

Jan. 20, 1959

J. J. WOODS

2,869,509

AUTOMATIC IMMERSION APPARATUS

Filed Sept. 14, 1955

2 Sheets-Sheet 1

FIG. 1

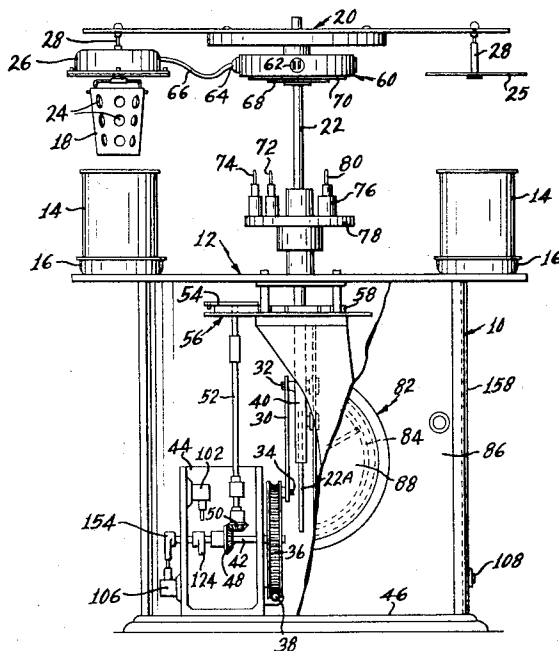
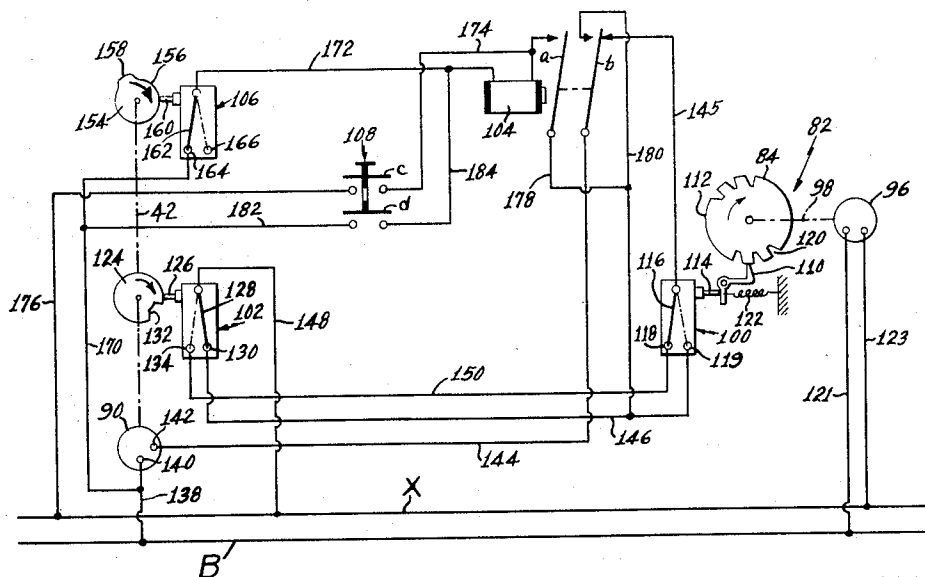


FIG. 2



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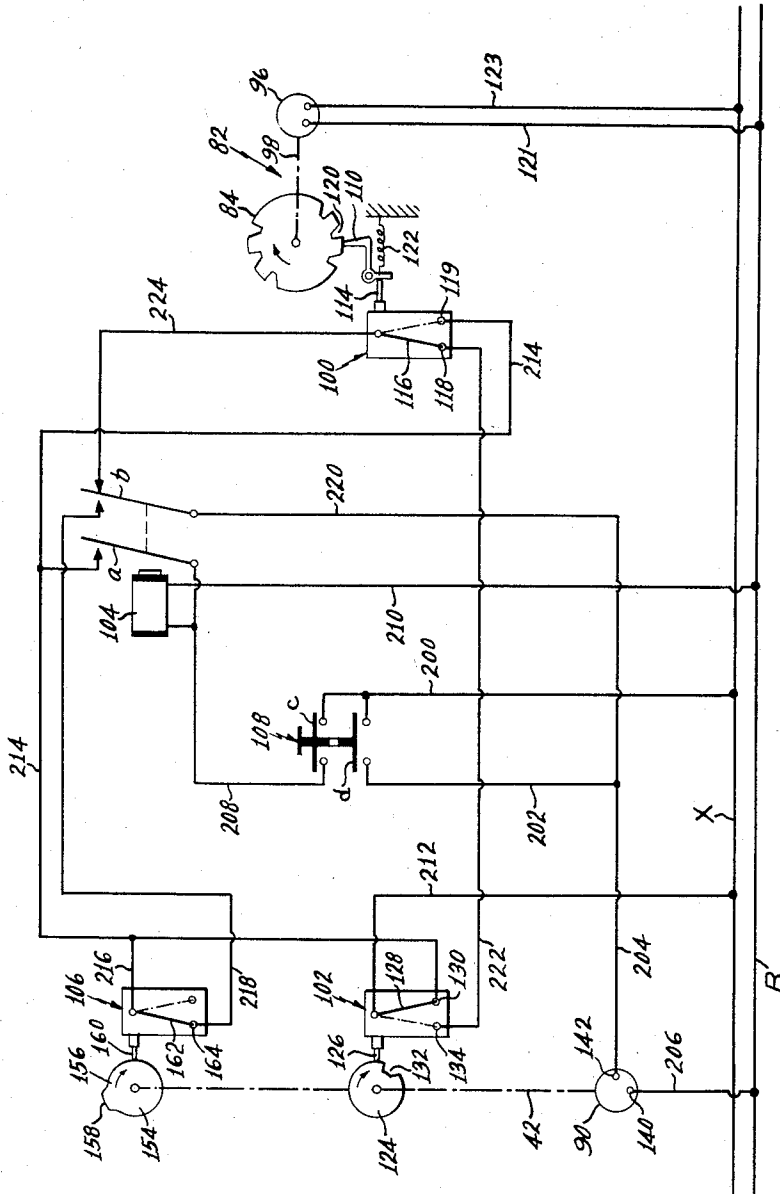
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2 Sheets-Sheet 2

