

March 24, 1931.

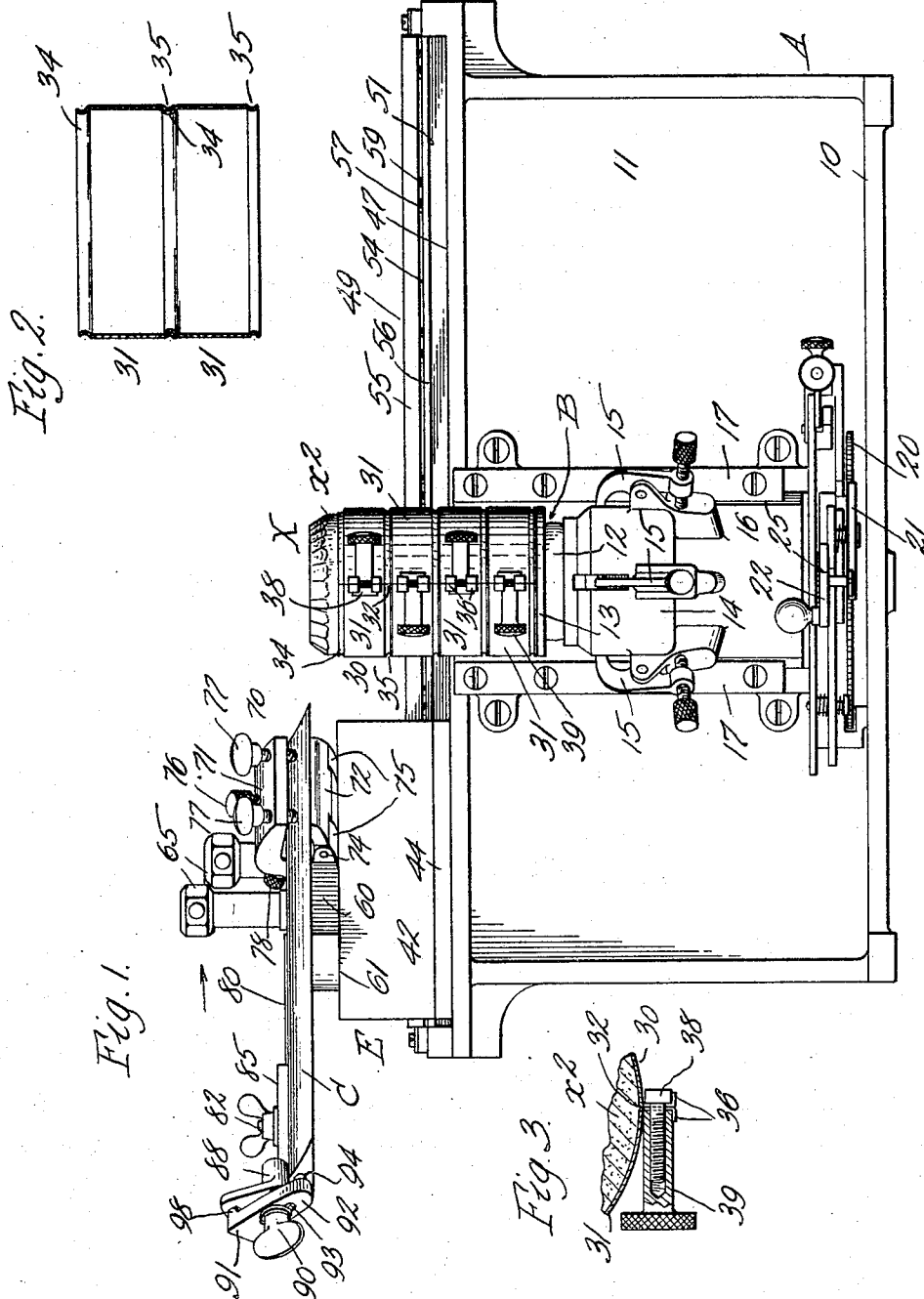
H. N. OTT

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MICROTOME

Filed Aug. 29, 1929

3 Sheets-Sheet 1



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