Jan. 20, 1959 M. H. PELAVIN 2,869,508

AUTOMATIC IMMERSION APPARATUS

Filed May 9, 1955 2 Sheets-Sheet 1

FIG. 1

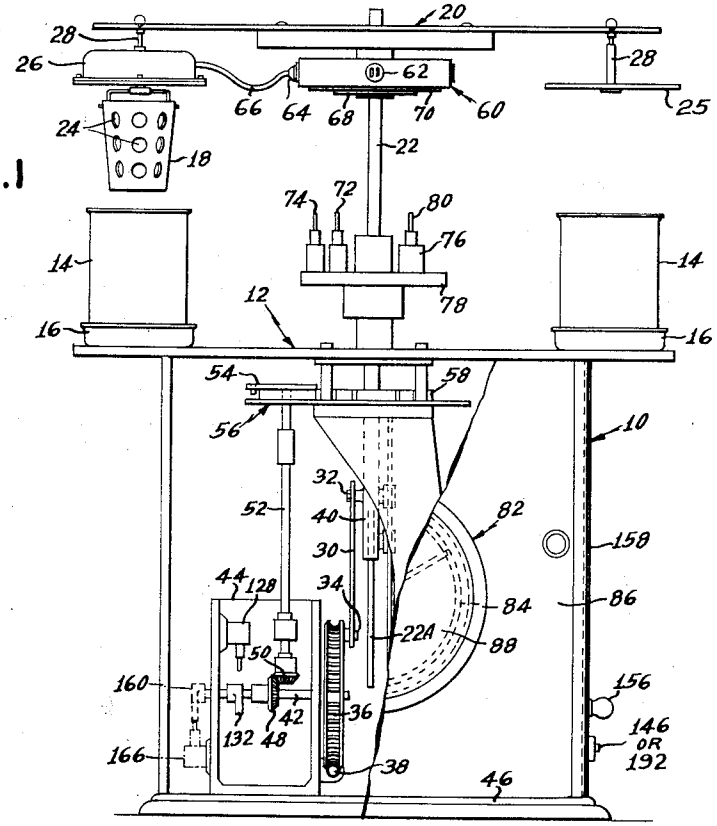
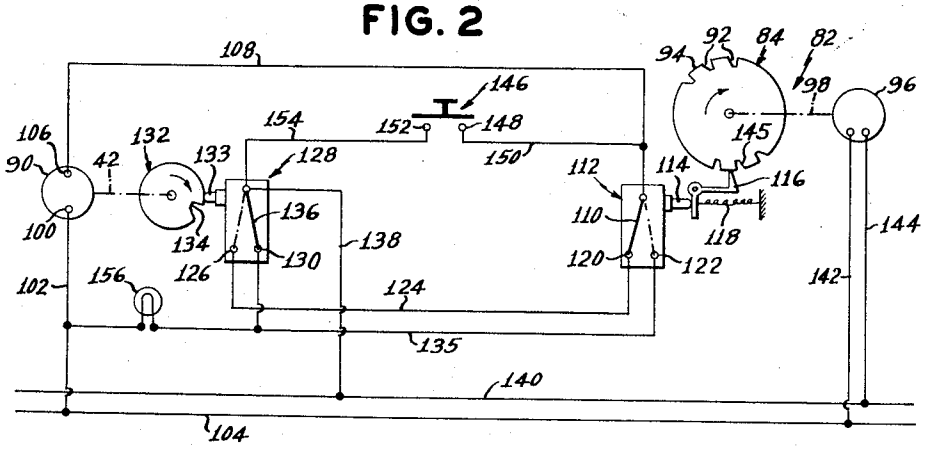


FIG. 2



INVENTOR.
Milton H. Pelavin
BY Edwin Sinsol & Harry Cole
ATTORNEYS

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AUTOMATIC IMMERSION APPARATUS

