

[54] METHOD AND DEVICE FOR BIOPSY SPECIMEN COLLECTING AND HANDLING

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[58] Field of Search **128/2, 2 B, 232, 218, 233, 128/304, 240, 276; 23/259, 292; 118/413, 414; 15/236**

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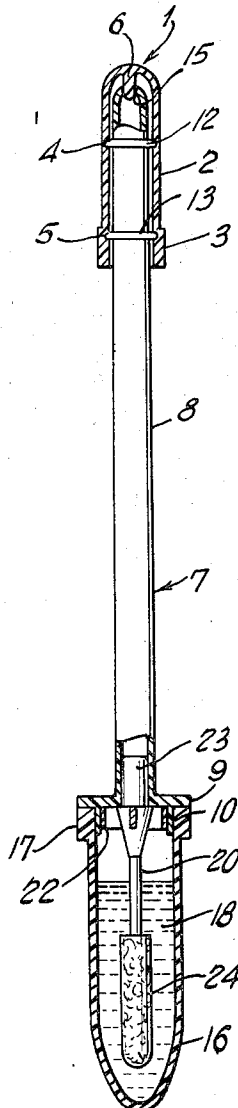
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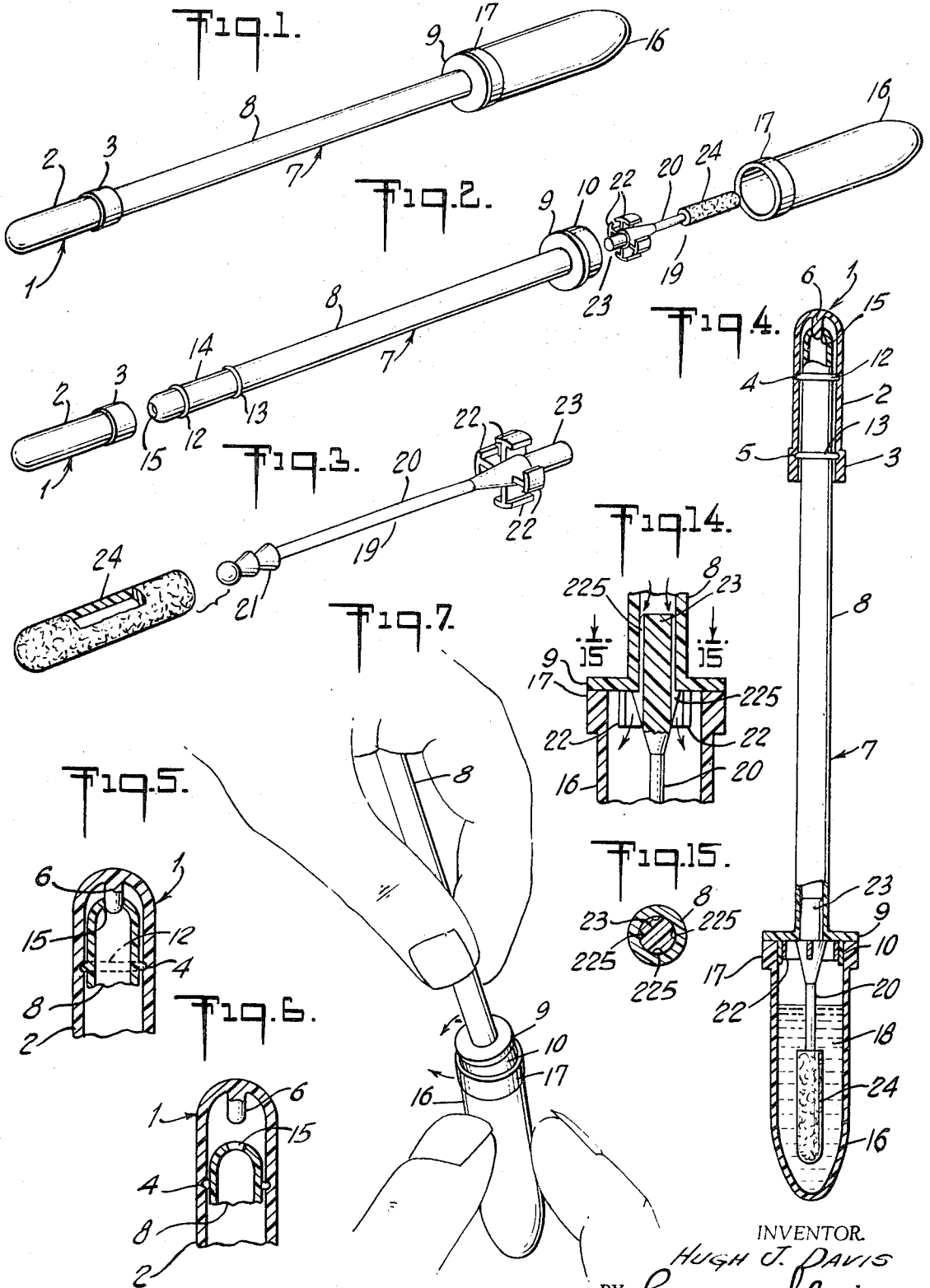
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[57] ABSTRACT

