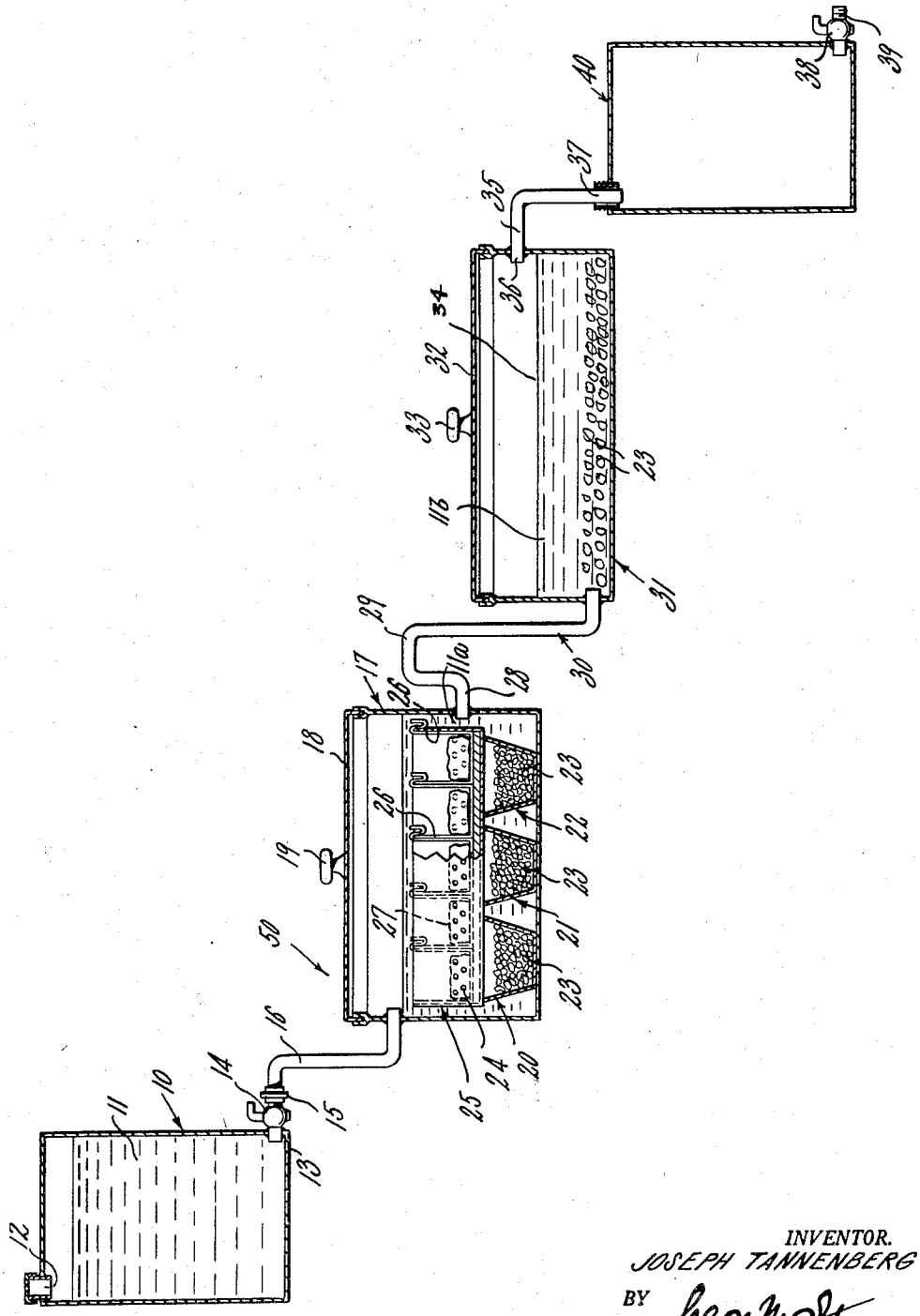
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PROCESS AND APPARATUS FOR DEHYDRATING TISSUE PRIOR TO EMBEDDING IN PARAFFIN AND THE LIKE

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PROCESS AND APPARATUS FOR DEHYDRATING TISSUE PRIOR TO EMBEDDING IN PARAFFIN AND THE LIKE

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This invention relates to a process and apparatus for dehydrating pieces or specimens of tissue to be used for histological purposes, microscopic examinations, etc.