Filed May 9, 1955 2 Sheets-Sheet 2

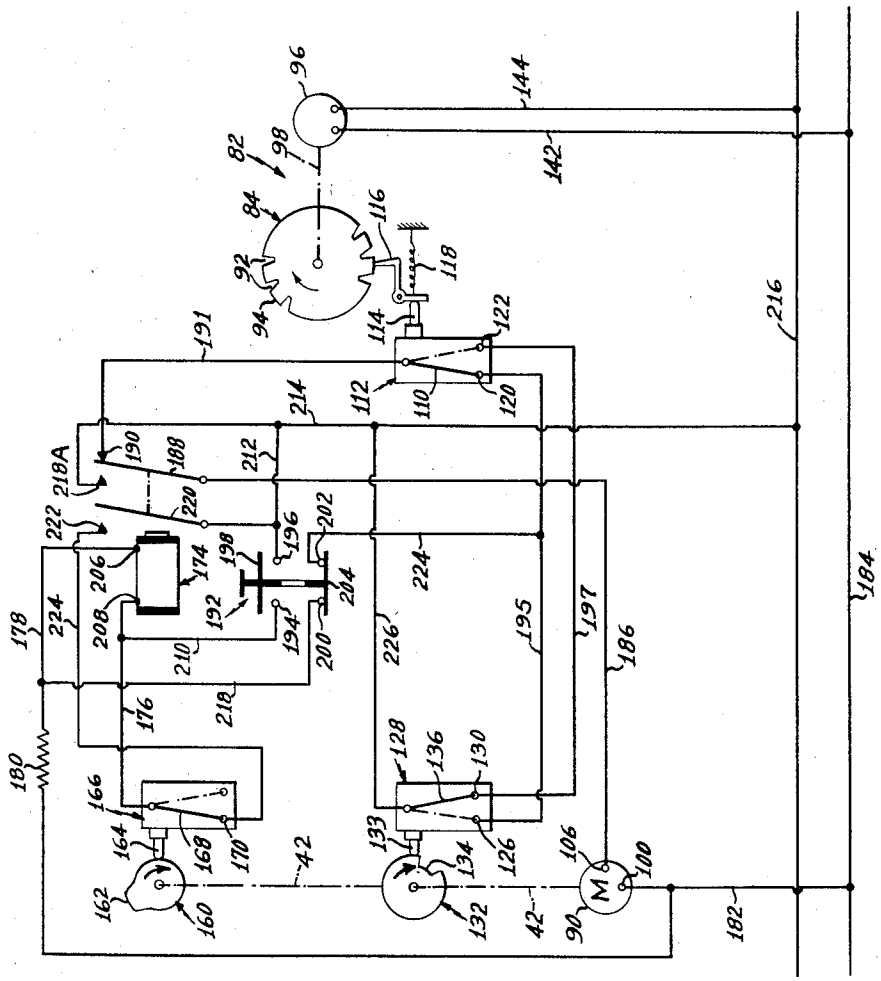


FIG. 3

INVENTOR.
Milton H. Pelavin
BY Edwin Denmark & Harry Cole
ATTORNEYS

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2,869,508

AUTOMATIC IMMERSION APPARATUS

Milton H. Pelavin, Queens, N. Y., assignor to Technicon International Ltd., Chauncey, N. Y., a corporation of New York

Application May 9, 1955, Serial No. 506,862

11 Claims. (Cl. 118—10)

The present invention relates to automatic immersion apparatus.

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 is the provision of a manual control to operate the actuating means for the conveyor to move the conveyor independently of the timing means from a lower position to a raised position of the conveyor and from the raised to the lowered position of the conveyor. In this connection, it is a more specific object to provide a signaling device which is operable in response to a predetermined movement of the conveyor to indicate a predetermined position of the conveyor.

A further object is the provision of a conveyor operating means operable under the control of a 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 receptable, which operating means can also be operated independently of the time control means by a 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 further object is the provision of a signalling device operable to indicate to the pathologist or to his technician that the conveyor has returned to the recycling position

thereof, whereby the manual operation thereof can be discontinued without interfering with the next cycle of operation under automatic control of the timing device.

A still further object is to provide generally improved automatic immersion apparatus which is adapted additionally for manual control.

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 which illustrate the best mode presently contemplated by me of carrying out the invention;

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

Fig. 2 is a circuit diagram of the control circuit illustrating the presently preferred embodiment of the invention, and

Fig. 3 is a circuit diagram illustrating a modified form of the control circuit.

The present invention is preferably utilized in connection with automatic processing apparatus of the general type illustrated and described in U. S. Patents No. 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 histological 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 **20**, 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 journalled 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 92 separated by continuous peripheral or circumferential edge portions 94 of the disk.

Referring now to Figure 2 in detail, there is illustrated the presently preferred embodiment of the present invention pursuant to which provision is made for controlling the operations of the motor 90 under the automatic control of the timing device 82, as well as under manual control. Under automatic control, the circuit of motor 90 is completed and interrupted at the proper times in substantially the same way as described in the previously identified U. S. Patent No. 2,157,875. One terminal 100 of the motor 90 is connected by the lead 102 to the power line 104. The other terminal 106 of the motor 90 is connected through lead 108 to the movable contact member 110 of a micro-switch 112. Said micro-switch is provided with an operating pin 114 which is operated by the operating lever 116, biased by the spring 118 for engagement in the notches 92 of the timing disk 84. More specifically, it will be understood that when the lever 116 enters a notch 92, the movable contact member 110 moves from the full line position thereof, illustrated in Fig. 2, wherein it engages the stationary contact 120, into the broken line position thereof wherein it engages the stationary contact 122. When the lever 116 rides on a rim portion 94 of the timing disk 84, the movable contact 110 is moved from the broken line to the full line position thereof. The stationary contact 120 of the micro-switch 112 is connected through the lead 124 to the stationary contact 126 of a micro-switch 128. The stationary contact 130 of the micro-switch 128 is connected to the stationary contact 122 of the micro-switch 112 by the lead 135. The micro-switch 128 has an operating pin 133 which rides on the periphery of a cam 132 which is carried by the previously mentioned shaft 42. It will be understood that when the pin 133 is engaged by the low cam portion 134 of the cam 132, the movable contact 136 of the micro-switch 128 moves from the full line position thereof, in engagement with the stationary contact 130, to the broken line position thereof in engagement with the stationary contact 126, and that when the pin 133 rides on the high portion of the cam 132, as illustrated in Fig. 2, the movable contact member 136 is engaged with the stationary contact 130. The movable contact member 136 is connected by the line 138 to the other power line 140.