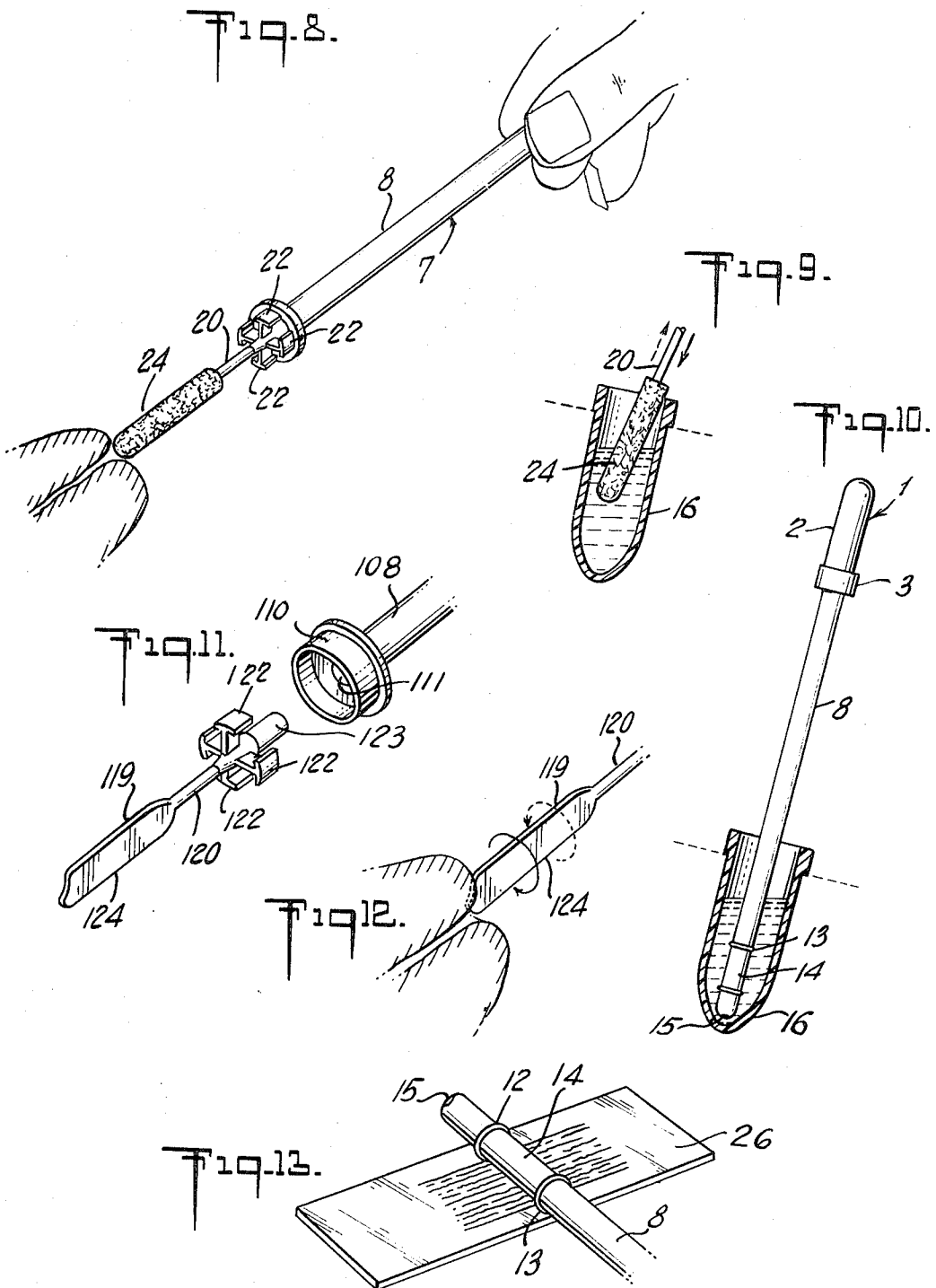
A method for procuring and processing samples of cellular material which comprises the steps of removing from a body cavity samples of cellular material, washing the samples of cellular material into a fluid container and processing the samples of cellular material directly within the container structure for eventual analysis in the cancer detection; the apparatus for use in carrying out the method includes a tubular member, a cap adapted to fit over one end of the tubular member to close the same, a fluid container adapted to be used as centrifuging container adapted to be connected to the other end and a swab structure or the like adapted to be removably connected with the other end of the tubular member. The dimension of the cap and other end are thereby so chosen that the cap can also be connected to the other end of the tubular member so as to form a pipette structure.

