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(12) **United States Patent**
**Hashiba**

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(54) **MEDICAL SYSTEMS, DEVICES AND METHODS FOR SUTURING PERFORATIONS**

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(51) **Int. Cl.**

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|---|---|
| ***A61B 17/04*** | (2006.01) |
| ***A61B 1/018*** | (2006.01) |
| ***A61B 1/00*** | (2006.01) |
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| ***A61B 17/062*** | (2006.01) |
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(52) **U.S. Cl.**

CPC ..... ***A61B 1/018*** (2013.01); ***A61B 1/0008*** (2013.01); ***A61B 17/0057*** (2013.01); ***A61B 17/0469*** (2013.01); ***A61B 17/0625*** (2013.01); *A61B 17/0482* (2013.01); *A61B 17/0487* (2013.01); *A61B 2017/00663* (2013.01); *A61B 2019/4857* (2013.01)

(58) **Field of Classification Search**

CPC ..... A61B 17/0057; A61B 17/0469; A61B 17/0482; A61B 17/062; A61B 17/0625; A61B 1/0008; A61B 1/018

USPC ..... 606/139, 144, 148, 140–143, 145–147

See application file for complete search history.

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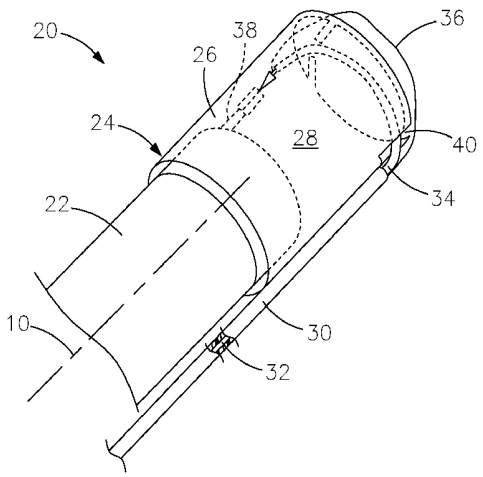
(57) **ABSTRACT**

Medical systems, devices and methods are disclosed for suturing a perforation in tissue, that may be employed endoscopically and/or laparoscopically, and that offer simple, reliable and controllable placement of sutures around a perforation for complete closure thereof. One embodiment of the medical system generally includes an endoscope, an endcap, an elongated side tube, a needle, a suture and a retrieval device. The endcap is fitted to a distal end of the endoscope. The elongated side tube defines a side channel and is connected to the endcap. The needle has a shaft and a needle tip detachably connected to a distal end of the shaft. The needle is sized to be translated through the side channel of the side tube. The suture is attached to the needle tip. The retrieval device is sized to be translated through a working channel of the endoscope and retrieve the needle tip.

