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(54) **MINIMALLY INVASIVE LAPAROSCOPIC RETRACTOR**

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(60) Provisional application No. 61/429,648, filed on Jan. 4, 2011, provisional application No. 61/450,682, filed on Mar. 9, 2011.

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(57) **ABSTRACT**

An inflatable retractor for use in laparoscopic surgery of a patient's body includes an inflatable element disposed at a distal end of a retractor shaft. The retractor shaft includes a port for receiving insufflating fluid. The inflatable element includes an inner and outer surface such that the inflatable element forms an angle with the retractor shaft and forms a compartment when the inflatable element is insufflated with fluid. The angle formed between the inflatable element and retractor shaft changes depending upon the insufflating pressure. In this way, the rigidity and shape of the inflatable element is controlled by the surgeon by the amount of insufflating pressure used, allowing for flexibility and ease of use.

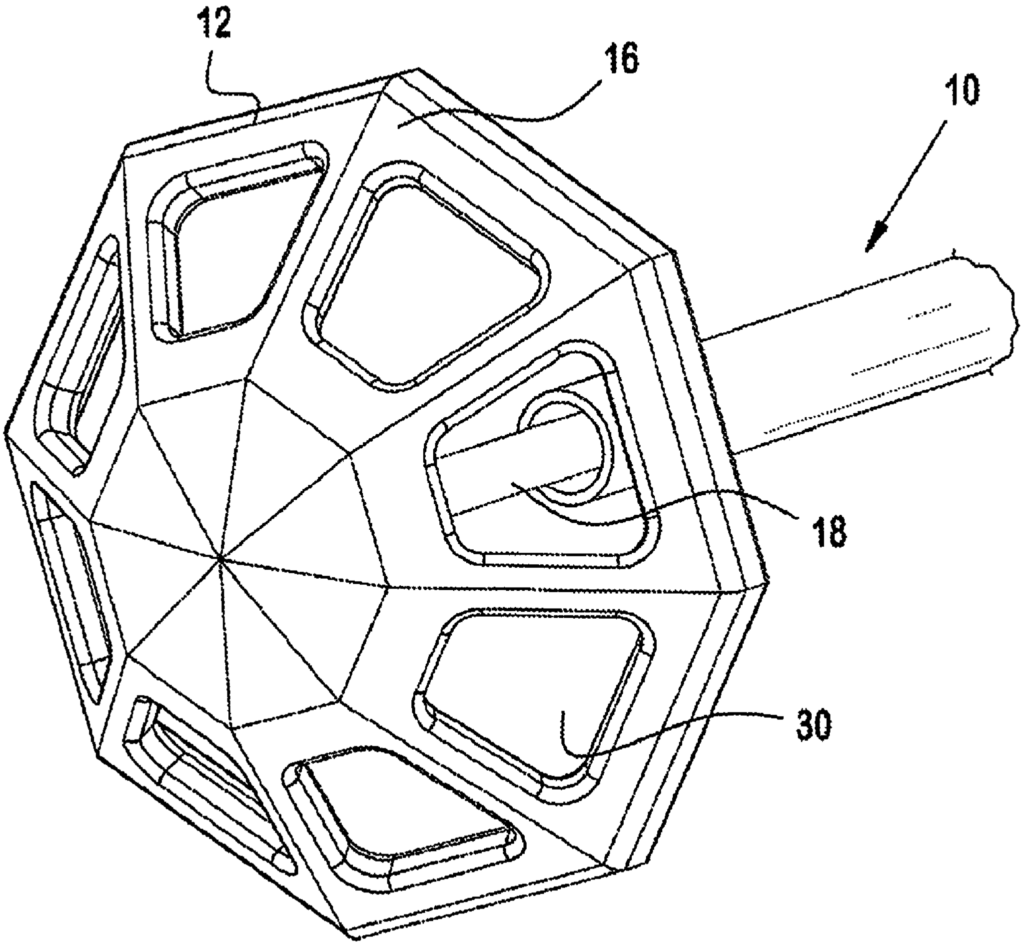
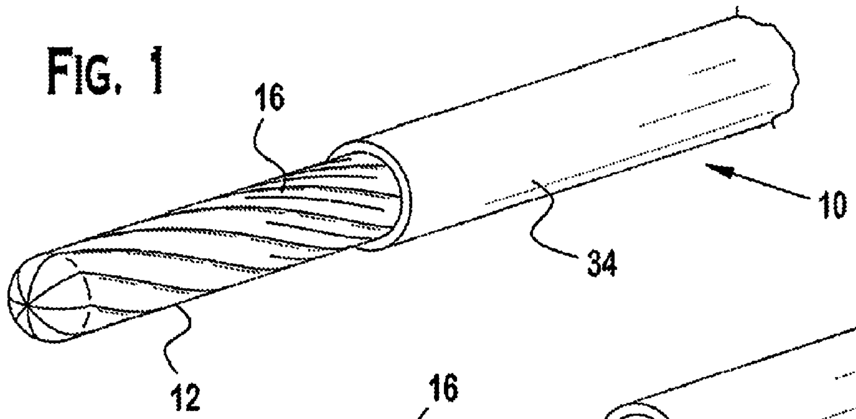


