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(54) **CLOSURE DEVICE WITH TEXTURED SURFACE**

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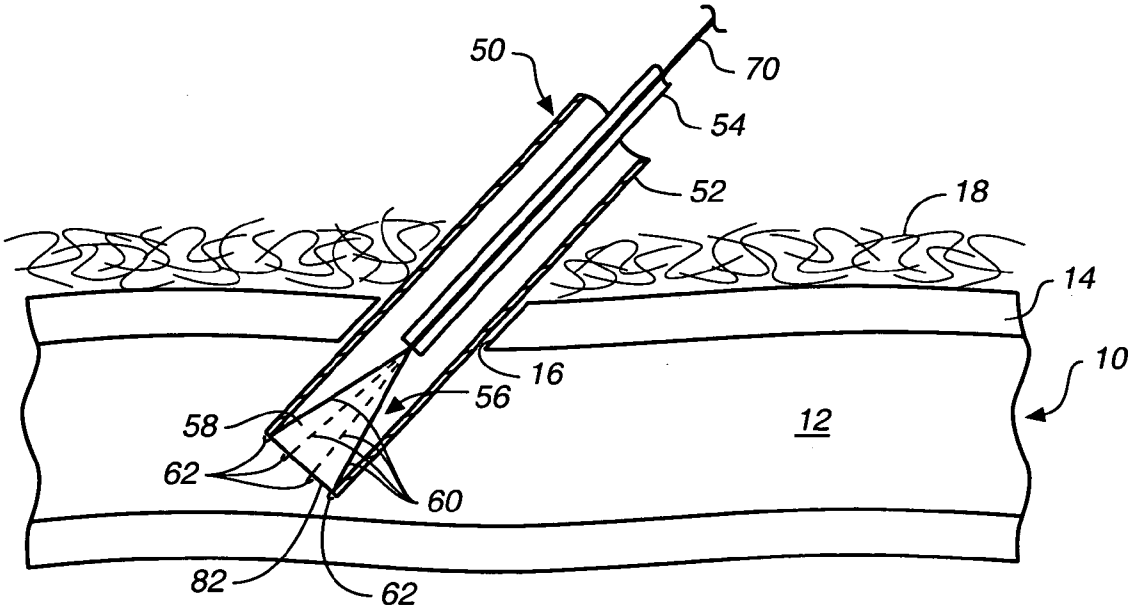
(57) **ABSTRACT**

A closure device closes an opening in a body cavity. The closure device includes a closure member that has an external, tissue-engaging surface formed with tissue engaging surface irregularities. An elongate member is disconnectably connected to the closure member.