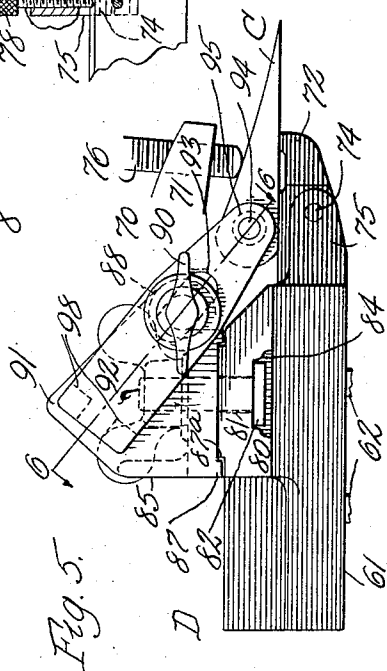
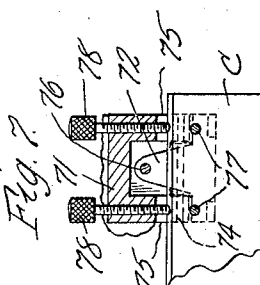
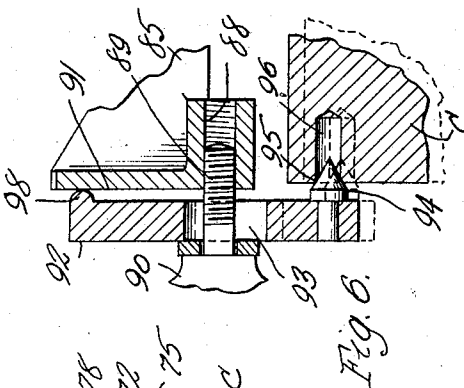
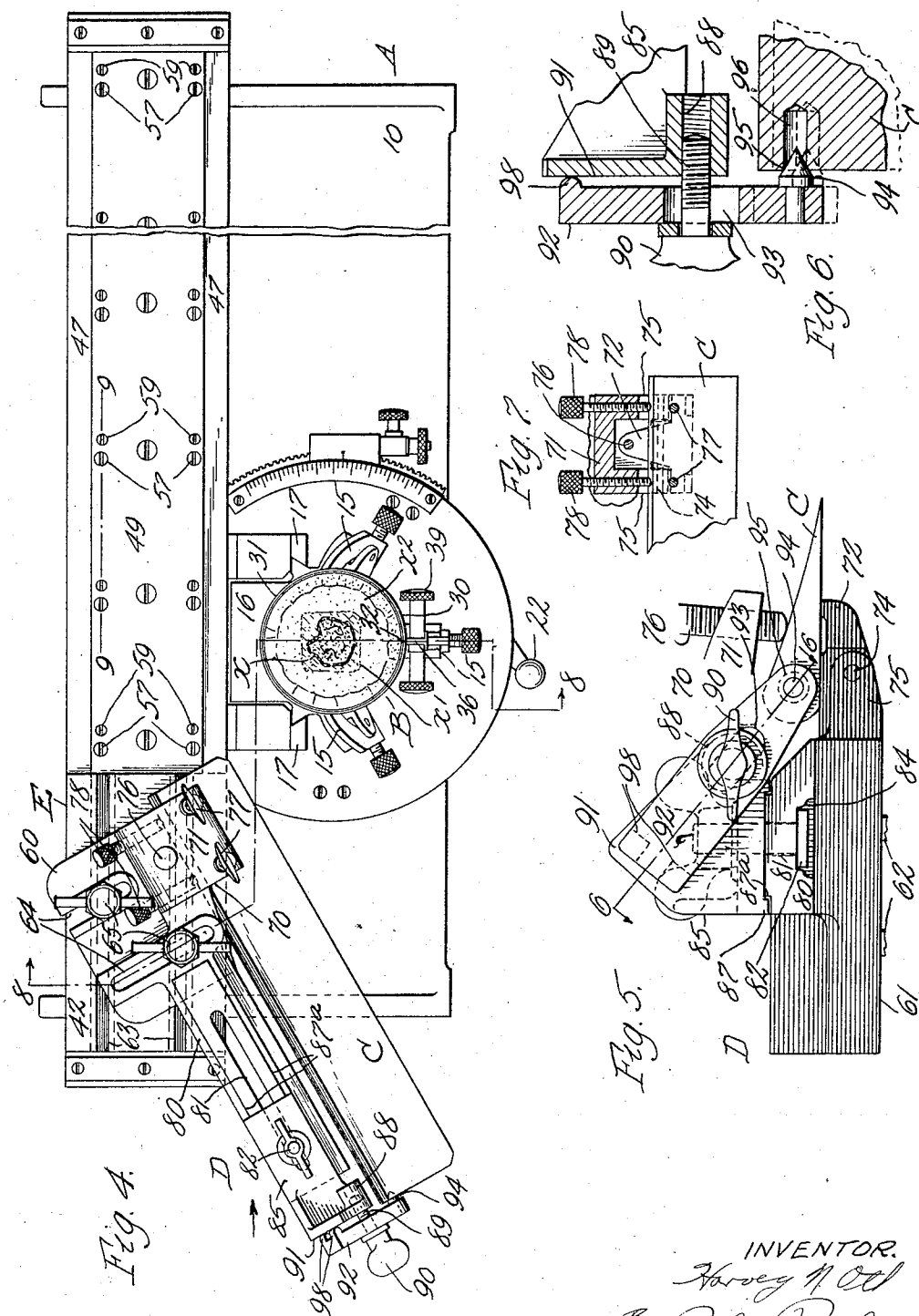
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