Assuming now that the material holder 18, containing the tissue or other material to be subjected to the action of the liquids in the various receptacles 14, is in one of the receptacles, said holder is rotated in said receptacle by the rotating device 26, the conveyor 20, being in its down or lower position. It will be noted that the motor 96 which motor drives the timing disk 84, is connected to the power lines 104 and 140 by the lines 142 and 144, respectively, so that the motor 96 operates continuously throughout the operation of the apparatus to continuously drive the timing disk 84. After the timing device 82 has operated for a certain length of time, as predetermined by the location of the notches 92 in the timing disk 84, the micro-switch 112 is actuated when the lever 116 engages in one of the notches 92, and a circuit is completed to the motor 90 so that the latter turns the shaft 42 and operates through the previously described mechanism including the gears 38, 36, the link 30 and the cross head 40, first to raise the conveyor 20 to its upper position, as illustrated in Fig. 1, for withdrawing the holder 18 from the receptacle, then to turn said conveyor to a position in which the holder 18 is centered over the next receptacle and then to lower said conveyor to insert said holder into said last mentioned receptacle. This operating cycle is completed during one revolution of the shaft 42, and at the end of said revolution of said shaft, the motor 90 is de-energized and stops operating. This cycle of operation is repeated at appropriate intervals according to the adjustment of the timing device 82 accomplished by the notched timing disk and associated mechanism, as described in the previously identified U. S. Patent No. 2,157,875, together with the micro-switches 112 and 128.

It will be noted that the supply circuit to the motor 90

is controlled jointly by the micro-switches 112 and 128, the latter being operated by the cam 132. Figure 2 illustrates the condition of the circuit with the material holder inserted in the liquid in one of the receptacles 14, the motor 90 being de-energized. As previously indicated, the timing motor 96 continuously operates to continuously rotate the timing disk 84 so that when the lever 116 engages in a notch 92, the pin 114 of the micro-switch 112 is released so that the movable contact member 110 moves into the broken line position thereof into engagement with the stationary contact 122. This completes a circuit for energizing the motor 90 which can be traced as follows: From the power line 104 through the lead 102 to the motor terminal 100, from the motor terminal 106 through the lead 108 to the movable contact member 110 of the micro-switch 112 which is now engaged with the stationary contact 122, through the line 135 to the stationary contact 130 of the micro-switch 128 which is engaged by the movable contact 136 and through the lead 138 to the power line 140. The micro-switch 128 remains in the circuit closing position thereof illustrated in Fig. 2 as long as the lever 116 is stationary in a notch of the disk 84, but at the end of one revolution of the shaft 42, cam 132 is rotated so that the low cam portion 134 thereof is opposite the pin 133 of the micro-switch 128 and the movable contact member 136 thereof moves out of engagement with the stationary contact 130 and into engagement with the stationary contact 126 thereof. It will be noted that the contact member 110 of the micro-switch 112 is at this time still in engagement with the contact 122 thereof, whereby the circuit to the motor 90 is interrupted at the micro-switch 128 and the motor stops. At the end of the cycle, that is, when motor 90 has stopped running, the material holder 18 is in its down or fully projected position in a receptacle 14. The clock motor 96 turning the disk 84 moves edge 145 of the notch, into which the lever 116 has entered, against said lever and turns the latter so as to operate the pin 114 of the switch 112 to move the contact member 110 into engagement with the contact 120. This completes the circuit through the motor 90 temporarily, that is, just long enough to turn the shaft 42 the short distance required to displace the cam fall portion 134 of the cam 132 out of engagement with the pin 133 of the switch 128, whereby the contact member 136 moves to the full line position thereof in engagement with the contact 130, as illustrated in Fig. 2 thus interrupting the circuit to the motor 90, and recycling the apparatus. It will be noted that the short angular movement of the shaft 42 required to rotate the cam 132 to the position thereof illustrated in Fig. 2, results only in a slight upward movement of the conveyor shaft 22. When the movable contact member 136 of the micro-switch 128 is in engagement with the stationary contact 126 thereof, the movable contact 110 of the micro-switch 112 being engaged with the stationary contact 120 thereof, as explained, the circuit through the motor 90 may be traced as follows: From the power line 104 to the motor, from the motor through the line 108 to the micro-switch 112, from the engaged contacts 110—120 thereof, through the line 124 to the engaged contacts 126—136 of the micro-switch 128 and through the line 138 to the power line 140. When the pin 133 of the micro-switch 128 rides out of the cam fall portion 134 onto the high portion of the cam 132, as illustrated in Fig. 2, the movable contact member 136 of switch 128 disengages the stationary contact 126 and engages the sationary contact 130 and thus interrupts the connection of the power line 140 to the motor and the latter stops running. At this time the stationary contact 130 is engaged by the movable contact 136 of the micro-switch 128, so that the micro-switch 128 is ready to complete the circuit to the motor as soon as the contact 110 of the micro-switch 112 again engages the stationary contact 122 thereof which occurs when the next notch 92 of the timing disk 84 is positioned to receive the switch control lever 116 of the timing device.

