

July 29, 1958

H. COHEN

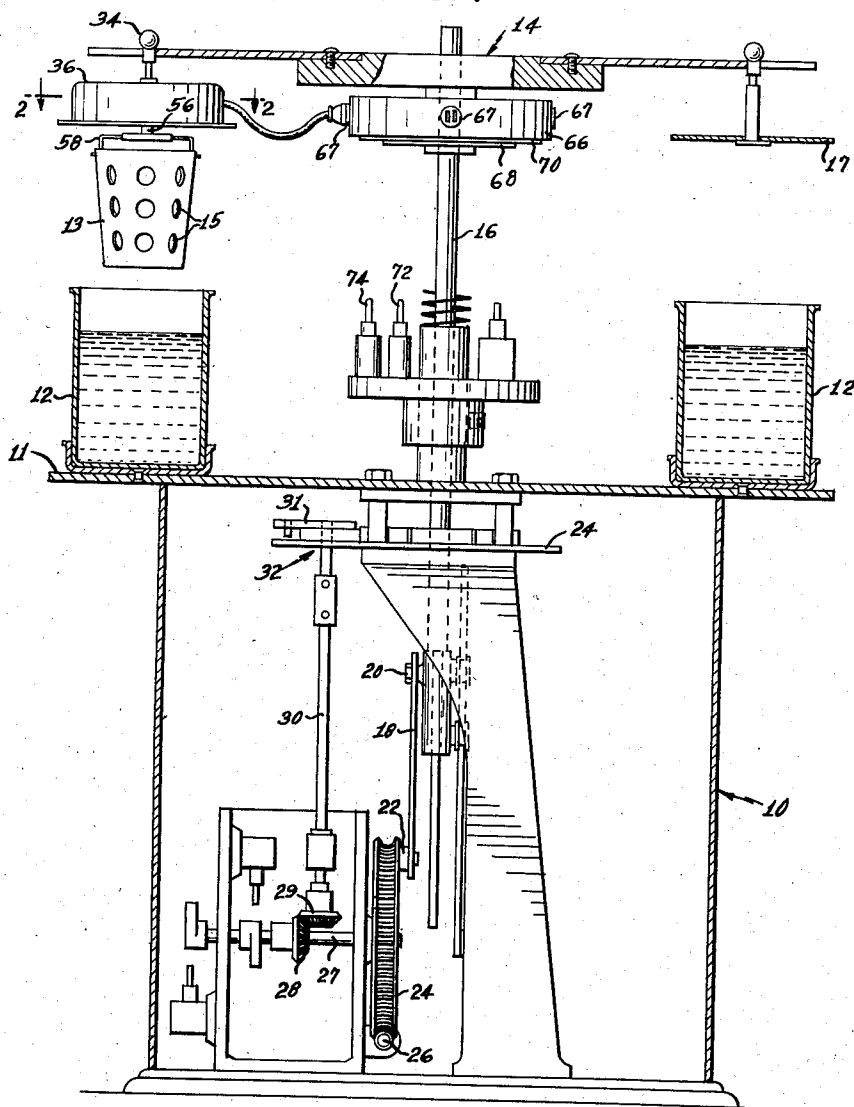
2,845,044

AUTOMATIC IMMERSION APPARATUS

Filed June 25, 1954

2 Sheets-Sheet 1

FIG. 1



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FIG. 3

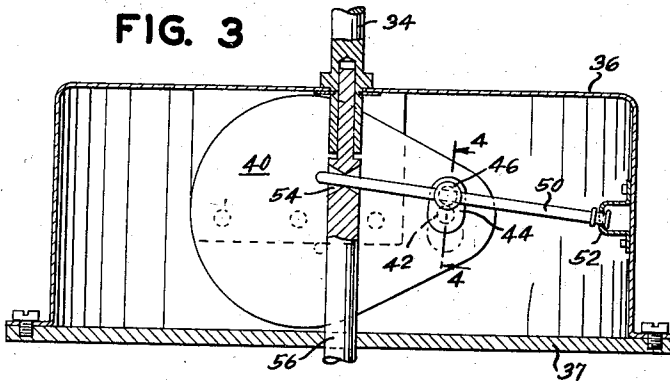


FIG. 4

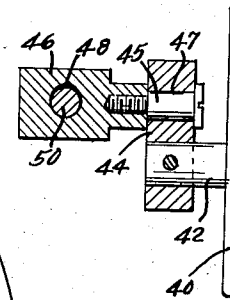


FIG. 2

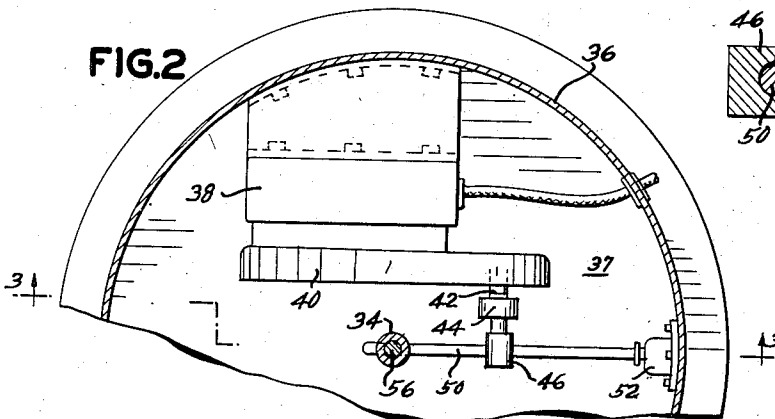


FIG. 5

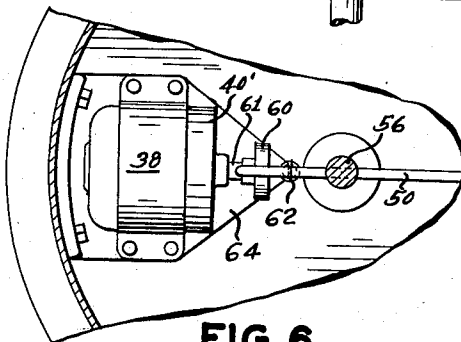
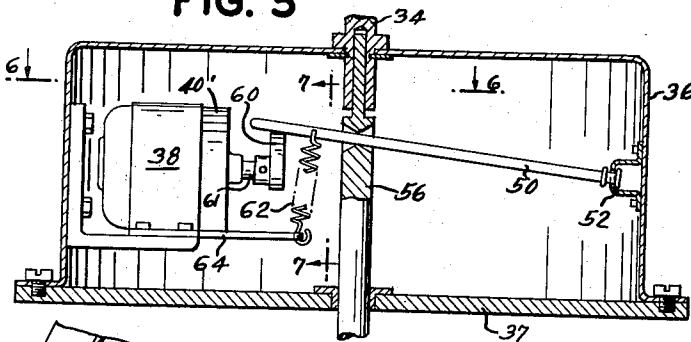
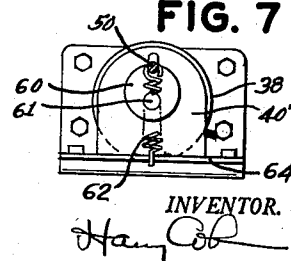


FIG. 6

FIG. 7



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2,845,044

AUTOMATIC IMMERSION APPARATUS

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12 Claims. (Cl. 118—425)

My invention relates to apparatus for preparing histologic tissue for microscopic examination.

The preparation of histologic tissue for microscopic examination involves immersion of the gross specimen of tissue in a series of liquid agents for certain periods of time. More particularly, the gross specimen is immersed in a fixative to fix the tissue, thereafter the tissue is dehydrated, subsequently the tissue is treated with a clearing agent, and thereafter the tissue is immersed in an infiltrating agent such as paraffin, celloidin, or any other suitable substance to embed the specimen in a block so that it can be cut into sections, for which purpose a microtome is employed. After the sections are cut, they are treated to remove the paraffin or other infiltrating material, after which they are stained, usually with hematoxylin and eosin stains, and are mounted on glass slides for examination under the microscope.

The primary object of my invention is to improve the action of the fixative and the other liquid agents on the tissue and to reduce the time required for treatment of the tissue in the processing thereof for microscopic examination.

Another object of my invention is to provide apparatus for carrying out the improved method of the present invention in a practical and convenient way.

Still another object of my invention is to provide means for reciprocating the tissue holding means in the various treating liquids in order to improve the action of the liquid on the tissue.

Other objects of my invention will become clear hereinafter as the characteristic features of construction and mode of operation are described in detail.