16 Claims, 15 Drawing Figures





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METHOD AND DEVICE FOR BIOPSY SPECIMEN COLLECTING AND HANDLING

The present invention relates to the processing of samples of cellular material collected from body cavities for microscopic examination and to apparatus for the collection of such samples.

In my copending application, Ser. No. 199,373 filed June 1, 1962, now abandoned, there is described a method and apparatus for obtaining and processing samples of cellular material from body cavities for microscopic examination which permits the use of untrained personnel to procure such samples. While the method and apparatus described in my copending application are eminently satisfactory for the purpose, microscopic slides prepared from such samples do not invariably contain as high a positive cell count as is usually desired by pathologists.

It is a purpose of the present invention to provide a method which enables individual cell specimens to be processed safely without the danger of cross-contamination.

It is a further purpose of the invention to provide a method which enables the use of the same apparatus for the entire processing whereby the danger of cross-contamination is avoided.

It is a further purpose of the invention to provide a method which enables all the necessary steps to be accomplished by means of one single apparatus, thereby obviating the necessity of multiple pipettes, aspirating syringes, collection bottles, etc.

It is a further purpose of the invention to provide a method which eliminates the need for using and washing multiple items of laboratory equipment.

It is a further purpose of the invention to provide a method which expedites the processing and cuts down the time required in the laboratory.

Still a further purpose of the invention is to provide the method which enables improvement of the quality of the microscopic preparations and thereby renders the microscopic examination more rapid and accurate.

It is a further purpose of the present method to provide means of effecting a specific cellular sampling from the squamocolumnar juncture of the cervix, irrespective of normal anatomic variations.

It is a further purpose of the present method to eliminate the need for spreading and fixation of the cellular material on a microscopic slide at the time of collection, thus simplifying the procurement of the sample.

It is a further purpose of the present method to secure a richer sample of atypical or positive cells for analysis than heretofore possible to recover and concentrate on a single microscopic slide in the laboratory.

It is a further purpose of the present method to assure a random mixture of atypical and positive cells with the normal cells on the microscopic slide, so that the probability of any individual microscopic field containing diagnostic cells is greatly increased.

It is a further purpose of the present method to assure fixation and distribution of the cellular material under laboratory control, so as to assure greater uniformity and quality of the microscopic preparations.

It is a further purpose of the invention to provide an apparatus for carrying out the method.

Among other purposes of the invention one purpose is to provide an apparatus which enables the utilization of a single container structure as a collecting as well as shipping and processing container.

Still a further purpose of the invention is to provide apparatus for the purpose specified, a part of which can be used as a centrifugal container for processing the sample material and another part of which can be used as a pipette for aspirating material from said centrifugal container and distributing the material directly on a microscopic slide.

Further purposes of the invention will appear from the following specification in connection with the accompanying drawing, in which

FIG. 1 is a perspective view of one embodiment of the pipette of the invention,

FIG. 2 is a perspective view of the pipette shown in FIG. 1 illustrating its parts unassembled,

FIG. 3 is a detailed perspective view of the swab assembly of the pipette shown in FIG. 1,

FIG. 4 is a schematic partial longitudinal section through the pipette shown in FIG. 1,

FIG. 5 is a longitudinal section through a modified portion of the pipette of the invention,

FIG. 6 is a longitudinal section further illustrating the modification of FIG. 5.

