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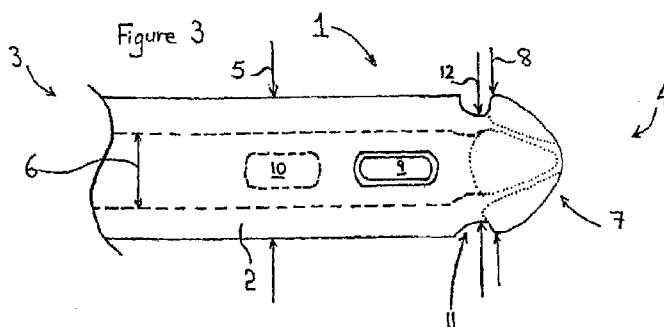
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**(54) Title:** CATHETER WITH FRICTION REDUCING SURFACE SHAPING



**(57) Abstract:** A catheter comprising a tube member having an open and a closed end (7) and either a head (8) at the tube member closed end, having a diameter greater than the tube outer diameter and /or a circumferential neck (12) adjacent the tube member closed end, the neck outer diameter being less than the tube outer diameter and greater than the inner diameter or greater than the tube outer diameter. In alternative embodiments, the closed tube end may have one or more dimples disposed on the tube surface, of a depth less than the tube wall thickness; one or more projections disposed on the tube surface; or more flute portions disposed on the tube surface, of a depth less than the tube wall thickness. One or more fluid apertures (9, 10) are disposed in the tube member, in or adjacent the closed end, neck, dimples, projections or fluted portions.

## CATHETER WITH FRICTION REDUCING SURFACE SHAPING

### Field of the Invention

The present invention relates to catheters.

- 5    The invention has been developed primarily with respect to disposable or single use urinary catheters and will be described hereinafter with reference to this application. However, it will be appreciated that the invention is not limited to this particular field of use.

### 10    Background Art

Urinary catheters have long been known. The urinary catheter is a tube which is inserted into the urethra of a person to drain urine. These are most typically used during surgical and clinical procedures, or by those suffering serious spinal injuries.

- 15    Typical urinary catheters comprise a first end configured for receiving urinary fluid when inserted into a urethra and a second end configured to be connected to a bag or other receptacle or container to collect or drain urine. The first end of the catheter can be cannular or syringe shaped where the catheter tube is simply sliced at an angle to its cross-section. Also well known are catheters having a first end which is closed and  
20    in which two or more urinary fluid apertures, or eyelets, are disposed in the tube adjacent the closed end. The apertures are typically longitudinally spaced along the catheter tube and are radially offset.

- Whilst catheters are often used in sterile or clinical environments, they can be used in  
25    sealed sterile field urinary catheter kits. One example of such a urinary catheter kit was invented by Dr. George O'Neil and is the subject of US Patent No. 4,652,259. These catheter kits are provided having a lubricated catheter tube disposed within the sterile urine collection bag and dispensable through an insertion tip or other opening for insertion into a urethra. Whilst catheter developments such as these employing an  
30    insertion tip have reduced the rate of infection in catheter use, conventional catheter tubes are widely used.

### Genesis of the Invention

It is the genesis of the present invention to provide a catheter having reduced resistance to insertion and/or removal, or to provide a useful alternative.

Summary of the Invention

- 5 According to a first aspect of the present invention there is provided a catheter comprising:

a tube member having an outer diameter and an inner diameter and extending between an open end and a closed end;

- 10 a catheter head disposed at said tube member closed end and having a diameter greater than said tube member outer diameter and less than three times said tube member outer diameter; and

one or more fluid apertures disposed in said tube member, in said catheter head, or in said closed end.

- 15 According to a second aspect of the invention there is provided a catheter comprising:

a tube member having an outer diameter and an inner diameter and extending between an open end and a closed end;

- 20 a catheter neck circumferentially disposed about said tube member adjacent said tube member closed end, said neck having an outer diameter less than said tube member outer diameter and greater than said tube member inner diameter; and

one or more fluid apertures disposed in said tube member, in said neck, or in or adjacent said closed end.

- 25 According to a third aspect of the invention there is provided a catheter comprising:

a tube member having an outer diameter and an inner diameter and extending between an open end and a closed end;

- 30 a catheter neck circumferentially disposed about said tube member adjacent said tube member closed end, said neck having an outer diameter greater than said tube member outer diameter and less than three times said tube member outer diameter; and

one or more fluid apertures disposed in said tube member, in said neck, or in or adjacent said closed end.

According to a fourth aspect of the invention there is provided a catheter comprising:

a tube member having an outer diameter and an inner diameter and extending between an open end and a closed end;

5 one or more catheter dimples disposed in said tube member, said dimples extending from said tube member outer diameter towards said tube inner diameter a predetermined depth being less than a distance between said tube inner and our diameters; and

10 one or more fluid apertures disposed in said tube member, in or adjacent said one or more dimples, or in or adjacent said tube member closed end.

According to a fifth aspect of the invention there is provided a catheter comprising:

15 a tube member having an outer diameter and an inner diameter and extending between an open end and a closed end;

one or more catheter projections disposed on said tube member outside diameter, said projections extending outwardly from said tube member outer diameter a predetermined distance; and

20 one or more fluid apertures disposed in said tube member, in or adjacent said one or more catheter projections, or in or adjacent said tube member closed end.

According to another aspect of the invention there is provided a catheter comprising:

25 a tube member having an outer diameter and an inner diameter and extending between an open end and a closed end;

one or more fluted portions disposed in said tube member outer diameter, said fluted portions extending a depth less than a distance between said tube member inner and outer diameters; and

30 one or more fluid apertures disposed in said tube member, in or adjacent said fluted portions, or in or adjacent said closed end.

It can therefore be seen that there is advantageously provided a catheter tube which has one or more neck portions which act to break the surface tension of fluid in the

urethra during insertion and/or removal. There is also advantageously provided a catheter having a catheter head with an outer diameter greater than the catheter tube which advantageously acts to reduce the resistance of the catheter during insertion and/or removal.

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Brief Description of the Drawings

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings.

Fig. 1 is a schematic cross-sectional side view of a catheter according to a first  
10 preferred embodiment;

Fig. 2 is a schematic cross-sectional side view of a catheter according to another preferred embodiment;

Fig. 3 is a schematic cross-sectional side view of a catheter according to another preferred embodiment;

15 Fig. 4 is a schematic cross-sectional side view of a catheter according to another preferred embodiment;

Fig. 5 is a schematic cross-sectional side view of a catheter according to another preferred embodiment;

20 Fig. 6 is a schematic cross-sectional side view of a catheter according to another preferred embodiment;

Fig. 7 is a schematic cross-sectional side view of a catheter according to another preferred embodiment;

Fig. 8 is a schematic cross-sectional side view of a catheter according to another preferred embodiment;

25 Fig. 9 is schematic a cross-sectional side view of a catheter according to another preferred embodiment; and

Fig. 10 is a schematic cross-sectional side view of a catheter according to another preferred embodiment;

30 Fig. 11 is a schematic cross-sectional side view of a catheter according to another preferred embodiment; and

Fig. 12 is a schematic cross-sectional side view of a catheter according to another preferred embodiment.

### Detailed Description

It will be appreciated that throughout the description of the preferred embodiments that like reference numerals have been used to denote like components.

- 5 Referring to Fig. 1, there is shown a schematic cross-sectional side view of a catheter 1 according to the first preferred embodiment. The catheter 1 is formed from a tube member 2 which extends between an open end 3 and a closed end 4.