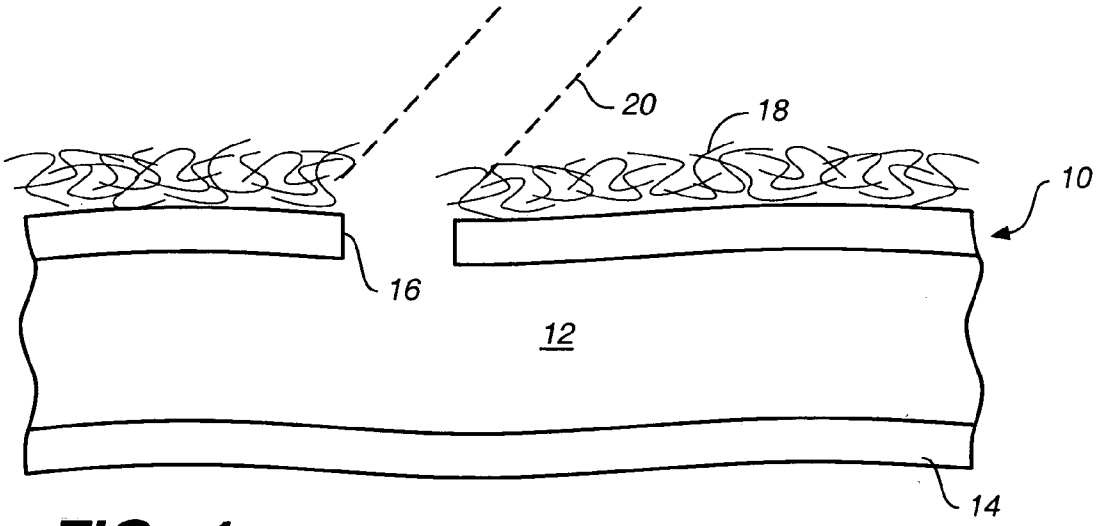


FIG._1

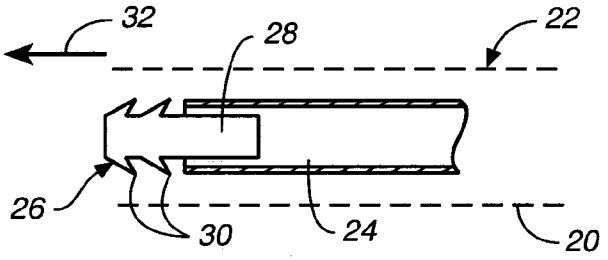


FIG._1A

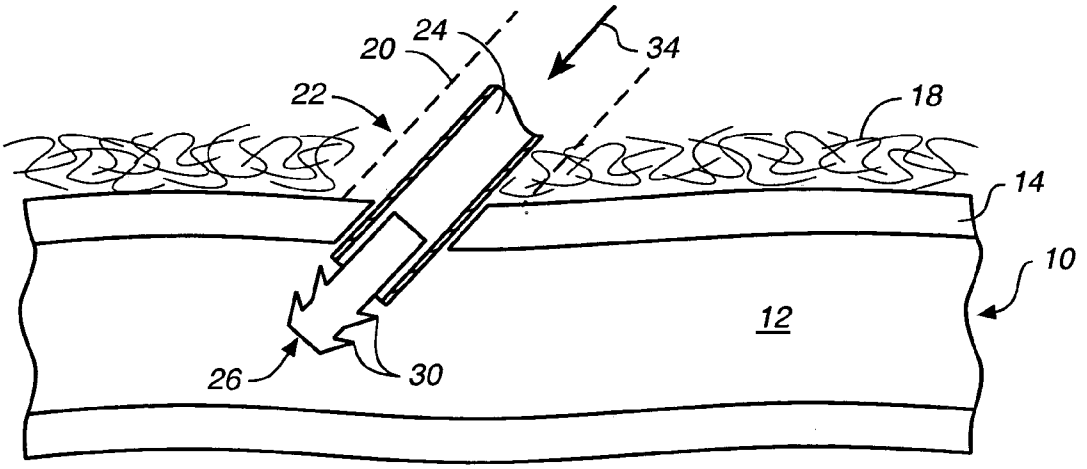


FIG._2A

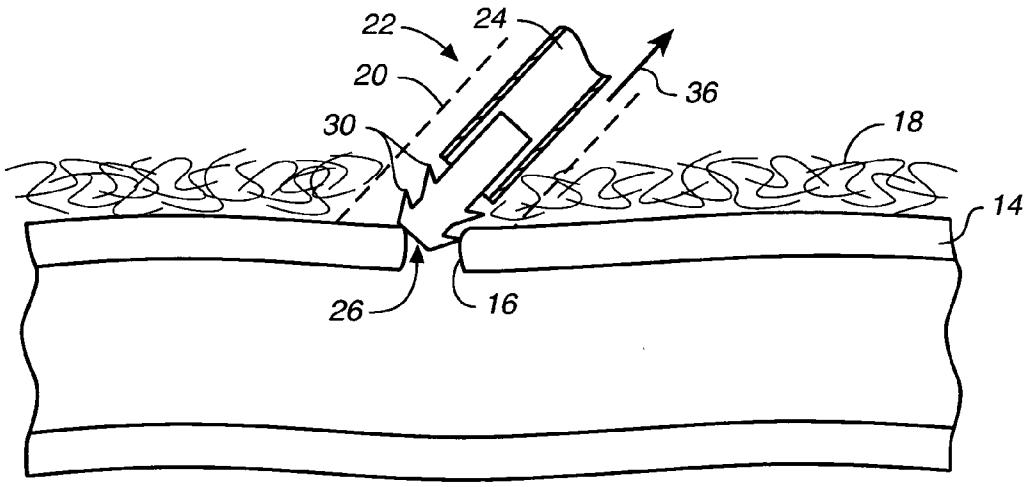


FIG._2B

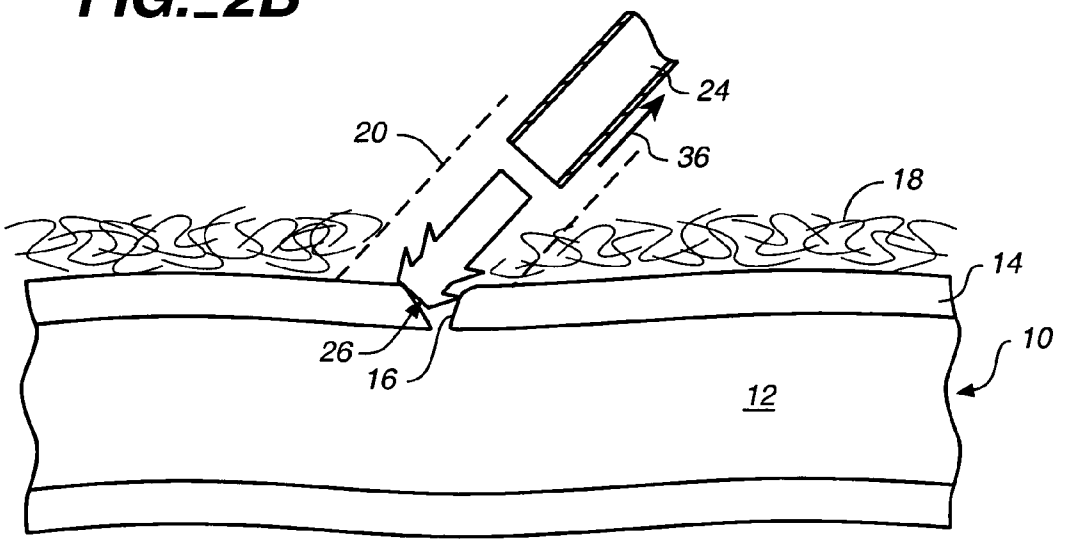


FIG._2C

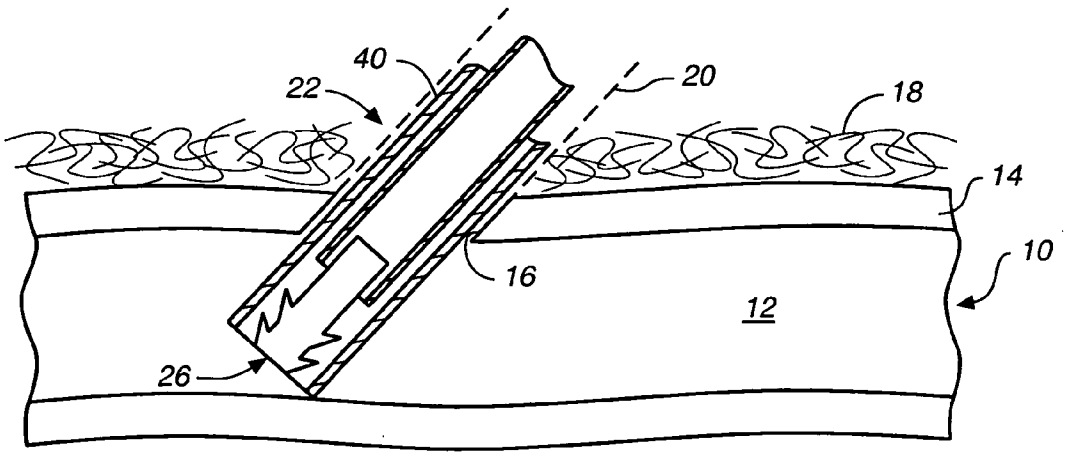


FIG._3

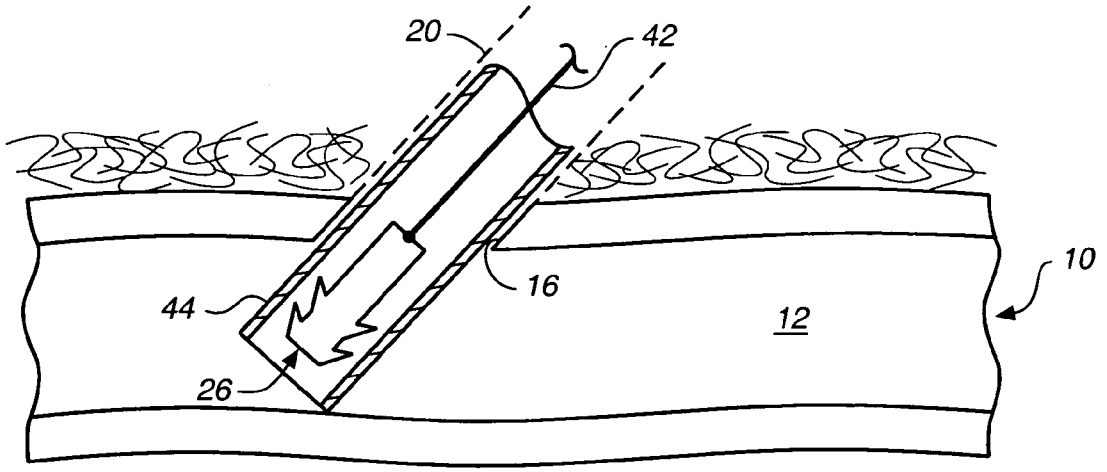


FIG._4A

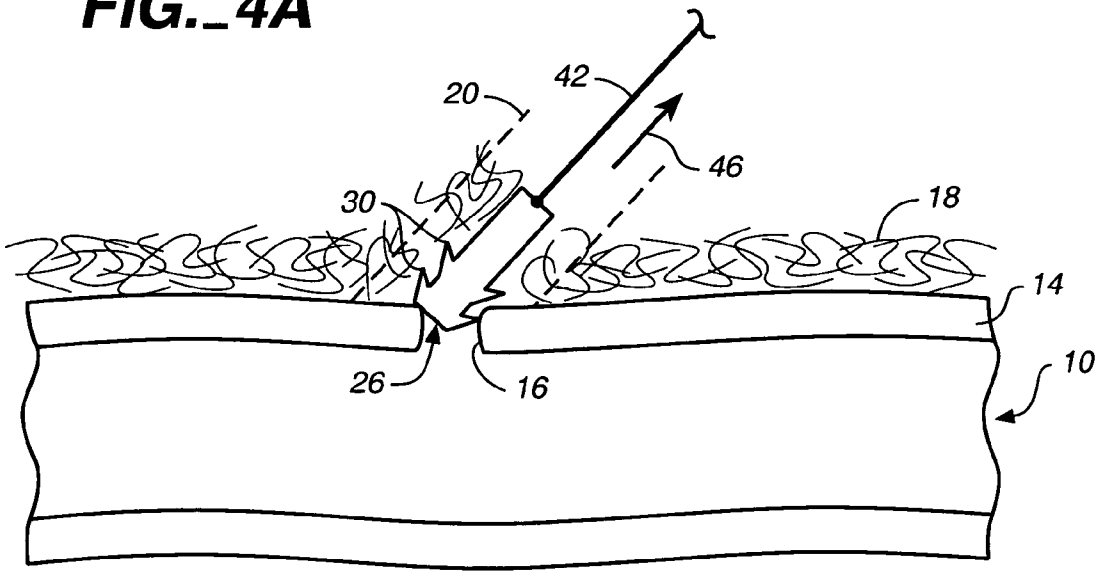


FIG._4B

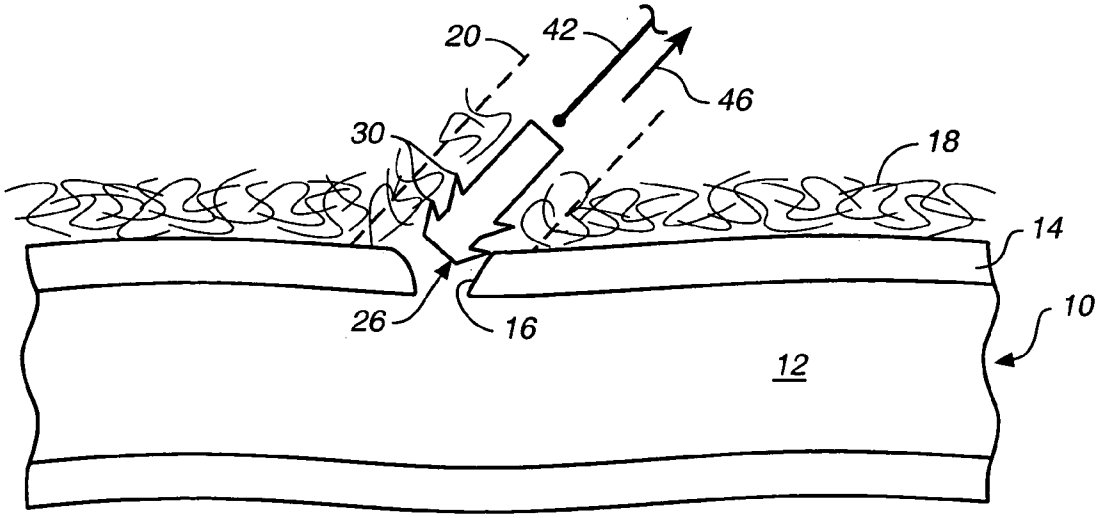


FIG._4C

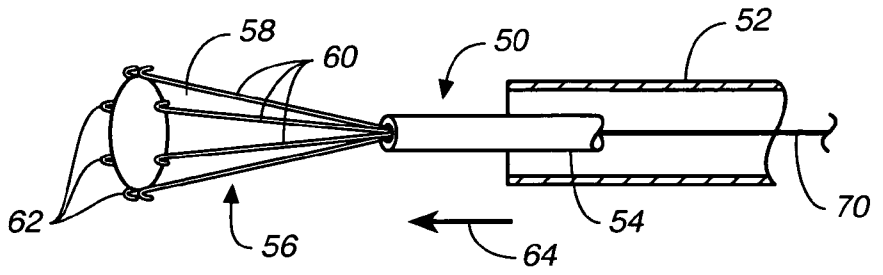


FIG._5

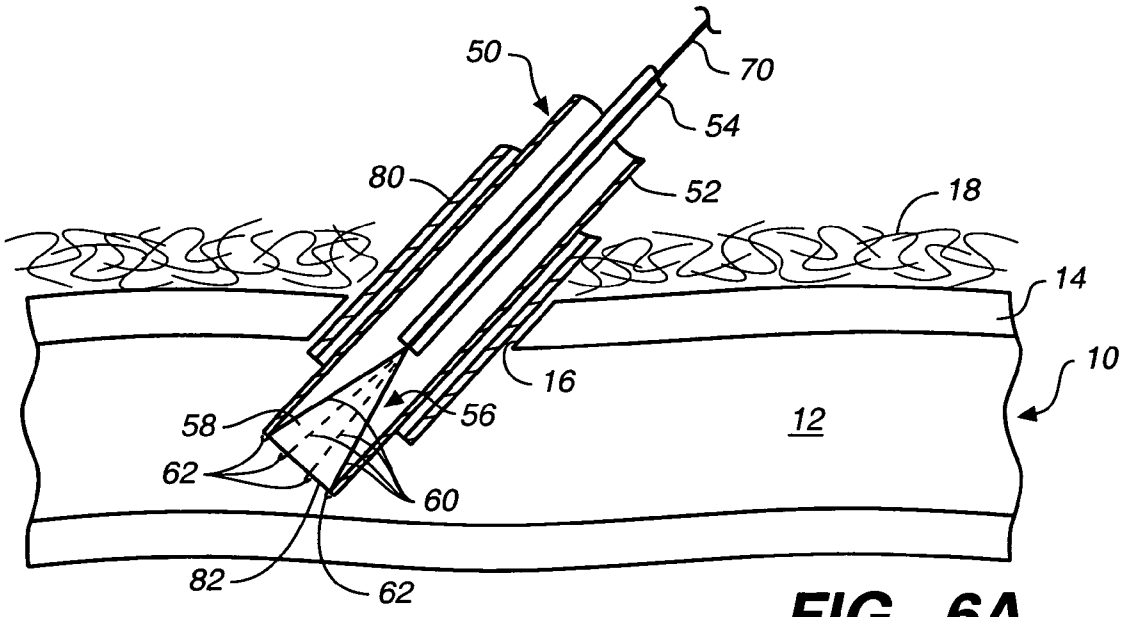


FIG._6A

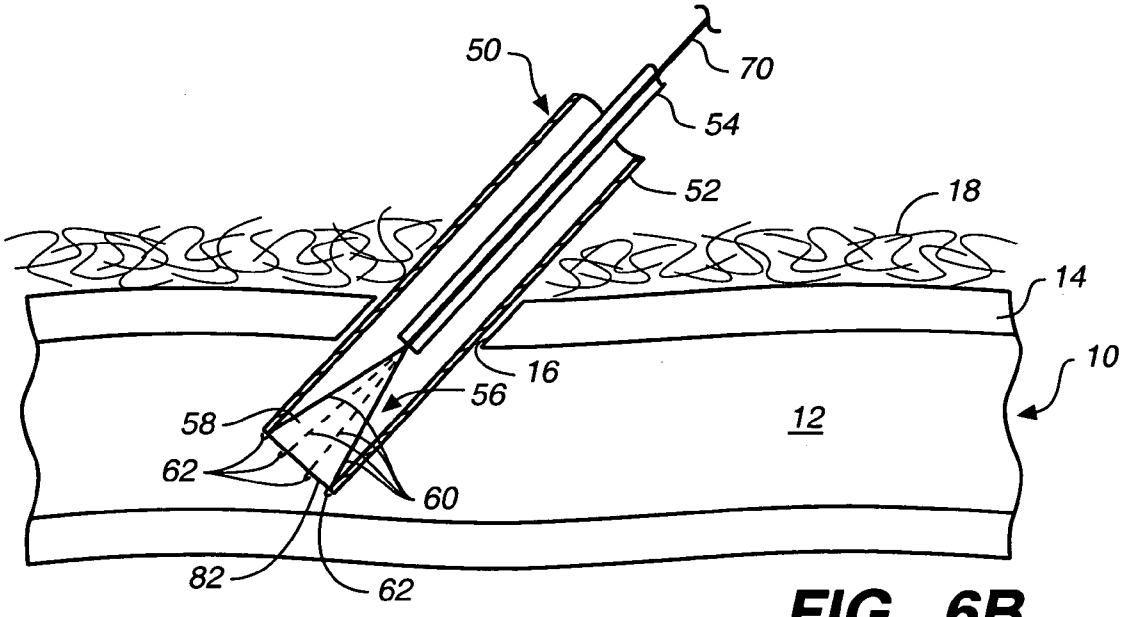


FIG._6B

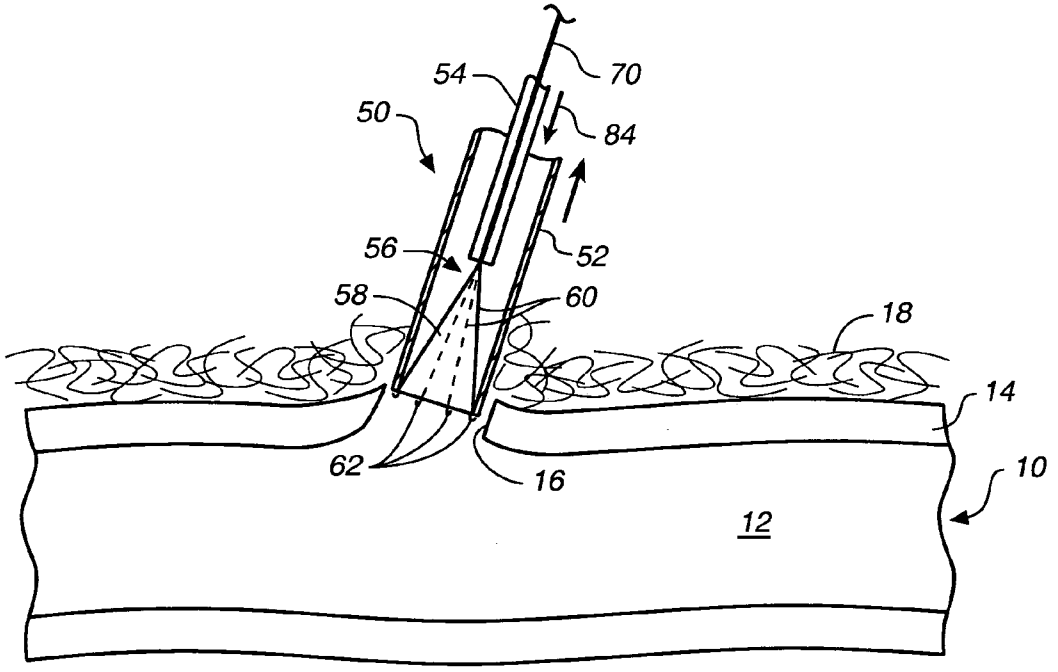


FIG._6C

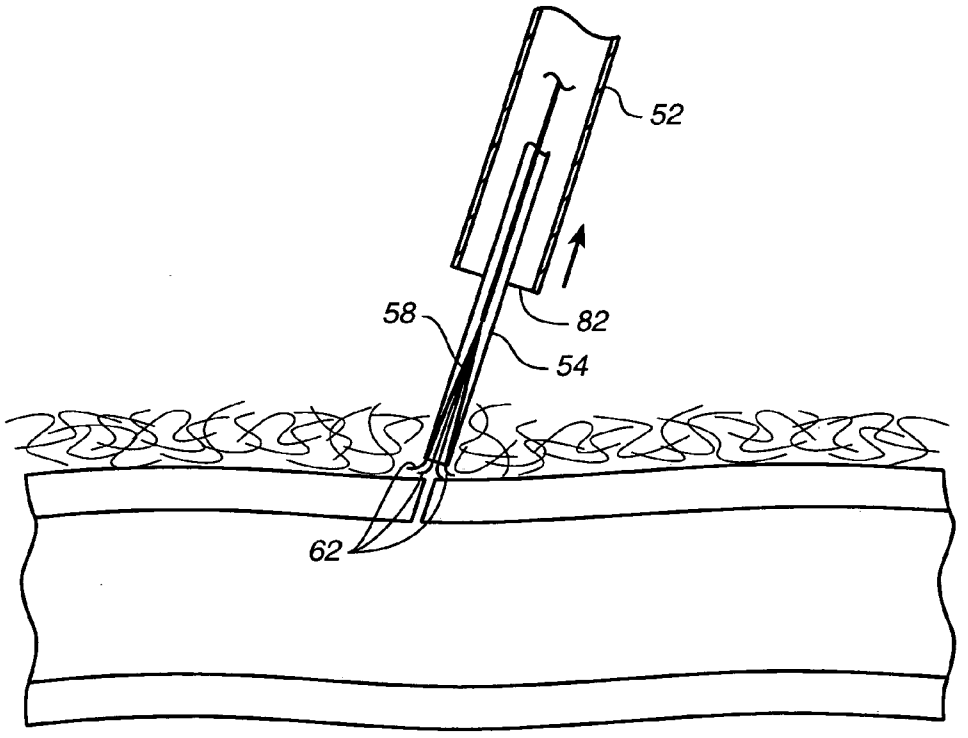


FIG._6D

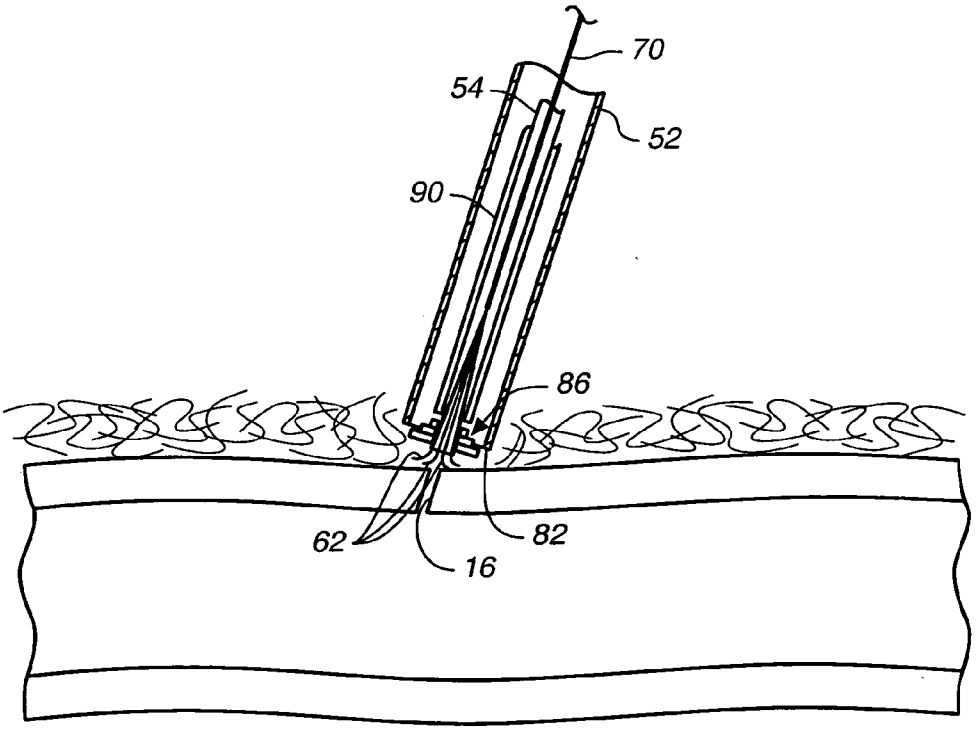


FIG._6E

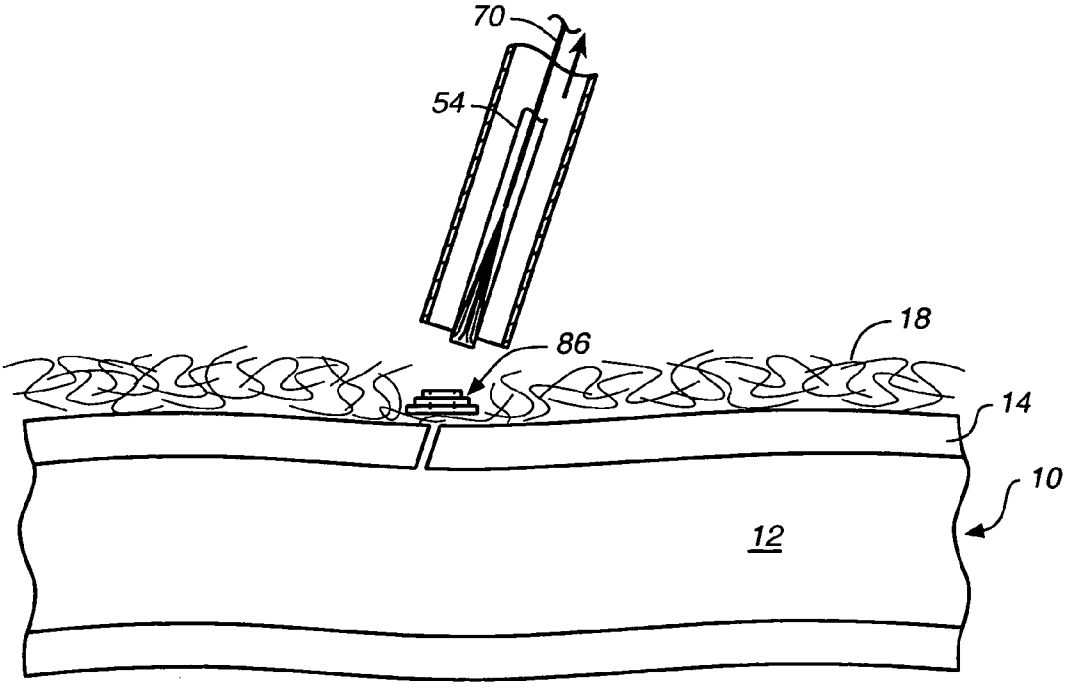


FIG._6F

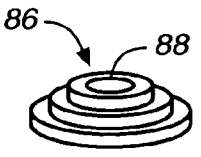


FIG._7

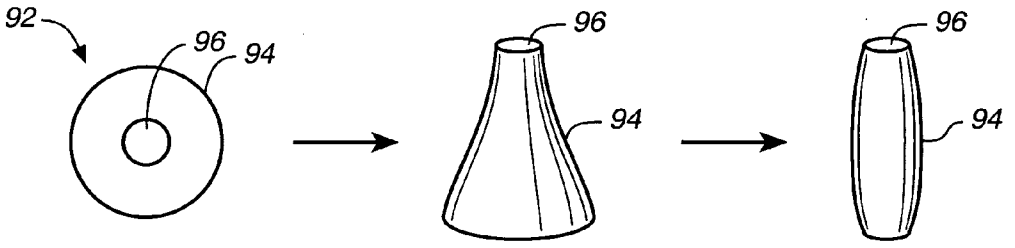


FIG._8A FIG._8B FIG._8C

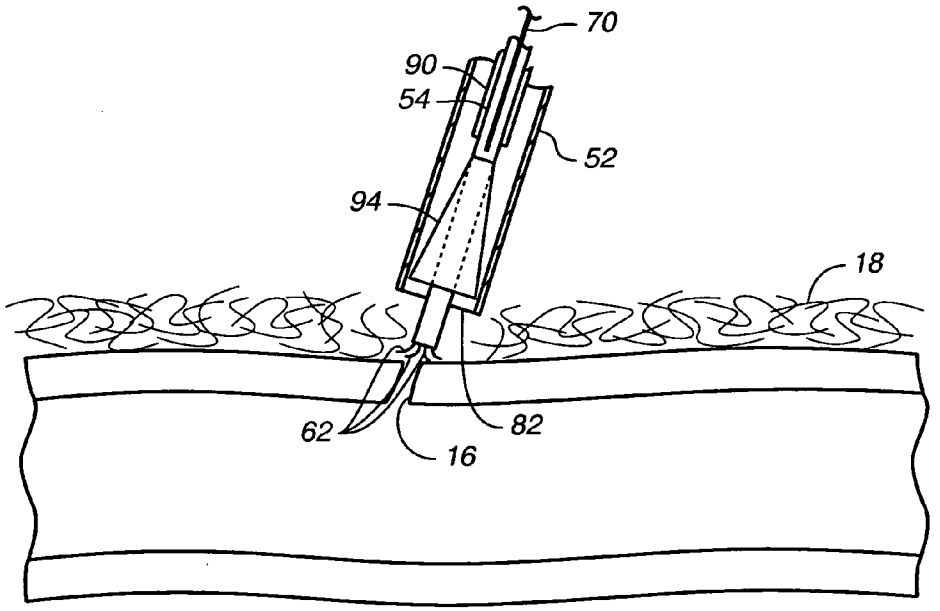


FIG._9A

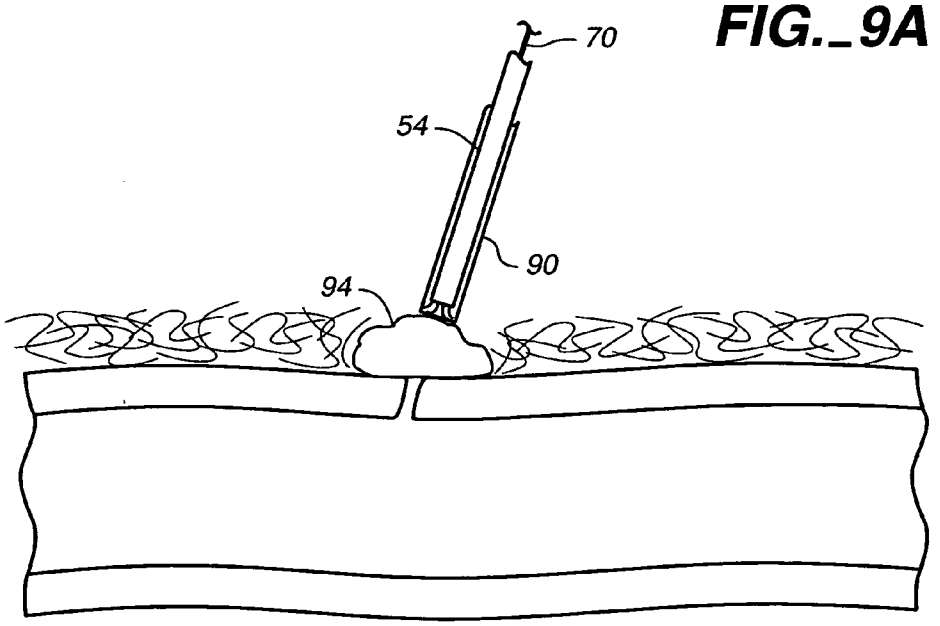


FIG._9B

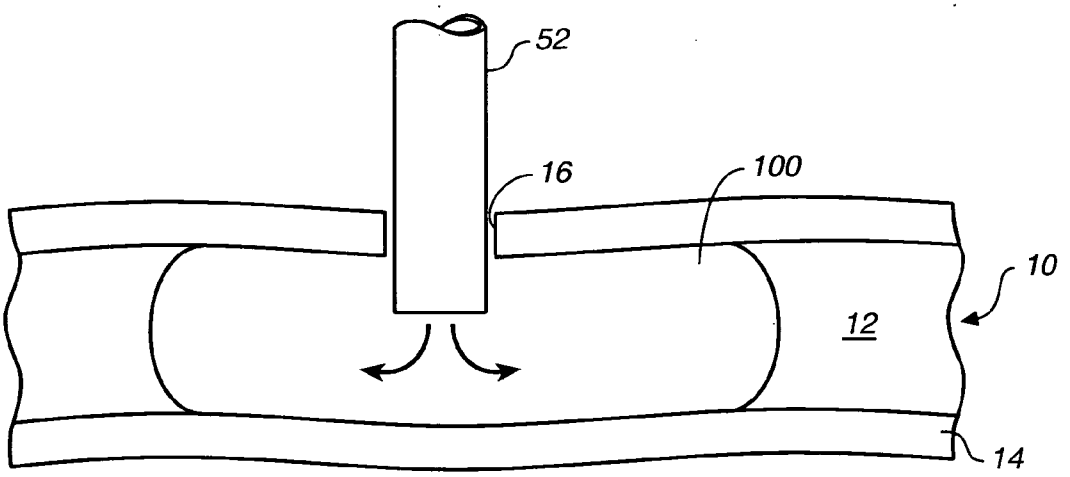


FIG._10A

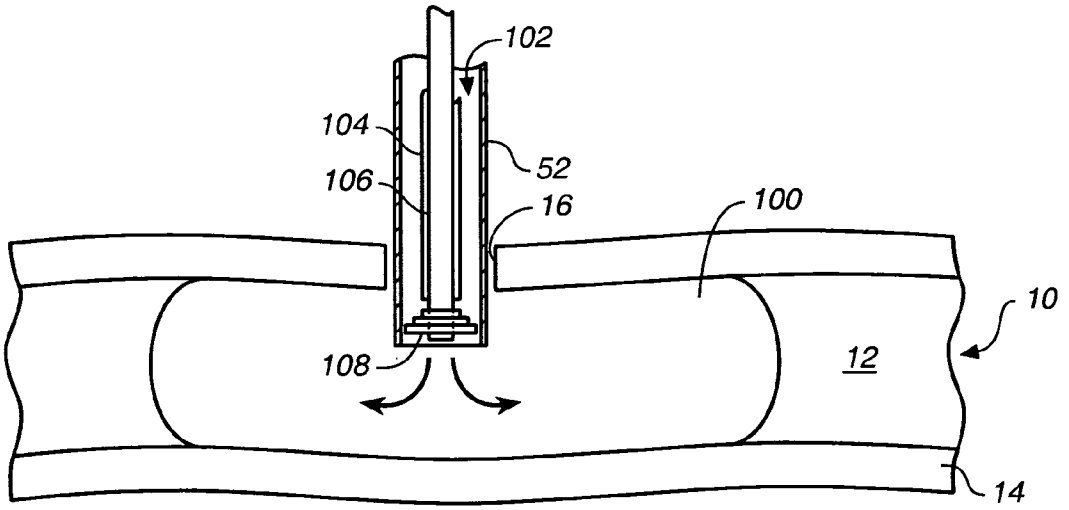


FIG._10B

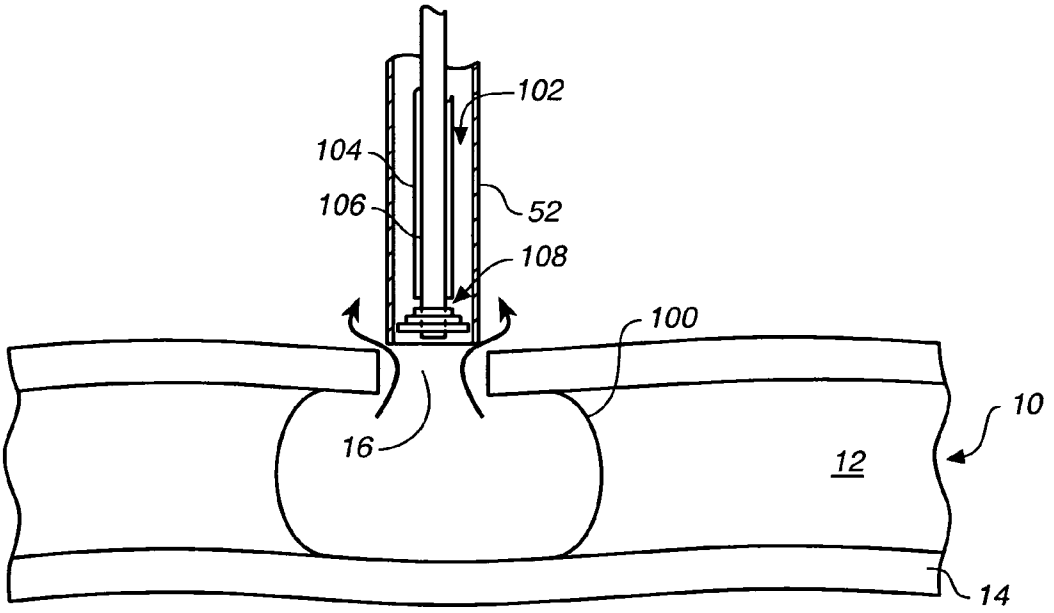


FIG._10C

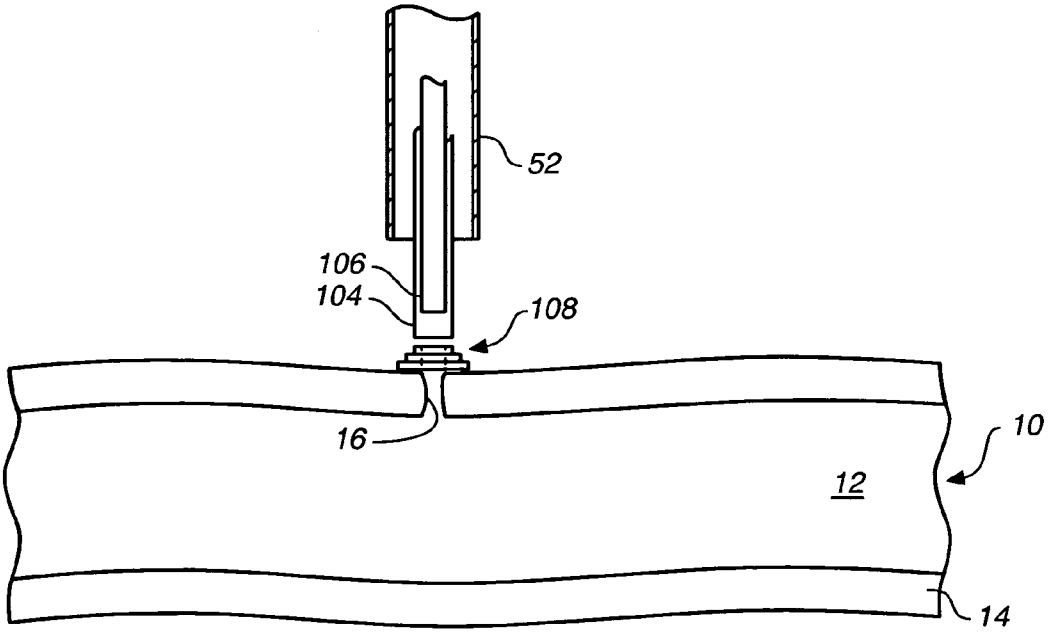


FIG._10D

CLOSURE DEVICE WITH TEXTURED SURFACE

BACKGROUND OF THE INVENTION

[0001] The present invention relates to closing openings in a vessel or other body cavity. More specifically, the present invention relates to a closure device that quickly closes openings in body tissue by engaging the adventitia closely adjacent the wall of the body cavity.

[0002] There are a wide variety of procedures which require gaining internal access to blood vessels or other body cavities. Many such procedures also require the insertion of treatment devices into the blood vessel or body cavity. Many of these procedures utilize accessible arteries as entry points for the treatment devices. For example, some such arteries include the femoral artery or subclavian artery. There are also a wide variety of procedures which gain access to other body cavities in a minimally invasive fashion.

