Feb. 10, 1959 J. ISREELI 2,872,894

AUTOMATIC IMMERSION APPARATUS

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FIG. 1

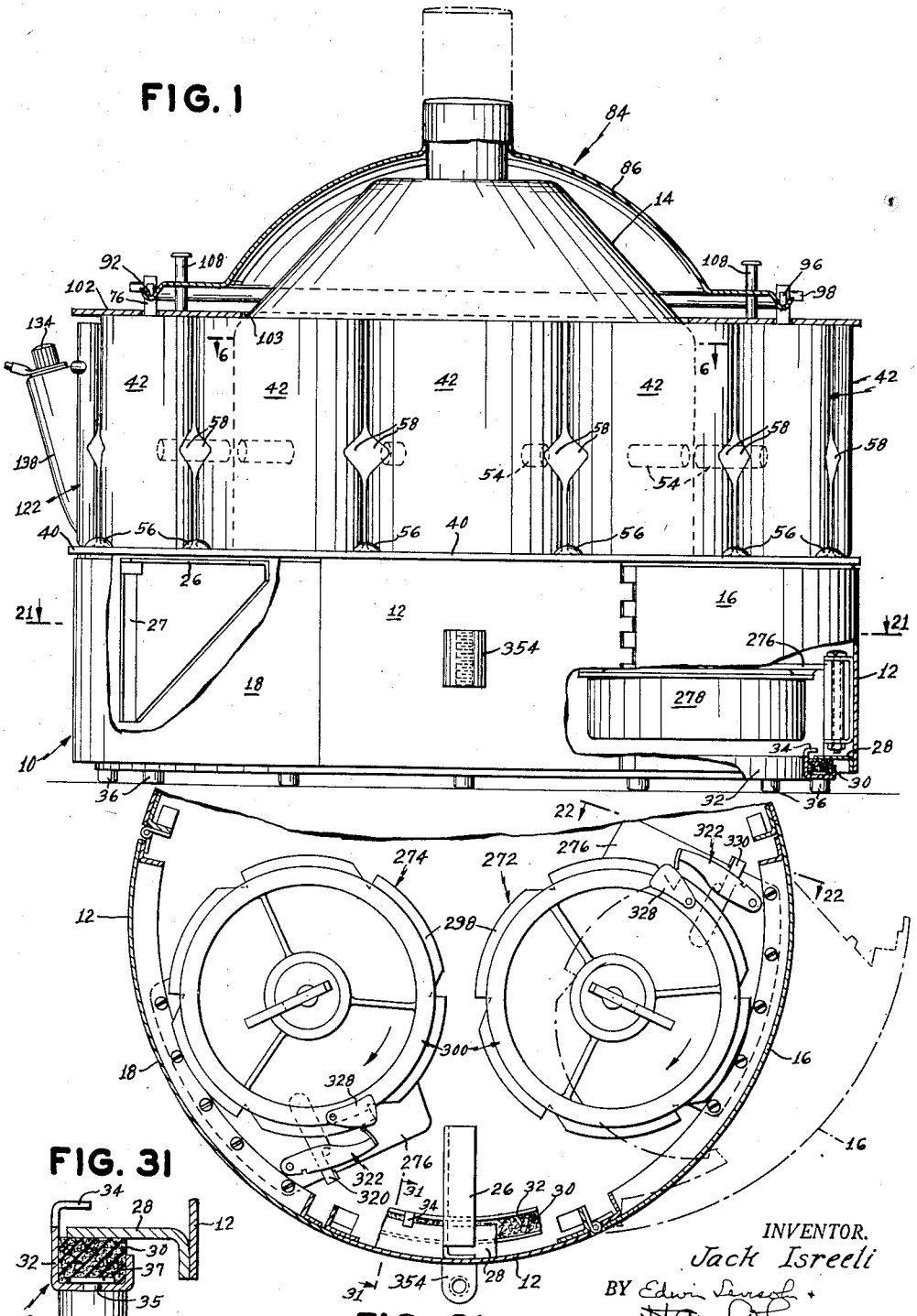


FIG. 31

FIG. 21

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Harry Cole
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FIG. 2

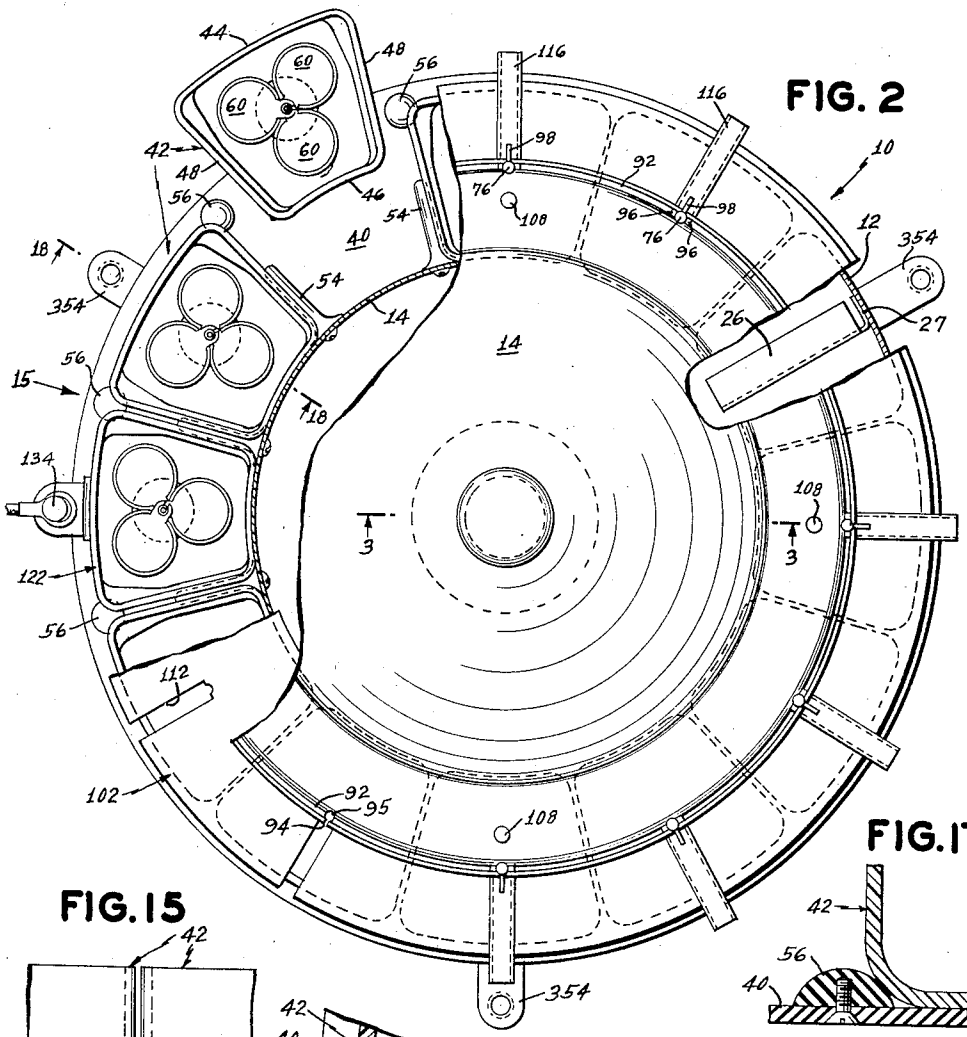
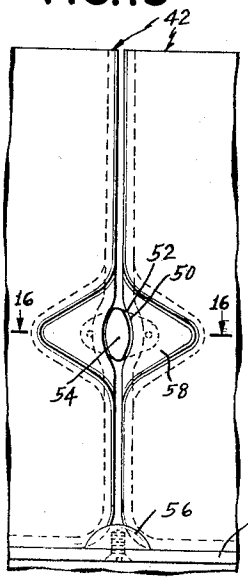


FIG. 17

FIG. 15



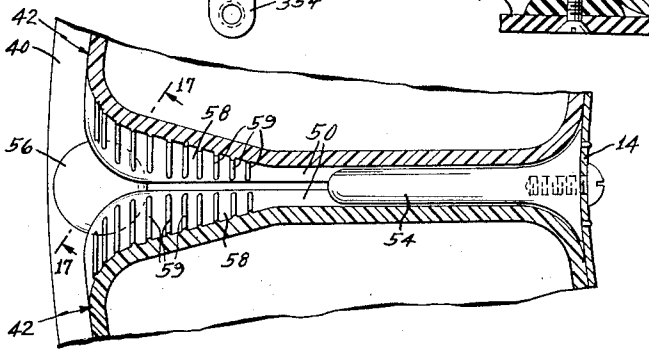


FIG. 16

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FIG. 3

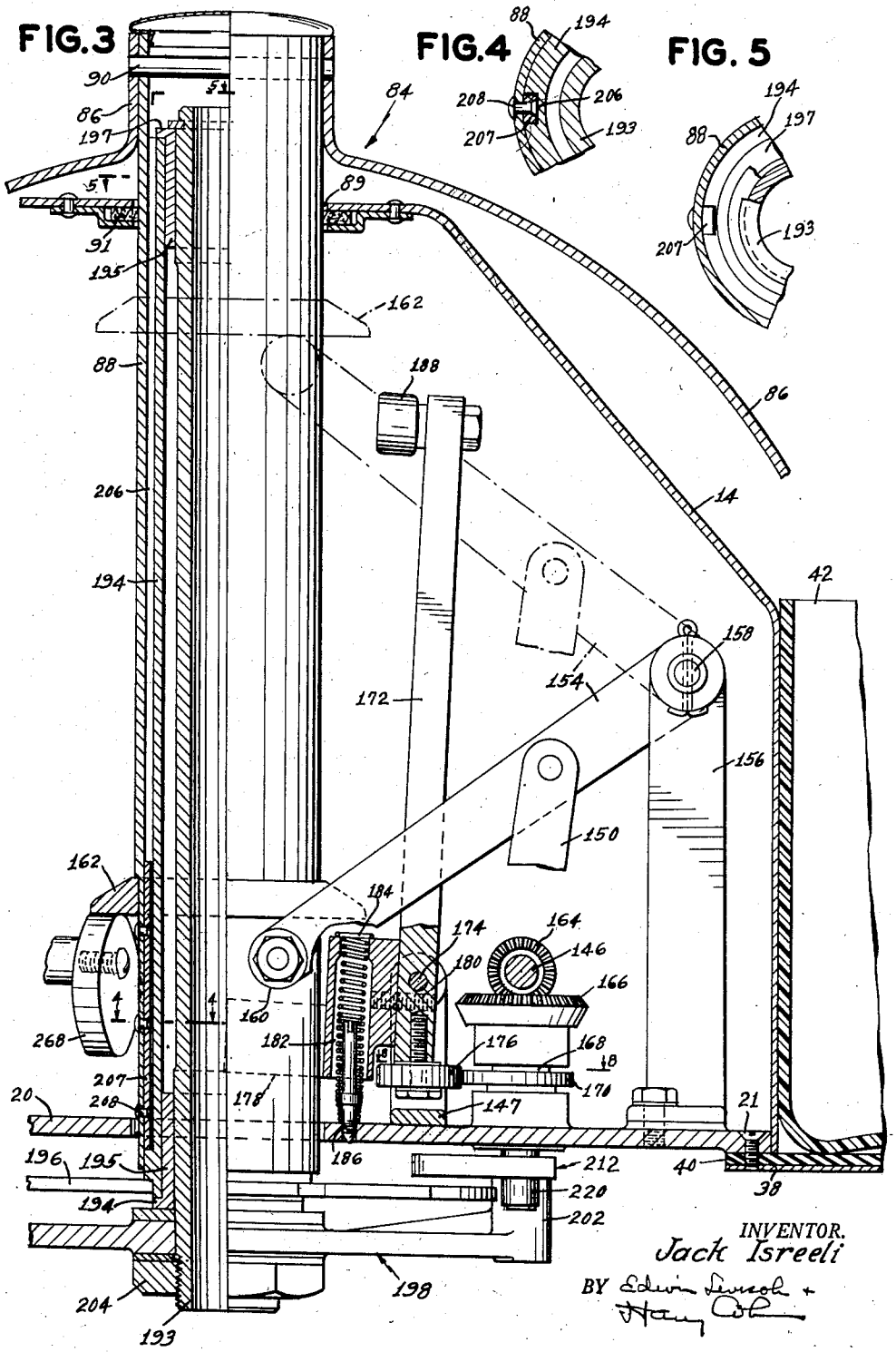


FIG. 4

FIG. 5

INVENTOR.
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Feb. 10, 1959 J. ISREELI 2,872,894

AUTOMATIC IMMERSION APPARATUS

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FIG. 6

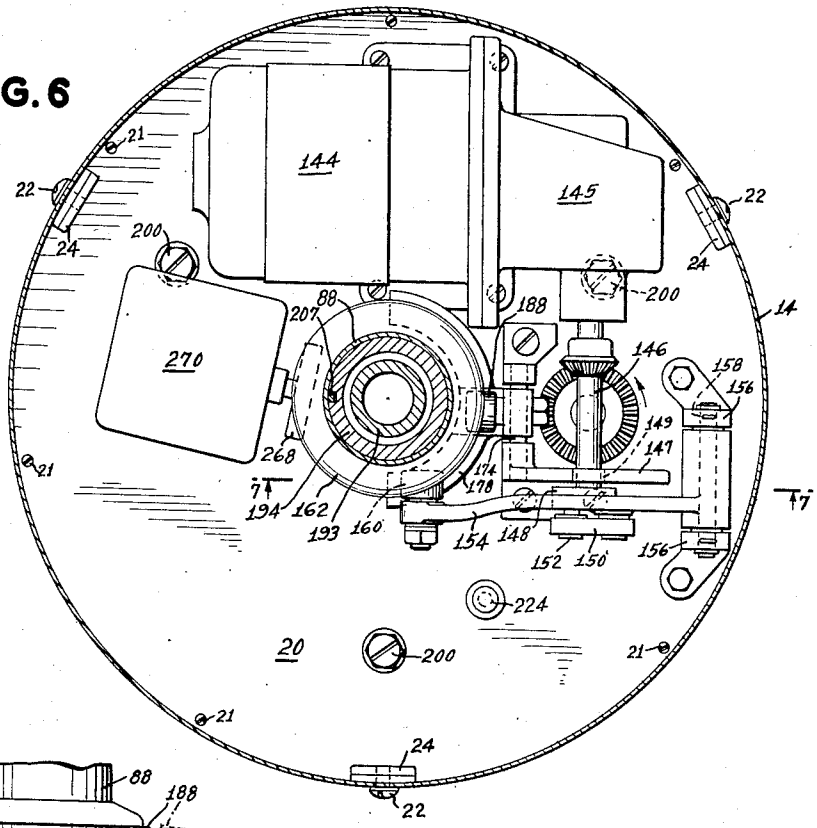


FIG. 7

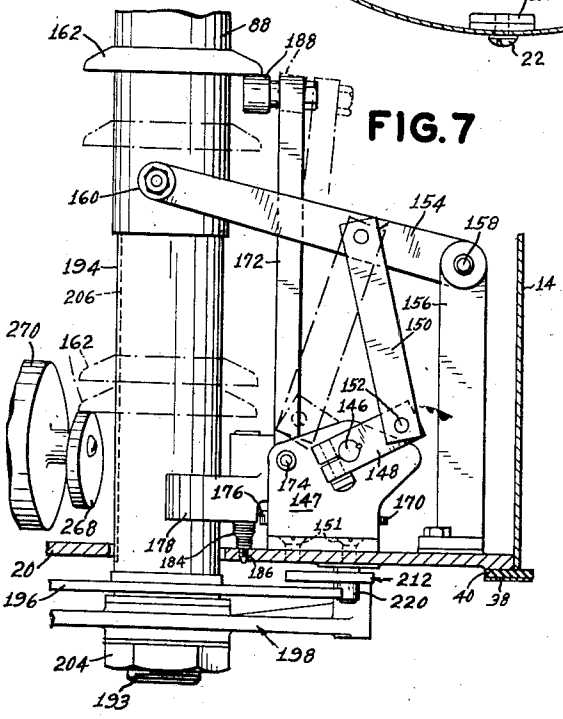
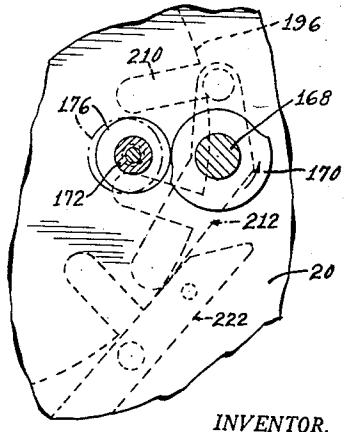


FIG. 8



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FIG. 10

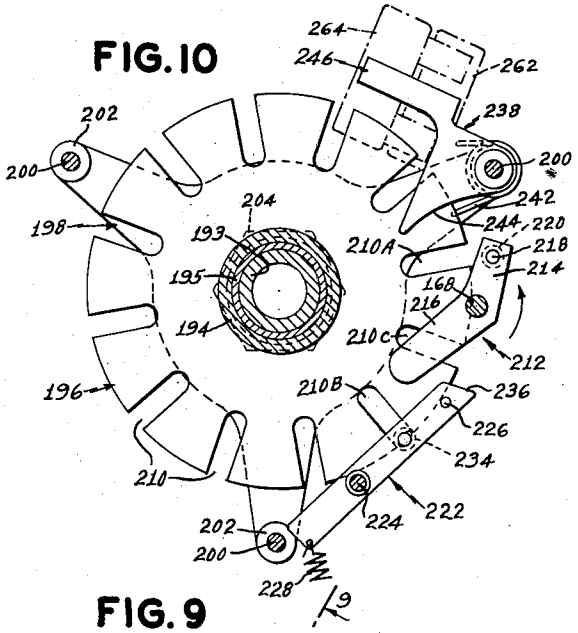


FIG. 11

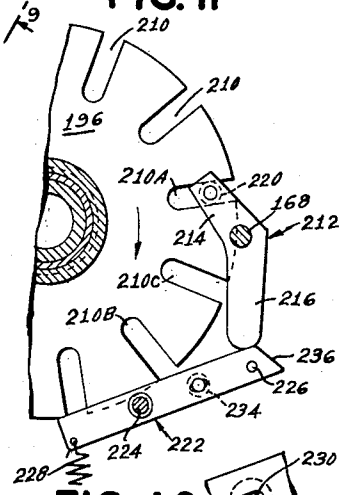


FIG. 40

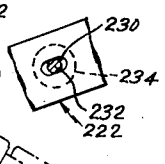


FIG. 9

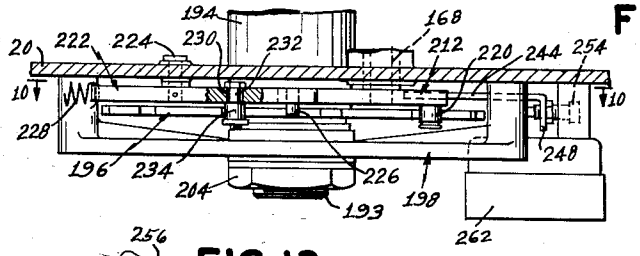


FIG. 12

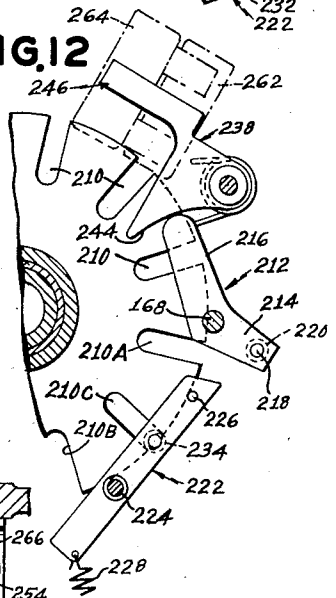


FIG. 13

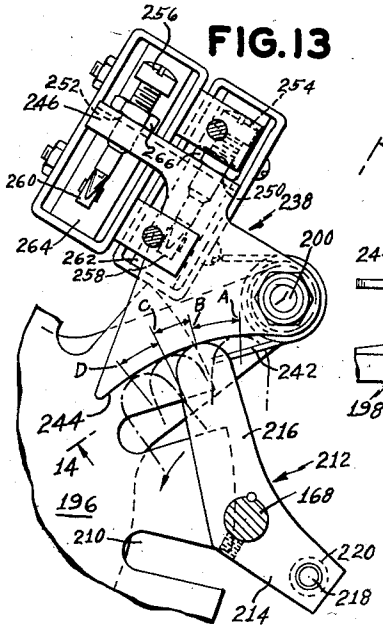
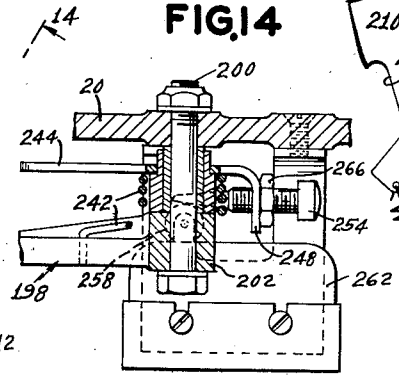