**13 Claims, 7 Drawing Sheets**



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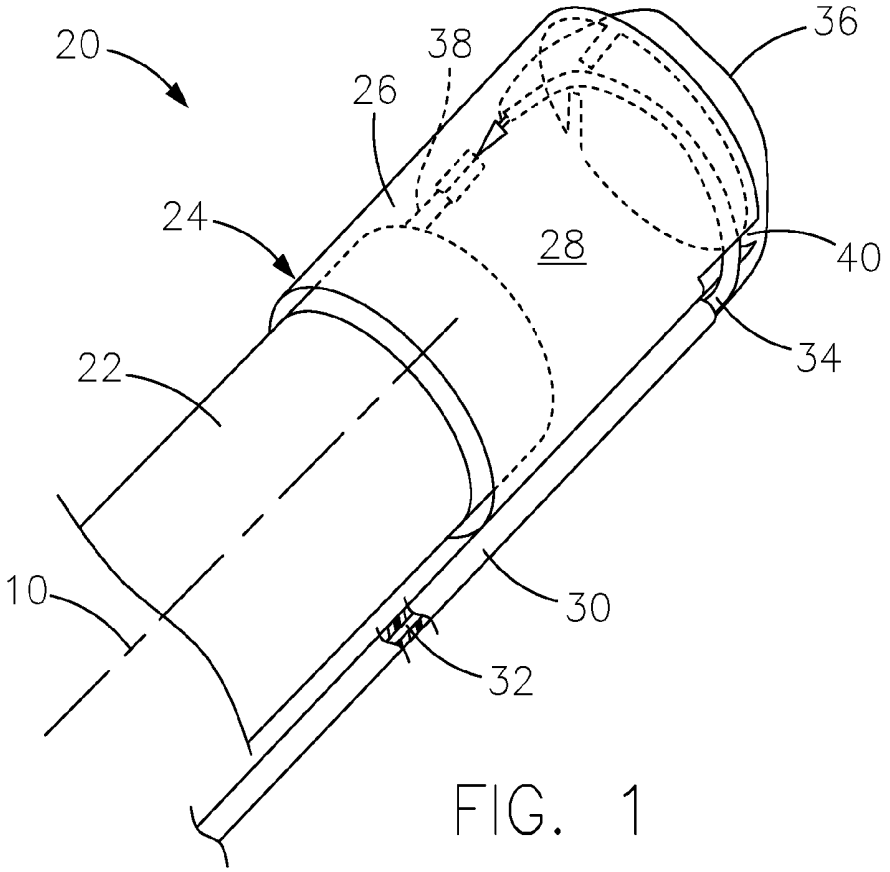
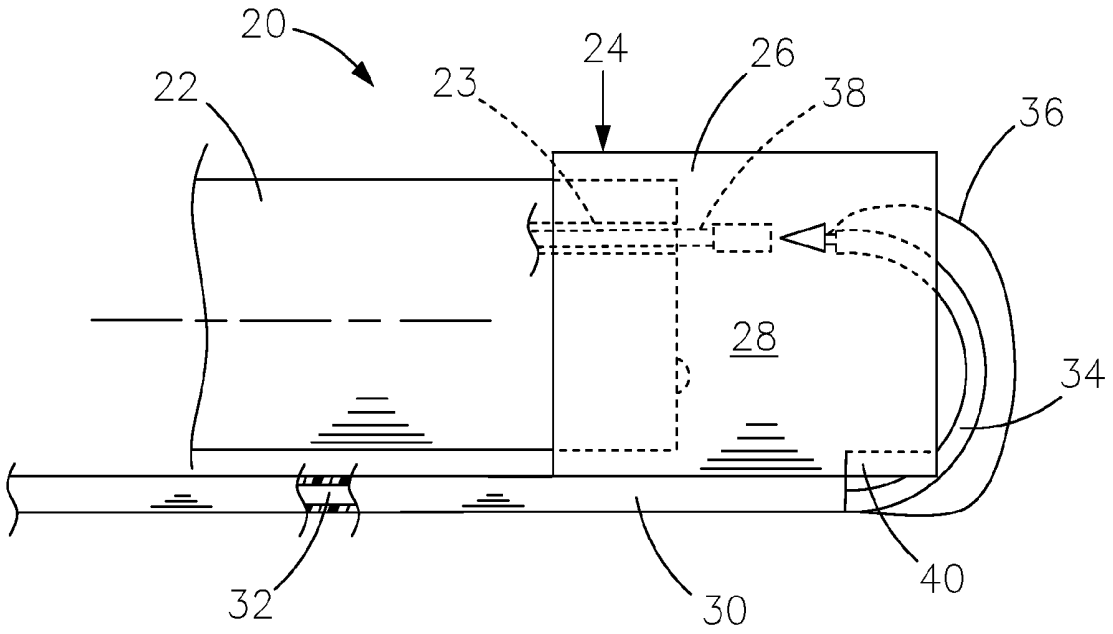



FIG. 1

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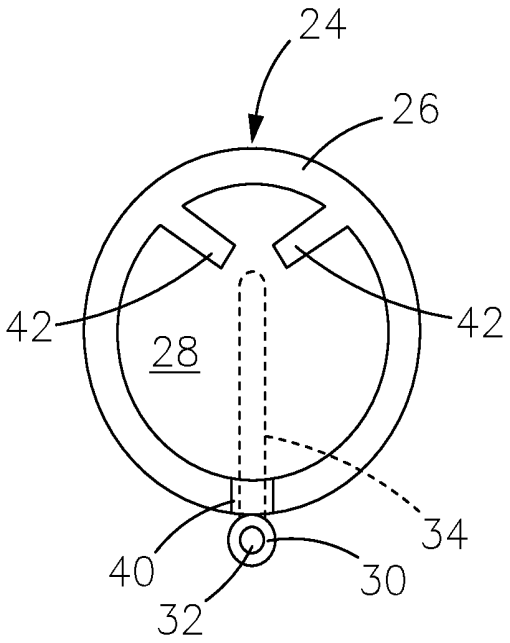


