No. 775,556. PATENTED NOV. 22, 1904.

C. F. DIECKMANN.

MICROTOME.

APPLICATION FILED FEB. 15, 1904.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

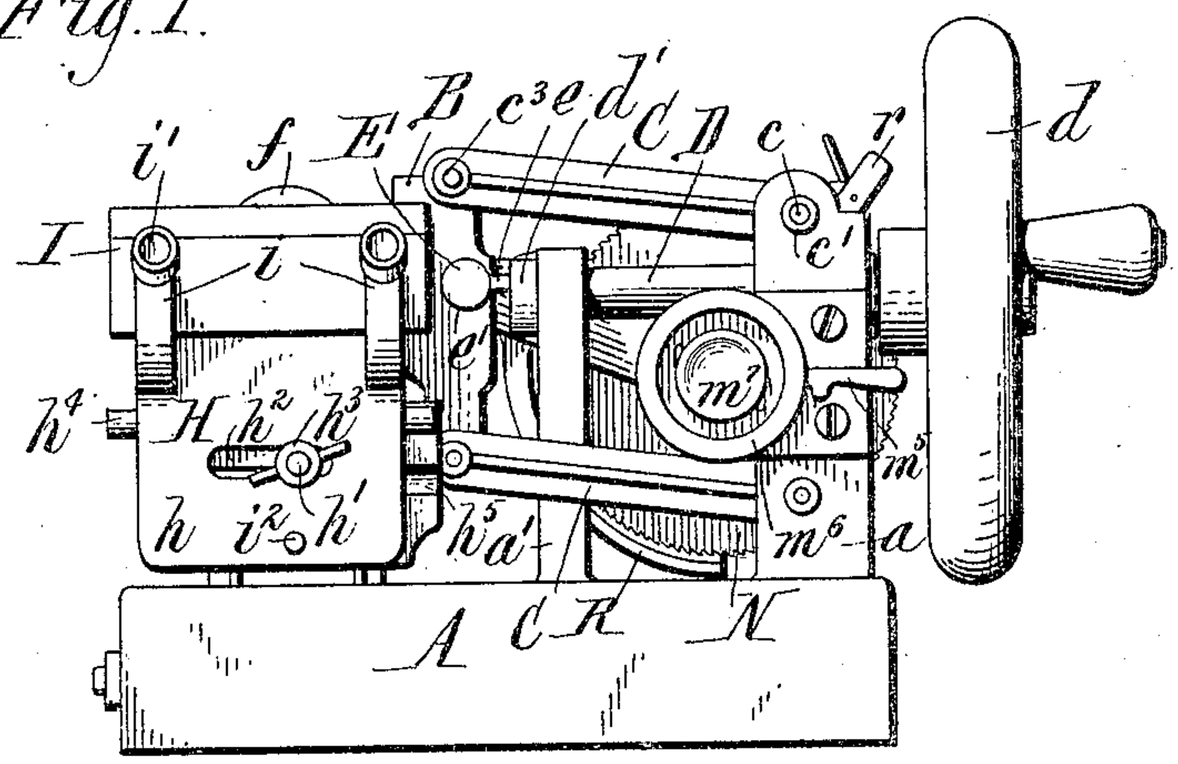


Fig. 2.

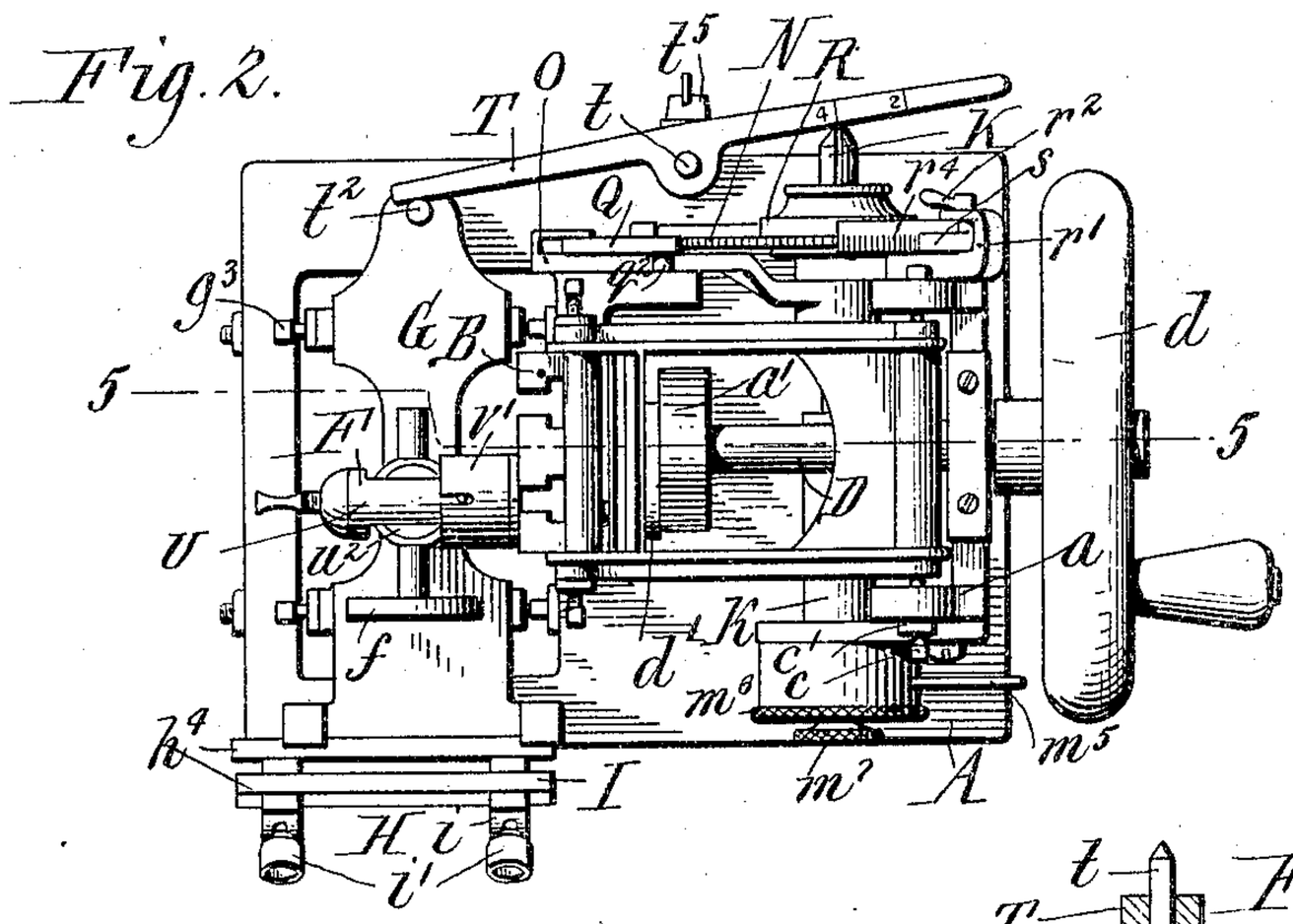


Fig. 3.

