

United States Patent

[11] 3,576,176

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- [54] COOPERATIVE HISTOLOGIC TISSUE CAPSULE
AND CAPSULE RACK
4 Claims, 8 Drawing Figs.

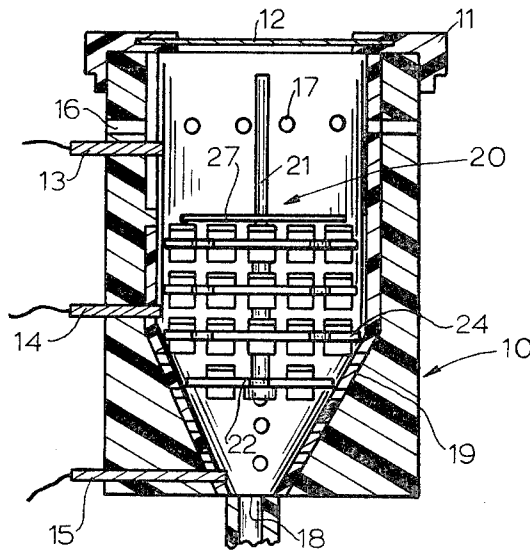
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| [52] | U.S. Cl..... | 118/500,
211/76 |
| [51] | Int. Cl..... | B05c 11/14 |
| [50] | Field of Search..... | 118/500;
211/74, 76, 77; 269/(Inquired); 117/(Inquired) |

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ABSTRACT: A rack handle mounts a set of vertically spaced discs each of which has a series of numbered holes. Each hole is adapted to loosely receive the body portion of an individual porous histology-processing tissue capsule and the capsule body portion is adapted to receive a cap which expands and wedges the body portion in place in its respective disc hole enabling a large number of histology tissue specimens to retain their identity in individual capsules and to be processed simultaneously.