In the drawings:

Fig. 1 is a sectional view of automatic immersion apparatus embodying my invention;

Fig. 2 is a sectional view taken along the line 2—2 of Figure 1;

Fig. 3 is a sectional view taken along the line 3—3 of Figure 2;

Fig. 4 is a sectional view taken on the line 4—4 of Figure 3;

Fig. 5 is a sectional view taken along the line substantially the same as line 2—2 in Figure 1 but showing another embodiment of my invention;

Fig. 6 is a sectional view taken along the line 6—6 of Figure 5; and

Fig. 7 is a sectional view taken on the line 7—7 of Figure 5.

The present invention is preferably utilized in conjunction with automatic tissue processing apparatus of the type shown and described in U. S. Patent No. 2,341,198, which is owned by the assignee of the present application. Such apparatus includes a housing 10, having a top horizontal surface 11 on which are mounted a plurality of receptacles or beakers 12. The beakers 12 contain the various liquids for treating histologic tissue in order to prepare the tissue for microscopic examination. The tissue is carried in a tissue holder 13 which

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is operatively connected by means which will be described in detail subsequently to a carrier or spider generally designated by the reference character 14. The carrier 14 is fixedly secured to a vertical shaft 16 which imparts lateral and vertical movement to the carrier 14 and the holder 13 for raising the holder out of one receptacle and then moving it laterally into alignment with another receptacle and then lowering the basket therein for immersing the tissue in the liquid in the receptacle for a predetermined time. Holder 13 is provided with a number of apertures 15 to make the tissue in holder 13 accessible to the liquid in receptacle 12. A number of covers 17 may also be connected to carrier 14 to fit over the tops of beakers 12 when holder 13 is in its lower position in order to prevent foreign matter from entering the beakers and to reduce evaporation of the liquids therein.

The mechanism for imparting the vertical motion to the shaft 16 includes a connecting rod 18 which is pivotally mounted at one end on a pin 20 secured to shaft 16 and which rod is pivotally mounted at its other end on a pin 22 which in turn is secured to a gear 24. Gear 24 is engaged by a gear 26 which is driven by a motor (not shown). When gear 24 is rotated by gear 26 and the motor, rod 18 will move up and down to thus impart vertical movement to shaft 16. Concentrically connected to gear 24 is a shaft 27 and mounted on shaft 27 is a bevel gear 28. Bevel gear 28 engages a companion bevel gear 29 which is mounted on a shaft 30 operatively connected to the driving member 31 of a Geneva gear movement generally shown as 32. Driving member 31 imparts rotary movement to a driven member 33 of the Geneva gear movement when shaft 16 is in its raised position thereby imparting a small rotary movement to shaft 16 to move tissue holder 12 laterally from a position over one receptacle to a position over the adjacent receptacle. Upon completion of the lateral movement, shaft 16 is lowered by rod and crank arrangement in order to immerse basket 13 and the tissue therein in the adjacent receptacle. A timing mechanism (not shown) is employed to initiate at predetermined time intervals the series of movements heretofore described. The apparatus for imparting the vertical and lateral movements has been described generally and if a more detailed description is desired, reference may be had to the aforementioned U. S. patent.

Pursuant to the present invention, provision is made for moving the tissue holder 13 vertically a short distance, for example but without limitation about $\frac{3}{4}$ inch, up and down, within each beaker 12, whereby the tissue specimens disposed in said holder are vertically reciprocated in the liquids so that the action of the liquids is hastened and improved penetration of the liquids in the tissue specimens is obtained. The means provided for the purpose will now be disclosed.

Secured to carrier 14 at distance from shaft 16 equal to the distance beakers 12 are mounted from said shaft is a depending stud 34. Secured to stud 34 is a housing 36 having a bottom plate 37. The details of the apparatus contained in housing 36 are shown in Figures 2—7. Fixedly mounted in housing 36 is a motor 38. Motor 38, as shown in Figures 2 and 3, is connected to a reduction gearing generally designated by the reference character 40. Operatively connected to the reduction gearing and slowly rotated thereby is a shaft 42 which has fixed thereon a crank 44. A stud 46 is rotatably mounted on crank 44 by means of a shoulder screw 45 disposed within a bearing opening 47 of the crank 44. An aperture 48 is provided in stud 46 and a connecting rod 50 slidably projects through said opening. Connecting rod 50 is pivotally mounted at one end in wall bracket 52 and is slideably and pivotally mounted at its other end in