It is one of the advantages of this invention to provide means ensuring automatic and substantially continuous flow or cycle of dehydrating fluid through a plurality of tissue specimens and like objects to be treated.

It is another advantage of the invention to provide means facilitating automatic change and replacement of the dehydrating fluid within an apparatus in which the aforesaid tissue pieces are placed for treatment.

Still a further advantage of this invention is to provide means for speedily and safely dehydrating tissue specimens and like substances without moving or contacting the same, for instance, by an operator during the entire dehydrating process.

Yet another object of this invention resides in the provision of means preventing any accidental drying out of the tissue samples under treatment in the event that continuous flow of dehydrating fluid should be interrupted.

Still another object of the invention is to provide means affording re-use of the dehydrating fluid by freeing it from water or watery admixtures which it has absorbed during preceding dehydrating processes.

These and other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawing which discloses, by way of example, the principle of the invention and preferred modes which have been contemplated for applying said principle.

In the accompanying drawing the process and apparatus made in accordance with this invention is schematically illustrated. It is well understood that the embodiment shown is one of many possible examples according to which this invention may be carried into effect.

Referring now more in particular to the attached drawing there is indicated by numeral 10 a tank which is filled with a suitable dehydrating liquid 11, such as dioxane or like fluid. A filling opening 12 closeable by a screw cap or the like is provided in tank 10 for a purpose later described. Near the bottom 13 of tank 10 there is arranged a stop-cock or valve 14 with coupling 15 for connection with a tube 16 leading into an inlet in the upper part of container or receptacle 17 which is tightly closeable by a lid 18 having a handle 19. Within the container or receptacle 17 there are arranged a plurality of lengthy trays 20, 21, 22 which are filled with layers 23 of calcium chloride, calcium oxide or like chemicals. On top of trays 20, 21, 22 are placed a plurality of embedding containers or boxes 25 with openings or perforations 24 similar in construction to those described in my Patent No. 2,437,713, dated March 16, 1948 and through which communication between boxes 25 and trays 20, 21, 22 within container 17 takes place. Within the compartments 26 of each embedding apparatus or box 25 are placed tissue pieces 27 to be dehydrated.

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Connected to receptacle 17 and at a level of the tissue samples deposited on the bottom of the embedding boxes 25 (only one embedding box being shown for clarity's sake) is the outlet of knee-shaped tube 28 having an upwardly turned bend 29 and a downwardly extending leg 30, the latter leading into the lower part of a further receptacle 31 having a lid 32 with a handle 33.

Receptacle 31 contains at the bottom several layers of calcium oxide or similar substances adapted to remove water from the dioxane used for dehydration. Dioxane entering the receptacle 31 at the bottom passes through several layers 23 of calcium chloride or calcium oxide whereby dioxane gives up its water. When the dehydration fluid finally has reached level 36, it is completely water-free and will now flow out through conduit 35 into the collecting tank 40 that may be made completely interchangeable with tank 10. This collector tank 40 is constructed similar to tank 10 and has the upper opening 37 into which tube 35 leads and has the valve 38 with fitting or connection 39 near the bottom of tank 40.

It will be easily realized that provisions may be made for use of tank 40 to replace tank 10 when the latter is emptied and tank 40 is refilled with clean dehydrating fluid for re-use.

The apparatus or plant 50 is constructed to automatically dehydrate a plurality of tissue or like samples 27 simultaneously and is adapted to cut the time heretofore required by about 50% to 70% on account of a novel concept by which movements of the tissue samples to be dehydrated from one container to another filled with dehydrating fluid of increasing concentration is avoided but the dehydrating fluid instead is continuously and automatically renewed within the same container in which the tissues have been placed until complete dehydration has been reached.

Aside from the relatively slow continuous change of the fluid, several abrupt and total changes of the fluid surrounding the tissue samples to be dehydrated are also provided in this apparatus by employing the syphon principle on account of which the embedding apparatuses or boxes containing the tissue samples to be dehydrated are automatically emptied and refilled with fresh dehydrating fluid.

The manner in which the plant **50** hereinabove outlined is operated will now be further explained. The tissues **27** to be dehydrated are placed in the compartments **26** of the respective boxes or containers **25** which are arranged next to each other on top of the trays **20, 21, 22,** which extend in perpendicular direction to the embedding boxes **25**. It is, of course, understood that receptacle **17** may be made of any desired size and dimensions in order to accommodate therein a plurality of boxes **25**. Valve **14** is then opened in such manner that dehydrating fluid, such as dioxane, is discharged in a continuous and slow flow from tank **10** through the pipe **16** into receptacle **17** until an upper filling level corresponding to bend **29** is reached in the receptacle.