FIG. 1



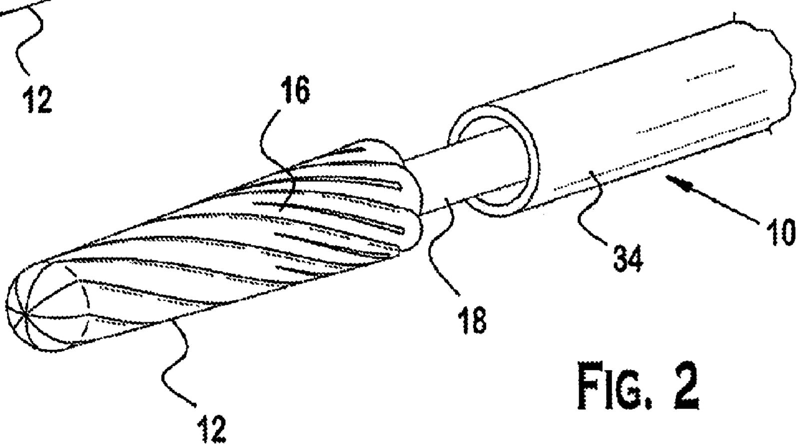


FIG. 2

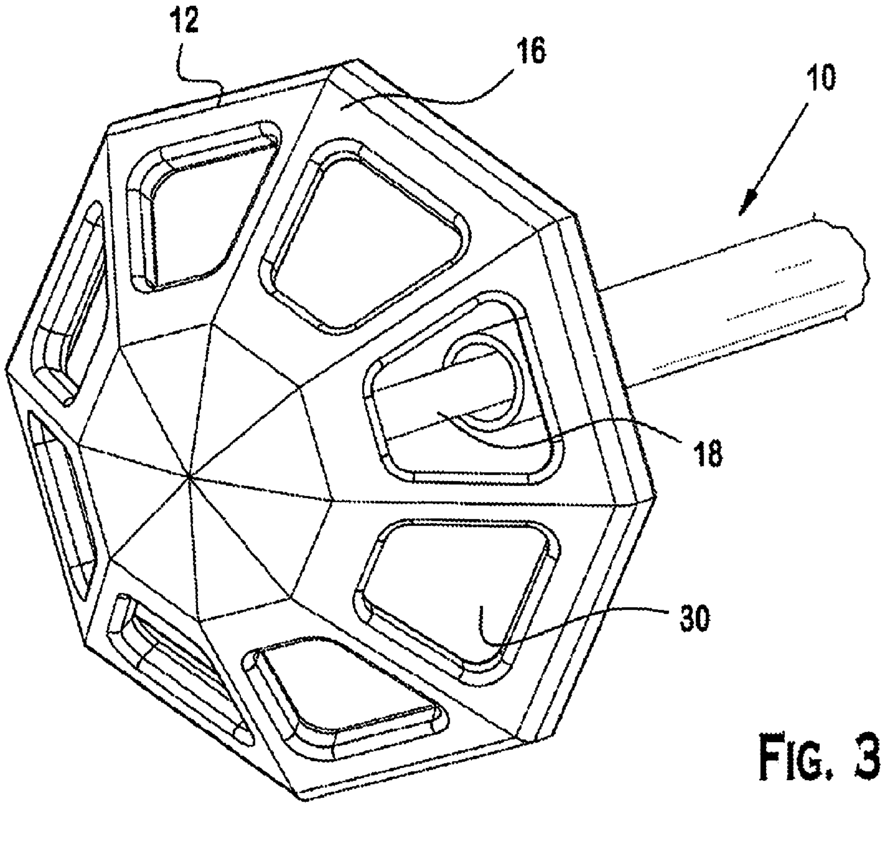


FIG. 3

FIG. 4

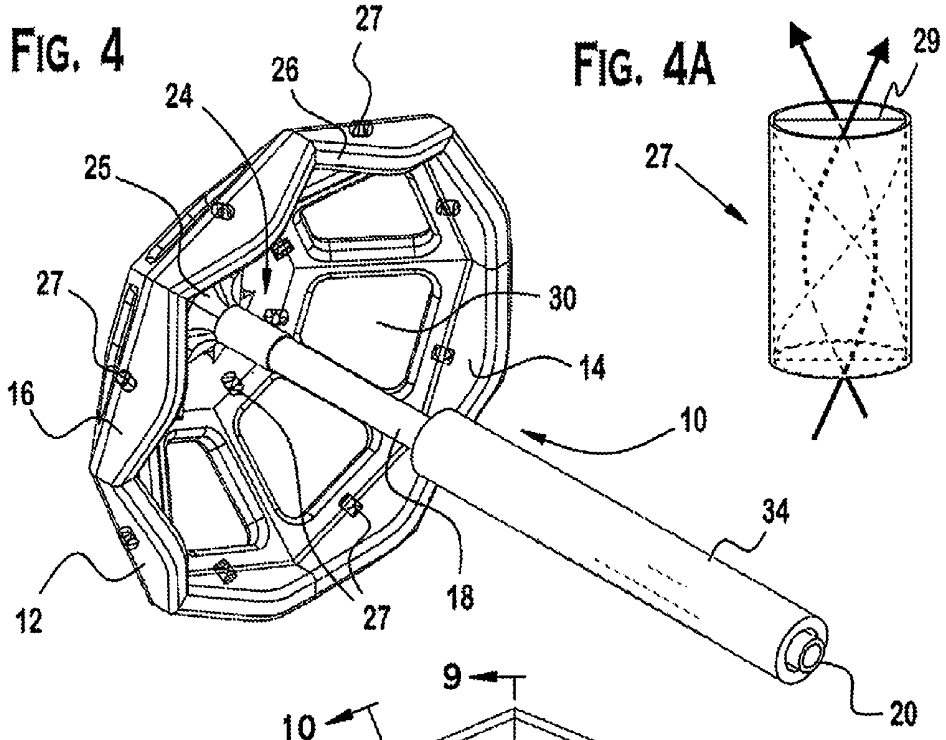


FIG. 4A

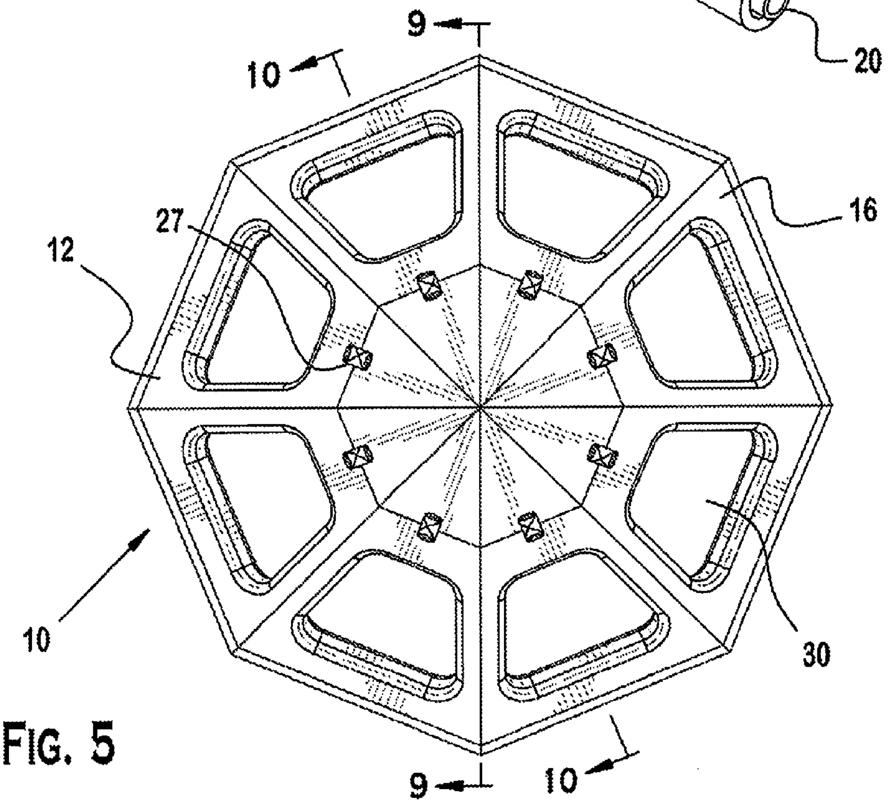


FIG. 5

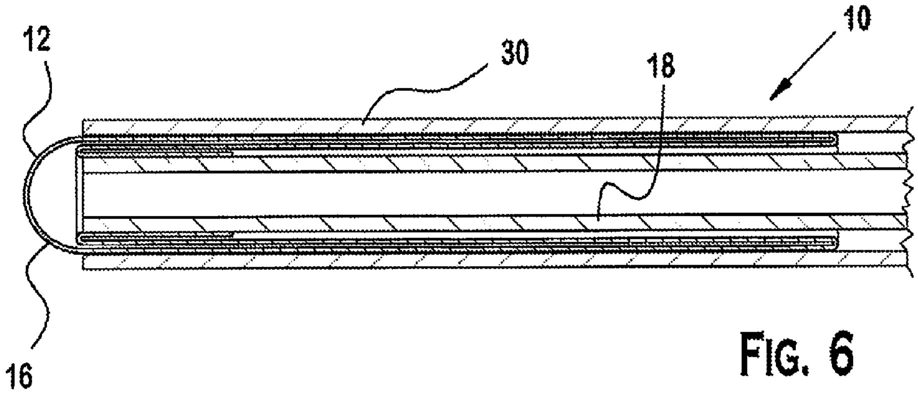


FIG. 6

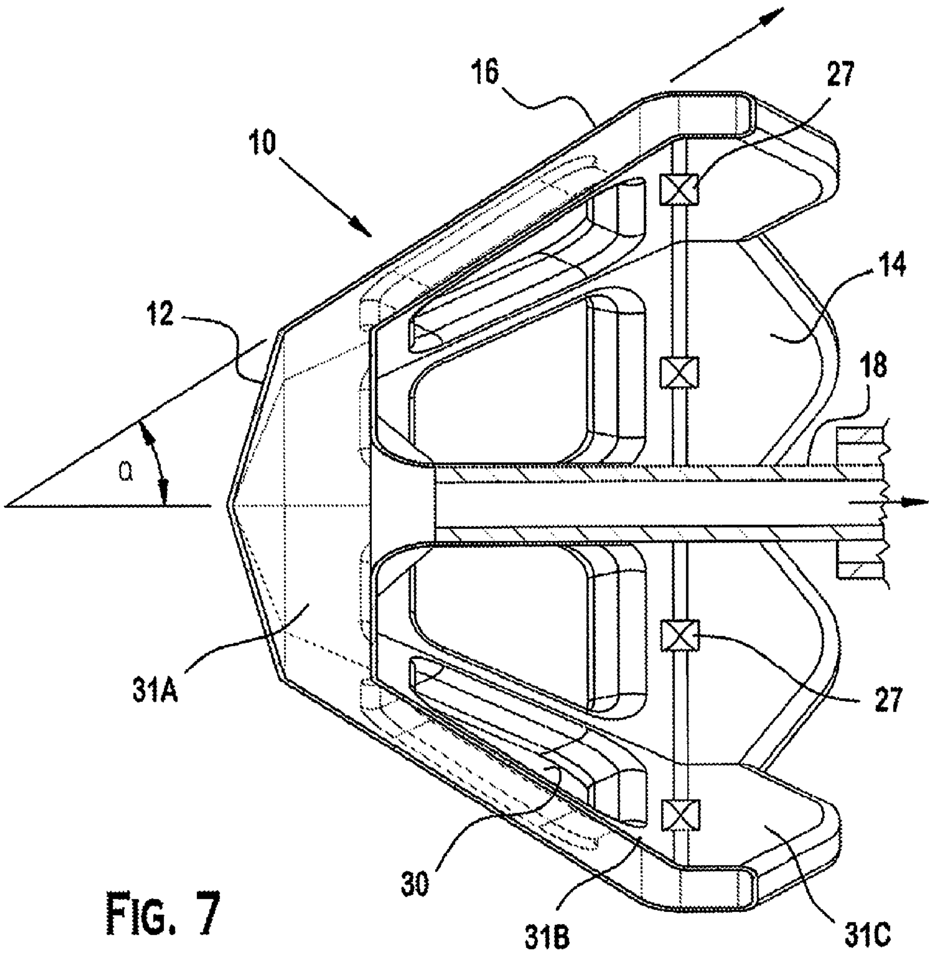