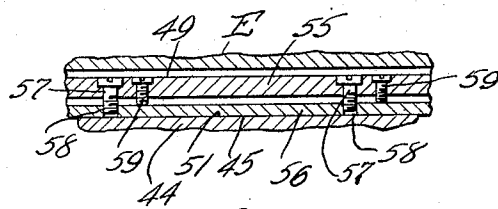
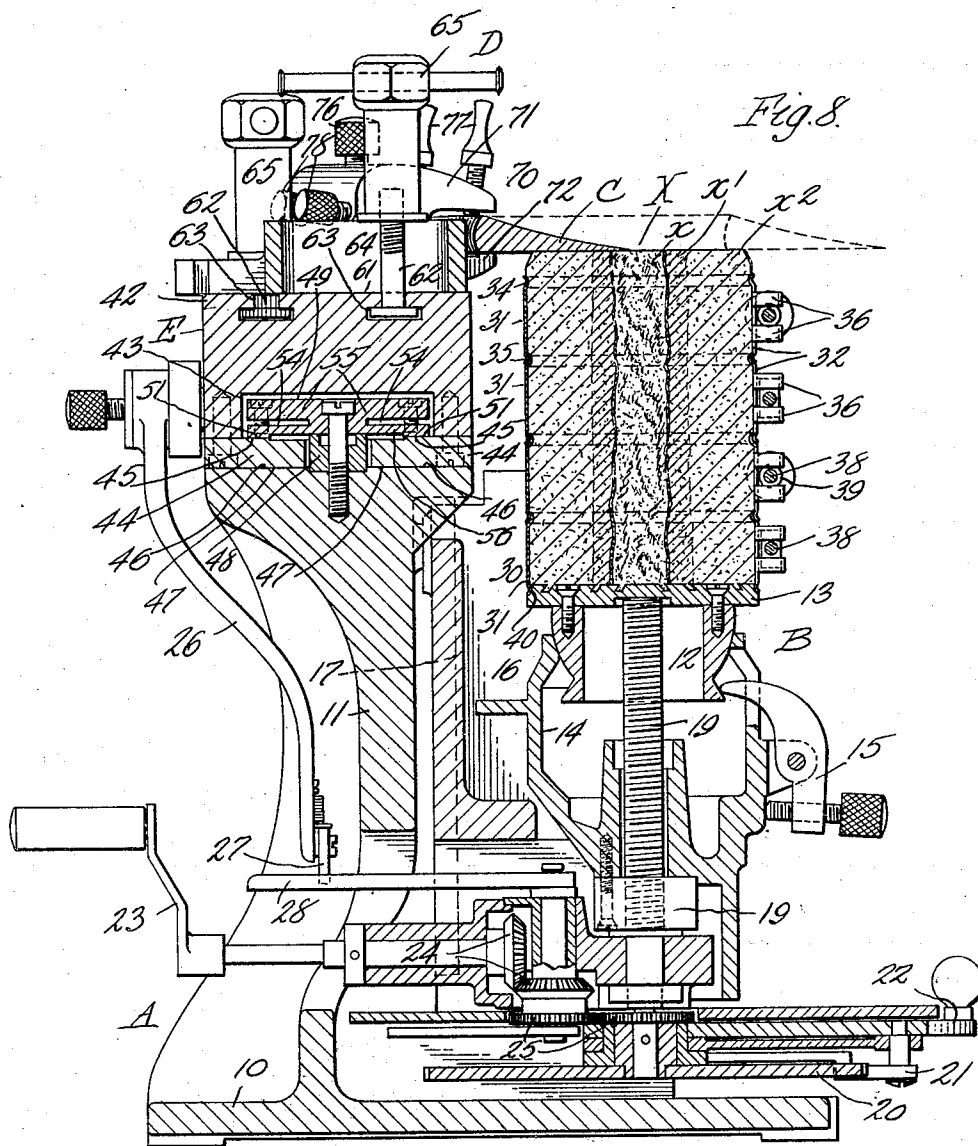


Fig. 9

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MICROTOME

Application filed August 29, 1929. Serial No. 389,189.

This invention relates to improvements in microtomes for cutting thin slices or sections of objects or materials for use as specimens for microscopic study.

5 Certain features of the invention relate to knife supporting and knife holding means used in connection with that type of micro-
tome having the knife or cutting member
10 mounted on a sliding support which is reciprocated by hand for passing the knife across the object to cut the slices therefrom, the latter being mounted in a holder which is advanced step by step to bring successive
15 portions of the object into the cutting plane. Other features of the invention relate to means for supporting the object, and these means are equally well adapted for use on microtomes of the kind designated, or on the other types well known in the art.

20 In some of the microtomes of the type above described the knife carriage is in the form of a block slidably mounted in a guide groove or way, and is held in engagement therewith by its own weight only. It has been found,
25 however, that in cutting specimens of relatively tough or resistant character on such apparatus that the knife carriage has a tendency to jump or move upwardly away from or out of contact with the guide or bearing
30 surfaces of the guideway when the knife engages the object. This of course makes it impossible to cut specimens of uniform thickness.

35 An object of the invention therefore, is to construct a microtome having a knife carriage so designed and mounted as to prevent the same from being displaced or moved out of contact with its guide when cutting specimens; also to construct a knife carriage and
40 guide therefor such that the carriage may be held accurately to and be moved smoothly and easily in a true plane or path; also to provide improved adjustable guide means for such carriages which enables close and uni-
45 form contact to be had between the bearing surfaces of said carriage and guide.

50 In some microtomes of this kind in which the knife, in the form of a straight razor like blade, is comparatively long, the knife holder included one or more adjustable clamps hav-

ing a pair of jaws embracing the opposite faces of the knife. When only one clamp is used this clamp usually engages the knife near the middle, thus leaving only a relatively short portion of the blade unob-
55 structed and available for cutting, or when the clamp engages the knife near one end, the distal end of the knife is unsupported. In such cases the knife is apt to yield or flex in use and does not cut uniform specimens.
60 On the other hand if the knife is secured in two clamps spaced apart, the available cutting portion of the knife is restricted to a relatively short intermediate portion between the clamps and care must be exercised to
65 see that the clamps do not strike the object from which the specimens are to be taken.

Other objects of the invention are to provide an improved knife holder for micro-
70 tomes in which the foregoing objections are avoided and whereby a relatively increased length of the knife is rendered available for cutting the specimens; also to construct a microtome knife holder which permits the
75 use of a relatively long knife and which is provided with means engaging the distal or outer end of the knife and which means co-operate with a clamp engaging the inner or proximal end or portion thereof to hold
80 the knife securely and rigidly against flexing in use; also to provide a knife holder having an adjustable clamp and means engaging the distal end of the knife and which is also
85 adjustable, so that the knife can be supported in or disposed at different inclinations relative to the object; also to provide adjustable means including a part engageable with the
90 distal end of the knife and which part is formed so as not to project into the face planes of the knife thereby permitting substantially all of the knife outwardly beyond
95 said clamp to be unobstructed and available for cutting the specimens; and also to provide means of this sort which are adjustable so as to cooperate with the holder clamp for
100 mounting knives of different lengths.