FIG. 7 is a schematic perspective view of the pipette of the invention illustrating one step of the method,

FIG. 8 is a schematic perspective view of the pipette of the invention illustrating another step of the method,

FIG. 9 is a schematic perspective view of the pipette of the invention illustrating a further step of the method,

FIG. 10 is a perspective view of the pipette of FIG. 1 with its parts differentially assembled to illustrate a still further step of the method,

FIG. 11 is a detailed perspective view of a modification of a portion of the pipette of the invention,

FIG. 12 is a schematic perspective view of one step of the method using the modification shown in FIG. 11,

FIG. 13 is a perspective view of the pipette structure shown in FIG. 1, illustrating its use in preparing a microscope slide.

FIG. 14 is a schematic longitudinal sectional view of a further modification of the invention.

FIG. 15 is a cross-sectional view of FIG. 14 through 15-15.

The invention provides a method for procuring and processing samples of cellular material by utilizing a single container structure which comprises the steps of effectively obtaining cellular material from a body cavity, washing said cellular material into said container structure, shipping said container structure to a laboratory for processing said cellular material exclusively within said container structure to condition said cellular material for microscopic examination, and eventually distributing said cellular material on a microscope slide directly from said container structure.

More specifically the invention provides a method for procuring and conditioning samples of cellular material for microscopic inspection by means of a single container structure which includes pipette means comprising the steps of collecting cellular material such as from a body cavity of a human being, washing said cellular material from the collecting means into said container by means of a solution within said container, shipping said container and pipette structure with the solution contained therein to a laboratory, processing said solution by centrifuging or sedimenting within said container structure to effectively condition the cellular material contained in said solution for microscopic examination, and eventually distributing said cellular material directly from said container by means of said pipette means on a microscope slide.

The invention provides apparatus for procuring and processing samples of cellular material by means of a swab or scraper which comprises first means effectively providing a container for a fluid, second means effectively providing a swab or scraper for the collection of cellular material and a third means effectively providing a pipette structure having a bulb and tubular portion. Said container, said swab or scraper and said pipette structure are assembled in a manner to provide easy separation so as to render the container operable as a centrifuge tube for processing the cellular material and conditioning said cellular material for microscopic examination. The structure also includes means operable to render said tube effective as a pipette for the withdrawal of cellular material from said centrifuge tube.

Referring now to the accompanying drawing, and specifically to FIGS. 1 through 4, the container structure is outwardly formed in three parts, a liquid container 16 which also effectively provides a centrifuge tube, a tubular structure 7 which effectively provides a pipette tube and a cap 1 which effectively provides a pipette bulb.

One end of tubular structure 7 is provided with a flange 9 having extending from it a tubular portion 10. Tubular portion 10 is detachably inserted into the open end of container 16 to form a liquidtight fit. The liquidtight fit may be provided by any conventional means, such as a force fit, heat sealing or gluing. The other end of tubular structure 7 is desirably provided with two circumferential ridges 12 and 13 which are spaced from the other end of the tubular structure and from each other. The cap 1 detachably covers the end of tubular structure 7 and desirably may be internally provided with circumferential recesses 4 and 5 which are spaced from one another to provide a liquidtight fit when circumferential ridges 12 and 13 snap into them.

A swab structure of the type illustrated in FIG. 3 is provided for the collection of cellular samples. The swab structure is an elongated member 20 having attached at one end a soft flexible material and at the other end appropriate means for detachably assembling the swab structure to the tubular structure 7. The soft flexible material may be any appropriate material such as rayon, cotton or a foamed plastic such as polyurethane foam. As illustrated, the soft flexible material is a tube 24 of polyurethane foam, closed at one end. The soft flexible material may be attached to the elongated member by any appropriate means, so long as it is prevented from becoming detached. Again as illustrated, in FIG. 3, the attachment is accomplished with a toothed member 21 which permits the sleeve 24 to freely slide thereover, but which prevents it from being removed. At the other end of the elongated member 20 there is provided means for detachably attaching the swab assembly 19 to the tubular structure 7. This may be accomplished by any appropriate means. One manner of attaching the swab assembly 19 to the tubular structure 7 is to provide one end of said swab assembly with footed prongs 22 which are circumferentially arranged around the elongated member 20, said footed prongs being of sufficient length to fit snugly into the cavity of the hub 10 of the tubular structure 7. To prevent the dislodgement of the swab assembly 19 during use, it is desirable to provide an extension 23 at the pronged end of the swab assembly, which extension 23 fits into the cannula of tube 8.

