

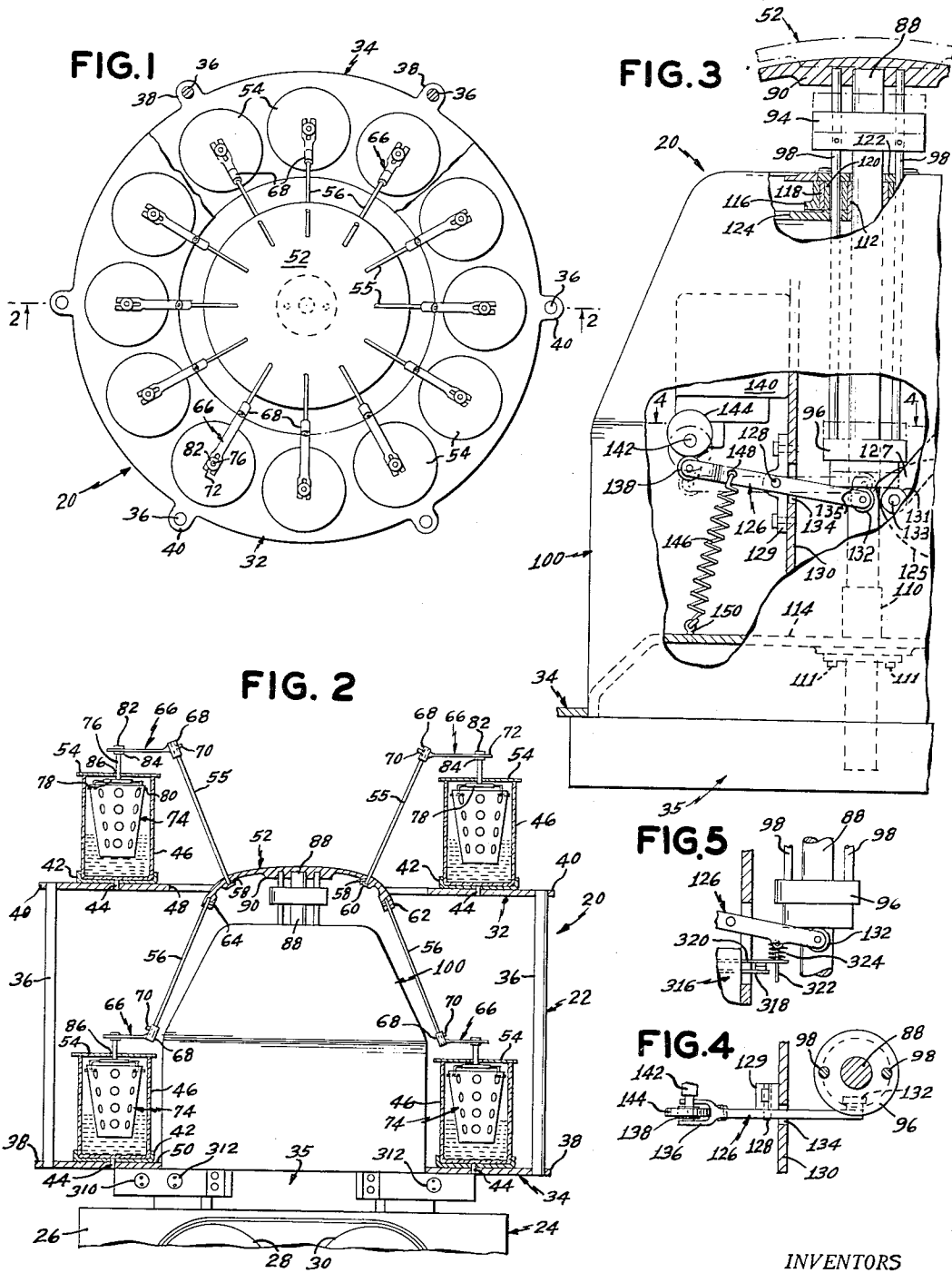
April 10, 1956

E. C. WEISKOPF ET AL
AUTOMATIC IMMERSION APPARATUS

2,741,221

Filed June 1, 1953

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

FIG. 6

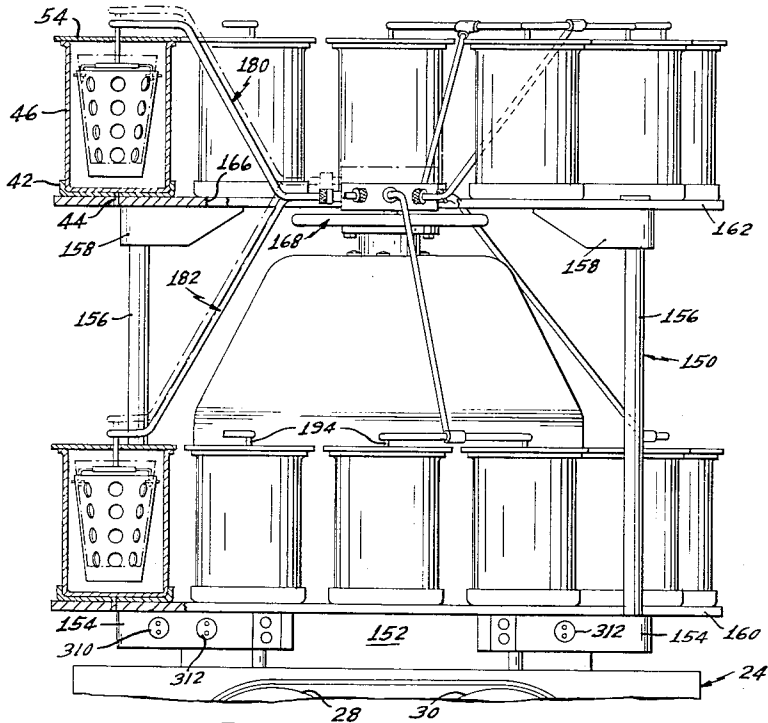


FIG. 7

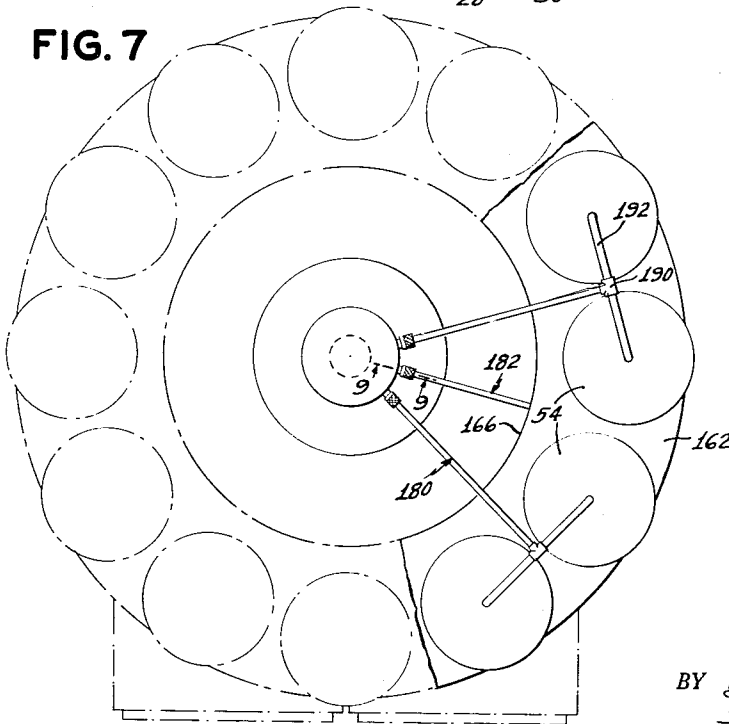
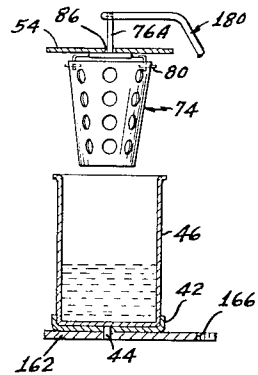