FIG. 14



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FIG. 20

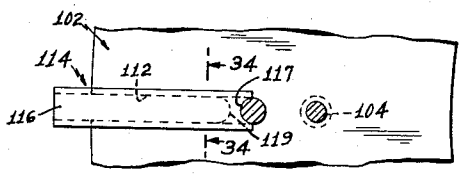


FIG. 34

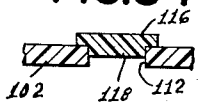


FIG. 35

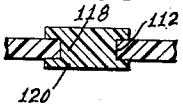


FIG. 19

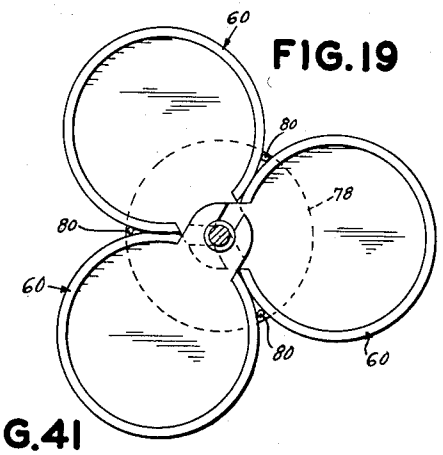


FIG. 18

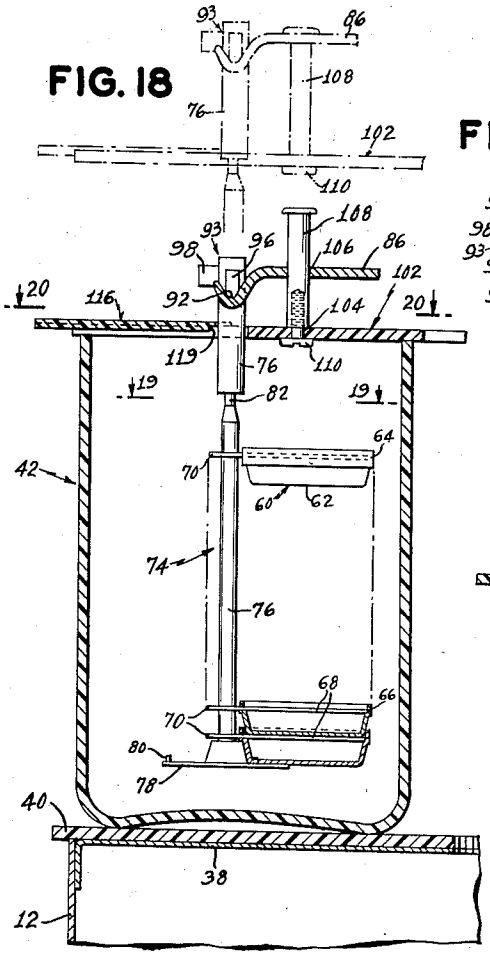


FIG. 41

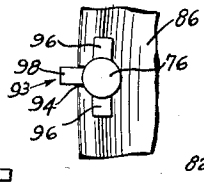


FIG. 32

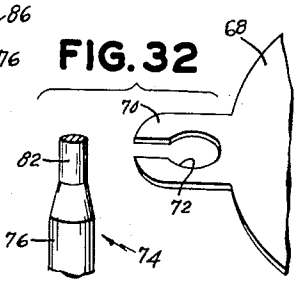
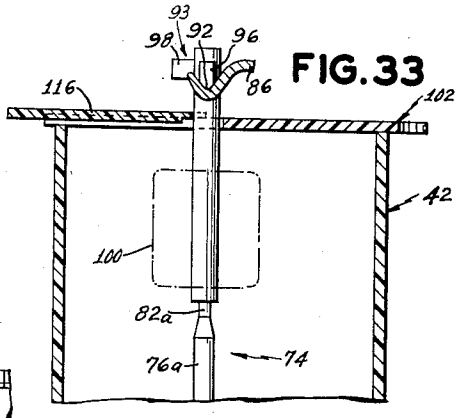


FIG. 33



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AUTOMATIC IMMERSION APPARATUS

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FIG. 23

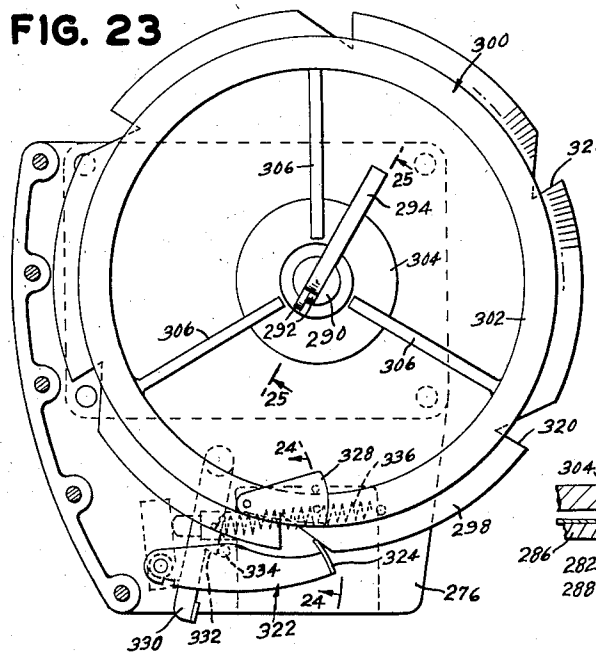


FIG. 25

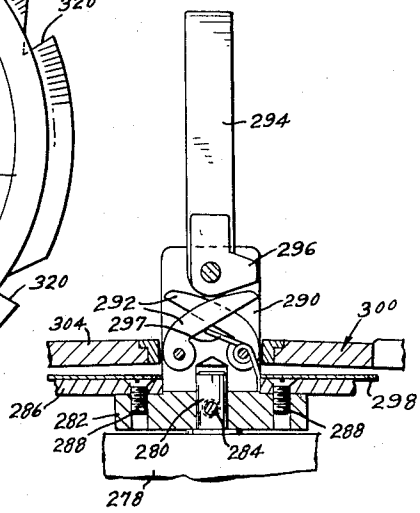


FIG. 22

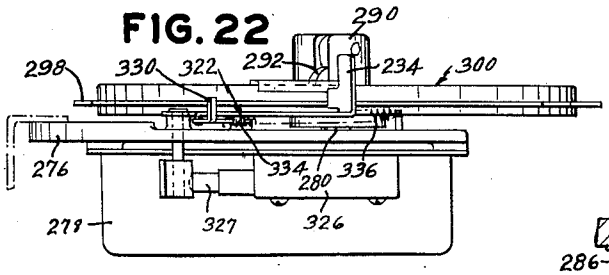


FIG. 26

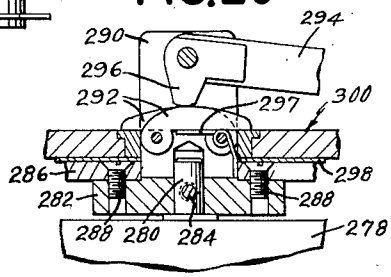


FIG. 24

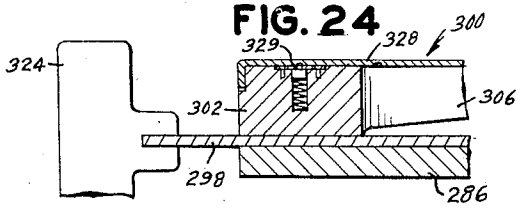


FIG. 29

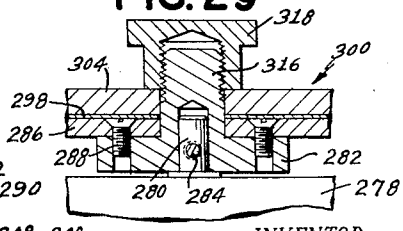


FIG. 27

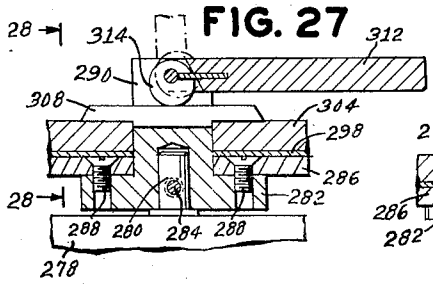
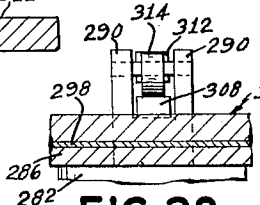


FIG. 28



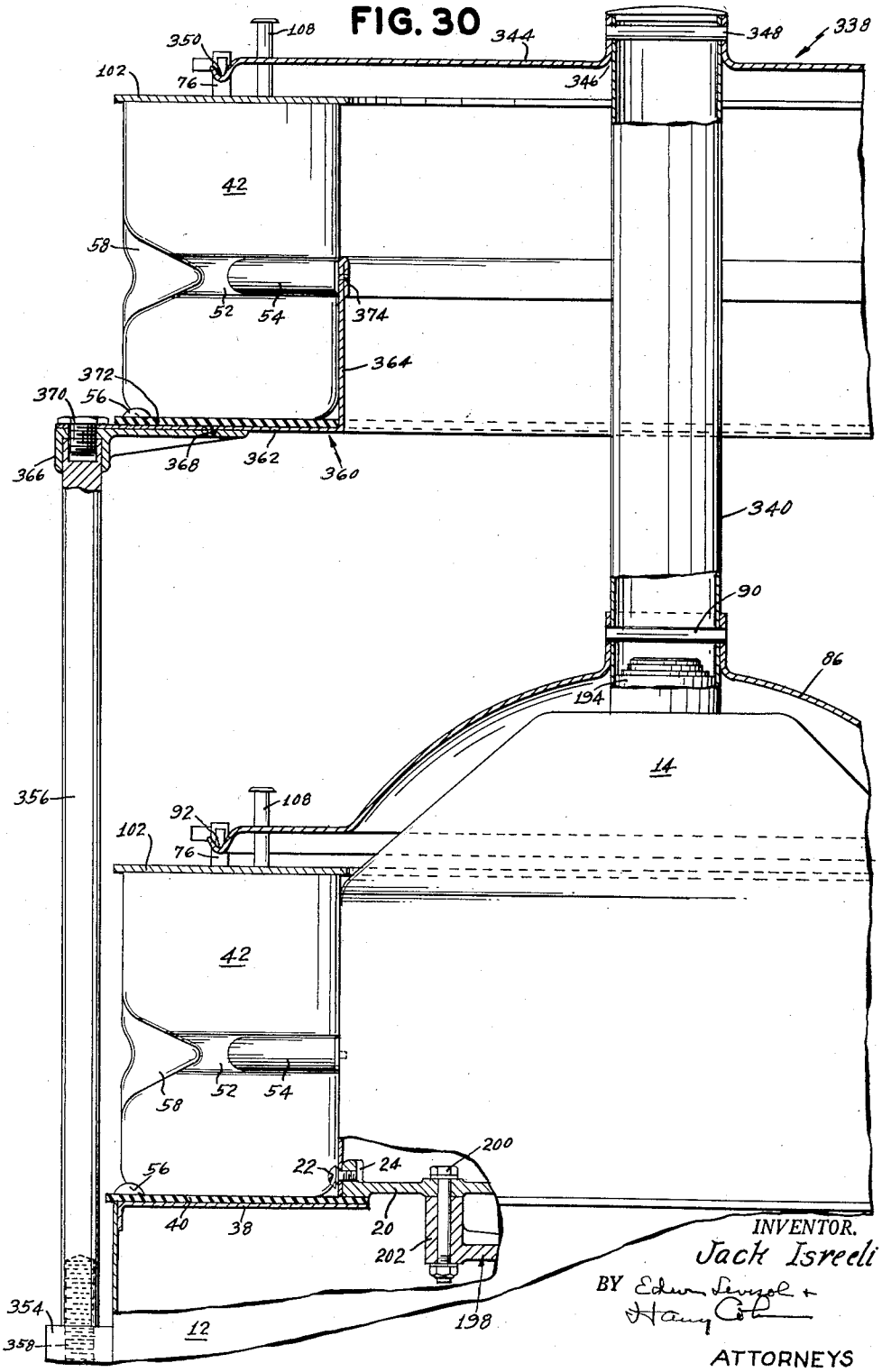
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Feb. 10, 1959 J. ISREELI 2,872,894

AUTOMATIC IMMERSION APPARATUS

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FIG. 30



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Feb. 10, 1959 J. ISREELI 2,872,894

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FIG. 36

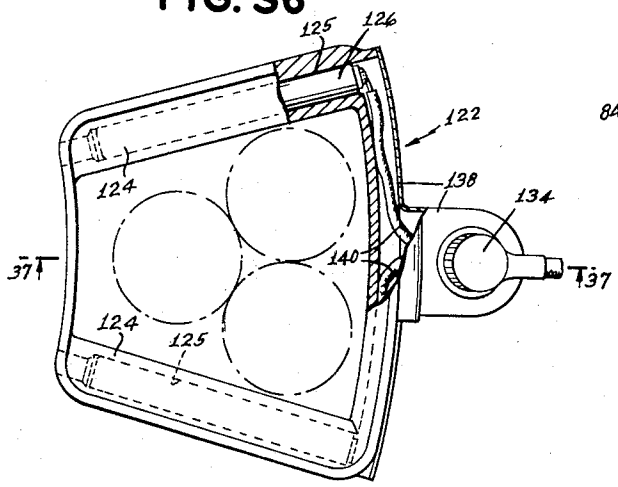


FIG. 38

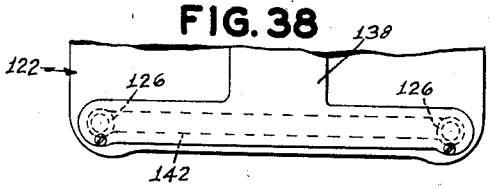


FIG. 37

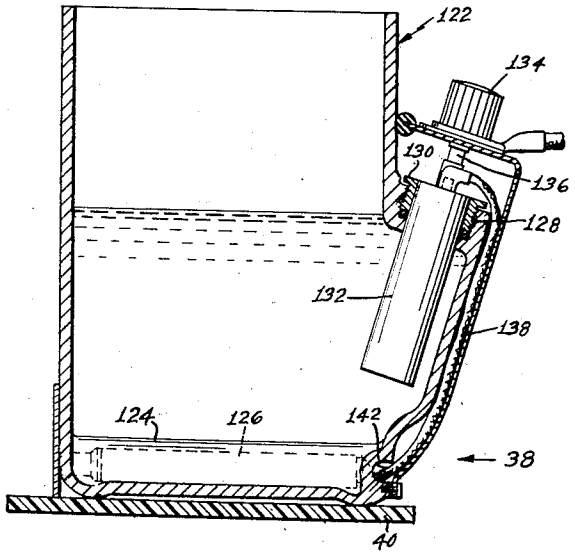
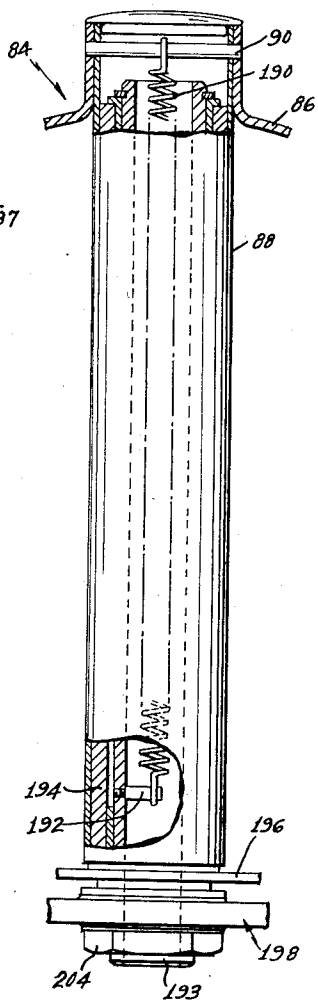


FIG. 39



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AUTOMATIC IMMERSION APPARATUS

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FIG. 42

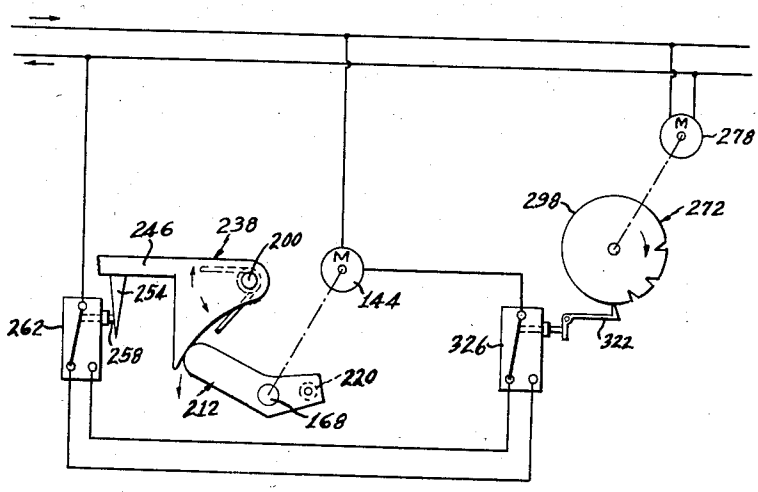
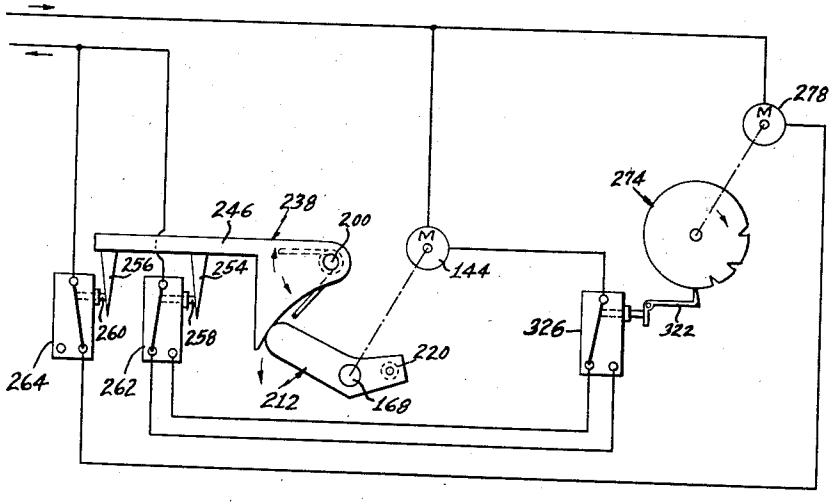


FIG. 43



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BY Edwin Lavesohn +
Harry Cohn
ATTORNEYS

United States Patent Office 2,872,894 Patented Feb. 10, 1959

2,872,894

AUTOMATIC IMMERSION APPARATUS

Jack Isreeli, Tuckahoe, N. Y., assignor to Technicon International, Ltd., New York, N. Y., a corporation of New York

Application December 9, 1954, Serial No. 474,210

94 Claims. (Cl. 118—10)

This invention relates to automatic immersion apparatus and particularly to automatic immersion apparatus for the preparation of histologic tissue for microscopic examination.

The preparation of tissue to enable the microscopic examination thereof involves a plurality of treatments of the tissue prior to the cutting of sections from the tissue specimens and the staining of the sections which are mounted on microscope slides. More particularly, in the preparation of tissue, it is necessary to immerse the tissue successively in a plurality of liquid agents for certain lengths of time, first to fix the tissue, then to wash the same for removing the fixative, then to dehydrate the tissue, usually by immersion of the tissue successively in a plurality of alcohols or other dehydration agents, then to immerse the tissue in a clearing agent, thereafter to infiltrate the tissue with an infiltration agent such as, for example, paraffin, celloidin, etc. After the tissue is thus treated, it is cut into sections of desired thickness; then the paraffin or other infiltration medium is removed from said sections, usually by a solvent for the paraffin, after which the sections are mounted on the slides and stained.

One object of the present invention is to provide an automatic immersion machine which is of such construction that it is of reduced size and weight in comparison with previously known machines of the same and smaller capacities.

Another object of the present invention is the provision of mechanism of improved construction and operation for transferring tissue or other material from one receptacle to another of a series of receptacles.

