Dec. 24, 1968 S. MISHKIN ETAL 3,417,744

CATHETER FOR SELECTIVE BRONCHOGRAPHY

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FIG. 2

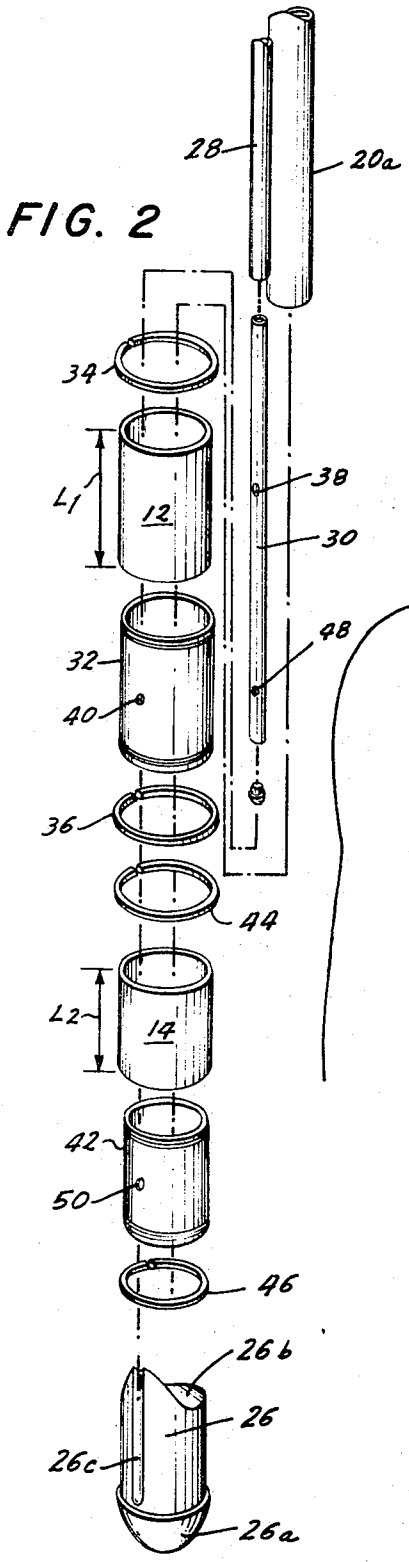

FIG. 1

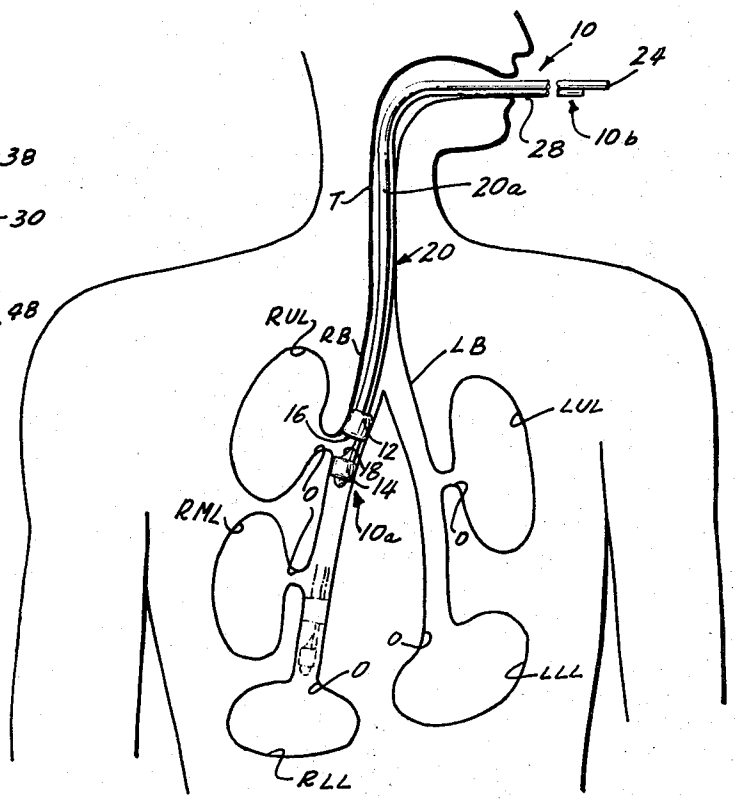

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FIG. 4

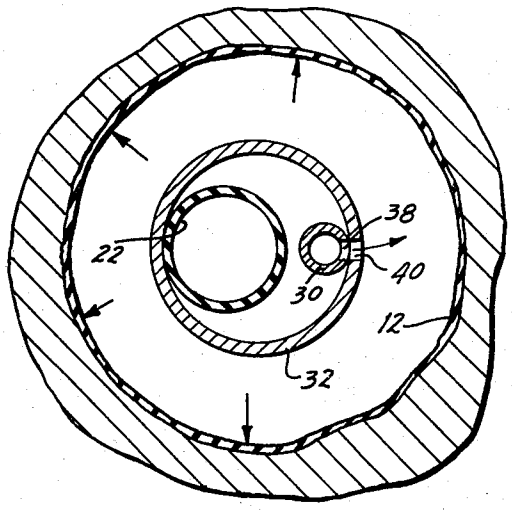


FIG. 3

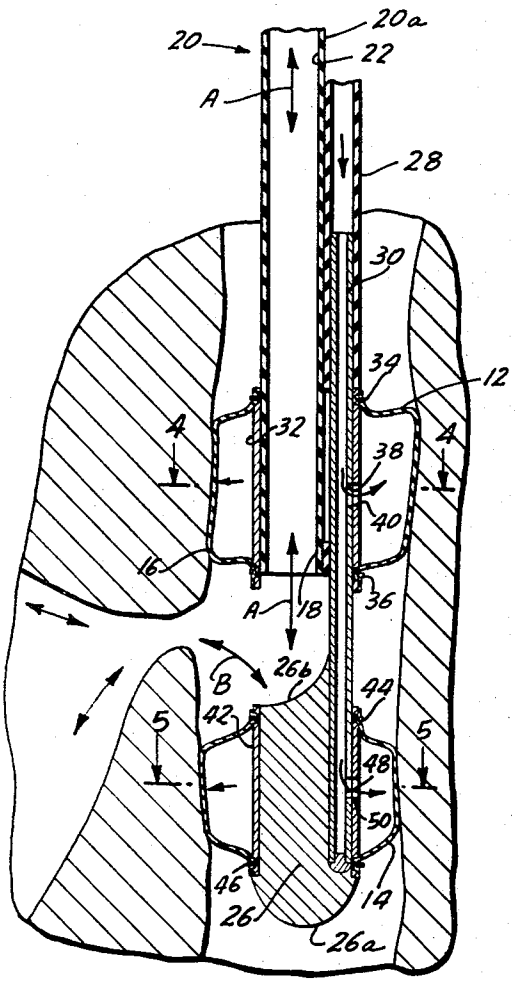
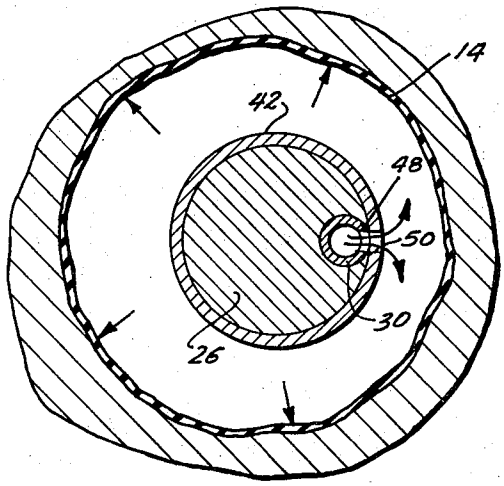


FIG. 5



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CATHETER FOR SELECTIVE BRONCHOGRAPHY

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ABSTRACT OF THE DISCLOSURE

A catheter adapted for selective bronchography of a lung lobe comprising a flexible elongated tubular portion terminating at a distal end opening and a body member connected to the distal end of the tubular portion. The body member includes an upper deflector surface for receiving and deflecting fluids from the tubular portion. A pair of inflatable collars are mounted on the catheter, one on the tubular portion and one on the body member, these collars being adapted to being inflated to form with said upper surface a transverse passageway. The construction may be such that only the collar on the tubular portion is inflated.

The present invention relates generally to a catheter, and more particularly to certain improvements in the construction of a catheter which greatly increase the precision and range of uses thereof as a diagnostic instrument.

Selective bronchography procedures as are now practiced with conventional catheters, are primarily limited to investigation of major lung regions or respiratory passages thereto. This is despite the advances that have been made in the performance of fluoroscope and X-ray equipment which, if taken full advantage of, can readily be used in the precise placement of the catheter. An important aspect of the present invention is thus the recognition of this disparity between what could and what actually is achieved using available auxiliary fluroscope or such equipment and a catheter, and also the provision of an improved catheter capable of more precise and varied uses in selective bronchography procedures.