FIG. 14



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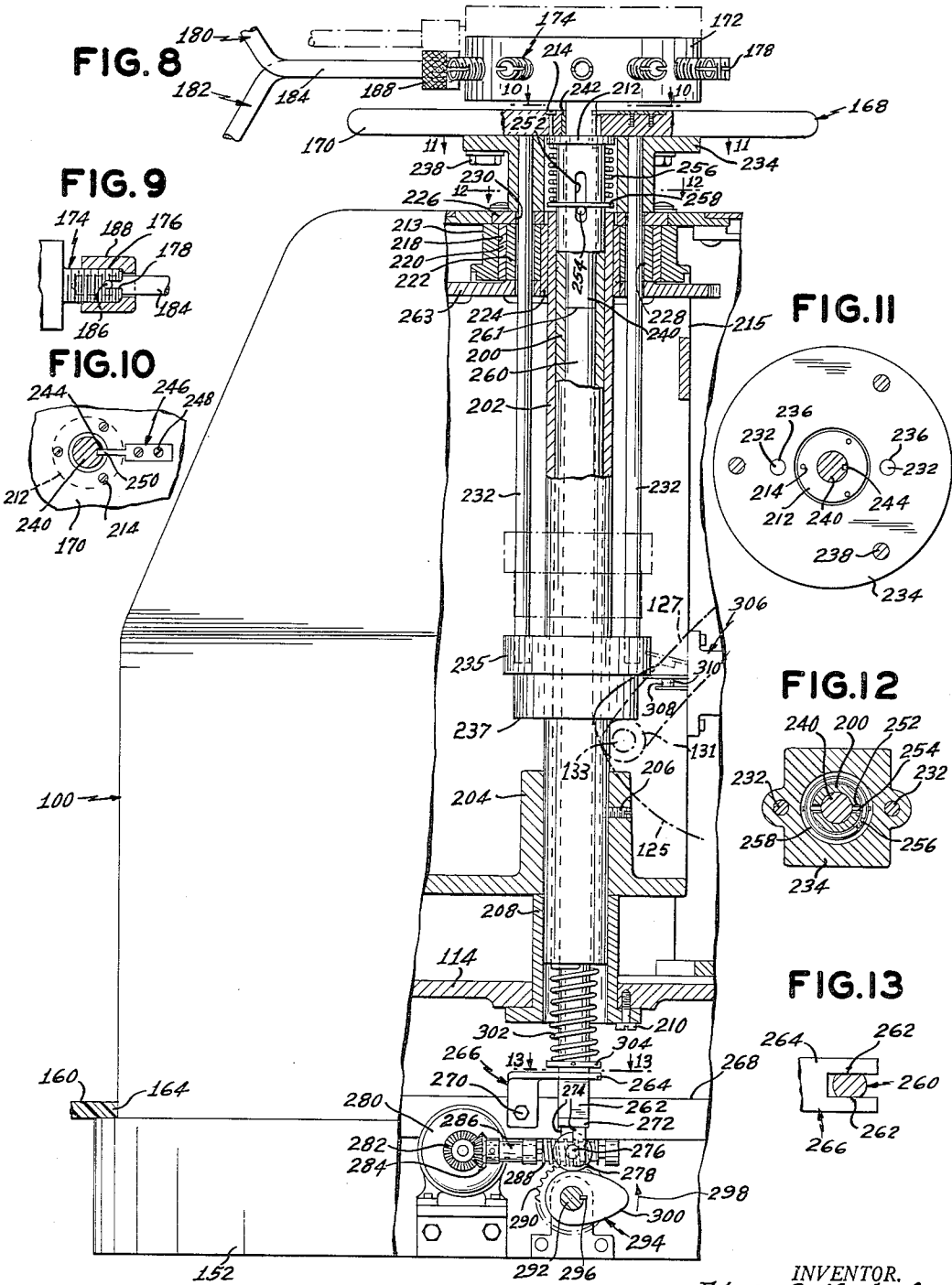
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3 Sheets-Sheet 3



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2,741,221

AUTOMATIC IMMERSION APPARATUS

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The present invention relates to automatic immersion apparatus. An object of the present invention is the provision of tissue processing apparatus having means for reciprocating the tissue in the treating liquid whereby to improve the penetration of the liquid into the tissue and to decrease the time of treatment of the tissue.

Another object is to provide an automatic immersion apparatus or tissue processing machine of the type shown in U. S. Letters Patent No. 2,341,197 and 2,341,198 granted to Edwin C. Weiskopf, a joint inventor hereof, and in U. S. Letters Patent No. 2,583,379 granted to Nelson G. Kling, which apparatus will proved for improved penetration of the liquid into the tissue and a decreased time of tissue treatment without the necessity for rotating the tissue in the treating liquid. In respect to one of the aspects of the present inventions, another object is to provide such a tissue processing machine with means for reciprocating the tissue while the latter is immersed in the liquids in the various receptacles.

A further object of the invention is generally to provide an automatic immersion apparatus or machine of generally simplified and improved construction and operation, while retaining the basic advantageous features of the machines shown by the patents referred to above.

The above and other objects, features and advantages of the present invention will be more fully understood from the following description considered in connection with the accompanying illustrative drawings.

In the drawings:

Fig. 1 is a top plan view of an apparatus pursuant to the present invention which illustrates the best mode presently contemplated by us of carrying out our invention, portions thereof being broken away for purposes of illustration;

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1, and illustrates the material holders in an uppermost position thereof in the fluid receptacles;

Fig. 3 is a fragmentary view similar to Fig. 2, on an enlarged scale, with parts omitted, broken away, and sectioned for purposes of illustration;

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

Fig. 5 is a fragmentary detail of a modification;

Fig. 6 is a front elevation view of apparatus pursuant to another embodiment of the present invention, parts thereof being illustrated in section;

Fig. 7 is a top plan view of the apparatus shown in Fig. 6 with parts broken away for purposes of illustration;

Fig. 8 is a fragmentary elevation view, on a larger scale, of a portion of the apparatus shown in Fig. 6, parts being omitted, broken away, and shown in section, for purposes of illustration;

Fig. 9 is a sectional view, on an enlarged scale, taken on the line 9—9 of Fig. 7;

Fig. 10 is a fragmentary view as seen on the line 10—10 of Fig. 8;

Figs. 11, 12, and 13 are sectional views taken on the

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lines 11—11, 12—12 and 13—13 respectively of Fig. 8; and

Fig. 14 is a view illustrating a material holder in position outwardly of a fluid receptacle into which the material holder is about to be immersed or from which it has just been withdrawn.

The immersion apparatus or tissue treatment machine of the present invention is of the general type illustrated and described in the previously identified Weiskopf and Kling patents. Referring now to Figs. 1—4 of the drawings in detail, the automatic immersion apparatus or tissue treating machine 20 which embodies the present invention comprises a frame 22 mounted on a support 24 which is preferably in the form of a cabinet 26, a portion only of which is illustrated, in which are mounted electrically operating timing devices, portions of which are illustrated at 28 and 30, said cabinet and timing devices being fully illustrated and described in the previously identified Kling patent. The frame 22 comprises the upper and lower receptacle supports 32 and 34, respectively, a base member 35 on which the lower support 34 is disposed, and a plurality of circumferentially spaced vertical rods 36 secured at their lower ends in the circumferentially spaced ears or lugs 38 provided on the lower support 34, and secured at their upper ends in the circumferentially spaced ears or lugs 40 provided on the upper support 32. A plurality of receptacle holders 42, each in the form of a shallow pan, is carried by supports 32 and 34, being secured thereto in any suitable way, as by screws 44. The receptacle holders 42 are arranged in uniform circumferentially spaced relation for similarly positioning the removable receptacles or beakers 46, as will be readily understood. It will be noted from Figs. 2 and 3 that the supports 32 and 34 surround various mechanisms and are therefore provided with central circular openings 48 and 50 respectively.

