

- [54] **FIBER GLASS REINFORCED CATHETER** 2,929,900 3/1960 White 138/130 X
 [76] Inventor: **William A. Cook**, 1208 E. Wylie St., 3,416,531 12/1968 Edwards 128/348
 Bloomington, Ind. 47401 3,485,234 12/1969 Stevens 128/348 X
 [22] Filed: **June 17, 1974** 3,498,286 3/1970 Polanyi et al. 128/348 X
 3,500,867 3/1970 Elson 138/125
 [21] Appl. No.: **480,004** 3,598,126 8/1971 Hoeltzenbein 128/348

Related U.S. Application Data

- [63] Continuation of Ser. No. 312,803, Dec. 7, 1972, abandoned, which is a continuation of Ser. No. 97,710, Dec. 14, 1970, abandoned.

- [52] **U.S. Cl.**..... **128/348; 128/2.05 R; 138/125;**
 138/130; 138/132
 [51] **Int. Cl.²**..... **A61M 25/00**
 [58] **Field of Search**..... 128/348, 349 R, 350 R,
 128/351, 2 M, 2.05; 138/124, 125, 130, 132,
 144

References Cited

UNITED STATES PATENTS

- 2,407,929 9/1946 Jeckel 128/349 R X
 2,437,542 3/1948 Krippendorf 128/349 R

Primary Examiner—Dalton L. Truluck

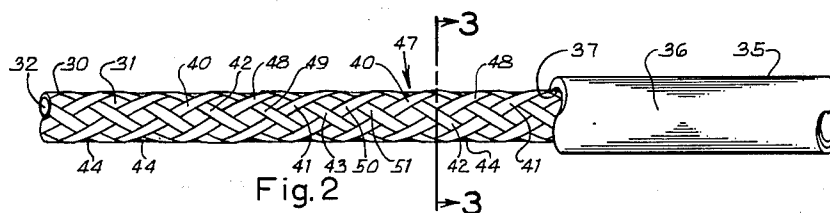
Attorney, Agent, or Firm—Woodard, Weikart,
 Emhardt & Naughton

[57]

ABSTRACT

A catheter body for intubation of body organs and vessels. A plastic inner core has fiber glass bands spiralingly wrapped around its length. Each fiber glass band has individual strands of fiber glass laid in a side by side position. An outer plastic tube encloses the inner core and fiber glass bands. The inner surface of the outer tube is united to the inner core between the bands of fiber glass. The fiber glass bands are wrapped in a mesh braid having five picks per inch.