A further object is the provision of simplified mechanism which is operable to move the material from an elevated position over one receptacle to a position over another receptacle in the operation of transferring the material from one receptacle to another and which is effective for positively preventing lateral movement of the material when it is not in an elevated position.

Yet another object is the provision of improved mechanism for raising and lowering material in automatic immersion apparatus.

A still further object is the provision of improved devices for controlling the operation of automatic immersion apparatus.

An additional object is to provide means for preventing unintended displacement or movement of the liquid receptacles on their support.

Another object of the invention is the provision of automatic immersion apparatus that is more readily convertible from a single to a double stack machine than apparatus heretofore employed.

A yet further object is generally to improve the construction and operation of automatic immersion apparatus.

Other objects and features of this invention will become apparent as the characteristic features of construction and mode of operation of apparatus according to this invention are hereinafter described.

In the accompanying drawings:

Fig. 1 is a side elevational view of a single stack automatic immersion apparatus embodying this invention with portions thereof cut away to more clearly illustrate the construction of the apparatus;

Fig. 2 is a plan view of automatic immersion apparatus embodying this invention with portions thereof broken away to more clearly illustrate several features of this invention;

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

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

Fig. 5 is a sectional view taken along the line **5—5** of Fig. 3;

Fig. 6 is a sectional view taken along the line **6—6** of Fig. 1;

Fig. 7 is a sectional view taken along the line **7—7** of Fig. 6;

Fig. 8 is a sectional view taken along the line **8—8** of Fig. 3;

Fig. 9 is a side elevational view looking along the line **9—9** of Fig. 10;

Fig. 10 is a sectional view taken along the line **10—10** of Fig. 9;

Fig. 11 is a partial sectional view similar to Fig. 10 illustrating another condition of the novel intermittent rotary drive included in the automatic immersion apparatus;

Fig. 12 is yet another sectional view similar to Fig. 10 showing still another condition of the intermittent rotary drive included in this invention;

Fig. 13 is a partial enlarged view similar to Figs. 10–12 illustrating in more detail the contact actuator employed in this automatic immersion apparatus;

Fig. 14 is a sectional view taken along the line **14—14** of Fig. 13;

Fig. 15 is a partial side elevational view looking along the arrow **15** of Fig. 2;

Fig. 16 is a sectional view taken along the lines **16—16** of Fig. 15;

Fig. 17 is a sectional view taken along the line **17—17** of Fig. 16;

Fig. 18 is a sectional view taken along the line **18—18** of Fig. 2;

Fig. 19 is a sectional view taken along the line **19—19** of Fig. 18;

Fig. 20 is a plan view taken along the line **20—20** of Fig. 18;

Fig. 21 is a partial sectional view taken along the line **21—21** of Fig. 1;

Fig. 22 is a side elevational view taken along the line **22—22** of Fig. 21;

Fig. 23 is a plan view of a timing mechanism for controlling the automatic immersion apparatus embodying this invention;

Fig. 24 is a sectional view taken along the line **24—24** of Fig. 23;

Fig. 25 is a sectional view taken along the line **25—25** of Fig. 23 illustrating a locking means for the timing disc of the timing mechanism shown in Fig. 21;

Fig. 26 is a sectional view similar to Fig. 25 showing the locking means in its locking condition;

Fig. 27 is a view similar to Figs. 25 and 26 showing a modification of the locking means in the timing mechanism;

Fig. 28 is a sectional view taken along the line **28—28** of Fig. 27;

Fig. 29 is a view similar to Figs. 25 and 26 showing another form of means for locking the timing disc in the clock mechanism shown in Fig. 23;

Fig. 30 is a side elevational view of automatic immersion apparatus embodying this invention having two tiers or stacks of receptacles, with some portions cut away to more clearly illustrate the construction of the apparatus;

Fig. 31 is an enlarged sectional view taken along the line 31—31 of Fig. 21;

Fig. 32 is a perspective view illustrating the manner in which the material holders are mounted on their support;

Fig. 33 is a partial sectional view similar to Fig. 18 illustrating a material holder support provided with ultrasonic transducer means;

Fig. 34 is a sectional view taken along the line 34—34 of Fig. 20;

Fig. 35 is a view similar to Fig. 34 showing the modification in the construction of the elongated slot cover;

Fig. 36 is a top plan view of a receptacle for paraffin, with some parts cut away to more clearly illustrate the construction of the paraffin receptacle;

Fig. 37 is a sectional view taken along the line 37—37 of Fig. 36;

Fig. 38 is a partial elevation view looking along the arrow 38 of Fig. 37;

Fig. 39 is a view similar to Fig. 3, with several parts deleted, illustrating a modified means for biasing the conveyor to its lowest position;

Fig. 40 is an enlarged partial plan view of the locking member of the intermittent rotary drive mechanism illustrating the means for adjustably positioning the locking roller thereon;

Fig. 41 is an enlarged partial plan view of a conveyor employed in the automatic immersion apparatus disclosed herein illustrating the indexing means for positioning a material holder support on the conveyor;

Figs. 42 and 43 are circuit diagrams with more-or-less schematic illustrations of associated swiching devices and illustrate the conditions for longer and shorter operating time cycles, respectively.

Referring now to the drawings in detail, the apparatus embodying the present invention comprises a housing or cabinet 10 having a cylindrical base portion 12 and an upwardly extending dome shaped enclosure 14. The base portion 12, which primarily houses the timing mechanism to be referred to in detail hereinafter, is provided with two hinged doors 16 and 18. The portion of the base underlying the dome shaped enclosure 14 is open but has secured thereto a relatively strong disc-like plate 20 which overlies substantially all of the opening in the base 12. The plate may be secured to the base by any suitable securing means such as welding or, as shown in Fig. 3, by screws 21 and plate 20 is suitably secured to enclosure 14 as by screws 22 extending through dome shaped enclosure 14 and ears 24 on the plate 20.

Base 12 is preferably made of sheet metal and to stiffen the structure, three angle brackets 26 spaced 120° apart are secured to the side wall of base 12 within the base in a suitable manner such as spot welding, as indicated at 27 in Fig. 2. To further stiffen base 12, an angle iron 28 is secured to the bottom of the base as by spot welding and extends around the entire periphery thereof. Angle iron 28 rests throughout its entire extent on an oiled felt ring 30 which is supported by a U-shaped member 32 of a sub-base 33. At a number of locations, U-shaped member 32 is provided with horizontal extensions 34 to limit relative vertical movement of base 12 and sub-base 33 to prevent inadvertent removal of the sub-base 33 from base 12. Furthermore, member 32 is provided with a plurality of apertures 35. A plurality of support elements 36 formed of rubber or similar material are secured to member 32 of the sub-base by means of enlarged knobs 37 which are forced through apertures 35 and spread out above the apertures as best seen in Fig. 31 to thus support the entire apparatus on a flat surface such as a table or desk top. Elements 36 have a sufficiently high coefficient of friction to resist movement of the sub-base on the table. With the above described support arrangement, base 12 can be rotated on sub-base 33 while the latter remains stationary. When the base is turned the horizontal portion of angle iron 28 slides over oiled felt pad 30 which does not produce an excessive amount of resisting frictional force. However, the friction between the angle iron and felt ring 30 is more than enough to prevent accidental rotation of the base.

The cylindrical base 12 has a substantially larger diameter than the diameter of enclosure 14 and the two are arranged concentrically. An inturned flange member 38 is secured to the upper part of the cylindrical wall of base 12 as by welding (Fig. 18). Flange member 38 extends inwardly of base 12 to a point under enclosure 14 to form a platform or support for a plurality of receptacles 42 which contain tissue treating reagents. Preferably a flat Bakelite ring 40 overlies the receptacle support 38 to resist corrosion by the liquids in said receptacles. Receptacles 42 are arranged in a circular row and are supported by the receptacle support 38 of cylindrical base 12 as best shown in Fig. 2. Each of said receptacles is provided with a front wall 44, a rear wall 46, and a pair of flat side walls 48 which diverge as they extend from the rear to the front wall. The rear walls 46 of the receptacles all abut against enclosure 14 to prevent movement of the receptacles toward the center of the circular row. With this configuration for the receptacles, the receptacles can be brought into side-by-side relation to thus occupy a relatively small area for a given size of receptacles as compared with the cylindrical receptacles heretofore employed in such apparatus. For instance, for a given amount of liquid area per receptacle the total area occupied by the 12 receptacles shown in Fig. 2 is substantially reduced over that heretofore necessary when substantially cylindrical receptacles or beakers were employed since there is no waste space between the receptacles. Because of this configuration for the receptacles, the entire apparatus may be reduced in size and weight without reducing the size of the tissue holders and, accordingly, the capacity of the machine, as explained in further detail and claimed in respect to the broader aspects of this feature of the apparatus in the United States patent application of Nelson G. Kling, Serial No. 474,138, filed concurrently herewith and assigned to the assignee of my present application.

Preferably, although not necessarily, except for the beaker for the impregnating agent, paraffin, which will be described subsequently, the wedge shaped beakers are made of a suitable plastic material such as nylon, polytetrafluoroethylene or polytrifluorochloroethylene, the latter two being purchasable under the trademarks "Teflon" and "Kel-F," respectively. These materials are highly desirable because they do not undergo any physical or chemical changes as a result of contact with any of the liquid reagents used in the preparation of tissue since they are inert to the reagents. Furthermore, the beakers need only have wall thicknesses of about $\frac{1}{16}$ of an inch as opposed to as much as $\frac{7}{32}$ of an inch wall thickness necessary for the glass beakers of similar shape. With this substantial reduction in the wall thickness, these plastic beakers have a capacity which is approximately 10 percent greater than glass beakers of the same outer dimensions. Since it is well established that as the ratio of the volume of reagent to the volume of tissue increases, the effectiveness of the reagent on the tissue increases, the efficiency of the entire apparatus is increased without increasing its size. This increase in efficiency can manifest itself either in an increase in reagent effect for the same immersion time or a decrease in immersion time for the same reagent effect.

It will be obvious that either choice will result in highly beneficial effects.

According to another novel feature of the present invention, the wedge shaped receptacles **42** may be held in side-by-side relationship and prevented from moving either horizontally or vertically by novel stop means. In order to prevent substantial vertical movement of the receptacles, a narrow groove **50** is provided in each side wall of each receptacle so that when the receptacles are in side-by-side relation, the grooves in the sides thereof will cooperate to form relatively narrow channels **52**. Secured to the side of the dome shaped enclosure **14** is a plurality of finger members **54** which fit into the channels **52** and thereby prevent substantial vertical movement of the receptacles **42**. Furthermore, in order to prevent horizontal movement of the receptacles, hemispherically shaped buttons **56** are fixedly secured to Bakelite plate **40** at each outer corner of a receptacle in such positions that if the receptacles are moved horizontally along the plate **40**, they will engage their associated buttons and will not be able to move further outward in a horizontal direction.

With the receptacles or beakers in such close side-by-side relation due to their wedge shape, means are provided for gripping the receptacles in order to remove them when desired. This means is provided herein by continuing the channels **52** along the sides of the receptacles and widening and deepening the grooves near front walls **44** so that there are substantially enlarged channels **58** at the front or wide ends of the wedge shaped receptacles which are adapted to receive the fingers of the operator or technician who is running the apparatus. The walls surrounding enlarged channels **58** are provided with ribs **59** to render the walls easier to grip when it is desired to remove one of the receptacles from the circular arrangement. In order to remove a receptacle from the circular arrangement as shown in Fig. 2, the operator or technician need merely insert his fingers into two adjoining channels **58** in order to grip the sides **48** of the receptacles and then move the receptacle upward the extent that the finger members and channel arrangement permit which is sufficient to allow the bottom of the receptacle to clear the buttons **56** and thereafter pull the receptacle in a horizontal direction over the buttons and out from the circular arrangement.

The tissue to be treated for microscopic examination may be carried in any suitable material holder. Preferably, however, the tissue will be carried in material holders similar to that shown and described in a U. S. patent application of Edwin C. Weiskopf and Andres Ferrari, Jr., Serial No. 423,187, filed and assigned to the assignee hereof. These material or tissue holders **60** are made of some suitable material such as a phenol-formaldehyde resin like Bakelite which is molded into a circular disc-like form with a perforated base **62** which has a slightly smaller diameter than the upper rim **64**. The upper rim is provided with an annular groove **66** which is adapted to retain a perforated paper cover **68** in covering relationship after it has been pressed into the groove. The paper cover is provided with a tab **70** having a keyhole shaped aperture **72** therein. The tissue, of course, is placed in the Bakelite receptacle and the cover is thereafter pressed into the groove on the rim to close the receptacle.

To support a number of the aforedescribed material holders **60** for simultaneous immersion in a beaker, a support **74** is employed. Support **74** comprises a rod **76** and a circular flange or horizontal shelf **78** for said holders **60**. Said support **78** has three pin-like protrusions **80** thereon spaced at 120 degrees to limit horizontal movement of said holders in relation to said support. Preferably, although not necessarily, the entire assembly is molded as one integral unit out of nylon, Teflon or Kel-F, although numerous other materials can be used. Furthermore, the assembly need not be molded but may be constructed out of separate components. It is to be noted that with the material holders, their supports and the receptacles all made out of non-metallic material, with the exception of the paraffin bath which will be described subsequently, the tissue does not come into contact with any metallic element throughout its entire processing.

Rod **76** is provided with a narrowed throat **82** which is of such diameter that the narrow portion of the keyhole shaped aperture **72** can fit around it. The round enlarged portion of aperture **72** has a diameter which is slightly larger than the diameter of the rod **76** below the throat. Accordingly, when it is desired to position a tissue holder on a support, the tab **70** is aligned with throat **82** and the holder is moved horizontally until the round portion of aperture **72** registers with the rod, as best illustrated in Fig. 32. Thereafter, the holder is moved downward until base **62** rests on flange **78** between two pins **80**. Thereafter, other tissue holders may be stacked one on top of the other. Since there is room for three tissue holders to rest on flange **78**, three stacks of tissue holders spaced 120 degrees from each other may be positioned on support **74** as best shown in Fig. 19. Certain features of the support **74** and tissue holders **60** are claimed and described in further detail in the U. S. patent application of Edwin C. Weiskopf and Andres Ferrari, Jr., Serial No. 474,218, and of Edwin C. Whitehead, Serial No. 474,244, both filed concurrently therewith and assigned to the assignee of my present application.

Support **74** is mounted on a conveyor **84**. Conveyor **84** comprises a dome shaped circular carrier **86** and, at the center of the carrier, a depending thin walled hollow shaft **88**. Carrier **86** is connected to shaft **88** to form conveyor **84** by any suitable means such as a removable pressed fit joint and a removable pressed fit pin **90** extending through both the top of the carrier and shaft **88**. Shaft **88** extends through an aperture **89** in enclosure **14** and at the aperture is surrounded by an oil ring **91** which lubricates shaft **88** and prevents entry of dust and other foreign matter into the enclosure. Carrier **86** is provided with an annular groove **92** adjacent its outer peripheral edge. Furthermore, at each point where it is desired to suspend a tissue holder support **74** from the carrier indexing means **93** is provided to properly orient the tissue holder support relative to receptacles **42**. This indexing means comprises a radial slot **94** extending from an aperture **95** in the groove **92** to the peripheral edge of the carrier is provided. A pair of horizontal arms **96** and **98** at right angles to each other are secured to rod **76** at its upper end. When the rod is properly positioned on the carrier, arm **96** will be positioned in groove **92** and arm **98** will fit into slot **94**. The indexing or keying arrangement at the top of rod **76** and on the carrier together with the pin arrangement on flange **78** all cooperate to insure that the tissue holders are properly positioned for introduction into the wedge shaped receptacle or beaker **42**. It will be noted that any orientation of the tissue holders other than that shown in Fig. 2 will cause the tissue holder to engage the tops of the walls of the receptacles and thus prevent their immersion.

It will be noted that the diameter of rod **76** above throat **82** is substantially larger than the remainder of the rod. The rod is so shaped in order to readily adapt the entire apparatus for use in conjunction with ultrasonic vibrating means for accelerating the penetration of the tissue by the various reagents according to the invention of Andres Ferrari, Jr. described and claimed in his U. S. patent application Serial No. 440,441, filed June 30, 1954, and assigned to the assignee of this application. Such means is shown in Fig. 33. Referring to that figure, throat **82*a*** of a rod **76*a*** is situated substantially farther down the rod than is throat **82** of rod **76**.

The structure of the tissue support below throat 82*a* is substantially the same as that of support 74 in Fig. 18. Above the throat rod 76*a* is hollow and has mounted thereon, by any suitable means, ultrasonic vibrating means such as a magnetostrictive transducer 100. Power for the transducer is supplied over a pair of conductors (not shown) which preferably extend through the hollow portion of rod 76*a* to the transducer. It is because rod 76*a* is hollow above throat 82*a* and must support the added weight of the transducer that it must be larger than the remainder of the rod. Accordingly, in order to make the two types of supports interchangeable, rod 76 must also have the enlarged diameter above throat 82. The manner of controlling the supply of energy to the transducer is not within the scope of this invention.

As will be described in greater detail subsequently, conveyor 84 is movable in an up and down direction and also is rotatable about the longitudinal axis of shaft 88 for moving the tissue holder out of one receptacle and into another. In order to prevent evaporation and contamination of the various reagents a cover member 102 is provided. This cover member, as shown best in Figs. 1 and 2, is a flat member having a central opening 103 and a radial width which is slightly greater than the radial width of the receptacles. The large central aperture 103 of member 102 is of approximately the same diameter as the vertically extending part of enclosure 14. The cover is provided with a number of small apertures 104 which register with a like number of apertures 106 in the dome-shaped carrier 86. Slidably extending through apertures 106 are studs 108, the heads of which are larger than the diameter of apertures 106 and the shanks of which are larger than the diameter of apertures 104. The shank ends of the studs bear against cover 102 over apertures 104 and are internally threaded. Threadedly secured to studs 108 are screws 110 which have heads larger than apertures 104 and which extend through the cover apertures when in threaded engagement with the studs, thus fixing the studs relative to the cover. It will be seen that with this arrangement, when the conveyor is in its lowered position, cover 102 will rest on the tops of the receptacle walls to effectively cover the receptacles, thus preventing contamination and evaporation of the reagents. When the conveyor is raised, it will travel upwardly for a short distance while the cover remains on the beakers, apertures 106 moving longitudinally relative to the studs. When the carrier engages the heads of studs 108, the upward movement of the conveyor will be transmitted to the cover for lifting the cover off the beakers.

With the cover mounted as just described, provision is made for removing the tissue holder supports without interference from the cover. To accomplish this aim, the cover is provided with a plurality of radial slots 112 extending from the outer periphery of the cover to a point far enough in from the periphery to permit support rod 76 to extend therethrough in a vertical direction. Of course, the number of slots 112 preferably corresponds to the number of tissue holder support positions and, as shown herein, that number is twelve. To prevent evaporation or contamination of the reagents through slots 112, covering means for the slots are provided. This covering means comprises a flat elongated member 114 having an upper portion 116 of width slightly wider than slots 112 and a lower portion 118 of slightly less width than slots 112 to fit therein for slidable movement, the wide portion 116 resting on top of the cover. Wide portion 116 is provided at one end with a concave curved portion 117 of the same curvature as rod 76 and portion 118 is provided with a convex curved portion 119 of the same curvature as the end of slots 112. When a rod extends through a slot 112 the associated member 114 is moved inwardly until the concave portion 117 of wide part 116 fits around rod 76 thus effectively eliminating any opening in the cover member 102. When there is no rod extending through the slot, the member 114 is moved further inward until the convex end 119 of narrow portion 118 fits against the end of the slot, thus effectively covering the entire slot. When it is desired to remove a tissue holder support from its mounted position on conveyor 84, cover member 114 is slidably removed from cover 102 and thereafter the support is raised to detach it from carrier 86 and moved radially outward through the slot together with the corresponding receptacle.

Fig. 35 shows a modified structure for member 114 with provision for positively preventing vertical movement of the member relative to cover 102. To accomplish this a third portion 120 similar in configuration to wide portion 116 is provided to sandwich narrow portion 118 therebetween thus defining a pair of longitudinal grooves on the member. When in position in the slots 112, the outwardly extending parts will lap over and under the cover adjacent the slots to prevent vertical movement of member 114 relative to the cover. The outer end of lower portion 120 is shorter than portions 116 and 118 so that it does not engage the top edges of receptacles 42 which would result in preventing the cover 102 from seating properly on the tops of said receptacles.