In sharp contrast to limited bronchography procedures possible with known catheters, it is an object of the present invention to provide an improved catheter capable of isolating only one lobe of the lungs, if necessary, to diagnostic investigation, rather than merely isolating larger and more extensive lung areas from each other. This greater precision of the improved catheter hereof not only minimizes the possibility of errors by accurate definition of the investigated area, but it also substantially reduces the amount of fluid required to be introduced and then drained in the course of conducting the diagnostic procedure. That is, since a single lobe under investigation is directly filled and drained to obtain a culture, rather than this lobe and also the surrounding areas such as occurs with conventional catheters, the amount of fluid handling is substantially reduced. This is significant since reduction in fluid handling results in a corresponding reduction in time to complete the procedure, in many instances according to actual experience changing a 15 minute procedure (one entire lung) to a procedure taking about 1 minute (one lobe of the lung). Considering that a bronchography procedure is, at best, uncomfortable, this shortening in time to complete the same is of noteworthy importance.

A further object of the present invention is to provide a catheter having improvements in the construction of the inflatable collars associated therewith, these improvements, more particularly, permitting inflation of one and then the other of these collars. This is useful when investigating either the left or right lowermost lung lobes, when only one collar is inflated and the fluid introduced and removed in the clearance provided by the non-inflated condition of the other collar.

A catheter demonstrating features and objects of the present invention has an elongated, flexible body defining a main longitudinal conduit terminating in openings in the proximal and distal ends of the catheter. Concentrically mounted on the catheter distal end, on opposite sides of and immediately adjacent the opening therein, are the usual inflatable collars, although of improved construction. Moreover, the position of these collars relative to the distal end opening is such that these collars, when inflated, define therebetween a passageway extension for this opening which is effective to precisely control directional flow out of and into this opening. With such control over flow, individual lobes are readily isolated for investigation by the catheter hereof.

Further, while both inflatable collars are fabricated of a suitable elastomeric material or the like, the upper collar, near the proximal end, is made larger and as a result inflates at a lesser pressure level, than the smaller lower collar adjacent the distal end. Thus, by merely maintaining the inflating pressure at a level sufficient to inflate the upper collar but below that necessary to inflate the lower collar, the catheter can be used with only the upper collar inflated.

The above brief description, as well as further objects, features and advantages of the present invention will be more fully appreciated by reference to the following detailed description of a presently preferred, but nonetheless illustrative embodiment in accordance with the present invention, when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a diagrammatical view illustrating a typical use of the catheter hereof for selective bronchography;

FIG. 2 is an exploded perspective view of the distal end of the catheter illustrating the construction and the assembly thereof;

FIG. 3 is an elevational view, in section and on an enlarged scale, of the distal end of the catheter in an assembled condition;

FIG. 4 is an enlarged plan view, in section taken on lines 4—4 of FIG. 3, illustrating structural features of the upper inflatable collar of the catheter; and

FIG. 5 is also an enlarged plan view, in section taken on line 5—5 of FIG. 3, similar to FIG. 4 but showing structural features of the lower inflatable collar of the catheter.

Reference is now made to the drawings, and in particular to FIG. 1, wherein there is shown a catheter, generally designated **10**, demonstrating features of the present invention. The catheter **10** is used generally for selective bronchography procedures in the same manner as known catheters, although due to novel features of construction thereof it is a more precise medical instrument and has a considerably increased and wider range of medical uses. As an illustration, attention is directed to the diagrammatic illustration of FIG. 1 wherein the catheter **10** is shown in a typical use in the lungs and respiratory passages thereto of a patient. Thus, as is generally understood, the trachea T branches into the right and left bronchi, RB and LB, respectively, which in turn connects with plural lobes of the lungs. Further, as is generally understood, the right lung includes an upper lobe RUL, a middle lobe RML, and a lower lobe RLL, whereas there are only two lobes, an upper and lower lobe LUL and LLL, respectively, comprising the left lung. Heretofore, only limited selective bronchography procedures could be practiced with prior art catheters, such limited procedures being primarily the introduction and removal of fluids into and from general right and left lung regions. That is, it was possible to introduce these fluids for diagnostic purposes through the right bronchi RB while isolating the left bronchi LB or vice versa. Heretofore, however, it was not possible to readily

employ a catheter so that selective introduction and removal of fluids for diagnostic purposes could be made specifically in connection with the individual lung lobes, such as, for example, as is possible with the catheter **10** hereof with respect to the right upper lobe RUL, as is illustrated in FIG. 1. Further, the novel construction of the catheter **10** also permits the selective introduction of fluids into either the right lower lobe RLL (as shown in phantom perspective in FIG. 1) or the left lower lobe LLL.