FIG. 7

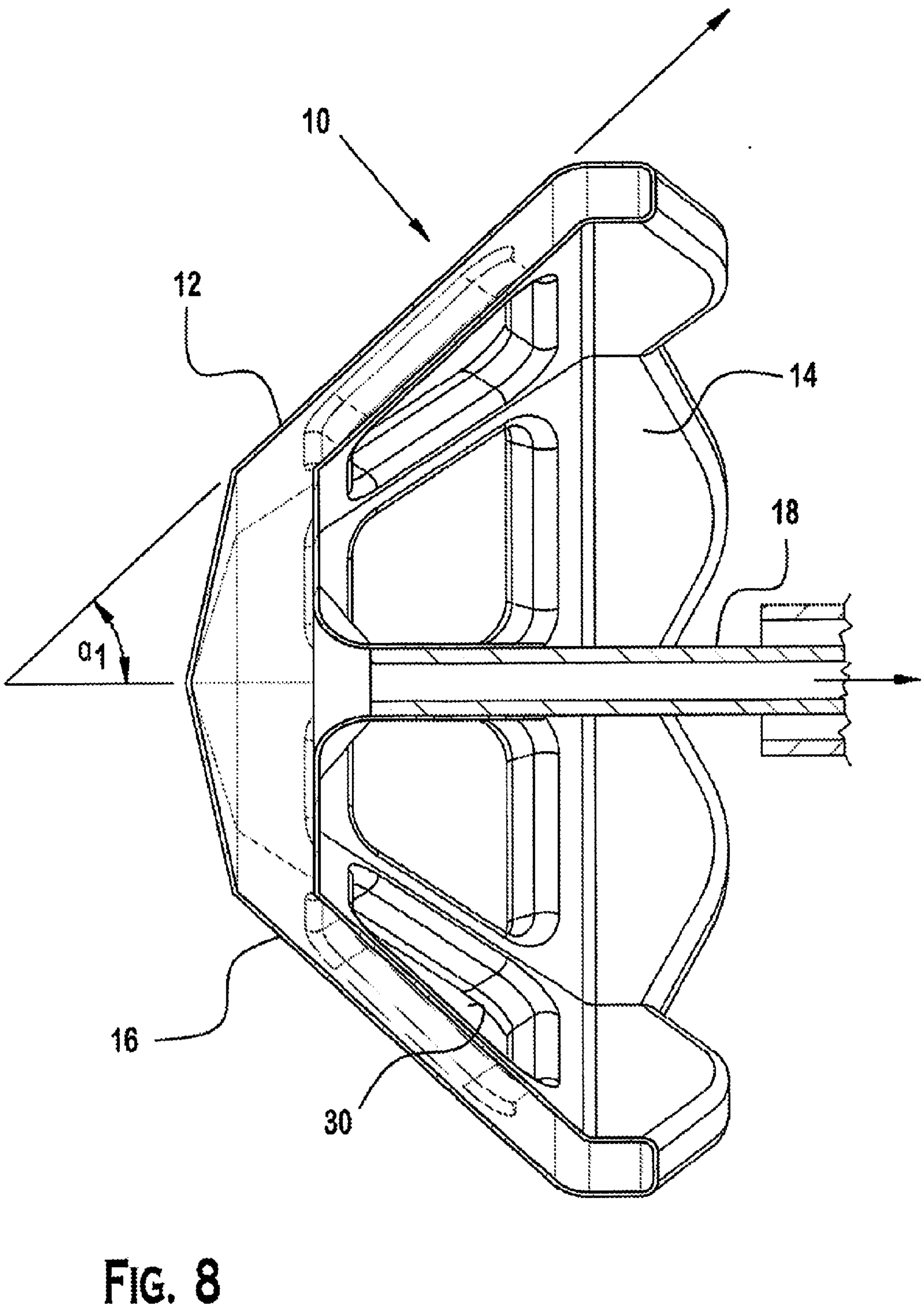


FIG. 8

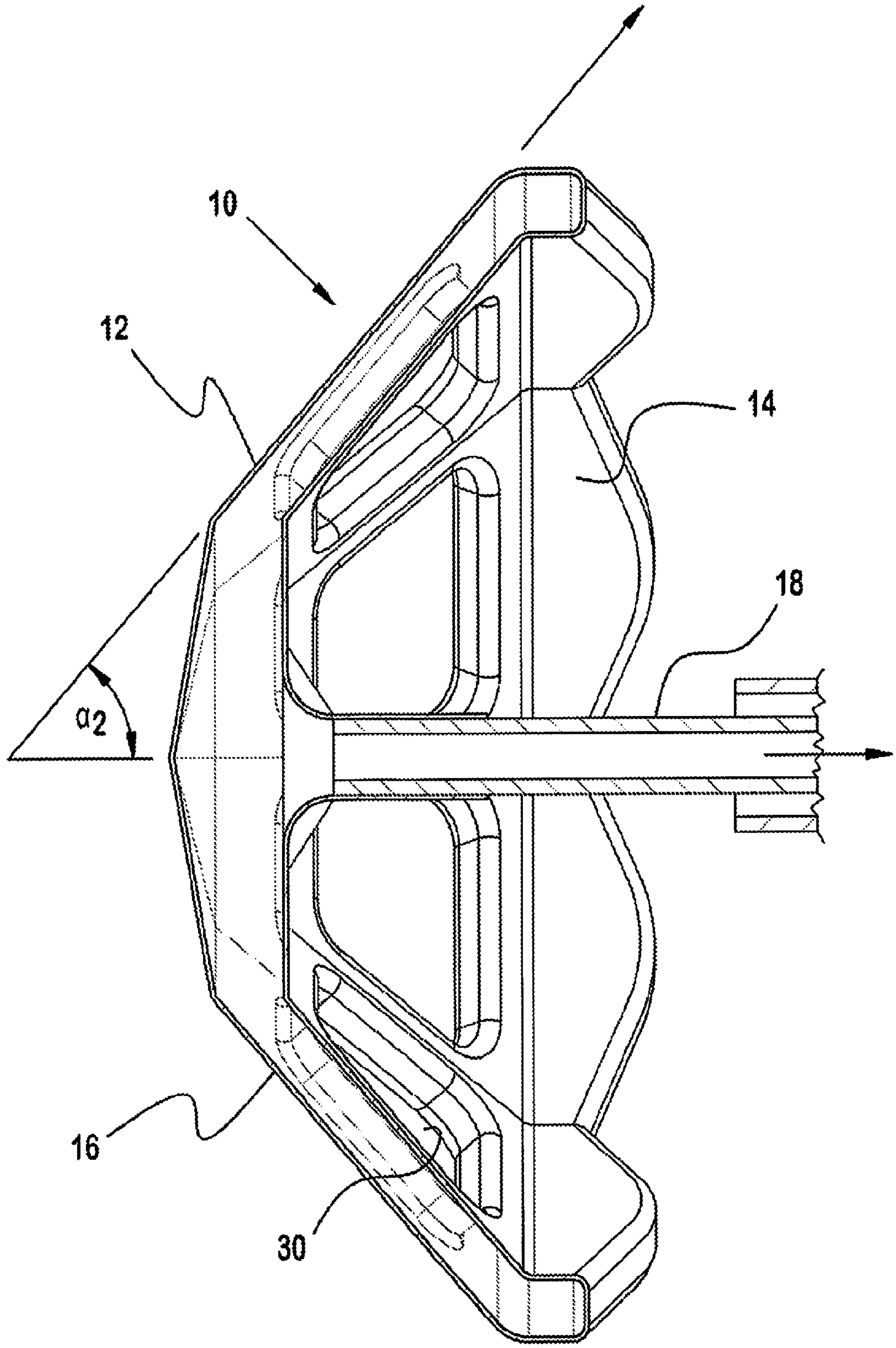


FIG. 9

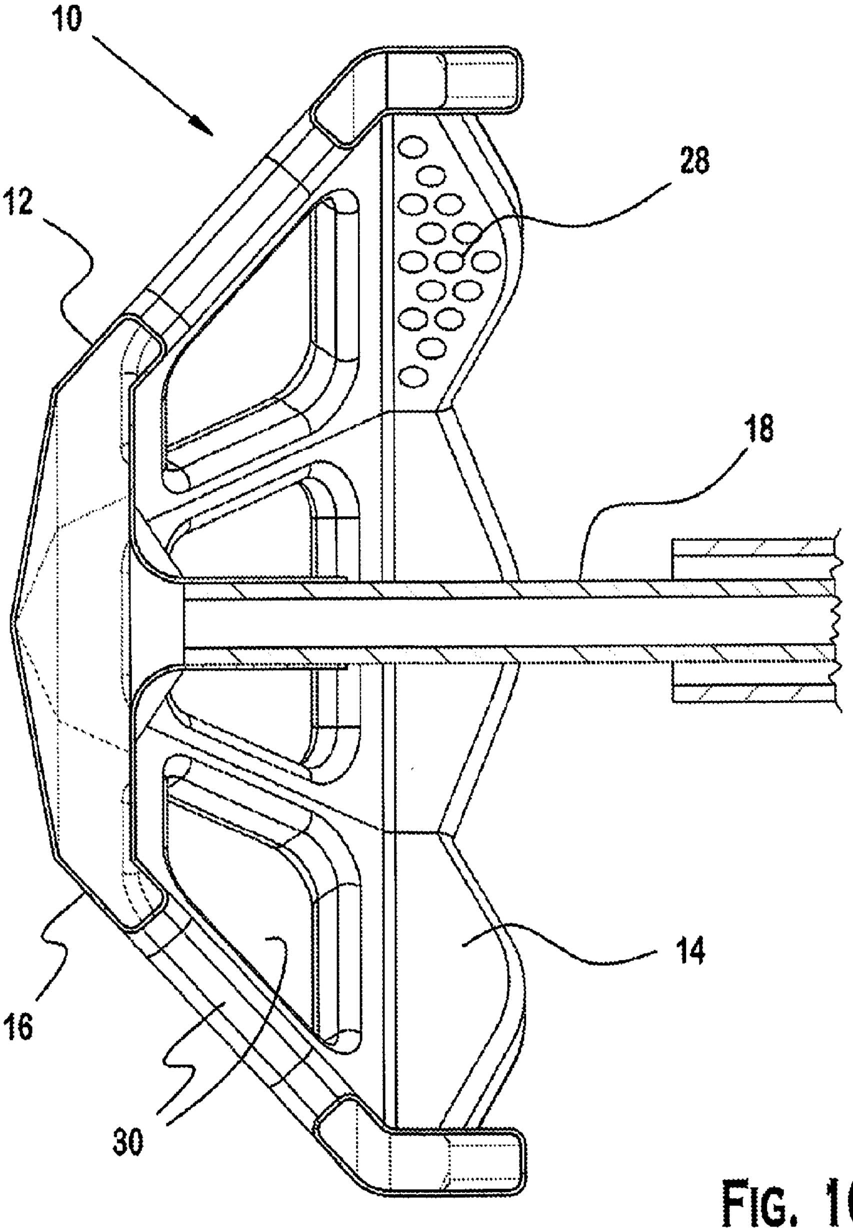


FIG. 10

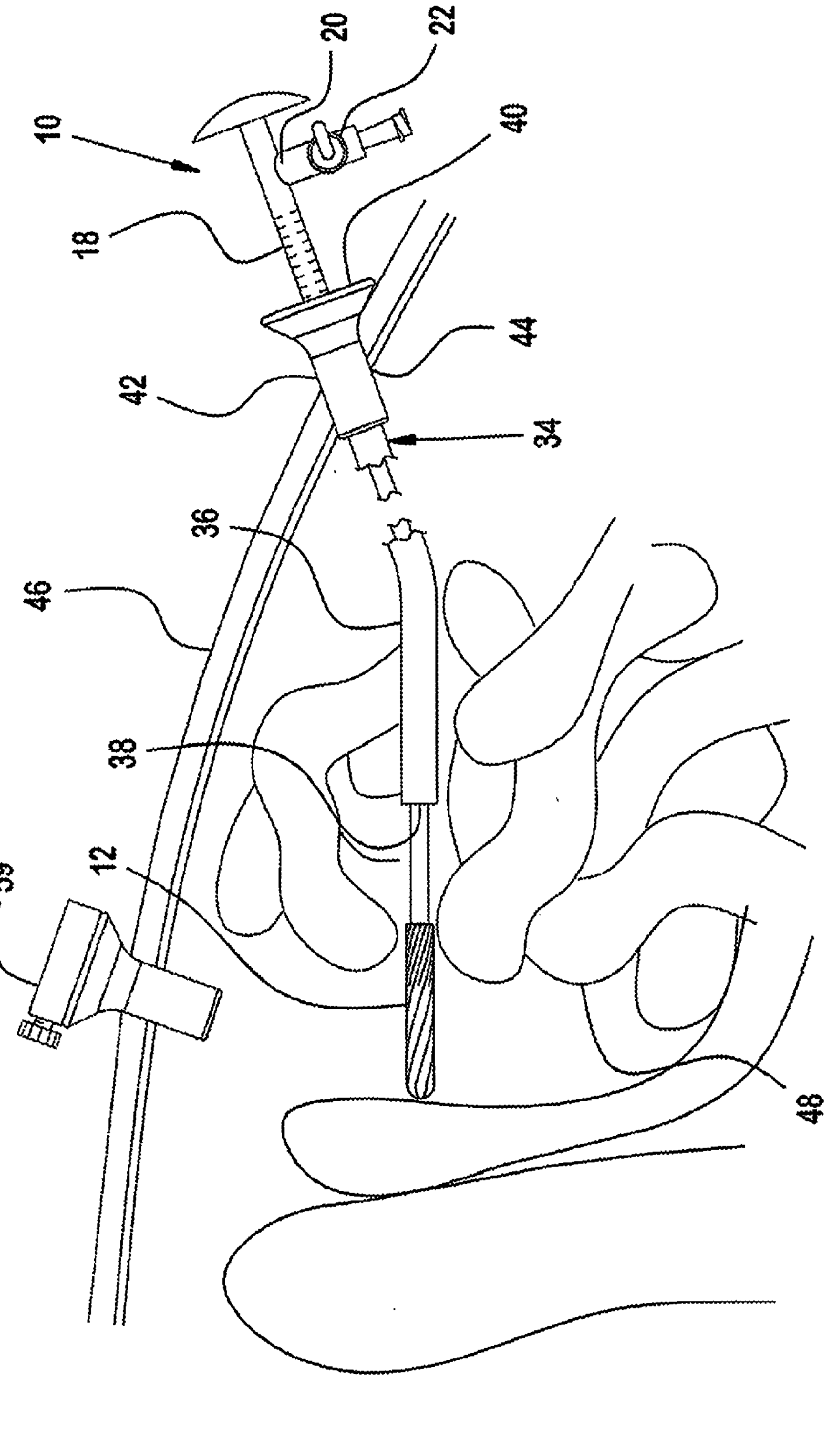


FIG. 11

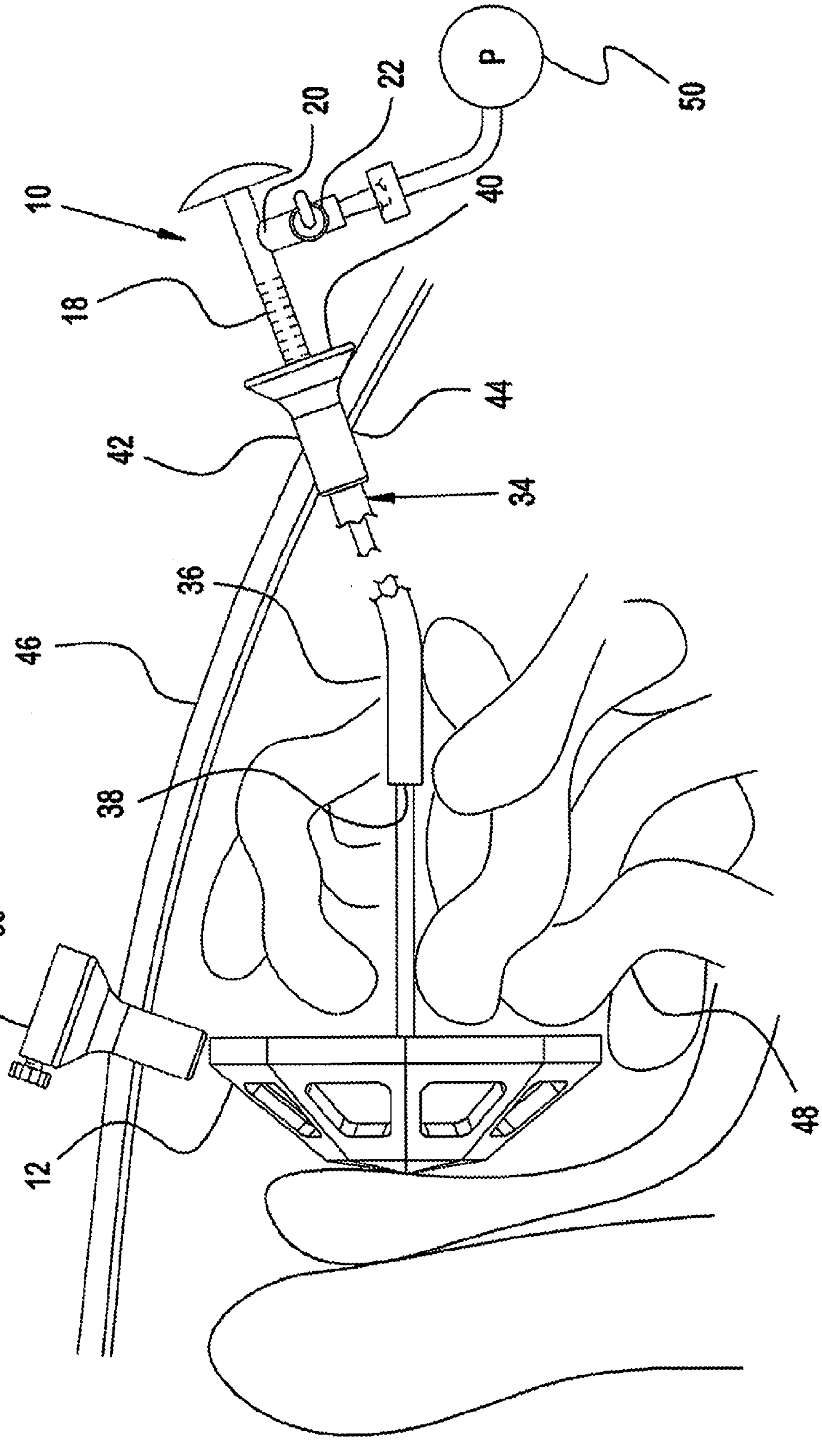


FIG. 12

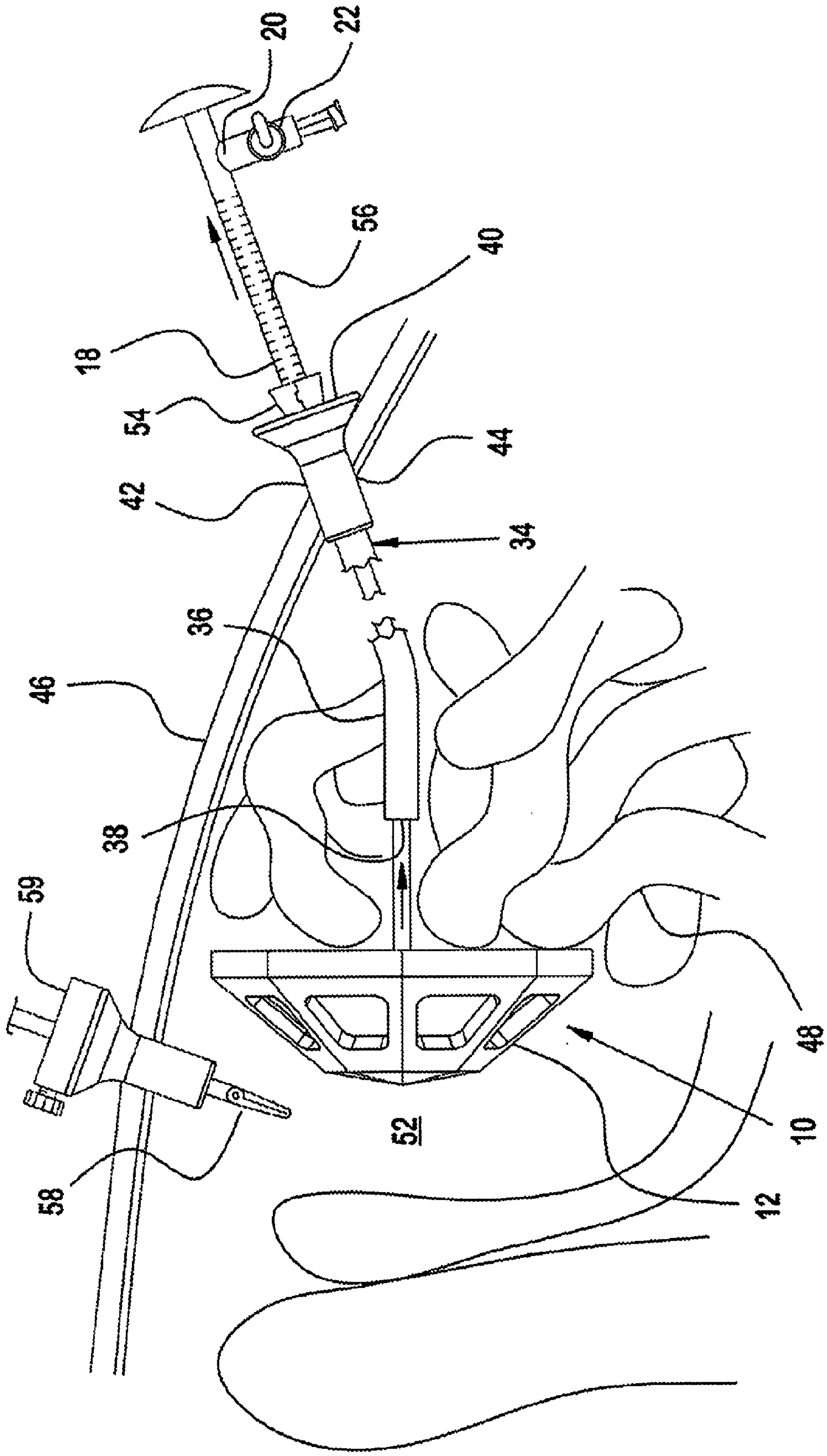


FIG. 13