2 Claims, 3 Drawing Figures



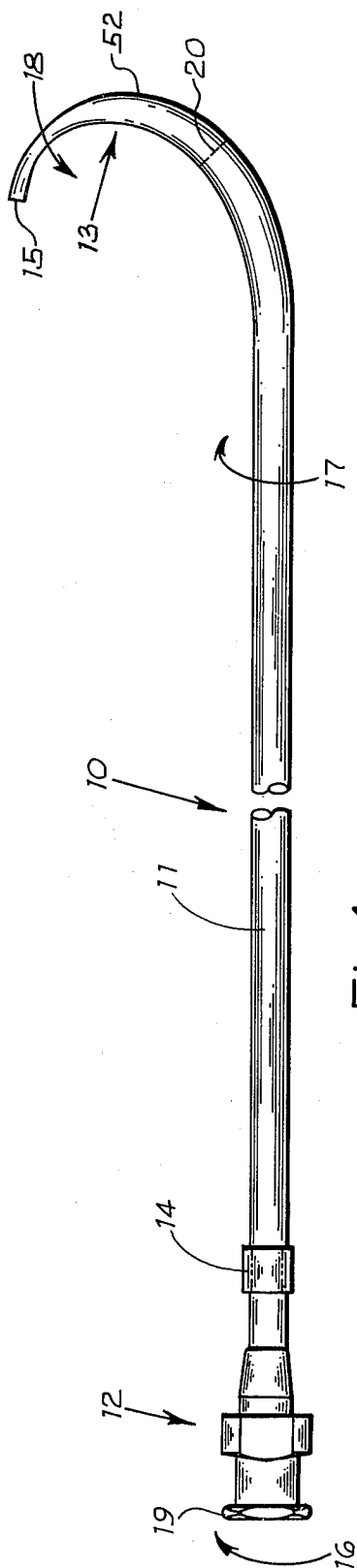


Fig. 1

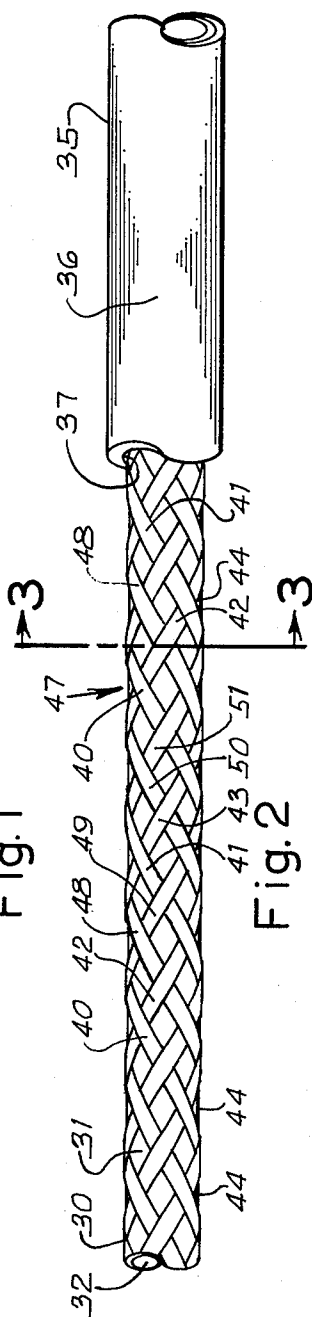


Fig. 2

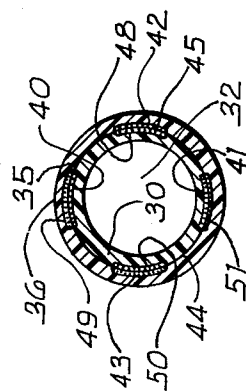


Fig. 3

INVENTOR.
WILLIAM A. COOK
BY
Woodard, Weikart, Emhardt & Naughton
ATTORNEYS

FIBER GLASS REINFORCED CATHETER

This is a continuation, of application Ser. No. 312,803 filed Dec. 7, 1972, which is a application Ser. No. 97,710 filed Dec. 14, 1970 both now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention is an improved catheter for intubation of body organs and vessels.

2. Description of the Prior Art

The manufacture and use of plastic and rubber tubes for intubation of blood vessels and organs are procedures well known to medical practitioners. The following U.S. Pats. disclose various types of catheters: U.S. Pat. Nos. 2,407,929 issued to Jackel; 2,472,485 issued to Krippendorff; 3,416,531 issued to Edwards; and 3,485,234 issued to Stevens. The prior catheters have reinforced bodies as well as bodies that are not reinforced. Typically, a wire braid is utilized to reinforce the body.

It is desirable to have a catheter which is sufficiently flexible so as to allow the tip to be guided in the various body passages. On the other hand, the catheter is rotated in the passage and as a result must possess torsional rigidity so as to prevent whipping of the catheter body. The conflicting requirements of flexibility and torsional rigidity have not been satisfied by the prior catheter tubes. The catheters utilizing wire for reinforcement have to some degree torsional rigidity; however, these catheters are excessively stiff and have a tendency for the body of the catheter to whiplash at each bend below the tip of the catheter. The reason for the whiplash reaction is that the wire prevents a true lamination of the inner core and outer tube of the catheter and, therefore, the torque caused by the rotation of the catheter and, therefore, the torque caused by the rotation of the catheter is delivered mostly by compression or tension of the wire. In addition, the force caused by the rotation of the catheter is delivered tangent to the horizontal axis. At each bend of the catheter body, the wire and plastic layers break away from each other and the tip tends to whiplash. In large vessels, the wire braid even allows the catheter body to coil.

The present invention provides a catheter body which is reinforced by the fiber glass bands. Each band has individual fiber glass strands which provide relatively less rigidity in the catheter body but at the same time imparts torsional rigidity without whiplash. This is true since the strands flatten against the inner core leaving less distance between the inner core and outer tube. Each band is in spaced relationship to another band thereby allowing the outer tube to be united to the inner core between bands. When the catheter is bent, the multi-strands of each band separate sufficiently so that a more flexible tube results.