[0003] One problem which must be addressed during these procedures is how to seal or close the opening in the blood vessel or other body cavity once the treatment procedure has been completed. Some prior techniques include simply applying pressure to the opening until it seals itself sufficiently that the pressure may be released. However, this technique often requires that pressure must be consistently applied for an undesirable amount of time after the procedure. Similarly, this type of technique can require a patient's hospitalization to be extended until the treating physician is certain that the closure is complete.

[0004] Other techniques have involved suturing the wall of the vessel or body cavity itself. This has typically required the physician to peel back a rather large portion of the tissue surrounding the puncture in order to gain sufficient access to the blood vessel or body cavity that it may be sutured adequately. This can be an undesirably time consuming procedure, and it can result in significant discomfort to the patient.

[0005] Still other techniques have involved the insertion of embolic materials adjacent the puncture. Of course, this carries with it its own difficulties. For instances, it is desirable that the embolic material not be placed within a blood vessel or body cavity because this can result in an embolus forming within the blood vessel or body cavity. Similarly, however, it is desirable that the embolic material not be located to far proximal of the puncture because this can result in the blood vessel or body cavity bleeding into the interstitial space proximal of the opening in the blood vessel or body cavity, but distal to the embolic material.

[0006] Similarly, when entry is gained into the lumen of the blood vessel by puncturing the blood vessel, the vessel may not have been punctured in a direction entirely orthogonal to the longitudinal axis of the blood vessel. Instead, the blood vessel may be punctured in a "side stick" fashion in which case the puncture is made in an off-center position. In such punctures, it is difficult to locate the outer wall of the blood vessel as well.