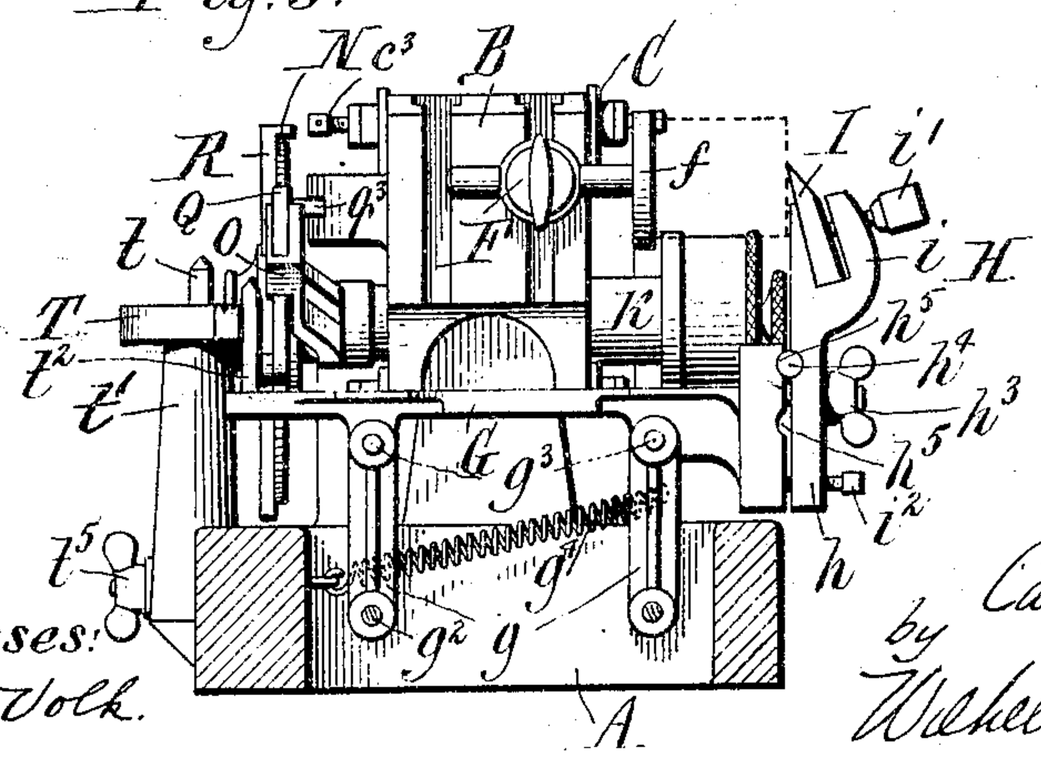
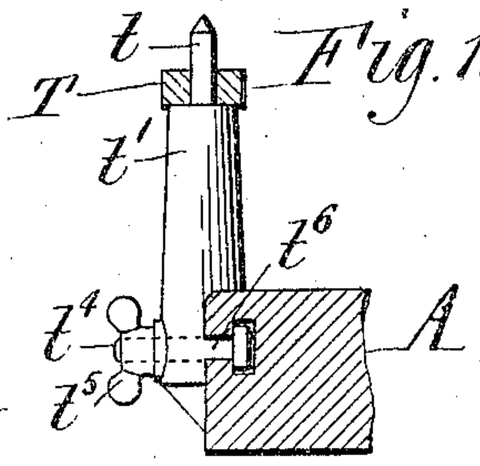


Fig. 12.



Witnesses:
E. A. Volk.
R. W. Rumer.

Inventor:
Carl F. Dieckmann
by Wheeler, Parker & Hard
Attorneys.

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 4.

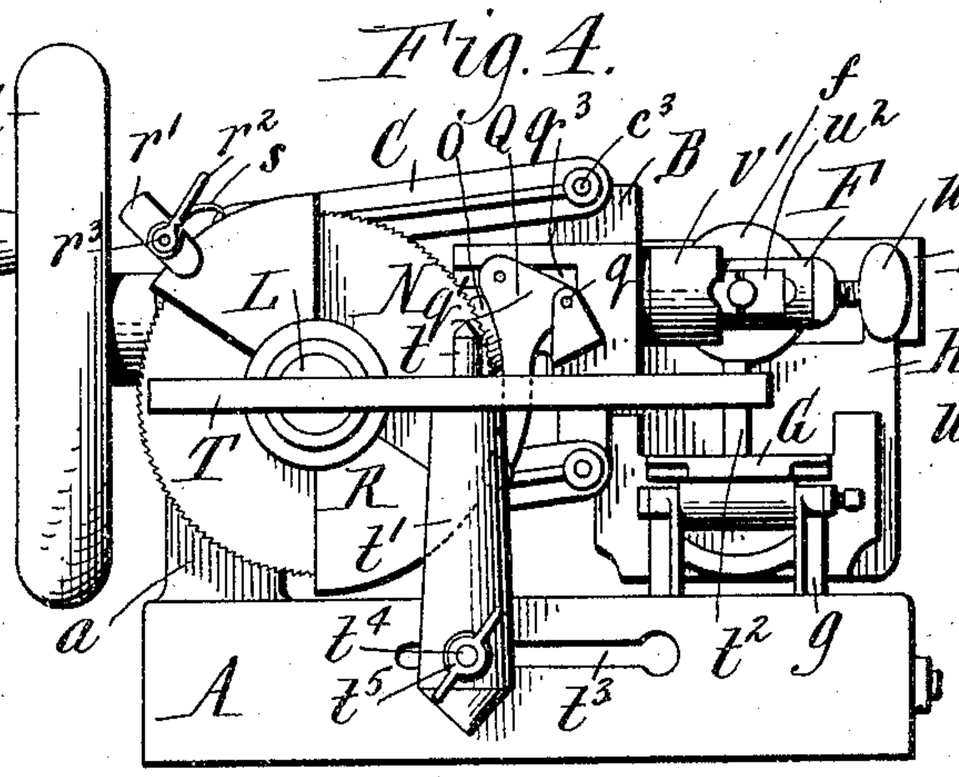


Fig. 7.