The infiltrating agent commonly used to infiltrate tissue so that it can be cut into sections for mounting on slides is paraffin, which, as is well known, is solid at room temperature. Accordingly, means must be provided in the receptacle for the paraffin for heating it to a temperature at which the paraffin will be sufficiently liquid to effectively infiltrate the tissue. Accordingly, a novel beaker or receptacle 122 has been provided to contain the infiltrating agent. Beaker 122 is best shown in Figs. 36–38. This beaker 122 has substantially the same configuration as the aforedescribed beakers 42, except that it is approximately one-fourth of an inch shorter than the beakers 42 as shown in Fig. 1. With beaker 122 shorter, cover 102 will rest on the tops of beakers 42 but not on the top of beaker 122 thus preventing the cover from coming into contact with the paraffin. Another advantage of keeping the cover out of covering relationship with the paraffin beaker 122 is that paraffin itself at the temperature to which it is heated herein is not particularly volatile but any of the other reagents will be relatively volatile. Accordingly, any of the other reagents contaminating the paraffin will evaporate and will be free to pass out of beaker 122 which, as already described, is always uncovered.

Beaker 122 may be made of any suitable material but is preferably made of cast aluminum because of that material's excellent thermal properties. The beaker has two bosses 124 extending along the sides and bottom. These bosses are provided with circular bores or cavities 125 which have removably positioned therein heating elements 126. The front wall of beaker 122, rather than being smooth and curved as are the front walls of beaker 42, extends outwardly and the upper surface of the protrusion is provided with a threaded aperture 123 which is adapted to threadedly engage a threaded collar 130 on a thermostatic control unit 132 so that the main body of the unit 132 is immersed in the paraffin. The thermostatic control unit may be of any suitable design but is preferably of construction substantially the same as that shown and described in the U. S. patent application of George Gorham, Serial No. 188,605, filed on October, 5, 1950, and assigned to the assignee hereof. An adjusting knob 134, mounted on a rotatable shaft 136 which extends into and is connected with the thermostatic control mechanism, is employed to calibrate control unit 132 as described in the aforementioned Gorham application. Shaft 136 is sufficiently long so that knob 134 will be positioned outside of an enclosure 138 mounted on the front wall of receptacle 122 to enclose the thermostatic control unit. To connect heating element 126 to unit

132 wires 140 extend therebetween. To give beaker 122 a neat appearance and to run the wires so that they will not be easily accessible to tamperers, a channel 142 is provided along the front wall of the receptacle adjacent the bottom and this channel is closed by enclosure 138. Accordingly, the wires extend out of view from the heater, through channel 142, upwardly within enclosure 138 to the thermostatic control unit. With heating elements 126 removably positioned in cavities 125, if they become defective for any reason, they may be removed readily and be replaced with relative ease, there being no necessity to disturb anything else on the heating receptacle other than enclosure 138.

As heretofore stated, conveyor 84 is movable up and down and rotatably in order to transfer the material holders from one receptacle to another. In order to effect the vertical movements of conveyor 84, a motor 144 having an integrally housed and connected reduction gearing 145 is provided. Shaft 146 which is the output shaft of the reduction gearing extends through a bracket 147 having a bearing 149 for shaft 146 and is connected directly to a crank 148 so that the crank will rotate with shaft 146. Bracket 147 is secured to plate 20 by suitable means such as screws 151. Crank 148 is connected to a link 150 by means of a crank pin 152 and the other end of link 150 is connected to a member 154 at a point intermediate the two ends of said member. One end of member 154 is pivotally mounted on fixtures 156 as at pivots 158. It will be seen that when shaft 146 is rotated by the motor 144 through the reduction gearing mechanism, crank 148 will rotate so as to cause link 150 to move outwardly and upwardly as shown in the dotted positions in Fig. 3. With the link 150 so moving in response to rotation of the motor, member 154 will pivot about pivots 158 from the position shown in solid lines in Fig. 3 to the uppermost dotted position shown in Fig. 3. Member 154 is provided with a roller 160 at its free end which roller engages the underside of a collar 162 fixedly mounted on hollow shaft 88 of conveyor 84 as by a pressed fit to cause the collar and shaft to move upwardly in response to the upward pivotal movement of member 154. With the roller 160 provided, the friction caused by the relative movement between collar 162 and member 154 is substantially reduced.

As may best be seen in Fig. 3, shaft 146 has connected thereon a bevel gear 164 which engages a companion bevel gear 166 which in turn is mounted on a rotatable shaft 168. As shown herein and as is presently preferred, the bevel gears 164—166 are so proportioned that shaft 168 rotates at one-half the angular velocity of shaft 146. Fixed in any suitable manner on shaft 168 is a cam 170. A substantially vertically disposed member 172 is mounted on a pivot 174 which is mounted in bracket 147. Member 172 is provided with a cam follower 176 which is suitably secured to member 172 and is adapted to engage cam 170. In order to insure that cam follower 176 is held in engagement with cam 170, both gravity and spring biasing means are employed. The gravity biasing means comprises a relatively heavy semicircular member 178 which is secured to member 172 below pivot 174 by any suitable securing means such as screws 180. With weighted member 178 so positioned, it will be seen that it will tend to rotate member 172 counterclockwise about pivot 174 thus maintaining cam follower 176 in engagement with cam 170. Extending through weighted member 178 adjacent member 172 is a hole 182. A spring 184 having its uppermost convolution of greater diameter than the remaining convolutions and its bottom few convolutions of smaller diameter than the remaining convolutions is positioned in hole 182 with its top convolution bearing against the upper surface of member 178 adjacent the hole to limit the downward movement of the spring. A screw 186 having a head of greater diameter than that of the bottom convolutions is positioned in said spring in holding engagement with the convolutions of smaller diameter and threadedly engages a threaded aperture in bottom plate 20. The parts are so proportioned that spring 184 is under tension so as to bias cam follower 176 against cam 170. The tension of said spring can be adjusted by turning the screw 186 by a screw driver which may be inserted through the top of said spring. It is to be understood that either of the above described biasing means is effective in and of itself to bias cam follower 176 against cam 170. However, both means have been provided so that the apparatus will continue to function in the normal manner even if one of these biasing means should become defective. Cam 170 is so shaped that once per revolution of shaft 168 member 172 turns about pivot 174 from the position shown in solid lines in Fig. 7 to the position shown in dotted lines in that figure and back to the solid line position. It will be noted that in the position shown in solid lines in Fig. 7, a roller 188 which is rotatably mounted on the uppermost end of member 172 is in position to engage the bottom of collar 162 to prevent movement of conveyor 84 to the lowered position. With the conveyor 84 in its lowered position, when motor 144 commences operating, member 154 commences moving upward and roller 160 engages the bottom of collar 162 to move the conveyor in an upward direction. During this time member 172 is in its retracted position as shown in solid lines in Fig. 3 so that collar 162 can move freely past roller 188 rotatably mounted on member 172. As collar 162 moves past roller 188, cam 170 causes member 172 to move to the position shown in solid lines in Fig. 7, that is the position in which roller 188 prevents a downward movement of conveyor 84 by engaging the under side of collar 162. As the motor continues operating, member 154 commences moving in a downward direction but the conveyor is held in its raised position by the engagement of roller 188 with collar 162. The member 154 moves to its lowermost position as shown in solid lines in Fig. 3 and then commences a second movement upward until it once again engages collar 162. At this point cam 170 has rotated sufficiently to again impart motion to member 172 so that it pivots to the position shown in solid lines in Fig. 3 in which position roller 188 is out of the line of downward movement of the collar. Accordingly, as member 154 moves downwardly for the second time, the collar remains in engagement with roller 160 and the conveyor thus moves to its lowered position downward under the control of member 154. As described herein, conveyor 84 moves downward due to its own weight which has been found to be satisfactory. If, however, it is desired to provide a more positive means for assuring that the conveyor will move downward and will not stick in its uppermost position, spring biasing means may be employed. As shown in Fig. 39, such spring means includes a helical spring 190 mounted at one end on pin 90 which secures carrier 86 to shaft 88 and at its other end on a pin 192 which is suitably fixedly mounted such as on a fixed shaft 193 to be referred to in more detail hereinafter. With the spring so mounted, each time conveyor 84 is moved to its raised position, spring 190 urges the conveyor downwardly toward its lowest position. It will be seen therefore that by employing a 2:1 ratio in the gearing 164–166, the vertical movement of shaft 88 may be so controlled that for one rotation of shaft 163, the conveyor remains in its upper position for 50% of the time. The reasons and advantages for this type of movement will be described below.

In order to move the tissue holders laterally when they have been moved out of the receptacles in the manner just described, an improved intermittent rotary drive mechanism is employed. The intermittent rotary drive mechanism is mounted on a three armed spider 198 which is secured in underlying relationship to plate 20 by means of bolts 200 extending through the plate and through lugs 202 on the ends of the spider arms. Fixedly secured

to spider 198 by means of a nut 204 is shaft 193 which is relatively stiff but preferably hollow. Disposed around shaft 193 at both ends thereof are sleeve bearings 195 and disposed around the sleeve bearings for rotation relative to shaft 193 is a shaft 194. Each sleeve bearing is provided with a radially extending portion 197 which fits over the adjacent ends of the shaft 194 to thus position the bearings relative thereto. Shaft 194 is secured in any suitable manner to a driven member 196 for rotation therewith. The means for connecting shaft 194 to driven member 196 is also effective to prevent longitudinal movement of shaft 194. Shaft 88 of conveyor 84 fits over shaft 194. Furthermore, shaft 194 is provided with a keyway 206 extending longitudinally thereof and shaft 88 is provided with a key 207 which is fixedly secured to shaft 88 as by rivets 208 and which extends into the keyway. With such an arrangement, it will be seen that conveyor 84 is movable longitudinally relative to shaft 194 but due to the aforementioned key and keyway arrangement, the conveyor rotates with shaft 194. In order to impart motion to driven member 196 and shaft 194, a plurality of radial slots 210 corresponding in number to the number of receptacles used in the mechanism are spaced around the periphery of the driven member equidistant from one another. For instance, in the embodiment shown having 12 receptacles, there are 12 slots provided therein with each of the slots being spaced at an angular distance of 30° from the adjacent slots. A driving member 212 is fixedly mounted on shaft 168 for rotation therewith. Driving member 212 is provided with a pair of angularly disposed arms 214 and 216, one of said arms, that is arm 214, having secured thereto a pin 218 having a roller 220 mounted thereon, said roller being adapted to fit into slots 210 in driven member 196. When shaft 168 is rotated in a counterclockwise direction as shown in Fig. 10, roller 220 on arm 214 enters one of the slots 210 to commence rotation of the driven member 196 in a clockwise direction. The length of the arm 214 is so proportioned that roller 220 will be traveling normal to the curvature of the circle of member 196 at the point of entry thereby eliminating any necessity for chamferring the slots to permit the roller 220 to enter therein and also eliminating any initial shock as the roller enters a slot. As the rotation of shaft 168 continues the movement of roller 220 proceeds into the slot and to move the member 196 in a clockwise direction as heretofore stated.

According to one feature of the present invention, a novel means is provided for preventing movement of driven member 196 during the time roller 220 is not in any of the slots 210. This means for preventing motion of the member when such motion is not desired includes a locking member 222 which is pivotally mounted at pivot 224 which in turn is secured to plate 20. Locking member 222 is provided with a stop pin 226 adjacent one end thereof, A spring 228 secured at one end to plate 20 is attached to the locking member 222 at its end opposite the end at which pin 226 is secured in order to bias the locking member toward the driven member 196. Positioned between pin 226 and pivot 224 on member 222 is an elongated slot 230. Secured to member 222 through slot 230 is a pin 232 on which is rotatably mounted a roller 234 having a slightly smaller diameter than the width of slots 210 in member 196. As shown in Fig. 40, the position of roller 234 may be adjusted within the limits provided by slot 230 so that as roller 234 moves out of a slot 210, roller 220 moves into one of the slots 210 in order to prevent any movement of the member 196. Pin 226 is provided to limit the movement of roller 234 into the slots in the driven member 196. For reasons that will become clear hereinafter, when motor 144 becomes energized, driving member 212 is in the position best shown in Fig. 12, with roller 220 being relatively remote from the slot 210 which it will enter for the next movement of the driven member 196.

Accordingly, it will take a substantial period of time for member 212 to rotate to the point at which roller 220 enters one of the slots 210A to rotate driven member 196 a fraction of a revolution, here preferred at 30°. It will be understood that the slot just referred to as slot 210A and the slots hereinafter referred to as slots 210B and 210C are so designated merely to facilitate the description of operation of the mechanism, all of these slots being the slots 210 hereinbefore described. As roller 220 approaches slot 210A in a direction normal to the curvature of the member 196 at slot 210A, the long arm 216 of member 212 engages the bevelled face 236 of locking member 222 to move it away from the periphery of member 196 and thereby move roller 234 out of slot 210B. With roller 234 out of slot 210B, member 196 is conditioned for rotation and as roller 220 moves into slot 210A, as best shown in Fig. 11, driven member 196 commences rotating in a clockwise direction. Driving member 212 continues rotating in a counterclockwise direction thus maintaining arm 216 in engagement with member 222. When the curved end of arm 216 comes into engagement with the bevelled face 236 of member 222, member 222 gradually moves toward driven member 196, until roller 234 slowly comes into engagement with the periphery of member 196. It will be seen that by providing a bevelled face on member 222, the possibility of roller 234 rapping into engagement with member 196 as arm 216 moves out of engagement with member 222 is obviated and the movement of roller 234 into engagement with member 196 is gradual. It will be noted however that after roller 234 on member 222 engages the periphery of member 196 between slots 210B and 210C the roller 220 on driving member 212 is still positioned in slot 210A and is still rotating the driven member 196 and hence shaft 194 in the clockwise direction. This movement continues until the slot 210C becomes aligned with roller 234 and permits that roller to enter slot 210C under the urging of spring 228 to thereby stop rotation of member 196. It will be noted however that this registering of the roller 234 with slot 210C occurs at precisely the time that roller 220 on driving member 212 moves out of slot 210A and, accordingly, there is no possibility of any jamming of the mechanism due to a misproportioning of the parts. As already stated, the position of roller 234 is adjustable so that means are provided to insure that roller 234 moves into slot 210C at the desired instant. After partial rotational movement of member 196 is completed, shaft 168 and member 212 continue rotating until arm 216 engages a contact actuator 238 at which time a switch will be operated to de-energize motor 144 in a manner to be made more clear hereinafter. As clearly shown in the drawings, the intermittent rotary drive is located at the base of shaft 194 and adjacent the top of base 12. By so disposing the rotary drive, shaft 168 is relatively short and stiff, thus permitting a substantial reduction in its diameter. Furthermore, this disposition of the rotary drive adds to the general compactness of the entire apparatus since the bulky supports heretofore used for the rotary drive are eliminated. In addition, with shorter connections from the motor to the drive, the necessary tolerances in machining are decreased thus decreasing the costs of fabrication.

In order to pivotally mount a contact actuator 238 for partly controlling motor 144 in a manner to become clear subsequently, one of the lugs 202 on spider 198 is much shorter than the other two, thus providing room for such mounting between the top of the short lug and the bottom of plate 20 as best seen in Fig. 14. Contact actuator 238 is biased by a spring 242 so that it tends to rotate counterclockwise. The contact actuator is provided with a cam portion or face 244 and an arm 246 extending outward and away from the cam portion. Arm 246 has a depending part 248 provided with two threaded apertures 250 and 252. Threadedly engaged

in apertures 250 and 252 are screws 254 and 256, respectively, having tapered ends which are adapted to engage under certain conditions of the contact actuator the rollers 258 and 260 of microswitches 262 and 264, respectively, to operate said switches between their two circuit controlling condition. Micro-switch 262 is employed to control motor 144 during both the dehydration-infiltration cycle heretofore mentioned and the relatively short staining cycle to be referred to in more detail hereinafter. Micro-switch 264 is employed to control the energization and de-energization of the clock motor in the timing mechanism which controls the staining immersion cycle, switch 264 being out of circuit when the apparatus is operating on the dehydration-infiltration immersion cycle. The reason for this will also become clear hereinafter. Suffice it to say at this point that with the screws 254 and 256 threadedly mounted as described above, the position at which they operate their respective switches can be readily adjusted. If desired, lock nuts 266 may also be threadedly mounted on screws 254 and 256 to lock them in their desired positions. Furthermore, the came face on actuator 238 is so shaped that when arm 216 of driving member 212 engages said face, the contact actuator turns clockwise against the bias of spring 242 as arm 216 moves from point A to point B, actuator 238 remains stationary as arm 216 moves over the constant radius portion from B to C, and it moves counterclockwise under the urging of spring 242 as arm 216 moves from point C to D. Screws 254 and 256 are so adjusted relative to switches 262 and 264, respectively, that as arm 216 moves over the cam face the following events occur in the stated sequence: prior to arm 216 engaging the cam face, switch 262 is in its first circuit controlling condition and switch 264 is open; just after arm 216 passes point A, switch 264 is closed; just prior to arm 216 reaching point B, switch 262 is operated to its second circuit controlling condition; just after arm 216 passes point C, switch 262 is restored to its first condition; and when arm 216 reaches point D, switch 264 is open. The manner in which the switches control the automatic immersion apparatus will become clear as this description progresses.

Referring now to Fig. 7 another feature of this invention is illustrated. According to the feature illustrated in Fig. 7, when the conveyor 84 is in its lowermost position thereby causing the material holders to be immersed in the liquid in the receptacles, collar 162 rests on a cam 268 which is rotated by a motor and unitized reduction gearing 270. Motor 270 is preferably continuously energized throughout the entire operation of the machine, it being controlled only by suitable circuit controlling means such as an ordinary knife switch (not shown) mounted on base 20. With collar 162 resting on cam 268 which is being rotated by motor 270, the cam causes conveyor 84 to vertically reciprocate through a short stroke to thereby cause the tissue holders to vertically reciprocate through a corresponding stroke. As already described in detail in a copending U. S. patent application of Edwin C. Weiskopf and Andres Ferrari, Jr., bearing Serial No. 358,812 and assigned to the assignee hereof, the vertical reciprocation of tissue holders in the liquids tends to increase the penetration of the liquids into the tissue and decrease necessary immersion time.

For controlling the above described apparatus through the successive movements for immersing the tissue holders successively in the plurality of liquids, timing mechanisms 272 and 274 are employed. Timing mechanism 272 is used to control the operation of the apparatus when the latter is used to dehydrate the tissue and to infiltrate it with paraffin preparatory to cutting the tissue into sections to be mounted on the microscope slides. The total time for so preparing the tissue is of the order of about 24 hours and, accordingly, timing mechanism 272 is adapted to make one revolution each 24 hours. The total time necessary for staining the tissue sections is of the order of about one hour and, accordingly, timing mechanism 274 is adapted to make one revolution in an hour. With the one exception heretofore noted, the two timing mechanisms are of the same construction. According to one feature of this invention, for conveniently setting the timing devices and for maintaining them in good working condition, each of the timing devices is mounted in a horizontal position on a bracket 276 which in turn is suitably mounted on one of the doors in the base. More particularly, mechanism 272 is mounted on door 16 and mechanism 274 is mounted on door 18 so that each may be removed outward of base 12 by merely opening the doors, thus pivotally moving the mechanism out of the base.

These timing devices operate substantially in the same manner as the devices shown and described in a patent granted to Edwin C. Weiskopf, No. 2,157,875, and assigned to the assignee hereof. Referring particularly to Figs. 21–29, each device contains a conventional clock motor 278 which causes a shaft 280 to rotate at the predetermined speed depending on whether the clock is for the 24 hour cycle or the 1 hour cycle. Shaft 280 is connected to a flanged bushing 282 by means of a pin 284 which extends through the bushing and shaft. Accordingly, rotation of shaft 280 imparts rotational movement to bushing 282. Bushing 282 is connected to a plate 286 by any suitable means such as screws 288 so that plate 286 rotates with shaft 280 and bushing 282 at the predetermined rotational speed. Plate 286 extends outwardly from the flanged bushing 282 and is substantially flat throughout. Extending upwardly from the bushing 282 are a pair of parallel ears or plates 290. Pivotally mounted between plates 290 are a pair of locking dogs 292 and a locking arm 294 having at the end adjacent the locking dogs a cam member 296. The locking dogs 292 are biased upwardly to a non-locking position by a spring 297. With the locking arm 294 in its vertical or non-locking position and locking dogs 292 in their non-locking positions as best shown in Fig. 25, a timing disk 298 having a central aperture therein may be placed over the plate 286 to rest thereon with the aperture in the timing disk fitting around the parallel plates 290 and the locking dogs. The timing disk may be made of any suitable relatively stiff material such as metal, pressed fiber, wood or stiff cardboard and is so proportioned that it extends outwardly from the edge of plate 286 as may best be seen in Fig. 23. In order to hold the timing disk in place a spider 300 having a circular peripheral rim 302 of substantially the same radius as plate 286 and a central hub 304 with an aperture therein is placed over timing disk 298 so that locking arm 294 and plates 290 fit through the central hub aperture in the spider. Radially extending arms 306 here shown as three in number, connect the hub to the rim of the spider. The spider is so constructed that it has a slightly concave shape in its unstressed condition so that when it is placed in position over the timing disk, as heretofore described, only the rim 302 engages the timing disk, the remaining portions of the spider being disposed upwardly of said timing disk. With the spider placed over the timing disk, locking arm 294 can be pivoted clockwise so that cam member 296 engages locking dogs 292 and moves them downwardly against the bias of spring 297. The outer edges of the locking dogs engage hub 304 and exert a downward force against the spider to cause the latter to clamp the timing disk between it and plate 286. When the spider is in its final clamped position, as best shown in Fig. 24, only rim 302 on the spider will be effective for clamping the timing disk in position, the remainder of the spider remaining out of engagement with the timing disk. With such an arrangement, timing disk 298 will be clamped adjacent its outer peripheral edge where the clamping is most effective for preventing movement of the timing disk relative to plate 286. Furthermore, with the aforedescribed arrangement for clamping the timing disk in position, it will

be seen that no removable parts are employed other than the spider itself. Accordingly, there is no possibility of any parts being misplaced prior to the beginning of operation of the machine when the machine is being set up by the operator or technician.