Still referring to FIG. 1, the catheter **10** includes a pair of spaced-apart inflatable collars **12** and **14** mounted concentrically on the catheter distal end **10***a* and which collars, when inflated, define therebetween a transverse passageway **16** which serves as an extension for an opening **18** in the catheter distal end **10***a*. Thus, the opening **18** can be placed, via the passageway **16**, in direct communication with any selected constricted opening or orifice O of a lobe which connects such lobe to the bronchi RB, LB.

Procedurally, it is contemplated that by following usual placement techniques for the catheter **10**, which as is generally understood may involve the use of such auxiliary equipment as a fluoroscope or X-ray device, that the opening **18** can be provided the advantageous position in the right bronchi RB as illustrated in FIG. 1 which is directly opposite the orifice O of the right upper lobe RUL. Once obtaining this position, the upper and lower inflatable collars **12**, **14** are inflated to form the transverse passageway **16** and also to completely isolate all other areas and respiratory passages of the lungs from the effects of the bronchography procedures which follow. Illustrative of such a procedure might be the injecting of dionosil aqueos, pantopaque or a similar dye into the right upper lobe RUL to obtain selective cultures or for other diagnostic reasons. Due to the blocking effect of the inflated collars **12**, **14** and also the formation of the transverse passageway **16** restricting the flow path of the dye fluid only between the opening **18** and the one lobe RUL, only the lobe RUL is involved and the remaining lung areas and respiratory passages are completely isolated during this selective bronchography procedure.

Turning now to the specific structural features of a preferred embodiment of the catheter **10**, the same includes a conventional flexible, elongated tubular body **20** having a cylindrical outer wall **20***a* which defines a main longitudinal conduit **22** in communication with the distal end opening **18** and with an opposite end opening **24** at the proximal end **10***b* of the catheter. As is best shown in FIGS. 3–5, the tube **20** in the embodiment illustrated herein terminates at the opening **18**, although there is additional structure beyond the opening **18** which forms the distal end **10***a* of the catheter. This additional structure includes a plug **26** having a smoothly curved, generally spherical nose **26***a* which, in an obvious manner, helps in guiding the catheter **10** through the confined and narrow respiratory passages. The plug **26** has an appropriately shaped upper arcuate surface **26***b* which occupies a position transverse to the normal flow path A through the main conduit **22** and which, as a result of this position, is effective to redirect material flow from the flow path A along a transverse path of flow B into any one of the lung lobes RUL, RML, or LUL.

Joined along the flexible tube **20** is a smaller flexible tube **28** which serves as a conduit for introducing pressure fluid into the upper and lower collars **12** and **14**. Disposed in the distal end of the tube **28** is a rigid tube **30** which at the lower free end thereof fits within a mounting groove **26***c* of the plug and serves to mount the plug **26** as an extension of the tube **20**, or more particularly, as the distal end **10***a* thereof. Disposed concentrically about the tubes **20**, **30**, in a location coextensive with the actual end of the tube **20** and with the medial portion of the tube **30** is an upper mounting sleeve **32**, this concentric mounting of the sleeve **32** and tubes **20** and **30** being rendered secure by a force fit or by any other appropriate technique. The upper collar **12**, which is the larger of the two collars having an axial length of **L1**, is mounted concentrically about the upper mounting sleeve **32** by upper and lower retaining rings **34** and **36**. The pressure fluid which is used to inflate the collars **12**, **14** and which may either be pressure air or hydraulic fluid, flows into the upper collar **12** through aligned openings **38** and **40** in the tube **30** and sleeve **32**, respectively.

As previously indicated, the plug **26** is mounted as a distal end extension of the catheter **10**. This is achieved by utilizing a lower mounting sleeve **42** disposed in a force fit concentrically about the plug **26** and the distal end of the tube **30**. The lower collar **14**, which is the smaller of the two collars having an axial length **L2** of a lesser extent than the axial length **L1** of the upper collar **12**, is circumferentially mounted about the mounting sleeve **42** by upper and lower retaining rings **44** and **46**. Aligned openings **48** and **50** in the tube **40** and sleeve **42**, respectively, are provided for flowing of the inflating medium into the collar **14**.