- 10 The tube member 2 has an outer diameter 5 in the range of 2mm to 20mm. The tube member 2 has an inner diameter 6 of between 1mm and 15mm. In the embodiment shown, the catheter length extending between open end 3 and closed end 4 is between 200mm to 600mm.

- 15 The catheter 1 includes a catheter head 7 disposed at the closed end 4. The catheter head 7 has a diameter 8 corresponding to the maximum diameter of the catheter head 7. The catheter 8 has a diameter greater than the outer diameter 5 of the tube member 2 but not greater than three times the outer diameter 5 of the tube 2. In the preferred embodiment of Fig. 1, the outer diameter 8 of the catheter head 1 is about 1½ times the outer diameter 5 of the tube member 2.

- 20 In the preferred embodiment of Fig. 1, the catheter head 7 is a bulbous shape and the catheter head diameter 8 described above refers to the maximum diameter thereof. On a portion of the catheter head 7 distal the tube member closed end 4 where the catheter head diameter 8 decreases from a maximum down to the tube member outer diameter 5, there is disposed a fluid aperture 9. A second fluid aperture 10 is disposed  
25 longitudinally further along the catheter tube.

- A neck 11 is disposed at a base of the catheter head 7. The neck 11 has an outer diameter 12 which is less than the catheter head diameter 8 and the tube outer  
30 diameter 5.

In use, the closed end 4 of the catheter tube 2 is inserted into the urethra of a person. Once the catheter is inserted a predetermined distance, it remains for a predetermined

period of time and any urine released by the bladder is collected by the fluid apertures 9 and 10 and drained through the inner diameter 6 of the tube member 2 out the open end 3 into a collection reservoir (not illustrated).

- 5 It will be appreciated that upon insertion, the catheter head 7 having a diameter greater than the tube member outer diameter 5 has the advantageous effect of reducing the resistance, particularly to insertion, faced by the catheter 1. It will be appreciated, however, that any preferred shaped catheter head can be provided if it has a maximum diameter being greater than the outer diameter 5 of the tube member 2 but less than  
10 three times that diameter.

It will also be appreciated that the catheter 1 can be formed from any preferred material such as silicone and the closed end 4 is most preferably formed by radio frequency cutting and sealing.

- 15 Further, it will also be appreciated that the fluid apertures 9 and 10 can be disposed in the tube member 2, as shown in Fig. 1, or may be disposed in or adjacent the closed end 4 or the catheter head, or in or adjacent the catheter neck 11. The location of the fluid apertures 9 and 10 can be any preferred.

- 20 Turning to Fig. 2, there is shown a schematic cross-sectional side view of a catheter 1 according to another preferred embodiment. This embodiment is similar to that of Fig. 1 except that the neck 11 is removed and the catheter head 7 is disposed directly to the tube member 2. It will be appreciated that any preferred transition  
25 configuration can be provided at or intermediate the tube member 2 and the catheter head 7.

- Referring to Fig. 3, there is shown a schematic cross-sectional side view of a catheter 1 according to another preferred embodiment of the invention. The catheter of this  
30 embodiment includes a tube member 2 extending between an open end 3 and closed end 4. The tube has an outer diameter 5 and an inner diameter 6. The tube member 2 includes a catheter neck 11 circumferentially disposed in the tube member 2 adjacent the closed end 4. The neck 11 has an outer diameter 12 which is less than the outer

diameter 5 of the tube member 2 and greater than the inner diameter 6 of the tube member 2.

5 A catheter head 7 is formed intermediate the neck 11 and the closed end 4. In the embodiment shown, the head 7 has diameter (maximum diameter) 8 which is substantially the same diameter as the outer diameter 5 of the tube member 2.

10 In the preferred embodiment of the catheter 1 of Fig. 3, there is provided a pair of fluid apertures 9 and 10 configured to drain urinary fluid. The fluid aperture 9 closest the closed end 4 is disposed in the head 7 adjacent the neck 11. The second fluid aperture 10 is disposed longitudinally further down the tube member 2. However, it will be appreciated that the fluid apertures can be disposed in any preferred location in the tube member 2 intermediate the open end 3 and the closed end 4.

15 It can be seen that insertion of the catheter 1 into the urethra also advantageously reduces the resistance. This is due to the presence of the neck 11 disposed adjacent the closed end 4.

20 Fig. 4 is a schematic cross-sectional side view of a catheter 1 according to another preferred embodiment. This embodiment is similar to the catheter 1 of Fig. 3 where the fluid aperture 10 has been removed and fluid aperture 9 is disposed in the closed end 4. It will be appreciated that the fluid aperture can be disposed in any preferred location in the tube member 2, in or adjacent the catheter head 7 or in the closed end 4. Further, it will be appreciated that any number of fluid apertures can be used.

25 Referring now to Fig. 5, there is shown a schematic cross-sectional side view of a catheter 1 according to another preferred embodiment. In this embodiment, the catheter 1 includes a catheter tube 2 extending between an open end 3 and a closed end 4. As with the other embodiments of the invention above, the catheter tube 2 includes an outer diameter 5 and an inner diameter 6.

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The catheter 1 includes a plurality of necks 11 having an outer diameter less than the outer diameter 5 of the tube member 2 but greater than the inner diameter 6 of the

tube member 2. The necks 11 are circumferentially disposed about the tube member 2 and are spaced apart from each other longitudinally along the tube member 2 from adjacent the closed end 4. Although the fluid aperture 9 in the embodiment of Fig. 5 as shown intermediate a first neck 11 and the closed end 4, it will be appreciated that  
5 it can be disposed in any neck 11 or at another position along the length of the tube member 2 intermediate the open end 3 and closed end 4.

Although not illustrated, it will be appreciated that any one or more of the necks 11 shown in Fig. 5 can be discontinuous in that they do not extend continuously or  
10 uniformly all the way around the tube member 2. Further, it will be appreciated one or more of the necks 11 can be formed intermittently around the tube member 2 whereby the neck 11 includes a plurality of neck components interspersed with the tube member 2 being portions without a neck. That is, the neck 11 can be 'dotted' about the tube member 2.

15 Turning to Fig. 6, there is shown a schematic cross-sectional side view of a catheter according to another preferred embodiment. In this embodiment, the catheter 1 includes a tube member 2 extending between an open end 3 and a closed end 4. The tube member 2 includes an outer diameter 5 and an inner diameter 6. The catheter 1  
20 includes a single neck 11 having an outer diameter less than the tube member outer diameter 5 and greater than the tube member inner diameter 6.

The neck 11 of the catheter 1 of this embodiment is helically disposed about the tube member 2 and extends along a predetermined length along the tube member 2. The  
25 helical neck 11 extends from or adjacent from the head 8 along the tube member 2.

In an alternative embodiment (not illustrated) to that shown in Fig. 6, it will be appreciated that the neck 11 of this embodiment can be discontinuous similarly to that described with reference to the embodiment of Fig. 5. The helical neck 11 can be  
30 interspersed with the tube member 2 being portions in place of portions of the neck 11.

Referring to Fig. 7, there is shown a schematic cross-sectional side view of a catheter 1 according to another preferred embodiment. In this embodiment, the tube member 2 includes a neck 11 disposed adjacent the closed end 4. Intermediate the neck 11 and the closed end 4 there is disposed a catheter head 7 having a maximum diameter being larger than the outer diameter 5 of the tube member 2 but less than three times the outer diameter 5. In this embodiment, it will be appreciated that the catheter head 7 and the neck 11 disposed adjacent the head 7 at end distal the closed end advantageously reduces the resistance when inserting and removing the catheter from a urethra.