SUMMARY OF THE INVENTION

[0007] A closure device closes an opening in a body cavity. The closure device includes a closure member that has an external, tissue-engaging surface formed with tissue engaging surface irregularities. An elongate member is disconnectably connected to the closure member.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] **FIG. 1** is a side view of a portion of a blood vessel with an opening therein.

[0009] FIGS. **2A-2C** illustrate one embodiment of closing the opening in the vessel shown in **FIG. 1**.

[0010] **FIG. 3** illustrates another embodiment for delivering a closure device.

[0011] FIGS. **4A-4C** illustrate another embodiment for closing the opening shown in **FIG. 1**.

[0012] **FIG. 5** illustrates another embodiment of a closure device.

[0013] FIGS. **6A-6F** illustrate the operation of the closure device shown in **FIG. 5**.

[0014] **FIG. 7** illustrates a closure plug in accordance with one embodiment of the present invention.

[0015] FIGS. **8A-8C** illustrate the formation of another closure plug in accordance with one embodiment of the present invention.

[0016] **FIGS. 9A and 9B** illustrate a closure operation using the closure plug shown in FIGS. **8A-8C**.

[0017] FIGS. **10A-10D** illustrate a closure device in accordance with another embodiment of the present invention.

DETAILED DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENTS

[0018] **FIG. 1** is a side view of a portion of a blood vessel **10**. While the present invention can be used with substantially any body cavity, a blood vessel is described herein for exemplary purposes only. Blood vessel **10** has a lumen **12** defined by a blood vessel wall **14**. Blood vessel wall **14** is shown as having an opening **16** therein. Opening **16** can be an opening which was made, for example, in order to perform a treatment procedure during which access to lumen **12** is needed. **FIG. 1** also illustrates an access tract or opening **20** which was made when opening **16** was made in vessel **10**.

[0019] Vessel wall **14** is formed of media having an endothelium inner layer. The media is generally smooth muscular tissue. As is known, the media is surrounded by adventitia **18** which includes fibrous collagen.

[0020] **FIG. 1A** illustrates a closure apparatus in accordance with one embodiment of the present invention. **FIG. 1A** shows that closure apparatus **22** includes an elongate delivery member **24** and a closure plug **26**. Elongate member **24** is, illustratively, a catheter or wire having a hollow distal tip. Closure plug **26** is made of a plugging material, such as collagen, or another suitable material, which has a proximal end **28** and distal surface irregularities (or hooks) **30**. Hooks **30** illustratively comprise annular rings or discrete hooks disposed about the exterior surface of closure plug **26**. The hooks **30** can form a regular pattern or be randomly located. Hooks **30** are illustratively oriented such that they are atraumatic when traveling in one direction, such as the direction indicated by arrow **32**, and such that they grasp or grip surfaces which they engage when traveling in the

opposite direction. In one embodiment, the hooks **30** face proximally so they only grip when traveling proximally. In another embodiment, hooks **30** are oriented randomly and are covered or encapsulated when traveling distally and are exposed when in a desired position or when moved proximally, so they only grip when traveling proximally.

[**0021**] The proximal end **28** of plug **26** is illustratively disconnectably connected to the distal end of elongate member **24**. In one illustrative embodiment, proximal end **28** of plug **26** is frictionally engaged within the distal hollow opening in elongate member **24**. In another embodiment, plug **26** is attached through a disconnectable adhesive to the distal end of elongate member **24**. In yet another embodiment, an active actuation mechanism can be used to disconnect plug **26** from elongate member **24**, or a frangible or other disconnectable connection can be used.