Pursuant to the present invention, provision is made to effect a manual control of the motor 90, independent of the timing device 82, so as to raise and lower the conveyor 20 during the time that the switch control lever 116 rides on a peripheral portion 94 of the timing disk 84 so that the circuit through the motor 90 is interrupted, as previously explained. In this connection, provision is made for a push button switch 146 which is biased to the open position thereof illustrated in Fig. 2. The terminal 148 of the switch 146 is connected by the lead 150 to the lead 108, and the terminal 152 of said switch is connected by the lead 154 to the movable contact 136 of the micro-switch 128. When the switch 146 is depressed to bridge the contacts 148—152 thereof, a circuit is established through the motor 90 as follows: From the power line 104 through the lead 102 to the motor 90, from the motor through the leads 108 and 150, through the closed switch 146 and through the leads 154 and 138 to the other power line 140. As long as the switch 146 is retained in its depressed position, said circuit is completed and the motor 90 is energized.

The pathologist or his technician can in this manner retain the motor 90 energized for raising the conveyor 20 to withdraw a holder 18 from a receptacle 14. When the conveyor 20 has been raised to the desired position, the push button 146 is released and the motor is de-energized, the holder 18 remaining in its raised or withdrawn position. The pathologist or his technician may now examine or replace the tissue within the holder 18, or perform any other desired operation or function, and when it is desired to return the holder 18 to the next receptacle, the push button is again depressed and the motor is energized so that the conveyor 20 is rotated and then move downwardly to position the holder 18 in the next receptacle. As previously explained, the automatic operation of the motor 90 is controlled by both the micro-switches 112 and 128, the latter being operated by the cam 132 on the motor driven shaft 42. In order to assure a correct automatic operation of the motor under the control of said micro-switches, after the motor has been operated under the manual control of the push button 146, it is important that when the holder 18 has been returned to a receptacle 14, that the operating pin 133 of the micro-switch 128 be engaged by the low portion 134 of the cam 132. This cam 132 is positioned within the cabinet 10, as illustrated in Fig. 1, so that it is not visible to the pathologist or his technician. Therefore, in this connection, provision is made for a signal means constituted by a signal light 156.

As here shown, the light 156 is connected between the leads or wires 102 and 135 so that a circuit through the light is completed when the movable contact member 136 of the micro-switch 128 is in the full line position thereof in engagement with the stationary contact 130. Since this is the position of the movable contact member 136 during the major portion of its engagement with the cam 132, except for the time when the pin 133 engages the low cam portion 134, the signal light 156 will be energized during most of the cycle of operation of the motor 90. However, when the motor is being operated to lower the holder 18 into a receptacle 14, after the holder 18 has moved all the way to a predetermined position in the liquid within the receptacle, the switch 128 operates so that the movable contact member 136 thereof moves from its full to its broken line position to break the circuit through the signal light 156 and the light goes out. This serves as a signal to the pathologist or his technician to release the push button 146 since it assures him that the conveyor 20 and the cam 132, as well as the switch 128, are all now properly conditioned or positioned for the recycling of the apparatus. It will be noted in this connection, that with the movable contact member 136 of switch 128 in the broken line position thereof, and

with the switch 112 closed at its contacts 110—120, an energizing circuit for the motor is completed. However, as previously explained, this operation of switch 128 completes the circuit through the motor 90 temporarily, that is, just long enough to turn the shaft 42 the short distance required to move the low portion 134 of the cam 132 past the pin 133 of the switch 128 whereby the movable contact member 136 moves to the full line position thereof, thus interrupting the circuit to the motor 90. As previously explained, this short angular movement of the shaft 42 does not result in appreciable movement of the conveyor shaft 22 and the switch 128 is now conditioned to complete the energizing circuit for the motor 90 when the switch lever 116 moves into the next notch 92.