Thereafter a syphoning or suction effect is produced in inverted U-shaped conduit **28—29—30** whereby that part of the dehydrating fluid **11***a* which has absorbed water from the tissue pieces to be dehydrated and which assumes a level above the outlet of conduit **30** and below inlet of tube **16** in receptacle **17** is then forced into the purifying tank **31**. The dehydrating fluid **11***a* has already been cleaned upon contact with water absorbing chemicals **23**, such as calcium chloride, calcium oxide or the like placed in trays **20, 21, 22**. The dehydrating fluid **11***a* upon reaching within receptacle **17** a level corresponding to the bend **29** of conduit **30** is then subjected to the syphoning effect produced in conduit **30** whereby receptacle **17** will be emptied from said filling level at **29** quite fast down to approximately somewhat above the level of the bottom of the boxes **25** on which the tissue pieces rest.

This syphoning action will be automatically interrupted until such time at which the receptacle will be supplied with further make-up fluid and again filled up through supply tube **16**, whereupon automatically the syphoning effect is effectuated again in a manner heretofore described.

This step automatically repeats itself until tank **10** has been emptied. If tank **10** is made of a size to contain about two gallons of dehydrating fluid, this will be enough to automatically complete dehydration of about 20 to 30 tissue samples placed in receptacle **17** within a relatively short period of time.

The dehydrating fluid entering tank **31** is now further freed from water or watery admixtures upon contact with calcium chloride or the like placed on the bottom of tank **31**. As soon as level **34** of dehydrating fluid **11***b* reaches the height of tube **35** the entirely purified dehydrating fluid will be conducted to the collector tank **40** for re-use as it is well understood.

It can be easily realized that containers or tanks **10, 17, 31,** and **40** should be fitted with tightly closing lids to prevent evaporation of the dehydrating fluid. These tanks are further so arranged that the dehydrating fluid may be supplied from tank **10** by gravity and the containers **10, 17, 31,** and **40** are so arranged with respect to each other that the aforesaid syphoning effect may be brought about in a most effective manner.

In this connection it is to be mentioned that outlet **28** of conduit **30** is so arranged with respect to the bottom of the embedding or dehydrating boxes **25** that the tissue samples therein will always remain in contact with the dehydrating fluid and will thus be prevented from drying out within their compartments in the event that the continuous flow or supply of the dehydrating fluid into tank or receptacle **17** is interrupted.

It is further understood that any other known water absorbent chemicals can be employed to purify the dehydrating fluid used, provided that these chemicals have a greater affinity for water than the dehydrating fluid employed has.

The principle of this hereinabove described process is to accelerate and to economically bring about dehydration of a plurality of tissue samples simultaneously to be embedded for histiological purposes by effectuating constantly and automatically changing flow of dehydrating fluid.

It can thus be seen that there has been provided in accordance with the present invention a process of automatically dehydrating tissue samples. This consists in subjecting tissue samples to the continuous change of dehydrating fluid, permitting said fluid to contact said tissue for a predetermined length of time, and thereafter causing a syphoning effect on said dehydrating fluid to thereby forcedly and automatically bring about complete dehydration to said tissue samples.

It might be desirable to provide tanks **10** and **40** with a glass gauge which permits the easy reading of the level of the fluid within each tank.

As many possible embodiments may be conceived of the above invention, and as alterations and changes may be made in the embodiments above set forth, it is to be stated that all matters hereinbefore explained or shown in the accompanying drawing, are to be interpreted as illustrative and not in a limitative sense.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. The process of dehydrating pieces of tissue and like articles which consists in immersing said tissue pieces in dehydrating fluid, syphoning off fluid from a predetermined fluid level above said tissue pieces while said fluid remains in contact with said tissue pieces, whereby said tissue pieces are automatically dehydrated without being exposed to desiccation, and feeding further fluid to said tissue pieces while fluid is syphoned off.

2. An apparatus for dehydrating tissue and like articles for histiological purposes comprising a first tank from which dehydrating liquid is supplied, a receptacle including a perforated container having a bottom for holding said tissue articles to be treated, a second tank for collecting said dehydrating liquid, said receptacle being positioned intermediate said first tank and said second tank and being connected with said tanks by respective conduits, the conduit extending between said receptacle and said second tank including an inverted U-shaped tube having an outlet from said receptacle at a level above the bottom of said container, the bend of said inverted U-shaped tube being positioned above said outlet to attain a syphoning effect between said

receptacle and said second tank, as soon as said dehydrating liquid reaches a predetermined level in said receptacle.