A conveyor or holder is mounted for vertical and rotary movements for moving the tissue, microscope slides, or other material into and out of the various receptacles 46 at predetermined intervals and for simultaneously moving the receptacle covers 54. Said conveyor comprises an inverted dished member or spider 52 which is provided with a series of circumferentially spaced upwardly extending arms, here shown as rods 55 and a plurality of circumferentially spaced downwardly extending rods 56, rods 55 being inclined upwardly and outwardly and rods 56 being inclined downwardly and outwardly. All of said rods are rigidly but preferably removably secured to the dished member 52. For this purpose, the rods 55 are preferably threadedly engaged in the upper surface of the dished member 52, being retained therein in any suitable way, as by the set screws 58, it being noted that the member 52 is provided at its inner surface with the bosses 60 for receiving said set screws. In order to receive the rods 56, the circumferential edge of the member 52 is thickened, as at 62, and the rods 56 are circumferentially secured in said thickened edge portion 62, being preferably threadedly engaged therein and secured therein as by the set screws 64. At the outer end thereof, each of the rods is provided with a bracket or arm 66, one end of which is provided with a tubular internally threaded portion 68 in which the free end of the rod is threadedly engaged and secured therein, as by a set screw 70. At the other end thereof, each bracket 66 is provided with an open slotted portion 72 for supporting an apertured material holder 74. Said material holder is substantially the same as the material holder illustrated and described in the Kling patent, as well as in U. S. Letters Patent No. 2,539,802 to Edwin C. Weiskopf, a joint inventor hereof. The holder 74 is carried by a spindle 76, the lower

end of which is provided with the channel shaped member 73, which has provision for removably mounting the holder 74, as fully illustrated and described in said latter patents, and as indicated herein at 80. At the other end thereof, the spindle is provided with an enlarged head 82 and with a flange 84 spaced below the head, the slotted end 72 of the bracket 66 engaging the spindle 76 between said head and flange. The cover 54 is provided with a central aperture 86 having a diameter substantially larger than the diameter of the spindle 76. Therefore, it will be readily apparent that when the perforated holder 74 is to be immersed into the fluid in a receptacle 46 from a position outwardly therefrom, as in Fig. 14, the downward movement of the holder into the receptacle will effect the engagement of the cover 54 on the companion receptacle and the holder will be free to continue moving further into the receptacle. Similarly, it will be readily apparent that outward movement of the holder from the receptacle will result in the removal of the cover from the receptacle, as illustrated in Fig. 14.

In order to operate the conveyor 52, the latter is mounted on a vertically extending shaft 88, the upper end of which extends through a housing 100 and is suitably secured in the central thickened portion 90 of the dish conveyor 52. The lower end of the shaft extends into the base member 35, which mounts said housing, and through a bearing member 110 secured to a frame member 114 within the housing, as at 111. The shaft 88 is provided with the vertically spaced collars 94 and 96, respectively, which are suitably secured thereto. The shafts or rods 98 are suitably secured in the lower collar 96 and extend through the upper collar 94, the upper ends of said rods being secured in the thickened portion 90 of the cupped conveyor member 52. Consequently, it will be readily apparent that the shaft 88, the collars 94 and 96, the rods 98 and the spider 52 are mounted for unitary movement.

The previously described unit is vertically and rotatably movable. More particularly, it will be understood that during one operating cycle of the machine, the conveyor 52 is moved vertically upwardly, for withdrawing the tissue or other material holder 74 from the receptacle in which it had previously been positioned, after which said conveyor is turned so as to align said holder axially with the succeeding receptacle, following which the conveyor carrier 52 is lowered so as to position said holder in said next receptacle where it remains for a predetermined length of time, after which the next operating cycle of the machine takes place. Mechanism for thus moving the unit which, as before stated, includes the conveyor member 52, the shaft 88 and the rods 98, comprises an intermittent mechanical movement, which is preferably of the type fully illustrated and described in the Kling patent. Since the mechanism for effecting said movement of the conveyor 52 does not, per se, constitute part of the present invention, said mechanism is not fully illustrated or described herein, in view of the complete illustration and description thereof in the Kling patent, and portions only thereof are illustrated and described herein.

The shaft 88 is mounted for vertical and rotary movement in the previously mentioned lower guide bearing 110 and in an upper guide bearing 112. As in the Kling patent, provision is also made for the horizontally disposed mounting 116 which is internally cylindrical and which is secured to suitable frame plates. Said member 116 has a circular opening through which and in which the shaft 88 and members associated therewith are movable. A cylindrical bearing 118 is fixed to mounting member 116 in said opening. A cylindrical member 120 is journaled for rotation in bearing 118 and is provided with the above mentioned bearing sleeve 112 in which the shaft 88 is journaled for rotation and for longitudinal movement. A plate 122 is fastened to cylindrical

member 120 at the top thereof, to rotate with said cylindrical member and is supported by the mounting member 116 thus, in turn, supporting the cylindrical member 120. Registering openings are provided in the cylindrical member 120 and in the plate 122 for the passage therethrough of the rods 98. The Geneva gear member 124 is fastened to the cylindrical member 120, said Geneva gear member being provided with openings for the passage therethrough of the rods 98. As fully illustrated and described in said Kling patent, a suitable motor operates through a main drive shaft to drive the Geneva gear member. As fully explained in said Kling patent, the motor is operated intermittently under the control of the previously identified timing devices 28 and 30. During one revolution of said main drive shaft, the conveyor member 52 hereof is turned through an angular distance required to move the holder 74 from a position over one receptacle 46 to a position over the adjacent receptacle. However, before this angular movement of carrier 52 can take place, it is necessary to move the unit, which includes the carrier member 52, upwardly to withdraw the holder 74 from the receptacle 46 in which it is positioned. The mechanism for moving said unit upwardly to withdraw the holder 74 from the receptacle, so that it can be moved to the next receptacle, and for moving the unit downwardly so as to position the holder within said last mentioned receptacle includes a rotary cam 125 which rotates with the main drive shaft and a pivoted cam follower arm 127 which is operated by the cam. A roller 131 is revolvably mounted on a pin 133 fixed to the outer end of said arm, said roller engaging the lower edge 135 of collar 96 to effect the vertical reciprocation of the shaft 88, as explained in said patent to Kling.

When the holder has been moved into a receptacle, it is moved within the liquid therein for improving the action of the liquid on the material. Pursuant to the present invention, the holder is reciprocated in a vertical direction in the liquid. More particularly, in the present invention, this is accomplished by moving the conveyor member 52 back and forth, upwardly from the full line position thereof illustrated in Fig. 3, to the broken line position thereof, and then back again to the full line position. It will be understood that when said conveyor is in said broken line position, the holders 74 are disposed within the companion receptacles 46 as illustrated in Fig. 2, it being noted that the covers 54 are not engaged during this upward movement of the holders within the receptacles so that it will be readily apparent that said upward movement is not sufficient to remove the holders completely from the fluid within the containers or to withdraw the holders from the receptacles, as in the case of the movement of the holders in succession from one receptacle to another, the withdrawn position of the holders in the latter case being as illustrated in Fig. 14.

In order to accomplish said vertical reciprocation of the holders within the receptacles, provision is made for a lever 126 which is pivoted intermediate the ends thereof on a pivot 128 carried by a bracket 129 provided on the frame member 130 within the housing 100. It will be understood that said frame member 130 is suitably supported by the base frame member 114. At one end thereof, the lever 126 is provided with a roller 132 which engages under the circular collar 96, as best illustrated in Fig. 5. It will be noted that the frame member 130 is provided with an opening 134 through which the lever 126 extends. At the other end thereof, the lever 126 is forked, as at 136, and said forked portion mounts a roller 138. In order to effect pivotal movement of the lever 126 about the pivot 128 thereof, provision is made for an additional electric motor 140, having a shaft 142 which mounts the disc or cam 144 for rotation. It will be noted from Fig. 3 that the disc 144 is eccentrically mounted on the shaft 142. A spring 146 has one end thereof secured to the lever 126 between the pivot 128

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and the fork 136 thereof, as at 148, and the other end of the spring is anchored to the frame base 114 as at 150. It will be understood that the spring biases the lever 126 for biasing the roller 132 against the collar 96.

The electric motor 140 operates continuously during the operation of the mechanism 20. The eccentric 144 operates upon the roller 138 to move the latter from the full line position thereof, illustrated in Fig. 3, to the broken line position thereof, whereby to raise the roller 132, from the full line position thereof to the broken line position thereof, for raising the conveyor member 52 from its full line to its broken line position in Fig. 3. Upon continued rotation of the eccentric 144 to eliminate the camming of the roller 138 thereby, the spring 146 continues to bias the roller 132 against the collar 96. However, upon said elimination of the camming of the roller 138, the weight of the conveyor 52 and its associated parts, and the weight of the shaft 88 and its associated parts, is sufficient to move the conveyor downwardly against the bias of the spring 146 to return the shaft to the full line position thereof and consequently to move the roller 138 up to its full line position for engagement by the eccentric 144 during the next cycle of rotation thereof. It will be readily apparent that the extent of travel of the holder 74 during said vertical oscillations or reciprocations thereof is dependent upon the size of the eccentric 144 and that the number of said oscillations per unit of time is dependent upon the speed of operation of the motor 140. We have found that satisfactory results have been achieved by oscillating the holder 74, 15½ times per minute through vertical movements of one-half inch in length.