When certain objects or substances such as tissues and other anatomical subjects are prepared for cutting into specimens on the microtome by the infiltration of celloidin or

the like into the intracellular structure of the object, it has been found that the latter is rendered more or less elastic or yielding and is apt to flex when the microtome knife enters the object, and thus prevent the cutting of uniform slices or specimens. On the other hand with objects of this kind prepared in paraffin wax and the like, the resulting block is usually sufficiently rigid or stiff for the purpose.

Further objects of the invention are to construct a microtome having improved means for mounting and supporting the objects to be cut, especially when prepared in celloidin, whereby the objects are rigidly supported and prevented from flexing when engaged by the knife; also to provide means of this sort which permits the specimen block to be surrounded by or embedded in paraffin wax or the like substance to render the object more rigid and resistant to lateral flexing or displacement; also to provide means which extend about the object in engagement with the sides thereof to rigidly support the same; also to provide means of this sort in the form of a continuous wall or shell extending about the object and which is constructed to permit successive portions of the latter to be exposed and project into the cutting plane; also to provide a supporting wall or the like of this sort which is adjustable and which may be formed of separately removable sections for the last mentioned purpose; and also to provide means of this sort which may be applied to or associated with the usual object support or plate so that an object or prepared block may be mounted on said support and the space between the same and said supporting means filled with paraffin wax or the like to act as a support or block of relatively large cross sectional area, and which is of rigid character such that it permits the slices or specimens to be readily cut while offering a maximum resistance to lateral flexing during such operation.

Other objects are to improve microtomes in the other respects hereinafter set forth and claimed.

Figure 1 is a front elevation of a microtome showing an embodiment of my invention.

Figure 2 is a vertical, sectional view of two sections of the supporting or reinforcing wall of the object holder.

Figure 3 is a fragmentary, horizontal section of the securing means for one of the sections, on an enlarged scale.

Figure 4 is a plan view of the microtome.

Figure 5 is an elevation, on an enlarged scale, of one end of the knife holder thereof.

Figure 6 is a fragmentary, horizontal section of a part of the knife holder on line 6—6 Figure 5.

Figure 7 is a horizontal sectional view of the knife holder clamp.

Figure 8 is a transverse, vertical section of the microtome, approximately on line 8—8 Figure 4, on an enlarged scale.

Figure 9 is a fragmentary, longitudinal section of the knife holder carriage, on line 9—9 Figure 4, on an enlarged scale.

The microtome illustrated in the drawings includes a stationary frame A comprising a base 10 and an upwardly extending longitudinal standard, web or wall 11. At the front of the standard 11 is arranged the object holder B which is movable and adjustable vertically by suitable feed means to advance the object toward the cutting plane of a knife C. The knife is horizontally supported in a knife holder D stationarily mounted upon a knife block or carrier carriage E which is adapted to reciprocate longitudinally on the frame A so as to engage the knife C with the object to cut the slices or specimens therefrom.

The object holder B, except as hereinafter described, is of usual construction comprising a segmental spherical block 12 which carries an object plate or support 13 which is grooved on its face for the attachment thereto of one end of the object so that the object projects upwardly therefrom. The block 12 is adjustably secured in a socket 14 by a plurality of screw actuated jaws 15 which permits the block 12 and the object to be oriented as a unit to any desired relation to the knife, and firmly secured in adjusted position. The object holder B is carried by a vertically adjustable slide 16 moving in parallel guideways 17 on the standard 11. Vertical step by step movements are imparted to the slide for advancing the object intermittently to the knife by a rotatable feed screw 19, having a fine thread and which is actuated by a ratchet wheel 20 and pawl 21, under the control of a hand lever 22. The feed screw 19 raises the object by means of the nut 19a bearing against the under side of support 14 and suitably held against rotation. A quick return or lowering of the screw and object holder is effected by a crank 23 through bevel pinions 24 and gears 25. The upward step by step movement of the object holder is normally effected automatically through a swinging arm 26 mounted on the reciprocatory knife carriage E, and which has at its lower end a pawl 27 which engages an arm 28 operatively connected to one of the pinions 24. Each time the carriage E is returned after being actuated to pass the knife C through the object, the pawl 27 strikes and swings the arm 28 and causes the desired rotation of the feed screw 19.

In Figure 8 the object or substance from which the slices or specimens are to be taken is represented at *x*, being preferably one treated in celloidin to form a "celloidin block" of the usual kind, indicated at *x'*. This block *x'* is in turn, in accordance with the

invention, surrounded by a hardened mass of suitable substance, such as paraffin wax x^2 , of substantial area which acts to stiffen the otherwise somewhat yielding or flexible block x' and affords a rigid support or reinforcement for said block. This wax or filler x^2 is applied to or retained about the block x' by arranging a suitable shell, wall or other supporting means in operative relation to the plate 13 so as to extend upwardly relatively thereto about the object x to form a cup-like receptacle. The wax or substance in melted form is introduced into the space between said object and said wall or supporting means or cup and allowed to harden. In this way the object is firmly embedded in the wax or substance x^2 , which forms an integral rigid block of relatively large cross section, which is further reinforced or supported by the surrounding wall. This wall or support can be of any suitable character and construction adapted to be adjusted or otherwise arranged to permit successive portions of the completed block or object X to be moved into the cutting plane for cutting the slices.