Both of the collars **12** and **14** are preferably fabricated of the same guage of elastomeric material, but due to the difference in axial lengths of these collars the larger upper collar **12** inflates at a lower pressure level than the smaller lower collar **14**. This is particularly useful when using the catheter **10** for bronchography procedures involving either the right lower lobe RLL or the left lower lobe LLL. In these instances, the inflating medium, which is derived from a suitable source such as an air compressor or the like and which is operatively connected to the proximal end **10***b* of the catheter **10**, is maintained at a pressure level sufficient to cause inflation of the upper collar **12** but below the pressure level necessary for inflation of the lower collar **14**. Thus, and as best illustrated in phantom perspective in FIG. 1, the inflated condition of the upper collar **12** is effective to isolate all but the right lower lobe RLL from the opening **18** of the catheter **10**, while the noninflated condition of the lower collar **14** does not prevent flow of fluid from the catheter **10** down past the distal end **10***a* of the catheter and into the right lower lobe RLL.

From the foregoing, it should be readily appreciated that the catheter **10** hereof represents a significant advance over known catheters in that a greater variety of bronchography procedures can be performed having a greater selectivity of the areas in the lungs and respiratory passages that may be diagnostically investigated. Not only is the catheter **10** hereof noteworthy in the foregoing respect, but the ability thereof to isolate individual lobes for diagnostic purposes also substantially reduces the time required to complete the medical procedure, from as much as fifteen minutes to one minute. Since bronchography procedures at best are exceedingly uncomfortable, the shortening in time for these procedures as is possible with the catheter **10** hereof is of considerable importance.

A latitude of modification, change and substitution is intended in the foregoing disclosure and in some instances some features of the invention will be employed without a corresponding use of other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the spirit and scope of the invention herein.

What is claimed is:

1. A catheter of a size to be placed within the lung respiratory passage for selective bronchography of a lung lobe, the catheter having a proximal end and a distal end, and comprising an elongated and flexible tubular body defining a main longitudinal conduit having a proximal opening at the proximal end of the catheter and a distal opening at the distal end of the catheter for flowing materials therebetween, a body member located in the longitudinal path of flow of said main longitudinal conduit adjacent the distal opening and having a first upper sur-

face at one end thereof oriented across said longitudinal path of flow for diverting material flow from said longitudinal conduit, and a second surface at the opposite end thereof having a smooth, generally spherical shape for guiding said catheter during the use thereof for selective bronchography, a pair of inflatable collars mounted concentrically of said catheter adjacent said distal end, one said collar being located immediately before the distal opening and the other being located on said body member immediately after said distal opening, and inflation conduit means connecting said body member to the tubular body and operatively connected to said collars for causing inflation thereof for blocking the respiratory passage on opposite sides of an opening into a lung lobe, whereby said collars, when inflated, define therebetween and with said upper surface of the body member a transversely extending passageway directing said flowing material flow into said lung lobe.

2. A catheter as defined in claim 1 wherein the construction of the one collar nearest the proximal end is such that said one collar is adapted to inflate at a lesser pressure level than said other collar whereby the selective inflating of only said one collar is achieved with an inflating medium limited in pressure to said lesser pressure level.

3. A catheter as defined in claim 2 wherein said one collar nearest the proximal end is constructed larger than said other collar.

4. A catheter of a size to be placed within the lung respiratory passage for selective bronchography of a lung lobe, the catheter having a proximal end and a distal end, and comprising an elongated and flexible tubular body defining a main longitudinal conduit having a proximal opening at the proximal end of the catheter and a distal opening at the distal end of the catheter for flowing materials therebetween, means at said distal end for diverting the flow transversely of the normal flow through said main longitudinal conduit, a pair of inflatable collars mounted concentrically of said catheter adjacent said distal end, said collars being located on opposite sides of and immediately adjacent said distal opening, and inflation conduit means operatively connected to said collars for causing inflation thereof for blocking the respiratory passage on opposite sides of an opening into a lung lobe, whereby said collars, when inflated, define therebetween a transversely extending passageway directing said material flow into said lobe, and wherein the one collar nearest the proximal body end is larger than the other collar such that when the collars are uninflated the said one collar has a larger expandable surface area than the other collar such that the said one collar is adapted to inflate at a lesser pressure level than said other collar whereby the selective inflating of only said one collar is achieved with an inflating medium limited in pressure to said lesser pressure level, whereby when the distal end is lowered down into one of the bronchi to examine a lower lung lobe and when said inflation conduit is supplied with an inflation medium at a predetermined pressure level, the upper collar will inflate to block the bronchi while the other collar remains sufficiently uninflated to permit liquid to flow therearound from the distal opening to the lower lobe.

5. A catheter as defined in claim 4 wherein said one collar nearest the proximal has a longer axial length than said other collar.

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U.S. Cl. X.R.

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