INSTRUMENT FOR OBTAINING A BIOPSY SPECIMEN
10 Claims, 8 Drawing Figs.

ABSTRACT: An instrument useful in obtaining biopsy specimens or the like from the body. In particular, the instrument is in the form of a gun having a triggerlike mechanism which, in a single stroke, will activate a vacuum-producing means to draw a specimen into a tip supported by the gun and, thereafter, cause a portion of the specimen drawn into the tip to become severed.
INSTRUMENT FOR OBTAINING A BIOPSY SPECIMEN

This application is a continuation-in-part of U.S. Pat. application Ser. No. 503,666 filed Oct. 23, 1965, now abandoned.

This invention relates to medical and surgical instruments and, more particularly, to an instrument for obtaining a specimen from a membrane body.

In order to avoid the difficulties of exploratory surgery, doctors rely on biopsy material obtained from the interior organs of the body by instruments inserted into the body through the mouth or other natural opening. Biopsy specimens from inaccessible regions of the body have, for the most part, been obtained by utilizing punch forceps and biting forceps. These instruments are fairly satisfactory but have the big disadvantage of requiring practice for the operator to gain facility in their use as well as a very high incidence of unsatisfactory material obtained. A specimen obtained with these instruments is frequently macerated because of the necessity of the operator having to make several "bites" to obtain the specimen. This is due in part to the dullness of the cutting edges of the instruments and in part to the design of the instruments themselves.

In addition, the type of biopsy instruments are not without dangers, that is to say, they frequently require the operator to twist, pull and, sometimes, tear the mucosa being biopsied in order to obtain a specimen. Moreover, it is difficult for the operator to accurately gauge the depth of the cut when using the punch or biting forceps.

In more recent years, another technique of intestinal biopsy has been advanced. This is the suction biopsy technique, wherein one person applies suction to the tube of the instrument while a second person draws back on the cutting blade. These instruments cut cleanly and are associated with a low incidence of complications, such as bleeding, and the depth of the specimen can be controlled by the amount of suction applied to the instrument.

In their present form, these instruments are so constructed that two individuals are required to effect the obtaining of a specimen. Furthermore, it has been rather difficult to sequentially effect movement of the knife at the correct time, so as to accurately gauge the amount of material being cut.

In view of the foregoing, a new and improved instrument for obtaining a specimen was required. The instrument must not only be operable by a single individual, but must also include means for controllably gauging the amount of material to be cut. Additionally, such an instrument must include means for pulling the material being biopsied into a portion of the instrument and thereafter sequentially actuating a cutting instrument at the proper moment to thereby sever a specimen of the right size.

Accordingly, it is an object of this invention to provide a new and improved instrument for obtaining a specimen.

Another object of this invention is to provide a new and improved instrument for accurately gauging the amount of material to be removed from a membrane body.

Another object of the invention is to provide a new and improved biopsy instrument operable by one individual.

Still another object of the invention is to provide a new and improved biopsy instrument for drawing material therein and severing the material after a predetermined amount of material has been drawn into the instrument.

A further object of the invention is to provide a new and improved instrument for obtaining biopsy specimens from previously inaccessible areas of the human body.

Still other objects and advantages of the invention will in part be apparent and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combinations of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description of the preferred embodiment taken in connection with the accompanying drawings, in which:

FIG. 1 is a longitudinal sectional view of the instrument according to the invention;

FIG. 2 is a sectional view along line 2-2 of FIG. 1;

FIG. 3 is a top view of the invention with a cover portion removed;

FIG. 4 is a sectional view along line 4-4 of FIG. 1;

FIG. 5 is a top view, similar to FIG. 3, showing the position of some of the moveable portions of the instrument;

FIG. 6 is a view similar to FIG. 5, showing the position of some of the moveable portions of the invention at a later time;

FIG. 7 is a sectional side view of a modified form according to the invention;

Referring to FIGS. 1-4, there is shown a housing 10 having a handle portion 11 and a front cap portion 12. The housing 10 may be constructed of plastic, wood, metal, or any other suitable material. An elongated hollow tube 14 having a fixedly positioned member 15 mounted thereon and a threaded flanged nut 16 surrounding the member 15, is coupled to a threaded plug 17. The plug 17 is itself threaded into the front cap portion 12. The tube 14 is provided with a hollow tip 20 having an opening 21 formed on one surface thereof for permitting a portion of a membrane body to be drawn into it. The tip 20 is preferably constructed of metal, but plastic or any other suitable material may be utilized. The tip 20 is removable from tube 14 to gain access to the specimen and for sterilization purposes.

Positioned within the tip 20 is a cutting member 24 which is slidable movable within the tip past the opening 21, such that any membrane material extending through opening 21 may be cut by the cutting edge 25 of the mechanism 24 as it moves past the opening. The cutting mechanism 24 should preferably have an edge engaging the inner cylindrical wall of the tip, such that it closes opening 21 after the cut has been made to prevent any tissue entering the opening 21 on the return of the cutting mechanism to its original position. In order to move the cutting mechanism past the opening at a predetermined time, there is provided an actuating wire 27 extending through the tube 14 and into the interior of the housing 10 through plug 15 and cap 12. The wire 27 is slidable supported by member 30 which forms a portion of the suction or vacuum-producing means of the instrument. The member 30 is mounted on a trigger 31 and is preferably resiliently biased by a spring 32 such that a force greater than a predetermined force is required to depress the trigger. The wire 14 threadedly engages a cutting mechanism 24 such that the tip 20 and the cutting mechanism may be discarded and a new sterile unit substituted therefor.

The suction-producing means of the instrument comprises bellows 35 mounted on one end to housing cap 12. It is coupled at its other end to member 30 in a manner such that, upon movement of member 30, the bellows 35 may be drawn to the left of FIG. 1 so as to suck air into the bellows. Positioned within the bellows is a filler plug 36 having a conduit 37 therethrough which is coupled to a conduit arrangement 38 in the cap 12. The arrangement 38 extends into a conduit 39 in plug 15 which cooperates with the interior of the tube 14. Also coupled to conduit 38 is a valve arrangement 40 for preventing air from escaping when the bellows is drawn to the left of FIG. 1 and for permitting air to escape when the bellows is in a collapsed position. Additionally, to prevent the vacuum from escaping into the housing by way of the cap portion surrounding wire 27, a ball wire vacuum seal 43, preferably made of Teflon, is utilized. To produce a vacuum to draw a portion of a membrane body into the tip 20 through opening 21, the trigger is pulled to the left (FIG. 1), thereby expanding the bellows and causing a vacuum to be formed in tube 14 to draw the membrane into the tip portion. The bellows may be of the normally expanded type or normally collapsed type, although the latter is preferred. If the normally expanded type is utilized, the spring 32 should provide a greater force in order to cause the bellows to remain in a collapsed position until the trigger 31 is pulled.

In order to effectuate the timed movement of cutting mechanism 24 past the opening 21, there is provided a triggering mechanism generally shown at 45, comprising a block 48...
fixedly mounted on wire 27. The block 48 cooperates with a cam follower 49a and spring mechanisms 49b and 49c positioned in a guide area 50 cut in the housing 10. A portion of the guide area 50 forms a cam surface generally shown at 51 for moving the member 49a as shown by the arrow 52 against the springs 49b and 49c when the member 50 contacts an adjustable screw member 53 threaded mounted on the cam follower 49a at a rearward portion 49d. As clearly shown in FIGS. 1 and 3, member 53 is mounted loosely in a channel 54 cut into housing 10. The block 48 is also coupled to member 50 by way of a spring 55. Thus, as the trigger is pulled rearwardly, the vacuum is formed in tube 14 and tip 20 while, at the same time, springs 49b and 49c being expanded. Member 50 engages the threaded smoothly adjustable screw 53, the cam follower 49a will pivot as shown by the arrow 52 against the cam 51 to permit the block to snap rearwardly until it hits a stop 56 as shown in FIG. 6. In this manner, the cutting mechanism 24 is snapped past the opening 21 to sever a portion of the membrane sucked therein.

It will be evident from FIGS. 1, 3 and 5 that channel 54, having a diameter slightly larger than that of screw 53, permits sufficient rearward and vertical motion of the portion 49a so that the forward portion of member 49a slides along the edge of cam 51 in the direction of arrow 52 (FIG. 5).

The adjustable screw 53 permits the depth of cut to be controlled much as it limits the amount of vacuum supplied by the bellows prior to actuating the cutting mechanism. Therefore, to cut a larger specimen, the screw is adjusted such that the trigger must travel a greater distance prior to snapping the cutting mechanism 24 past opening 21.

In order to return the block 48 to its original blocked position, a tubular member 58 is slidably mounted on wire 27 and is of a dimension such that upon return of the member 30 to the right of FIG. 5, the side of the block 48 will be engaged by tubular member 58 and forced forward past the edge of the cam follower 49a.

As an additional improvement, the invention includes a member 60 mounted on the tube 14 for rotating the tip when the tip is inserted in the body from which a specimen is to be extracted. It is to be further understood that the tube 14 may be constructed of any suitable material such as plastic, metal, etc. Additionally, it is to be understood that the tube 14 may be rigid or flexible so as to permit its guidance into remote regions of the human body.

In operation, the instrument of this invention is generally placed in an endoscopic tube which has been inserted in the region of the body from which the specimen is to be taken. The trigger 31 is then pulled rearwardly to form a vacuum and thereby pull a specimen into the tip 20. As the trigger continues in rearward movement, the member 30 is contacted to trigger the cutting mechanism 24 past the opening 21 to sever the specimen. The instrument is then removed in the manner in which it was inserted and the specimen is taken from the tip.

Referring now to FIGS. 7 and 8, there is shown a modified form of the invention described in connection with FIGS. 1—6. In place of the bellows shown in FIGS. 1—6, there is utilized a syringe for producing a vacuum. The instrument, according to this invention, is essentially in the form of a gun having a handle shown at 60 with an outer casing 61. The triggerlike mechanism 62 in the form of a ring is for permitting an index finger to move a member 63 slideably within a slot shown at 64 positioned within the casing 61. The member 63 is coupled to a member 65 having a caplike member 66 affixed thereto. Positioned within the casing 61 and supported by the sidewall thereof are syringe support elements 68. The syringe shown at 67 is mounted within a piston 70 mounted within the casing 61. The member 70 fits within the cap member 66 and the piston 70 is movable therewith. The syringe element 69 is provided with a screwable insert tip member 73 which is coupled to a plastic (or other type material) tubing 74 which is itself coupled to a tube member 75. The tube 75 extends into a passage shown at 76 formed within the rodlike member 79 connected to the casing 61 by a coupling joint 80.

A tip, such as disclosed in FIGS. 1—6, and shown at 81, is supported at the end of the member 79 and has an opening 82 for permitting a specimen to be drawn therein. The syringe 69 as well as its cooperating tubings 74 and 75 provide a vacuum which will draw a specimen into the tip 81 through the opening 82.

Positioned within the tip 81 is a severing member 85 which moves past the window or opening 82 to sever a piece of tissue (specimen) drawn therein. The severing member 85 is connected to a wire 86 which is in turn looped at 88 about a member 87. The member 87 is slidable movably within the coupling member 80. In order to effect movement of the member 87, to move the severing knife 85, there is provided a member 89 which is supported on two pins shown at 90 and 91, respectively. The pins 90 and 91 are themselves supported by the casing 61 in a manner not shown. The member 89 is provided with two slots 92 and 93, respectively, the slot 92 being in the direction of movement of the member 87 whereas, in the preferred embodiment, slot 93 is positioned at an angle of about 45°. It should be understood that this angle could be varied.

The member 89 is supported at its rear by a sponge like spring member 95, such as of foam rubber, which is itself supported from a member 96 formed as part of the housing. The member 65 supports a tube shown at 99 having a slot 100 cut therein, in which there is movable a bar 101 supported by a threaded screw member 102 so as to position the bar 101 within the tube 99. The bar 101 is movable by the use of a knob 103 by way of a flat 104 shown on the screw member 102. The flat permits the screw member 102 to be rotated by the knob 103 but permits screw member 102 to slide therein.

A member 97 is coupled to the member 99 by means of a spring 105. A pin 106 is also provided on the member 99 and cooperates with the bar 101. In operation, the bar 101 is moved rearwardly as the member 65 moves rearwardly and engages pin 106 causing the member 89 to move rearwardly. This in turn causes member 89 to pivot and cause the member 97 which, by way of the spring 105, forces the member 87 rearwardly and this, in turn, causes the severing knife to move rearwardly past the opening 82. The spring 95 is of sufficient resiliency to force the member 89 to return to its original position after the member 97 is returned to the position shown in FIG. 8.

Thus, by the operation of a triggerlike mechanism, a vacuum is first formed to draw tissue into the opening of the tip 81 and thereafter, in a single stroke, causes the severing knife to move rearwardly to sever tissue drawn within the tip. By adjusting the position of the knob 103 and, thus the bar 101, the amount of vacuum required may be varied since the syringe will pull more or less amount if the bar 101 is moved toward the front of the instrument.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and since certain changes may be made in the foregoing construction without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is to be understood that the following claims are intended to cover all the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

We claim:

1. An instrument for obtaining a specimen from a membrane body, comprising a housing, a hollow tube extending from said housing with the end of said tube, said tube having an opening in a wall thereof, cutting means positioned in said tip and movable past the opening in said tip, vacuum-producing means mounted in said housing and having a movable portion for producing the vacuum, a vacuum conduit between said tube and said vacuum-producing means, means for actuating said vacuum conduit to draw a portion of the membrane body into the tip and move
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said cutting means past said tip opening to sever a specimen from said membrane body drawn into said tip; said actuating means including a trigger, a first member for moving the vacuum-producing means' movable portion coupled to said trigger, a wire extending through the tube and connected to the severing means at one end and supported by said first member at its other end, a block responsive to movement of said wire, means connected between said block and said first member for resiliently biasing said block, a cam follower positioned to prevent movement of the block while said first member is being moved over a portion of its travel, and an abutment member positioned on said cam follower in the line of travel of said first member such that upon contact of said first member and said abutment member, said cam follower is moved to release said block, whereby said cutting means is moved.

2. An instrument in accordance with claim 1 including means mounted on the cam follower adjustable so as to set the amount of vacuum provided prior to moving the cutting means.

3. An instrument in accordance with claim 1 including a tubular member slidably mounted on the wire and positioned to engage said block and said first member.

4. An instrument according to claim 1 in which said vacuum-producing means comprises a syringe having a piston, said piston adapted to move with said actuating means.

5. An instrument according to claim 1 in which said vacuum-producing means is a bellows which is actuated to produce a vacuum by the movement of said actuating means.

6. An instrument according to claim 1 including means mounted on said hollow tube for rotating said tip.

7. An instrument according to claim 1 in which said actuating means includes means for setting the amount of vacuum provided to said tube prior to moving the severing member.

8. An instrument according to claim 1 in which said abutment member comprises an adjustable screw and said block is mounted on said wire.

9. An instrument according to claim 1 in which said abutment member comprises a pin.

10. An instrument according to claim 1 including means mounted on said housing for resiliently biasing said cam follower.