Referring now to Figs. 6-14 in detail, there is illustrated another embodiment of our present invention. The present embodiment, as in the Kling construction, provides for each rod carried by the conveyor member having provision for operating a pair of holders. Referring now specifically to Fig. 6, provision is made for the frame 150 which is mounted on the support 24, which, as previously indicated, is in the form of a cabinet in which the electrically operated timing devices 28 and 30 are mounted. The frame 150 includes a base 152, a plurality of circumferentially spaced hollow bracket arms 154, a plurality of vertical rods 156 secured at their lower ends in the outer ends of arms 154, respectively, and a plurality of bracket arms 158 secured to the upper ends of the vertical rods 156. Lower and upper receptacle supports 160 and 162 respectively, are mounted on the bracket arms 154 and 158 to provide a construction which is substantially similar to that shown in the Kling patent. A plurality of receptacle holders 42, as previously described in connection with the prior embodiment, are carried by the supports 160 and 162, being secured thereto preferably by the screws 44. The receptacle holders 46 are arranged in uniform circumferentially spaced relation for similarly positioning the removable receptacles or beakers 46. It will be noted from Figs. 6 and 8 that the supports 160 and 162 surround various mechanisms and are therefore provided with central circular openings 164 and 166 respectively.

The conveyor 168 is mounted for vertical and rotary movements for moving the tissue, microscope slides, or other material into and out of the various receptacles 46 at predetermined intervals and for simultaneously moving the receptacle covers 54. Instead of the unitary conveyor member, as at 52 in the prior embodiment, the conveyor 168 comprises the conveyor plate 170 and the spider 172. As hereinafter described in detail, the conveyor members 170 and 172 operate as a unit for removing the holders from the receptacles and for rotating the holders to position the latter over the next receptacles into which they are to be inserted and then to move the holders downwardly into said latter receptacles. However, in order to effect the vertical reciprocation of the holders within the receptacles, the conveyor member 170

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remains stationary while the spider 172 is reciprocated. The spider 172 is provided with a plurality of circumferentially spaced bayonet coupling elements 174. The elements 174 are hollow members which are threaded externally thereof, as at 176, and which are provided with the diametrical slotted portions 178. By means of said tubular elements 174, the conveyor member 172 is adapted to mount a series of circumferentially spaced upwardly extending arms, here shown as rods 180, and a plurality of circumferentially spaced downwardly extending rods 182, said rods 180 being inclined upwardly and outwardly and rods 182 being inclined downwardly and outwardly. All of said rods are rigidly but preferably removably secured to the spider 172. It will be noted that the upper rods are secured to alternate ones of the connector elements 174, and similarly the lower rods are secured to alternate ones of the connectors 174 so that each upward rod extends between a pair of downward rods and similarly each downward rod extends between a pair of the upward rods. The securement is the same for all the rods 180 and 182 as is illustrated by Fig. 9 with reference to one of the rods 182. It will be noted that at the connecting end thereof, each of the rods is provided with a horizontal portion 184 which is provided with the transversely extending pin member 186 which is adapted to engage in the slotted portions 178 of the connector element 174 when the horizontal portion 184 is inserted within said connector element. Each rod is also provided with the internally threaded nut 188 which threadedly engages the connector element 174 to secure the rod therein. Therefore, it will be apparent that the rods are releasably secured to the spider 172 by the bayonet couplings constituted by the connector elements 174, the pins 186, and the nuts 188. As here shown, each of the rods is provided at the other end thereof with a T coupling 190 in which is secured a rod member 192 which extends transversely of the rod 180 or 182 as the case may be. The rod member is provided at the opposite ends thereof with depending portions 194 each of which is adapted to threadedly engage a spindle 76A of the material holder 74. As in the prior embodiment, the spindle 76A extends through an aperture 86 provided in the cover 54, the diameter of the aperture being substantially larger than the diameter of the spindle. The spindle 76A mounts the material holder 74 in substantially the same manner as previously described by means of the pins 78 and 80. In view of the foregoing it will be readily apparent that each of the rods 180 and 182 is adapted to carry two of the holders 74 and two of the covers 54.

The mechanisms for raising and lowering the conveyor 168 and for turning the latter to move the tissue or other material holders 74 into and out of the receptacles 46, in succession, with intervening rest periods of the holders in the respective receptacles is substantially similar to that described in connection with Figure 3 and that illustrated and described in the Kling patent. As illustrated in Fig. 8, the conveyor part or plate 170 is mounted at the top of a tubular member or hollow shaft 200, which is mounted for movement in a longitudinally extending bearing sleeve 202. The bearing sleeve 202 is mounted in position by the frame member 204 to which it is secured as by the screw 206. The sleeve 202 also extends into the hollow member 208 which is suitably secured to the frame member 114, as by the bolts 210. In order to secure the conveyor plate 170 to the tubular shaft 200, it will be noted that the upper end of the latter project from the upper end of the sleeve and is provided with a flange 212. The bolts 214, which are countersunk in the conveyor plate 170, connect the latter to the flange 212 as illustrated in Fig. 10. A horizontally disposed mounting 213, which is internally cylindrical, is releasably secured to the upper ends of frame plates, of which one is illustrated herein at 215, as illustrated and described in said Kling patent. Said member 213 has a circular opening

218 into which the sleeve 202 extends. A cylindrical bearing 220 is fixed to mounting member 213 in said opening 218 thereof. A cylindrical bearing member 222 is journaled for rotation in bearing 220 and is provided with a sleeve 224 which bears against the sleeve 202. A plate 226 is fastened to cylindrical member 222, as illustrated and described in said Kling patents. Therefore, it will be apparent that the plate 226 being secured to the rotary member 222 rotates with the latter and is supported by mounting member 213, thus in turn supporting the cylindrical member 222.

Openings 228 are provided in the cylindrical member 222, being diametrically disposed therein and similar openings 230 are provided in the plate 226 in registry with the openings 228 for the passage therethrough of the shafts or rods 232. The lower ends of said rods 232 are fixed to a collar 235 and the upper ends of the rods are connected to flanged coupling member 234 which is provided with openings 236 (Fig. 11) in which the upper end portions of said rods are received. The bolts 238 connect the flanged member 234 to the conveyor plate 170.

It will be noted that the shaft 200, the collar 235, the rods 232, the member 234 and the conveyor plate 170 constitute a movable unit, and that said unit is vertically and rotatably movable. The conveyor spider 172 is mounted on a shaft 240 which extends from the upper end of the tubular shaft 200, the companion conveyor member 170 being provided with a bearing member 242 in which the shaft 240 is mounted for vertical movement. In order to permit the vertical relative movement of the shaft 240 and the conveyor plate 170 and yet retain said parts against relative rotation, the shaft 240 is provided with a vertically extending key way or slot 244 and the conveyor plate 170 is provided with a key 246 which is secured thereto, as at 248, and which is provided with a projecting finger 250 which is slideably engaged in the key way 244. In addition, it will be noted that the hollow shaft 200 is provided with the opposed longitudinally extending closed slots 252 and the shaft 240 is provided with a transverse pin 254 which extends into said slots. A spring 256 is mounted on the hollow shaft 200 being disposed thereon between the upper flange 212 thereof and a collar 258 which is slideably movable on the hollow shaft 200 and which rests on the pin 254. It will be understood that during one operating cycle of the machine, the conveyor plate 170 is moved upwardly to engage the companion conveyor member 172 and then both of said members, which constitute the conveyor 168, continue to move vertically upwardly for withdrawing the tissue or other material holder 74 from the receptacle in which it had previously been positioned, after which said conveyor is turned so as to align said holder axially with the succeeding receptacle, following which the conveyor 168 is lowered so as to position the holder in said next receptacle where it remains for a predetermined length of time after which the next operating cycle of the machine takes place. The mechanism for thus moving the unit, which as before stated includes the conveyor plate 170, comprises an intermittent mechanical movement, which as here shown, is preferably constituted by a Geneva gear movement of the same type, as previously described in connection with Figure 3, and which is fully illustrated and described in the Kling patent. The driven Geneva gear member is indicated herein at 263 and, as previously indicated, is operated by a power actuated shaft as shown and described in detail in said Kling patent.