FIG. 3



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2,869,509

AUTOMATIC IMMERSION APPARATUS

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Application September 14, 1955, Serial No. 534,255

6 Claims. (Cl. 118—10)

The present invention relates to automatic immersion apparatus, and particularly to automatic immersion apparatus for treating histologic tissue preparatory to microscopic examination thereof.

Although the apparatus embodying the present invention is useful for various purposes, it is intended primarily for use in the preparation of tissue specimens for microscopic examination. In such use, the tissue is immersed in various liquids or other media, for predetermined lengths of time and is automatically transferred from one liquid to another liquid at the proper times. The times of the cycles of operation vary depending upon the particular treatments to which the tissue or other material is subjected. For example, the time of the cycle of operation of the apparatus may vary from one day or more to one hour or less, and for this purpose, provision is made for a suitable timing device which may include an electric motor of the electric clock type for operating a rotary selector disk of the type illustrated and described in U. S. Patent No. 2,157,875, owned by the assignee of the present invention. The timing disk is notched or pre-set so that the cycle of operation, which includes the raising or withdrawal of the tissue from one liquid and its immersion into another liquid, is repeated at appropriate intervals according to the adjustment of the timing disk. This is an automatic type of operation, the tissue being successively immersed in the various liquids or other media until the treatment thereof is completed at which time the operation of the apparatus is automatically discontinued. For various different reasons, it may be necessary or desirable to withdraw the tissue holder from a treatment liquid prior to the time pre-set for said withdrawal by the automatic timing means.

Therefore, the primary object of the present invention is the provision of means to raise the material holder out of a receptacle to a predetermined position above the receptacle which means operates independently of the timing means which normally controls the operation of the conveyor.

Another object of the present invention is the provision of manually controlled means to operate the actuating means of the conveyor to move the conveyor independently of the timing means from a lower position to a raised position of the conveyor, and subsequently from the raised position to the lower position of the conveyor.

A further object of the present invention is the provision of a conveyor operating means operable under the control of the timing means to provide for the automatic operation of the conveyor so as to raise the holder from one receptacle and carry it to another receptacle, which operating means can also be operated independently of the time controlled means by manual control, the manual control, however, being ineffective to prevent the lowering of the conveyor from a raised position thereof under the control of the timing means.

A still further object of the present invention is to provide a new improved automatic immersion apparatus which has both automatic and manual means for actuating the conveyor moving means.

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A yet further object of the present invention is to provide generally improved automatic immersion apparatus having both automatic and manual means for actuating the conveyor moving means which actuating means is highly efficient and consumes a minimum of power.

Yet another object of this invention is the provision of manual means for actuating the conveyor in automatic immersion apparatus which once actuated cannot be controlled by automatic actuating means therein.

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 drawing:

Fig. 1 is a front elevation view of automatic immersion apparatus embodying the present invention, a portion thereof being broken away for the purposes of illustration, and the conveyor being illustrated in a raised position thereof, with only two receptacles being shown in position in the apparatus;

Fig. 2 is a schematic representation of a control circuit illustrating the present invention; and

Fig. 3 is a schematic representation of a control circuit pursuant to the presently preferred embodiment of the invention.

The present invention is preferably utilized in connection with automatic processing apparatus of the general type illustrated and described in U. S. Patent Nos. 2,341,198 and 2,583,379 which are owned by the assignee of the present invention. Such apparatus includes a cabinet or housing 10, having a table or support 12 on which there is mounted, in laterally disposed relationship, a plurality of receptacles or beakers 14, only two of which are illustrated in Fig. 1. The receptacles 14 contain the various liquids for treating histologic tissue specimens in order to prepare the tissue for microscopic examination. Said beakers 14 are removably positioned in the trays 16 which are suitably affixed to the table 12. The tissue specimens are usually placed in small perforated containers (not illustrated) which are disposed in a perforated holder or basket 18 removably carried by a conveyor, generally indicated by the reference numeral 20. The conveyor is mounted by a vertical shaft 22 which imparts lateral and vertical movement to the conveyor, and to the holder 18 carried thereby, for raising the holder out of one receptacle and then moving it laterally into alignment with another receptacle, and then lowering the holder therein for immersing the tissue in the liquid in the receptacle for a predetermined time. While only two receptacles 14 are illustrated herein, it will be understood that the receptacles are arranged in a circle on the support 12, as illustrated in said previously identified patents. The holder or basket 18 is provided with a plurality of apertures 24 to subject the tissue in the holder to the liquid in the receptacles 14. A number of covers 25 may also be carried by the conveyor 14, as by spindles 28 provided on the conveyor, to engage the tops of the receptacles 14 when the holder 18 is in its lowered position, in order to prevent foreign matter from entering the receptacles and to reduce evaporation of the liquids therein in the case of the more volatile liquids.