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a double funnel shaped aperture 54 in a reciprocating shaft 56. Shaft 56 is slidably mounted for vertical movement in stud 34 and extends through the bottom of housing 36 and is operatively connected at the portion extending without housing 36 to a bracket 58. Removably secured to bracket 58 is tissue holder 13. With the parts arranged and described above it will be seen that when motor 38 is energized, a vertical reciprocating motion will be imparted to the shaft 56 so that tissue holder 13 will move up and down in a vertical direction. It has been found that with such a motion imparted to tissue holder 13, the penetration of the liquid in receptacle 12 into the tissue disposed in holder 13 is accelerated thereby reducing the time necessary for the immersion of the tissue in any of the liquids held in the automatic tissue processing machine. The preferred speed of reciprocatory movement of the holder 13 is about ten cycles per minute, i. e., ten up and down movements per minute, but it will be understood that the invention is not limited to this speed.

Figures 5, 6 and 7 illustrate another embodiment of my invention. In this embodiment, the stud and crank arrangement 42-44 of the first embodiment are replaced by a cam 60. As here shown cam 60 is circular and is eccentrically mounted on the shaft 61 of the output gear of the reduction gearing 40' which is driven by motor 38. Connecting rod 50 which is mounted in housing 36 in the same manner as heretofore described is held in engagement with cam 60 by any suitable means such as, for instance, a spring 62 connected at one end to connecting rod 50 and at the other end to a bracket 64. When motor 38, through reduction gearing 40' and shaft 61, causes cam 60 to rotate oscillatory motion will be imparted to connecting rod 50 which in turn will impart vertical reciprocating motion to shaft 56 in the same manner as described with regard to the first embodiment. Shaft 56 will, of course, transfer its reciprocating motion to tissue holder or basket 13 immersed in the liquid in a receptacle 12.

When my novel means for vertically reciprocating a tissue holder is employed in an automatic tissue processing machine such as that described earlier in this detailed specification, it has been found desirable and economical to impart this vertical reciprocating motion to the tissue holder only when the tissue holder is immersed in the liquid in one of the receptacles 12. In order to accomplish this, I mount a hub 66 on shaft 16 preferably just below the carrier 14. Hub 66 is provided with a plurality of female outlet receptacles and is also provided on its under surface with two rings of conducting material, 68 and 70 which are insulated from each other. Fixedly mounted below hub 66 are a pair of contact pins 72 and 74 which are adapted to engage ring 68 and 70, respectively, when shaft 16 is in its depressed position. Pins 72 and 74 are electrically connected to the source of energy for motor 38. It will be seen therefore that when shaft 16 has been moved downwardly in order to immerse tissue holder 13 in the liquid in receptacles 12, electrical contact will be made between pins 72 and 74 and rings 68 and 70, respectively, to close a circuit for energizing motor 38. With motor 38 energized tissue holder 13 will reciprocate in a vertical direction as already described and thereby increase the penetration of the liquid into the tissue held within the tissue holder. It will be noted that when shaft 16 is in its lower position in order to immerse basket 13 in the liquid in receptacle 12, bottom plate 37 of housing 36 will rest on the top of the receptacle so as to provide a cover therefor. It will be observed that when the plate 37 rests on the receptacle 12, it supports the motor 38 and the associated shaft reciprocating mechanism so that the holder may be reciprocated while the carrier 14 is stationary.

Although I have described two forms of my invention, it will be understood that various changes and modifica-

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tions may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim and

5 desire to secure by Letters Patent, is:

1. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue for predetermined periods of time in liquids contained within a plurality of receptacles, respectively, arranged laterally of each other, comprising conveyor means 10 mounted for vertical movement for lowering a tissue holder into and raising it out of one of said receptacles and for lowering the tissue holder into another of said receptacles, for immersion of the tissue in said receptacles, respectively, means carried by said conveyor and operatively connected to said tissue holder for moving the latter vertically up and down in each of said receptacles for imparting vertical reciprocatory motion to the tissue within the liquid in each of said receptacles, said last 15 means comprising a pivoted member and means for connecting said pivoted member to said holder; and power actuated means operatively connected to said pivoted member for oscillating the latter in a vertical plane and thereby actuating said means for moving the tissue holder up and down in each of the receptacles. 25

2. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue for predetermined periods of time in liquids contained within a plurality of receptacles, respectively, arranged laterally of each other, comprising conveyor means 30 mounted for vertical movement for lowering a tissue holder into and raising it out of one of said receptacles and for lowering the tissue holder into another of said receptacles, for immersion of the tissue in said receptacles, respectively, means carried by said conveyor and operatively connected to said tissue holder for moving the latter vertically up and down in each of said receptacles for imparting vertical reciprocatory motion to the tissue within the liquid in each of said receptacles, said last 35 means comprising a pivoted member and means for connecting said pivoted member to said holder; and power actuated means operatively connected to said pivoted member for oscillating the latter in a vertical plane and thereby actuating said means for moving the tissue holder up and down in each of the receptacles, said power 40 actuated means comprising eccentric means operable on said pivoted lever for imparting said oscillatory movements thereto.

3. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue for predetermined periods of time in liquids contained within a plurality of receptacles, respectively, arranged laterally of each other, comprising conveyor means 50 mounted for vertical movement for lowering a tissue holder into and raising it out of one of said receptacles and for lowering the tissue holder into another of said receptacles, for immersion of the tissue in said receptacles, respectively, means carried by said conveyor and operatively connected to said tissue holder for moving the latter vertically up and down in each of said receptacles for imparting vertical reciprocatory motion to the tissue within the liquid in each of said receptacles, said last 55 means comprising a pivoted member and means for connecting said pivoted member to said holder, said last mentioned means comprising a member mounted for vertical reciprocation and said pivoted member engaging said last mentioned member in pivotal relation thereto; and power actuated means operatively connected to said pivoted member for oscillating the latter in a vertical 60 plane and thereby actuating said means for moving the tissue holder up and down in each of the receptacles.

4. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue for predetermined periods of time in liquids contained within a plurality of receptacles, respectively, arranged 75

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laterally of each other, comprising conveyor means mounted for vertical movement for lowering a tissue holder into and raising it out of one of said receptacles and for lowering the tissue holder into another of said receptacles, for immersion of the tissue in said receptacles, respectively, means carried by said conveyor and operatively connected to said tissue holder for moving the latter vertically up and down in each of said receptacles for imparting vertical reciprocatory motion to the tissue within the liquid in each of said receptacles, said last means comprising a pivoted member and means for connecting said pivoted member to said holder, said last mentioned means comprising a member mounted for vertical reciprocation and said pivoted member engaging said last mentioned member in pivotal relation thereto; and power actuated means operatively connected to said pivoted member for oscillating the latter in a vertical plane and thereby actuating said means for moving the tissue holder up and down in each of the receptacles, said power actuated means comprising eccentric means operable on said pivoted lever for imparting said oscillatory movements thereto.

5. In apparatus for treating histologic tissue for preparing it for microscopic examination by immersing the tissue in a number of liquids, a plurality of receptacles for containing the liquids, a carrier movable laterally of said receptacles and toward and away from said receptacles, in a vertical line, motor means mounted on said carrier for movement therewith to positions over and in line with said receptacles, a vertical shaft operatively connected to said motor means for vertical reciprocating motion thereby, a holder secured to said shaft for movement therewith, whereby when said shaft is being reciprocated by said motor means said holder will reciprocate therewith and when said carrier is moved upward, laterally and downward said holder will be moved out of one receptacle into another.

6. In apparatus for treating histologic tissue for preparing it for microscopic examination by immersing the tissue in a number of liquids, a plurality of receptacles for containing the liquids, a carrier movable laterally of said receptacles and toward and away from said receptacles in a vertical line, a housing mounted on said holder for movement therewith to positions over and in line with said receptacles, a motor mounted within said housing, eccentric means operatively connected to said motor for rotation therewith, a connecting rod pivotally mounted on said housing and operatively engaging said eccentric means, a vertical shaft slideably mounted in said housing and depending therefrom and engaging said connecting rod whereby when said motor is energized said shaft will reciprocate in a vertical direction, a holder secured to said shaft below said housing for reciprocating movement with said shaft and for movement with said carrier out of one receptacle into another, and means for energizing said motor when said holder is in one of said receptacles.

7. In automatic immersion apparatus for preparing histologic tissue for microscopic examination and having a housing, a vertical main shaft mounted in said housing for vertical and rotatable movement, drive means for raising said main shaft, rotating said main shaft a predetermined angular distance and then lowering said main shaft, at least two receptacles each mounted on said housing at a given radial distance from said main shaft and being laterally disposed from each other at said predetermined angular distance, and a horizontal arm secured to said main shaft for movement therewith, the combination comprising a motor means secured to said arm at said given radial distance from said shaft, a holder, means operatively connecting said motor to said holder for imparting vertical reciprocating motion thereto when said motor means is energized, said last mentioned means also being effective for causing said holder to move in unison with said main shaft and arm to thereby move

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said holder out of one of said receptacles into another, and means effective when said holder is in one of said receptacles for energizing said motor means.