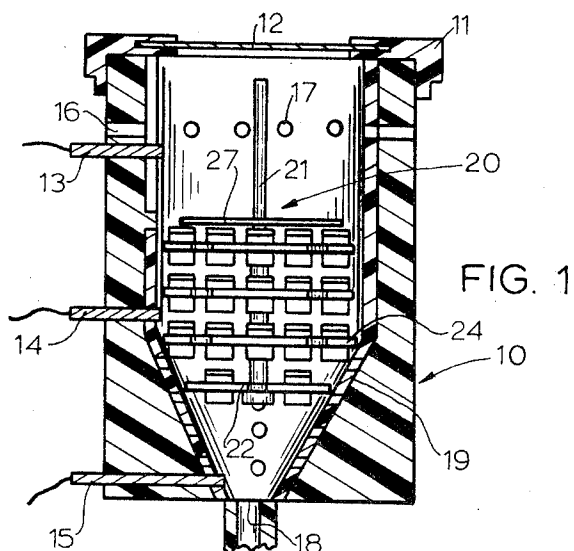


FIG. 1

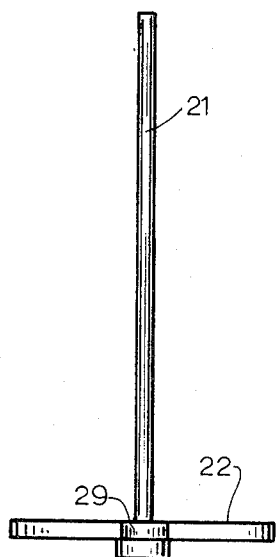


FIG. 2

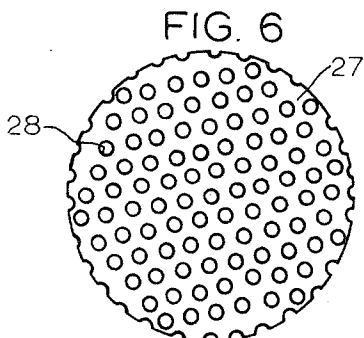


FIG. 6

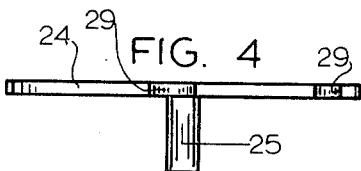


FIG. 4

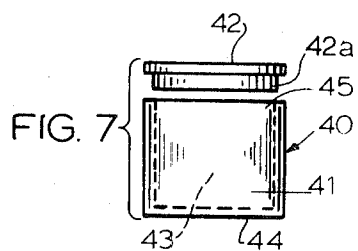


FIG. 7

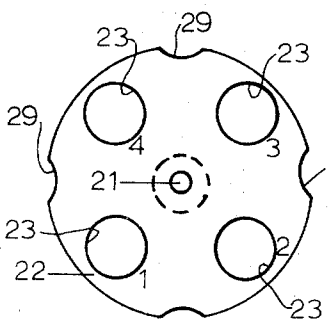


FIG. 3

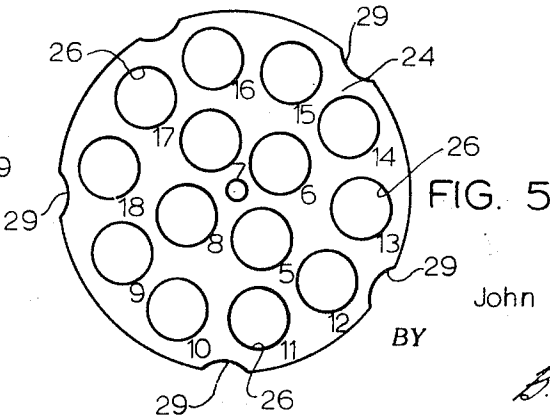


FIG. 5

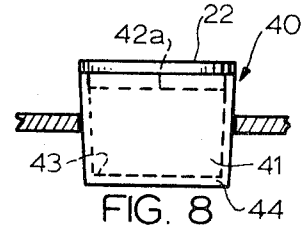


FIG. 8

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COOPERATIVE HISTOLOGIC TISSUE CAPSULE AND CAPSULE RACK

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a porous specimen capsule of special construction and a cooperative rack for orderly receiving of such porous capsules while small tissue specimens are being sequentially immersed in electron microscopy fixative and processing fluids and alternatively through light microscopy fixative and processing fluids.

2. Description of the Prior Art

U.S. Pat. Nos. 2,783,180; 2,800,102; 2,837,055; 2,959,151; 3,227,130; and my prior U.S. Pat. Nos. 3,411,185 and 3,456,300, may be referred to for general background on the prior art relating to tissue capsules and apparatus for holding such capsules during tissue processing. Reference may also be made for additional background to my copending applications, Ser. No. 658,252, filed Aug. 3, 1967, "Microscopy Tissue Receptacle and Method," and Ser. No. 719,434, filed Apr. 8, 1968, "Electron Microscopy Tissue Processor."

In general, the prior art has not taught a cooperative capsule-rack structure adapted to hold in fixed positions a large number of small, disposable, porous tissue capsules of a modified design of that shown in Ser. No. 658,252 and in corresponding numbered positions so as to insure correct identities and complete penetration as the capsules are successively submerged in the processing liquids. In this regard the prior art has suggested use of nondisposable, relatively large capsules as in U.S. Pat. No. 2,800,102 and loosely stacked on a rack without numbered positions or use of bags stacked loosely and at random as in U.S. Pat. No. 2,959,151. Other distinctions over the prior art could be made but most basic is the fact that the prior art has not provided a practical capsule-rack combination suited to the liquid-processing steps associated with histology tissue processing where large numbers, i.e. sometimes hundreds, of tissue specimens are required to be processed daily in a uniform manner and where each such specimen absolutely must retain its own identification, e.g. from adult patient Mr. X versus child Miss Y, and where the size of the specimen is in the electron microscopy range.

SUMMARY OF THE INVENTION

The invention is directed to cooperative rack and tissue capsule constructions such that a large number of the tissue capsules can be held fixed in numbered positions on the rack during submersion of the capsule in various histology processing liquids. While adapted to the relatively large light-microscopy-size tissue, the invention is particularly adapted to processing the extremely small electron-microscopy-size tissue having a dimension, for example, in the order of 1 millimeter or less.