Figs. 27 and 28 illustrate another form of means for clamping spider 300 against timing disk 298 to hold the latter in fixed position relative to plate 286. In this form, locking dogs 292 are eliminated and in their place, a flat elongated member 308 is placed against hub 304 of the spider. A clamping arm 312 is pivotally mounted on parallel plates 290 and is provided with an eccentric cam portion 314. When the arm 312 is vertically disposed as shown in dotted lines in Fig. 27, the raised part of cam portion 314 is out of engagement with member 308 thus removing the pressure on the spider to enable movement of the timing disk relative to plate 286. With arm 312 horizontally disposed, as shown in solid lines in Fig. 27, the raised part of cam portion 314 engages member 308 to clamp the timing disk between the spider and plate. Although in the clamping arrangement shown in Figs. 27 and 28, member 308 can be removed, there is no necessity of its removal in order to properly position the timing disk since movement of the disk is possible with arm 312 in its vertical position, even though member 308 is resting against the hub of spider 300.

If it is desired to use a removable threaded arrangement to hold spider 300 in position, an arrangement similar to that shown in Fig. 29 may be employed. Referring to Fig. 29, the flanged bushing 282 is provided with an upwardly extending threaded stud 316 which stud extends through the registered apertures of the plate 286, timing disk 298 and spider 300. An internally threaded cap 318 is threadedly mounted on stud 316 and the cap can be moved downwardly by rotating it until it engages spider 300 and moves into the position shown in Fig. 29.

As heretofore stated, timing disk 298 is made of a relatively rigid material such as sheet metal, fiber board or a stiff cardboard. The timing disk has cut therein a plurality of V-shaped notches 320 at the angular distance corresponding to the amount of time it is desired to have a tissue holder remain immersed in a particular liquid held by the receptacles described heretofore. For instance, if the clock motor is designed to rotate the timing disk one revolution for each 24 hours and it is desired to hold the tissue holder in a particular receptacle for 1 hour, then the angular distance between the two notches which define the beginning and end of this particular immersion will be spaced at 1/24 of the arcuate distance of the entire timing disk, that is 15° apart. Pivotally mounted on bracket 276 is a sensing member 322 which has a free outwardly extending end 324 adapted to move into and out of notches 320. In engagement with member 322 at the end opposite to end 324 is a limit switch 326 of any suitable design such as the well known microswitch. The spring in switch 326 which biases the contact actuator 327 of the switch into engagement with member 322 is effective for biasing the member 322 against the periphery of the timing disk. The switch is so controlled that when end 324 is riding along the periphery of timing disk 298, the switch 326 is in one condition and when the free end of member 322 is in one of the notches 320, switch 326 is in another condition. The manner in which switch 326 functions to control the apparatus will be described subsequently. Suffice it to say for the present, when free end 324 of member 322 moves into a notch 320, switch 326 is operated to close an energizing circuit for motor 144 to cause the conveyor to move upwardly, to turn a fraction of a revolution and then to be lowered so as to transfer the material holders from one receptacle to another.

According to another of the features of this invention, a timing shut-off member 328 is pivotally mounted on the rim 302 of spider 300. Furthermore, detent means 329 are provided on the shut-off member and the spider so that the shut-off member may be pivoted between a first or retracted position in which the periphery of the shut-off member is more or less coincident with the periphery of the spider, as shown in Fig. 23, and to a second or extended position in which the periphery of the shut-off member extends outwardly beyond the periphery of the timing disk, as may best be seen in Fig. 21. The shut-off member in its distended or second position is adapted to engage the ber 330 is pivotally mounted on bracket 276 and has a notched edge 332 which is adapted to engage a latch or pin 334 mounted on member 322 to hold member 322 out of engagement with the periphery of the timing disk. In order to insure that the latching will be accomplished, the latching member is biased by a spring 336 so that the edge of the latching member will always be in engagement with the latch 334. When end 324 engages the periphery of the distended shut-off member 328 and rides outwardly from the periphery of the timing disk along said edge, the latch 334 moves downwardly as viewed in Fig. 23 to permit the latching member 330 to move to the right with the notched edge 332 riding over the top of latch 334. Spring 336 subsequently holds the latching member in the described position to prevent any return of end 324 into engagement with the periphery of the timing disk. For reasons which will become clear hereinafter in such a position microswitch 326 opens the energizing circuit for motor 144 and thereby prevents any further energization of that motor. Therefore, any further movement of the conveyor and material holders is prevented. This shut-off mechanism is particularly desirable since automatic immersion apparatus so provided may be set up on a Friday night for operation over the weekend and when the cycle of operation is complete some time during the weekend, the machine will automatically shut off to prevent any further action. When the operator returns on Monday he may remove the tissue holders from the receptacles and reset the machine for daily operation. It is to be noted that one of the highly desirable features of the aforedescribed shut-off mechanism is the permanent pivotal mounting of the shut-off member on the spider. With such an arrangement, it will be seen that the shut-off member cannot be removed from the spider in which removed condition it is possible for it to be misplaced or lost. With the present arrangement, the shut-off member is firmly and permanently mounted on the spider to prevent any loss thereof. Another feature of the shut-off mechanism is that the latch member is spring biased which permits the disposition of the entire timing mechanism in any plane desired, for instance, in the horizontal plane as is shown in the preferred embodiment illustrated herein. In the event that a gravity bias were employed, it would be necessary to mount the timing mechanism in the vertical plane which would obviate the possibility of employing the convenient mounting on the hinged doors 16 and 18. Furthermore, with the timing mechanisms disposed in a vertical plane, the necessity of making the base 12 of the mechanism substantially larger would arise which, of course, would increase the cost of manufacture of the apparatus.

As heretofore stated, the operation of the automatic immersion apparatus for moving the tissue holders from one receptacle to another is initiated when end 324 of member 322 moves into one of the notches 320 on timing disk 298. When motor 144 becomes energized shaft 146 commences rotating at a predetermined speed and shaft 168 will commence rotating at a speed one-half the angular velocity of shaft 146 as already made clear. With the starting of rotation of these two shafts, shaft 146 imparts through crank 148 and link 150, the pivotal movement to member 154 which commences moving upwardly and causes roller 160 to engage collar 162 and

move conveyor 84 in an upward direction. At this time, member 172 is in its retracted position so that it does not block the upward movement of shaft 88 by engaging collar 162, and driving member 212 is rotating but has not as yet moved to the position in which roller 220 enters slot 210A to start turning member 196 and hence the conveyor 84. Conveyor 84 continues its upward movement to the uppermost dotted position shown in Fig. 3 at which time cam 170 actuates member 172 and rocks it to its blocking position so that as member 154 starts moving in a downward direction, collar 162 comes to rest on roller 188 to thereby prevent further downward movement of the conveyor. Member 154, of course, continues moving in a downward direction and furthermore, at this time, driving member 212 continues its rotary movement, but roller 220 has not as yet entered slot 210A. Accordingly, the carrier remains stationary in its raised position during the downward move of member 154 to thereby provide a period of dwell for the tissue holders over the receptacles they were just removed from so that the liquid on the material holders can drip back into the proper receptacle, thus reducing the contamination of one liquid by another. At approximately the time that member 154 reaches its downwardmost position, as shown in solid lines in Fig. 3, arm 216 of driving member 212 engages locking member 222 to move roller 234 out of slot 210B and roller 220 enters slot 210A to thereby impart rotary movement to member 196 and therefore to shaft 194. Through means of the key and keyway arrangement on shafts 88 and 194 the rotary movement of shaft 194 is imparted to shaft 88 which revolves with collar 162 moving on roller 188. During the rotary movement of conveyor 84, member 154 makes a second upward movement. At the time that the rotary movement is completed, roller 234 moves into slot 210C as heretofore described, and at approximately the same time member 154 again engages the underside of collar 162 and cam 170 causes member 172 to rock to its non-holding or retracted position to thereby permit the conveyor to move downwardly. Accordingly, it will be seen that conveyor 84 moves downwardly while collar 162 is resting on roller 160 of member 154 until collar 162 is engaged by continuously rotating cam 268 which commences to vertically reciprocate the conveyor. At this time arm 216 engages contact actuator 238 at a point between points A and B thereon and thereby operates switch 262 to deenergize motor 144.

It should be noted that the motor control system herein employed is a two switch, three wire control system similar to that used in the aforementioned Weiskopf Patent No. 2,157,875. In such a control system, each time a reversal of condition of either switch occurs, a reversal of the condition of the controlled mechanism occurs. For instance, as shown in Fig. 42, if motor 144 is deenergized, the operation of switch 262 or switch 326 energizes the motor. As heretofore stated, when free end 324 of member 322 drops into a notch 320 of timing disk 298, the condition of switch 326 is reversed so as to energize motor 144 which remains energized until shaft 168 makes approximately one complete revolution at which time arm 216 of driving member 212 engages pivotally mounted contact actuator 238 near point B to reverse the condition of switch 262 thereby deenergizing motor 144. Because clock 272 turns so slowly as compared with the time it takes arm 212 to make one revolution, end 324 of member 322 is still in the notch of the timing disk at the time motor 144 is initially deenergized at the completion of the material holder transfer. Subsequently, the timing disk moves sufficiently to lift end 324 along the angular face of the notch so that the condition of switch 326 is again reversed thus reenergizing motor 144. Motor 144 causes the outer end of arm 216 to move along contact actuator 238 to a point adjacent point C on its surface where, due to the contour of the cam face 244 of said contact actuator, the latter rotates counterclockwise to thus operate switch 262 for a second time, hence deenergizing motor 144 again. This second energizing-deenergizing cycle of motor 144, known as a reload cycle, is of very short duration and because of the lost motion in member 154 at the bottom of its path of movement, moves conveyor 84 an imperceptible amount or not at all. However, the reload cycle does condition the apparatus for the next transfer of the material holders from one receptacle to another so that when free end 324 of member 322 drops into the next notch 320, motor 144 will once again become energized to repeat the above described sequence of movements.

It will be noted that with a dwell period provided over each receptacle, the entire transfer cycle can be speeded up since the only limiting factor in the movement of the tissue holders from one receptacle to the other is a period of time sufficient to insure a predetermined amount of dripping of the liquid back into the receptacle from which the tissue holder has just been removed so that the liquids in the adjacent receptacles will not become contaminated.

It is believed that from the foregoing description, it will also be clear that the ratio of rotational speeds of shafts 146 and 168 may be any desired ratio. For instance, if the shafts have a 1:1 speed ratio, there is no dwell period, the rotary movement commencing towards the end of the upward movement of member 154 and finishing towards the beginning of the downward movement of member 154. If the ratio is, for instance, 3:1, then member 154 moves conveyor 84 upward where member 172 holds it and then member 154 makes two upward and downward moves without any effect upon the apparatus. Thereafter, member 172 is moved out of its holding position to permit the downward movement of the conveyor 84. Accordingly, in a 3:1 movement the dwell period takes up approximately 5/12 or 42% of the time of a complete cycle of upward, lateral and downward movements of the tissue holders as compared with a 25% dwell period when a 2:1 ratio is employed. When operating the automatic immersion apparatus on the one hour or staining cycle, timing mechanism 272 is switched out of the control circuit for motor 144 and timing mechanism 274 is switched into the control circuit, see Fig. 43. With the switching of timing mechanism 274 into the control circuit, microswitch 264 is also connected into a control circuit for the clock motor of timing mechanism 274. This latter control circuit is so arranged that when switch 264 is closed, the timing mechanism motor is energized and when switch 264 is open, the clock motor is deenergized. Referring to Fig. 13, during the period of immersion in one of the staining liquids, arm 216 of member 212 is in engagement with contact actuator 238 at a point between locations C and D thereon. In such a position, motor 144 is deenergized and switch 264 is closed thus energizing the clock motor of timing mechanism 274. When free end 324 of member 322 falls into a notch on the timing disk of timing mechanism 274, the condition of switch 376 which functions in the same manner as switch 326 of timing mechanism 272 is reversed to energize motor 144. Accordingly, shaft 168 starts rotating to turn driving member 212 of the intermittent rotary drive. Accordingly, arm 216 moves along the cam face of actuator 238 past point D at which point actuator 238 has turned counterclockwise a sufficient amount to open switch 264 and hence deenergize the clock motor of timing mechanism 274. Therefore, the timing disk ceases rotating and the end 324 of member 322 remains in the notch on the timing disk. Conveyor 84 moves upward, laterally and downward in the same manner as heretofore described. At about the time the conveyor is returned to its lower position, arm 216 of driving member 212, which has been rotating in a counterclockwise direction, comes into engagement with contact actuator 238 and as it moves by point A of the cam face thereon, the actuator rotates clockwise so as to close switch 264 and reenergize the clock motor of timing

mechanism 274. Arm 216 continues moving along the cam face until it is just in approach to point B thereon where, as already stated, contact actuator 238 is moved sufficiently counterclockwise to reverse the condition of switch 262 and thus deenergize motor 144 to discontinue movement of the conveyor. With the timing mechanism reenergized, the timing disk rotates until it moves end 324 out of the notch at which time switch 376 reverses its condition. Accordingly, motor 144 again becomes energized and thus causes arm 216 to move over the cam face of actuator 238 until it moves just past point C where the condition of switch 262 is reversed to again deenergize motor 144, in the same manner as described with regard to the reload cycle above.

The principal reason for deenergizing the clock motor during the time in the one hour cycle that the material holders are being transferred from one receptacle to another is due to the fact that the timing disk on mechanism 274 is turning at such a fast rate that free end 324 of member 322 may be forced out of notch 320 while the tissue is in raised position out of the receptacles. When end 324 is moved outward of the notch, it causes switch 326 to reverse its condition and thus deenergize motor 144, thereby stopping further movement of the conveyor. With the conveyor stopped, further processing of the tissue would be discontinued and the required treatment of the tissue would not be completed. Of course, in the 24 hour cycle, because of the slow movement of the timing disk on mechanism 272, there is no possibility of the conveyor stopping in mid-air, except for the desired dwell period described above, and hence, no provision for deenergizing the motor in timing mechanism 272 is necessary.

In accordance with one of the objects of this invention, the machine disclosed herein is readily convertible from the single stack machine heretofore described to a double stack machine shown in Fig. 30. The double stack machine may be employed to double the capacity of the apparatus by treating twice as much tissue with the same reagents at the same time, the reagents in one stack of receptacles being the same as those in the other stack. On the other hand, if desired, the double stack apparatus may be operated so that one stack is idle during the operation of the apparatus.

The double stack machine shown in Fig. 30 employs the identical mechanism for moving the material holders up and down and laterally as was heretofore described with regard to the single stack machine. The double stack conveyor 338, however, is provided with a hollow shaft 340 which is longer than shaft 88. Mounted on shaft 340 for movement therewith are a lower carrier 86 and an upper carrier 344. Carrier 86 is the same as the carrier on conveyor 84 in the single stack arrangement and is mounted on shaft 340 in the same manner as it is mounted on shaft 88, that is by means of pin 90 in addition to the pressed fit. Upper carrier 344 is a flat disk-like member with a center aperture 346. Carrier 344 has a raised portion adjacent aperture 346 and this portion is pressed fit on shaft 340 to connect the two parts. To further insure a good connection, a fixed pin 348 extends through shaft 340 and the raised portion of carrier 344, thus positively connecting the two. Extending around carrier 344 adjacent its outer peripheral edge is an annular groove 350 which cooperates with radial slots therein to serve as a supporting and keying arrangement for material holder supports 74 as already described in connection with the single stack machine. Each carrier supports a cover 102 of the same construction and in the same manner as heretofore described.

Secured on the side wall of base 12 opposite brackets 26 therein are a plurality of apertured brackets 354, here shown as three in number, that are spaced from each other at 120 degrees, as best illustrated in Fig. 2. Extending through the apertures in the brackets are support rods 356 which are internally threaded at each end. Screws 358 threadedly engage rods 356 at the bottom in order to secure the rods to their respective brackets. Mounted on the support rods at their upper ends is a receptacle support 360. The receptacle support is circular in shape and has a horizontal portion 362 and a vertical portion 364. In order to mount the receptacle support on rods 356 and to secure it thereto, a number of brackets 366, one associated with each rod, are secured to portion 362 of the receptacle support in any suitable manner as by screws 368. Brackets 366 extend inward from the outer edge of horizontal portion 362 and the brackets are provided with apertures which are of slightly greater diameter than rods 356 from the bottom of the bracket to some intermediate point where the aperture narrows to a diameter substantially the same as the threaded aperture in rods 356. Accordingly, when the receptacle support is placed over rods 356 so that the apertures in the brackets 366 register with the rods, the support may be moved downward until the rods contact the narrowing points in the bracket apertures at which point the support will be prevented from further movement. To secure the receptacle support to the support rods, screws 370 are inserted through the bracket apertures and threadedly engage rods 356. To resist corrosion of receptacle support 360 by the liquids in the receptacles thereon, a flat Bakelite ring 372 similar to ring 40 may be placed in overlying relationship with horizontal portion 362 of the receptacle support.

Resting on the horizontal portion of receptacle support 360 is a plurality of beakers 42 which are the same as those used in the single stack machine. The inner or narrow wall of the beakers bear against the vertical portion of the beaker support which limits the beaker's horizontal movement toward shaft 340. Secured to vertical portion 364 by suitable securing elements 374 are another plurality of radially extending finger members 54 which fit into the channels 52 defined by the grooves 50 in the side walls of the beaker to prevent substantial vertical movement of them. Furthermore, hemispherical buttons 56 are secured to Bakelite ring 372 to prevent horizontal movement of the receptacles as already described. From the foregoing discussion, it will be seen that a simplified double stack machine is disclosed.

Furthermore, with the double stack arrangement described, it is believed clear that the single stack machine described earlier in this application may be readily converted to the double stack machine described herein with little expenditure in time or money. In order to accomplish the conversion of the above described single stack machine to the double stack machine, only the following steps need be taken. Pin 90 is forced out of its connecting relationship with carrier 86 and shaft 88 and the carrier 86 is moved upwardly off the shaft. Dome shaped enclosure 14 is disconnected from plate 20 by the removal of screws 22. Thereafter, enclosure 14 is moved off the plate 20 and out of enclosing relationship with the actuating mechanism and the lower part of shaft 88. Shaft 88 is then moved upwardly off shaft 194 and long shaft 340 is slidably moved downward onto shaft 194 until its collar 162 operatively engages the actuating mechanism. Enclosure 14 is then replaced over the actuating mechanism and reconnected to plate 20 by means of screws 22. Carrier 86 is then pressed downwardly onto shaft 340 to its intended position and pin 90 is inserted through the carrier and shaft 340 to positively hold the two in the desired relative position. Carrier 344 is then pressed downwardly onto shaft 340 to its desired position and pin 348 is inserted through carrier 344 and shaft 340 to hold them in the desired relative position. Thereafter, the support rods are connected to brackets 354 and the upper receptacle support 360 is mounted thereon to complete the conversion. It is to be understood that the above steps necessary to convert a single to a double stack machine need not be per-

formed in the stated sequence but may be performed in any sequence found convenient by the person effecting the conversion.