In the particular construction shown an annular wall or shell 30 is employed, which comprises a plurality of separate detachable rings or sections 31 interconnected to each other to form a cylinder like member or shell which, in turn, is detachably connected to the object plate 13. Each of the sections or rings 31 is formed of sheet metal bent to circular form split lengthwise and with the split edges 32 in abutting relation. The top and bottom ends or edges 34 and 35 of each section is indented, grooved or otherwise formed, so that an end of one section can be engaged with and connected to an end of another section, and firmly secured in this position by any suitable means.

In the construction shown for this purpose the edges 32 of each section is provided with pairs of offset tabs or projections 36, the extreme outer edges of which are offset in opposite directions, and a bolt 38, extending transversely of the split or joint, with its head engaging one pair of lugs 36, is received in a threaded sleeve or clamp member 39, which when tightened upon the threads of the bolt 38, bears against the other pair of projections 36 and acts to draw opposite pairs of projections on each section toward each other until the edges 32 of the section engage. In this manner the several sections or rings are closed and at the same time the interfitted ends are rigidly clamped one to the other.

The periphery of the supporting plate 13 is formed with an annular groove 40, for the reception of the end of one of the rings or sections 31, so that a group of sections can be secured thereto so as to extend upwardly therefrom as shown in Figures 1 and 8.

When the required number of sections 31 have been secured together upon support

13 as shown in Figures 1 and 8, the paraffin wax or other substance, in melted condition, is poured into this receptacle so as to fill the space between the celloidin block or object and the walls of the sections 31 and allowed to harden.

After this has taken place the uppermost section 31 is removed so as to expose the upper end of the completed block, and the ratchet mechanism actuated so as to bring the upper end of the block into the cutting plane.

The apparatus is now operated by reciprocating the knife holder carriage E so as to pass the knife C across the top of the object or block X to remove a specimen therefrom, and during the retrograde movement of the carriage E, the ratchet mechanism is actuated so that the feed screw 19 will advance or elevate the object holder B and position said object so as to enable another slice to be taken therefrom by repeating the described movement of the knife holder carriage E.

After the major portion of the exposed end of the block or object has been cut away in this manner an additional amount or portion of the upper end of said block can be exposed to the cutting operation by removing another of the sections 31, which is effected by unscrewing the sleeve 39 of that section so as to permit the ends of the section to separate sufficiently to disconnect the grooved lower end thereof from the corresponding grooved end of the section below.

Preferably, the exposed portion of the block X is pared away to tapered form as shown in Figures 1 and 4 to reduce the area or size of the slice.

By the construction and arrangement of the separable annular structure described, the somewhat resilient or yielding celloidin block x' is amply reinforced by the interposition of the hard wax between the same and said annular wall or structure. Nevertheless successive portions of the block or object can be exposed as required to the cutting action of the knife. By this arrangement also a relatively long block or object can be prepared and cut into a correspondingly large number of specimens with each single attaching operation.

An important result attained by the foregoing is that the entire structure consisting of the support parts 12 and 13 and the sections 31 connected thereto, can be oriented as a single unit together with the object X carried thereby.

In accordance with the invention the knife holder carriage E is so mounted that during its operative movements it is positively prevented from lifting or jumping from the guide when the knife C enters the object or block. For this purpose said carriage E is constructed in the form of a substantially rectangular block 42 which is provided with a longitudinal downwardly opening recess

43 on its under side closed in part by a pair of opposed fixed bearing plates 44. These plates 44 are provided, within the recess 43, with upper bearing surfaces 45, and their lower faces form bearing surfaces 46. These bearing faces 45 and 46 extend parallel one with the other in horizontal planes lengthwise of the carriage E. The upper face of the standard 11 of the frame A is finished or planed to provide parallel, horizontal bearing surfaces 47 against which the lower bearing faces 46 of the knife carriage E having sliding contact. Secured to and extending lengthwise of said standard 11 and disposed between said plates 44, is a longitudinal bar 48, to the top face of which is rigidly secured a guide plate 49. This guide plate is adapted to pass through the recess 43 and has formed thereon a pair of spaced longitudinal guide faces 51 slidably engaging the upper bearing faces 45 of the carriage E. The guide plate or bar 49 is constructed so that its bearing faces may be adjusted towards or from the faces 45, so that a smooth and exact contact may be had between the carriage E and its guide and upward movement or displacement of the carriage prevented. For this purpose the plate 49 is divided lengthwise at each side thereof by longitudinal, horizontally disposed slits or grooves 54 providing a pair of opposed laterally extending and relatively rigid upper portions 55 and a pair of corresponding, somewhat yielding lower portions 56. The bearing surfaces 51 are formed on the parts 56. As shown in Figures 4 and 9, the upper portions 55 of the guide bar 49 are provided with a plurality of screws 57 which turn freely in holes in said plate with their lower ends operatively engaging in threaded holes 58 in the lower yielding portions 56 of the plate so that by turning these screws in one direction or the other the relatively yielding portion 56 of the plate can be drawn toward or moved away from the upper portion 55 thereof. A second series of screws 59 having threaded engagement in holes in the plate parts 55 extend with their lower ends bearing against the upper face of the lower portions 56. These screws can be turned so as to force the lower portion of the plate away from the upper portion thereof to a limited extent, so that by appropriate adjustments of the screws 57 and 59 the bearing faces 51 can be placed into accurate relation to the carriage bearing faces 45, in a manner to effect an exact sliding fit for the carriage between the opposed guide faces 45 and 47.

By this construction a very accurate, smooth and easy running adjustment or fit may be obtained between the knife carriage E and its guide, so that the carriage may move at all times in a direct plane while being prevented from displacement when the knife

C engages a relatively tough object on the specimen holder.