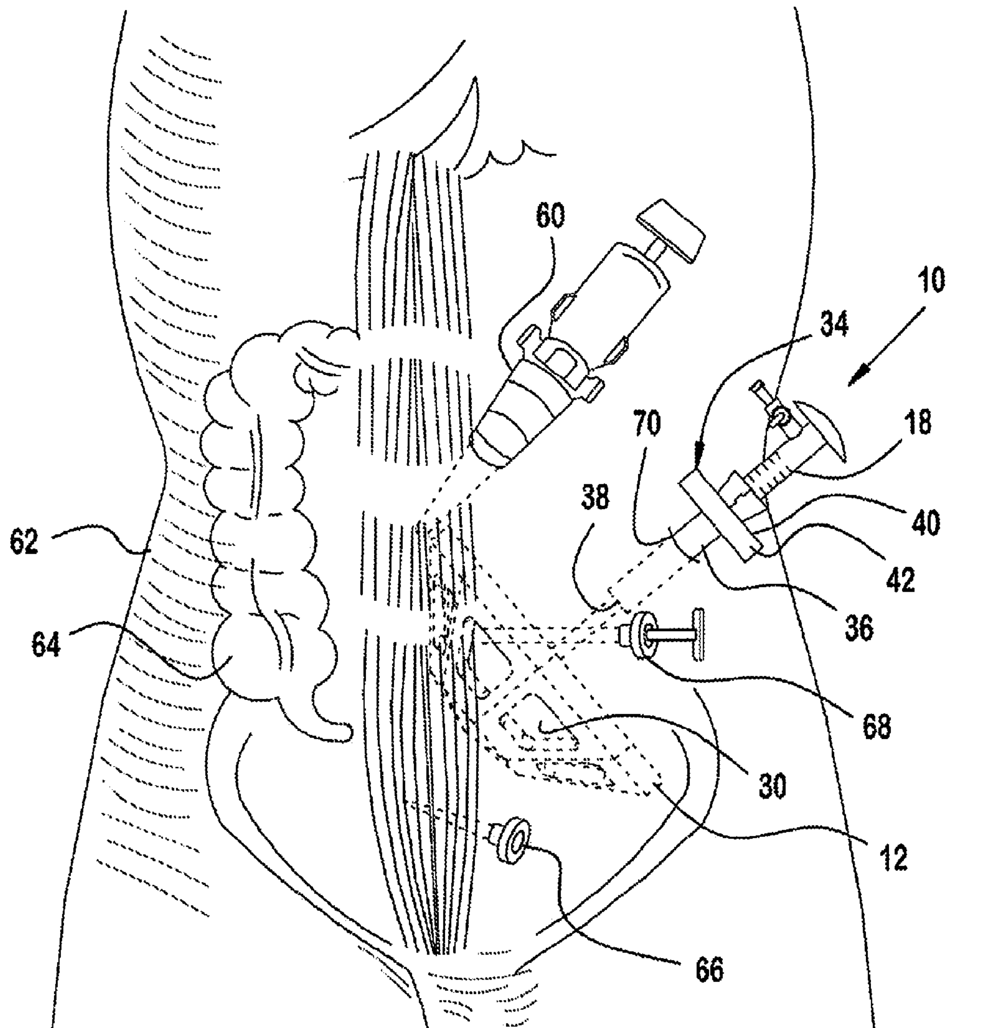


FIG. 14

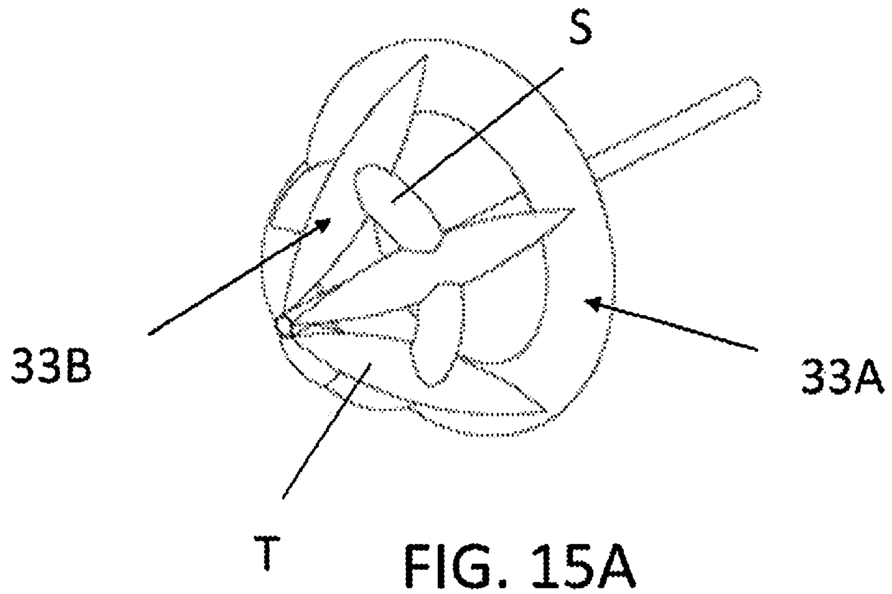


FIG. 15A

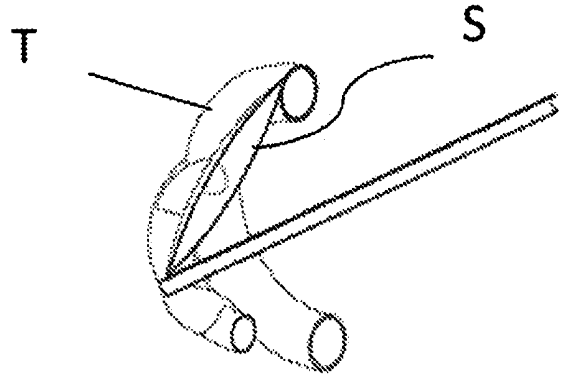


FIG. 15B

MINIMALLY INVASIVE LAPAROSCOPIC RETRACTOR

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 61/429,648 filed Jan. 4, 2011 and U.S. Provisional Application No. 61/450,682 filed Mar. 9, 2011, which are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

[0002] The present invention pertains to a retractor for use in laparoscopic surgery. More particularly, the present invention pertains to a minimally invasive inflatable retractor for use in laparoscopic surgery.