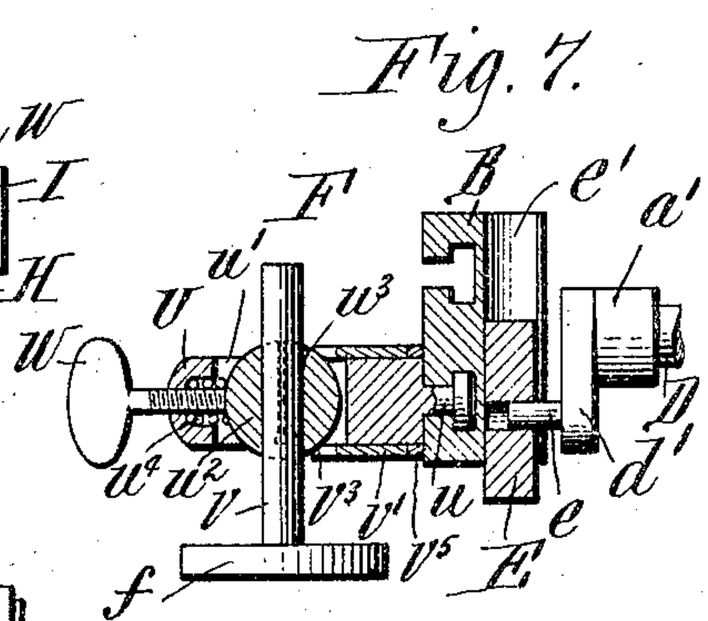


Fig. 8.

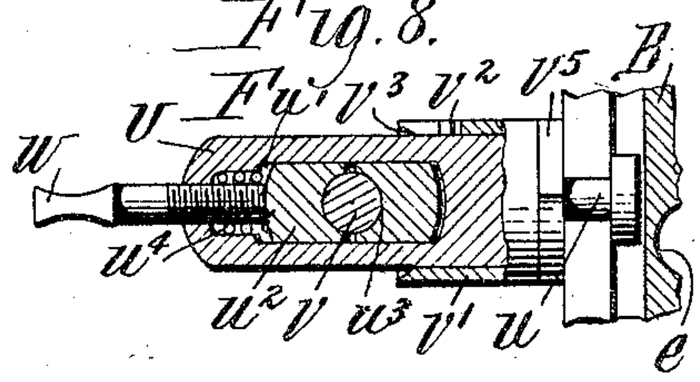


Fig. 5.

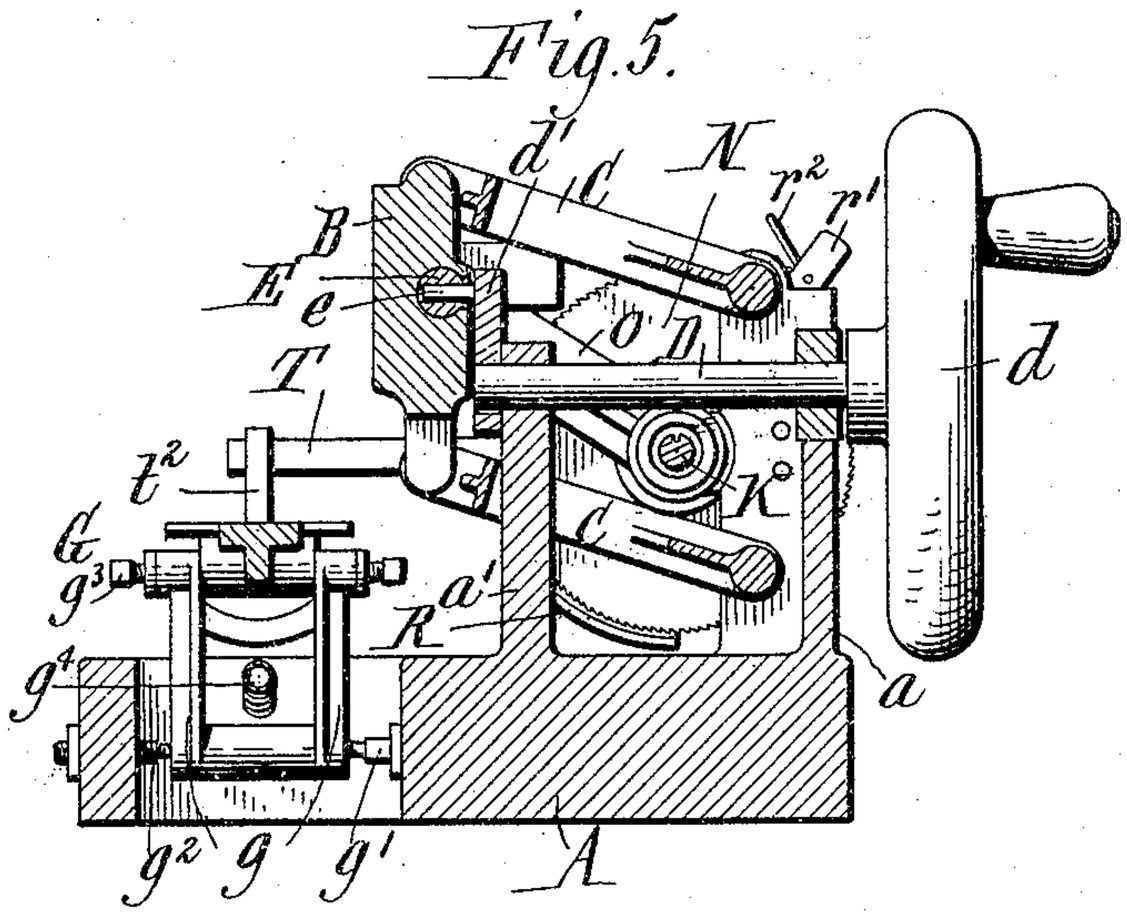


Fig. 9.

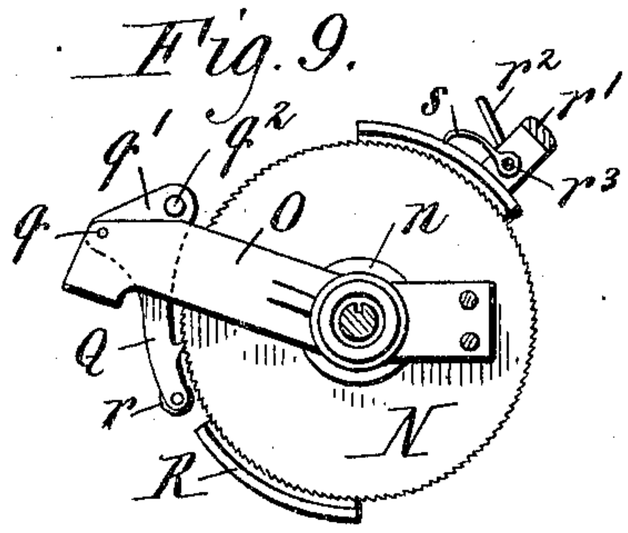


Fig. 6.