The rack portion of the invention basically comprises a series of vertically spaced thin, discs assembled and mounted on a central vertical shaft which also serves as a handle. Each disc is provided with a large number of uniform-size holes and each hole has permanent indicia, i.e. a number. The capsules are relatively small and have a uniform-size body portion of uniform diameter, e.g. 12 millimeters, that somewhat loosely fits the hole. A cap fits on the body portion and the body portion hole and cap sizes are such that placement of the cap tends to slightly expand and wedge the corresponding body portion in place. The overall length of the cap and body in one embodiment are approximately 14 millimeters. The rack-capsule construction thus allows a large number of the relatively small capsules to be temporarily fixed on each disc and be identified by a numbered location. The fact that several such discs are employed means that a very large number of such capsules can be processed simultaneously in an orderly and uniform manner. The disc hole numbers provide positive identification and eliminate the need to mark or number the capsules or insert numbered slips in the capsules according to prior art practices. Also, the fact that each capsule is tem-

porarily wedged in place eliminates any tendency for the capsules to float to the surface and out of the fluid in which they are intended to be fully submerged. Yet the capsules are easily removed by removing the caps or by simply forcing them out of the holes. Furthermore, uniform stacking of uniform-size capsules in fixed positions leads to more uniform handling procedures than are obtained with those prior art arrangements in which the tissues are placed in nonuniform receptacles and randomly stored during processing and lessens the need for skilled technicians.

During electron microscopy processing, tissue specimens, normally having at least one dimension in the order of 1 millimeter or less, are placed within the capsule body and the capsule is installed on the disc platform as previously explained. Such tissue may be obtained, for instance, by needle biopsy, surgical biopsy, surgical removal from live, anesthetized animals or humans or merely by the removal of a cover slip from a culture medium. Since cytolytic and post mortem changes can occur very rapidly and can greatly influence the appearance of the tissue at a fine structural level, the tissue must be brought into contact with the fixative liquid as quickly as possible. Therefore, since the tissue is small and must be rapidly brought into contact with the fixative liquids, any container into which the tissue may be placed must possess the desired porosity to readily admit the fluid with the pore size being small enough to prevent the tissue from escaping the capsule. The capsule of the invention utilizes those fine porous materials taught in pending application Ser. No. 658,252, namely porous hydrophilically treated polyethylene, polypropylene, nylon or polyester and the rack is made of a material inert to the various processing fluids, e.g. stainless steel or a suitable plastic of the kind mentioned for use in the capsule. Alcohol and xylene are typical organic liquids and osmium tetroxide, alcohol and formalin form typical aqueous solutions all of which liquids and solutions must reach the specimen.

Therefore, an object of this invention is to provide cooperative rack and capsule constructions which enable large numbers of small, disposable porous tissue capsules to be temporarily positively fixed and identified while being submerged through histology processing liquids.

Another object is to provide cooperative capsule and rack constructions which are partially adapted to processing simultaneously large numbers of minute electron-microscopy-size tissue specimens while insuring positive submersion and without loss of identification of the source of the individual specimens.

The foregoing and other objects will appear from the drawings and description to follow.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectioned elevation view through a capsule chamber of the type which accommodates the capsule rack of the invention and showing the rack filled with capsules constructed according to the invention.

FIG. 2 is a side elevation view of the elongated shaft and integral lower disc platform.

FIG. 3 is a plan view of the shaft and disc platform of FIG. 2.

FIG. 4 is a side elevation view of a disc platform which can be slid onto the elongated shaft and thereby provide additional capsule receiving holes.

FIG. 5 is a plan view of the disc platform of FIG. 4.

FIG. 6 is a plan view of a weighted disc.

FIG. 7 is an exploded view of the porous tissue capsule used in combination with the capsule rack.

FIG. 8 is a fragmentary section view of a porous tissue capsule constructed according to the invention residing within one of the holes in a disc platform and illustrating how the capsule sidewalls are forced outward by the capsule cap to hold the capsule within the platform hole.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In reference to the drawings of FIG. 1, a suitable processing chamber 10 for receiving capsule rack 20 is generally shown and can be found and described in more detail in the previously referred to copending application Ser. No. 719,434. Such a chamber employs a removable cap 11 having a viewing window 12, electrodes 13, 14, 15 connected to suitable level control means not shown, fluid admission channels 16 connected to admit fluids into the processing chamber through holes 17 and a drain 18. It should of course be understood that the present invention is directed to capsule and capsule rack constructions utilized by such a processing chamber but is not directed to the processing chamber per se.