SUMMARY OF THE INVENTION

This invention is a reinforced fiber glass catheter. An inner hollow and flexible plastic core has fiber glass bands spiraled around its outside surface. Each fiber glass band is spaced apart from its adjacent band and has individual fiber glass strands laid in a side by side position. An outer flexible plastic tube covers the inner core and fiber glass bands and is united to the inner core between the fiber glass bands. The bands are spiraled clockwise and counterclockwise around the inner

core and are mesh braided to approximately five picks per inch.

It is an object of the present invention to provide an improved catheter which is relatively flexible as compared to prior catheters but which has a high degree of torsional response without body whip.

It is an additional object of the present invention to provide an improved catheter having a fiber glass reinforced body.

Yet another object of the present invention is to provide an improved catheter having fiber glass bands spaced apart and spiraled on a plastic core with an outer plastic tube covering the bands.

In conjunction with the previous object, it is an object of the present invention to provide an improved catheter wherein the outer tube is united to the inner core between the fiber glass bands.

Related objects and advantages of the present invention will be apparent from the following description.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary side elevation of a catheter incorporating the present invention.

FIG. 2 is a fragmentary enlarged view of the catheter body of FIG. 1 with a portion of the outer tube removed therefrom to show the fiber glass bands encircling the inner core.

FIG. 3 is an enlarged sectional view of the catheter body of FIG. 2 taken along the line 3—3 and viewed in the direction of the arrows.

DESCRIPTION OF THE PREFERRED EMBODIMENT

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiment illustrated in the drawing and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

Referring now to FIG. 1, there is shown a catheter having a tubular body 11 with a coupling 12 fixedly attached at one end with the opposite end portion 13 of the body being curved ending at tip 15. Catheters are well known being utilized for the intubation of various body organs and vessels. These catheters have standard couplings 12 attached to their end for connecting on to some instrument or device which is used with the catheter. Coupling 12 has a hollow stem, not shown, extending a short distance into body 11 with clamp 14 securing the catheter body to the coupling stem. The coupling has a keyed flange 19. As the catheter is rotated in the direction of arrow 16, the catheter body will rotate in the direction of arrows 17 and 18.

The catheter typically has a flexible control means extending through the center of the catheter such as disclosed in U.S. Pat. No. 3,521,620 to William A. Cook. The means may be a single continuous flexible coil spring which has a bent distal end as disclosed in U.S. Pat. No. 3,547,103 also issued to William A. Cook. The flexible coil spring is guided by pulling together the coils of the spring. The catheter must be sufficiently flexible so as to allow the free end 15 to be guided through the various channels and passages of

the body vessel. In addition, the catheter body must be sufficiently rigid so as to avoid body whiplash as the catheter is rotated. Thus, the catheter body must be designed to meet the conflicting requirements of flexibility in bending and torsional rigidity. The catheter disclosed by this specification satisfies both requirements by having fiber glass bands spiraled between an inner core and an outer tube. The bands have individual flexible strands which move laterally a small amount during bending of the tube thereby improving the flexibility of the catheter.

FIG. 2 is an enlarged fragmentary view of a portion of the catheter of FIG. 1 with the outer tube 35 partially cut away to show the fiber glass bands positioned around the inner core. Core 30 has a hollow interior 32 and is made from a plastic material such as polyethylene. The outer tube 35 has an outer surface 36 and an inner surface 37 in abutting relationship with the outer surface 31 of core 30 between the fiber glass bands. Tube 35 is also made from a plastic material such as polyethylene. Fiber glass bands 40, 41, 42, 43, 48, 49, 50 and 51 are spiralingly wrapped around the length of core 30. FIG. 3 is an enlarged cross sectional view of the catheter body taken along the line 3—3 of FIG. 2 and viewed in the direction of the arrows showing the fitting relationship of the fiber glass bands 40 through 43 and 48 through 51 with respect to the inner core 30 and the outer tube 35. Each fiber glass band is composed of individual strands 45 of fiber glass each being laid in a side by side position. Bands 40, 41, 48 and 50 are spiraled around tube 30 in a clockwise direction as viewed in FIG. 3. Bands 42, 43, 49 and 51 are spiraled around tube 30 in a counterclockwise direction as viewed in FIG. 3. The bands cross one another forming a mesh braid. For example, band 40 passes over band 42 at location 47. FIG. 3 illustrates the crossing relationship of the bands. The mesh braid formed by the bands is approximately five picks per inch with eight to sixteen strands in each band. The resulting multi-filament bands fit flat against core 30 allowing inner surface 37 of tube 35 to contact outer surface 31 of core 30 in the gaps 44 formed between the bands.