BACKGROUND OF THE INVENTION

[0003] Laparoscopic surgery, also known as minimally invasive surgery, is becoming an increasingly popular method of surgery. The number of surgeons graduating each year with advance minimally invasive training continues to increase, which means that the number of minimally invasive abdominal cases will also increase. One of the most challenging aspects of laparoscopic surgery is to be able to clearly visualize the organ of concern without having to constantly clear away intestines or other nearby organs from falling into the operative field.

[0004] For example, the removal of an inflamed appendix requires the surgeon to be able to isolate this organ from its nearby surrounding tissues, such as the colon, sigmoid, ileum, jejunum, ovaries, etc. If this operation were performed openly, through a large incision, then the surgeon has the option of using sterile towels to push the other intestines and organs away from the inflamed appendix, thereby creating a clear visual field for the safe removal of the organ.

[0005] Laparoscopically, the surgeon does not have the option of using a sterile towel. The frustration is amplified by the fact that the visualized operative field through a laparoscope is very narrow and close-up, and the avalanche of intestines into the operative field is often visualized suddenly at a critical part of the dissection process. Therefore, the surgeon must constantly "clear the field" by constantly pushing the adjacent organs away as they fall back and cover up the appendix, or try to utilize the tilt function of the operating room table to hopefully allow the adjacent organs to fall away from the operative field. This is an inconsistent method of isolating the operative field, which leads to an inefficient and sometimes dangerous operation.

[0006] Various tools have been developed for retracting organs from the field of vision during surgery. However, some of these tools themselves have been known to impart damage to the organs themselves.

[0007] Accordingly, there is a need in the art for a retractor for laparoscopic surgery that removes organs from the field of vision safely and effectively.

SUMMARY

[0008] According to a first aspect of the present invention, an inflatable retractor comprises an inflatable element including an inner surface and an outer surface and a retractor shaft including a port for receiving insufflation pressure, wherein the inflatable element is attached to a distal end of the retractor shaft. The inflatable element is configured so as to form a compartment for retaining the organ when the inflatable element is insufflated with fluid.

[0009] According to a second aspect of the present invention, an inflatable retractor comprises an inflatable element including at least a first chamber and a second chamber and a retractor shaft including a port for receiving insufflating pressure. The inflatable element is secured to a distal end of said retractor shaft. The inflatable element is configured so as to form a compartment when the inflatable element is insufflated with fluid. By using the term fluid, we also refer to air as a particular type of fluid that is useful.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The accompanying drawings provide visual representations which will be used to more fully describe the representative embodiments disclosed herein and can be used by those skilled in the art to better understand them and their inherent advantages. In these drawings, like reference numerals identify corresponding elements and:

[0011] FIG. **1** illustrates a perspective view of an exemplary retractor, in part, according to the features of the present invention showing the inflatable element in a deflated position.

[0012] FIG. **2** illustrates a perspective view of an exemplary retractor, in part, according to the features of the present invention showing the commencement of deployment of the inflatable element.

[0013] FIG. **3** illustrates a perspective view of the exemplary retractor in an inflated position according to the features of the present invention.

[0014] FIG. **4** illustrates a perspective view of the exemplary retractor in an inflated position according to the features of the present invention.

[0015] FIG. **4**A illustrates a perspective view of a valve to be used in connection with the exemplary retractor according to the features of the present invention.

[0016] FIG. **5** illustrates a top plan view of the exemplary retractor in an inflated position according to the features of the present invention.

[0017] FIG. **6** illustrates a cross sectional view of the inflatable element positioned within an outer deployment shaft according to features of the present invention.

[0018] FIG. **7** illustrates a cross sectional view of the inflatable element in a partially inflated position according to features of the present invention.

[0019] FIG. **8** illustrates a cross sectional view of the inflatable element in another partially inflated position according to features of the present invention.

[0020] FIG. **9** illustrates a cross sectional view of the inflatable element in a fully inflated position according to features of the present invention.

[0021] FIG. **10** illustrates a cross sectional view of the inflatable element in an inflated position and showing optional bumps according to features of the present invention.

[0022] FIG. **11** illustrates a partial schematic view of a patient during laparoscopic surgery illustrating initial deployment of the inflatable retractor according to features of the present invention.

[0023] FIG. **12** illustrates a partial schematic view of a patient during laparoscopic surgery illustrating insufflation of the inflatable retractor according to features of the present invention.

[0024] FIG. 13 illustrates a partial schematic view-of a patient during laparoscopic surgery illustrating engagement of the bowels by the inflatable retractor according to features of the present invention.

[0025] FIG. 14 illustrates a schematic view of a patient showing how the inflatable retractor of the present invention may be used during an appendectomy performed by laparoscopic surgery.

[0026] FIG. 15A illustrates a perspective view of another exemplary embodiment of the inflatable retractor according to features of the present invention.

[0027] FIG. 15B illustrates a perspective view of the inflatable retractor of FIG. 15B, with the crown removed.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] The present invention pertains to an inflatable retractor used in laparoscopic surgery to retract organs from the field of vision so that laparoscopic surgery of a particular organ may be performed. However, it should be understood that the inflatable retractor of the present invention is not limited to laparoscopic use, but may be applied to a wide variety of procedures, including open surgery, thoracic surgery, and endoluminal surgery.

[0029] With reference to FIGS. **1-10**, an inflatable retractor **10** includes an inflatable element **12** having an inner surface **14** and an outer surface **16**, and disposed at a distal end of a retractor shaft **18**, as shown, for example, in FIGS. **2-4** and **6-10**. The inflatable element **12** is configured such that, when deflated, the inflatable element can be wrapped around the distal end of the shaft **12**, and when inflated, the inflatable element **12** opens up like an umbrella to trap organs therein. In this way, the retractor **10** can be easily deployed without causing interference when in the deflated condition, while providing a substantial device that allows retraction of major organs when in the inflated condition.

[0030] To insufflate the inflatable element **12**, the retractor shaft **18** is hollow and includes a port **20** which communicates with an internal channel (not shown) for receiving insufflating fluid such as air (FIG. **4**), which causes the inflatable element **12** to expand and inflate. The size of the internal channel of the retractor shaft may be sufficiently large to allow another laparoscopic instrument (e.g., a grasper) to be deployed through the internal channel, thereby allowing the retractor **10** be used as an extended trocar. A 5 mm camera may also be placed through the internal channel of the retractor **10** to minimize visual impedance by the retractor **10**. In addition, while the port **20** is shown in FIG. **4** as being at the proximal end of the retractor shaft **18**, it should be understood that it may be at any location on the retractor shaft **18** that remains outside the patient's body during the procedure. For example, FIGS. **11-13** show the port **20** being located at the side of the retractor shaft **18**. In this way, a valve **22** is associated with port **20** to allow a surgeon to control insufflating the inflatable element **12**.

[0031] With reference back to FIG. **4**, the inflatable element **12** is configured so as to form a compartment **24** when the inflatable element **12** is insufflated with fluid. A "compartment" is hereby defined as a 3-dimensional volumetric space, which can retain organs therein. In this way, a "compartment" is like a bowl or an upside down umbrella, so that at least a portion of the organ or tissue can be constrained inside the compartment. As such, the compartment **24** acts to trap organs behind it, so that organs may be cleared from the field of vision. As shown in FIG. **4**, the compartment **24** is preferably umbrella shaped. However, the compartment **24** may be any other shape, depending upon application and design preference. For example, the compartment **24** may be flatter and v-shaped to bluntly isolate organs, such as the gallbladder, or for safe dissection of adhesed intra-abdominal planes.

[0032] Similarly, the inflatable element **12** is shown as being circular. However, other shapes are possible, including but not limited to, oval, rectangular, diamond, triangular, or square. In addition, while the inflatable element **12** is shown as being symmetrical, it should be understood that the inflatable element **12** may be asymmetrical, depending on application and design preference. In this way, the inflatable element **12** may be manufactured to any specific size or configuration to accommodate the operation, depending on application and design preference.

[0033] Preferably, the inflatable element **12** is made from a material that becomes rigid once inflated and has a sufficient tensile strength to hold large organs, such as the bowels that could weigh as much as 5 pounds. In addition, the inflatable element **12** is preferably made of an inert compound, so as to not aggravate patients with latex allergies. Examples of materials include, but are not limited to, any plastic or polymer based materials, such as polyurethane, silicone, and polyethylene.

[0034] In addition, the inflatable element **12** should be sufficiently sized and configured to hold particular organs at issue. For example, in the case of retracting bowels, the width of the inflatable element **12** may be up to 50-75% of the cross sectional view of the abdominal cavity. In addition, inflatable element **12** should be sufficiently thick so as to prevent the inflatable element **12** from turning inside out. However, other sizes and shapes are possible, depending upon application and design preference. Similarly, the retractor shaft **18** should be made from a material that is rigid and sturdy, and able to hold the inflatable element **12** and the organs retained therein. Such materials include, but are not limited to, polyethylene, silicone, polyurethane or any plastics or polymer based material.

