since more material has to be removed. The apparatus of this invention enables the labour required for resharpening blades which have developed wide cutting facets to be reduced by increasing the angle of the facets slightly, as by advancing each threaded rod 12, 12' by about one half pitch, whereby a new very narrow facet may be produced on each side in a very short time.

What I claim is:

1. Apparatus for use in the hand sharpening of knife blades and the like comprising a blade holder, a tongue on and extending rearwardly of the blade holder, a first adjusting rod threadably engaging the tongue near its rear edge and making an angle of about 90° with the plane of the tongue, said rod including an enlarged end provided with an internal hemispherical seat, a hemisphere engaging in said seat to form a self-aligning bearing and having a flat surface, a pad of abrasive resistant material secured to the flat surface of the hemisphere, a locknut for the adjusting rod, a second adjusting rod also threadably engaging the tongue near its rear edge and making an angle of about 90° with the plane of the tongue, said second rod including an enlarged end provided with an internal hemispherical seat on the opposite side of the tongue to the first-mentioned enlarged end, a second hemisphere engaged in said last-mentioned seat to form a second self-aligning bearing, a second pad of abrasive resistant material secured to the flat surface of the second hemisphere, and a lock nut for the second adjusting rod.

2. Apparatus for use in the hand sharpening of knife blades and the like comprising a blade holder, a tongue on and extending rearwardly of the blade holder, a first adjusting rod threadably engaging the tongue near its rear edge and making an angle of about 90° with the plane of the tongue, said rod including an enlarged end provided with an internal hemispherical seat, a hemisphere engaging in said seat to form a self-aligning bearing and having a flat surface, a pad of abrasive resistant material secured to the flat surface of the hemisphere, and a locknut for the adjusting rod.

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