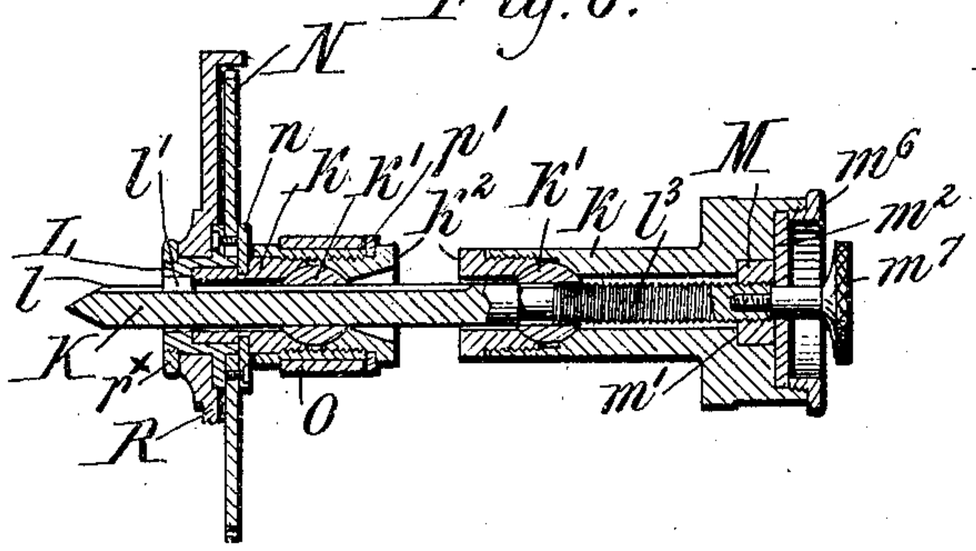


Fig. 10.

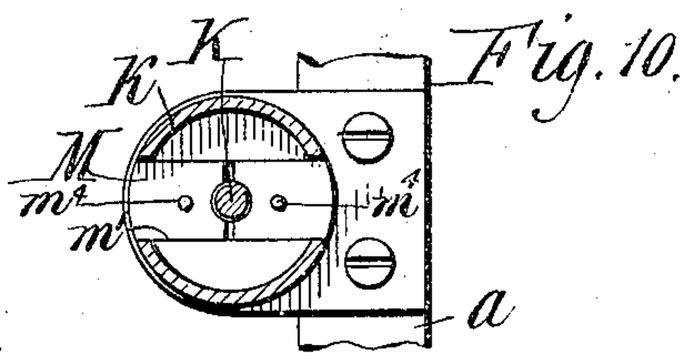
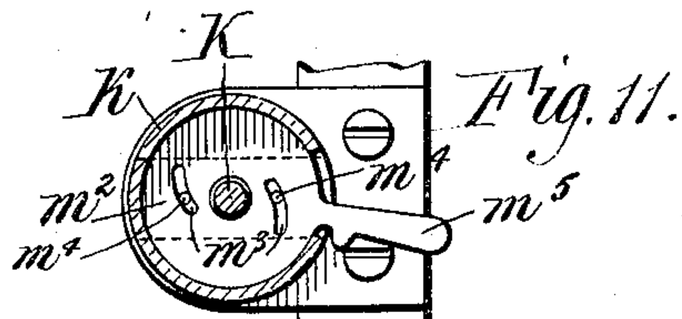


Fig. 11.



Witnesses:
E. A. Volk.
P. W. Rumer.

Inventor.
Carl F. Dieckmann
by Wilhelm, Parker & Hard
Attorneys.

No. 775,556. Patented November 22, 1904.

UNITED STATES PATENT OFFICE.

CARL F. DIECKMANN, OF BUFFALO, NEW YORK, ASSIGNOR TO SPENCER LENS COMPANY, OF BUFFALO, NEW YORK.

MICROTOME.

SPECIFICATION forming part of Letters Patent No. 775,556, dated November 22, 1904.

Application filed February 15, 1904. Serial No. 193,581. (No model.)

To all whom it may concern:

Be it known that I, CARL F. DIECKMANN, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Microtomes, of which the following is a specification.

This invention relates to a microtome or machine for cutting microscopic sections of that kind comprising a vertically-reciprocating support on which the specimen or object to be cut is fixed, a knife-carriage on which is mounted a relatively stationary knife past which the specimen is moved and which slices off a section at each forward movement of the specimen-support, and feed mechanism for advancing the knife toward the specimen a distance equal to the thickness of the sections prior to each forward movement of the specimen-support, whereby the knife cuts the successive sections.

The primary object of the invention is to provide a practical and desirable microtome of strong, compact, and simple construction which can be made at reasonable cost and which is more in the nature of a strong durable machine than a delicate instrument, while at the same time it is capable of adjustment to cut sections varying in thickness from the thinnest to the thickest required.

Another object of the invention is to provide a knife-feed mechanism comprising an adjustable leverage device between the knife-carriage and the feed-screw therefor, whereby a single feed-screw with a comparatively coarse strong thread can be employed to produce varying movements of the knife-carriage, to provide for quickly setting the knife-feed mechanism so that the knife can be positioned in the proper relation to the specimen without loss of time, to enable the ready removal of the feed-screw for cleaning and lubricating the same or for any other reason, and to permit the knife and carriage to be moved away from the specimen independently of the feeding mechanism and without disturbing the same or its adjustment to facilitate the examination or cleaning of the knife.

Another object is to provide a simple and desirable adjustable knife-holder permitting the angularity of the knife to be quickly adjusted to operate to the best advantage on a particular specimen and allowing the knife to be adjusted longitudinally of itself, so that the entire length of its edge can be used in cutting, thereby avoiding the necessity for so frequently sharpening the knife.

Another object of the invention is to furnish a holder for the specimen of simple construction and composed of the minimum number of parts, whereby the specimen can be universally adjusted and can be adjusted in any plane without disturbing its other adjustments.

A still further object of the invention is to improve and simplify the machine in various respects, which will appear from the following description and claims.