As indicated above in connection with the previously described embodiment, vertical movement of the conveyor unit for moving the tissue holder into and out of the receptacles is accomplished by the rotary cam 125 and the pivoted cam follower arm 127 which is operated by the cam as illustrated and described in Figure 6 of the Kling patent. Said arm is provided with the roller 131 which engages the lower edge 237 of the collar 235

hereof to raise the conveyor plate 170 until the latter engages the conveyor spider 172 and carries the complete conveyor unit upwardly to remove the holders 74 from the companion receptacles. It will be understood that in the operation of the mechanism for actuating the conveyor 168, the main power actuated shaft which operates the Geneva gear mechanism makes one complete revolution under the control of either the timing device 28 or 30, and during that revolution the tissue holder is transferred from one receptacle to the next receptacle.

In order to provide for the vertical reciprocation of the various holders within the various receptacles after the holders have been immersed in the various fluids by the downward movement of the conveyor 168, provision is made herein for an additional shaft 260 which is mounted for vertical movement within the hollow shaft 200. While the shaft 260 is substantially circular in cross section throughout the major longitudinal extent thereof, its lower end portion is provided with flat opposing faces, as illustrated at 262 in Figs. 8 and 13, said faces being slideably engaged in the forked end 264 of a bracket 266 which is secured to the frame member 268 as at 270. Below said flat faces, the shaft 260 is provided with the circular portion 272 which has extending therefrom the spaced fingers 274—274 which mount a pin 276 for a roller 278. In order to effect vertical reciprocation of said shaft 260, provision is made for the electric motor 280 which is suitably mounted in the base of the housing 100. Said motor operates the beveled gear 282 which meshes with a companion beveled gear 284 carried by a shaft 286 which is suitably mounted for rotation in the base of the housing 100. The shaft 286 is provided with a worm gear 288 which meshes with a gear 290 provided on a shaft 292. A cam 294 is keyed to the shaft 292, as at 296, for rotation thereby in the direction of the arrow 298. Said cam is provided with a raised peripheral portion 300.

It will be noted that the roller 278 rides on the periphery of the cam 294. A spring 302, which is mounted on the shaft 260 between a collar 304 carried by the shaft and the lower end of the stationary sleeve 202, biases the roller 278 against the cam 294. It will therefore be apparent that during each complete revolution of the cam 294, the raised portion 300 thereof engages the roller 278 to carry the shaft 260 upwardly. It will be noted that the upper end of the shaft 260 abuts the lower end of the short shaft 240, as at 261, the spring 256 serving to bias the upper shaft against the lower shaft. Therefore, the upward movement of the lower shaft 260, against the bias of the springs 302 and 256, will cause the upper shaft 240 to move vertically upwardly, whereby to carry the spider 172 from the full line position thereof illustrated in Fig. 8 to the broken line position thereof. It will be understood that said movement of the spider 172 will cause the various holders to move to the position thereof illustrated in Fig. 2. When the raised cam portion 300 rides past the roller 278, the compressed springs 256 and 302 will expand to return both shafts to the position thereof illustrated in Fig. 8. It will be understood that springs 258 and 302, when compressed, do not have sufficient force to move the conveyor plate 170 upwardly. It will be noted that during said vertical reciprocation of the shafts, the lower shaft is retained against rotation by the previously described engagement of the flat faces 262 thereof in the fork 264 and the upper shaft 240 is retained against rotation by the key portion 250 projecting into the keyway 244 of the upper shaft.

In order to provide for said vertical reciprocation of the spider 172 only during the rest periods of the companion conveyor plate 170, during which the various holders are disposed within the companion receptacles, provision is made for a switch 306 which is suitably mounted on the frame part 215. Said switch is provided with a stationary contact arm 308 and with a companion movable contact arm 310 which is normally biased to the broken

line position thereof illustrated in Fig. 8 for retaining the switch 306 in the open condition thereof. It will be understood that the switch 306 is in circuit with a motor starter of any suitable type (not illustrated herein) which motor starter operates to energize the electric motor 280, as is well known to those skilled in the art. The movable switch arm 310 extends into the path of movement of the collar 235 so that when the collar is returned to the full line position thereof illustrated in Fig. 8, the collar engages the movable switch arm 310 to carry the latter into engagement with the companion stationary switch arm 308 for closing the switch 306 whereby to energize the electric motor 280. Therefore, it will be understood that the electric motor 280 operates to effect the vertical reciprocation of the spider 172 only between the vertical movements of the companion conveyor plate 170 during which time the various holders are immersed in the fluids contained in the receptacles.

While motor 140 in the prior embodiment has been described as operating continuously during the operation of the mechanism 20, provision may be made to operate said motor only during the rest periods of the conveyor, as described in connection with the embodiment of Fig. 8. For example, as illustrated in Fig. 5, provision may be made for a normally open switch 316 which controls the energization of motor 140. Said switch is provided with the stationary contact arm 318 and with the movable contact arm 320 which is biased to open the switch. The lever 126 is provided with a pivotally mounted pin 322 which slideably engages in the movable arm 320 and a spring 324 is mounted on the pin between the lever and said movable arm. It will be understood that during the previously described relatively short vertical reciprocation of the shaft 88 and the collar 96, the spring 324, although expanding and contracting, remains sufficiently tensioned to keep the switch arm 320 engaged with the switch arm 318. However, upon upward movement of the shaft 88 to withdraw the holders 74 from the receptacles 46, the spring 324 is expanded so that it is not under tension and the arm 320, which is biased to switch open position, disengages the companion switch arm to discontinue the operation of motor 140. Upon the return movement of the shaft to position the holders in the receptacles, arm 320 is carried into engagement with arm 318 to energize the motor.

It will be noted that in each of the embodiments of the present invention, the mechanism is provided with suitable electric outlets, as illustrated at 310 and 312 for operating auxiliary equipment which may be used with the automatic immersion apparatus of the present invention, as fully illustrated and described in the Kling patent.

Although the apparatus embodying the present invention has been illustrated and described in connection with its primarily intended use in the preparation of histological specimens for microscopic examination, it will be understood that it is useful for various other purposes and that its use is not limited to the preparation of histological specimens.

While we have shown and described the preferred embodiments of our invention, it will be understood that various changes may be made in the present invention without departing from the underlying idea or principles of the invention within the scope of the appended claims.

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

1. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue, in a holder, in a liquid within a receptacle for a period of time, comprising means to mount a plurality of receptacles laterally of each other for movement of the holder into and out of said receptacles, respectively, for immersing the tissue for predetermined periods in the liquids therein, means for effecting relative vertical and lateral movements of said holder and receptacles for conveying said holder out of one of said receptacles and into

another of said receptacles, and means additional to said last mentioned means for effecting relative vertical reciprocating movements of said holder and the receptacle into which it is conveyed whereby to provide relative vertical reciprocating movements of the tissue and the liquid within which it is immersed, said last mentioned means comprising a conveyor for said holder, a vertical shaft mounting said conveyor, means operable to raise said shaft from a lower position to an upper position, to turn said shaft in said upper position and to lower said shaft, and said additional means being means to vertically reciprocate said shaft in said lower position thereof.

2. In immersion apparatus, comprising means to mount a plurality of receptacles for movement of a holder into and out of said receptacles, respectively, and means for effecting relative vertical and lateral movements of said holder and receptacles for conveying said holder out of one of said receptacles and into another of said receptacles; that improvement which comprises means additional to said last mentioned means and operable in timed relation therewith for effecting relative vertical reciprocating movements of said holder and the receptacle into which it is conveyed, said last mentioned means comprising a conveyor for said holder, a vertical shaft mounting said conveyor, means operable to raise said shaft from a lower position to an upper position, to turn said shaft in said upper position and to lower said shaft, and said additional means being motor driven cam means operatively engaging said shaft in said lower position thereof for vertically reciprocating the latter.