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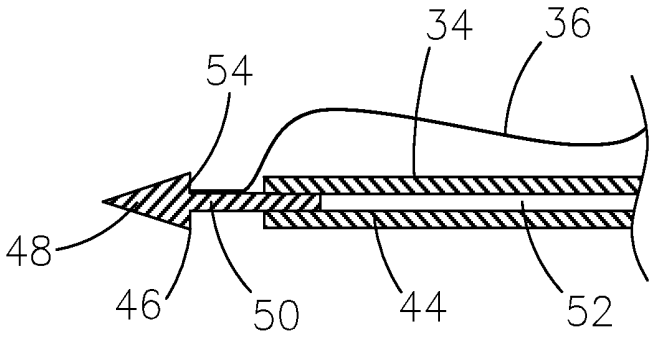


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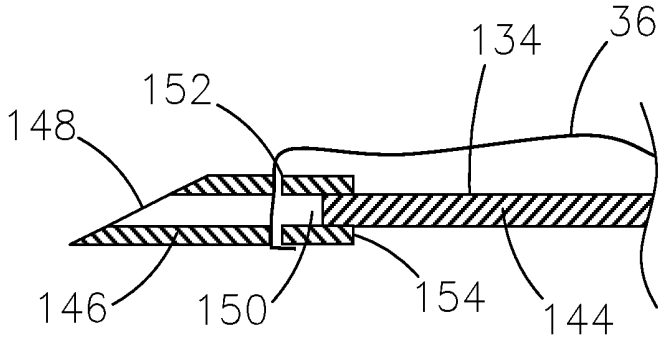


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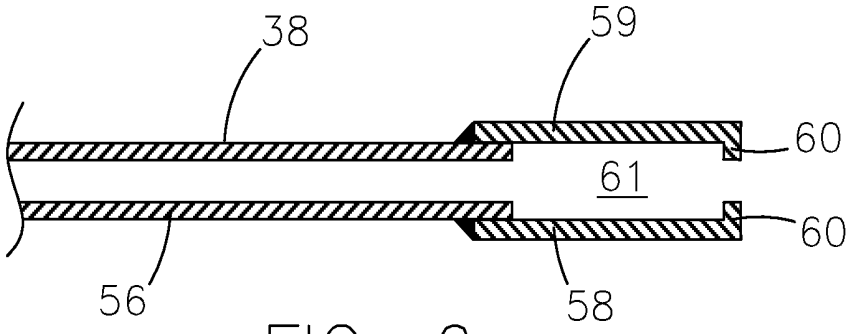


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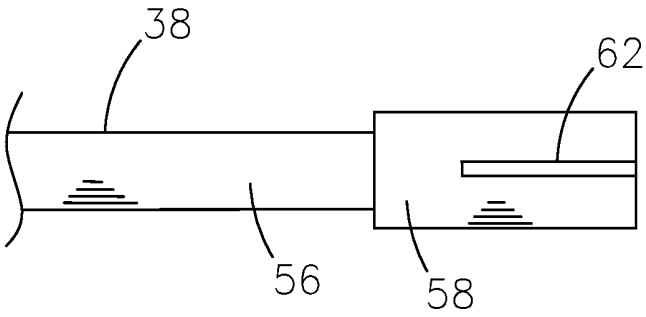


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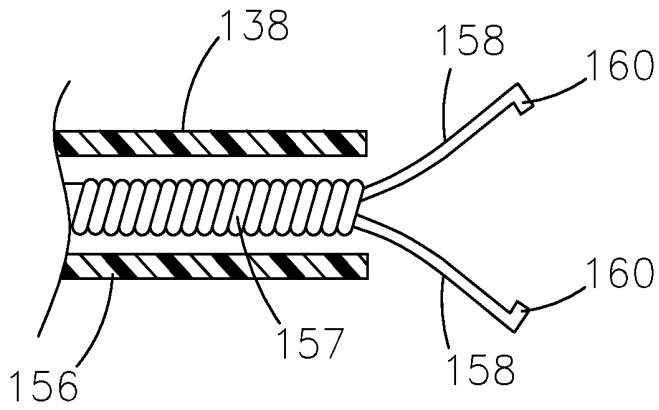


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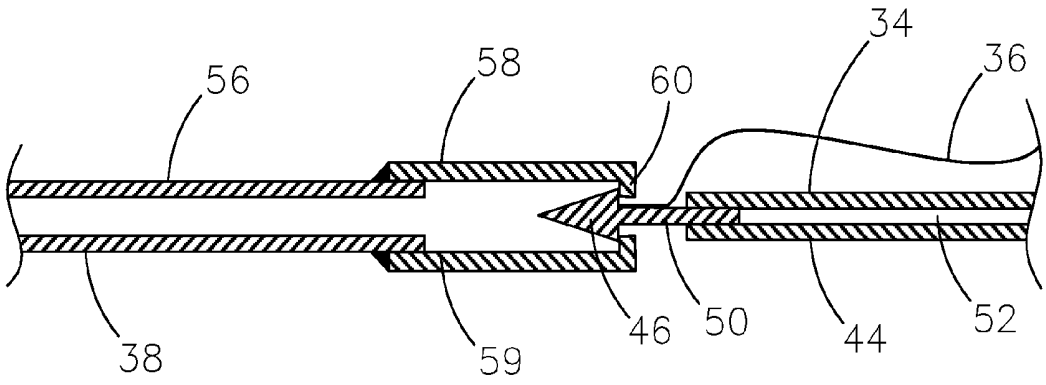