The fiber glass bands extend from coupling 12 to an approximate area indicated by dashed line 20. The fiber glass bands do not extend past the location marked by line 20. A second tube 52 having the same outside diameter and approximately the same total wall thickness is bonded to the tubing having the fiber glass. This provides a more flexible and bendable end. The second unbraided tube 52 is pulled down by hand after attachment to the braided tubing. This pulling down or reduction can be accomplished since the fiber glass bands do not extend into the curved portion 13 beyond line 20 and since the stretching of tube 35 results in a smaller tube diameter.

The core 30 and the outer tube 35 are bonded together and the tube 52 is attached to them at the same time. To accomplish bonding and attachment, the sandwich including the core 30 and outer tube 35 with fiber glass therebetween is slipped into a straight constant diameter laboratory glass tubing and the second unbraided tube 52 is inserted into the other end of the glass tubing into abutment with the core 30 and outer tube 35. A straight constant diameter mandrel is then placed within the hollow interior of the catheter body (i.e. core 30 and tube 52) extending from the coupling end to end 15. The catheter within the glass tubing is then subjected to sufficient heat so as to cohesively unite the inner surface 37 of the outer tube to the outer surface 31 of core 30 in gaps 44 and so as to cohesively

unite the tube 52 to the core 30 and outer tube 35. The catheter is then cooled and withdrawn from the glass tubing and the mandrel is extracted from the catheter body. The end of the catheter is then pulled down as above described and the end portion 13 of the catheter heat set in the illustrated curved configuration.

Excellent results have been obtained by utilizing fiber glass strands having a thickness not greater than 0.0005 inch. It will be obvious from the above description that the present invention provides an improved catheter which is relatively flexible compared to prior catheters but which has a high degree of torsional response without body whip. In addition, it will be obvious that the improved catheter has a fiber glass reinforced body.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character it being understood that only the preferred embodiment has been shown and described and that all changes and modifications that come within the spirit of the invention are desired to be protected.

The invention claimed is:

1. An intravascular catheter comprising:
 - a. an inner hollow and flexible plastic core having a circular cross section, an outer surface and a first length;
 - b. an outer flexible plastic tube having an inner surface united to said outer surface of said core along said first length;
 - c. and fiber glass bands spaced apart and spiralled around said core between said core and said tube; some of said bands being spiralled clockwise and some of said bands being spiralled counterclockwise around said core, said bands each comprising individual multi-filament strands of fiber glass laid in a side-by-side position, said individual strands moving relative to one another during bending of the catheter allowing the cross section of the bands to change and thus facilitating flexibility of the catheter as well as maintaining good torsional rigidity, said outer surface of said inner core being cohesively united to said inner surface of said outer tube between said bands.
2. An intravascular catheter comprising:
 - a. an inner hollow and flexible plastic core having a circular cross section, an outer surface and a first length;
 - b. an outer flexible plastic tube having an inner surface united to said outer surface of said core along said first length;
 - c. fiber glass bands spaced apart and spiralled around said core between said core and said tube; some of said bands being spiralled clockwise and some of said bands being spiralled counterclockwise around said core, said bands each having individual multi-filament strands of fiber glass laid in a side-by-side position, said individual strands being capable of moving relative to one another during bending of the catheter allowing the cross section of the bands to change and thus facilitating flexibility of the catheter as well as maintaining good torsional rigidity, said outer surface of said inner core being cohesively united to said inner surface of said outer tube between said bands;
 - d. and a distal end portion connected to the core and the tube and formed of a flexible thermoplastic material.

* * * * *