The knife holder D before mentioned, with the exception of certain parts to be described, may be of any suitable construction adapting it to support the knife C in a horizontal plane in angular relation to the object on the object holder B. In the construction shown the knife holder D comprises an attaching portion or block 60 having a flat lower bearing face 61, which rests upon the plane top face of the knife holder carriage E. The knife holder can be adjustably secured on the carriage E by any suitable means, such as a pair of clamping screws 62, the heads of which engage in T shaped longitudinal slots 63 formed in the top face of the carriage or slide E. The threaded portions of the screws 62 extend upwardly through transverse slots 64 in the block 60, and are received in hand nuts or clamp members 65 which, when tightened, bear on the top of the block 60 and draw the screw heads up tightly in their slots. Thus the knife holder can be adjusted and rigidly secured at any desired angle in a horizontal plane with reference to the knife carriage E.

Extending forwardly from the block 60 is a suitable knife clamp 70 which includes a fixed upper jaw 71 formed integral with the block 60, and an adjustable lower jaw 72. The jaws 71 and 72 are adapted to straddle the back of the knife C preferably near its inner end so as to extend for a distance over the upper and lower faces of the knife. The lower jaw 72 is mounted on a horizontal pivot 74 extending through, and between a pair of fixed lugs 75 on the knife holder, and an adjusting screw 76, passing downwardly through the upper fixed jaw and bearing upon the lower movable jaw rearwardly of its pivot so that the knife may be tilted to position its cutting edge in different planes. After the lower jaw has been adjusted, a pair of clamping screws 77 also passing through the fixed upper jaw are rotated so that their lower ends engaged the top face of the knife C, thereby forcing it firmly against the lower jaw 72. This clamp 70 is also provided with a pair of transverse screws 78, the ends of which bear against the back edge of knife C for adjusting the knife in a transverse direction.

Extending laterally from the block C of the knife holder D, is a supporting arm or member 80 which is provided with means at its outer or free end for engaging and supporting the outer or distal end of the knife C. These means are also adjustable as to cooperate with clamp 70 for positioning the knife in different planes in accordance with the material to be cut.

In the construction shown the arm 80 of the knife holder is slotted lengthwise at 81 for the reception of clamp device or screw 82 which passes through said slot 81 with its

head operatively engaging in a groove 84 extending along the bottom face of the arm 80. The upper end of the screw 82 passes through a slide or member 85 mounted on the top of the arm 80, and is provided with a nut by which the slide can be clamped in different positions lengthwise of the arm 80. Lateral displacement of the slide 85 is prevented by interfitting parts 87 and 87^a on said slide and said arm respectively.

As shown particularly in Figures 4 to 6 inclusive the outer end of the slide 85 is provided with a threaded horizontal socket 88 in which the threaded shank or portion 89 of a clamp screw is received, and between the head 90 of the clamping screw and the vertical end wall 91 of the slide 85 is disposed a knife engaging and supporting member 92 provided with a transverse slot 93 for the passage therethrough of said screw 89. At its front end this knife engaging member 92 is provided with a tapered lateral projection or stud 94 which is adapted to enter and bear against a seat 95 at the outer end of a hole 96 extending longitudinally into the distal end of the knife C near its back edge. At its opposite end, rearwardly of the clamp screw said knife engaging member 92 is provided with one or more laterally offset portions or lugs 98 which are adapted to bear against the vertical wall 91 of the slide 85. It will be seen that by mounting the knife C in the clamp 70 and adjusting it into the desired position, and then engaging the stud 94 of the knife engaging member 92 in the seat 95 at the distal end of the knife, this end of the knife can be secured and firmly supported by adjusting said member about the screw 89 and then tightening said screw so as to force the stud 94 firmly against the seat 95 of the knife, and the projections 98 of said member 92 firmly into contact with the end of the slide 85 on the arm 80.

It will be seen also that knives of various lengths can be accommodated by moving and securing the slide 85 in different positions along the arm 80.

The knife engaging member 92, when the clamping screw 89 is loosened, can be readily adjusted endwise in accordance with the transverse position of the knife as determined by the adjustment of the clamp 70 by the provision of the slot 93 in said member, and can also, rotate with reference to said screw 89 in accordance with the different relative positions of the front and back edges of the knife C.

Claims:

1. A microtome having an object support upon which an object may be securely mounted so as to project therefrom in an endwise direction, a knife in operative relation to the free end of an object so mounted, said knife and said support being relatively mov-

able for slicing specimens from said object, and means engaging the sides of said object for bracing the same against lateral deflection during said slicing operation, said means being adjustable to progressively uncover the sides of the object and expose successive portions of the unattached end of said object while the same remains mounted upon said support.

2. A microtome having an object holder comprising a member upon which an end of a somewhat flexible object may be mounted for supporting the same, a rigid wall extending from said supporting member around said object in spaced relation thereto, and a mass of hardened filling material surrounding said object and in which said object is embedded and which fills the space between the same and said wall, and forms a solid block which stiffens said object against lateral deflection when specimens are cut therefrom in the use of said microtome.

3. A microtome having an object support upon which an object may be securely mounted so as to project therefrom, a knife in operative relation to the free end of an object so mounted, said knife and said support being relatively movable for slicing specimens from said object, a wall extending from said support around said object, a solid mass of hardened filling material in which said object is embedded and which fills the space between the same and said wall for bracing said object, and said wall being adjustable to progressively uncover the sides of said mass and expose successive portions of the unattached end of said object to said knife.

4. A microtome having an object holder comprising a support to which an end of an object is attached, and a bracing member secured on said support and extending therefrom about the sides of said object with a part of said object projecting therefrom to permit sections to be cut from projecting part of said object, and said bracing member being detachable relatively to said support and said object to permit sections to be cut from the remaining portion of said object.