[**0022**] Plug **26** is illustratively formed of collagen or any other suitable plugging, biocompatible or bioabsorable material. Similarly, it may require rigidity, in some embodiments, during deployment. Therefore, if it is formed of collagen, it can illustratively be coated, using any suitable coating technique, by a coating which imparts rigidity for an initial 30-90 seconds, or so. However, after that time, the rigidity will illustratively give way to allow fluid to swell plug **26**. One such coating may be, for example, hydroxypropycelluouse, which is a water soluble polymer with favorable biocompatabiltiy properties.

[**0023**] FIGS. **2**A-**2**C illustrate the use of closure plug **26** in closing opening **16** in vessel **10**. As shown in **FIG. 2**A, closure apparatus **22** is first inserted, in a distal direction shown by arrow **34**, through access tract **20**. Because hooks or ridges **30** are atraumatic when traveling in the distal direction shown by arrow **34**, plug **26** and elongate member **24** slide easily through tract **20**. Once inside the lumen **12** of vessel **10**, elongate member **24** is retracted in the proximal direction opposite that of arrow **34**. This is better illustrated in **FIG. 2B**.

[**0024**] **FIG. 2B** shows that hooks **30**, when retracted in the proximal direction shown by arrow **36**, do not engage the relatively smooth media which forms wall **14** of vessel **10**. However, when hooks **30** encounter adventitia **18**, they immediately become securely lodged in tract **20**. In the embodiment shown, the hooks **30** become snagged and entangled in adventitia **18**. However, other means of becoming securely lodged are contemplated as well, such as frictionally engagement of the surface irregularity and not simply entanglement. Because adventitia **18** lies immediately proximal of media **14**, plug **26** becomes entangled, in place, immediately proximal of opening **16**. This placement is highly desired.