In the accompanying drawings, consisting of two sheets, Figure 1 is a front elevation of a microtome embodying the invention. Fig. 2 is a plan view thereof. Fig. 3 is an end elevation thereof, showing the base or main frame partly in section. Fig. 4 is a rear elevation thereof. Fig. 5 is a longitudinal vertical sectional elevation thereof in line 5 5, Fig. 2. Fig. 6 is a sectional elevation of the feed-screw and associated parts. Fig. 7 is a horizontal section, partly in plan, on an enlarged scale, of the holder for the specimen. Fig. 8 is a vertical sectional elevation, on an enlarged scale, of the holder for the specimen. Fig. 9 is an elevation, partly in section, showing the ratchet-and-pawl mechanism for operating the feed-screw. Fig. 10 is a sectional elevation showing the feed-nut for the feed-screw. Fig. 11 is a sectional elevation showing the operating disk or plate for the feed-nut sections. Fig. 12 is a detail sectional view showing the securing means for the post of the feed-lever.

Like letters of reference refer to like parts in the several figures.

A represents the main frame or base of the machine, which is preferably in the form of a rectangular casting of sufficient weight to give the machine the necessary stability when placed on a table or support without requir-

ing fastening means. The base is provided at or near one end with an upright bearing-standard *a* and opposite the same with a second upright bearing-standard *a'*.

B represents a vertically-reciprocating support or carriage for the holder for the specimen or object to be cut. The support is mounted on vertically-swinging parallel links or arms C, which are pivoted at their inner ends on bearings *c* on the side portions of the bearing-standard *a*. The bearings *c* are preferably in the form of studs provided with threaded shanks passing through screw-threaded holes in the sides of the bearing-standard, so that they can be adjusted toward and from the links, and having conical inner ends bearing in conical seats in the swinging links and outer ends fashioned in any suitable manner for the engagement of a tool for turning them. The bearing-studs at the front side of the bearing-standard are held in an adjusted position by clamping-nuts *c'*, screwed on their threaded shanks against the sides of the bearing-standard. The outer or free ends of the swinging links are bifurcated and straddle the vertically-reciprocating support or carriage, to which they are pivoted by adjustable bearing-cones c^3 similar to the bearing-cones for the inner ends of the swinging links.

The support for the specimen-holder is reciprocated by a drive-shaft D, which is journaled in suitable bearings on the upright bearing-standards *a a'* and is provided at its outer end with a hand-wheel *d*, having a crank-handle or other driving pulley or wheel if the machine is to be driven by power. At its inner end the shaft carries a crank-arm *d'*, Figs. 2, 5, and 7, provided at its outer end with a pin *e*, engaging in a hole in a slide block or head E, which is arranged to slide horizontally in a suitable guideway or groove *e'* in the vertically-reciprocating support or carriage. By rotating the drive-shaft the support or carriage is reciprocated vertically.

F represents the holder for the specimen or object to be cut. This holder is provided with a specimen plate or disk *f*, on which the specimen or object to be cut is cemented or fixed in the usual manner. The specimen-holder is constructed, as hereinafter described, to enable the adjustment of the specimen or object to present it at the necessary or desired angle relative to the knife.

G represents the knife carriage or support, which is arranged adjacent to the vertically-reciprocating support beneath the specimen-holder. The knife-carriage is mounted to move laterally in a direction transversely of the plane of movement of the specimen support or carriage and is preferably pivoted to the upper ends of parallel swinging links *g*, which are pivoted at their lower ends on the base or main frame of the machine. In the construction shown the swinging links for the knife-carriage are located in an opening or recess in the main frame or base of the machine and are provided at the inner sides of their lower ends with conical seats for bearing-cones *g'*, secured to the main frame or base of the machine, and at the outer sides of their lower ends with conical seats in which engage adjustable bearing-cones g^2 on the base or main frame. The upper ends of the swinging links *g* are bifurcated or forked and straddle depending lugs on the bottom of the knife-carriage, to which they are pivoted by adjustable bearing-cones g^3, carried by the upper ends of the swinging links. These various bearing-cones are preferably similar to those described in connection with the support or carriage for the specimen-holder. The knife-carriage is yieldingly pressed rearwardly toward the specimen-holder by a spring, such as the coil-spring g^4, secured at one end of the front supporting-link for the carriage and at the other end to the main frame or base of the machine.

H, Figs. 1, 2, and 3, represents the knife-holder, which preferably consists of a plate *h*, arranged in an upright position at the front end of the knife-carriage, to which it is adjustably secured by a screw *h'*, fixed to the front end of the knife-carriage and passing through a horizontal elongated slot h^2 in the plate of the knife-holder and provided with a clamping thumb-nut h^3. The knife-holder plate is provided on its rear face with a horizontal cylindrical fulcrum-bar h^4, which bears loosely against and is adapted to turn and also slide longitudinally in semicircular seats h^5 in the front face of the knife-carriage. The knife-holder plate is provided at its upper end with crotches or forks *i*, in which the knife-blade I is arranged parallel with the fulcrum-bar and held by set-screws *i'*, passing through threaded holes in the front arms of the forks or crotches and bearing against the knife-blade to clamp the knife firmly between the same and the rear arms of the knife forks or crotches. i^2 represents an adjusting-screw passing through a threaded hole in the knife-holder plate below its fulcrum and bearing at its inner end against the front face of the knife-carriage. The knife-blade can be moved longitudinally and secured in the forks or crotches of the knife-holder, and the latter, with the knife-blade, can be adjusted longitudinally of the knife by loosening the clamping-nut h^3 and sliding the holder bodily in a direction lengthwise of the knife-blade, thereby positioning any desired portion of the knife-blade in cutting relation to the specimen, so that the entire cutting edge of the knife can be used and the knife requires to be sharpened less frequently. The angularity of the knife-blade relative to the specimen to insure the best results can also be easily adjusted by means of the set-screw i^2, while the clamping-nut is loosened. After the knife-holder has been adjusted as to angular-

ity and also longitudinally of the knife-blade the clamping-nut is tightened, thereby securing the knife-holder firmly on the knife-carriage. The clamping-nut and screw thus constitute the only securing device for the knife-holder and allow the knife to be adjusted both as to angularity and also lengthwise of itself.