8. Apparatus for preparing histologic tissue for microscopic examination comprising a receptacle, a carrier, a housing mounted on said carrier above and in line with said receptacle, a motor within said housing, eccentric means operatively connected to said motor, a connecting rod pivotally mounted on said housing and operatively engaging said eccentric means, a vertical shaft slideably mounted in said housing and extending without said housing at the bottom thereof, said shaft being operatively connected to said connecting rod so that when said connecting rod is being driven by said eccentric means it will impart vertical reciprocating motion to said shaft, and a holder insertable in said receptacle secured to the portion of said shaft extending without said housing and depending therefrom.

9. Automatic immersion apparatus for preparing histologic tissue for microscopic examination comprising a housing, a shaft mounted in said housing for vertical and rotatable movement, a portion of said shaft extending above said housing a main motor within said housing, drive means within said housing connected to said motor for raising said shaft, rotating said shaft a predetermined angular distance and then lowering said shaft, a plurality of receptacles mounted on said housing at a given radial distance from said main shaft and each receptacle being separated from its adjacent receptacle by said predetermined angular distance, a horizontal cross arm secured to said main shaft adjacent the top thereof for movement therewith, an auxiliary housing secured to said cross arm at said given radial distance from said shaft and above the top of said receptacles, an auxiliary motor mounted within said auxiliary housing, eccentric means operatively connected to said motor for rotation therewith when said motor is energized, a connecting rod pivotally mounted within said auxiliary housing and operatively engaging said eccentric means, an auxiliary vertical shaft slideably mounted in said auxiliary housing and having a portion extending below said auxiliary housing, said auxiliary shaft being operatively connected to said connecting rod so that when said eccentric means is rotating said connecting rod will impart vertical reciprocating motion to said auxiliary shaft, a holder secured to the portion of said auxiliary shaft extending below said auxiliary housing and depending therefrom, said basket being movable in unison with said main shaft out of one of said receptacles into the adjacent receptacle, contact means associated with said main housing and shaft and closed only when said shaft is in its lower position, and circuit means including said contact means for energizing said auxiliary motor.

10. In apparatus having a receptacle containing a liquid for penetrating histologic tissue for preparing said tissue for microscopic examination, a carrier, a motor operatively supported by said carrier, eccentric means operatively connected to said motor, a vertical shaft, means operatively connecting said vertical shaft and said eccentric means for imparting vertical reciprocating motion to said vertical shaft, a tissue holder adapted to be inserted in the receptacle for immersion in the liquid contained therein, and means operatively securing said tissue holder to said shaft for moving said holder in unison with said shaft.

11. In apparatus for treating histologic tissue for preparing it for microscopic examination by immersing the tissue in a number of liquids, a plurality of receptacles for containing the liquids, a carrier movable laterally of said receptacles and toward and away from said receptacles, in a vertical line, motor means mounted on said carrier for movement therewith to positions over and in line with said receptacles, a vertical shaft operatively connected to said motor means for movement thereby in opposite directions in a vertical plane, and a holder adapted

to be secured to said shaft for movement therewith, whereby when said shaft is moved in opposite directions said holder moves therewith in opposite directions in a vertical plane and when the carrier is moved upward, laterally and downward said holder will be moved out of one receptacle and into another.

12. In apparatus for treating histologic tissue for preparing it for microscopic examination by immersing the tissue in a number of liquids, a plurality of receptacles for containing the liquids, a carrier movable laterally of said receptacles and toward and away from said receptacles, in a vertical line, motor means mounted on said carrier for movement therewith to positions over and in line with said receptacles, a vertical shaft operatively connected to said motor means for movement thereby in opposite directions in a vertical plane, and a holder adapted to be secured to said shaft for movement therewith, whereby when said shaft is moved in opposite di-

rections said holder moves therewith in opposite directions in a vertical plane and when the carrier is moved upward, laterally and downward said holder will be moved out of one receptacle and into another, the operative connection between said motor and said shaft for moving said shaft in said opposite directions comprising an eccentric driven by said motor and a pivoted member oscillated by said eccentric.

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