[0035] To further prevent the inflatable element **12** from turning inside out, a support structure **25** may be positioned between the inflatable element **12** and the retractor shaft **18** (FIG. **4**). Preferably, the support structure **25** is configured and sized to provide maximum support, while taking up minimum space. In the preferred embodiment, the support structure **25** is inflatable and made from the same material as the inflatable element **12**. However, the particular shape, configuration and material of the support structure **25** will depend upon application and design preference.

[0036] With reference to FIGS. **4**, **5**, and **7**, valves **27** are provided at various locations within the inflatable element **12** to control insufflation of various parts of the inflatable element **12**. With reference to FIG. **4**A, the valve **27** is configured to include a partition **29** down the middle, which may be twisted 90 to 180 degrees, which acts as a flow restrictor. The twistable partition **29** makes it a plug at low insufflation pressures, which requires more back pressure to insufflate the first compartment. After adequate insufflation, it allows air to pass and fill up the second compartment, to allow for "staged" insufflation of the retractor **10**.

[0037] According to a preferred embodiment as shown in FIGS. **4**, **5**, and **7**, the valves **27** are placed at strategic locations between the inner surface **14** and outer surface **16** of the inflatable element **12** so as to form staged insufflation of the inflatable element **12**. According to the preferred embodiment shown in FIG. **4**A, staged insufflation may proceed, whereby the first insufflatable chamber **31**A is filled first (see FIG. **7**), followed by the second insufflatable chamber **31**B, and then the third insufflatable chamber **31**C.

[0038] For example, the inflatable element **12** may be designed such that when the first inflatable chamber **31** A reaches a predetermined insufflation pressure, the valves **27** positioned between the first inflatable chamber **31**A and second inflatable chamber **31**B open to allow fluid into the second inflatable chamber **31**B. Similarly, when the second inflatable chamber **31**B reaches a predetermined insufflation pressure, the valves **27** positioned between the second inflatable chamber **31**B and the third inflatable chamber **31**C open to allow fluid into the third inflatable chamber **31**C.

[0039] In another exemplary embodiment as shown in FIGS. **15**A and **158**, two independent and separate chambers **33**A and **33**B are illustrated. In this way, one or more tubes may be used to insufflate each chamber independently, allowing for varying pressures in each chamber. For example, the outer rim or crown **33**A of the inflatable element **12** may be tilled with less pressure so as to minimize damage to bowels during retraction, while a rigid base with a greater pressure would provide more stability to the device. The second chamber **33**B may include support elements S, connected by an extra tubular section T, which connects the tubular section T and support elements S to a single sphere.

[0040] Accordingly, the insufflation pressure of the different chambers **33**A and **33**B may be controlled by the user to obtain specific and/or different pressures in each chamber. In addition, each of the support elements S may be separately inflatable, allowing for an asymmetric pumping of the inflatable element, thereby achieving a single larger side observation window.

[0041] While two chambers are shown in the exemplary embodiment, it should be understood that any number of chambers may be used depending upon application and design preference. To aid in attachment to surrounding tissue to maximize retraction potential, the inner surface **14** may include bumps **28**, as shown in FIG. **10**. In addition, the outer edge **26** of the inflatable element **12** (FIG. **4**) may be wedged or scalloped, to further aid in adhesion of the surrounding tissue. Importantly, there should be no sharp edges or hard substances on the inflatable element **12** to potentiate bowel injury or vessel damage. However, the bumps **28** and wedged outer edge **26** are not necessary, particularly if inflatable element **12** is made from material having a sufficiently high surface roughness.

[0042] With reference to FIGS. **3-5**, a plurality of windows **30** may be disposed through the inflatable element **12**. The windows **30** should be sufficiently large so as to enable a field of vision beyond the outer surface **16** of the retractor **10**. That is, the windows **30** should be sized to allow the surgeon to see behind the retractor **10**. The windows **30** may be any size or shape, and in any pattern or configuration, depending on application and design preference. In addition, the windows **30** also should be sufficiently sized to allow for other instruments to be positioned there through, as will be described in more detail below.

[0043] With reference to FIGS. **7-9**, the inflatable element **12** may be insufflated to different levels, such that a configuration of the compartment **24** changes according to the insufflating level. For example, in the particular embodiment shown in FIGS. **7-9**, the amount of concavity of the inflatable element **12** is adjustable by changing the insufflation pressure of the inflatable element **12**. As shown in FIG. **7**, a more compact, deeper compartment is possible when the inflatable element **12** is insufflated to a lower level. In this way, the angle α formed between a longitudinal axis of the retractor shaft **18** and a predominant axis of the inflatable element **12** is relatively small. Comparatively, a flatter compartment is shown in FIG. **8**, wherein the inflatable element **12** is insufflated to a medium level. In this way, the angle α_1 formed between a longitudinal axis of the retractor shaft **18** and a predominant axis of the inflatable element **12** is greater than the angle α from FIG. **7**.

[0044] Still, a further flattened compartment **24** is shown in FIG. **9**, wherein the inflatable element **12** is insufflated to a high level. In this way, the angle α_2, formed between a longitudinal axis of the retractor shaft **18** and a predominant axis of the inflatable element **12** is greater than the angle α from FIG. **7** and angle α_1 from FIG. **8**. Preferably, the angle α formed between a longitudinal axis of the retractor shaft **18** and a predominant axis of the inflatable element is between 0 and 90 degrees, and more preferably, between 20 and 70 degrees. Importantly, the angle must be chosen so that the retractor does not turn inside out during use. The optimum angle chosen will also depend upon the size, thickness and configuration of the inflatable element.

[0045] With reference, for example, to FIG. **7**, the level of insufflating is under complete control of the surgeon by way of valve **22**. By operating the valve **22**, the surgeon may control the rate of insufflation, as well as the final rigidity and shape of the retractor **10**. As such, the insufflation process may be operated in a gentle way to retract and separate intestines, even in the setting of adhesion. However, it should be understood that other types of mechanisms for insufflating the inflatable element may be used, depending upon application and design preference.

[0046] For example, a pressure indicator may be included, which indicates the pressure of the inflatable element **12**. The pressure indicator may be correlated to the inflatable element **12**, such that certain chambers of the inflatable element **12** collapse when the pressure exceeds a predetermined level. As such, the fully inflated element **12** allows for a built in load limiter which limits the load applied to the intestine. In addition, the correlation between the collapsing value and the internal pressure level may be preset, and the user should be instructed on what volume of air should be pumped into the trocar.

[0047] With reference to FIGS. **1**, **2** and **6**, deployment of the retractor **10** will be described in more detail. In particular, the inflatable element **12** may be housed in an outer deployment shaft **34**. Preferably, the outer deployment shaft **34** is adapted to retain the inflatable element **12** therein when in the deflated condition, as shown, for example, in FIGS. **1**, **2**, and **6**. In this way, the inflatable element **12** is positioned around the retractor shaft **18**, and nestled within the inner channel of the outer deployment shaft **34**.

[0048] With reference to FIGS. **11-14**, the outer deployment shaft **34** may be constructed as a standard trocar-induced cannula. In particular, the outer deployment shaft **34** may include a cannula **36** at a distal or insertion end **38** for penetration into body of a patient, and a proximal end **40** having a cannula handle **42** maintained outside the body of the patient. The outer deployment shaft **34** may be made from a material that is easily sterilized, biocompatible, and durable, such as polyethylene, and the like.

[0049] While retractor **10** is illustrated in connection with an outer deployment shaft **34**, it should be understood that the retractor **10** may be inserted inside any laparoscopic port without the use of the outer deployment shaft **34**. In this way, the retractor is inserted directly into an existing port. As such, the retractor **10** is not limited to any particular housing or shaft, or method of insertion into a patient's body.

[0050] With reference to FIGS. **11-13**, the retractor **10** may be deployed through a standard trocar, such as a 10/12 mm trocar, although any sized trocar is possible, depending upon application and design preference. For example, the retractor **10** may be designed to fit through 5 mm trocars to optimize efficiency.

[0051] With particular reference to FIG. **11**, the retractor **10** may be inserted into a port **44** of the body **46** of a patient. In particular, the retractor **10** is moved out of the outer deployment shaft **34** towards the organ to be retracted. As described above, the outer deployment shaft **34** may be part of a trocar-induced cannula, but may also be a separate shaft, as shown, for example, in FIG. **4**. During deployment of the retractor **10**, the inflatable element **12** remains in a deflated condition. As described above, the surface roughness of the material of the inflatable element **12** preferably allows it to stay positioned about the retractor shaft **18** during deployment. This self-adhesive ability would also allow the inflatable element **12** to be deployed into an existing port without an outer deployment shaft, as described above.