At each downward or operative movement of the reciprocating support for the specimen-holder the specimen is carried past the knife-blade, which cuts off a section or slice of the specimen, and during the upward or retrograde movement of the support the knife-carriage is advanced to carry the knife toward the specimen a distance equal to the thickness of the section or slice cut, thereby cutting sections or slices of the same thickness at the successive downward or operative movements of the support. The feed mechanism for thus advancing the knife-carriage is constructed as follows: K, Figs. 2, 5, and 6, represents a feed screw or device which is arranged horizontally of the machine and is given a partial rotation to advance it a predetermined distance at each upward movement of the support for the specimen-holder, the advance movements of the feed-screw being transmitted to the knife-carriage to advance the knife toward the specimen or object being cut. The feed-screw passes loosely through hollow bearings or sleeves k, secured by suitable brackets to the front and rear portions of the upright bearing-standard a of the main frame. The feed-screw is preferably journaled, as shown in Fig. 6, to prevent it from binding in its bearings and to insure a perfectly free easy movement of the same. As shown in said Fig. 6, the feed-screw has a plain cylindrical portion which passes through cylindrical holes in spherical bearing-blocks k', which are seated in hemispherical sockets in the hollow bearing-sleeves, in which they are held and permitted to turn universally by tubular nuts k^2, screwed into the threaded inner ends of the bearing-sleeves and having hemispherical sockets at their inner ends for the bearing-blocks. The nuts can be adjusted to more or less tightly clamp and hold the bearing-blocks to prevent looseness of the same and to take up wear in the parts. L represents a rotary hollow feed-shaft which surrounds and bears on the rear hollow bearing for the feed-screw, to which it is connected to turn the latter with the shaft while at the same time permitting the feed-screw to be advanced longitudinally in its bearings independently of the feed-shaft, which is held from longitudinal movement. For this purpose the feed-screw is provided with a longitudinal keyway or groove l, in which engages a key l', secured to the hollow feed-shaft. The feed-screw has a threaded portion l^3 working in the screw-threaded hole of a feed-nut M, Figs. 6 and 10, mounted in the front hollow bearing or sleeve for the feed-screw. To enable the removal of the feed-screw from its bearings and to permit it to be moved longitudinally therein to any desired extent without turning the screw, the feed-nut is made in separable sections or halves mounted to slide toward and from the feed-screw in transverse guides or ways m' in the front bearing-sleeve. Each nut-section is provided at its inner end with a semicircular threaded socket which when the two nut-sections are moved together embrace and surround the threaded portion of the feed-screw, so that when the latter is turned by the rotation of the hollow feed-shaft it is advanced longitudinally or lengthwise of itself. The feed-nut sections are moved toward and from the feed-screw by suitable means, preferably consisting of a circular operating-disk m^2 arranged to turn in a cylindrical recess in the front hollow bearing or sleeve and provided with oppositely-disposed cam-slots m^3, Fig. 11, into which extend pins or projections m^4 on the two sections of the feed-nut. The operating-disk is provided with a lever or handle m^5, extending out through a slot in the hollow bearing. The operating-disk and feed-nut sections are held in place by a screw ring or nut m^6, which is screwed into the internally-screw-threaded outer end of hollow bearing and is provided with a milled flange for turning it. When the sections of the feed-nut are separated to release the feed-screw, the latter can be moved longitudinally in the bearing-sleeve to any desired extent to quickly set the knife-carriage or can be wholly removed from the bearing-sleeve for cleaning and oiling the same or to replace a worn feed-screw. The feed-screw is provided at its front end with a milled head or portion m^7 for turning and adjusting it.

The hollow feed-shaft L is intermittently rotated to advance the feed-screw by a suitable ratchet-and-pawl mechanism, which constitutes the subject-matter of a separable application for patent. This ratchet-and-pawl mechanism, briefly stated, is constructed as follows: N, Figs. 2, 4, 6, and 9, represents a ratchet-wheel which is secured in any suitable manner to the inner end of the hollow feed-shaft L, which is held from longitudinal movement on its bearing or journal by a divided washer or collar n, secured to the central portion of the ratchet-wheel and extending into an annular groove in the journal or bearing. The ratchet-wheel and feed-shaft are free to turn on the journal or bearing. O represents a pawl lever or arm which is provided at its inner end with a hub loosely surrounding and free to turn on the journal for the feed-shaft. (See Fig. 6.) The hub of the pawl lever or arm is confined between an annular shoulder on the journal and a washer p' between the inner end of the journal and a washer p' between the inner end of the journal and the adjusting-nut for the spherical bearing-block for the feed-screw. The ad-

justing-nut therefore serves also as a means for adjusting the washer for the hub of the pawl-lever to increase or decrease the freedom of its movement. Q, Figs. 4 and 9, represents a pawl which is pivoted in a recess at the outer end of the pawl-lever on a pin q. The pawl is provided with an arm or portion depending from its fulcrum and having a projecting tooth to engage with the teeth of the ratchet-wheel to turn the latter and is also provided with an arm or portion q', which projects toward the ratchet-wheel and is provided with an operating-pin q^2, which projects into and slides in a horizontal slot or way q^3, formed in an arm or portion on the rear side of the vertically-reciprocating support for the specimen-holder. When the support or carriage is lowered, the upper side of the groove for the pawl-operating pin presses down on the pin and swings the pawl out of engagement with the teeth of the ratchet-wheel and lowers the outer end of the pawl-lever, and when the support or carriage moves upwardly the lower side of the groove for the pawl-operating pin lifts the pin and swings the pawl into engagement with the teeth on the ratchet-wheel and also lifts the outer end of the pawl-lever to turn the ratchet-wheel. The ratchet-wheel feed-shaft and feed-screw are thus intermittently rotated by the successive upward movement of the pawl-lever and pawl.

The operative movement of the pawl is adjustable to vary the intermittent movements of the ratchet-wheel and advance movements of the feed-screw, as follows: The depending arm of the pawl is provided with a roller r, which engages and rides on the circular periphery of a segmental adjusting-shield R, which is loosely mounted on the hollow feed-shaft between the ratchet-wheel and a nut $r^\times$, screwed on the threaded end of the feed-shaft. The upper portion of the adjusting-shield has a lateral flange overhanging the ratchet-wheel and passing between the legs of an inverted-U-shaped clamp r', which is fixed to the rear side of the upright bearing-standard a of the main frame. The legs of the clamp are forced together to grip and hold the adjusting-shield by a thumb-nut r^2, screwed on the threaded end of a pin r^3, secured to the inner leg of the clamp and passing through a hole in the outer leg. The flange on the upper portion of the adjusting-shield is preferably provided with graduations r^4, (see Fig. 2,) and a pointer or index s is pivoted on the pin r^3, with its free outer end adjacent to the graduations on the adjusting-shield. When the pawl-lever moves downwardly, the roller on the depending arm of the pawl engages and rides on the adjusting-shield, which holds the tooth of the pawl out of engagement with the ratchet-wheel in the upward movement of the pawl-lever until the roller passes off of the shield. By adjusting the shield the tooth of the pawl can be made to engage with the teeth of the ratchet-wheel sooner or later in its upward movement, thereby regulating as desired the amount of rotation of the ratchet-wheel at each upward movement of the pawl.