In the embodiment of Fig. 7, the fluid apertures 9 and 10 are disposed in the tube 2 at the catheter head 7 at a point where the catheter head 7 is distal from the closed end 4 and is adjacent the neck 11. In this way, the apertures 9 and 10 are disposed in the catheter head where it has a diameter less than its maximum diameter 8 so as to partially or totally face away from the closed end 4. This advantageously reduces any risk of tearing of the urethra by the tube member 2 about the aperture circumference in addition to reducing the resistance to insertion of the catheter.

It will be appreciated that the tube member 2 of the catheter 1 can have an outer diameter 5 which is uniform or which is non-constant (not illustrated). Likewise, it will be appreciated that the inner diameter 6 of the tube member 2 can also be uniform or it may be non-constant and vary (not illustrated). Furthermore, it will be appreciated that the catheter 1 of any one of the preferred embodiments can be used in a sterile field urinary catheter kit.

It will also be appreciated that in the embodiment of Fig. 1, for example, the head diameter 8 being wider than the outer diameter 5 of the tube member 2 can be used to break or rupture or a seal formed by a silicone tip at the exit to sterile field urinary catheter reservoir. Yet further, it will be appreciated that any preferred lubricants can be used with the catheter 1 of the preferred embodiments including, but not limited to, gels and hydrophilic salts.

Referring to Fig. 8, there is shown a schematic cross-sectional side view of another preferred embodiment of a catheter 1. In this embodiment, the catheter 1 includes a tube member 2 which extends between an open end 3 and a closed end 4.

- 5 The tube member 2 has an outer diameter 5 in the range of 2mm to 20mm. As with the preferred embodiment described above, the tube member 2 has an inner diameter 6 of between 1mm and 15mm. The catheter 1 extends a length of between 200mm to 600mm between the open end 3 and closed end 4.
- 10 The tube member 2 includes a catheter neck 11 circumferentially disposed about the tube member 2 adjacent the closed end 4. The catheter neck 11 has an outer diameter which is greater than the outer diameter of the tube member 2 and, as shown in the preferred embodiment, is about 1.25 times the tube member outer diameter 6. The catheter 1 further includes a pair of fluid apertures 9 and 10 configured to drain
- 15 urinary fluid and the apertures 9 and 10 can be disposed at any preferred location along the length of the tube member 2.

- The catheter neck 11 extends along the tube member 2 a length of between 1mm and 20mm. Upon insertion of the catheter 1 into a urethra this embodiment has the
- 20 advantageous effect of reducing the resistance faced by the catheter 1. It will be appreciated, however, that any preferred shaped catheter neck 11 can be provided if it has a maximum diameter being greater than the outer diameter 5 of the tube member 2 but less than three times that diameter.

- 25 It will be appreciated that in other embodiments of the invention of Fig. 8, not illustrated, the catheter 1 can include a plurality of catheter necks longitudinally spaced apart along the tube member 2. Furthermore, it will be appreciated that the inner 6 and/or outer 5 diameters of the tube member 2 can be constant or can vary as desired.

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Referring to Fig. 9, there is shown a schematic cross-sectional side view of a catheter 1 according to another preferred embodiment. The catheter 1 includes a tube member 2 having an outer diameter 5 and an inner diameter 6. The catheter 1 extends between

an open end 4 and a closed end 3. A plurality of catheter dimples 20 are disposed in the tube member 2. The dimples 20 extend from the tube member outer diameter 5 towards the tube inner diameter 6 a predetermined depth being less than a distance between said tube inner and outer diameters.

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The dimples 20 are disposed in the tube member 2 from adjacent the closed end 4 and the tube member 2 is dimpled therefrom along a predetermined length towards the open end 3. The catheter 1 includes two fluid apertures 9 and 10 disposed in said tube member but it will be appreciated they can be disposed in or adjacent said one or more dimples, or in or adjacent said tube member closed end. The presence of the dimples advantageously acts to minimise the resistance to insertion and removal of the catheter 1 from a urethra.

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In another preferred embodiment (not illustrated), the dimples 20 can be substituted with projections extending from the tube member 2 a distance not greater than twice the outer diameter 5. This advantageously also acts to minimise the resistance to insertion and removal of the catheter 1 from a urethra.

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Referring to Fig. 10, there is shown a schematic cross-sectional side view of a catheter 1 according to another preferred embodiment. In this embodiment, the catheter 1 includes a tube member 2 having an outer diameter 5 and an inner diameter 6. The tube member 2 extends between an open end 3 and a closed end 4. A plurality of fluted portions 21 are disposed in the tube member outer diameter 5. The fluted portions 21 extend a depth less than a distance between the tube member inner 6 and outer 7 diameters.

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The catheter 1 includes a plurality of fluid apertures 9 and 10 disposed in the tube member 2. However, it will be appreciated the fluid apertures can be disposed in any desired location in order to drain urine such as in or adjacent the fluted portions, or in or adjacent the closed end 4. It can be seen the fluted portions 21 advantageously act to minimise the resistance to insertion and removal of the catheter 1 from a urethra.

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Turning to Fig. 11, there is shown a schematic cross-sectional side view of a catheter 1 according to another preferred embodiment. The catheter 1 of this embodiment includes a tube member 2 extending between an open end 3 and closed end 4. The tube has an outer diameter 5 and an inner diameter 6.

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The tube member 2 includes a catheter neck 11 circumferentially disposed about the tube member 2 adjacent the closed end 4. The neck 11 has an outer diameter 12 which is about 1.25 times greater than the outer diameter 5 of the tube member 2. Preferably, the outer diameter 12 of the neck 11 is not greater than three times the

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A catheter head 7 is formed intermediate the neck 11 and the closed end 4. In the embodiment shown, the head 7 has diameter (maximum diameter) 8 which is substantially the same or less in diameter than the outer diameter 5 of the tube member 2.

15

There is also provided a pair of fluid apertures 9 and 10 configured to drain urinary fluid. The fluid apertures 9 and 10 are spaced apart along the tube 2 about the same distance from the neck 11 and they are circumferentially offset. However, it will be appreciated that the fluid apertures can be disposed in any preferred location in the tube member 2 intermediate the open end 3 and the closed end 4.

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It can be seen that insertion of the catheter 1 into the urethra also advantageously reduces the resistance. This is due to the presence of the neck 11 disposed adjacent the closed end 4. Although not illustrated, it will be appreciated that a plurality of longitudinally spaced apart necks 11 can be disposed on the tube member 2. Further, the necks 11 can be discontinuous or non-uniform in maximum diameter 12.

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Referring to Fig. 12, there is shown a schematic cross-sectional side view of a catheter 1 according to another preferred embodiment. The catheter 1 includes a tube member 2 having an outer diameter 5 and an inner diameter 6. The tube member 2 extends between an open end 3 and a closed end 4. A plurality of catheter projections 22 are disposed on the tube member outside diameter 5. The projections 22 extending

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outwardly from said tube member outer diameter 5 a predetermined distance. The catheter 1 further includes a pair of fluid apertures 9 and 10 disposed in the tube member 2. It will be appreciated that the fluid apertures 9 and 10 can be disposed in any preferred location such as in or adjacent the one or more catheter projections 22,  
5 or in or adjacent the tube member closed end 4.

The projections 22 are spaced apart on the tube member outer diameter 5 and extend a predetermined length along said tube member from adjacent the closed end 4. The projections 22 extend outwardly a distance less than two times the tube member outer  
10 diameter 5.

It can be seen the projections 22 advantageously act to minimise the resistance to insertion and removal of the catheter 1 from a urethra. It will be appreciated that the projections 22 can longitudinally extending along the tube member 2 any desired  
15 length and can be discontinuous or 'dotted' therealong. Further, ribbed projections or the like may also be used.