[**0025**] **FIG. 2C** illustrates that elongate member **24** is further withdrawn in the proximal direction shown by arrow **36**. However, because the hooks **30** of plug **26** have become securely entangled in the strong fibrous collagen in adventitia **18**, the frictional engagement (or other disconectable engagement) between plug **26** and the distal end of elongate member **24** comes loose, such that plug **26** is disengaged from elongate member **24**. This leaves plug **26** in place, where it became entangled, just proximal of opening **16** in media **14** of vessel **10**. Elongate member **24** is then simply withdrawn through tract **20**.

[**0026**] **FIG. 3** illustrates another embodiment for deploying plug **26**. Instead of simply advancing elongate member **24** and plug **26** through tract **20**, as shown in **FIG. 2**A, elongate member **24** and plug **26** are advanced distally into lumen **12** of vessel **10** through an introducer sheath, such as sheath **40**. Sheath **40** may be a sheath specially formed to be used with apparatus **22**, or it can simply be the introducer sheath which was used in performing the treatment which required the formation of access tract **20**. In any case, once plug **26** is in place within lumen **12**, introducer sheath **40** is withdrawn proximally and the operation is completed as shown with respect to FIGS. **2**B-**2**C.

[**0027**] FIGS. **4**A-**4**C illustrate yet another embodiment in which plug **26** is used to close opening **16** in vessel **10**. In the embodiment shown in FIGS. **4**A-**4**C, instead of elongate member **24** being used to deploy plug **26**, a core wire or other flexible wire or thread **42** is used. In this embodiment, plug **26** is advanced to within lumen **12** of vessel **10** through a delivery catheter (or through an introducer) designated as item **44** in **FIG. 4A** or it is advanced using a separate pusher, such as a catheter, not shown. In any case, once plug **26** is inserted within lumen **12** of vessel **10**, the items used for delivering it, other than elongate wire **42**, are withdrawn proximally.

[**0028**] **FIG. 4B** shows that wire **42** is then withdrawn proximally in the direction indicated by arrow **46**. This causes proximal movement of plug **26**, through the opening **16** defined by media **14**. This also causes hooks or ridges **30** to engage adventitia **18** and become entangled therein.

[**0029**] In one embodiment, wire **42** is connected to the distal end of plug **26** by a frangible connection which can simply be broken when enough force is applied to the connection point. Therefore, as shown in **FIG. 4**C, once plug **26** becomes entangled in adventitia **14**, and proximally directed force is applied to wire **42**, the connection point between the proximal end of plug **26** and wire **42** is broken, leaving plug **26** in place. Again, plug **26** is placed just proximal of the media **14** which defines opening **16** in vessel **10**. Wire **42** is then simply withdrawn proximally through tract **20**.

[**0030**] **FIG. 5** illustrates another embodiment of a closure apparatus **50** in accordance with one embodiment of the present invention. Apparatus **50** includes a delivery sheath **52**, a closure sheath **54**, and a wire array **56** which is disposed on a cone shaped seal member **58**. Elongate members **52** and **54** illustratively extend proximally all the way to a proximal region accessible by a user. Wire array **56** includes a plurality of individual wires **60**, each of which have a hook **62** on its distal end. The wires **60** in wire array **56** extend proximally in either a wire bundle **70**, or they are connected to a single wire **70** which extends proximally. Hooks **62**, like hooks or ridges **30** shown in the above Figures, are oriented such that, as they are advanced in the direction shown by arrow **64**, they are atraumatic. However, when withdrawn in the opposite direction, they hook or snag some tissues. Hooks **62** can be formed of conventional hooks used with hook and loop fabric (one embodiment which is sold under the trade name VELCRO), or they can be other desired hooks as well.

[**0031**] FIGS. **6**A-**6**F illustrate one embodiment in which apparatus **50** is used for closing opening **60** in vessel **10**.

[**0032**] **FIG. 6A** shows vessel **10** with an introducer sheath **80** inserted through opening **16** in vessel **10**. **FIG. 6A** also

shows that delivery sheath **52** has been advanced distally relative to wire array **56** such that the distal end **82** of delivery sheath **52** is in engagement with hooks **62**. In this position, delivery sheath **52** is advanced distally relative to introducer sheath **80** until the distal tip of apparatus **50** is within lumen **12** of vessel **10** as shown in **FIG. 6A**.

[**0033**] **FIG. 6B** shows apparatus **50** in the same position as that shown in **FIG. 6**A, except that introducer sheath **80** has been withdrawn proximally. It can be seen that the sides of opening **16**, once introducer sheath **80** is withdrawn, close in around delivery sheath **52**.

[**0034**] **FIG. 6C** shows that, in a next step, apparatus **50** is withdrawn proximally. In one embodiment, wire **70** is simply withdrawn proximally. This causes hooks **62** to withdraw delivery sheath **52** and elongate member **54** in the proximal direction as well. Hooks **62** readily pass through the generally smooth media tissue forming opening **16**. However, once they encounter adventitia **18**, they become firmly entangled therein, as shown in **FIG. 6C**. The treating physician can easily tell that apparatus **50** is in this position because the resistance to further proximal movement of wire **70** becomes significant.

[**0035**] Closure sheath **54** is than advanced proximally over wire **70**, wire array **56**, and wires **60**, in the direction shown by arrow **84**. This causes flexible cone-shape seal **58**, and wires **60**, to collapse inwardly pulling hooks **62** together. **FIG. 6D** shows closure sheath **54** advanced all the way proximally relative to wire **70**, such that hooks **62** are pulled closely adjacent to one another at the distal end of closure sheath **54**. Seal **58** is shown collapsed within closure sheath **52**.

[**0036**] In one embodiment, the proximal end of closure sheath **54** is illustratively provided with a snap lock fitting. Therefore, when closure sheath **54** is advanced a sufficient distance distally such that hooks **62** are substantially closed and in the position shown in **FIG. 6**D, the snap lock engages so the user can readily tell this. Of course, any other relative measurement device can be used to indicate that the sheath **54** is in the position shown in **FIG. 6D** as well.

[**0037**] **FIG. 6E** shows that a plurality of closure plugs **86** have been delivered to the closure site. One embodiment of a plurality of generally disc shaped closure plugs **86** is shown in **FIG. 7**. The disc shaped plugs **86** are illustratively, arranged generally coaxially and have a central lumen **88** defined therethrough. The plugs can be formed of collagen, absorbable gel, or any other material or substance suitable for closing opening **16**. **FIG. 6E** shows that plugs **86** are illustratively mounted over closure sheath **54** and advanced distally thereover by advancing a second delivery sheath **90**. Sheath **90** has a distal end which is sized to engage the most proximal of disc-shaped plugs **86**. The disc-shaped plugs **86** are advanced through delivery sheath **52** by advancing delivery sheath **90** over closure sheath **54**. Plugs **86** are advanced to the position shown in **FIG. 6**E, just proximal of opening **16**.

[**0038**] Next, wire array **56** is removed. This is better illustrated with respect to **FIG. 6F**. **FIG. 6F** shows that closure sheath **54** is advanced further distally until it deforms hooks **62** until they reside within the distal end of closure sheath **54**. Once in that position, wires **70** and closure sheath **54** are withdrawn proximally, to the position shown in **FIG. 6F** relative to second delivery sheath **90**. At anytime during this process, and after delivery of plugs **86**, the first delivery sheath **52** can be withdrawn proximally.

[**0039**] Delivery sheath **90** can then be used to tamp plugs **86** firmly in place. Then, the entire system is withdrawn proximally, in any desired order.

[**0040**] FIGS. **8A-8**C illustrate another embodiment of a plug **92** which can be formed and used in accordance with the system shown in FIGS. **6A-6**F. Plug **92** is formed of a sheet of material **94** having a generally centrally located aperture **96** therein. Sheet **94** can be substantially any shape, but is shown in a generally circular shape for the sake of simplicity. Sheet **94** is illustratively formed of a vascular occluding material such as that in the QuickSeal Arterial Closure System from Sub-Q, Inc. of San Clamente, Calif. Sheets **94** are illustratively pliable material which can be bent and folded. Therefore, sheets **94** are folded or twisted to a fully collapsed shape having a generally central lumen extending therethrough, as shown in **FIGS. 8B and 8C**. Instead of loading disc-shaped plugs **86** over closure sheath **54**, plugs **94** are loaded thereover.