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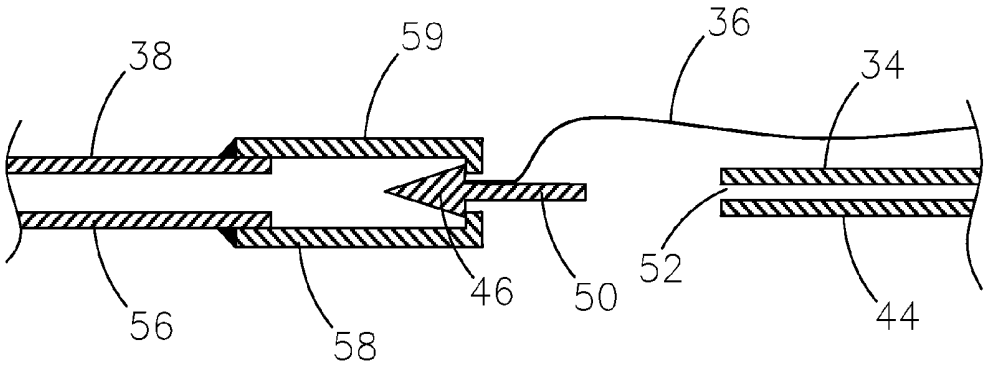


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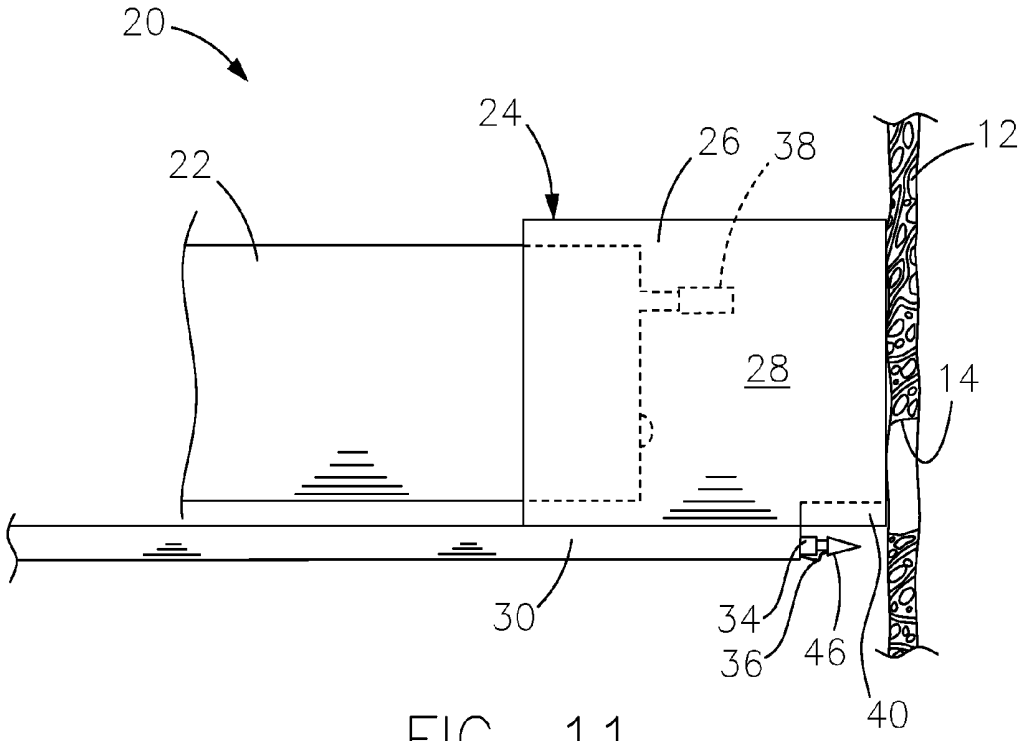