Yet further, it will be appreciated that the neck 11 can include one or more portions which have a diameter equal to the outer diameter 6 of the tube member 2. In this  
20 way, a circumferentially discontinuous or non-uniform neck 11 is formed. Similarly in the case of the preferred embodiments described above, the head 7 or neck 11 can include one or more portions having an outer diameter that is equal to the outer diameter 5 of the tube member 2. For example, the head 7 or neck 11 can include one or more longitudinally extending portions having a diameter substantially equal to the  
25 tube member 2 outer diameter 6.

The foregoing describes only preferred embodiments of the present invention and modifications, obvious to those skilled in the art, can be made thereto without departing from the scope of the present invention.

30 The term "comprising" (and its grammatical variations) as used herein is used in the inclusive sense of "including" or "having" and not in the exclusive sense of "consisting only of".

CLAIMS

1. A catheter comprising:
  - a tube member having an outer diameter and an inner diameter and extending between an open end and a closed end;
  - a catheter head disposed at said tube member closed end and having a diameter greater than said tube member outer diameter and less than three times said tube member outer diameter; and
  - one or more fluid apertures disposed in said tube member, in said catheter head, or in said closed end.
2. A catheter according to claim 1 wherein said catheter head diameter is twice said tube member outer diameter.
3. A catheter according to claim 1 wherein said catheter head is bulbous.
4. A catheter according to claim 1 comprising a neck portion disposed at a base of said catheter head.
5. A catheter according to claim 4 wherein said neck diameter is less than said tube member outer diameter.
6. A catheter according to claim 4 wherein said neck outer diameter is greater than one-third of said tube member outer diameter and less than said tube member outer diameter, or is greater than said tube member inner diameter and less than said tube member outer diameter.
7. A catheter according to claim 1 wherein said tube member outer diameter and/or said tube member inner diameter are non constant.
8. A catheter according to claim 1 wherein said tube member extends between 200mm to 600mm in length between said open and closed ends of said tube member, said tube member inner diameter between 2mm to 10mm, and said tube member outer diameter between 3mm to 20mm.
9. A catheter comprising:
  - a tube member having an outer diameter and an inner diameter and extending between an open end and a closed end;
  - a catheter neck circumferentially disposed about said tube member adjacent said tube member closed end, said neck having an outer diameter less than said tube member outer diameter and greater than said tube member inner diameter; and

- one or more fluid apertures disposed in said tube member, in said neck, or in or adjacent said closed end.
10. A catheter according to claim 9 comprising a catheter head formed intermediate said neck and said tube member closed end, said head outer diameter being greater than said tube member outer diameter.
  11. A catheter according to claim 9 wherein an outer diameter of said neck is less than said tube member outer diameter and greater than one-third of said tube member outer diameter.
  12. A catheter according to claim 10 wherein part or all of said one or more fluid apertures is disposed on said catheter head adjacent said neck portion where said catheter head has an outer diameter less than a maximum catheter head outer diameter.
  13. A catheter according to claim 9 including a plurality of catheter necks disposed in said tube member longitudinally spaced apart along said tube member from said closed end.
  14. A catheter according to claim 9 wherein said neck is helically disposed about said tube member and extends a predetermined distance therealong.
  15. A catheter according to claim 9 wherein said neck is discontinuous or intermittently formed.
  16. A catheter according to claim 9 wherein said tube member extends between 200mm to 600mm in length between said open and closed ends of said tube member, said tube member inner diameter is between 2mm to 10mm, and said tube member outer diameter is between 3mm to 20mm.
  17. A catheter comprising:
    - a tube member having an outer diameter and an inner diameter and extending between an open end and a closed end;
    - a catheter neck circumferentially disposed about said tube member adjacent said tube member closed end, said neck having an outer diameter greater than said tube member outer diameter and less than three times said tube member outer diameter; and
    - one or more fluid apertures disposed in said tube member, in said neck, or in or adjacent said closed end.

18. A catheter according to claim 17 wherein said neck outer diameter is between 1.25 to 1.5 times said tube member outer diameter.
19. A catheter according to claim 17 wherein said neck extends along said tube member a length of between 1 mm and 20mm.
20. A catheter according to claim 17 comprising a plurality of catheter necks longitudinally spaced apart along said tube member.
21. A catheter according to claim 17 wherein said tube member inner diameter and/or outer diameter is constant.
22. A catheter according to claim 17 wherein said tube member extends between 200mm to 600mm in length between said open and closed ends of said tube member, said tube member inner diameter between 2mm to 10mm, and said tube member outer diameter between 3mm and 20mm.
23. A catheter according to claim 17 wherein said neck is helically disposed about said tube member and extends a predetermined distance therealong.
24. A catheter according to claim 17 wherein said neck is discontinuous or intermittently formed.
25. A catheter comprising:
  - a tube member having an outer diameter and an inner diameter and extending between an open end and a closed end;
  - one or more catheter dimples disposed in said tube member, said dimples extending from said tube member outer diameter towards said tube inner diameter a predetermined depth being less than a distance between said tube inner and outer diameters; and
  - one or more fluid apertures disposed in said tube member, in or adjacent said one or more dimples, or in or adjacent said tube member closed end.
26. A catheter comprising:
  - a tube member having an outer diameter and an inner diameter and extending between an open end and a closed end;
  - one or more catheter projections disposed on said tube member outside diameter, said projections extending outwardly from said tube member outer diameter a predetermined distance; and

one or more fluid apertures disposed in said tube member, in or adjacent said one or more catheter projections, or in or adjacent said tube member closed end.