3. An apparatus according to claim 2, wherein said conduit connecting said first tank with said receptacle terminating in an inlet within said receptacle, said bend being positioned intermediate said inlet and said outlet, said bottom of said container being arranged at a level below said inlet said outlet and said bend.

4. The process of simultaneously dehydrating a plurality of pieces of tissue and like articles comprising the steps of first placing said tissue pieces in a perforated container within a receptacle, introducing into said receptacle dehydrating fluid for contact with said tissue pieces, causing said fluid to reach a predetermined level in said receptacle at which said contact with said tissue pieces is maintained at all times, thereafter withdrawing fluid from said receptacle through syphoning means which is connected to said receptacle at said predetermined level and extends thereabove relatively to the top of said receptacle to thereby obtain a filling level of said fluid within said receptacle, and continuously feeding make-up fluid into said receptacle upon syphoning off fluid above said predetermined level, whereby said tissue pieces are continuously and automatically dehydrated without being exposed to desiccation.

5. The process of continuously dehydrating pieces of tissue and like articles comprising placing said tissue pieces in a receptacle, then introducing into said receptacle dehydrating fluid for contact with said tissue pieces, causing said fluid to assume a predetermined level in said receptacle to thereby maintain contact of said fluid with said tissue pieces, syphoning off fluid above said predetermined level to thereby adjust an upper filling level for said receptacle, and continuously feeding make-up fluid into said receptacle up to said filling level whereby said tissue pieces are continuously and automatically dehydrated without being exposed to desiccation.

6. The process of dehydrating pieces of tissue and like articles which consists in subjecting said tissue pieces to the influence of dehydrating fluid within a receptacle through which said fluid passes, causing said fluid to maintain within said receptacle a predetermined level to thereby establish continuous contact with said tissue pieces, syphoning off fluid above said predetermined level to thereby adjust an upper filling level for said receptacle, and continuously feeding make-up fluid into said receptacle up to said filling level, whereby said tissue pieces are continuously and automatically dehydrated without being exposed to desiccation.

7. The process of simultaneously and automatically dehydrating a plurality of tissue pieces or like articles; comprising the steps of placing said tissue pieces in perforated means, thereafter placing said perforated means with said tissue pieces in a receptacle, introducing and partly filling said

receptacle with dehydrating fluid to thereby assume a predetermined low fluid level, at which said tissue pieces within their perforated means are covered by said fluid, regulating supply of make-up dehydrating fluid to said receptacle to fill same in such a manner that said fluid will rise slowly within the receptacle from said predetermined low level to a predetermined upper level therewithin whereby floating out of said tissue pieces from said perforated means to the surface of the rising dehydrating fluid is prevented, interrupting automatically further rise of said continuously supplied make-up fluid as soon as said fluid reaches said predetermined upper level by comparatively fast removing fluid through U-shaped bent syphoning means connected to said receptacle at said low fluid level and having the bend at said upper level, whereby said syphoning means removes fluid from the receptacle at a faster rate than the rate of make-up fluid supply to thereby permit automatic interruption of the removal of dehydrating fluid from the aforementioned receptacle when the fluid has reached said predetermined low level, purifying and freeing said dehydrating fluid thus syphoned off from water by dehydrating means, and reusing the resultant purified dehydrating fluid for supply of make-up fluid into said receptacle.

8. The process of simultaneously and automatically dehydrating a plurality of tissue pieces or like articles; comprising the steps of placing said tissue pieces in a receptacle, introducing into said receptacle dehydrating fluid to thereby fill same to a predetermined low fluid level, at which said tissue pieces are covered by said fluid, regulating supply of make-up dehydrating fluid to said receptacle to fill same from said predetermined low level to a predetermined upper level therewithin, and causing automatic interruption of further rise of said make-up fluid in said receptacle as soon as said fluid reaches said predetermined upper level by comparatively fast removing fluid through U-shaped bent syphoning means connected to said receptacle at said low fluid level and extending with its bend to said upper level, whereby said syphoning means removes fluid from the receptacle at a faster rate than the rate of make-up fluid supply to thereby permit automatic interruption of the removal of dehydrating fluid from the aforementioned receptacle when the fluid has reached said predetermined low level.

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