The advance movements of the feed-screw are transmitted to the knife-carriage preferably by a lever T, which is arranged horizontally at the rear side of the machine and is fulcrumed intermediate of its ends on a pivot-pin t at the upper end of an upright post or standard t', which is adjustably secured to the base or main frame of the machine. This feed-lever bears at one side of its fulcrum on the rear end of the feed-screw and at the other side of its fulcrum on a pin or part t^2, rising from the rear end of the knife-carriage. By adjusting the pivot-post for the feed-lever toward and from the feed-screw the knife-carriage can be caused to move a distance equal to the advance movement of the feed-screw or a distance equal to any desired fraction or multiple of the distance which the feed-screw advances. The pivot-post for the feed-lever can be adjustably secured to the base or main frame of the machine in any desired manner. In the construction shown in the drawings (see Figs. 4 and 12) the rear side of the base or main frame of the machine is provided with a horizontal keyhole-slot t^3, in which the headed inner end of a horizontal screw t^4, passing through a hole in the lower end of the pivot-post, engages. A thumb-nut t^5 is screwed on the outer end of the screw and bears against the outer side of the pivot-post to clamp the same in adjusted positions. The pivot-post is provided at its lower end with a lateral rib t^6, which slides in the slot in the main frame to hold the post vertical. The headed screw is moved to the large end of its slot in the main frame to enable the detachment of the pivot-post. The feed-lever arranged as described not only enables a regulation of the movements of the knife-carriage, but also provides a convenient means for moving the knife-carriage by hand away from the specimen at any time to clean the knife or for any other reason without disturbing the adjustment of the feed-screw or its operating mechanism.

The holder F for the specimen is constructed as follows, (see Figs. 2, 7, and 8:) U represents a cylindrical post which is provided at its inner end with a headed stud or stem u, which slidably engages in a vertical undercut slot in the face of the vertically-reciprocating support or carriage for the specimen-holder. The post is provided with a transverse slot or chamber u', in which is confined a circular swivel-block u^2, which is provided with a transverse cylindrical hole u^3 and is split partially through at opposite sides of said hole. The plate or disk f, on which the specimen or object to be cut is cemented or secured in the usual manner, is provided with a cylindrical stem v, which engages loosely in the

cylindrical hole in the swivel-block. v' is a sleeve which loosely surrounds the post of the specimen-holder and is prevented from turning, but permitted to slide longitudinally thereon by a pin v^2 on the post engaging in a longitudinal slot in the sleeve v'. The front end of the sleeve is provided with a circular concaved face v^3, against which the circular face of the swivel-block bears. The swivel-block is pressed against this face by a coil-spring v^4, confined in a pocket in the outer end of the post and bearing against the circular face of the swivel-block. v^5 is a split spring-ring surrounding the inner end of the post between the inner end of the sleeve and the support. W represents a thumb-screw provided with a threaded shank which works in a screw-threaded hole in the end of the post and passes through the coil-spring v^4, bearing at its inner end against the circular face of the swivel-block. When the thumb-screw is loosened, the post of the specimen-holder is loosened and free to turn and slide in its holding-groove in the reciprocating support, the swivel-block is free to turn in the post, and the stem of the specimen-plate is free to turn and slide in the swivel-block. The specimen-plate can thus be adjusted universally to place a desired portion of the specimen at the desired or necessary angle relative to the plane of the knife-blade. After the specimen-plate has been adjusted it is only necessary to tighten the thumb-screw to firmly secure all of the parts of the holder. When the set-screw is tightened, it forces the swiveled block and the sleeve against which the same bears toward the support, pressing the split spring-ring against the face of the support and at the some time drawing the head of the stud outwardly against the overhanging sides of the guide-slot for the post, thereby securely clamping the post in place on the support. At the same time the thumb-screw presses the portions of the split swivel-block toward each other, thereby firmly clamping and holding the stem of the specimen-plate. When the set-screw is loosened, the split spring-ring between the sleeve and the support exerts the necessary pressure to frictionally hold the post from sliding or turning in its groove except by the application of pressure, and the coil-spring at the end of the post presses the swivel-block against the sleeve with sufficient force to hold the swivel-block and stem of the specimen-plate from movement except by the application of pressure. Thus when the thumb-screw is loosened the parts retain the position to which they have been adjusted and the post can be turned or slid in its groove in the support, the swivel-block can be turned in the post independently of the adjustment of the post, and the stem of the specimen-plate can be turned and slid longitudinally in the swivel-block independently of the movement of the block, thereby enabling the specimen to be adjusted in any plane independently of its adjustment in any other plane. The one thumb-screw securely clamps and holds all of the parts of the specimen-holder and dispenses with the various screws and devices heretofore necessary for securing the various parts of the holder.

I claim as my invention—

1. The combination of a specimen-holder, and a knife which are movable and one of which is advanced in a direction transversely of the plane of movement of the other, and feed mechanism for advancing said part including a feed-screw which is movable independently of other parts of the feed mechanism, substantially as set forth.

2. The combination of a specimen-holder, and a knife which are movable and one of which is advanced transversely of the plane of movement of the other, and feed mechanism for advancing said part including a feed-screw which is removable from and independently of the other parts of the feed mechanism substantially as set forth.

3. The combination of a specimen-holder, a knife, and feed mechanism for advancing the knife including a feed-screw which is movable independently of other parts of the feed mechanism to provide a quick set for the knife, substantially as set forth.

4. The combination of a movable specimen-holder, a knife, a knife-carriage, a feed device for the knife-carriage, and mechanism for intermittently moving said feed device, said feed device being movable independently of its operating mechanism to provide a quick set for the knife, substantially as set forth.

5. The combination of a movable specimen-holder, a knife, a knife-carriage, a feed-screw for the knife-carriage, and mechanism for operating said feed-screw, said feed-screw being movable independently of its operating mechanism, substantially as set forth.

6. The combination of a movable specimen-holder, a knife, a knife-carriage, a feed-screw for the knife-carriage, and mechanism for operating said feed-screw, said feed-screw being removable from the machine independently of its operating mechanism, substantially as set forth.

7. The combination of a movable specimen-holder, a knife, a knife-carriage, a rotary hollow feed-shaft, and a feed-screw for the knife-carriage rotatable with and movable lengthwise in said hollow feed-shaft for advancing the knife-carriage, said feed-screw being movable independently of said feed-shaft to provide a quick set for the knife, substantially as set forth.

8. The combination of a movable specimen-holder, a knife, a knife-carriage, a rotary hollow feed-shaft, and a feed-screw for the knife-carriage rotatable with and movable lengthwise in said hollow feed-shaft for advancing the knife-carriage, said feed-screw being re-

movable from the hollow feed-shaft, substantially as set forth.