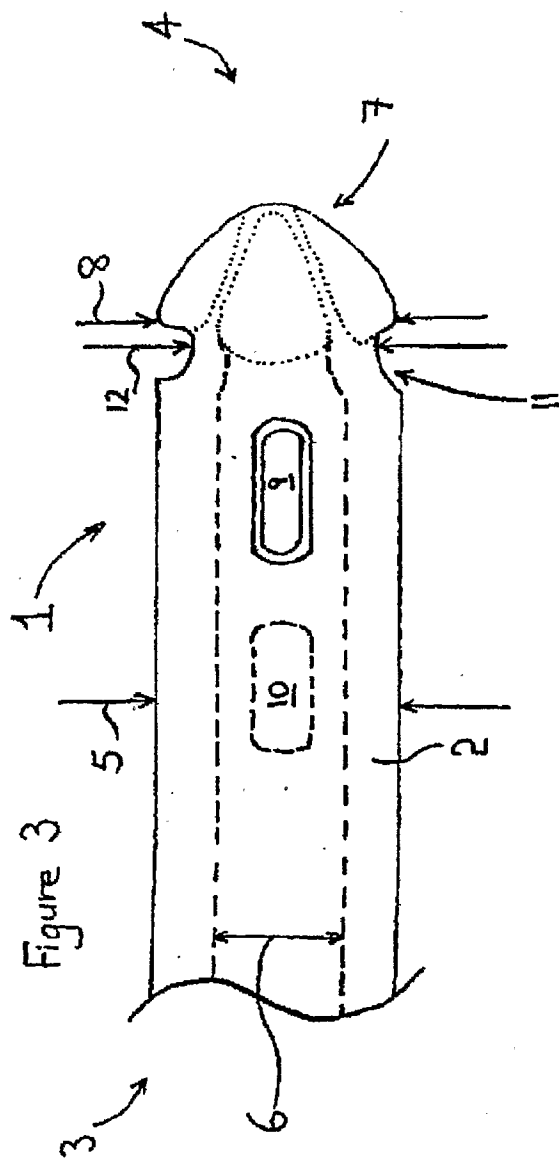
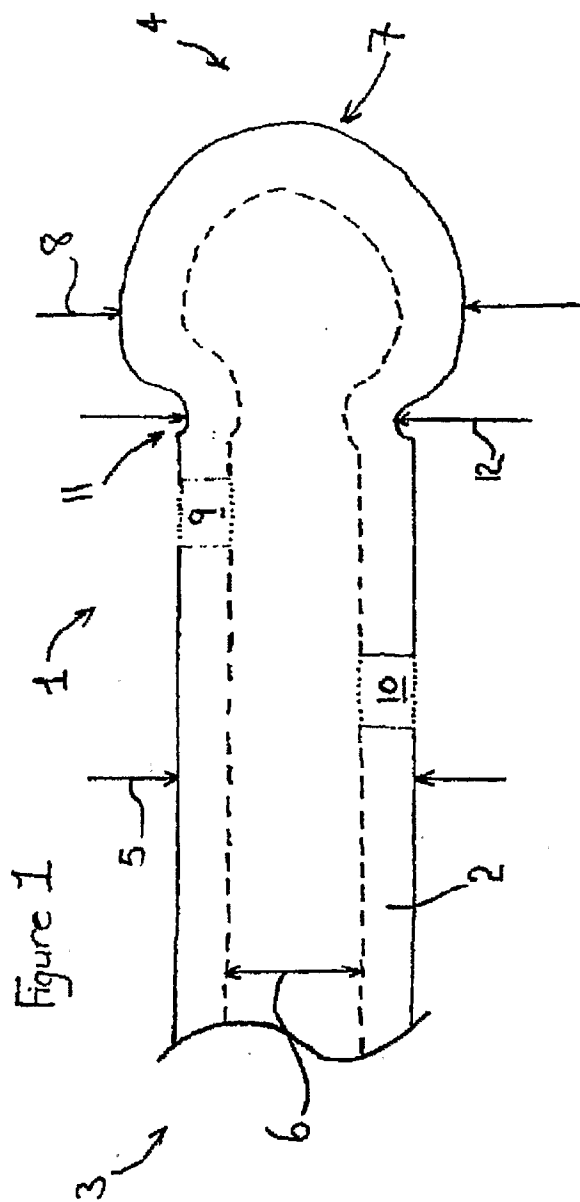
27. A catheter according to claim 32 comprising a plurality of substantially parallel projections spaced apart about said tube member outer diameter, said catheter projections extending a predetermined length along said tube member and extending outwardly a distance less than two times said tube member outer diameter.

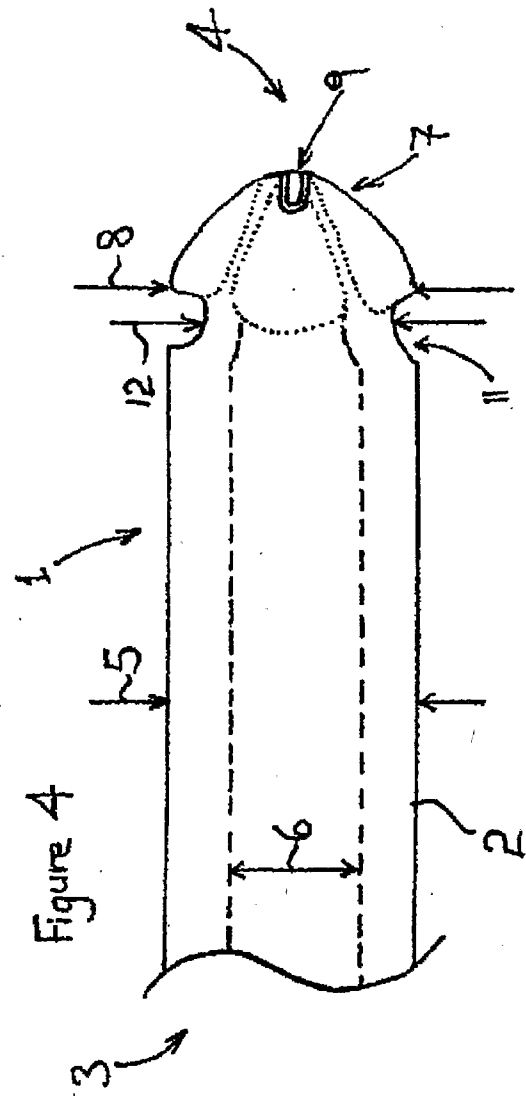
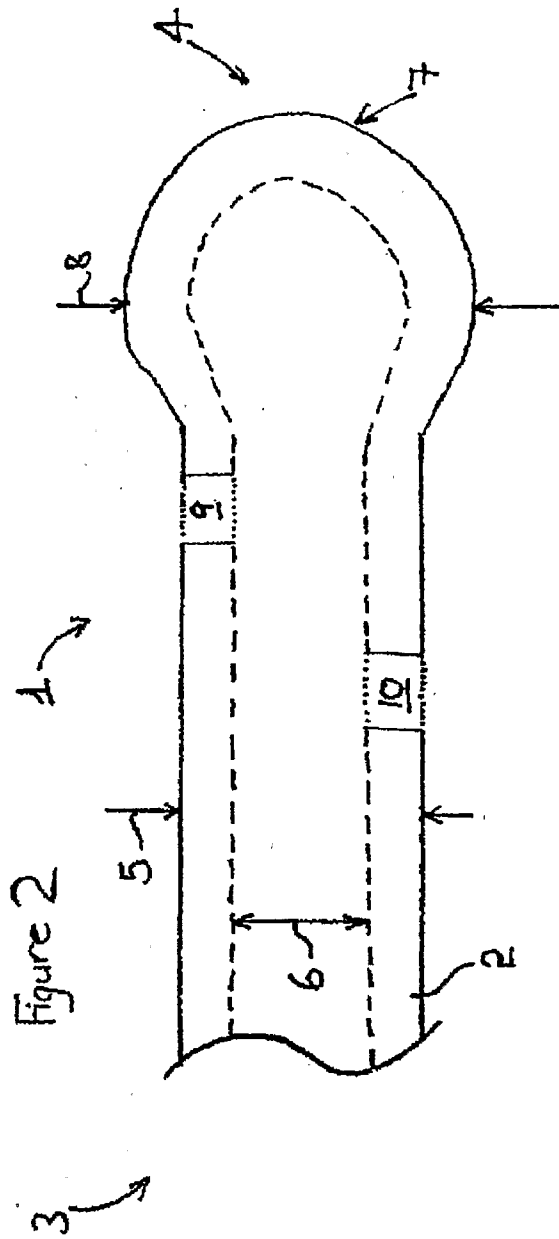
28. A catheter comprising:

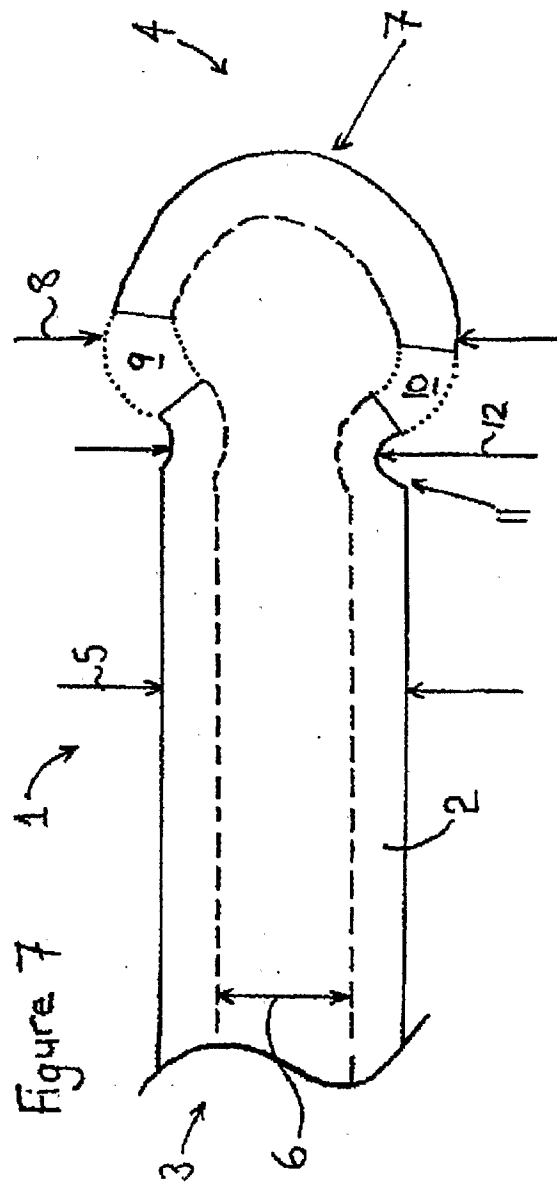
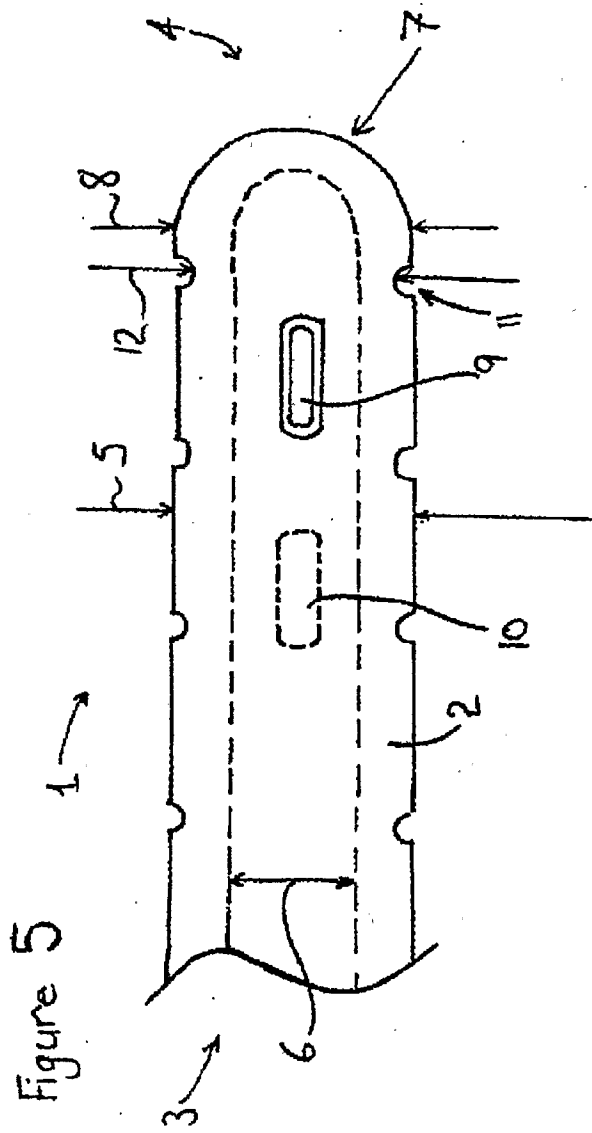
a tube member having an outer diameter and an inner diameter and extending between an open end and a closed end;

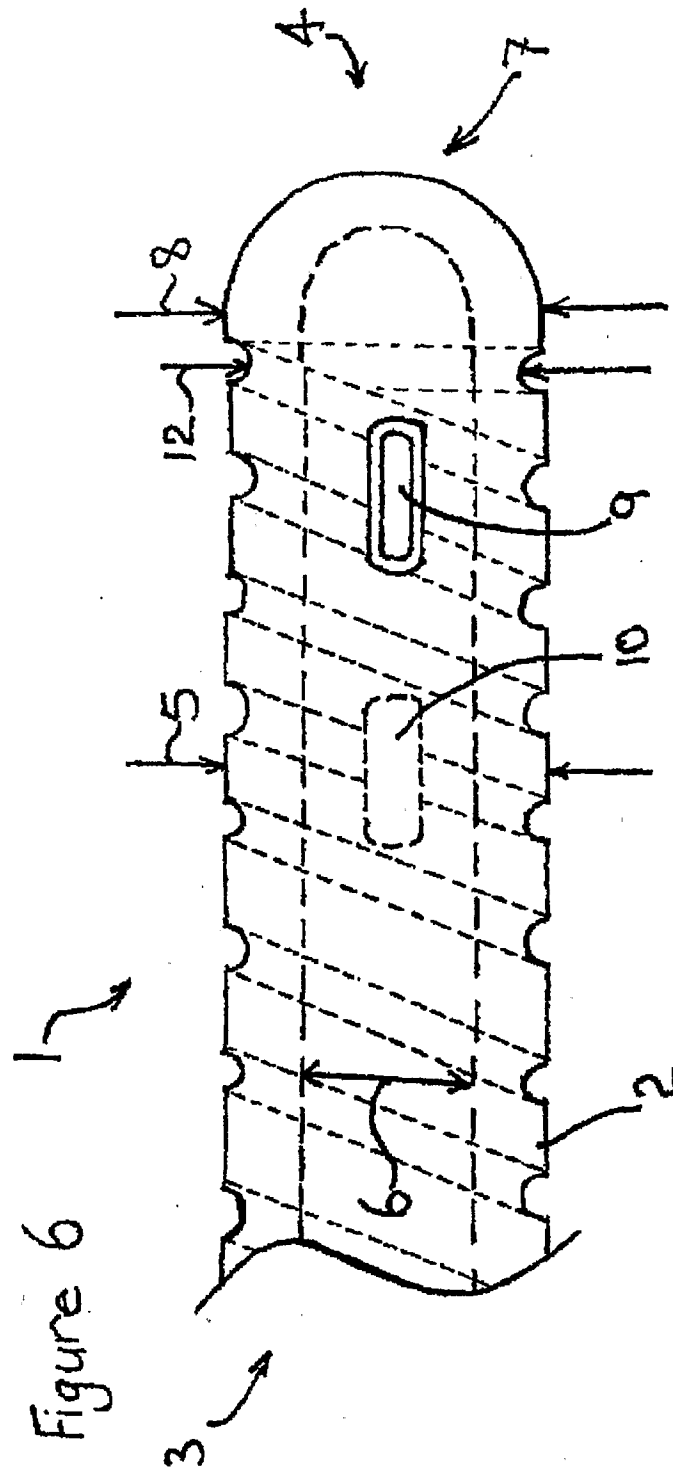
one or more fluted portions disposed in said tube member outer diameter, said fluted portions extending a depth less than a distance between said tube member inner and outer diameters; and

one or more fluid apertures disposed in said tube member, in or adjacent said fluted portions, or in or adjacent said closed end.