[**0041**] **FIGS. 9A and 9B** illustrate delivery of a plug **94** using the apparatus shown in FIGS. **6A-6**F. Plug **94** is advanced over closure sheath **54** using sheath **90**. Delivery sheath **52** is then withdrawn proximally, and closure sheath **54** is advanced distally to retrieve hooks **62**. Then, closure sheath **54** is withdrawn proximally and sheath **90** is advanced distally to tamp in place plug **94**. This is shown in **FIG. 9B**. Of course, a plurality of plugs **94** can be loaded onto closure sheath **54** and delivered by sheath **90**, either one at a time, or multiple plugs at a single time, as desired.

[**0042**] FIGS. **10A-10**D illustrate another embodiment of a closure device in accordance with the present invention. In **FIG. 10**A, delivery sheath **52** is shown inserted within the lumen **12** of vessel **10**. A small bolus of inert gas, such as CO_2, is then injected into vessel **10** through sheath **52** (which can be attached to a source of the inert gas). This forms a dry field **100** of the inert gas within the lumen **12** of vessel **10**. Distal pressure on vessel **10** may be used in order to better hold the gas bolus **100** in place.

[**0043**] **FIG. 10B** shows that a delivery apparatus **102** is then inserted through sheath **52** into lumen **12** of vessel **10**. Delivery apparatus **102** includes an elongate delivery sheath **104** an elongate delivery member **106**, and liquid swellable plug or plugs **108**. Plugs **108** are inserted through sheath **52** until swellable plugs **108** are within the lumen **12** and reside at the distal end of sheath **52**. This can be ensured by proximal markings on sheaths **52** and **104**, or using any other desired mechanism or method. Because swellable plugs **108** are within a dry field formed by bolus **100**, they do not begin to swell or to occlude.

[**0044**] **FIG. 10C** shows that sheath **52**, along with swellable plugs **108**, are then withdrawn proximally. As soon as sheath **52** and plugs **108** are withdrawn proximally to a point outside of vessel **10**, the gas bolus **100** escapes from vessel **10**. This produces a visual and audio feedback indicating that sheath **52** and plugs **108** have just cleared vessel **10**. Sheath **52** is then withdrawn further proximally. Once the gas bolus **100** has vented, blood from within vessel **10** engages and wets swellable plugs **108**. Sheaths **52** and **104** and delivery member (or wire) **106**, are then withdrawn proximally as shown by **FIG. 10**B, leaving plugs **108** in place in the desired position.

[0045] Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.

What is claimed is:

1. A closure device for closing an opening in a body cavity, comprising:

a closure member having an external, tissue engaging surface formed with fibrous tissue engaging surface irregularities; and

an elongate member disconnectably connected to the closure member.

2. The closure device of claim 1 wherein the surface irregularities are in a non-grasping orientation relative to movement of the closure member in a first direction.

3. The closure device of claim 2 wherein the surface irregularities are in a grasping orientation relative to movement of the closure member in a second direction, opposite the first direction.

4. The closure device of claim 3 wherein the surface irregularities are on a distal portion of the closure member.

5. The closure device of claim 4 wherein the elongate member is disconnectably connected to a proximal portion of the closure member.

6. The closure device of claim 5 wherein the elongate member is frictionally connected to the closure member.

7. The closure device of claim 5 wherein the elongate member is connected to the closure member with a frangible mechanical connection.

8. The closure device of claim 1 wherein the elongate member includes a hollow distal end sized to receive a portion of the closure member therein.

9. The closure device of claim 1 wherein the elongate member comprises a catheter.

10. The closure device of claim 1 wherein the elongate member comprises a wire.

11. The closure device of claim 3 wherein the surface irregularities comprise proximally facing hook portions.

12. The closure device of claim 11 wherein the hook portions comprise ridges extending about the surface of the closure member.

13. The closure device of claim 1 wherein the closure member comprises a substantially rigid material during delivery.

14. The closure device of claim 13 wherein the closure member comprises a swellable material.

15. The closure device of claim 14 wherein the swellable material is coated with a soluble coating that imparts rigidity prior to dissolution.

16. The closure device of claim 14 wherein the swellable material comprises collagen.

17. The closure device of claim 1 wherein the opening has fibrous tissue located proximally thereof and wherein the surface irregularities engage and become entangled in the fibrous tissue as the collapsible member is moved proximally relative thereto.

18. The closure device of claim 17 wherein the opening is defined by relatively smooth tissue and wherein the surface irregularities pass the relatively smooth tissue without becoming entangled therein when the closure member is moved proximal relative thereto.

19. A method for closing an opening in a body cavity having fluid therein, comprising:

establishing a dry field in the body cavity adjacent the opening;

inserting a liquid swellable material into the dry field;

withdrawing the liquid swellable material from the body cavity through the opening until the liquid swellable material engage fibrous tissue proximal of the opening; and

implanting the liquid swellable material outside the body cavity to close the opening.

20. A method of claim 19 and further comprising:

removing the dry field from the body cavity so liquid from the body cavity contacts and swells the swellable material.

21. A method of claim 20 wherein establishing a dry field comprises:

introducing an inert gas into the body cavity to establish a bolus of the gas adjacent the opening.

22. The method of claim 21 wherein introducing an inert gas comprises:

introducing a sheath into the body cavity through the opening; and

introducing the gas through the sheath.

23. The method of claim 22 wherein inserting a swellable material comprises:

inserting the swellable material with an elongate member through the sheath.

24. The method of claim 23 wherein removing the dry field comprises:

withdrawing the liquid swellable material and the sheath from the opening such that the gas vents from the body cavity through the opening.

25. A method of closing an opening in a body cavity, comprising:

advancing fibrous tissue engaging members distally through the opening into the body cavity;

withdrawing the fibrous tissue engaging members proximally through the opening to an engagement region where the fibrous tissue engaging members engage fibrous tissue proximal of the opening; and

placing a closure member at the engagement region.

26. The method of claim 25 wherein placing the closure member comprises:

advancing a swellable material to the engagement region; and

releasing the swellable material.

27. The method of claim 25 wherein the fibrous tissue engaging members are connected to an elongate member and wherein advancing the swellable material comprises:

advancing the swellable material over the elongate member to the engagement region.

28. The method of claim 27 wherein the swellable material comprises a plurality of disc shaped pieces having an aperture therein and wherein advancing the swellable material over the elongate member comprises:

advancing the swellable material over the elongate member such that the aperture receives the elongate member.

29. The method of claim 27 wherein the swellable material comprises a sheet of swellable material and wherein advancing the swellable material over the elongate member comprises:

folding the sheet to form a generally cylindrical member having an aperture defined therethrough;

advancing the folded sheet over the elongate member such that the aperture receives the elongate member.

30. The method of claim 27 wherein the fibrous tissue engaging members comprise hooks, and further comprising:

prior to advancing the swellable material, moving the hooks toward one another to reduce a size of the opening.

31. The method of claim 30 wherein the hooks are supported in a spread configuration by a collapsible member and wherein moving the hooks comprises:

sliding a closing sheath over the collapsible member to collapse the collapsible member.

32. The method of claim 31 and further comprising:

after advancing the swellable material, advancing the closure sheath distally to receive the hooks therein; and

withdrawing the hooks in the closure sheath proximally.

33. A closure apparatus for closing an opening in a body cavity, comprising:

a plurality of fibrous tissue engaging members coupled to a proximally extending elongate member, the fibrous tissue engaging members being movable between an expanded position and a collapsed position;

a closure sheath sized to receive the elongate member and slidable thereover to move the fibrous tissue engaging members from the expanded position to the collapsed position;

a delivery sheath sized to receive the closure sheath and having a distal end sized to engage the fibrous tissue engaging members when in the expanded position; and

a closure member having an aperture defined therein sized to receive the closure sheath.

34. The closure apparatus of claim 33 wherein the closure member comprises:

a generally disc shaped member having the aperture defined therein.

35. The closure apparatus of claim 34 wherein the generally disc shaped member comprises:

a plurality of disc shaped pieces each having an aperture defined therein and being arranged in a generally coaxial orientation.

36. The closure apparatus of claim 33 wherein the closure member comprises:

a sheet of pliable, swellable material folded into a generally tubular shape having the aperture defined therethrough.

37. The closure apparatus of claim 33 wherein the closure member comprises:

a plurality of sheets of pliable, swellable material, each folded into a generally tubular shape having the aperture defined therethrough.

38. The closure apparatus of claim 37 wherein the plurality of sheets are disposed over the closure sheath in a generally coaxial arrangement.

39. The closure apparatus of claim 33 wherein the fibrous tissue engaging members comprise:

a plurality of hook-shaped members.

40. The closure apparatus of claim 39 wherein the plurality of hook-shaped members are oriented to be proximally facing hook-shaped members.

41. The closure apparatus of claim 40 wherein the proximally facing hook-shaped members are sufficiently resilient to deform to be received within the closure sheath upon distal advancement of the closure sheath distally beyond the proximally facing hook-shaped members.

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