From the above description it will be clear that because the conveyor can be disconnected from and operatively connected to the actuating mechanism of the machine by sliding the conveyor off and onto shaft 194, respectively, no time consuming operation must be performed on the actuating mechanism itself in order to accomplish the conversion. Furthermore, a maximum number of parts from the single stack machine are employed in the double stack machine, thus reducing the cost of the conversion. Also, it will be understood that the apparatus may be assembled at the factory initially with the double stack provision. In other words, the apparatus may be sold either as a single stack machine or as a double stack machine and can be converted from one to the other in a very simple way and by a very simple substitution of a few interchangeable parts.

Although I have shown and described only one form of automatic immersion apparatus embodying my invention and have shown and suggested various modifications therein, other changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

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

1. In automatic immersion apparatus having conveyor means for moving a material holder into and out of each of a plurality of receptacles; means for raising and lowering said conveyor to raise and lower said holder for moving it out of one receptacle and into another, means for intermittently moving the conveyor horizontally for moving the raised material holder from a position over one receptacle to a position over another receptacle so that it may be lowered into the latter releasable means operatively connectable with said conveyor for retaining the latter temporarily in its raised position for maintaining the holder temporarily above the receptacle from which the holder is widthdrawn to permit draining of entrained liquid in such receptacle before the holder is moved to the next receptacle, and means operable in timed relation to the means for moving the conveyor horizontally for operatively connecting said conveyor-retaining means to and disconnecting it from said conveyor.

2. In automatic immersion apparatus having conveyor means for moving a material holder into and out of each of a plurality of receptacles; means for raising and lowering said conveyor to raise and lower said holder for moving it out of one receptacle and into another, means for intermittently moving the conveyor horizontally for moving the raised material holder from a position over one receptacle to a position over another receptacle so that it may be lowered into the latter, said conveyor including a part mounted for vertical movement to raised and lowered positions, and said conveyor raising means comprising a member releasably engageable with said part of the conveyor to raise the latter, means releasably engageable with said conveyor part to retain the conveyor temporarily in a raised position, and means operable to disengage said retaining means from said conveyor part and to concomitantly engage said member therewith for controlling the movement of said conveyor to its lowered position.

3. In automatic immersion apparatus having conveyor means for moving a material holder into and out of each of a plurality of receptacles; means for raising and lowering said conveyor to raise and lower said holder for moving it out of one receptacle and into another, means for intermittently moving the conveyor horizontally for moving the raised material holder from a position over one receptacle to a position over another receptacle so that it may be lowered into the latter, said conveyor including a part mounted for vertical movement to raised and lowered positions, and said conveyor raising means comprising an oscillatory member releasably engageable with said part of the conveyor to raise the latter, means including a second oscillatory member operable in timed relation to said first mentioned oscillatory member releasably engageable with said conveyor part to retain the conveyor temporarily in a raised position, and means operable to disengage said retaining means from said conveyor part and to concomitantly engage said first mentioned oscillatory member therewith for controlling the movement of said conveyor to its lowered position.

4. In automatic immersion apparatus having conveyor means for moving a material holder into and out of each of a plurality of receptacles; means for raising and lowering said conveyor to raise and lower said holder for moving it out of one receptacle and into another, means for intermittently moving the conveyor horizontally for moving the raised material holder from a position over one receptacle to a position over another receptacle so that it may be lowered into the latter, said conveyor including a part mounted for vertical movement to raised and lowered positions, and said conveyor raising means comprising a first member pivotally mounted at one end and releasably operatively engageable with said conveyor at its other end, means for oscillating said first member upwardly and downwardly for raising and controlling the lowering of said conveyor, a second pivotally mounted member movable between a position in which it operatively engages said conveyor for temporarily holding it in said raised position and to a non-engaging position, means for oscillating said second member in timed relation with the movement of said first member whereby said second member moves into said engaging position when said conveyor is in its raised position and thereafter remains in said engaging position for at least one complete downward and upward movement of said first member.

5. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed and means for raising and lowering said conveyor; means for rotating said conveyor when the latter is in a raised position for moving the material holder from a position above one receptacle to a position above another receptacle comprising a driven member operatively connected to said conveyor for turning the latter about said axis, said driven member having a plurality of circumferentially spaced slots, rotary driving means including a driving member movable into and out of each of said slots in succession for intermittently turning said driven member, and means operable under the control of said driving means and engageable with said driven member in each of said slots in succession as soon as said driving means disengages said driven member to positively lock said driven member against turning movement, and disengageable from said driven member as soon as said driving member is engaged in said slots for turning said driven member.

6. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation having a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed and means for raising and lowering said conveyor; means for rotating said conveyor when the latter is in a raised position for moving the material holder from a position above one receptacle to a position above another receptacle comprising a driven member operatively connected to said conveyor for turning the latter about said axis, said driven member having a plurality of circumferentially spaced slots, rotary driving means including a driving member movable into and out of each of said slots in succession for intermittently turning said driven member, and means operable under

the control of said driving means and engageable with said driven member in each of said slots in succession as soon as said driving means disengages said driven member to positively lock said driven member against turning movement, and disengageable from said driven member as soon as said driving member is engaged in said slots for turning said driven member, a member having a lower part to which said driven member is connected for turning the conveyor, said conveyor being movable longitudinally of said last mentioned member for raising and lowering the conveyor and rotatable by said last mentioned member for turning said conveyor, and means for actuating said raising and lowering means in timed relation to the operation of said driven member.

7. Means for intermittently turning a driven member having a plurality of circumferentially spaced slots, comprising rotary driving means including a driving member movable into and out of each of said slots in succession for intermittently turning said driven member, and means movable into and out of said slots under the control of and in timed relationship wtih said driving member for positively locking said driven member against rotation when said driving member is out of said slots.

8. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed and means for raising and lowering said conveyor; means for rotating said conveyor when the latter is in a raised position for moving the material holder from a position above one receptacle to a position above another receptacle comprising a driven member operatively connected to said conveyor for turning the latter about said axis, said driven member having a plurality of circumferentially spaced radially extending slots, rotary driving means including a driving member movable into and out of said slots for intermittently turning said driving member, locking means including a locking member movable into and out of said slots for preventing rotation of said driven member, said rotary driving means being releasably engageable with said locking means for moving said locking member out of said slots when said driving member is in said slots.

9. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed and means for raising and lowering said conveyor; means for rotating said conveyor when the latter is in a raised position for moving the material holder from a position above one receptacle to a position above another receptacle comprising a driven member operatively connected to said conveyor for turning the latter about said axis, said driven member having a plurality of circumferentially spaced radially extending slots, rotary driving means including a driving member movable into and out of said slots for intermittently turning said driving member, locking means including a locking member movable into and out of said slots for preventing rotation of said driven member, biasing means operable on said locking means for urging said locking member into said slots, said rotary driving means being releasably engageable with said locking means for moving said locking member out of said slots against the urging of said biasing means when said driving member is in said slots.

10. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed and means for raising and lowering said conveyor; means for rotating said conveyor when the latter is in a raised position for moving the material holder from a position above one receptacle to a position above another receptacle comprising a substantially circular driven member operatively connected to said conveyor for turning the latter about said axis, said driven member having a plurality of radially extending slots equi-spaced about the circumference thereof, rotary driving means having a driving member movable into and out of said slots for intermittently rotating said driven member, said driving means being so proportioned that said driving member enters each of said slots in a path normal to the curvature of said circular driven member, and means operable under the control of said driving means and engageable with said driven member in each of said slots in succession as soon as said driving means disengages said driven member to positively lock said driven member against turning movement, and disengageable from said driven member as soon as said driving member is engaged in said slots for turning said driven member.

11. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed and means for raising and lowering said conveyor; means for rotating said conveyor when the latter is in a raised position for moving the material holder from a position above one receptacle to a position above another receptacle comprising a driven member operatively connected to said conveyor for turning the latter about said axis, said driven member having a plurality of circumferentially spaced slots, rotary driving means including a driving member movable into and out of each of said slots in succession for intermittently turning said driven member, motor means for rotating said rotary driving means, means for energizing said motor means, and means for deenergizing said motor means controlled by said rotary driving member.

12. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed, a horizontal support for said receptacles, said conveyor having a part disposed above said receptacles for moving said material holder into and out of the receptacles on said support, and means for actuating said conveyor to raise and lower said part thereof and to turn said part when said conveyor is in a raised position; means for releasably connecting said conveyor to said actuating means for operation thereby comprising vertically extending relatively slidable parts on said actuating means and on said conveyor, respectively, said last mentioned part of said conveyor being disengageable from said vertically extending part of said actuating means by upward sliding movement of said vertically extending part of said conveyor on said vertically extending part of said actuating means.

13. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed, a horizontal support for said receptacles, said conveyor having a part disposed above said receptacles for moving said material holder into and out of the receptacles on said support, and means for actuating said conveyor to raise and lower said part thereof and to turn said part when said conveyor is in a raised position; means for releasably connecting said conveyor to said actuating means for operation thereby comprising vertically extending relatively slidable parts on said actuating means and on said conveyor, respectively, said last mentioned part of said conveyor being disengageable from said vertically extending part of said actuating means by upward sliding movement of said vertically extending part of said conveyor on said vertically extending part of said actuating means, said actuating means comprising intermittently operable rotary driving

mechanism connected to said vertically extending part of said actuating mechanism, and further comprising mechanism operatively connected to said vertically extending part of said conveyor for raising and lowering the latter.

14. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed, a horizontal support for said receptacles, said conveyor having a part disposed above said receptacles for moving said material holder into and out of the receptacles on said support, and means for actuating said conveyor to raise and lower said part thereof and to turn said part when said conveyor is in a raised position; means for releasably connecting said conveyor to said actuating means for operation thereby comprising vertically extending relatively slidable parts on said actuating means and on said conveyor, respectively, said last mentioned part of said conveyor being disengageable from said vertically extending part of said actuating means by upward sliding movement of said vertically extending part of said conveyor on said vertically extending part of said actuating means, said conveyor being automatically connected for operation by placing said conveyor in position with its said vertically extending part in said slidable relation with said vertically extending part of the conveyor.

15. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed, a horizontal support for said receptacles, said conveyor having a part disposed above said receptacles for moving said material holder into and out of the receptacles on said support, and means for actuating said conveyor to raise and lower said part thereof and to turn said part when said conveyor is in a raised position; means for releasably connecting said conveyor to said actuating means for operation thereby comprising companion parts on said conveyor and actuating means which are relatively movable vertically but which are in rotary driving relation, said conveyor being removable by upward movement thereof to a point beyond its normal upward movement in the operation of the apparatus, and being automatically connected for operation by placing said conveyor in position.

16. In automatic immersion apparatus having a horizontal support for a plurality of receptacles in position laterally of each other and a conveyor for moving a material holder vertically and laterally of said receptacles for moving the material into and out of said receptacles, respectively, said conveyor having a part disposed above said receptacles for moving said material holder into and out of the receptacles on said support, and means for actuating said conveyor to raise and lower said part thereof and to move said part laterally of said receptacles when said part is in a raised position; means for releasably connecting said conveyor to said actuating means for operation thereby, said last mentioned means comprising parts on said conveyor and actuating means which are relatively movable vertically and are connected for operation of said conveyor by said actuating means for effecting said lateral movement of the material holder, said conveyor being removable by upward movement thereof to a point beyond its normal upward movement in the operation of the apparatus, and being automatically connected for operation by placing said conveyor in position.

17. In automatic immersion apparatus having a horizontal support for a plurality of receptacles in position laterally of each other and a conveyor for moving a material holder vertically and laterally of said receptacles for moving the material into and out of said receptacles, respectively, said conveyor having a part disposed above said receptacles for moving said material holder into and out of the receptacles on said support, and means for actuating said conveyor to raise and lower said part thereof and to move said part laterally of said receptacles when said part is in a raised position; said actuating means comprising intermittently operable mechanism for moving said conveyor part vertically up and down and intermittently operable mechanism actuated in timed relation to said first mentioned mechanism for moving said conveyor part only when the latter is in a raised position, means for releasably connecting said conveyor to said actuating means for operation thereby, said last mentioned means comprising parts on said conveyor and actuating means which are relatively movable vertically and are connected for operation of said conveyor by said actuating means for effecting said lateral movement of the material holder, said conveyor being removable by upward movement thereof to a point beyond its normal upward movement in the operation of the apparatus, and being automatically connected for operation by placing said conveyor in position.

18. In automatic immersion apparatus having a horizontal support for a plurality of receptacles in position laterally of each other and a conveyor for moving a material holder vertically and laterally of said receptacles for moving the material into and out of said receptacles, respectively, said conveyor having a part disposed above said receptacles for moving said material holder into and out of the receptacles on said support, and means for actuating said conveyor to raise and lower said part thereof and to move said part laterally of said receptacles when said part is in a raised position; said actuating means comprising intermittently operable mechanism for moving said conveyor part vertically up and down and intermittently operable mechanism actuated in timed relation to said first mentioned mechanism for moving said conveyor part only when the latter is in a raised position, means for releasably connecting said conveyor to said actuating means for operation thereby, said last mentioned means comprising parts on said conveyor and actuating means which are relatively movable vertically and are connected for operation of said conveyor by said actuating means for effecting said lateral movement of the material holder, said conveyor being removable by upward movement thereof to a point beyond its normal upward movement in the operation of the apparatus, and being automatically connected for operation by placing said conveyor in position, said mechanism for raising and lowering the conveyor comprising a vertically movable member from which the conveyor is disengageable by upward movement of the conveyor and with which the conveyor is automatically connected for normal vertical movement when the conveyor is placed in position.

19. In automatic immersion apparatus having a horizontal support for a plurality of receptacles in position laterally of each other and a conveyor for moving a material holder vertically and laterally of said receptacles for moving the material into and out of said receptacles, respectively, said conveyor having a part disposed above said receptacles for moving said material holder into and out of the receptacles on said support, and means for actuating said conveyor to raise and lower said part thereof and to move said part laterally of said receptacles when said part is in a raised position; means for releasably connecting said conveyor to said actuating means for operation thereby, said last mentioned means comprising parts on said conveyor and actuating means which are relatively movable vertically and are connected for operation of said conveyor by said actuating means for effecting said lateral movement of the material holder, said conveyor being removable by upward movement thereof to a point beyond its normal upward movement in the operation of the apparatus, and being automatically connected for operation by placing said conveyor in position, and means for moving said conveyor while the latter is in its lowered position for moving the mate-

rial repeatedly while it is immersed in the receptacle, said conveyor being automatically disconnected from said last mentioned means upon upward movement of the conveyor by said actuating means and automatically connected for operation by said last mentioned means when said conveyor is in lowered position.

20. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed, said conveyor having an upper part for carrying said material into and out of said receptacles; means for actuating said conveyor to raise and lower said part thereof and to turn said part when said part is in a raised position, and means operatively connecting said conveyor to said actuating means for operation thereby comprising vertically extending relatively slidable parts on said actuating means and on said conveyor, respectively, said relatively slidable parts being held against relative rotation, means for raising and lowering one of said relatively slidable parts to raise and lower said upper part of the conveyor, and means for imparting said turning movements to the conveyor connected to said other relatively slidable part adjacent the lower portion of the latter, said upper part of the conveyor being connected to said other relatively slidable part only through said first mentioned slidable part whereby said upper part of the conveyor is removable automatically from the apparatus by disconnecting said relatively slidable parts.

21. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed, said conveyor having an upper part for carrying said material into and out of said receptacle; means for actuating said conveyor to raise and lower said part thereof and to turn said part when said part is in a raised position, and means operatively connecting said conveyor to said actuating means for operation thereby comprising vertically extending relatively slidable parts on said actuating means and on said conveyor, respectively, said relatively slidable parts being held against relative rotation, means for raising and lowering one of said relatively slidable parts to raise and lower said upper part of the conveyor, and means for imparting said turning movements to the conveyor connected to said other relatively slidable part adjacent the lower portion of the latter, said upper part of the conveyor being connected to said other relatively slidable part only through said first mentioned slidable part and said first mentioned slidable part being removable from said other relatively slidable part by a predetermined upward movement of the former whereby said upper part of the conveyor is removable automatically from the apparatus by said last mentioned upward movement of said first mentioned slidable part.

22. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed and means for raising and lowering said conveyor; means for rotating said conveyor when the latter is in a raised position for moving the material holder from a position above one receptacle to a position above another receptacle comprising a vertical member extending along said axis, a rotatable driven member connected to the lower part of said vertically extending member, said driven member having a plurality of circumferentially spaced slots, rotary driving means including a driving member movable into and out of each of said slots in succession for intermittently turning said driven member, said conveyor having a vertical hollow part adapted to fit over the upper part of said vertically extending member, and key means for releasably connecting said hollow part of said conveyor to said upper part of said vertical member, said last mentioned means being arranged so that said conveyor will turn with said vertical member but will be free to move up and down relative to said vertical member.

23. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed; a vertical member extending along said axis, means for preventing vertical movement of said vertically extending member, means for turning said vertically extending member on its own axis operatively connected to the lower part of the latter, means for releasably connecting said conveyor to the upper part of said vertical member, said last mentioned means being arranged so that said conveyor will turn with said member but will be free to move up and down relative to said member, and means engageable with said conveyor for moving the latter up and down.

24. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed; a vertical member extending along said axis, means for preventing vertical movement of said vertically extending member, means for turning said vertically extending member on its own axis operatively connected to the lower part of the latter, means for releasably connecting said conveyor to the upper part of said vertical member, said last mentioned means being arranged so that said conveyor will turn with said member but will be free to move up and down relative to said member, and means engageable with said conveyor for moving the latter up and down, and other means engageable with said conveyor when the latter is in its lower position for vertically reciprocating said conveyor.

25. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed; a vertical member extending along said axis, means for preventing vertical movement of said vertically extending member, means for turning said vertically extending member on its own axis operatively connected to the lower part of the latter, said conveyor having a vertical hollow part for fitting over the upper part of said vertical member, means for releasably connecting said hollow part to said vertical member, said connecting means being arranged so that said conveyor turns with said vertical member but said conveyor is free to be raised and lowered relative to said vertical member, means engageable with said hollow part for raising and lowering said conveyor, and other means engageable with said hollow part when said conveyor is in its lowered position for vertically reciprocating said conveyor.

26. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed; a vertical member extending along said axis, means for preventing vertical movement of said vertically extending member, means for turning said vertically extending member on its own axis operatively connected to the lower part of the latter, said conveyor having a vertical hollow part for fitting over the upper part of said vertical member, means for releasably connecting said hollow part of said vertical member, said connecting means being arranged so that said conveyor turns with said vertical member but said conveyor is free to be raised and lowered relative to said vertical member, said hollow part having an out-

wardly extending part thereon, means releasably engageable with said outwardly extending part for raising and lowering said conveyor, and rotary cam means releasably engageable with said outwardly extending part when said conveyor is in its lowered position for vertically reciprocating said conveyor.

27. In automatic immersion apparatus having a rotary conveyor movable up and down for moving a material holder into and out of a plurality of receptacles arranged in a circular row, and a base member; a stationary vertical member in fixed position relative to said base member, a hollow shaft disposed about said vertical member and rotatable relative thereto, means for rotating said hollow shaft relative to said vertical member, said shaft-rotating means being operatively connected to said hollow shaft adjacent its bottom, the top of said hollow shaft being adapted to fit within a portion of said conveyor, and means for connecting said hollow shaft to said conveyor portion so that said conveyor turns with said shaft but is movable up and down relative to said vertical member, and means for moving said conveyor up and down longitudinally of said hollow shaft relatively thereto.

28. In automatic immersion apparatus having a rotary conveyor movable up and down for moving a material holder into and out of a plurality of receptacles arranged in a circular row, and a base member; a vertical member in fixed position relative to said base member, a hollow shaft disposed about said vertical member, bearing means between said vertical member and said hollow shaft for rendering said shaft rotatable relative to said vertical member, means for rotating said hollow shaft relative to said vertical member, said last mentioned means being operatively connected to said hollow shaft adjacent its bottom, said hollow shaft fitting within a portion of said conveyor and said portion of the conveyor being movable longitudinally of said hollow shaft, means for connecting said rotatable shaft to said conveyor portion so that said conveyor turns with said shaft but is movable up and down relative to said vertical member, and means for moving said conveyor up and down longitudinally of said hollow shaft relatively thereto.

29. Automatic immersion apparatus, comprising a housing adapted to support a first group of receptacles arranged in a circular row about a vertical axis, a rotatable shaft in said housing, means for rotating said shaft about said axis operatively connected to said rotatable shaft adjacent its bottom, a conveyor having a pair of vertically spaced carriers and a hollow shaft which is adapted to fit over the upper part of said rotatable shaft, said carriers being movable with said hollow shaft, means releasably connecting said hollow shaft of the conveyor to said first mentioned shaft so that said conveyor rotates with said first mentioned shaft and is movable up and down relative to said first mentioned shaft, means in said housing releasably engageable with said hollow shaft for moving said conveyor up and down, a receptacle support for a second circular row of receptacles, means operatively connecting said housing and said receptacle support for supporting the latter in vertical spaced relation to the former so that one carrier is associated with each row of receptacles, each of said carriers being adapted to be connected to a material holder for moving the latter into and out of its associated receptacles.