Bearing in mind that the invention is directed to both a rack as well as a capsule construction it will be noted that the capsule rack 20 of the invention is comprised of an elongated vertically disposed, central shaft 21, which serves as a handle, having a relatively thin, disc-shaped platform 22 integrally secured to one end of shaft 21 by any suitable means, e.g. threads, screw, welding, etc. Shaft 21 and platform 22 should be of some material, e.g. stainless steel that is inert to all the liquids normally encountered. Shaft 21 is of a predetermined length which in the example illustrated depends upon the internal depth of processing chamber 10. The diameter of platform 22 may also be determined by the processing chamber's normally internally bottom-sloped wall 19. Platform 22 is received by and rests on wall 19 upward a distance from drain 18 to allow sufficient drainage of chamber 10 through drain 18. Platform 22 has in the example shown four relatively small and uniform-size holes 23 which receive cooperating small-size capsules 40 as later explained and hold them in relatively fixed but easily released positions.

A second thin, disc platform 24 is illustrated in FIGS. 4 and 5. Platform 24 is larger in diameter than platform 22 and the diameter of platform 24 is determined primarily by the internal diameter of vertical wall 19 of chamber 10. Platform 24 has a sleeve 25 which is adapted to slidably receive shaft 21. Sleeve 25 is of a predetermined length designed to properly space platform 24 vertically above platform 22 so that the capsules positioned in both platforms do not touch each other and so that fluid may flow unhampered around the platform. Grooves 29 may be employed if desired to facilitate passage of the processing liquid during filling and draining of chamber 10. Platform 24 also has holes 26 for receiving a plural number of the small, uniform-size porous capsules 40 as later explained. The plurality of holes 26 and 23 are preferably of the same uniform diameter which allows any capsule to be placed in any platform position.

As illustrated in FIG. 1, shaft 21 will accommodate several platforms like platform 24. At no time however should the platforms when filled with capsules be above the level of the processing fluids. Once platforms 22, 24 are filled with capsules, a weighted disc 27, see FIG. 6, is placed on shaft 21 and slides down and rests on capsules 40 in the uppermost platform 24. Disc 27 may be of stainless steel or the like and has perforations 28 which allow the processing fluids to pass through and penetrate the various capsules 40 stored below during processing. Since each capsule may have a buoyant effect in liquid and is fixed to its particular platform as later explained each platform is subject to being buoyed and the effect of disc 27 is to help overcome such buoyance so as to insure submersion of the capsules in the liquid.

The description will now be shifted to the special construction of capsule 40 of FIGS. 1, 7 and 8 which as previously stated cooperates with and is received in plural groups by the platforms 22, 24. Tissue capsule 40 is generally comprised of a uniform-size hollow cylindrical body 41 and a cylindrical cap 42. Cylindrical body 41 includes a cavity 43 for holding the tissue specimen, and integral bottom 44 and an open end 45 in which cap 42 seats to effectively enclose cavity 43.

Capsule 40 is preferably formed of porous polypropylene, nylon, polyester or polyethylene and is completely hydrophilically treated which allows both the aqueous and the organic solutions to readily pass through capsule structure 40. Hydrophilic treatment according to the preferred embodiment of this invention is accomplished with an oil-soluble agent though other commonly known hydrophilic processes may be employed and for certain processing of certain kinds of tissue only a portion of the capsule may be hydrophilically treated. With an affinity for water as well as aqueous solutions capsule 40 is easily wetted and passes such liquids through its pores which insures proper treating of the respective tissue particles confined in the capsule. For electron microscopy tissue the pore size of the material employed in body 41 and cap 42 will normally be small enough, in the range of 35 to 200 microns, to prevent passage of the smallest dimension and this is normally about 1 millimeter.

Cylindrical body 41 at its open end 45 has an outside diameter slightly less than that of the internal diameter of holes 23, 26 so as to provide a close but sliding fit. It will also be noted that cap 42 is slidably received by body 41 and that cap 42 has a shoulder 42a which fits within the open end of body 41. Shoulder 42a has a diameter slightly larger than the internal diameter of the open end 45 of capsule body 41. Thus, once cap 42 is pressed and fitted into the open end 45 of body 41, the walls of body 41 are bulged outwardly. Therefore, by placing the capsule body 41, containing a respective tissue particle, in its respective hole 23 or 26 and then pressing its respective cap 42 in place the sides of the body 41 are bulged outward slightly just enough to wedge the body 41 in its respective hole and which effect positively but releasably fixes each capsule. Furthermore, such action insures that the capsule cannot float off its platform during processing.