5. A microtome having an object holder comprising a support to which an object is attached, and a bracing member detachably secured on said support and extending therefrom about and substantially enclosing the sides of said object with a relatively small part of said object projecting therefrom to permit sections to be cut from said object, said object bracing member being adjustable relatively to said support and to said object to permit further portions of said object to be exposed as the latter is cut away in the use of the microtome.

6. A microtome having an object holder comprising a support to which an object is attached, and a bracing member extending

therefrom about said object and which comprises a plurality of split rings connected end to end to form a substantially continuous annular wall, and which are removable one after another to expose successive portions of said object to permit sections to be cut therefrom.

7. A microtome having an object holder comprising a support to which an object is attached, and a bracing member extending therefrom about said object and which comprises a plurality of longitudinally split members having interfitting parts for connecting them together end to end, means for drawing the severed portions of said sections together, and said means permitting the sections to be released and disconnected one after another to expose successive portions of said object for cutting slices therefrom.

8. A microtome having an object holder comprising a support to which an object is attached, and a bracing member extending therefrom about said object and which comprises a plurality of longitudinally split members having interfitting parts for connecting them together end to end, means for drawing the severed portions of said sections together, and which means simultaneously causes said interfitting parts of adjacent sections to rigidly interlock, and said means being adjustable to release said sections one after another to expose successive portions of said object for cutting slices therefrom.

9. An object holder for a microtome including a support for the object, and a plurality of sections each comprising an annular wall having its opposite ends formed to detachably interfit with the ends of other sections whereby a continuous wall adapted to surround said object may be formed by connecting said sections end to end, and means for detachably and securely retaining said sections in connected relation, and which means also permits said sections to be detached one after another to expose successive portions of said object.

10. An object holder for a microtome including a support for the object, and a plurality of sections each comprising an annular wall split lengthwise and the severed edges of which are adapted to abut, and each having its opposite ends formed to interfit with the ends of other sections, whereby a continuous wall adapted to surround said object may be formed by connecting said sections end to end, means for holding the abutting edges of said sections in contact and for securing said sections rigidly together, and which means also permits said sections to be detached one after another to expose successive portions of said object.

11. An object holder for a microtome, including a support for the object, and a plurality of sections each comprising an annular wall of sheet metal split lengthwise and the severed ends of which are normally separated

and which may be brought into abutting relation by flexing said section, securing means on each section for holding said abutting edges together, and said sections having interfitting parts permitting said sections to be connected end to end to form a continuous wall about said object, and said sections being detachable one after another by releasing said securing means thereof to expose successive portions of said object.

12. An object holder for a microtome including a support for an object, and a plurality of sections each comprising an annular wall having its opposite ends formed to detachably interfit with the ends of other sections, whereby a continuous wall adapted to surround said object may be formed by connecting said sections end to end, and said support also having a part formed to interfit with an end of one of said sections, so that said connected sections may be mounted thereon, and means detachably and securely retaining said sections and said support in connected relation, and which means also permits said sections to be removed one after another to expose successive portions of said object.

13. An object holder for a microtome including a member on which said object is supported, a part on which said member is mounted by a ball and socket connection, and a rigid bracing member comprising a plurality of sections detachably connected end to end and one of which is detachably connected to said object support, whereby successive portions of said object may be exposed by detaching one after another of said sections, and said ball and socket connection permitting said object, said support and said sectional bracing member to be oriented as a unit to different positions so that specimens may be cut from the exposed portions of said object.

14. A microtome having a support for an object, a knife, a carriage on which said knife is rigidly mounted and which is reciprocable for engaging said knife with said object to cut specimens therefrom, said carriage having a substantially horizontal bearing face, a frame having a complementary bearing face on which said carriage face slidably engages, and means on said frame engaging said carriage to maintain positive engagement of said carriage bearing face with said frame bearing face in the reciprocatory movements of said carriage.

15. A microtome having a support for an object, a knife, a carriage on which said knife is rigidly mounted and which is reciprocable for engaging said knife with said object to cut specimens therefrom, said carriage having opposed bearing faces, a frame having a bearing face with which one of said carriage bearing faces engages, and a part fixed on said frame and engaging said other carriage bearing

ing face, whereby said carriage is positively maintained in sliding contact with said frame in its reciprocatory movements.

16. A microtome having a support for an object, a knife, a carriage on which said knife is rigidly mounted and which is reciprocable for engaging said knife with said object to cut specimens therefrom, said carriage having opposed bearing faces, a frame having a bearing face with which one of said carriage bearing faces engages, and a part fixed on said frame engaging said other carriage bearing face whereby said carriage is positively maintained in sliding contact with said frame in its reciprocatory movements, and said part on said frame being adjustable to effect a precise and uniform contact thereof with said carriage.

17. A microtome having a support for an object, a knife, a carriage on which said knife is rigidly mounted and which is reciprocable for engaging said knife with said object to cut specimens therefrom, a frame having a bearing face, and said carriage having opposed bearing faces one of which slidably engages said frame bearing face, a fixed part disposed in spaced relation to said frame bearing face and having a face complementary to the latter and which slidably engages said other carriage bearing face, whereby said carriage is positively maintained in sliding engagement with said frame in its reciprocatory movements.

18. A microtome having a support for an object, a knife, a carriage on which said knife is rigidly mounted and which is reciprocable for engaging said knife with said object to cut specimens therefrom, said carriage having a laterally extending part formed with upper and lower parallel bearing faces, and a frame having complementary upper and lower parallel bearing faces engaging said carriage bearing faces for guiding and maintaining said carriage in positive relation to said frame in its reciprocatory movements.