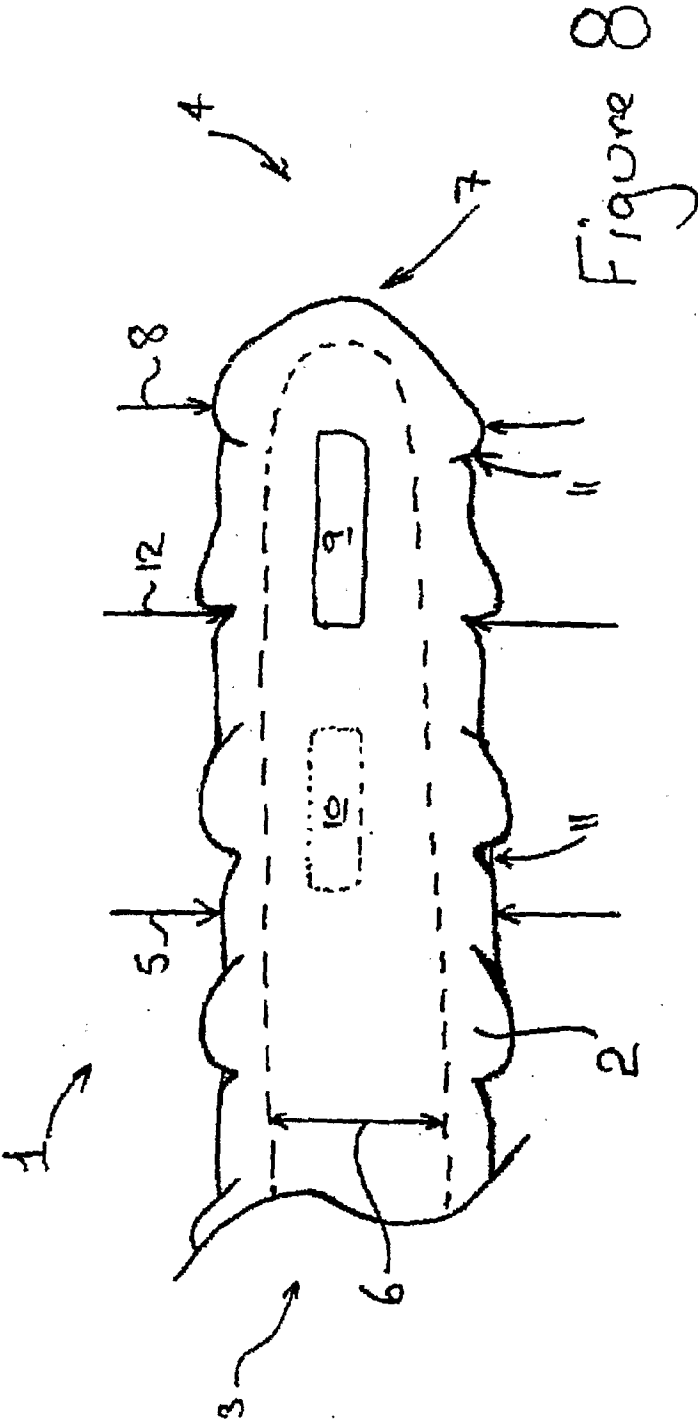




Figure 10

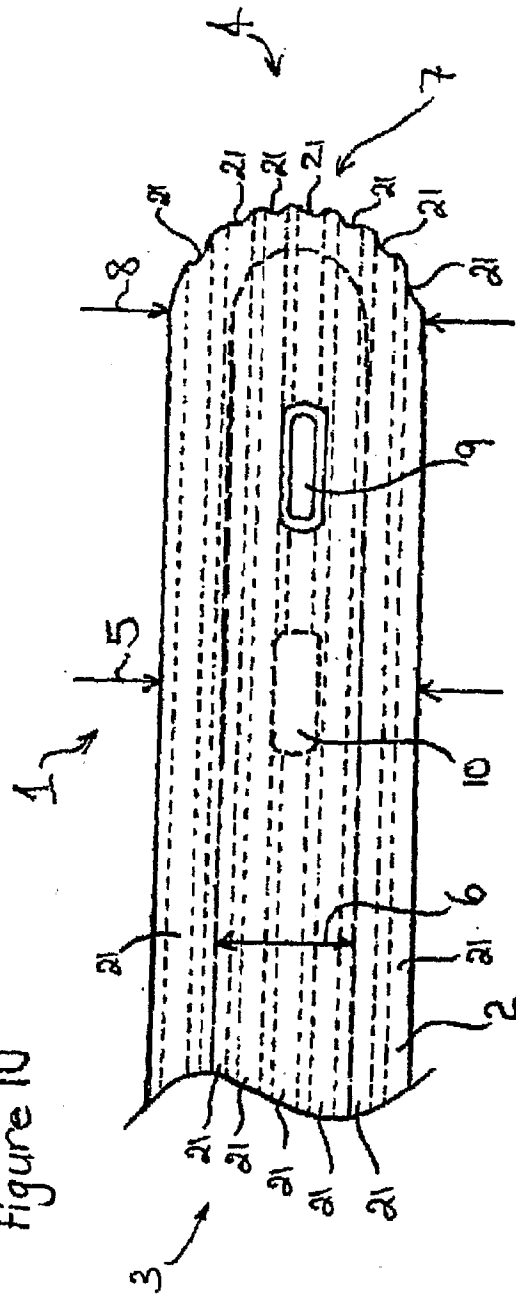
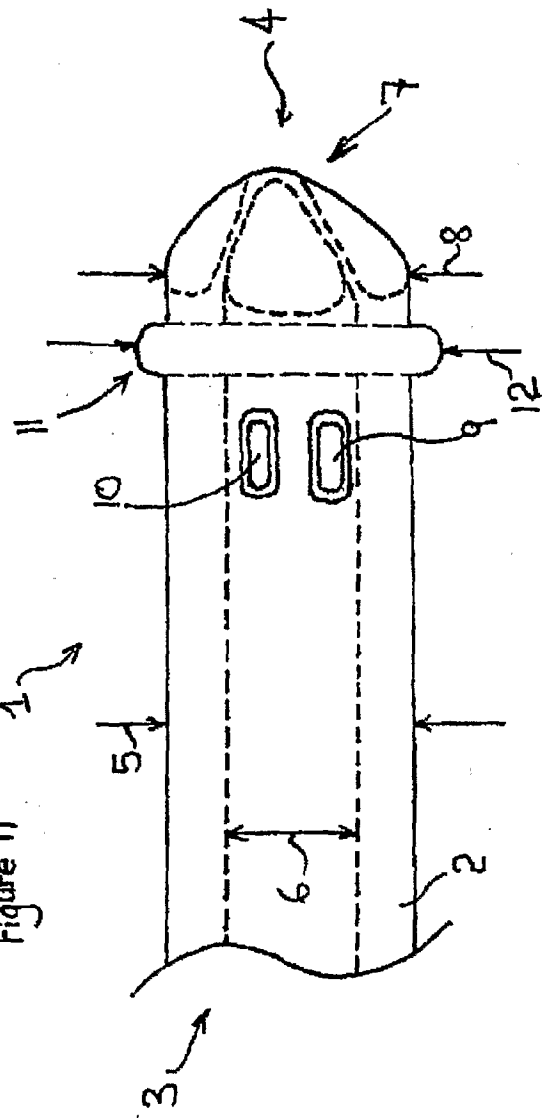
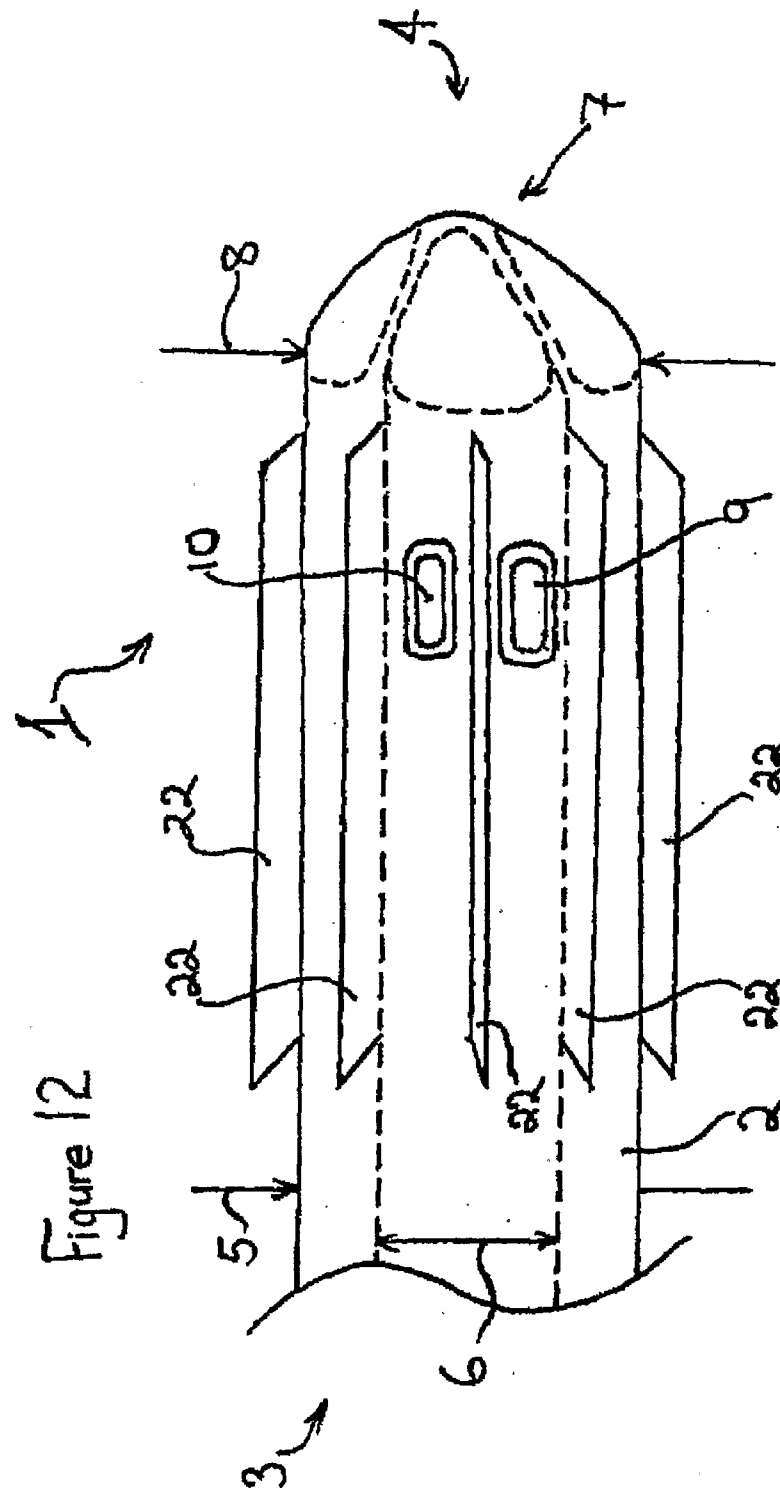