The method of procuring and processing cellular material is as follows:

The seal between the tubular structure 7 and the container 16 is broken in the manner shown in FIG. 7. Cellular samples are taken from the site to be examined by swabbing the site as shown in FIG. 8, in which case the site examined is the cervix. The cellular material is then washed from the swab into the container 16 as shown in FIG. 9. The cellular material is concentrated in the container 16, preferably by centrifugation. The supernatant solution is removed, as by decanting and a fixing solution is placed in the container 16 and is mixed with the cellular material. The cellular material can be further processed by:

a. separation from the supernatant fixing solution, by sedimentation or centrifugation, and distribution on a microscope slide for examination of further processing or

b. by the addition of staining agents to the container 16; further processing may be carried out directly prior to the examination of the material.

The structure of the present invention provides a single unit, the components of which serve all of the apparatus necessary to collect, contain and process cellular material without the danger of cross-contamination.

The structure is delivered to the physician prefilled with a preservative solution. Cellular material can be collected by the physical and is either processed and examined immediately by the physician or shipped in the structure to a laboratory for processing and examination.

FIGS. 5 and 6 illustrate a modification of the cap 1 wherein the cap is provided with an internal nib 6 which depends from the inner end of said cap. The nib is such diameter that when the cap 1 is fitted over the end of the tubular member 8, the nib enters the opening 15 and forms a liquidtight seal, thus preventing leakage of the liquid.

A modification of the invention is shown in FIGS. 11 and 12. In this embodiment of the invention, the swab assembly 19 is replaced by the scraper assembly 119. Scraper assembly 119 is an elongated member 120 having at one end a flattened rigid scraper 124 which is adapted to collect cellular material from the anterior and posterior lips of the cervix and from the external os. The scraper 124 is attached to prongs 122 by a shank 120. The shank extends beyond prongs 122 to form an axial rod 123. The prongs 122 are of such dimension to form a snug fit in the hub 110, with the axial rod 123 extending into cannula 111 of tube 108 to help provide stability. The method of taking a scraping with the scraper assembly 119 is illustrated in FIG. 12.

The device of the invention is used not only to collect cellular samples, but is also to process the samples and to prepare the microscope slides.

After obtaining the sample, the swab 24 or the scraper 124 is washed in the fluid 18 which is contained in container 16, to remove the cellular material from the swab or scraper. The container is then placed in a standard centrifuge and the cells are concentrated at the bottom of the container 16. The supernatant fluid is decanted and a fixing solution is admixed with the cellular material in container 16. The mixture is re-centrifuged to again concentrate the cellular material in the bottom of container 16.

Cap 1 is then inserted into hub 10 end of pipette assembly 7 so as to form a pipette.

As shown in FIG. 10, the thus formed pipette is used to suck the cellular material out of container 16. The cellular material is placed onto a microscope slide 26 by squeezing cap 1.

The distribution of the cellular material on microscope slide 26 is accomplished as illustrated in FIG. 13. The cellular sample is distributed in the form of an even layer because of the circumferential ridges 12 and 13 on tube 8 which permit the surface of the portion 14 to be spaced from the surface of the microscope slide a distance which is substantially that of the desired thickness of the sample layer.

Obtaining cellular samples by routine spatula scraping has the advantage of permitting the preparation of a microscope slide from a specific site under direct vision. For example, the usual site of early cervical cancer is the squamocolumnar juncture, accessible to routine spatula collections. But the juncture may be withdrawn into the cervical canal, routine wooden spatula scraping may be ineffective to obtain samples from this site. The collapsible nature of the swab or sponge modification and the present invention permits introduction of the collecting surface of the present device into the cervical canal, to obtain good samples even in the face of such anatomic variations.

A further embodiment of the invention is useful for obtaining cellular samples to include cells exfoliating from still higher levels. This modification is illustrated in FIGS. 14 and 15 wherein the shank 20 of swab assembly 19 has disposed at one end thereof channels 225 extending through mount 22. By substituting this swab assembly for the swab assembly shown in FIG. 2, the device may be used first to irrigate the body cavity from which the cellular material is to be obtained in order to wash out the cells from the cavity, and then the device is used as hereinbefore described to obtain samples by swabbing or scraping.

Irrigation is accomplished by removing the cap 1 from the pipette 7, inserting the tubular member 8 into the vagina until only the container 16 is exposed, squeezing the container 16 to eject the irrigating solution, releasing the pressure on the container to reaspirate the irrigating solution together with cellular material suspended in the solution. If desired, the irrigation can be repeated several times. After completion of the irrigation, additional cellular material may be obtained by swabbing or scraping.