9. The combination of a movable specimen-holder, a knife, a knife-carriage, a feed-screw for the knife-carriage, means for rotating said feed-screw, and means releasably engaging the screw for advancing the same, said feed-screw being movable independently of its rotating means to provide a quick set for the knife, substantially as set forth.

10. The combination of a movable specimen-holder, a knife, a knife-carriage, a feed-screw for the knife-carriage, means for rotating said feed-screw, a nut consisting of separable sections engaging said feed-screw for advancing the same, means for operating said nut-sections to engage and release said feed-screw, said feed-screw being movable independently of its rotating means, substantially as set forth.

11. The combination of a movable specimen-holder, a knife, a knife-carriage, a feed-screw for the knife-carriage, means for rotating said feed-screw, a nut consisting of separable sections engaging the feed-screw for advancing the same, and a cam-plate for operating said nut-sections to engage and release said feed-screw, substantially as set forth.

12. The combination of a rotary feed-shaft, a feed-screw mounted concentrically with said feed-shaft, means connecting said shaft and feed-screw to turn the latter, and means for moving said feed-screw lengthwise relative to said shaft, said means permitting the feed-screw to be moved at will independently of said shaft, substantially as set forth.

13. The combination of a feed-screw, hollow bearings through which said feed-screw passes, means for rotating said feed-screw, and movably-supported bearing-blocks in said hollow bearings and provided with cylindrical bearing-openings for said feed-screw, substantially as set forth.

14. The combination of a feed-screw, hollow bearings through which said feed-screw passes, a rotary feed-shaft mounted on one of said bearings for turning said feed-screw, and spherical bearing-blocks mounted to turn universally in said hollow bearings and having cylindrical bearing-openings for said feed-screw, substantially as set forth.

15. The combination of a movable holder for the specimen, a knife, a knife-carriage, a movable feed device for the knife-carriage, and a lever interposed between said feed device and the knife-carriage and movable independently of said feed device, substantially as set forth.

16. The combination of a movable holder for the specimen, a knife, a knife-carriage, a movable feed device for the knife-carriage, a lever interposed between said feed device and the knife-carriage for moving the latter, and a pivot-post for said lever adjustable toward and from said feed device to vary the movement of said knife-carriage, substantially as set forth.

17. The combination of a movable holder for the specimen, a knife, a knife-carriage, a movable feed device, a lever interposed between said feed device and the knife-carriage for moving the latter, and a pivot-post for said lever adjustable toward and from said feed device to vary the movements of said knife-carriage, substantially as set forth.

18. The combination of a movable holder for the specimen, a knife, a knife-carriage, a feed device for said knife-carriage, operating mechanism for said feed device, adjusting means for varying the movement of said feed device, and an adjustable device interposed between said feed device and said knife-carriage to vary the movements of the knife-carriage relative to the movements of the feed device, substantially as set forth.

19. The combination of a movable holder for the specimen, a knife, a knife-carriage movable transversely of the plane of movement of the holder for the specimen, means acting to move the knife-carriage toward the holder for the specimen, a feed device for intermittently moving the knife-carriage, and a lever interposed between the knife-carriage and said feed device and adapted to be moved independently of the feed device to move said carriage away from the holder for the specimen, substantially as set forth.

20. The combination of a movable holder for the specimen, a knife, a knife-carriage, parallel swinging links on which said knife-carriage is mounted to move transversely of the plane of movement of the holder for the specimen, and feed mechanism for moving said knife-carriage, substantially as set forth.

21. The combination of a knife, a knife-carriage, a knife-holder provided with means for securing the knife thereon and slidably and pivotally mounted to move lengthwise of the knife and also in a plane at an angle to the plane of the knife, and a single device for securing said knife-holder in adjusted positions, substantially as set forth.

22. The combination of a knife, a knife-carriage, a knife-holder provided with means for securing the knife thereon and mounted slidably and pivotally on the knife-carriage for adjustment in the plane of the knife and also in a plane at an angle to the plane of the knife, and a screw device for clamping the knife-holder in adjusted positions, substantially as set forth.

23. The combination of a knife-carriage, a knife-holder, provided with means for securing the knife thereon and having a fulcrum-block loosely seated in bearings on the knife-carriage to move about said fulcrum-block as an axis and also to slide longitudinally of said fulcrum-block, a screw secured to the knife-carriage and passing through a slot in said knife-holder, an adjusting-screw for adjusting

the knife-holder pivotally, and a clamping-nut working on said first screw to clamp the knife-holder in adjusted positions, substantially as set forth.

24. The combination of a support, a specimen-holder mounted for universal adjustment on said support, and comprising a part to which the specimen is secured and which is adjustable in a plane independently of its adjustment in another plane, and a single device for securing said part in adjusted positions, substantially as set forth.

25. The combination of a support, a specimen-holder comprising a post adjustable bodily and about its axis on said support, a specimen-plate adjustable transversely, angularly and about its own axis on said post, and a single device for securing the post and specimen-plate in adjusted positions, substantially as set forth.

26. The combination of a support, a post adjustable bodily and also about its axis on said support, a specimen-plate adjustable transversely, angularly and also about its own axis on said post, and a set-screw at the end of said post for securing the latter and said specimen-plate in adjusted positions, substantially as set forth.

27. The combination of a support provided with a guide-groove, a post having a headed stud engaging slidably and rotatably in said groove, a swivel-block mounted to swing on said post, a specimen-plate provided with a stem passing through a hole in said swivel-block and movable longitudinally and rotatably in said swivel-block, and a single device for securing said post, swivel-block and specimen-plate in adjusted positions, substantially as set forth.

28. The combination of a support provided with an undercut groove, a post having a headed stud slidably engaging in said groove and adapted to turn therein, a split ring between said post and said support, a specimen-plate mounted on said post to swing thereon at an angle to said post and also movable transversely of said post and about its own axis, and a device for securing said post and specimen-plate in adjusted positions, substantially as set forth.

29. The combination of a support provided with an undercut groove, a post having a headed stud which slidably and rotatably engages in said groove, a sleeve movable on said post and provided with a socket in its end, a swivel-block arranged in a chamber in said post and bearing in the socket in said sleeve, said swivel-block having a transverse cylindrical hole and being split, a specimen-plate provided with a cylindrical shank which is movable longitudinally and adapted to turn in the hole in said swivel-block, and a clamping-screw for securing the several parts in adjusted positions, substantially as set forth.

Witness my hand this 11th day of February, 1904.

CARL F. DIECKMANN.

Witnesses:
C. M. BENTLEY,
C. B. HORNBECK.