Figure 11





# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/AU2009/000246

## A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

A61M 25/00 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
EPOQUE (EPODOC and WPI), EC A61M25 or IPC A61M25, Keywords: bulbous, expanded, project, enlargement or similar

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0384476 B1 (LIEBENZELLER VERPACKUNG) 6 October 1993 Figures 2, 5-7	9, 26
X	US 5989230 A (FRASSICA) 23 November 1999 Column 15 and Figures 3-4, 7, 14-15, 24, 31A and 33	1, 3, 4, 7, 8, 17, 19, 21-24, 26, 28
Y		4-6, 15
X	WO 2002/011810 A1 (RANIER LTD) 14 February 2002 Page 5-6, claim 16 and Figures 1 and 3	1-4, 7, 8
Y		4-6



Further documents are listed in the continuation of Box C



See patent family annex

* Special categories of cited documents:	
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search  
26 May 2009

Date of mailing of the international search report

02 JUN 2009

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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2009/000246

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4571241 A (CHRISTOPHER) 18 February 1986 Figure 3	17, 19, 20, 22
X Y	EP 1149604 A1 (THIEL) 31 October 2001 Paragraphs 0008, 0011 and Figures 1-5	1, 3, 4 4-6
X	WO 2001/093935 A1 (BTG INT. LTD.) 13 December 2001 Pages 11 and 12 and Figures 1-5	9-11, 17-19, 22, 26
Y	Pages 11-12 and Figure 2	4-6
X	US 4249536 A (VEGA) 10 February 1981 Column 5 lines 7-28, claims 3 and 6 and Figures 1-2	9, 13, 14, 26, 28
X	EP 1707234 A1 (CORDIS NEUROVASCULAR INC) 04 October 2006 All figures	25, 26
X	US 4391276 A (LAZARUS ET AL) 05 July 1983 Column 4 lines 7-10 and 18-20, claim 1 and Figures 1-5	17-22, 24, 26
X	EP 0185865 A1 (INTERMEDICAT GMBH) 02 July 1986 Figure 1	17, 19-22, 24, 26
X	WO 2001/037923 A1 (RADIUS INTERNAT LTD PARTNERSHIP) 31 May 2001 Page 16 lines 7-8 and Figure 19	26
X Y	WO 2000/041742 A1 (BARTOLOME) 20 July 2000 Page 3 lines 10-15 and Figures 1 and 3	9, 11, 13-14, 16, 28 15

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2009/000246

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: **12, 27**  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:  
  
See Supplemental Box
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2009/000246

## Supplemental Box

(To be used when the space in any of Boxes I to IV is not sufficient)

### Continuation of Box II

Claim 12 is not fully enabled across its full scope by the description as the phrase "a maximum catheter head outer diameter" is not limiting. This claim cannot be searched, and is therefore excluded from further consideration.

Claim 27 asserts dependency from a non-existent claim. The intended claim from which claim 27 depends cannot be determined, hence claim 27 has not been searched.

### Continuation of Box II

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are different inventions as follows:

- Claims 1-8, 17-24 and 26 define a catheter with surface projections of greater diameter than the catheter outer wall diameter or extending outwardly from the catheter outer diameter. It is considered that surface projections of greater diameter than the catheter outer wall comprises a first special technical feature.
- Claims 9-16, 25 and 28 define a catheter with surface indentations less than the distance between the catheter outer and inner diameters. It is considered that surface projections of lesser diameter than the catheter outer wall comprises a second special technical feature.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

Each of the abovementioned groups of claims has a different distinguishing feature and they do not share any feature which could satisfy the requirement for being a special technical feature. Because there is no common special technical feature it follows that there is no technical relationship between the identified inventions. Therefore the claims do not satisfy the requirement of unity of invention *a priori*.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2009/000246

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
EP	0384476	DE	3905552		
US	5989230	AU	77201/00	CA	2609048
		EP	1885410	US	6379334
		US	2002045855	US	2005251108
		US	2006206002	US	2007005041
		WO	0123027	WO	2006093976
		WO	2008144033	US	2006125187
WO	0211810	AU	75728/01	EP	1305075
		ZA	200300901	US	2004049170
US	4571241	US	4710169		
EP	1149604	DE	20007733U		
WO	0193935	AU	60477/01	CA	2408948
		US	6852098	US	2003135200
US	4249536	NONE			
EP	1707234	CA	2541187	JP	2006280941
US	4391276	NONE		US	2006229574
EP	0185865	DE	3446033		
WO	0137923	AU	20454/01	EP	1231979
		EP	1407798	EP	1357960
		US	6540714	US	6461321
		US	2001018576	US	6702776
		WO	02062407	US	2002026156
				US	2003032918
WO	0041742	AU	30527/00	EP	1144020
		FR	2788223	FR	2788222
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.					
END OF ANNEX					