30. In automatic immersion apparatus having a conveyor which is vertically movable and rotatable for moving a material holder into and out of a plurality of receptacles arranged laterally of each other in a circular row; means for mounting said conveyor for said rotary and vertical movements thereof, comprising an upstanding stationary member, a vertically extending member mounted for rotation on said upstanding member around the vertical axis of the latter, a vertically extending part on said conveyor surrounding said last mentioned member in slidable relation thereon and rotatable thereby, and means operatively connected to said vertically extending member at the lower end thereof for intermittently turning the latter and thereby intermittently turning said conveyor for accomplishing said rotation thereof.

31. In automatic immersion apparatus having a conveyor which is vertically movable and rotatable for moving a material holder into and out of a plurality of receptacles arranged laterally of each other in a circular row; means for mounting said conveyor for said rotary and vertical movements thereof, comprising an upstanding stationary member, a vertically extending member mounted for rotation on said upstanding member around the vertical axis of the latter, a vertically extending part on said conveyor surrounding said last mentioned member in slidable relation thereon and rotatable thereby, and means operatively connected to said vertically extending member at the lower end thereof for intermittently turning the latter and thereby intermittently turning said conveyor for accomplishing said rotation thereof, and means operatively connected to said conveyor part for effecting vertical movement thereof longitudinally of said vertically extending member for accomplishing said vertical movement of the conveyor.

32. In automatic immersion apparatus having a conveyor which is movable up and down and laterally for moving a material holder from one to another of a plurality of receptacles arranged laterally of each other; a rotatable plate for mounting a timing disc and a spider arranged to sandwich said timing disc between said plate and spider, and a locking arm operatively connected to said plate for pivotal movement relative thereto between first and second positions, said arm having a camming portion which is operatively engageable with said spider for forcing the latter into clamping engagement with said timing disc when said arm is in said first position and which is movable to a position in which said timing disc is free to move relative to said plate when said arm is in said second position.

33. In automatic immersion apparatus having a conveyor which is movable up and down and laterally for moving a material holder from one to another of a plurality of receptacles arranged laterally of each other; a rotatable plate for mounting a timing disc and a spider arranged to sandwich said timing disc between said plate and spider, means for clamping said timing disc between said plate and spider, a sensing member having a free-end biased into engagement with the periphery of said timing disc for moving in and out of the notches thereon in response to the turning of said timing disc, switching means controlled by said sensing arm and dependent on whether or not said sensing arm is in a notch for controlling the movements of said conveyor, a shut-off member mounted on said timing mechanism for movement between a first position in which said edge of said shut-off member does not extend beyond the periphery of said timing disc and to a second position in which said edge extends beyond the periphery of said timing disc for engaging said sensing arm to move the latter out of engagement with the periphery of said timing disc, and means for holding said sensing arm out of engagement with the periphery of said timing disc.

34. In automatic immersion apparatus having a conveyor which is movable up and down and laterally for moving a material holder from one to another of a plurality of receptacles arranged laterally of each other; means including a driving member for imparting said lateral movement to said conveyor, a movable contact actuator having a cam operatively engaged by said driving member, said cam being so shaped that when said driving member operates in engagement therewith, said contact actuator first moves in one direction and later in the opposite direction, and circuit controlling means having first and second circuit controlling conditions and being responsive to movement of said contact actuator for

controlling the movement of said conveyor, whereby when said driving member engages one point on said cam said circuit controlling means operates from said first to said second condition and when said driving member engages a second point on said cam said circuit controlling means operates from said second to said first condition.

35. In automatic immersion apparatus having a conveyor which is movable up and down and laterally for moving a material holder from one to another of a plurality of receptacles arranged laterally of each other; means including a driving member for imparting said lateral movement to said conveyor, a pivotally mounted contact actuator having a cam face releasably engageable with said driving member and an arm having an adjustably positionable screw mounted thereon, said cam face being so shaped that as said driving member operates in engagement therewith, said contact actuator first pivots in one direction and later in the opposite direction, circuit controlling means having first and second circuit controlling conditions, said circuit controlling means being engageable by said screw and responsive to the latter's movement to operate to and from said first and second conditions as said rotary driving member operates in engagement with said cam face.

36. In automatic immersion apparatus having a conveyor which is movable up and down and laterally for moving a material holder from one to another of a plurality of receptacles arranged laterally of each other; means including a driving member for imparting said lateral movement to said conveyor, motor means for actuating said driving member, a first circuit controlling means effective for energizing said motor means at predetermined time intervals, a movable contact actuator engageable by said driving member for moving said contact actuator, and a second circuit controlling means operatively engageable by said contact actuator and effective for de-energizing said motor means when said contact actuator has been moved a predetermined amount.

37. In automatic immersion apparatus having a conveyor which is movable up and down and laterally for moving a material holder from one to another of a plurality of receptacles arranged laterally of each other; means including a driving member for imparting said lateral movement to said conveyor, motor means for actuating said driving member, a timing mechanism, a first circuit controlling means having first and second circuit controlling conditions, said first circuit controlling means being controlled by said timing mechanism and operable between its two circuit controlling conditions at predetermined times in response to operation of said timing mechanism, a movable contact actuator having a cam face which is engageable by said driving member for moving said contact actuator from a first to a second position and later from said second to said first position as said driving member moves over said cam face, a second circuit controlling means having first and second circuit controlling conditions operatively engaged by said contact actuator and operable from said first to said second condition when said contact actuator is moved a predetermined amount out of said first position, and circuit means effective when both said circuit controlling means are in said first condition and both are in said second condition for energizing said motor means.

38. In automatic immersion apparatus having a conveyor which is movable up and down and laterally for moving a material holder from one to another of a plurality of receptacles arranged laterally of each other; means including a driving member for imparting said lateral movement to said conveyor, motor means for actuating said driving member, a timing mechanism, a first circuit controlling means having first and second circuit controlling conditions, said first circuit controlling means being controlled by said timing mechanism and operable between its two circuit controlling conditions at predetermined times in response to operation of said timing mechanism, a movable contact actuator having a cam face which is engageable by said driving member for moving said contact actuator from a first to a second position and later from said second to said first position as said driving member moves over said cam face, a second circuit controlling means having first and second circuit controlling conditions operatively engaged by said contact actuator and operable from said first to said second condition when said contact actuator is moved a predetermined amount out of said first position, and circuit means effective when both said circuit controlling means are in said first condition and both are in said second condition for energizing said motor means, and a third circuit controlling means operatively engaged by said contact actuator and operable from first to second circuit controlling condition when said contact actuator is moved out of said first position a predetermined amount which is less than said predetermined amount necessary to operate said second circuit controlling means, and circuit means effective only when said third circuit controlling means is in said second condition for energizing said timing mechanism.

39. In automatic immersion apparatus having a conveyor which is movable up and down and laterally for moving a material holder from one to another of a plurality of receptacles arranged laterally of each other; means including a driving member for imparting said lateral movement to said conveyor, motor means for actuating said driving member, a timing mechanism, a first circuit controlling means having first and second circuit controlling conditions, said first circuit controlling means being controlled by said timing mechanism and operable between its two circuit controlling conditions at predetermined times in response to operation of said timing mechanism, a pivotally mounted contact actuator having a cam face and an arm with a pair of threaded apertures therein, said cam face being adapted to removably engage said rotary driving member and being so shaped that as said driving member moves over said cam face said contact actuator will first pivot in one direction and subsequently in the other direction, a pair of screws adjustably threadedly mounted in said threaded aperture and movable with said contact actuator, second and third circuit controlling means each having first and second circuit controlling conditions, each of said second and third circuit controlling means being operatively engageable by one of said screws to operate said circuit controlling means between their said two conditions, the parts being so positioned and proportioned that as said contact actuator pivots in said one direction first said second circuit controlling means operates from its first to its second condition and then said third circuit controlling means operates from its first to its second condition and as said actuator moves in said other direction first said third circuit controlling means operates from its second to its first condition and then said second circuit controlling means operates from its second to its first condition, circuit means effective when said first and third circuit controlling means are both in said first condition and when both are in said second condition for energizing said motor means, and circuit means effective only when said second circuit controlling means is in said second condition for energizing said timing mechanism.

40. In automatic immersion apparatus having a base adapted to support a plurality of receptacles arranged laterally of each other, and a conveyor adapted to move up and down and laterally for transferring a material holder from one receptacle to another; means for supporting said apparatus on a surface, comprising means adapted to engage said surface, said last mentioned means having a relatively high coefficient of friction so that it is relatively unslidable on said surface, a laterally-extending member having a relatively low coefficient of friction and operatively supported by said surface engag-

ing means, and means operatively connected to said base and engaging said low friction member for slidable movement relative thereto, whereby said base can be moved laterally relative to said supporting surface and said surface engaging means.

41. In automatic immersion apparatus having a housing with a circular base adapted to support a plurality of receptacles arranged in a circular row thereon, and a conveyor which is rotatable and movable up and down for transferring a material holder from one receptacle to another; means for supporting said apparatus on a horizontal surface, comprising a plurality of resilient buttons having relatively high coefficients of friction and adapted to engage said surface and to be unslideable relative thereto, a substantially circular member having a relatively low coefficient of friction and being supported by said buttons, and a horizontally extending member operatively connected to said base and slideably engaging said circular member, whereby said apparatus can be turned with relative facility on said support means but can be slideably moved along said surface only with relative difficulty.

42. In automatic immersion apparatus having a housing with a circular base adapted to support a plurality of receptacles arranged in a circular row thereon, and a conveyor which is rotatable and movable up and down for transferring a material holder from one receptacle to another; means for supporting said apparatus on a horizontal surface, comprising surface engaging means having a relatively high coefficient of friction to render said last mentioned means relatively unslideable on said surface, a substantially circular member having a relatively low coefficient of friction and being supported by said surface engaging means, and a horizontally extending member operatively connected to said base and slideably engaging said circular member, whereby said apparatus can be turned with relative facility on said support means but can be slideably moved along said surface only with relative difficulty.

43. Automatic immersion apparatus comprising a base, mechanism carried by said base for operating said apparatus, a sub-base, means for mounting said base on said sub-base for limited movement horizontally thereon, means interposed between said base and sub-base for releasably opposing said movement of said base, and friction means on said sub-base engageable with a support for the latter to resist movement of said sub-base on said support with sufficient force to enable said limited movement of said base on said sub-base to take place without causing movement of said base on said support.

44. Automatic immersion apparatus comprising a base, mechanism carried by said base for operating said apparatus, a sub-base, means for mounting said base on said sub-base for limited movement horizontally thereon, means interposed between said base and sub-base for releasably opposing said movement of said base, and friction means on said sub-base engageable with a support for the latter to resist movement of said sub-base on said support with sufficient force to enable said limited movement of said base on said sub-base to take place without causing movement of said base on said support, said interposed means between the base and sub-base comprising friction means having a lower coefficient of friction than said first mentioned friction means.

45. Automatic immersion apparatus comprising a base, mechanism carried by said base for operating said apparatus, a sub-base, means for mounting said base on said sub-base for rotary movement horizontally thereon, means interposed between said base and sub-base for releasably opposing said movement of said base, and friction means on said sub-base engageable with a support for the latter to resist movement of said sub-base on said support with sufficient force to enable said rotary movement of said base on said sub-base to take place without causing movement of said base on said support.

46. Automatic immersion apparatus comprising a base, mechanism carried by said base for operating said apparatus, a sub-base, means for mounting said base on said sub-base for rotary movement horizontally thereon, means interposed between said base and sub-base for releasably opposing said movement of said base, and friction means on said sub-base engageable with a support for the latter to resist movement of said sub-base on said support with sufficient force to enable said rotary movement of said base on said sub-base to take place without causing movement of said base on said support, said interposed means between the base and sub-base comprising friction means having a lower coefficient of friction than said first mentioned friction means.

47. In automatic immersion apparatus, comprising a base having a support for a plurality of receptacles positioned laterally of each other on said base, and a conveyor movable up and down and laterally for transferring a material holder from one receptacle to another; said base comprising a housing, a closure for said housing mounted on said base and movable to open and closed positions, and a timing mechanism for controlling movement of said conveyor operatively connected to said closure for movement therewith from within to outside said housing for access thereto.

48. In automatic immersion apparatus, comprising a base having a support for a plurality of receptacles positioned laterally of each other on said base, and a conveyor movable up and down and laterally for transferring a material holder from one receptacle to another; said base comprising, a pair of closures mounted on said housing for movement between closed and open positions, and a pair of timing mechanisms having horizontally disposed timing discs, each timing mechanism being operatively connected to one of said closures for movement therewith from within to outside said housing for access thereto.

49. Automatic immersion apparatus comprising a plurality of receptacles arranged laterally of each other in an arcuate row, and a conveyor mounted for vertical movement and for rotation about a vertical axis at the center of said arc for moving a material holder into and out of each of said receptacles, said receptacles having substantially flat side walls which converge toward the center of the arc and extend radially thereof whereby said receptacles may be disposed in adjacent side-by-side relation in said arcuate arrangement, covering means for said receptacles movable with said conveyor, and means releasably engageable with the side walls of said receptacles for preventing substantial upward movement thereof by said covering means in the event of adhesion of the latter to the top of a receptacle.

50. Automatic immersion apparatus comprising a plurality of receptacles arranged laterally of each other in an arcuate row, and a conveyor mounted for vertical movement and for rotation about a vertical axis at the center of said arc for moving a material holder into and out of each of said receptacles, said receptacles having substantially flat side walls which converge toward the center of the arc and extend radially thereof whereby said receptacles may be disposed in adjacent side-by-side relation in said arcuate arrangement, covering means for said receptacles movable with said conveyor, said side walls having recesses therein, and means releasably engageable in said recesses of said receptacles for preventing substantial upward movement thereof by said covering means in the event of adhesion of the latter to the top of a receptacle.

51. In automatic immersion apparatus having a frame, a conveyor for a material-holder mounted in said frame for vertical movement and for rotation about a vertical axis and a receptacle support on said frame extending around said axis of the conveyor; a series of receptacles for liquids adapted to be arranged laterally of each other on said support in a circular row extending around said

axis so that the material holder may be moved into and out of said receptacles for immersion in the liquids therein when said conveyor is operated, said receptacles having substantially flat planar vertical side walls which are disposed in converging relation radially of and toward said axis whereby said receptacles may be disposed on said support in adjacent side-by-side relation, said receptacles having radially spaced vertical end walls, and means on said frame releasably engageable with said receptacles at the end walls which are more remote from said axis for releasably holding said receptacles in position on said support.

52. In automatic immersion apparatus having a frame adapted to support a plurality of receptacles arranged laterally of each other in side-by-side relation, a conveyor mounted on said frame and movable vertically and laterally for moving a material holder into and out of the receptacles, and closure means upwardly and downwardly movable with the conveyor to cover and uncover said receptacles; means for preventing upward movement of the receptacles by said closure means in the event of adhesion of the latter to said receptacles, comprising means carried by said frame and adapted to releasably interengage the side walls of the receptacles to hold the latter against displacement by upward movement of said closure means.

53. Automatic immersion apparatus comprising a plurality of receptacles arranged laterally of each other in an arcuate row, and a conveyor mounted for vertical movement and for rotation about a vertical axis at the center of said arc for moving a material holder into and out of each of said receptacles, a support for said circularly arranged receptacles, said receptacles having substantially flat side walls which converge toward the center of the arc and extend radially thereof whereby said receptacles may be disposed in adjacent side-by-side relation in said circular arrangement, complementary interengaging means associated with said support and the sides of said receptacles for preventing substantial upward movement of said receptacles due to upward movement of said covering means in the event that said covering means adheres to any of said receptacles, said receptacles further having radially spaced end walls, and means on said support releasably engageable with the end walls which are furthest from the center of said circle for releasably holding said receptacles in position on said support.

54. Automatic immersion apparatus comprising a plurality of receptacles arranged laterally of each other in an arcuate row, and a conveyor mounted for vertical movement and for rotation about a vertical axis at the center of said arc for moving a material holder into and out of each of said receptacles, said receptacles having substantially flat side walls which converge toward the center of the arc and extend radially thereof, each of said side walls having a groove therein so that when said receptacles are in side-by-side relation said grooves will cooperate to form a plurality of channels, and a plurality of outward radially extending members in fixed position relative to said support, said last mentioned members being adapted to fit into said channels to prevent substantial upward movement of said receptacles.

55. A receptacle for automatic immersion apparatus, said receptacle comprising an end wall and side walls extending from said end wall in converging relation, and recesses in said side walls adjacent said end wall forming means to facilitate gripping of the side walls and handling of the receptacle when it is disposed between and adjacent two other similar receptacles.

56. A receptacle for automatic immersion apparatus, said receptacle comprising an end wall and side walls extending from said end wall in converging relation, and recesses in said side walls adjacent said end wall forming means to facilitate gripping of the side walls and handling of the receptacle when it is disposed between and adjacent two other similar receptacles, said side wall also having recesses to receive means for holding the receptacle against substantial upward movement on a receptacle support.

57. A receptacle for automatic immersion apparatus, said receptacle comprising an end wall and side walls extending from said end wall in converging relation, and finger grip means on the side walls of said receptacle adjacent the end wall thereof to facilitate gripping and handling thereof when it is disposed between and adjacent two other similar receptacles.

58. A receptacle for automatic immersion apparatus, said receptacle comprising side walls having recesses therein so that when two of the receptacles are placed in side-by-side relation on a horizontal support the recesses of the adjacent side walls of the two receptacles form a key-way for a key to prevent substantial movement of said two receptacles upwardly from said support.

59. A receptacle for automatic immersion apparatus, said receptacle comprising side walls, at least one side wall of said receptacle having a portion projecting into the receptacle and providing an external recess to receive a holding element to prevent substantial upward movement of the receptacle on a support.

60. Automatic immersion apparatus comprising a plurality of receptacles arranged laterally of each other in an arcuate row and a conveyor mounted for vertical movement and for rotation about a vertical axis at the center of said arc for moving a material holder into and out of each of said receptacles, said receptacles having substantially flat side walls which converge toward the center of the arc and extend radially thereof whereby said receptacles may be disposed in adjacent side-by-side relation in said arcuate arrangement, a support for said receptacles, and means on said apparatus and on said receptacles automatically engaged with each other by movement of the receptacles horizontally toward said axis to position them on said support for preventing substantial inadvertent movement of said receptacles on said support.

61. Automatic immersion apparatus comprising a plurality of receptacles arranged laterally of each other in an arcuate row, and a conveyor mounted for vertical movement and for rotation about a vertical axis at the center of said arc for moving a material holder into and out of each of said receptacles, said receptacles having substantially flat side walls which converge toward the center of the arc and extend radially thereof whereby said receptacles may be disposed in adjacent side-by-side relation in said arcuate arrangement, a support for said receptacles, and means on said apparatus and on said receptacles automatically engaged with each other by movement of the receptacles horizontally toward said axis to position them on said support for preventing substantial inadvertent movement of said receptacles on said support in a direction away from said axis.

62. Automatic immersion apparatus comprising a plurality of receptacles arranged laterally of each other in an arcuate row, and a conveyor mounted for vertical movement and for rotation about a vertical axis at the center of said arc for moving a material holder into and out of each of said receptacles, said receptacles having substantially flat side walls which converge toward the center of the arc and extend radially thereof whereby said receptacles may be disposed in adjacent side-by-side relation in said arcuate arrangement, a support for said receptacles, and means on said apparatus and on said receptacles automatically engaged with each other by movement of the receptacles horizontally toward said axis to position them on said support for preventing substantial inadvertent movement of said receptacles upwardly from said support.

63. Automatic immersion apparatus comprising a plurality of receptacles arranged laterally of each other in an arcuate row, and a conveyor mounted for vertical movement and for rotation about a vetrical axis at the center of said arc for moving a material holder into and out of each of said receptacles, said receptacles having substan-

tially flat side walls which converge toward the center of the arc and extend radially thereof whereby said receptacles may be disposed in adjacent side-by-side relation in said arcuate arrangement, a support for said receptacles, and means on said apparatus and on said receptacles automatically engaged with each other by movement of the receptacles horizontally toward said axis to position them on said support for preventing substantial inadvertent movement of said receptacles upwardly from said support and for preventing substantial inadvertent horizontal movement of said receptacles in a direction away from said axis.