Provision may be made for rotating the tissue or other material holder 18 in the various liquid receptacles 14. In this connection, the holder 18 is carried by a supporting and rotating device 26 which is carried by the conveyor 20, as by the stud or pin 28. Said rotating device may be of the type fully illustrated and described in Patent No. 2,341,198, or the holder may be rotated in the manner illustrated and described in Patent No. 2,583,379.

The mechanism for imparting the vertical motion to

the shaft 22, as described in Patent No. 2,341,198, includes a connecting rod or lever 30 which is pivotally mounted at one end thereof on a pin 32 secured to a cross-head 40, and which is further pivotally mounted at its other end on a pin 34 which, in turn, is secured to a gear 36. Gear 36 is engaged by a worm gear 38 which is driven by an electric motor 90 (Fig. 2) suitably disposed in cabinet 10. The lower portion 22A of the shaft 22 is slidably and rotatably movable in the cross-head 40. As illustrated in said latter patent, the shaft 22 is provided with a shoulder which is engaged by the upper end of the cross-head 40 during the upward movement of the cross-head by the link 30 for carrying the shaft and the conveyor from the lowermost position thereof, in which the receptacle 18 is immersed in the fluid within a receptacle 14, to the uppermost position thereof illustrated in Fig. 1. On the other hand, when the cross-head 40 is moved downwardly by the link 30, the shaft 22 and the conveyor 20 move downwardly by gravity, without any downward pull on the shaft by the cross-head 40. The gear 36 is mounted on a shaft 42 which is journaled for rotation in the frame 44 suitably mounted on the base 46 of the cabinet 10. The shaft 42 carries a bevel gear 48 which engages a companion bevel gear 50 which is mounted on a shaft 52 operatively connected to the driving member 54 of a Geneva gear mechanism, generally indicated by the reference numeral 56. It will be understood that the rotation of the gear 36 results in the rotation of the bevel gears 48 and 50 for operating the driving member 54 of the Geneva gear mechanism. Said driving member 54 imparts rotary movement to a driven member 58 of the Geneva gear mechanism when the shaft 22 is in its raised position, thereby imparting a small rotary movement to the shaft 22 to move the tissue holder 18 laterally from a position over one receptacle to a position over and in registry with the adjacent receptacle. Upon completion of the lateral movement, the shaft 22 is lowered through the operation of the gear 36 and the link 30 in order to immerse the basket 18 into the liquid within the receptacle for subjecting the tissue therein to said liquid.

In order to supply the current for operating the basket rotating device 26, provision is made for a hub 60 which is mounted on the shaft 22. The hub is provided with a plurality of female outlet receptacles 62 for receiving plugs 64 carried by cables 66 from the rotating devices 26. The hub 60 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 the hub 60, on a plate 78, are a pair of contact pins 72 and 74 which are adapted to engage the rings 68 and 70, respectively, when the shaft 22 is in its lowered position. The pins 72 and 74 are electrically connected to a suitable source of energy through a normally open switch 76 whereby to provide the electrical energy for the rotating device 26 when the conveyor 20 is in the lower position thereof so that the hub engages the operating pin 80 of switch 76 to close the switch.

The apparatus is operated under the control of a timing device generally indicated by the reference numeral 82, having a notched control disk 84, driven by an electric motor 96, as indicated at 98 in Fig. 2, and as described in the previously identified patents and in U. S. Patent No. 2,324,122 assigned to the assignee of the present invention. Said timing device 82 is positioned within the cabinet 10, and the cabinet is provided with a hinged door 86, having a transparent window 88 through which the timing disk 84 and other parts of the timing device are visible. The circuit of the motor 90, which drives the actuating mechanism, including the gears 38, 36 and the link 30, for operating the shaft 22, and the linkage 48, 50 and the shaft 52 for operating the Geneva mechanism 56, is completed and interrupted at the proper times by the timing device 82 substantially in the same way as described in the above mentioned patents. The timing disk

84 is provided with peripherally spaced notches 120 separated by continuous peripheral or circumferential edge portions 112 of the disk.

Referring now to Fig. 2 in detail, there is diagrammatically illustrated the circuit arrangement for controlling the operations of motor 90 under the automatic control of the timing device 82 as well as under manual control. As will be described in detail hereinafter, motor 90 when under automatic control, is controlled primarily by microswitches 100 and 102. Furthermore, as will be described hereinafter in detail, motor 90 may be manually controlled by a relay 104 in combination with a microswitch 106 and a push-button switch 108. As shown in Fig. 2, the apparatus is illustrated in the condition in which the conveyor 20 is shown in its lowered position so that tissue basket 18 is immersed in one of the receptacles 14 for treatment of the tissue therewithin. In this condition, lever 110 engages the outer periphery 112 of timing disk 84 in the timing mechanism 82. With the lever so disposed on the timing disk, the pin 114 of microswitch 100 is operated to the left as viewed in Fig. 2 to thereby cause the movable contact member 116 of microswitch 100 to engage left-hand contact 118 of microswitch 100. It will be obvious that when the timing disk is moved so that lever 110 engages a notch 120 in timing disk 84, spring 122 biases lever 110 to pivot in a counterclockwise direction thereby permitting pin 114 to move to the right and accordingly operate movable contact 116 to the right so that it engages right-hand contact 119 of microswitch 100.

Microswitch 102 is controlled by a cam 124 which is mounted on shaft 42 and rotates therewith. Accordingly, cam 124 makes one revolution for a complete cycle of operation of conveyor 20, that is cam 124 turns through one revolution for one upward movement, partial rotational movement and downward movement of conveyor 20. Accordingly, pin 126 of microswitch 102 normally engages the outer peripheral edge of cam 124 thereby holding movable contact member 128 of microswitch 102 in its right-hand position as viewed in Fig. 2. However, when pin 126 moves into the notch 132 on cam 124, then switch 126 moves to the left as viewed in Fig. 2 and accordingly moves movable contact member 128 to the left so that it disengages right-hand contact 130 and engages left-hand contact 134 of microswitch 102. For reasons which will become more clear hereinafter, relay 104 is normally deenergized thereby causing front contacts *a* and *b* to be open and back contact *b* of relay 104 to be closed. Furthermore, it is to be noted that motor 96 of the timing mechanism 82 is directly connected to the power lines B and X by conductors 121 and 123 so that it operates continuously throughout the entire period of treatment of the tissue.

Under automatic operation, when lever 110 moves into a notch 120 in timing disk 84 and thereby operates movable contact member 116 of microswitch 100 to the right to open contact 118 and to close contact 119, an energizing circuit for motor 90 is established. This circuit may be traced from one power line B, through lead 138 to terminal 140 of motor 90, through motor 90 and out through terminal 142 to conductor 144, over back contact *b* of relay 104, through conductor 145, over movable contact member 116 of microswitch 100 to terminal contact 119 thereof, through conductor 146 to contact 130 of microswitch 102, over movable contact member 128 of microswitch 102 and through conductor 148 to power line X. Accordingly, motor 90 is energized and causes conveyor 20 to move upwardly, to rotate so as to move tissue holder 18 from position over one receptacle to a position over an adjacent receptacle and then to move downwardly to the lowered position. During this time, cam 124 turns through substantially one revolution in a clockwise direction as viewed in Fig. 2, until pin 126 of microswitch 102 moves into notch 132 in the cam. When pin 126 moves into notch 132 in cam 124 the above traced

circuit becomes open at contact 128—130 of microswitch 102 since movable contact member 123 is moved out of engagement with contact 130 and moved into engagement with contact 134. Accordingly, motor 90 becomes deenergized and the conveyor is at rest. Subsequently, timing disk 84 rotates sufficiently far to move lever 110 out of notch 120 and back onto the periphery of disk 84. Accordingly, movable contact 116 moves back into engagement with contact 118 of microswitch 100 and thereby closes a second energizing circuit for motor 90 which energizing circuit may be traced as follows: from power line B, through conductor 138 to terminal 140 of motor 90, out of terminal 142 of motor 90, through conductor 144, over back contact *b* of relay 104, through conductor 145, through movable contact member 116 of microswitch 100, through contact 118, to conductor 150, through contact 134 of microswitch 102 to movable contact 128 and through conductor 148 to power line X of the power source. Accordingly, motor 90 becomes reenergized and moves conveyor 20 a second time. However, the second movement is a very short movement and lasts only until cam 124 rotates sufficiently to move pin 126 of microswitch 102 out of notch 132 at which time, movable contact member 128 of microswitch 102 moves out of engagement with contact 134 and back into engagement with contact 130. Accordingly, the motor becomes deenergized a second time and the tissue basket remains immersed in its receptacle 14 for treatment of the tissue within the basket until a predetermined period of time elapses at which time lever 110 engages another notch 120 on timing disk 84 to restart the above described cycle of movement.

In accordance with the present invention as hereinbefore stated, provision is made to effect a manual control of motor 90 independent of timing device 82 so as to raise and lower the conveyor 20 during the time that switch control lever 110 rides on the peripheral portion 112 of timing disk 84 so that the automatically controlled circuit through motor 90 is interrupted, as previously explained. Furthermore as hereinbefore stated, this manual operation of motor 90 is controlled by relay 104, microswitch 106 and push-button switch 108, the latter element having two normally open contacts *c* and *d*. Microswitch 106 is controlled by a cam 154 which is mounted on shaft 42 and is rotated therewith. Accordingly, cam 154 makes one revolution for an operation of conveyor 20. More particularly, and for reasons which will be made clear hereinafter, cam 154 is provided with a substantially circular portion 156 and a raised cam portion 158 the latter cam portion engaging pin 160 of microswitch 106 when the conveyor is in its raised position. The movable contact member 162 of microswitch 106 is normally in its left-hand position as viewed in Fig. 2 engaging fixed contact 164 of the microswitch. However, when pin 160 engages raised cam portion 158, movable contact member 162 moves to the right as viewed in Fig. 2 to become disengaged from fixed contact 164 and to engage fixed contact 166 of microswitch 106.

Assuming the conveyor is in its lowered position in which the tissue baskets 18 are immersed in liquids contained in receptacles 14 and further assuming that the pathologist or technician wishes to gain access to the baskets or the tissue specimens therewithin, initiation of the operation of motor 90 under manual control means to be described hereinafter is achieved by pressing manual push-button 108 so as to close its normally open contacts *c* and *d*. When this occurs, relay 104 becomes energized and picks up. This circuit energizing relay 104 may be traced as follows: from power line B, through conductor 138, conductor 170, conductor 182, contact *d* of push-button switch 108, conductor 184, the winding of relay 104, conductor 174, contact *c* of push-button switch 108, and conductor 176 to power line X. Accordingly, relay 104 picks up to open its back contact *b* and close its front

contacts *a* and *b*. With back contact *b* of relay 104 open, the previously traced automatically controlled energizing circuits for motor 90 are interrupted at this additional point. With front contact *a* of relay 104 now closed a stick circuit is established for maintaining relay 104 in its energized condition. This stick circuit may be traced from power line B, through conductor 138, conductor 170, contacts 164—162 of microswitch 106, conductor 172, the winding of relay 104, front contact *a* of relay 104, conductor 178, conductor 180, conductor 146, contacts 130—128 of microswitch 102, and conductor 148 to power line X. With the stick circuit just traced established, push-button switch 108 may be released to open contacts *c* and *d* thereof without affecting the energization of relay 104.

With relay 104 picked up to close its front contacts *a* and *b*, an auxiliary energizing circuit for motor 90 is established. This auxiliary energizing circuit may be traced from power line B, through conductor 138 to terminal 140 of motor 90, out of terminal 142 of motor 90 and through conductor 144, over front contact *b* of relay 104, through conductor 180, conductor 146, contacts 130—128 of microswitch 102, and through conductor 148 to the power line X. Accordingly, motor 90 becomes energized and starts moving conveyor 20 upward to its raised position. At the time the conveyor reaches its raised position raised cam portion 158 of cam 154 engages pin 160 of microswitch 106 to thereby open contacts 162—164 of said microswitch and thereby open the previously described stick circuit of relay 104. Accordingly, relay 104 becomes deenergized and releases and thereby opening its front contacts *a* and *b* and closing its back contact *b*. With front contact *b* of relay 104 now open, the auxiliary energizing circuit for motor 90 becomes open at said contact and, accordingly, motor 90 becomes deenergized. With motor 90 deenergized, the conveyor comes to rest in its raised position and accordingly permits the pathologist or technician to gain access to the tissue baskets and the tissue specimens therewithin in order to rearrange these specimens or perform any other operation he so desires.

After the pathologist or his technician is through with the tissue specimens, and desires to restart the automatic operation of the automatic immersion apparatus, he depresses push-button switch 108 again to reclose contacts *c* and *d* of the push-button switch. Upon the reclosing of contacts *c* and *d* of push-button switch 108, the previously traced energizing circuit for relay 104 is reclosed and, accordingly, relay 104 picks up to open its back contact *b* and to reclose its front contacts *a* and *b*. Accordingly, motor 90 becomes reenergized over its previously traced auxiliary energizing circuit and commences to operate the conveyor. However, the pathologist or technician cannot immediately release push-button 108 since the energizing circuit for relay 104 must be maintained in its closed condition until after raised portion 158 moves out of engagement with pin 160 of microswitch 106 to reclose contact 162—164. This period of time is relatively short and after it expires, the push-button switch 108 may be released to open contacts *c* and *d* thereof since with contact 162—164 of microswitch 106 reclosed, the previously traced stick circuit for relay 104 is reestablished to maintain the relay in its energized condition. Accordingly, motor 90 restarts its operation and rotates the conveyor so as to move the tissue basket from a position over one receptacle to a position over the second receptacle at which time the motor causes the conveyor to be lowered to its lowered position. As the conveyor reaches its lowered position, pin 126 moves into notch 132 of cam 124 and, accordingly, opens contact 128—130 and closes contacts 128—134. With contact 128—130 opened the previously traced stick circuit for relay 104 becomes open and thereby deenergizes relay 104 and causes that relay to release. With relay 104 released, the previously traced auxiliary energizing

circuit for motor 90 becomes open at front contact *b* of relay 104 as well as at contact 130—128 of micro-switch 102. However, the previously traced energizing circuit for motor 90 including contact 128—134 is re-closed so as to continue the energization of the motor 90 so as to continue movement of the conveyor and to continue rotating cam 124 until pin 126 of switch 102 is moved out of notch 132 at which time the last mentioned energizing circuit for motor 90 becomes open at contact 128—134 and motor M becomes deenergized. By re-closing the last mentioned energizing circuit for motor 90 which circuit includes contact 128—134 of micro-switch 102 and thereby maintaining motor 90 in an energized condition until cam 124 revolves sufficiently far to move pin 126 out of notch 132, the automatic control means for motor 90 becomes reset for automatic operation which can then follow in the normal manner.

Assuming now that the pathologist or his technician has raised the conveyor through the operation of push-button switch 108 and has neglected or forgotten to return the conveyor to its lowered position, the condition of the circuit controlling means for motor 90 will be as follows: pin 160 or microswitch 106 is in engagement with raised portion 158 of cam 154 thereby causing contact 162—164 to be open. Accordingly, relay 104 is deenergized, and motor 90 is also deenergized at this time. Now in this condition, let it further be assumed that timing disk 82 has revolved sufficiently far to cause lever 110 to move into one of the notches 120 therein. Accordingly, movable contact 116 of microswitch 100 moves out of engagement with the contact 118 and into engagement with contact 119. Accordingly, an energizing circuit is established for motor 90 which circuit may be traced from power line B, through conductor 138 to terminal 140 of motor 90, out of terminal 142 of motor 90, through conductor 144, over back contact *b* of relay 104, through conductor 145, through contact 116—119 of microswitch 100, through conductor 146, through contact 128—130 of microswitch 102, and through conductor 148 to power line X of the power source. Accordingly, motor 90 is reenergized and moves the conveyor laterally and then downwardly so as to move tissue basket 118 from a position over one receptacle to a position over an adjacent receptacle and then lower the basket into the adjacent receptacle 14 at which time pin 126 of microswitch 102 moves into notch 132 in cam 124 to open contact 128—130 and thereby open the last mentioned energizing circuit for motor 90. Accordingly, it will be seen that the automatic control means for motor 90 overrides the manual control means therefor and reestablishes the automatic control so that the machine may function normally in the automatic manner.

The pathologist or his technician may desire to raise the conveyor by the manual control means when the condition of the apparatus is such that pin 126 of micro-switch 102 is in cam notch 132 in which case contact 128—134 of microswitch 102 is closed. Accordingly, the pathologist or technician depresses push-button switch 108 to close push-button switch contacts *c* and *d*. When this is done, the previously traced energizing circuit for relay 104 through push-button switch contacts *a* and *b* is established. Accordingly, relay 104 picks up and opens its back contact *b* and closes its front contacts *a* and *b*. With front contact *b* of relay 104 closed and with push-button switch 108 being retained in depressed condition so as to maintain its contacts *c* and *d* closed, another energizing circuit for motor 90 is established which circuit may be traced as follows: from power line B, over conductor 138 to terminal 140 of motor 90, out of terminal 142 of motor 90, over conductor 144, over front contact *b* of relay 104, conductor 180, conductor 178, front contact *a* of relay 104, conductor 174, contact *c* of push button switch 108, and conductor 176 to power line X of the power source. Push button switch 108 must be retained in its depressed condition until

motor M has rotated cam 124 sufficiently far to move notch 132 out of engagement with pin 126 of micro-switch 102 at which time the previously traced auxiliary energizing circuit for motor 90 becomes established along with the previously traced stick circuit for relay 104. Accordingly, after these circuits are re-established, push button switch 108 may be released in order to open contacts *c* and *d* thereof and the operation of the apparatus thereafter is the same as that hereinbefore described.

It should be noted that in all conditions of operation of the apparatus, none of the auxiliary apparatus for operating motor 90 under manual control consumes any power except when the auxiliary apparatus is actually energizing motor 90. Accordingly, the present invention consumes relatively little power and is therefore highly efficient.

Referring now to Fig. 3 in which the presently preferred form of the invention is illustrated, the various circuit controlling means hereinbefore described with regard to Fig. 2 are all included in the form shown in Fig. 3. However, as will be described in more detail hereinafter, the various circuits have been rearranged so that when motor 90 becomes energized by operation of push button switch 108, the automatic control means for motor 90 including timing mechanism 82 is switched out of circuit and has no effect upon motor 90 until the motor has raised the conveyor, moved it laterally and lowered the conveyor. With such an arrangement the conveyor may be raised and may be kept in the raised position as long as desired, any operations of time controlled switch 100 having no effect whatsoever on the motor 90 during the period of manual control thereof.

The apparatus is shown in Fig. 3 in condition to be automatically controlled, and is particularly shown in the condition in which the tissue baskets 18 are immersed in receptacles 14 for periods of time predetermined by timing mechanism 82. In said condition the contacts of push button switch 108 are open, contact 116—118 of microswitch 100 is closed, contact 128—130 of micro-switch 102 is closed and contact 162—164 of microswitch 106 is closed. Accordingly, for reason which will become clear hereinafter, relay 104 is de-energized and released thereby having its front contacts *a* and *b* open and its back contact *b* closed. With back contact *b* of relay 104 closed, motor 90 is controlled by timing mechanism 82 and microswitch 102 in the exact same manner as hereinbefore described with regard to Fig. 2.

Assuming the pathologist or his technician desires to raise the conveyor in order to perform some operation on the tissue within the baskets 18, the operator depresses push button 108 thereby closing its contacts *c* and *d*. With contact *b* of push button switch 108 closed, an auxiliary energizing circuit for motor 90 is established, which circuit may be traced from power line X, through conductor 200, contact *d* of push button switch 108, conductor 202, conductor 204 to terminal 142 of motor 90, out terminal 140 of motor 90 and over conductor 206 to power line B. Accordingly, motor 90 commences operating and commences raising the conveyor from its lowered position. At the same time, an energizing circuit is established for relay 104 and this circuit may be traced from power line X, over conductor 200, contact *c* of push button switch 108, conductor 208, the winding of relay 104, and conductor 210 to power line B of the power source. Accordingly, relay 104 picks up and opens its back contact *b* and closes its front contacts *a* and *b*. With back contact *b* open the automatically controlled energizing circuits for motor 90 become open at back contact *b* of relay 104 and the automatic circuits are, accordingly, ineffective for controlling motor 90.

With relay 104 picked up a stick circuit for relay 104 becomes established. The stick circuit may be traced as follows: from power line X, over conductor 212, contact 128—130 of switch 102, conductor 214,

front contact *a* of relay 104, the winding of relay 104, and conductor 210 to power line B. Accordingly, push button 108 may be released and relay 104 remains in its picked up condition since the stick circuit does not include push button switch contact *c*. Furthermore, it is to be noted that the stick circuit for relay 104 does not include contact 162—164 of switch 106 and, accordingly, is independent of said switch. Therefore, relay 104 will remain energized when the conveyor is raised to its uppermost position and will continue to remain energized until contact 128—130 of switch 102 is opened upon the conveyor being relowered.

Upon relay 104 picking up another auxiliary energizing circuit for motor 90 is established and this circuit may be traced from power line X, over conductor 212, contact 128—130 of switch 102, conductor 214, conductor 216, contact 162—164 of switch 106, conductor 218, front contact *b* of relay 104, conductor 220, conductor 204 to terminal 142 of motor 90, through motor 90 to terminal 140 thereof, and over conductor 206 to power line B. Accordingly, when push button switch 108 is released to cause the contacts thereof to open, the last traced auxiliary energizing circuit for motor 90 will maintain the motor in an energized condition until the conveyor has been raised to its uppermost position at which time raised cam portion 158 of cam 154 engages pin 160 of switch 106 to move movable contact member 162 away from fixed contact 164 and thereby open contact 162—164. At this time, the last traced auxiliary energizing circuit for motor 90 becomes open and motor 90 becomes deenergized and the conveyor comes to rest in its uppermost position. However, as previously stated, relay 104 remains energized by its stick circuit and, accordingly, the automatically controlled energizing circuits for motor 90 remain open at back contact *b* of relay 104. Therefore, even if lever 110 moves into a notch 120 in timing disc 84 to operate switch 100 so that contact 116—118 thereof opens and contact 116—119 thereof closes, motor 90 will not become energized so as to move the conveyor laterally and downwardly.

After the operator has completed working on the tissue and desires to reinsert the tissue baskets into receptacles 14, he once again depresses push button 108 to close contacts *c* and *d* thereof. With contact *d* of push button switch 108 closed the previously traced auxiliary energizing circuit for motor 90 including said push button switch contact *d* becomes re-established and motor 90 commences to move the conveyor laterally. At the same time, the motor rotates cam 154 in order to move raised cam portion 158 out of engagement with pin 160 of switch 106 to thereby cause contact 162—164 to reclose. Upon the reclosing of contact 162—164, manual push button switch 108 may be released to thereby open its contacts since the auxiliary energizing circuit for motor 90 heretofore traced including contact 162—164 is now reclosed. The conveyor completes its lateral move and moves downwardly to its lowermost position at which time cam notch 132 on cam 124 registers with pin 126 of switch 102 and thereby moves movable contact member 128 to the left to open contact 128—130 and close contact 128—134. Accordingly, the previously traced stick circuit for relay 104 becomes open at contact 128—130 and relay 104 releases to open its front contacts *a* and *b* and close its back contact *b*. When relay 104 releases the previously traced energizing circuit for motor 90 including front contact *b* of relay 104 becomes open at said contact as well as at contact 128—130 of switch 102.

Assuming at this time that microswitch 100 is in the condition in which contact 116—118 is closed, an automatically controlled energizing circuit for motor 90 becomes established. This circuit may be traced from power line X, over conductor 212, contact 128—134 of switch 102, conductor 222, contact 116—118 of switch

100, conductor 224, back contact *b* of relay 104, conductor 220, conductor 204 to terminal 142 of motor 90, through motor 90 to terminal 140, and through conductor 206 to power line B. Accordingly, motor 90 will remain energized until cam 124 has rotated sufficiently to move cam notch 132 out of engagement with pin 126 of switch 102 at which time contact 128—134 will open and contact 128—130 will close. Accordingly, motor 90 becomes deenergized and the apparatus is restored to its original condition in which the automatically controlled circuits for motor 90 are effective for energizing said motor at predetermined time intervals.

Assuming that the operator depresses push button switch 108 to lower the conveyor when lever 110 is in a notch 120 in timing disc 84, the same series of events as hereinbefore described take place. That is, the operator depresses push button switch 108 to re-energize the motor and the motor will remain energized by the manually controlled auxiliary circuits until cam notch 132 in cam 124 registers with pin 126 at which time the motor will become de-energized. However, the last traced automatic energizing circuit for motor 90 is open at contact 116—118 of switch 100 and, accordingly, the conveyor comes to rest in its lowered position. However, when timing disc 84 has rotated sufficiently to move lever 110 out of said notch 120, then said automatically controlled energizing circuit becomes established and motor 90 operates the conveyor and cam 124 until cam notch 132 moves out of registry with pin 126 in order to open contact 128—134 and thus de-energize said automatically controlled circuit and restore the apparatus to its original condition.

Assuming that the operator desires to raise the conveyor when pin 126 of microswitch 102 is in cam notch 132 and lever 110 is disposed in a notch 120 in timing disc 84, all that need be done is for the operator to depress push button switch 108 to close that switch's contacts *c* and *d* to energize motor 90 over the previously traced manually controlled auxiliary energizing circuit including contact *d* of push button switch 108. With motor 90 energized it will commence operating and will rotate cam 124 a sufficient distance to move cam notch 132 out of engagement with pin 126 of switch 102 at which time contact 128—134 will open and contact 128—130 will close. Accordingly, the energizing and stick circuits for relay 104 will become established and the energizing circuit for motor 90 including contact 128—130 of switch 102 and front contact *b* of relay 104 will also become established. At this time, the operator may release push button switch 108 to open contacts *c* and *d* thereof and the operation of the apparatus thereafter will be exactly the same as the operation previously described.

In view of the foregoing, it will be apparent that in each of the embodiments illustrated in Figs. 2 and 3, provision is made for a time-controlled circuit operable by the pre-set timing means 82 to energize the motor 90 at predetermined timed intervals and for an auxiliary time-free circuit operable under the control of the manual switch 108 to energize said motor to raise the material holder from a receptacle during a timed period of immersion thereof in the liquid in the receptacle.

Having thus described the preferred embodiment of this invention and a modification thereof, it will be understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of this invention.

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

1. In automatic immersion apparatus, comprising a conveyor movable up and down and laterally for transferring a material holders from one to another of laterally arranged receptacles, means for actuating said conveyor,

time-control means, and means operable under the control of said time-control means for operating said actuating means to operate said conveyor for transferring said holder from one receptacle to another receptacle at predetermined times; time-free control means for controlling the operation of said conveyor actuating means, independently of said time-control means, to move said conveyor independently of said time controlled means to a raised position for raising the material holder out of the receptacles, respectively, and to move said conveyor downwardly independently of said time controlled means to lower the material holder into the receptacles, respectively, independently of the operation of said time-control means, said time-free control means including switch means operable to releasably prevent operation of said conveyor under the control of said time-control means, following the raising thereof under the control of said time-free control means.

2. In automatic immersion apparatus, comprising a conveyor movable up and down laterally for transferring a material holder from one to another of laterally arranged receptacles, means for actuating said conveyor, time-control means, and means operable under the control of said time-control means for operating said actuating means to operate said conveyor for transferring said holder from one receptacle to another receptacle at predetermined times; normally inoperable auxiliary time-free control means for controlling the operation of said conveyor actuating means independently of said time-control means to move said conveyor to a raised position for raising the material holder out of the receptacles, respectively, and to move said conveyor downwardly to lower the material holder into the receptacles, respectively, independently of the operation of said time-control means, and means for releasably retaining said conveyor in said raised position thereof free of control by said time-control means upon energization of said auxiliary control means for raising said conveyor.

3. In automatic immersion apparatus, comprising a conveyor movable up and down and laterally for transferring a material holder from one to another of laterally arranged receptacles, means for actuating said conveyor, time-control means, and means operable under the control of said time-control means for operating said actuating means to operate said conveyor for transferring said holder from one receptacle to another receptacle at predetermined times; normally inoperable auxiliary time-free control means for controlling the operation of said conveyor actuating means independently of said time-control means to move said conveyor to a raised position for raising the material holder out of the receptacles, respectively, and to move said conveyor downwardly to lower the material holder into the receptacles, respectively, independently of the operation of said time-control means, and means for retaining said conveyor in said raised position thereof free of control by said time-control means upon energization of said auxiliary control means for raising said conveyor, and means for rendering said retaining means ineffective upon energization of said auxiliary control means for lowering said conveyor.

4. In automatic immersion apparatus, comprising a conveyor movable up and down and laterally for transferring a material holder from one to another of laterally arranged receptacles, means for actuating said conveyor, time-control means, and means operable under the control of said time-control means for operating said actuating means to operate said conveyor for transferring said holder from one receptacle to another receptacle at predetermined times; normally inoperable auxiliary time-free control means for controlling the operation of said conveyor actuating means independently of said time-control means to move said conveyor to a raised position

and for retaining said conveyor in said raised position and for lowering said conveyor to a predetermined lowered position, and manually operable switch means, for energizing said auxiliary time-free control means for alternately raising and lowering said conveyor when said switch means is momentarily operated, said auxiliary time-free control means being effective to prevent lowering of said conveyor under the control of said time-control means.

5. In automatic immersion apparatus, comprising a conveyor movable up and down and laterally for transferring a material holder from one to another of laterally arranged receptacles, means for actuating said conveyor, time-control means, and means operable under the control of said time-control means for operating said actuating means to operate said conveyor for transferring said holder from one receptacle to another receptacle at predetermined times; time-free control means for controlling the operation of said conveyor actuating means, independently of said time-control means, to move said conveyor independently of said time controlled means to a raised position for raising the material holder out of the receptacles, respectively, and to move said conveyor downwardly independently of said time controlled means to lower the material holder into the receptacles, respectively, independently of the operation of said time-control means, said auxiliary time-free control means comprising relay means operable during time-free operation of said conveyor, and switch means in the energizing circuit of said relay for interrupting said circuit to de-energize said relay for terminating the operation of said conveyor.

6. In automatic immersion apparatus comprising a conveyor movable up and down and laterally for transferring a material holder from one to another of a plurality of receptacles arranged laterally of each other, actuating means for said conveyor, an electric motor for operating said actuating means to effect said movement of said conveyor, timing means, a circuit operable under the control of said timing means for automatically initiating the energization of said motor for operating said actuating means to move said conveyor to transfer said holder from one to another of said receptacles at predetermined timed intervals after predetermined periods of immersion of the holder in liquids in said receptacles, a normally inoperable time-free auxiliary control circuit for energizing said motor independently of said first mentioned control circuit, manual operating means for energizing said auxiliary circuit, whereby said motor can be energized to raise and lower said conveyor independently of said timing means, said auxiliary circuit including relay means energizable under the control of said manual operating means to interrupt said first mentioned circuit and to complete said auxiliary circuit to energize said motor, first switch means in the energizing circuit of said motor operable in response to a predetermined raising movement of said conveyor, to de-energize the motor retaining the conveyor in said raised position, and second switch means operable in response to a predetermined lowering movement of said conveyor to interrupt said auxiliary circuit and to reestablish said first mentioned circuit.

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