[0052] With continued reference to FIG. **11**, the retractor **10** is directed past the organ it is intended to retract. As shown in FIG. **11**, the retractor **10** is positioned below the bowels **48**. Once the retractor **10** is appropriately positioned, the surgeon operates valve **22** to inflate the inflatable element **12**, as shown in FIG. **12**. In particular, a pump **50** may be provided to direct insufflation fluid to the inflatable element **12**. The inflatable element **12** may be filled with any type of fluid, including but not limited to, liquid such as saline and air such as CO_2. The pump **50** may be the same source providing CO_2 to insufflate the abdomen, or may be a separate source, depending on application or design preference. For example, a hand-held pump similar to one used to take blood pressure, may be provided. The pump preferably is designed to attach onto the insufflation port, which would allow a surgeon to manually pump the appropriate amount of fluid into the inflatable element.

[0053] Moreover, as described above, the surgeon controls the level of insufflation of the retractor **10** by controlling valve **22**. That is, the retractor **10** may be filled to different levels, as shown for example, in FIGS. **7-9**, with the final shape and rigidity of the inflatable element **12** depending on the amount of fluid that is insufflated into the system. As the inflatable element **12** is insufflated with fluid, the inflatable element **12** opens up and moves away from the retractor shaft **18**, similar to the opening of an umbrella. Once the appropriate orientation, size, and rigidity are achieved, the inflatable element **12** is set to trap and hold the organs behind it.

[0054] With reference to FIG. **13**, once the organs (and in this case, the bowels **48**) are trapped within the inflatable element **12**, the surgeon pulls back on the retractor shaft **18** to clear the field of view of the surgical area **52**. As shown in FIG. **13**, the retractor **10** may be secured into place by way of clamp **54**. Preferably, the clamp **54** is circular and includes inner ridges (not shown) which mate with outer ridges **56** on the exterior surface of the retractor shaft **18**, keeping the retractor **10** in place. The corresponding ridges allow the clamp to anchor the retractor **10** onto the outer deployment shaft **34** or cannula, without allowing it to slide. Preferably, the clamp **54** is hinged, and has a simple locking mechanism (such as a latch) to allow it to close circumferentially around the retractor shaft **18**. When closed, the clamp **54** rests on top of the outer deployment shaft **34** or cannula and prevents the retractor **10** from sliding within the outer deployment shaft **34**, thereby potentially obviating the need of additional assistance.

[0055] A laparoscope (not shown) can then be advanced either past the balloon, or through the windows **30** to keep it out of the visual field. In addition, one or more surgical tools **58** may be advanced through other ports via a cannula **59** or the like to perform the particular laparoscopic procedure. Once the operation is complete, the inflatable element **12** may be deflated by opening up valve **22**, and removing the deflated inflatable element **12** from the body of the patient. Alternatively, the inflatable element **12** may be easily punctured, so that the insufflation fluid falls into the body of the patient, before the deflated inflatable element **12** is removed, allowing for quick removal.

[0056] The retractor **10** according to the features of the present invention is easily deployable and mobile. It has a variable shape and rigidity, which is controlled by the surgeon or assistant. As such, the retractor **10** may be particularly helpful to surgeons having high volumes, or who will be operating on deeper structures in the abdominal cavity or pelvis, where a still operative field is necessary for line and intricate dissection. It also allows for consistent and atraumatic retraction of the adjacent organs for a safer and more efficient operation to be performed.

[0057] In addition, the retractor **10** of the present invention allows for the safe and consistent isolation and retraction of adjacent organs to allow clear visualization of the target organ of interest. It can be used in multiple quadrants of the abdomen, and will not cause injury to healthy intestines or solid organs. It is easily deployed through a laparoscopic port, and does not require advanced laparoscopic training to use.

EXAMPLE 1

[0058] With reference to FIG. **14**, use of the retractor **10** of the present invention is described in connection with abdominal surgery. In particular, the surgeon makes an infraumbilical incision with a Hasson trocar **60** and safely enters the abdominal cavity. The patient **62** has adhesions in the right lower quadrant of the abdomen due to an inflamed appendix **64**. A first 5 mm trocar **66** is inserted in the supra-pubic position and a second 5 mm trocar **68** is placed into the left lower quadrant. The retractor **10** is deployed through an incision **70** in the left upper quadrant cannula **34**, and graspers (not shown) are placed in the 5 mm trocars **66** and **68**. The inflatable element **12** is brought into view. The intestines are retracted toward the left upper quadrant away from the appendix **64**, and the inflatable element **12** is deployed by insufflation.

[0059] As the inflatable element **12** opens like a spiraling umbrella, the inflatable element **12** systematically traps the intestines behind it. The surgeon may help by gently positioning the intestines behind the inflatable element. The insufflation pressure of the inflatable element **12** is adjusted by the surgeon to provide adequate retraction and rigidity. The retractor **10** is then pulled back towards the left upper quadrant to create more space around the appendix **64**. The laparoscope position may be adjusted so that the view is unimpeded by the retractor **10**. This can be done by further retracting the inflatable element **12** away from the field, or by adjusting the scope so that it is looking through the windows **30** of the inflatable element **12**. The appendix **64** is then clearly visualized, the operative field is free of cascading intestines and the operation is safely and efficiently performed. Once the appendix **64** is removed, the inflatable element **12** is desufflated and the retractor **10** is removed from the abdominal cavity.

[0060] While the inflatable retractor **10** has been described primarily in connection with retracting organs from the field of vision during laparoscopic surgery, it should be understood that it may have different uses, including but not limited to, as a dissection tool for the dissection of a target organ or adhesed planes. For example, the insufflating property of the retractor **10** will allow it to safely open adhesed planes in an atraumatic fashion. The retractor **10** may also be useful for hemostatic or tamponade bleeding. In particular, the inert material will allow it to be used as a compressive device to minimize bleeding from an injured vessel or gastrointestinal spillage from an enterotomy. The retractor **10** may also be used for thoracic surgery to isolate the lung or pulmonary vessel. However, it should be understood that the retractor **10** may have many different uses, depending upon application and design preference.

[0061] Although the present invention has been described in connection with preferred embodiments thereof, it will be appreciated by those skilled in the art that additions, deletions, modifications, and substitutions not specifically described may be made without departing from the spirit and scope of the invention as defined in the appended claims.

1-21. (canceled)

22. An inflatable retractor, comprising:

a rigid retractor shaft having a proximal end and a distal end;

an inflatable element secured to a distal end of said shaft; said inflatable element comprising no hard substances;

wherein a predominant axis of said inflatable element is configured to be at a selectable angle relative to a longitudinal axis of said shaft, said angle selectable from the range of 0-90 degrees.

23. The retractor of claim **22**, wherein said inflatable element is configured so as to form a compartment for retaining an organ when said inflatable element is insufflated with fluid.

24. The retractor of claim **22**, wherein said shaft includes a port for receiving insufflating fluid for insufflating said inflatable element.

25. The retractor of claim **22**, wherein said inflatable element is configured to be wrapped around a distal end of said shaft when deflated.

26. The retractor of claim **22**, wherein said inflatable element includes at least a first chamber and a second chamber.

27. The retractor of claim **22**, wherein said inflatable element is configured such that the final shape and rigidity of the element depends on the amount of fluid insufflated.

28. The retractor of claim **22**, wherein said inflatable element comprises one or more valves for regulating insufflation pressure.

29. The retractor of claim **22**, further comprising an outer deployment shaft disposed about said retractor shaft and adapted to surround said inflatable element when in a deflated condition.

30. The retractor of claim **22**, wherein said shaft is hollow and comprises an internal channel sufficiently large to allow a laparoscopic instrument to be deployed through.

31. The retractor of claim **22**, wherein said inflatable element is made of an inert compound, including plastic or polymer based materials.

32. The retractor of claim **22**, wherein said retractor comprises a pressure indicator.

33. The retractor of claim **22**, wherein said angle is selectable from the range of 20-70 degrees.

34. The retractor of claim **22**, wherein in a deflated condition said retractor is shaped and sized to fit through a trocar.

35. A method of retracting tissue using the retractor of claim **22**, comprising:

introducing at least a portion of said device into the body, wherein said inflatable element is in a deflated condition;

insufflating said inflatable element with fluid;

forming an angle between said inflatable element and said longitudinal axis of said retractor shaft;

pulling back on said shaft to retract tissue so as to clear the field of vision.

36. The method according to claim **35**, further comprising changing said angle by changing an insufflation pressure.

37. The method according to claim **35**, further comprising, prior to said pulling, directing said inflatable element past an organ it is intended to retract.

38. The method according to claim **35**, wherein said insufflating comprises filling said inflatable element with one or more of air, saline, and CO_2.

39. The method according to claim **35**, further comprising deflating said inflatable element by opening up a valve on said inflatable element or by puncturing said inflatable element.

40. The method according to claim **35**, further comprising selecting said angle by insufflating said inflatable element to a predetermined level.

41. The method according to claim **40**, further comprising adjusting the amount of concavity of said inflatable element by changing said insufflation level.

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专利名称(译)	微创腹腔镜牵开器

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摘要(译)

一种用于在病人身体的腹腔镜手术中使用的充气牵开器包括设置在牵开器的轴的远端的可膨胀元件。牵开器的轴包括用于接收吹入流体的端口。可膨胀元件包括一个内表面和外表面，使得可膨胀元件形成与牵开器的轴的角度，当可膨胀元件与流体吹入形成的隔室。取决于吹气压力可膨胀元件和牵开器的轴的变化之间形成的角度。以这种方式，可膨胀元件的刚性和形状由外科医生通过吹气压力的使用量进行控制，从而为灵活性和易用性。