64. Automatic immersion apparatus comprising a plurality of receptacles arranged laterally of each other in an arcuate row, and a conveyor mounted for vertical movement and for rotation about a vertical axis at the center of said arc for moving a material holder into and out of each of said receptacles, a support for said circularly arranged receptacles, said receptacles having substantially flat side walls which converge toward the center of the arc and extend radially thereof whereby said receptacles may be disposed in adjacent side-by-side relation in said arcuate arrangement, covering means for said receptacles movable with said conveyor, complementary interengaging means associated with said support and the sides of said receptacles for preventing substantial upward movement of said receptacles due to upward movement of said covering means in the event that said covering means adheres to any of said receptacles, said receptacles further having radially spaced end walls, and means on said support releasably engageable with the end walls which are furthest from the center of said circle for releasably holding said receptacles in position on said support, each of said receptacles being removable from said circular arrangement by upwardly moving said receptacle the extent permitted by said complementary interengaging means to thereby move said end wall out of engagement with said holding means and then moving said receptacle horizontally to disengage said complementary interengaging means.

65. Automatic immersion apparatus comprising a plurality of receptacles arranged laterally of each other in a circle and a conveyor mounted for vertical movement and for rotation about a vertical axis at the center of said circle for moving a material holder into and out of said receptacle, said receptacles having substantially flat side walls which converge toward the center of said circle and extend radially therefrom whereby said receptacles can be disposed in adjacent side-by-side relation in said circular arrangement for substantially the full radial extent of said side walls, said receptacles being formed of a plastic material of the group consisting of nylon, polytetrafluoroethylene and polytrifluorochloroethylene.

66. In automatic immersion apparatus having a conveyor movable up and down and laterally for moving a material holder into and out of tissue processing liquids; a plurality of receptacles for said liquids arranged laterally of each other and adapted to successively receive said material holder, said receptacles being molded of a plastic material of the group consisting of nylon, polytetrafluoroethylene and polytrifluorochloroethylene.

67. In automatic immersion apparatus having a rotary conveyor movable up and down for moving a material holder through corresponding moves; a plurality of wedge-shaped receptacles arranged in adjacent side-by-side relation to form a circular group concentric with the axis of rotation of said conveyor, said receptacle being adapted to receive said material holder, one of said receptacles being shorter than the other of said receptacles, a cover member operatively connected to said conveyor for movement therewith so that when said conveyor is raised said cover is out of covering relationship with said receptacle and when said conveyor is in its lowered condition, said cover is in covering relationship with said other of said receptacles but not with said one receptacle.

68. Automatic immersion apparatus comprising a plurality of receptacles arranged laterally of each other in an arcuate row, and a conveyor mounted for vertical movement and for rotation about a vertical axis at the center of said arc for moving a material holder into and out of each of said receptacles, said receptacles having substantially flat side walls which converge toward the center of the arc and extend radially thereof whereby said receptacles may be disposed in adjacent side-by-side relation in said arcuate arrangement, and a single cover for all of said receptacles movable with said conveyor to cover said receptacles when the material holder is positioned therein and to uncover said receptacles when the material holder is being transferred from one receptacle to another by said conveyor, one of said receptacles being a paraffin bath receptacle having its top edge underlying said cover in spaced relation thereto whereby said cover is held out of contact with said paraffin bath receptacle in order to prevent the deposit of paraffin on said cover whereby to prevent the deposit of paraffn on the top edges of the other receptacles.

69. Automatic immersion apparatus comprising a plurality of receptacles arranged laterally of each other in an arcuate row, and a conveyor mounted for vertical movement and for rotation about a vertical axis at the center of said arc for moving a material holder into and out of each of said receptacles, and a single cover for all of said receptacles movable with said conveyor to cover said receptacles when the material holder is positioned therein and to uncover said receptacles when the material holder is being transferred from one receptacle to another by said conveyor, one of said receptacles being a paraffin bath receptacle having its top edge underlying said cover in spaced relation thereto whereby said cover is held out of contact with said paraffin bath receptacle in order to prevent the deposit of paraffin on said cover thereby to prevent the deposit of paraffin on the top edges of the other receptacles.

70. In automatic immersion apparatus having a support for a plurality of receptacles arranged laterally of each other and a conveyor adapted to move up and down and laterally for moving a releasably mounted material holder from one receptacle to another; a cover member adapted to fit over said receptacles in covering relation therewith, means for operatively connecting said cover member to said conveyor for movement therewith, said cover member being provided with a slot therein from the outer edge thereof to a predetermined point thereon, said slot providing passage for said material holder to and from its mounted position, and means for covering said slots.

71. In automatic immersion apparatus having a plurality of receptacles arranged in a circular row, a conveyor adapted to move up and down and to rotate about the center of said circle and a material holder releasably connected to said conveyor for movement therewith into and out of said receptacles; a circular cover member adapted to fit over said receptacles in covering relation therewith, means operatively connecting said cover member to said conveyor so that said cover member moves only when said conveyor moves, said cover member being provided with a slot extending from its outer edge to a point intermediate its edges, said slot providing passage for said material holder to and from its connected position, and means slideably engageable with said cover member for covering said slot.

72. In automatic immersion apparatus, a conveyor adapted to move laterally and up and down, a material holder support adapted to be releasably connected to said conveyor for movement from one to another of a plurality of receptacles arranged laterally of each other, said conveyor having a groove and a slot extending from its edge to said groove at an angle relative to the latter, said material holder support having a pair of arms disposed from each other at said angle, whereby said arms fit into said groove and slot to releasably connect said support in only one predetermined position relative to said conveyor.

73. In automatic immersion apparatus having a plurality of receptacles arranged laterally of each other in a circular row; a conveyor adapted to be turned about the center of said circle and to be moved up and down, a material holder support adapted to be releasably connected to said conveyor for movement into and out of said receptacles, said conveyor having an annularly extending groove and a slot extending from its outer periphery to said groove so as to intersect said groove at an angle, said support being provided with a pair of arms disposed from each other at said angle and adapted to fit in said groove and slot for releasably connecting said support to said conveyor in a predetermined position relative thereto.

74. In automatic immersion apparatus including a plurality of receptacles having wide and narrow portions, said receptacles being arranged laterally of each other; a material holder support adapted to support a plurality of laterally disposed material holders arranged in a configuration having wide and narrow portions, a conveyor movable up and down and laterally, means for connecting said material holder support to said conveyor so that said support moves into and out of said receptacles in response to movement of said conveyor, said last mentioned means including indexing means on said support and conveyor for positioning said support so that the wide and narrow portions of said material holder configuration register with the wide and narrow portions of said receptacles, respectively.

75. In automatic immersion apparatus including a plurality of wedge-shaped receptacles arranged in adjacent side-by-side relation to form a circular row; a material holder support adapted to support a plurality of stacks of material holders, indexing means on said material holder for positioning said stacks of material holders in a substantially triangular configuration, a rotary conveyor movable up and down, means for releasably connecting said material holder support to said conveyor so that said support moves into and out of said receptacles in response to movement of said conveyor, said last mentioned means including complementary indexing means on said conveyor and said material holder support for positioning said support so that the base of said triangular stack configuration registers with the wide part of said wedge-shaped receptacles and the apex of said triangular stack configuration registers with the narrow part of said receptacles, whereby said material holders fit into said receptacles.

76. In automatic immersion apparatus including a plurality of wedge-shaped receptacles arranged in adjacent side-by-side relation to form a circular row; a material holder support adapted to support a plurality of stacks of material holders, indexing means on said material holder for positioning said stacks of material holders in a substantially triangular configuration, a rotary conveyor movable up and down, means for releasably connecting said material holder support to said conveyor so that said support moves into and out of said receptacles in response to movement of said conveyor, said last mentioned means comprising an annularly extending groove on said conveyor and a slot extending from the outer peripheral edge of said conveyor to said groove and intersecting said groove at a predetermined angle, and a pair of arms on said material holder support disposed from each other at said predetermined angle and adapted to fit into said groove and slot, said arms being so disposed relative to said indexing means on said support that when they are disposed in said groove and slot the base of said triangular stack configuration registers with the wide part of said wedge-shaped receptacle and the apex of said triangular stack configuration registers with the narrow part of said receptacles, whereby said material holders fit into said receptacles.

77. A heating receptacle comprising, front and rear walls and substantially flat converging side walls extending therebetween, a pair of integral bosses formed on the lower portions of said side walls and extending between said front and rear walls, each of said bosses having a cavity extending from the front wall to the rear wall, a pair of heating elements removably disposed in said cavities, said front wall being provided with an outwardly protruding portion having a top opening, control means for said heating element having thermal responsive means and means for adjusting said thermal responsive means, said control means extending through said top opening and being carried by said front wall so that said thermal responsive means extends into said receptacle and is partially surrounded by the inner surface of said front wall protrusion and said adjusting means is positioned externally of said receptacle, said front wall being further provided at the bottom thereof with a groove extending between said cavities in said bosses, electrical conducting means extending between said control means and said heating element and disposed within said groove, and cover means disposed over said protruding portion of said front wall and said groove, said means for adjusting said thermally responsive means being disposed externally of said cover means.

78. In automatic immersion apparatus having conveyor means for moving a material holder into and out of each of a plurality of receptacles; means for raising and lowering said conveyor to raise and lower said holder for moving it out of one receptacle and into another, means operable in timed relation to said raising and lowering means for intermittently moving the conveyor horizontally for moving the raised material holder from a position over one receptacle to a position over another receptacle so that it may be lowered into the latter, said raising and lowering means being operatively engageable with and disengageable from said conveyor and means operable in timed relation to said raising and lowering means for holding said conveyor temporarily in raised position when said raising and lowering means is disengaged from the conveyor.

79. In automatic immersion apparatus having a conveyor mounted for vertical movement and for rotation about a vertical axis for moving a material holder into and out of a plurality of receptacles for liquids in which the material is to be immersed, and means for raising and lowering said conveyor; means for rotating said conveyor when the latter is in a raised position for moving the material holder from a position above one receptacle to a position above another receptacle, comprising a driven member operatively connected to said conveyor for turning the latter about said axis, said driven member having a plurality of circumferentially spaced slots, rotary driving means including a driving member movable into and out of each of said slots for intermittently turning said driven member, and means operable under the control of said driving means and movable into said slots as soon as said driving means becomes disengaged from said driven member to positively lock said driven member against turning movement, and movable out of said slots as soon as said driving means becomes engaged with said driven member in said slots for freeing said driven member for turning by said driving member.

80. In automatic immersion apparatus having a conveyor which is movable up and down and laterally for moving a material holder from one to another of a plurality of receptacles arranged laterally of each other; timing means for controlling the movement of said conveyor, comprising a rotatable plate, a timing disc and a spider arranged to sandwich said timing disc between said plate and spider, and locking means being operatively pivotally mounted on said plate and being pivotally movable, in a plane transversely of the plane of said plate about a pivot parallel to the plane of said plate, to and from a position in which said locking means operatively engages said spider to apply a force in a direction to clamp said timing disc between said spider and plate.

81. In automatic immersion apparatus having a conveyor which is movable up and down and laterally for moving a material holder from one to another of a plurality of receptacles arranged laterally of each other; timing means for controlling the movement of said conveyor, comprising a rotatable plate, a timing disc and a spider arranged to sandwich said timing disc between said plate and spider, and a locking lever having cam means thereon, said locking lever being operatively pivotally mounted on said plate and movable to and from a position in which said cam means is operable to apply a force in a direction to clamp said timing disc between said spider and plate.

82. In automatic immersion apparatus having a conveyor which is movable up and down and laterally for moving a material holder from one to another of a plurality of receptacles arranged laterally of each other; timing means for controlling the movement of said conveyor, comprising a rotatable plate, a timing disc and a spider arranged to sandwich said timing disc between said plate and spider, said spider having a hub, a rim and radial arms connecting said hub and rim, said hub and timing disc having apertures defined therein which are adapted to register with one another when said plate and spider sandwich said timing disc therebetween, an ear operatively connected to said plate and adapted to extend through said registered apertures in said disc and spider, and a locking lever having cam means thereon, said locking lever being operatively pivotally mounted on said ear and movable to and from a position in which said cam means is operable to apply a force in a direction to clamp said timing disc between said spider and plate.

83. Automatic immersion apparatus comprising a support for plurality of receptacles arranged laterally of each other in an arcuate row, and a conveyor mounted for vertical movement and for rotation about a vertical axis at the center of said arc for moving a material holder into and out of each of said receptacles, said receptacles having substantially flat side walls which converge toward the center of the arc and extending radially thereof whereby said receptacles may be disposed in adjacent side-by-side relation in said arcuate arrangement, and means on said support releasably engageable with wall portions of said receptacles for preventing substantial upward movement thereof.

84. Automatic immersion apparatus, comprising a plurality of receptacles arranged laterally of each other in an arcuate row, and a conveyor mounted for vertical movement and for rotation about a vertical axis at the center of said arc for moving a material holder into and out of each of said receptacles, said receptacles having substantially flat side walls which converge toward the center of the arc and extend radially thereof whereby said receptacles may be disposed in adjacent side-by-side relation in said arcuate arrangement, covering means for said receptacles movable with said conveyor, and means for preventing substantial upward movement of said receptacles by said covering means in the event of adhesion of the latter to the top of a receptacle.

85. Automatic immersion apparatus, comprising a conveyor which is movable vertically and rotatably about a vertical axis for moving a material holder into and out of processing liquids, a plurality of receptacles for the processing liquids arranged laterally of each other in an arcuate row about said axis and adapted to receive said material holder, said receptacles having flat side walls which converge toward said axis and are arranged in adjacent side-by-side relation in said arcuate arrangement and spaced radially from said vertical axis, and mechanism for raising and lowering said conveyor disposed in the space between said receptacles and said axis of the conveyor.

86. Automatic immersion apparatus, comprising a plurality of receptacles arranged laterally of each other in a circular row, a conveyor having a vertically extending part and an upper part for carrying a material holder, said conveyor being rotatable and vertically movable for transferring said material holder from one of said receptacles to another, said vertical part of said conveyor extending along the rotary axis thereof, said receptacles being spaced from said vertical part of said conveyor and having flat radially extending side walls in adjacent side-by-side relation in said circular arrangement, and mechanism engageable with said vertical part of said conveyor for raising and lowering the latter, said mechanism being disposed within the space between said vertical part of said conveyor and said receptacles.

87. Automatic immersion apparatus, comprising a conveyor which is movable vertically and rotatably about a vertical axis for moving a material holder into and out of processing liquids and a plurality of receptacles for the processing liquids arranged laterally of each other in a complete circular row about said axis and adapted to receive said material holder, said receptacles having flat side walls which converge toward said axis and are arranged in adjacent side-by-side relation in said arcuate arrangement and spaced radially from said vertical axis, and mechanism for raising and lowering said conveyor disposed in the space between said receptacles and said axis of the conveyor, and a single cover for all of said receptacles operatively connected to said conveyor for movement thereby during the transfer of the material holder from one receptacle to another.

88. Automatic immersion apparatus, comprising a plurality of receptacles arranged laterally of each other in a circular row, a conveyor having a vertically extending part and an upper part for carrying a material holder, said conveyor being rotatable and vertically movable for transferring said material holder from one of said receptacles to another, said vertical part of said conveyor extending along the rotary axis thereof, said receptacles being spaced from said vertical part of said conveyor and having flat radially extending side walls in adjacent side-by-side relation in said circular arrangement, and mechanism engageable with said vertical part of said conveyor for raising and lowering the latter, said mechanism being disposed within the space between said vertical part of said conveyor and said receptacles, other mechanism releasably engageable with said conveyor in the lowered position thereof for vertically reciprocating said conveyor in said lowered position whereby to vertically reciprocate said material holder when disposed within said receptacles, said other mechanism being disposed in said space between said vertical part of said conveyor and said receptacles, a cover for said plurality of receptacles, and means operatively connecting said cover to said conveyor for movement thereby during the transfer of said material holder from one receptacle to another, said connecting means permitting limited relative movement between said conveyor and said cover, whereby said cover remains stationary in covering relation with said plurality of receptacles when said conveyor is being vertically reciprocated by said other mechanism.

89. A receptacle for automatic immersion apparatus in which a plurality of the receptacles are arranged in a row on a support to receive a material holder transferred from one receptacle to another during the operation of the apparatus; said receptacle being molded of a plastic material of the group consisting of nylon, polytetrafluoroethylene and polytrifluorochloroethylene.

90. A receptacle for automatic immersion apparatus in which a plurality of the receptacles are arranged in an arcuate row on a support to receive a material holder transferred from one receptacle to another during the operation of the apparatus; said receptacle having flat side walls and opposite relatively wide and narrow end walls connecting said side walls, said side walls converging toward each other from said relatively wide end wall toward said opposite end walls so that when a plurality of such receptacles are placed in adjacent relation on

the support of the apparatus they can be positioned with the adjacent side walls of adjacent receptacles, respectively, in abutting relation substantially throughout the radial extent of said side walls in the arcuate row, said receptacle being molded of a plastic material of the group consisting of nylon, polytetrafluoroethylene and polytrifluorochloroethylene.

91. Automatic immersion apparatus for processing histologic tissue for microscopic examination, comprising a receptacle-support, a plurality of receptacles for tissue treating liquids arranged on said support and having substantially flat side walls, the side walls of at least one of said receptacles being heat conductive and said one receptacle being provided with heating means, the flat side walls of adjacent receptacles being in close side-by-side relation when arranged on said support, so that heat from said one of the receptacles is transmitted to the adjacent receptacles through their adjacent side walls for heating the liquids therein, a conveyor for moving tissue into and out of said receptacles, and time-controlled means for actuating said conveyor so that the tissue is immersed in said heated liquids, respectively, for predetermined periods of time.

92. Automatic immersion apparatus for processing histologic tissue for microscopic examination, comprising a receptacle-support, a plurality of receptacles for tissue treating liquids arranged on said support and having substantially flat side walls, the side walls of at least one of said receptacles being heat conductive and said one receptacle being provided with heating means, the flat side walls of adjacent receptacles being in close side-by-side relation when arranged on said support, so that heat from said one of the receptacles is transmitted to the adjacent receptacles through their adjacent side walls for heating the liquids therein, a conveyor for moving tissue into and out of said receptacles, and time-controlled means for actuating said conveyor so that the tissue is immersed in said heated liquids, respectively, for predetermined periods of time, said one receptacle being a paraffin bath provided with an electric heater for maintaining paraffin in melted liquid condition for impregnating the tissue with the paraffin in said receptacle.

93. Automatic immersion apparatus for processing histologic tissue for microscopic examination, comprising a receptacle-support, a plurality of receptacles for tissue treating liquids arranged on said support and having substantially flat side walls, the side walls of at least one of said receptacles being heat conductive and said one receptacle being provided with heating means, the flat side walls of adjacent receptacles being in close side-by-side relation when arranged on said support, so that heat from said one of the receptacles is transmitted to the adjacent receptacles through their adjacent side walls for heating the liquids therein, a conveyor for moving tissue into and out of said receptacles, and time-controlled means for actuating said conveyor so that the tissue is immersed in said heated liquids, respectively, for predetermined periods of time, said receptacles being disposed in a circular row circumferentially of said conveyor and said opposite side walls of each receptacle converging toward the center of the circle of said row.

94. Automatic immersion apparatus for processing histologic tissue for microscopic examination, comprising a receptacle-support, a plurality of receptacles for tissue treating liquids arranged on said support and having substantially flat side walls, the side walls of at least one of said receptacles being heat conductive and said one receptacle being provided with heating means, the flat side walls of adjacent receptacles being in close side-by-side relation when arranged on said support, so that heat from said one of the receptacles is transmitted to the adjacent receptacles through their adjacent side walls for heating the liquids therein, a conveyor for moving tissue into and out of said receptacles, and time-controlled means for actuating said conveyor so that the tissue is immersed in said heated liquids, respectively, for predetermined periods of time, said one receptacle being a paraffin bath provided with an electric heater for maintaining paraffin in melted liquid condition for impregnating the tissue with the paraffin in said receptacle, said receptacles being disposed in a circular row circumferentially of said conveyor and said opposite side walls of each receptacle converging toward the center of the circle of said row.

References Cited in the file of this patent

UNITED STATES PATENTS

923,445	Rose	June 1, 1909
1,590,286	Davis	June 29, 1926
2,324,122	Weiskopf	July 13, 1943
2,341,198	Weiskopf	Feb. 8, 1944
2,510,912	Schurenberg	June 6, 1950
2,575,294	Putorak	Nov. 13, 1951
2,583,379	Kling	Jan. 22, 1952

FOREIGN PATENTS

681,424	Great Britain	Oct. 22, 1952