FIGS. 3 and 5 show the numbering of each hole in platforms 22 and 24. Each capsule when being entered into and removed from the processing procedure is treated by its corresponding hole number. Thus, neither the specimen nor the capsule has to be numbered as such during the liquid processing. Since subsequent embedding devices provide for numbers to be affixed to each specimen the individual capsules 40 of the invention are removed one at a time, embedded and numbered. Thus, by knowing the source of each tissue specimen before processing with the capsule and rack of the invention and by assigning each specimen a hole number during processing with the invention and then assigning the specimen its final embedded number as it is removed from the capsule of the invention the opportunity to lose specimen identity is minimized and such is, of course, extremely important particularly in dealing with large numbers of the minute electron-microscopy-size surgical specimens from a large number of operating rooms handling live human patients.

In operation, the body portions 41 of four capsules 40 are filled with their respective tissue particles or specimens and the filled body portions are placed in holes 23, numbered 1 through 4, in disc platform 22. The respective caps 42 are placed and this wedges the body portions 41 so that they are each releasably fixed in position on the platform 22. If additional capsules are to be filled and processed, disc platform 24 is placed on shaft 21 by means of sleeve 25 and is slid down shaft 21 until sleeve 25 resides on disc platform 22. Disc platform 24 is then filled with capsules 40 as was platform 22 and the body portion 41 of each individual capsule is wedged into its particular hole 26 by its cap 42. This step may be repeated with other platforms until the necessary number of capsules are filled. FIG. 1 illustrates a plural number of such disc platforms 24 loaded with capsules ready for processing. Finally, weighted and perforated disc 27 is slid onto post 21 and resides on top of the capsules 40 in the uppermost platform 24 so as to overcome any buoyant effect as previously discussed. The filled capsule rack 20 is next lifted by shaft 21 and placed within the processor 10 as illustrated in FIG. 1 and sequential immersion and processing through the various liquids may then take place. Upon completion of the processing sequence,

capsule rack 20 is removed, disc 27 removed and, one at a time, caps 42 removed which releases the corresponding body portions 41 and the specimens are removed for the next operation, normally embedding. The capsules themselves to avoid sterilization and because of their cheapness are discarded.

I claim:

1. A cooperative capsule rack and capsule construction for processing, in a processing chamber having sequentially liquid-changing means, histology tissue specimens particularly of electron-microscopy size, comprising in combination:

a. a plurality of tissue capsules, each capsule having an expandable, hollow cylindrical body of uniform diameter with a closed bottom and an open end and a closure cap for said open end, said cap being adapted to seat in said open end and to slightly expand said body, said body defining a cavity adapted to receive and retain a microscopy tissue specimen for sequential immersion in fixation and processing liquids; and

b. a rack for receiving said capsules, comprising:

1. a plurality of thin discs each having a plurality of indicia-identified holes of a uniform diameter adapted to slidably receive said capsule bodies and with the respective said caps installed to provide with said cap-

sule bodies expanded a substantially tight and fixed engagement between each disc and the capsules mounted thereon; and

2. mounting and carrying means adapted to mount, vertically space and assemble said discs one above the other for handling prior to and during processing and subsequent to processing being adapted to disassembly of said discs for removal of said capsules and the tissues therein.

2. The construction of claim 1 in which said mounting and carrying means includes a vertically disposed shaft having one of said discs integrally secured centrally and to the lower end thereof and adapted to loosely and centrally mount the remainder of said discs thereabove.

3. The construction of claim 1 in which each said body and cap is formed of a material inert to said liquids and selected from the group consisting of polyethylene, polypropylene, nylon and polyester and having pores ranging in average diameter from 35 to 200 microns and having at least a portion thereof of a hydrophilic nature.

4. The construction of claim 2 including an auxiliary disc adapted to mount centrally of said shaft above said discs and to weight said discs during processing.

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