It will be appreciated that for the irrigation procedure, the container 16 must be formed of a resilient, flexible material. The cap 1 should be formed of a similar material.

The solution with which container 16 is prefilled, where to be used as an irrigating solution must be capable of such use without injury to body tissue. It must also be capable of inhibiting decomposition of the cellular material; however obtained.

I have found that a suitable solution for use with my invention comprises a mixture of alcohol and physiological salts to which has been added a small amount of a fungicide or antibiotic. The saline concentration should be sufficient to prevent the cells from swelling or shrinking. The alcohol concentration should be high enough to inhibit bacterial growth and/or decomposition of the cellular material, but low enough not to injure the patient or alter the cells in such a manner as to make further processing difficult. The concentration of the fungicide or antibiotic should be sufficient to ensure against decomposition of the solution on prolonged storage.

I claim:

1. Apparatus for procuring and processing samples of cellular material from body cavities comprising in combination a tubular member open at both ends, a first hollow flexible closure member having an open end, a second hollow flexible closure member having an open end, a swab means, a first connector means detachably assembling said first hollow closure member to one end of said tubular member, a second connector means detachably assembling said second hollow closure member to the other end of said tubular member, and third connector means detachably assembling said swab means to said one end of said tubular member to enable said swab means to depend into said first hollow member.

2. Apparatus for procuring and processing samples of cellular material from body cavities comprising in combination a first hollow flexible member of a first interior volume and of a physical strength sufficient to enable it to be used as a centrifugal container and having an open end, a second hollow flexible member of relatively smaller interior volume and having an open end, and a tubular member open at both ends, first releasable connector means detachably assembling said first hollow member to said tubular member, second connector means detachably assembling said second hollow member to the other end of said tubular member, a swab means, a third releasable connector means interior of said first releasable connector means detachably assembling said swab means to said tubular member, and said second hollow member being of sufficient external diameter to be detachably connected to said third connector means to provide a pipette bulb upon disengagement of said swab means.

3. Method of procuring and processing cellular material from a body cavity by means of a container structure including means forming a swab and a fluid containing structure, comprising the steps of introducing the swab into a body cavity, withdrawing the swab from the body cavity and introducing said swab into the containing structure to wash the samples of cellular material from the swab into the containing structure, processing the samples of cellular material by centrifuging the samples within said containing structure, and eventually distributing the thus processed cellular material on a microscope slide directly from said container structure.

4. Method of procuring and processing samples of cellular material by means of a container structure including means forming a swab, a pipette and a fluid containing structure, comprising the steps of aspirating by the use of the pipette of said structure from the body cavity into the containing structure, introducing the swab into the body cavity, withdrawing the swab from the body cavity and introducing said swab into said containing structure to wash the samples of cellular material from the swab into the containing structure, processing the samples of cellular material by centrifuging the samples within said containing structure, and eventually distributing the thus processed cellular material on a microscope slide directly from said container structure.

5. Apparatus for procuring and processing samples of cellular material from body cavities comprising in combination: a first hollow member, a hollow tubular member of greater

length than said first hollow member, swab means, a cap detachably closing one end of said tubular member to close said hollow tubular member, and connector means operatively associated with said first hollow member and said tubular member detachably assembling first hollow member to said tubular member at the other end of said tubular member, said swab means depending from the other end of said tubular member into the interior of said first hollow member upon assembly of said hollow member to said tubular member by said connector means, at least one of said first hollow members and said cap being of flexible material.

6. Apparatus for procuring and processing samples of cellular material from body cavities comprising in combination a first hollow flexible member, a hollow tubular member of greater length than said first hollow member, a swab means, a cap detachably closing one end of said tubular member to close said first hollow member at said one end, and connector means operatively associated with said members detachably assembling said first hollow member to said tubular member at the other end of the latter, said first hollow member containing a cell-preservative fluid, and said swab means depending from said other end of said tubular member into the interior of said first hollow member upon assembly of said first hollow member to said tubular member by said connector means.

7. Apparatus according to claim 9, wherein said cap is flexible.

8. A method for procuring samples of cellular material from a body cavity and processing said cellular material to be conditioned for analysis by utilizing a single container structure including means forming a swab and a fluid container structure, comprising the steps of at least partly filling said container structure with a cell-preservative solution, introducing the swab into a body cavity, withdrawing the swab from the body cavity and introducing the swab into the fluid in said container structure to wash the samples of cellular material from the swab into the fluid of said container structure, and processing said samples of cellular material directly in said container structure to condition the cellular material contained in said solution for analysis whereby the danger of cross-contamination is substantially eliminated.