3. In immersion apparatus, comprising means to mount a plurality of receptacles for movement of a holder into and out of said receptacles, respectively, and means for effecting relative vertical and lateral movements of said holder and receptacles for conveying said holder out of one of said receptacles and into another of said receptacles; that improvement which comprises means additional to said last mentioned means and operable in timed relation therewith for effecting relative vertical reciprocating movements of said holder and the receptacle into which it is conveyed, said last mentioned means comprising conveyor means for said holder, a tubular shaft mounting said conveyor means, means operable to raise said shaft from a lower position to an upper position, to turn said shaft in said upper position and to lower said shaft, and said additional means being a pair of shafts mounted in normal endwise abutment in said tubular shaft, the upper shaft of said pair being engaged with said conveyor means, and motor driven cam means operatively engaging the lower shaft of said pair for vertically reciprocating said upper shaft.

4. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue in a liquid within a receptacle for a period of time, comprising a horizontal support provided with means to support a plurality of receptacles laterally of each other, a conveyor mounted both for vertical movement, and for movement in a horizontal plane in relation to said support, supporting means on said conveyor to carry a material holder into and out of the receptacles on said support, mechanism operatively connected to said conveyor for moving the latter vertically and in said horizontal plane in relation to said support, and additional mechanism operatively connected to said conveyor to vertically reciprocate the latter for vertically reciprocating the material holder in a receptacle, an electric motor operatively connected to said first mentioned mechanism to actuate the latter, an electric motor operatively connected to said additional mechanism to actuate said additional mechanism, normally open switch means in circuit with said latter motor, and means operable in response to movement of said material holder into a receptacle to close said switch means for energizing said latter motor.

5. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tis-

sue in a liquid within a receptacle for a period of time, comprising means movable a predetermined distance to and from upper and lower positions, respectively, for positioning the tissue in the liquid in the receptacle for immersion therein and for removing the tissue from the receptacle, means for actuating said movable means to move the latter said predetermined distance, a timing device for controlling the operation of said actuating means and providing a dwell period during which the tissue is immersed within the liquid for said period of time, and said timing device being operable at the end of said dwell period to effect the operation of said movable means for removing the tissue from the liquid, and means for operating said actuating means to move said movable means repeatedly less than said predetermined distance while said movable means is in said lower position thereof whereby said actuating means is operable to repeatedly move the tissue within the liquid.

6. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue in a liquid within a receptacle for a period of time, comprising means movable a predetermined distance to and from upper and lower positions, respectively, for positioning the tissue in the liquid in the receptacle for immersion therein and for removing the tissue from the receptacle, means for actuating said movable means to move the latter said predetermined distance to said upper and lower positions, respectively, means for actuating said movable means to move said movable means in the lowered position thereof repeatedly less than said predetermined distance whereby to repeatedly move the tissue within the liquid for a predetermined period of time, and time-controlled means automatically operable, after said predetermined period of time to operate said actuating means to move said movable means to said upper position thereof for removing the tissue from the liquid.

7. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue, in a holder, in a liquid within a receptacle for a period of time, comprising a conveyor for said holder vertically movable for moving the holder into and out of the receptacle to immerse the tissue in the liquid and to remove it therefrom, means for actuating said conveyor for effecting said movements thereof, a timing device operable to start and stop said conveyor actuating means and providing when said actuating means is stopped a dwell period during which the tissue holder is within the liquid for said period of time, and means operable in said dwell period for imparting additional movements to said conveyor so that it is operable to impart motion to the tissue holder to move the tissue repeatedly within the liquid during said period of immersion therein.

8. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue, in a holder in a liquid within a receptacle for a period of time, comprising a conveyor for said holder vertically movable for moving the holder into and out of the receptacle to immerse the tissue in the liquid and to remove it therefrom, said conveyor comprising a horizontally disposed part for suspending the tissue holder therefrom, a vertically movable shaft for raising and lowering said horizontally disposed part for moving the tissue holder into and out of the receptacle, time controlled means for actuating said shaft to raise the latter for moving the tissue holder out of the receptacle after a predetermined time of immersion of the tissue in the liquid, and means operable to raise and lower said shaft repeatedly distances less than the distance required to remove the holder from the receptacle whereby to move the tissue repeatedly in the liquid during the period of tissue immersion therein.

9. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue, in a holder, in a liquid within a receptacle for a period of time, comprising a conveyor for said holder vertically

movable for moving the holder into and out of the receptacle to immerse the tissue in the liquid and to remove it therefrom, said conveyor comprising a horizontally disposed part for suspending the tissue holder therefrom, means including a vertically movable shaft for raising and lowering said horizontally disposed part for moving the tissue holder into and out of the receptacle and for moving the horizontal part of the conveyor laterally when in a raised position for lowering the tissue holder into another receptacle positioned laterally of said first mentioned receptacle, time controlled means for actuating said last mentioned means to raise said shaft and to move said horizontal part of the conveyor for said movements thereof for moving the tissue holder from one receptacle to the other, and means operable to raise and lower said shaft repeatedly distances less than the distance required to remove the holder from the receptacle whereby to move the tissue repeatedly in the liquid during the period of tissue immersion therein.

10. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue, in a holder, in a liquid within a receptacle for a period of time, comprising a conveyor for said holder vertically movable for moving the holder into and out of the receptacle to immerse the tissue in the liquid and to remove it therefrom, said conveyor comprising a horizontally disposed part for suspending the tissue holder therefrom, means for raising and lowering said horizontally disposed part for moving the tissue holder into and out of the receptacle and for moving the horizontal part of the conveyor laterally when in a raised position for lowering the tissue holder into another receptacle positioned laterally of said first mentioned receptacle, time controlled means for actuating said last mentioned means to raise said horizontal part of the conveyor, to move it laterally, to lower it into the other receptacle, and to provide a dwell period during which the tissue is immersed in the liquid for said period of time and means operatively connected to said horizontal part of the conveyor and disposed in continuous operative relation therewith to raise and lower it repeatedly in said dwell period through distances less than that required to move the tissue holder from one receptacle to another whereby to move the tissue repeatedly in the liquid during the period of tissue immersion therein.

11. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue, in a holder, in a liquid within each of a plurality of receptacles for a period of time, comprising means operable to raise said holder from one receptacle and to lower said holder into another receptacle, a timing device to start and stop the operation of said raising and lowering means and to provide when the holder is within a receptacle a dwell period during which the tissue is immersed for said period of time, and means operatively connected to said holder through said raising and lowering means for vertically reciprocating said holder in said dwell period through a vertical range of movement which is less than that required for raising and lowering said holder to move the latter from one receptacle to another.

12. 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 each of a plurality of receptacles, respectively, arranged 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, timing mechanism for controlling said movement of the conveyor to provide dwell periods when the holder is lowered into the receptacles and before it is raised therefrom during which the tissue is immersed for said predetermined periods of time, and means operable to vertically reciprocate said conveyor means in said

dwelt periods through a range of movement less than said first mentioned vertical movements thereof, for vertically reciprocating the tissue holder, whereby to move the tissue in the liquid in each of said receptacles during the periods of immersion of the tissue in said liquids, respectively.

13. 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 each of a plurality of receptacles, respectively, arranged laterally of each other, comprising conveyor means mounted for vertical movement to and from lower and upper positions 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, timing mechanism for controlling said movement of the conveyor to provide dwell periods when the holder is lowered into the receptacles and before it is raised therefrom during which the tissue is immersed for said predetermined periods of time, and means comprising motor-operated cam means releasably engageable with said conveyor means in said lower position thereof to reciprocate said tissue holder vertically during said dwell periods in each of the liquids of said receptacles, respectively, during at least part of the periods of immersion of the tissue therein.

14. Apparatus for treating histologic tissue to prepare it for microscopic examination by the immersion of the tissue for predetermined periods of time in each of a plurality of liquids, comprising means for mounting a series of liquid receptacles arranged laterally of each other, time controlled means operable to lower a tissue holder into the liquid in one of said receptacles, to raise said holder after a predetermined period of time from said one receptacle, to move the raised tissue holder into registry with another of said receptacles, to lower said tissue holder into said other receptacle and to provide a dwell period during which the tissue is immersed for a predetermined period of time in the liquid in said latter receptacle, and means operatively common to said receptacles and operable to reciprocate said tissue holder vertically in each of the liquids of said receptacles, respectively, during at least part of said dwell periods, the distance of vertical movement of the tissue holder during said reciprocation thereof being less than the vertical movement required for moving the tissue holder from one receptacle to another.

15. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue, in a holder, in a liquid within a receptacle for a period of time, comprising means operatively connected to said holder for actuating the latter for movement through a predetermined distance for positioning the tissue in the liquid in the receptacle for immersion therein and for removing the tissue from the receptacle, a timing device to start and stop the operation of said actuating means and to provide when the holder is within the receptacle a dwell period during which the tissue is immersed for said period of time, and means operatively connected to said holder for actuating the latter in said dwell period for repeated movements in the same directions as said first mentioned movement and less than said predetermined distance to repeatedly move the tissue within the liquid, said operative connections having a common portion in continuous operative relation with said holder between the latter and each of said actuating means during the operation of said apparatus.

16. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue in a liquid within a receptacle for a period of time, comprising upper and lower horizontal supports each provided with means to support a plurality of receptacles laterally of each other, a conveyor mounted both for vertical movement and for movement in a horizontal plane in relation to said supports, means on said con-

veyor for supporting a plurality of tissue holders in positions thereon for movement into and out of certain of the receptacles on each of said supports, respectively, means for moving said conveyor vertically and horizontally for transferring said tissue holders from certain receptacles to other receptacles on said upper and lower supports, respectively, and means for repeatedly moving said conveyor vertically up and down while the tissue holders are positioned in said receptacles whereby the tissue is reciprocated in the liquid while immersed therein, said means for moving said conveyor for transferring said tissue holders from certain receptacles to other receptacles comprising time controlled means, and mechanism operable intermittently under the control of said time controlled means to provide a dwell period of said intermittently operable mechanism during which the tissue holder is immersed in liquid for said period of time, said means for reciprocating the tissue holder being operable at least during part of the dwell period of said intermittently operable mechanism.

17. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue in a liquid within a receptacle for a period of time, comprising means for supporting a plurality of receptacles disposed laterally of each other, means for transferring a tissue holder from one to another of said receptacles for immersing the tissue in the liquids therein, and means for repeatedly vertically reciprocating the holder while immersed in the liquid within a receptacle, said holder-transferring means comprising time controlled means and mechanism operable intermittently under the control of said time controlled means to provide a dwell period of said intermittently operable mechanism during which the tissue holder is immersed in liquid for said period of time, and said means for reciprocating the tissue holder being operable at least during part of the dwell period of said intermittently operable mechanism.

18. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue in a liquid within a receptacle for a period of time, comprising means for supporting a plurality of receptacles disposed laterally of each other, means for transferring a tissue holder from one to another of said receptacles for immersing the tissue in the liquids therein, and means for repeatedly vertically reciprocating the holder while immersed in the liquid within a receptacle, said holder-transferring means comprising time controlled means and mechanism operable intermittently under the control of said time controlled means to provide a dwell period of said intermittently operable mechanism during which the tissue holder is immersed in liquid for said period of time, and said means for reciprocating the tissue holder being operable at least during part of the dwell period of said intermittently operable mechanism, said transfer means being vertically movable for lowering the holder into one receptacle and raising it out of the latter at the start and end, respectively, of each period of immersion and said means for reciprocating the holder being operable to vertically move the latter up and down in the liquid a distance less than that of said transfer means in the operation thereof for transferring the holder from one receptacle to another.

19. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue, in a holder, in a liquid within a receptacle for a period of time, comprising means for supporting a plurality of liquid receptacles, means including a horizontal arm horizontally and vertically movable for moving said holder into and out of each of said receptacles, a timing device to start and stop the operation of said holder moving means to provide when the holder is within the receptacle a dwell period during which the tissue is immersed for said period of time, and mechanism for reciprocating said tissue holder during said

dwelt period within each receptacle longitudinally thereof for reciprocating the tissue in the liquid during its immersion therein, said holder reciprocating means being bodily movable with said means for moving said holder into and out of said receptacles.

20. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue, in a holder, in a liquid within a receptacle for a period of time, comprising a conveyor for said holder vertically movable for moving the holder into and out of the receptacle to immerse the tissue in the liquid and to remove it therefrom, said conveyor comprising a horizontally disposed part for suspending the tissue holder therefrom, a vertically movable shaft for raising and lowering said horizontally disposed part for moving the tissue holder into and out of the receptacle, time controlled means for actuating said shaft to raise the latter for moving the tissue holder out of the receptacle after a predetermined time of immersion of the tissue in the liquid, and a second shaft mounted for vertical movement relative to said first shaft for repeatedly raising and lowering said horizontally disposed part through distances less than the distance required to remove the holder from the receptacle whereby to move the tissue repeatedly in the liquid during the period of tissue immersion therein.

21. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue in a liquid within a receptacle for a predetermined period of time, comprising a receptacle-support, conveyor means mounted for vertical movement to and from lower and upper positions for positioning a tissue holder in and withdrawing it from the receptacle on said support to immerse and withdraw the holder from the liquid within the receptacle, a timing device for controlling said vertical movement of the conveyor and for providing a dwell period in which the tissue is immersed in the liquid for said predetermined period of time, said timing device being operable at the end of said dwell period to effect the movement of said conveyor means for withdrawing the tissue holder from the receptacle, and means operable in said dwell period to vertically reciprocate said conveyor means while in said lower position thereof through a vertical distance less than the extent of said vertical movement thereof, whereby to effect vertical reciprocation of the tissue holder in the receptacle.

22. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue in a liquid within a receptacle for a predetermined period of time, comprising means for positioning tissue within the receptacle, means for moving said positioning means for immersing the tissue in the liquid within the receptacle and for withdrawing the tissue therefrom, a timing device operable to start and stop said moving means and providing when said moving means is stopped a dwell period in which the tissue is immersed in the liquid for said predetermined period of time, and means operable in said dwell period for effecting repeated relative vertical reciprocating movements of said positioning means and the receptacle to repeatedly move the tissue within the liquid, said vertical reciprocating means comprising vertical shaft means in continuous operative relation with said positioning means during the operation of said apparatus, and means for reciprocating said shaft means.

23. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue in a liquid within a receptacle for a predetermined period of time, comprising means for positioning tissue within the receptacle, means for moving said positioning means for immersing the tissue in the liquid within the receptacle and for withdrawing the tissue therefrom, a timing device operable to start and stop said moving means and providing when said moving means is stopped a dwell period in which the tissue is immersed in the

liquid for said predetermined period of time, and means operable in said dwell period for effecting repeated relative vertical reciprocating movements of said positioning means and the receptacle to repeatedly move the tissue within the liquid, said vertical reciprocating means comprising shaft means mounted for vertical movement and operatively connected to said positioning means, and motor driven cam means for effecting vertical reciprocation of said shaft means.

24. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue, in a holder, in a liquid within a receptacle for a predetermined period of time, comprising means for moving the tissue holder for immersing the tissue in the liquid within the receptacle and for withdrawing the tissue therefrom, a timing device operable to start and stop said moving means and providing when said moving means is stopped a dwell period in which the tissue is immersed in the liquid for said predetermined period of time, and mechanism operable in said dwell period for reciprocating the tissue holder longitudinally of the receptacle while immersed in the liquid, said holder-moving means and said holder-reciprocating means including a common shaft operable through a predetermined distance to immerse the tissue holder in the liquid and to withdraw the tissue holder therefrom and operable in said dwell period through a lesser distance to reciprocate the holder when immersed in the liquid.

25. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue in a liquid within a receptacle for a predetermined period of time, comprising a plurality of receptacles disposed in a circular row, a holder movable into and out of said receptacles, respectively, for immersing the tissue for predetermined periods in the liquids therein, means for effecting relative vertical and lateral movements of said holder and receptacles for conveying said holder out of one of said receptacles and into another of said receptacles, a timing device operable to start and stop said moving means and providing when said moving means is stopped a dwell period in which the tissue is immersed in the liquid in one of said receptacles for a predetermined period of time, and means additional to said movement-effecting means operatively common to said receptacles and operable in the dwell period for effecting relative vertical reciprocating movements of said holder and the receptacle into which it is conveyed, whereby to provide relative vertical reciprocating movements of the tissue and the liquid within which it is immersed.

26. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue in a liquid within a receptacle for a predetermined period of time, comprising a plurality of receptacles disposed in a circular row, a holder movable into and out of said receptacles, respectively, for immersing the tissue for predetermined periods in the liquids therein, means for effecting relative vertical and lateral movements of said holder and receptacles for conveying said holder out of one of said receptacles and into another of said receptacles, a timing device operable to start and stop said moving means and providing when said moving means is stopped a dwell period in which the tissue is immersed in the liquid in one of said receptacles for a predetermined period of time, and means additional to said movement-effecting means operatively common to said receptacles and operable in the dwell period for effecting relative vertical reciprocating movements of said holder and the receptacle into which it is conveyed, whereby to provide relative vertical reciprocating movement of the tissue and the liquid within which it is immersed, said movement-effecting means including a conveyor for said holder, and said additional means being operatively connected to said holder through said conveyor means to

vertically reciprocate said conveyor means for vertically reciprocating the holder.

27. Apparatus for treating histologic tissue to prepare it for microscopic examination by the immersion of the tissue for predetermined periods of time in each of a plurality of liquids, comprising a horizontal support provided with means to support a series of receptacles laterally of each other in an arcuate row, a conveyor mounted both for vertical movement and for rotary movement in a horizontal plane in relation to said support, supporting means on said conveyor to carry a material holder into and out of the receptacles on said support for immersing the tissue for predetermined periods in the liquids therein, mechanism operatively connected to said conveyor for moving the latter vertically and in said horizontal plane in relation to said support for withdrawing the holder from the liquid in one receptacle and for inserting the holder in the liquid in another receptacle in said row, timing mechanism for controlling said movement of the conveyor to provide dwell periods when the holder is lowered into the receptacles and before it is raised therefrom during which the tissue is immersed for said predetermined periods of time, and additional mechanism operatively connected to said conveyor to vertically reciprocate the latter for vertically reciprocating the material holder in the liquid in the receptacle in which it is inserted.

28. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue in a liquid within a receptacle for a predetermined period of time, comprising upper and lower horizontal supports each provided with means to support a plurality of receptacles laterally of each other, a conveyor mounted both for vertical movement and for movement in a horizontal plane in relation to said supports, means on said conveyor for supporting a plurality of tissue holders in position thereon for movement into and out of certain of the receptacles on each of said supports, respectively, means for moving said conveyor vertically and horizontally for transferring said tissue holders from certain receptacles to other receptacles on said upper and lower supports, respectively, timing mechanism for controlling said conveyor moving means to provide dwell periods when said holders are lowered into said receptacles and before they are raised therefrom during which the tissue in said holders is immersed for said predetermined period of time, and means for repeatedly moving said conveyor vertically up and down in said dwell periods while the tissue holders are positioned in said receptacles whereby the tissue is reciprocated in the liquid while immersed therein.

29. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue, in a holder, in a liquid within each of a plurality of receptacles for a period of time, comprising means for moving the tissue holder vertically and laterally of the receptacles for transferring the holder from one receptacle to another, said means including a vertically movable member movable to upper and lower positions, means for actuating said moving means, a timing device for controlling the operations of said actuating means so as to provide a dwell period of a predetermined time of the holder in each receptacle, and means for imparting reciprocatory motion to said vertically movable member in the dwell period of the holder in the receptacle so as to move the tissue repeatedly in the liquid in the receptacle for improving the action of the liquid on the tissue, said last mentioned means comprising a motor actuated mechanism having a part operatively connected to said vertically movable member and automatically operable to reciprocate said movable member in the lower position thereof to impart said movements to the tissue in the liquid in the dwell period without removing the tissue from the liquid.

30. In automatic immersion apparatus for preparing tissue for microscopic examination, a support for mounting a plurality of liquid receptacles in a circular row for immersion of the tissue, in a holder therefor, in the liquids in said receptacles, respectively, means for moving the tissue holder vertically up and down to upper and lower positions, and laterally of the receptacles in an arcuate path for transferring the tissue holder from one receptacle to another, actuating means for said moving means, a motor for operating said actuating means, a timing device for controlling the operations of said motor for operating said actuating moving means so as to provide a dwell period of the holder in each receptacle, and means including a movable member automatically operable in conjunction with said moving means in said lower position thereof to reciprocate the tissue holder during the dwell period and including a motor operable independently of said first mentioned motor for actuating said means for reciprocating the tissue in the dwell period.

31. In automatic immersion apparatus for preparing tissue for microscopic examination, a support for mounting a plurality of liquid receptacles in a circular row for immersion of the tissue, in a holder therefor, in the liquids in said receptacles, respectively, means for moving the tissue holder vertically up and down and laterally of the receptacles in an arcuate path for transferring the tissue holder from one receptacle to another, actuating means for said moving means, a motor for operating said actuating means, a timing device for controlling the operations of said motor for operating said actuating moving means so as to provide a dwell period of the holder in each receptacle, said holder moving means including a member which is vertically movable to upper and lower positions and which has a lateral part, means engageable with said lateral part in the lower position of said last mentioned member for reciprocating the holder in the dwell period thereof, and means for repeatedly actuating said reciprocating means in the dwell period of the holder.

32. In automatic immersion apparatus for preparing tissue for microscopic examination, a support for mounting a plurality of liquid receptacles in a circular row for immersion of the tissue, in a holder therefor, in the liquids in said receptacles, respectively, means for moving the tissue holder vertically up and down and laterally of the receptacles in an arcuate path for transferring the tissue holder from one receptacle to another, actuating means for said moving means, a motor for operating said actuating means, a timing device for controlling the operations of said motor for operating said actuating moving means so as to provide a dwell period of the holder in each receptacle, said holder moving means including a member which is vertically movable to upper and lower positions and which has a lateral part, means engageable with said lateral part in the lower position of said last mentioned member for reciprocating the holder in the dwell period thereof, and means for repeatedly actuating said reciprocating means in the dwell period of the holder, said means which is engageable with said lateral part being positioned below and in the path of the latter in the movement of said member to said lower position so as to be automatically operable to reciprocate the holder upon movement of the latter into a receptacle for the dwell period therein.

33. In automatic immersion apparatus for preparing tissue for microscopic examination, a support for mounting a plurality of liquid receptacles in a circular row for immersion of the tissue, in a holder therefor, in the liquids in said receptacles, respectively, means for moving the tissue holder vertically up and down and laterally of the receptacles in an arcuate path for transferring the tissue holder from one receptacle to another, actuating means for said moving means, a motor for operating said actuating means, a timing device for con-

trolling the operations of said motor for operating said actuating moving means so as to provide a dwell period of the holder in each receptacle, said holder moving means including a member which is vertically movable to upper and lower positions and which has a lateral part, means engageable with said lateral part in the lower position of said last mentioned member for reciprocating the holder in the dwell period thereof, and means for repeatedly actuating said reciprocating means in the dwell period of the holder, said means which is engageable with said lateral part comprising a motor operated cam device positioned below and in the path of said lateral part in the movement of said member to said lower position so as to be automatically operable to reciprocate the holder upon movement of the latter into a receptacle for the dwell period therein.

34. Apparatus for treating histologic tissue to prepare it for microscopic examination by immersion of the tissue, in a holder, in a liquid within each of a plurality of receptacles for a period of time, comprising means for moving the tissue holder vertically and laterally of the receptacles for transferring the holder from one receptacle to another, said means including a vertically movable member movable to upper and lower positions, means for actuating said moving means, a timing device

for controlling the operations of said actuating means so as to provide a dwell period of a predetermined time of the holder in each receptacle, and means for imparting reciprocatory motion to said vertically movable member in the dwell period of the holder in the receptacle so as to move the tissue repeatedly in the liquid in the receptacle for improving the action of the liquid on the tissue, said last mentioned means comprising a motor actuated mechanism having a part positioned below and in the path of said vertically movable member so as to be automatically operable to reciprocate said movable member in the lower position thereof to impart said movements to the tissue in the liquid in the dwell period without removing the tissue from the liquid.

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