19. A microtome having a support for an object, a knife, a carriage on which said knife is rigidly mounted and which is reciprocable for engaging said knife with said object to cut specimens therefrom, said carriage having a laterally extending part formed with upper and lower parallel bearing faces, and a frame having a lower bearing face upon which the corresponding face of said carriage slidably engages, and a bar on said frame overhanging said laterally extending part of said carriage and having a bearing face engaging downwardly upon said upper bearing face of the latter to positively hold said carriage against said frame bearing face in its reciprocatory movements.

20. A microtome having a support for an object, a knife, a carriage on which said knife is rigidly mounted and which is reciprocable for engaging said knife with said object to cut

specimens therefrom, said carriage having a laterally extending part formed with upper and lower parallel bearing faces, and a frame having a lower bearing face upon which the corresponding face of said carriage slidably engages, and a bar on said frame overhanging said laterally extending part of said carriage and having a bearing face engaging downwardly upon said upper bearing face of the latter to positively hold said carriage against said frame bearing face in its reciprocatory movements, and said bearing face of said bar being formed on a part thereof which is adjustable to effect precise and uniform contact of said face with the adjacent bearing face of said carriage.

21. A microtome having a support for an object, a straight knife, and a holder for said knife which is mounted so as to be reciprocated for engaging said knife with said object to cut specimens therefrom, a clamp firmly engaging opposite faces of said knife adjacent one end thereof, and a part carried by said knife holder which firmly engages and supports the distal end of said knife without obstructing the same.

22. A microtome having a support for an object, a straight knife, and a holder for said knife which is mounted so as to be reciprocated for engaging said knife with said object to cut specimens therefrom, and a clamp firmly engaging opposite faces of said knife adjacent one end thereof and which is adjustable to permit said knife to be positioned in different relations to said object, and a part carried by said holder which firmly engages and supports the distal end of said knife without obstructing the latter, and which part is adjustable to different positions relative to said holder to correspond with the adjustments of said clamp.

23. A microtome having a support for an object, a straight knife, and a holder for said knife which is mounted so as to be reciprocated for engaging said knife with said object to cut specimens therefrom, and clamp firmly engaging opposite faces of said knife adjacent one end thereof, and which is adjustable to permit said knife to be adjusted about and also transversely of its longitudinal axis to position it in different relations to said object, and a part carried by said knife holder which firmly engages and supports the distal end of said knife and which is also adjustable about and transversely of said axis of said knife to correspond with the adjustments of said clamp, and said part being also adjustable lengthwise of said axis for accommodating knives of different lengths.

24. A microtome having a support for an object, a straight knife having opposite converging faces terminating in a cutting edge, and a knife holder upon which said knife is secured and which is reciprocably mounted

for engaging said knife with said object to cut specimens therefrom, and a member on said holder having a projecting part which firmly engages the distal end of said knife and which is disposed between the planes of said knife faces so as not to obstruct the latter.

25. A microtome having a support for an object, a straight knife having opposite converging faces terminating in a cutting edge, and a knife holder upon which said knife is secured and which is reciprocally mounted for engaging said knife with said object to cut specimens therefrom, and a member on said holder having a projecting part which firmly engages the distal end of said knife and which is disposed between the planes of said knife faces so as not to obstruct the latter, and said member being adjustable relatively to said holder to permit said knife to be adjusted about and also transversely of its longitudinal axis in different relations to said object.

26. A microtome having a support for an object, a straight knife having a transverse end wall and a seat formed therein, and a knife holder upon which said knife is secured and which is reciprocally mounted for engaging said knife with said object to cut specimens therefrom, a member on said holder having a stud extending parallel with the longitudinal axis of said knife and which is adapted to engage in said seat in said wall thereof, whereby said knife may be turned on said stud and adjusted about said axis in different relations to said object, and means rigidly securing said member and said knife in adjusted positions.

27. A microtome having a support for an object, a straight knife, and a holder for said knife which is mounted so as to be reciprocated for engaging said knife with said object to cut specimens therefrom, securing means on said holder engaging said knife adjacent one end thereof, an arm extending laterally from said holder, and a part adjustably mounted on the free end of said arm for movement relatively thereto toward said securing means for engaging and supporting the distal end of said knife.

28. A microtome having a support for an object, a straight knife having a transverse end wall and a seat formed therein, a knife holder upon which said knife is secured and which is reciprocally mounted for engaging said knife with said object to cut specimens therefrom, adjustable securing means on said holder for engaging and supporting said knife adjacent one end thereof, an arm extending laterally from said holder, a member adjustably mounted thereon for movement parallel with the longitudinal axis of said knife, and a part carried by said member which is adjustable transversely of said axis and relatively to said member and which

operatively engages and supports the distal end of said knife, means for securing said member on said arm and means for clamping said part against said member and said knife.

29. A microtome having a support for an object, a straight knife having a transverse end wall and a seat formed therein, a knife holder upon which said knife is secured and which is reciprocally mounted for engaging said knife with said object to cut specimens therefrom, adjustable securing means on said holder for engaging and supporting said knife adjacent one end thereof, an arm extending laterally from said holder, a knife supporting member having a part formed to bear against said arm and a part engageable with the distal end of said knife, and means for forcing said member firmly against said arm and said knife.

30. In a microtome, a knife having opposite converging faces terminating in a cutting edge and having a transverse end wall, and a holder for said knife comprising clamping means engaging said opposite faces thereof at a distance from said end wall thereof, and means extending between the planes of said knife faces and bearing against said end wall thereof for supporting that end of the knife without obstructing said faces.

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