9. A method according to claim 8, further comprising the step of first irrigating the body cavity by the use of the fluid in said container structure to wash out the cells from the cavity.

10. A method according to claim 8, wherein the step of processing the samples of cellular material includes centrifuging the solution containing the samples within the fluid container structure.

11. A method for procuring samples of cellular material from a body cavity and for processing the procured samples of cellular material by utilizing a single-pipette structure having a first portion adapted to be used for procuring cellular material, a fluid container containing a fluid and a second portion adapted to be used as an auxiliary pipette, comprising the steps of introducing the first portion into a body cavity, withdrawing the first portion from the body cavity and introducing the first portion into the fluid container to wash the samples of cellular material from the first portion into the fluid in said fluid container, and thereafter processing the samples of cellular material directly in said fluid container structure for eventual analysis whereby the danger of cross-contamination is substantially eliminated.

12. A method according to claim 11 wherein the step of processing includes concentrating by centrifuging or sedimenting the cellular material in said fluid container.

13. Apparatus for procuring and processing samples of cellular material within the apparatus to minimize the danger of cross-contamination comprising in combination: a tubular portion open at both ends, means forming a structure for gathering cellular material from a body cavity, a first closure member detachably closing one end of said tubular portion, a second closure member, at least one of said closure members being provided with a flexible wall portion constituting a flexible bulb, and connecting means selectively including first

means detachably connecting said structure to the other end of said tubular portion, second means selectively and detachably connecting the one closure member constituting said bulb member with the other end of said tubular portion to constitute pipette means, and third means selectively and detachably connecting the other one of said closure members with said other end of the tubular member to enable use of said other closure member as a centrifuging container.

14. Apparatus for procuring and processing samples of cellular material comprising in combination: a first hollow flexible member having only one open end, a second hollow flexible member having only one open end, a tubular portion open at both ends, a further element for obtaining cellular samples from a body cavity, first connector means detachably assembling said first hollow member with said tubular portion to provide a first pipette structure with said first hollow member constituting a pipette bulb, second connector means detachably assembling said second hollow member with said first pipette structure to effectively provide a closure member therefor, and third connector means adapted to detachably assemble said second hollow member with said tubular portion upon removal of said first hollow member to effectively provide a second pipette structure, and further means detachably assembling said further element and said tubular portion.

15. Apparatus according to claim 19 wherein said first hol-

low member is of a physical strength sufficient to enable it to be used as a centrifugal container when disassembled from said tubular member.

16. A structure for procuring and processing samples of cellular material from a living body which minimizes the danger of cross-contamination, comprising: a first hollow member, a second hollow member, said hollow members being open at only one end thereof, a tubular portion open at both ends thereof, at least one of said hollow members being provided with flexible wall means constituting a bulb, a structure for removing the samples of cellular material from the living body, means operatively associated with said hollow members and said tubular portion and constituting connecting means including first means detachably connecting said hollow members and said tubular portion in such a manner that one hollow member is connected to one end of said tubular portion and the other hollow member is connected to the other end thereof and to enable disassembly of said members to constitute one of said hollow members a centrifuging container, and further means detachably connecting said structure to the end of said tubular portion to which said one hollow member is normally connected, said tubular portion being considerably longer than said hollow members.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,640,268 Dated February 8, 1972

Inventor(s) Hugh J. Davis

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

IN THE SPECIFICATION

Column 3, line 57, "... of..." should be --... or... --
Column 3, line 67, "... physical..." should be --... physician... --
Column 4, line 3, "... the..." should be --... a... --
Column 4, line 16, the word "... used..." should appear after
"... also..." and before "... to..." (first occurrence)

IN THE CLAIMS

Claim 7 should read: "Apparatus according to claim 6 wherein
said cap is flexible."
Claim 13, column 6, line 75, delete the word "... selectively..."
Claim 13, column 7, line 1, insert the words "... selectively
and..." after the word "... means..."
Claim 14, column 7, line 22, "change "... effective..." to
--... effectively... --
Claim 15, column 7, line 25, change "... 19..." to --... 14... --

Signed and sealed this 29th day of August 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents