Oct. 7, 1969 S. GOLDSMITH 3,470,867

BIOPSY NEEDLE

Filed Nov. 23, 1964

FIG. 1

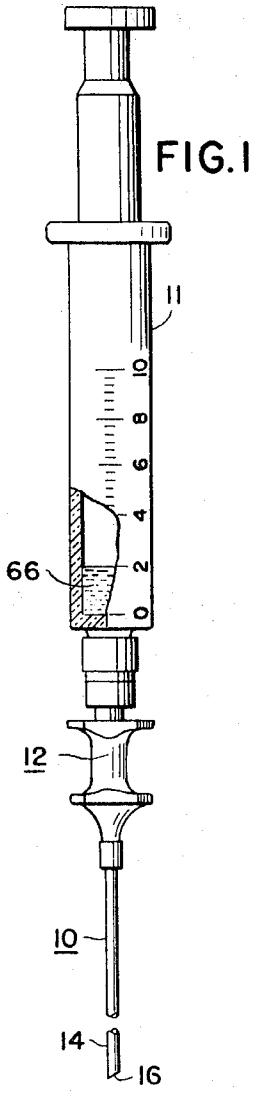


FIG. 2

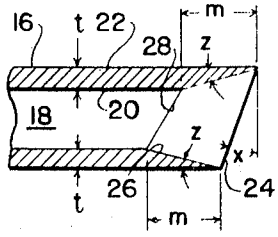


FIG. 3

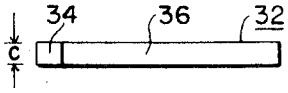
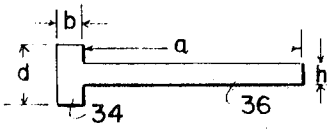


FIG. 4



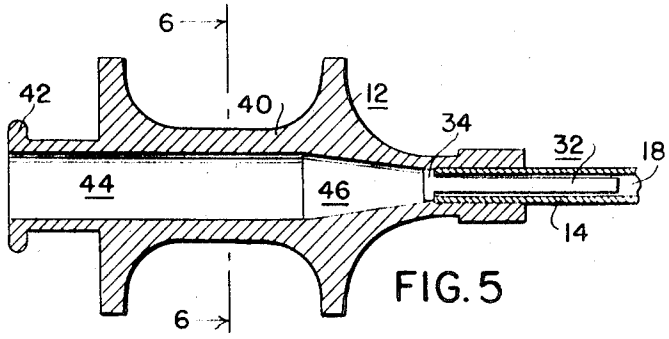


FIG. 5

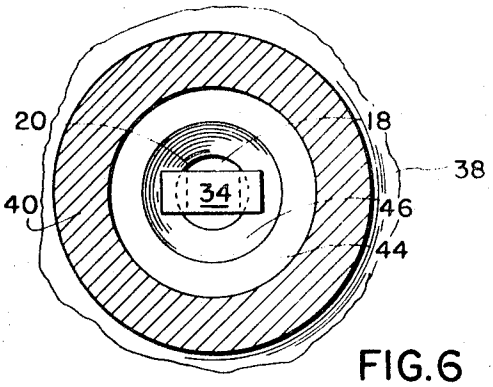


FIG. 6

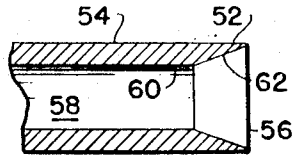


FIG. 7

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BIOPSY NEEDLE

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ABSTRACT OF THE DISCLOSURE

A biopsy needle for taking tissue specimens having a needle end wherein the bore has an end taper formed equiangularly around the circumference thereof. A further feature is a stop member frictionally fitted within the other end of the needle bore to help increase the compression on the specimen passing through the equiangular taper. The stop member has a particular cross-section dimension which stops the passage of the specimen passing through the bore but yet allows fluid to flow past the stop member.

This invention relates to a biopsy needle and more particularly to an improvement therein for taking tissue specimens.

Biopsy needles are used to take tissue specimens, such as from the liver, kidney, breast and thyroid. In the prior art difficulty has been encountered in the taking of such specimens in that the specimen was lost in withdrawing the needle or the specimen would fragment and part would be lost so that the part of the specimen left would be unsatisfactory for testing. The loss of the specimen is very serious since the taking thereof involves insertion of the needle a substantial amount into the body and an organ of a patient. If the specimen is lost, then the needle must be inserted again, and repeated insertions may be harmful to the patient. This is very discouraging both to the doctor and the patient, and may result in the use of an alternative procedure in obtaining the specimen wherein an operation is performed to obtain the specimen. Such an "exploratory" operation is obviously to be avoided if possible, but this can only be accomplished by designing a biopsy needle that would be certain to obtain a specimen whenever inserted.

It is an object of the present invention to provide an improved biopsy needle that is certain to obtain a specimen whenever it is inserted in a patient.

It is another object of the invention to provide an improved biopsy needle that is easily and simply manipulated to obtain a specimen.

It is a further object of the invention to provide an improved biopsy needle that has an opening at the end of the needle larger than the bore within.

It is still another object of the invention to provide an improved biopsy needle that has an inside taper to flare out the end of the needle.

It is a still further object of the present invention to provide an improved biopsy needle that has an inside bevel at the end of the needle forming an edge that is inclined with respect to the longitudinal axis of the needle.

It is yet another object of the present invention to provide an improved biopsy needle that receives an improved stop member that substantially fills the needle bore.

It is yet a further object of the present invention to

provide an improved stop member for a biopsy needle that has an enlarged end and a shank member substantially filling the bore of the needle but allowing fluid to pass therethrough.

These and other objects will be apparent from the following description when read in connection with the drawings, in which:

FIG. 1 is an elevational view of the improved biopsy needle attached to a syringe shown partly in cross-section;

FIG. 2 is an enlarged showing in cross-section of the end of the needle;

FIG. 3 is a plan view of an improved stop member for use in the improved biopsy needle;

FIG. 4 is an elevational view of the improved stop member;

FIG. 5 is a view of the base portion of the needle in cross-section showing the stop member inserted therein;

FIG. 6 is a cross-sectional view along line **6—6** in FIG. 5; and

FIG. 7 is a cross-sectional view of another embodiment of the end of the needle.

Reference is now made to FIG. 1 wherein the improved biopsy needle **10** is shown connected to a syringe **11**. The fitting of the syringe **11** to the needle **10** is conventional so it need not be described herein. Suffice to say that the end of the syringe is inserted into one end of the needle and lock in place by rotation for use. After use, the syringe is rotated in reverse direction for separation from the needle.

The needle comprises a base portion **12** and a needle portion or cannula **14**. The needle portion **14** includes an end **16** which is more clearly shown in FIG. 2. The needle portion **14** includes an outside surface **22** and a bore **18** forming inside surface **20**. End **16** terminates in edge **24**, and it is clearly seen in FIGS. 1 and 2 that edge **24** is inclined at angle x with respect to a plane at right angles to the longitudinal axis of needle portion **14**. Edge **24** is seen to be entirely included within a plane that is formed at angle x to the needle longitudinal axis, and a preferred angle in actual practice has been found to be approximately 15°.

Outside surface **22** forms a cylinder of unchanging diameter terminating in the edge **24**. From edge **24** a tapered surface **26** extends radially inwardly to intersect inner surface **20** at meeting edge **28**. Inner surface **20** extends from edge **28** to form a cylinder of unchanging diameter. It is seen that end **16** persents an inner taper or bevel in the form of surface **26** so that any tissue specimen taken into end **16** and forced up into bore **18** will be compressed as it moves past surface **26**.

The taper formed by surface **26** forms an angle z with respect to the longitudinal axis of needle portion **14**. The thickness of the needle portion **14** between the inner surface **20** and the outer surface **22** is designated t, and the distance from the edge **24** to the meeting edge **28** is designated m. A desirable ratio is approximately $3t=m$. A preferred embodiment in actual practice for 14 gauge biopsy needle has the following dimensions:

angle $z = 17° 23'$
$m = 0.031$ inch
$t = 0.010$ inch

A novel stop member **32** is provided in this invention as illustrated in FIGS. 3 and 4. Stop member **32** com-

prises an enlarged end **34** and a shank portion **36**. The size of shank portion **36** is critical in that the shank portion **36** which is rectangularly shaped in cross-section (as seen in FIG. 6) must substantially fill bore **18** in cross-section and yet allow fluid to pass therearound. The size of the enlarged end **34** is also critical as will be seen when the stop member **32** is inserted in bore **18** as shown in FIGS. 5 and 6.

In FIG. 5 it is seen that needle base **12** includes curved part **40** shaped to provide for finger gripping. Base **12** also includes rim **42** connected to part **40** and providing locking arrangement with syringe **11**. Within base **12** is an enlarged bore **44** that is joined to the smaller bore **18** by a connecting opening **46** of decreasing diameter.

When stop member **32** is inserted through base **12** into needle bore **18**, the shank **36** slides therein until enlarged end **34** abuts the end of needle portion **14**. The enlarged end **34** has at least one dimension greater than bore **18** which prevents further insertion of the stop member **32** into bore **18**. At this point the enlarged end **34** will be in abutment with the tapered wall **46** and the frictional contact thereof along with the complete insertion and close fit of at least one side of shank **36** in bore **18** maintains stop member **32** in place in the needle. To give an example of a preferred embodiment, such as in a 14 gauge needle having a bore **18** measuring 0.063 inch, a stop member had dimensions *a*, *b*, *c*, *d* and *h* as shown in FIG. 4 as follows:

a=1.156 inches
b=0.187 inch
c=0.050 inch
d=0.117 inch
h=0.060 inch

From the above dimensions it is to be noted that although the cross-sectional areas of shank **36** fills a substantial portion of bore **18**, there is sufficient unfilled area in the bore to allow passage of fluid around the stop member between bores **18** and **44**. These measurements of the stop member are critical to insure a proper fit and to insure taking of the specimen in a satisfactory manner, as will be explained hereinafter. The dimension *a*, of course, determines the length of the specimen drawn into the needle and will vary as indicated hereinafter.

A further embodiment of the invention is illustrated in FIG. 7 wherein the end **52** of needle portion **54** is shown with an edge **56** that is formed entirely in a plane positioned at right angles to the longitudinal axis of the needle portion. The bore **58** in needle portion **54** provides an inner surface **60**, and from the edge **56** extending radially inwardly is a surface **62** that forms an inner bevel between outer surface **52** and inner surface **60** so that a tissue specimen entering end **52** is compressed as it moves up bore **58**.

To take a tissue specimen an initial penetration is first made with a conventional pointed instrument or trocar where the specimen is to be taken. The stop member **32** is intersted in bore **18**, and the syringe **11** is then attached to needle **10** and locked in place. The syringe **11** contains a predetermined amount of saline solution **66**, such as 2 ml. as shown in FIG. 1. The end **16** of the needle is then inserted in the opening made by the trocar and approximately one ml. of saline is injected to clear bore **18**. To take the specimen the syringe **11** is now aspirated to apply suction to the needle, and the needle is simultaneously and rapidly thrust inwardly to a predetermined depth. The thrust is straight forward with no rotation as the inside bevel of edge **24** or **56** provides an improved cutting action for cutting out the desired specimen.

In the prior art the thrust of the needle would cut the specimen for passage into the bore of the needle, but often in the withdrawal of the needle the tissue specimen would be lost or it would fragment into an unsatisfactory form. In the improved needle illustrated the beveled end provides an improved cleaner cut of the specimen which helps prevent fragmentation. Further, the bevel or taper of the end causes the tissue specimen to be compressed as it passes up the needle bore. At this time the stop member comes into use in two ways. First the length of the stop member determines the length of the specimen to be taken for a certain size needle. Second the stop member allows a pressure relation to be maintained to help take the specimen as will be explained hereinafter.

In 65 biopsies performed with the improved needle, tissue speciments taken ranged from 2 inches to 3 inches, and in every case a tissue specimen was obtained. The tissue specimens obtained with the improved needle having the compression feature were smooth and shiny in appearance as compared to prior art specimens that were ragged and fragile. Preferred dimensions for the improved biopsy needles are as follows:

Liver biopsy needle, adult, 14 gauge—3" long
Liver biopsy needle, adult, 16 gauge—2" long
Liver biopsy needle, child or baby, 18 gauge—2" long
Soft tissue (breast, skin, lymph nodes, etc.) biopsy needle 14 gauge—2" long
Soft tissue (breast, skin, lymph nodes, etc.) biopsy needle 16 gauge—2" long
Biopsy stops for 14 gauge needle should be about 3 cm. long.
Biopsy stops for 16 gauge needles should be about 2 cm. long.
Biopsy stops for 18 gauge needles should be about 2 cm. long.

A further advantage of the improved stop member is the fitting provided by the enlarged end. When the syringe is aspirated, the substantial closure of the needle bore by the enlarged end holds the suction or "back pressure" and prevents suction leakage so that the specimen is moved in a positive manner up into the bore.

After removal of the needle from the body of the patient, the tissue specimen is expelled from the needle bore by ejecting the remaining saline from the syringe. The tissue specimen thus expelled is found to be compact and satisfactory for examination due to the compression feature. The needle may then be separated from the syringe and the stop member removed by insertion of a conventional stylet through the beveled end. The needle and syringe are then cleaned and sterilized in a conventional manner for reuse.

The particular embodiment of the invention illustrated and described is to be considered illustrative only. The present invention includes such other modifications and equivalents as may readily occur to those skilled in the art, within the scope of the appended claim.

It is claimed and desired to secure by Letters Patent:

1. A biopsy needle adaptable for connection to a syringe, comprising a hollow needle portion having longitudinal axis and inner and outer surfaces, said inner surface forming a bore, one end of said needle terminating in a needle base, the other end of the needle portion terminating in an edge all points of which are located in a plane inclined at an angle of approximately 15° with respect to a plane located at right angles to the longitudinal axis of the needle portion, said outer surface formed as a cylinder of unchanging diameter extending from said one end to said edge, a tapered surface formed on said other end and extending radially inwardly from said edge that is located on said outer surface to one end of said inner surface, said tapered surface forming with said outer surface a constant angle of less than 20° around the entire circumference of said edge, the length of the tapered surface being approximately three times the cross-sectional thickness between the inner and outer surfaces, a stop member, said stop member positioned in said bore to provide a close sliding fit therewith, said stop member having a shank portion of rectangular shape with both of the side dimensions being less than the diameter of said bore, said stop member having an enlarged end of rectangular shape, one side of said enlarged end having a

dimension less than the diameter of said bore, and the other side of said enlarged end having a dimension greater than the diameter of said bore so that said enlarged end cannot pass therethrough.

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U.S. Cl. X.R.

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