As explained, the conveyor 20 can be raised independently of the operation of the timing device 82, by the operation of the push button 146. Assuming now that the conveyor is in the raised position thereof, as illustrated in Fig. 1, and the switch control lever 116 is riding on the peripheral portion 94 of the timing disk 84, if the pathologist or his technician for any reason should forget or neglect to lower the conveyor so as to return the holder 18 to the next receptacle 14, this will be accomplished automatically by the timing means 84 when the switch control lever 116 falls into the next notch 92. As previously explained, this will result in the energization of the motor 90 so as to complete the cycle of movement of the conveyor 20 to return the latter to its lowermost position, the signal light 156 going off when the holder 18 is fully inserted into the liquid, as previously explained. This occurs, when the switch 128 is operated by the cam 132 to move the movable contact member 136 from the full to the broken line position thereof to interrupt the circuit through the motor 90 so that the holder 18 remains in the receptacle 14. As previously explained, when the switch control lever 116 moves out of the notch 92, the motor 90 is temporarily energized to move the low cam portion 134 out of engagement with the pin 133 so that the movable contact member 136 is moved back to the full line position thereof, the signal light 156 being energized, and the control circuit being conditioned for the next cycle of operation when the switch control lever 116 moves into the next notch 92. From the foregoing, it will be readily apparent that the energization of the motor 90 under the control of the manually operable switch means 146 is ineffective to prevent the lowering of the conveyor 20 under the control of the time control means 82 in the event that the conveyor is left inadvertently in its raised position.

The push button switch 146 and the signal light 156 may be mounted on any suitable part of the apparatus. As here shown, said switch and signal light are mounted on the side wall 158 of the cabinet 10.

Referring now to Figure 3, there is illustrated a modified form of control circuit for providing both for the operation of the motor 90 under automatic control and under manual control. As in the previously described embodiment, the motor 90 operates the shaft 42 which mounts the cam 132 having the low cam portion 134 for operating the micro-switch 128, the micro-switch 112 being operated by the timing device 82 comprising the timing disc 84 which is operated by the clock motor 96 through the shaft 98. Said micro-switches are interconnected in a main control circuit. The motor operated shaft 42 also mounts a cam 160 (as illustrated in broken line in Fig. 3) having a cam rise 162, which rise operates the pin 164 of a micro-switch 166, of an auxiliary circuit, for moving the movable switch member 168 thereof out of its closed position, in engagement with the stationary contact 170, into switch-open position, as indicated in the broken line position thereof. Provision is also made in the auxiliary circuit for a relay 174. One end of the relay is connected through the lead 176 to the movable contact member 168 of the micro-switch 166, and the other end of the relay is connected through the lead 178, which includes a resistor 180, to the lead 182 connected to the power line 184. Said lead 182 also connects the motor terminal 100 of motor 90 to the power line 184, the motor terminal 106 of said motor being connected through the lead 186 to the movable switch member or armature 188 of the relay 174. Said armature is normally engaged, that is, in the de-energized condition of the relay 174, with the contact 190 which is connected through the lead 191 to the movable switch member 110 of the micro-switch 112. As in the prior embodiment, the stationary contact 120 of said micro-switch is connected through the lead 195 to the stationary contact 126 of the micro-switch 128. The stationary contact 122 of the micro-switch 112 is connected through the lead 197 to the stationary contact 130 of the micro-switch 128. It will be noted that the automatic operation of the motor 90 under the control of the micro-switches 112 and 128, of the main control circuit, in Fig. 3 is exactly the same as said automatic operation under the control of said micro-switches in Fig. 2, the only difference in the circuits being that in Fig. 3 the circuit between the terminal 106 of the motor 90 and the micro-switch 112 includes the armature 188 and the stationary contact 190. However, it will be apparent that this makes no difference whatsoever in the automatic operation of the motor under the control of said micro-switches as long as the movable contact member 188 engages the stationary contact 190. However, when it is desired to operate the motor 90 under manual control, the relay 174 is energized to interrupt the main control circuit between the motor terminal 106 and the micro-switch 112 by disengaging the armature 188 from the stationary contact 190. As previously indicated, such manual operation may occur when the switch control lever 116 is riding on a raised peripheral portion 94 of the timing disc 84, at which time the conveyor 20 is normally in its lowermost position with the holder 18 immersed in the liquid within a receptacle 14.

In order to energize the relay 174 of the auxiliary circuit, to break the circuit for the automatic control of the motor under the timing disc 82, and to effectuate the manual control of said motor, provision is made for a double section push button switch 192. Said push-button includes the terminals 194 and 196 which are bridged by the push-button part 198 when the push-button is depressed, and the push-button terminals or contacts 200 and 202 which are normally bridged by the push-button part 204. It will be understood that the push-button bridging parts 198 and 204 are electrically insulated from each other and that the push button 192 is normally biased to the position thereof illustrated in Fig. 3, wherein the contacts 194 and 196 thereof are normally open, and the contacts 200 and 204 thereof are normally closed. Upon depressing the push button 192, there is established a circuit through the push button contacts 194 and 196 for energizing the relay 174 as follows:

From the power line 184 through the leads 182 and 178 to the relay terminal 206, through the relay, from the relay terminal 208 through the leads 176 and 210, through the bridged contacts 194 and 196 of the push button switch 192, and through the leads 212 and 214 to the other power line 216. The relay 174 being energized, the armature 188 thereof is disengaged from the stationary contact 190 so as to interrupt the automatic timing control circuit, as previously described, and engages the stationary contact 218A which is connected to the lead 214. In addition, the other relay armature 220, which is ganged with the armature 188, makes contact with the stationary contact 222 which is connected by the lead 224 to the stationary contact 170 of the micro-switch 166. It will be noted that the relay terminal 208, in addition to being connected to the terminal 194 of the push-button 192, is also connected through the lead 176, the engaged contacts 168 and 170 of the micro-switch 166, the lead 224, the engaged relay contacts 222 and

220 to the lead 212, and through the lead 214 to the other power line 216 so as to establish a "stick" or holding circuit for the relay which retains the relay energized upon release of the push-button 192. The push-button 192 having been depressed and released to energize the relay 174, establishing the holding circuit therethrough, and the armature 188 having disengaged the contact 190 and engaged the contact 218A, there is established an energizing circuit for the motor 90 which can be traced as follows:

From the power line 184 through the lead 182 to the motor terminal 100, from the motor terminal 106 through the lead 186 and the engaged relay contacts 188 and 218A to the lead 214 and through the latter to the other power line 216. Consequently, the motor operates to raise the conveyor 20. When the conveyor arrives at the raised position thereof illustrated in Fig. 1, the cam rise 162 of the cam 160, which cam is mounted on the motor driven shaft 42, operates the pin 164 of the micro-switch 166, suitably carried on the frame 44, as illustrated in Fig. 1, to move the movable contact member 168 from the full to the broken line position thereof. This breaks the previously described relay holding circuit so that the relay 174 is de-energized, whereby the armature 188 thereof disengages the stationary contact 218A to interrupt the motor circuit between the terminal 106 and the power line 216. The conveyor now is positioned in its raised position and the pathologist and his technician may examine, inspect, replace or perform any other desired operation upon the material within the holder 18.

In order to lower the conveyor so as to return the holder 18 to the liquid within the next receptacle, the push-button 192 is again depressed to energize the relay 174 for energizing the motor 90. However, the push-button 192 must now be retained in its depressed position until the cam rise 162 disengages the micro-switch pin 164 so as to re-establish the previously described relay holding circuit, at which time the push-button may be released. It will be understood that this requires only a very short time interval during which the push-button need be retained in its depressed position. The micro-switch 128 is utilized to de-energize the motor when it has carried the conveyor back to its lower position. In this connection, as previously indicated, when the holder 18 is again completely immersed within the liquid within a receptacle, the cam fall portion 134 of the cam 132 is opposite the pin 133 of the micro-switch 128, so that the movable contact member 136 moves to the broken line position thereof to engage the stationary contact 126. This completes a circuit, which shorts out the relay 174, as follows:

From the relay terminal 206, through the leads 178 and 218, through the engaged push button contacts 200 and 202 to the lead 224, through the lead 195 to the now engaged contacts 126 and 136 of the switch 128, from the switch 128 through the leads 226 and 214 to the lead 212, through the engaged contacts 220 and 222 of the relay 174, through the lead 224, and through the engaged contacts 168 and 170 of switch 166, and through the lead 176 to the relay terminal 208. This circuit shorts out the relay 174 to de-energize the latter so as to disengage the contacts 220 and 188 from the contacts 222 and 218A, respectively, the contact 188 being now engaged with the contact 190. This results in the interruption of the holding circuit for the relay and completes the main control circuit for energizing the motor under the control of the timing device 82. The motor is now in its original position for energization under the control of the timing device when the switch control lever 116 moves into the next notch 92.

When the previously described short circuit is established across the relay 174, the resistor 180 prevents the shorting of the main power lines 184 and 216. In this connection, it will be noted that the 110 volts provided by the power lines 184 and 216 normally divides across the resistor 180 and the relay 174, to provide the desired relay operating voltage, and when the relay is shorted out by operation of the micro-switch 128, as previously described, the entire 110 volts is developed across the resistor 180, with no voltage being developed across the relay so that the relay is de-energized and opens, as previously described.

Assuming now that the pathologist or his technician has raised the conveyor through the operation of the push button 192 and has neglected or forgotten to return the conveyor to its lowermost position, the relay contacts 188 and 190 being engaged when the relay was de-energized by operation of the cam 160 upon the micro-switch 166, the timing device 82 has continued to operate under the control of the continuously operable clock motor 96, so that when the switch control lever 116 enters the next notch 92, the circuit for energizing motor 90 is completed through the micro-switch 112, wherein the contacts 110 and 122 are now engaged, and the micro-switch 128 wherein the contacts 130 and 136 are engaged, and the conveyor moves down until the circuit is interrupted when the low cam portion 134 of cam 132 is engaged by the pin 133 of the micro-switch 128. Thereafter, when the switch control lever 116 is moved out of the notch 92 to temporarily energize the motor 90 to provide the short angular movement of cam 132 necessary to move the movable contact 136 from contact 126 to 130, the motor is de-energized without appreciably raising the holder from the receptacle, as previously described, and the circuit is again conditioned for the next automatic operation thereof when the switch control lever 116 falls into the following notch 92.

The pathologist or his technician may desire to raise the conveyor through manual operation when the condition of the apparatus is such that the pin 133 is engaged by the low portion of the cam 132, and lever 116 is in a notch 92 so that switch contacts 110 and 122 are engaged, in which case the contacts 136 and 126 thereof are in engagement. As previously explained, in this position of the switch 128, a short circuit would be established across the relay 174 if the relay is energized by the depression of the push button 192 to close the contacts 194, 196 thereof so as to close the relay contacts 220 and 222. In order to prevent such a short circuit under the described conditions, provision is made for the previously described second section of the push button which includes the push button contacts 200 and 202 normally bridged by the bridging part 204. Consequently, in the described condition of the circuit, when the push button 192 is depressed to complete the circuit through the push-button contacts 194 and 196 to energize the relay 174, the previously described circuit for shorting the relay is interrupted when the bridging part 204 disengages the push-button contacts 200 and 202 simultaneously with the bridging of the push-button contacts 194 and 196, by part 198 and the push-button must be retained in said depressed position thereof until the low cam portion 134 disengages the pin 133 of the switch 128. As soon as this occurs, the push-button can be released and the conveyor will move upwardly to its upper position until the cam 160 operates the micro-switch 166 to stop the upward movement of the conveyor, as previously described.

From the foregoing, it will be apparent that the motor 90 is normally energized through the normally closed contacts 190 and 188 of the relay 174 when the motor is operating under the control of the automatic timing device 82. However, when the motor is being operated under the manual control provided through the relay 174, the motor is energized through the normally open relay contacts 188 and 218A.

It will be understood that in each of the embodiments illustrated in Figs. 2 and 3, suitable provision (not illustrated) is made to disconnect both the clock motor

96 and conveyor operating motor 90 from the power lines when the apparatus is not in use.

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 a manual pushbutton 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.

While I have shown and described the preferred embodiment of my invention, it will be understood that various changes may be made in the idea or principles of the invention within the scope of the appended claims.

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 holder from one to another of laterally arranged receptacles, means for actuating said conveyor, time-control means, and electrical 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; and auxiliary time-free control means for operating 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, independently of the operation of said time-control means, said auxiliary control means comprising manually operable means and electric-relay means operable under the control of said manually operable means to control the energization of said electrical means for operating said conveyor, said manually operable means being ineffective to prevent the lowering of said conveyor under the control of the time controlled means.

2. 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, and 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, and manual operating means for energizing said auxiliary control circuit, whereby said motor can be energized to operate said conveyor during said predetermined periods independently of the timing means for the automatic control of said motor, 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 for raising and lowering said conveyor independently of said timing means, first switch means operable in response to a predetermined raising movement of said conveyor to interrupt said auxiliary circuit to releasably retain said 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.

3. 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, and 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, and manual operating means for energizing said auxiliary control circuit, whereby said motor can be energized to operate said conveyor during said predetermined periods independently of the timing means for the automatic control of said motor, said auxiliary circuit including relay means having contacts in series with the first mentioned circuit energizable under the control of said manual operating means to interrupt said first mentioned circuit and to complete said auxiliary circuit for raising and lowering said conveyor independently of said timing means, first switch means operable in response to a predetermined raising movement of said conveyor to interrupt said auxiliary circuit to releasably retain said 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, said relay means having a holding circuit, said first switch means being operable upon said predetermined raising movement to interrupt said holding circuit and said second switch means being operable upon said predetermined lowering movement of said conveyor to short said holding circuit for de-energizing said relay.

4. 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, and manual operating means for energizing said auxiliary control circuit, whereby said motor can be energized to operate said conveyor during said predetermined periods independently of the timing means for the automatic control of said motor, 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, first switch means operable in response to a predetermined raising movement of said conveyor to interrupt said auxiliary circuit, and second switch means operable in response to a predetermined lowering movement of said conveyor to interrupt said auxiliary circuit, said relay means having a holding circuit, said first switch means being operable upon said predetermined raising movement to interrupt said holding circuit and said second switch means being operable upon said predetermined lowering movement of said conveyor to short circuit said holding circuit for de-energizing said relay, a resistance, means for automatically inserting said resistance in said auxiliary circuit upon short circuiting of said relay, and said manual operating means having provision to discontinue said short and to complete said holding circuit.

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, an electric motor for operating said actuating means, and a

normally open circuit for energizing said motor, said circuit including a first switch, time-control means for operating said switch to complete said circuit to energize said motor to raise said conveyor, to move said conveyor laterally, and to lower said conveyor, a second switch in the energizing circuit of the motor, means operable in the lowered position of said conveyor to operate said second switch to open said circuit for de-energizing said motor; a normally open time-free auxiliary circuit for energizing said motor for raising said conveyor and lowering said conveyor to a predetermined position, said auxiliary circuit including a relay having a set of normally closed contacts included in said first mentioned circuit and a manual control for energizing said relay to interrupt said first mentioned circuit and to complete said auxiliary circuit for energizing said motor.

6. 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, an electric motor for operating said actuating means, and a normally open circuit for energizing said motor, said circuit including a first switch, time-control means for operating said switch to complete said circuit to energize said motor to raise said conveyor, to move said conveyor laterally, and to lower said conveyor, a second switch in the energizing circuit of the motor, means operable in the lowered position of said conveyor to operate said second switch to open said circuit for de-energizing said motor; a normally open time-free auxiliary circuit for energizing said motor, said auxiliary circuit including a relay having a set of normally closed contacts included in said first mentioned circuit and a manual control for energizing said relay to interrupt said first mentioned circuit and to complete said auxiliary circuit for energizing said motor, said auxiliary circuit including a third switch, means operable in the raised position of said conveyor to operate said third switch to interrupt said auxiliary circuit, and said second switch being operable in said lowered position of said conveyor to discontinue the energization of said motor by said auxiliary circuit, said auxiliary circuit being ineffective to prevent the lowering of said conveyor under the control of the time-control means.

7. 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 electrical 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; manually operable auxiliary time-free control means for controlling the operation of said means for operating 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, independently of the operation of said time-control means, and for operating said conveyor actuating means to move said conveyor independently of said time-control means from a raised position to a lowered position in which the material holder is positioned in the next receptacle, said auxiliary time-free control means comprising manually operable switch means biased to open position and movable to closed position for energizing said electrical means independently of said time-control means, said manually operable switch means being automatically movable to open position upon termination of its manual closing operation whereby to prevent repeated non-controlled operations of said conveyor independently of said time-control means, said auxiliary time-free control means including a holding circuit for releasably maintaining said electrical means energized after termination of said manual closing operation of said switch means and until said conveyor is in a predetermined position.

8. 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 electrical 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; manually operable auxiliary time-free control means for controlling the operation of said means for operating 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, independently of the operation of said time-control means, and for operating said conveyor actuating means to move said conveyor independently of said time-control means from a raised position to a lowered position in which the material holder is positioned in the next receptacle, said auxiliary time-free control means comprising manually operable switch means biased to open position and movable to closed position for energizing said electrical means independently of said time-control means, said manually operable switch means being automatically movable to open position upon termination of its manual closing operation whereby to prevent repeated non-controlled operation of said conveyor independently of said time-control means, and switch means operable to interrupt the operation of said electrical means after the raising movement of said conveyor is initiated under the control of said time-free means.

9. 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 electrical 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; manually operable auxiliary time-free control means for controlling the operation of said means for operating 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, independently of the operation of said time-control means, and for operating said conveyor actuating means to move said conveyor independently of said time-control means from a raised position to a lowered position in which the material holder is positioned in the next receptacle, said auxiliary time-free control means comprising manually operable switch means biased to open position and movable to closed position for energizing said electrical means independently of said time-control means, said manually operable switch means being automatically movable to open position upon termination of its manual closing operation whereby to prevent repeated non-controlled operation of said conveyor independently of said time-control means, said auxiliary time-free control means including a holding circuit for releasably maintaining said electrical means energized after termination of said manual closing operation of said switch means and until said conveyor is in a predetermined position and switch means operable to interrupt the operation of said electrical means after the raising movement of said conveyor is initiated under the control of said time-free means.

10. 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 and 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, and manual operating means for energizing said auxiliary control circuit, whereby said motor can be energized to operate said conveyor during said predetermined periods independently of the timing means for the automatic control of said motor, 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 for raising and lowering said conveyor independently of said timing means, and switch means to interrupt the movement of said conveyor in a raised position thereof.

11. In automatic immersion apparatus, comprising a conveyor for moving a material holder into and out of a plurality of receptacles disposed laterally of each other, mechanism for actuating said conveyor to raise and lower the material holder and to move it laterally of the receptacles while in a raised position, means including an electric motor for operating said mechanism, and timing means for controlling the operations of said motor for transferring the holder from one receptacle to another with a predetermined dwell period of the holder in each receptacle; manually controlled means operable independently of said timing means for controlling the operation of said motor independently of said timing means, said manually controlled means including means operable by momentary manual operation to initiate the operation of said motor to actuate said conveyor mechanism, said manually controlled means including a holding circuit for maintaining the motor energized following said momentary manual operation of said manually operable means, said manually controlled means also including means operable automatically upon the lowering of the conveyor to a predetermined position to de-energize said motor and to restore it to the control of said timing means.

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