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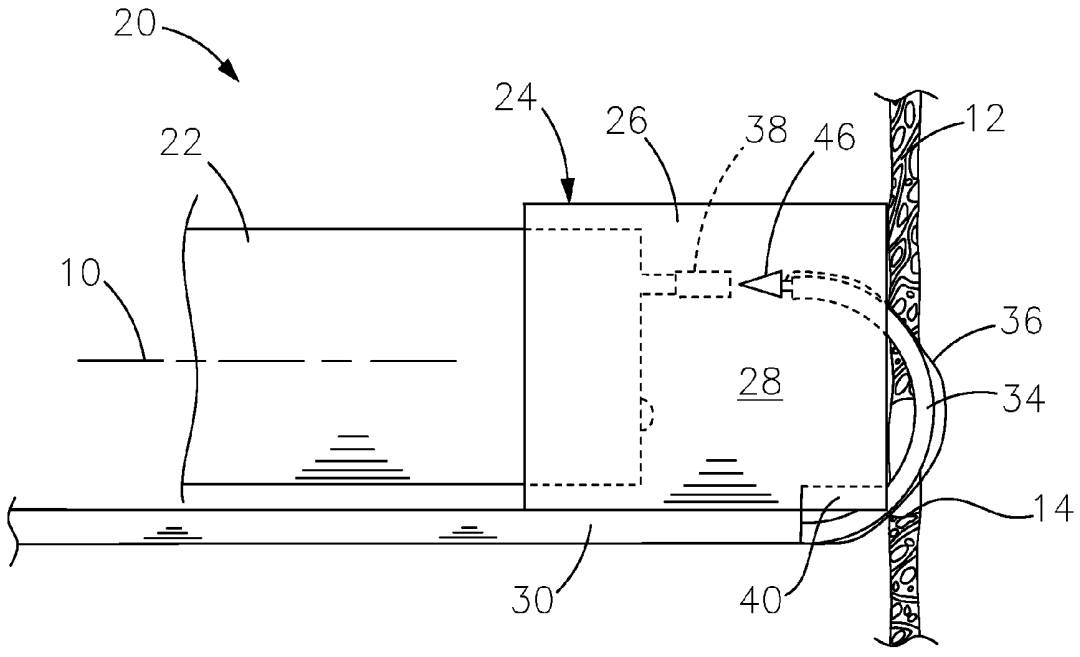
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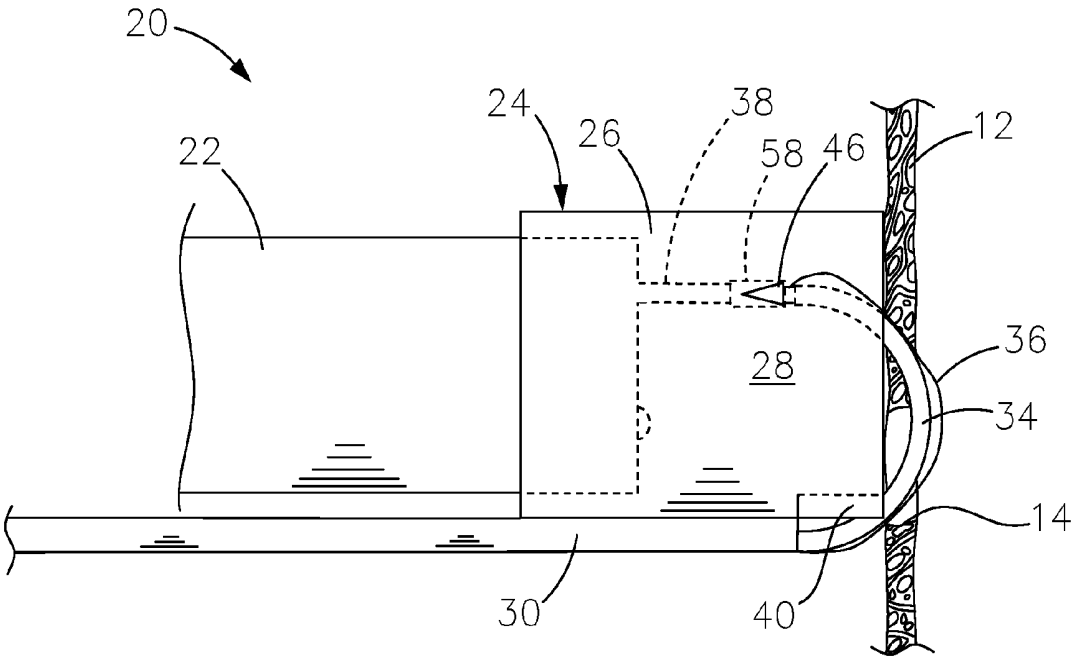
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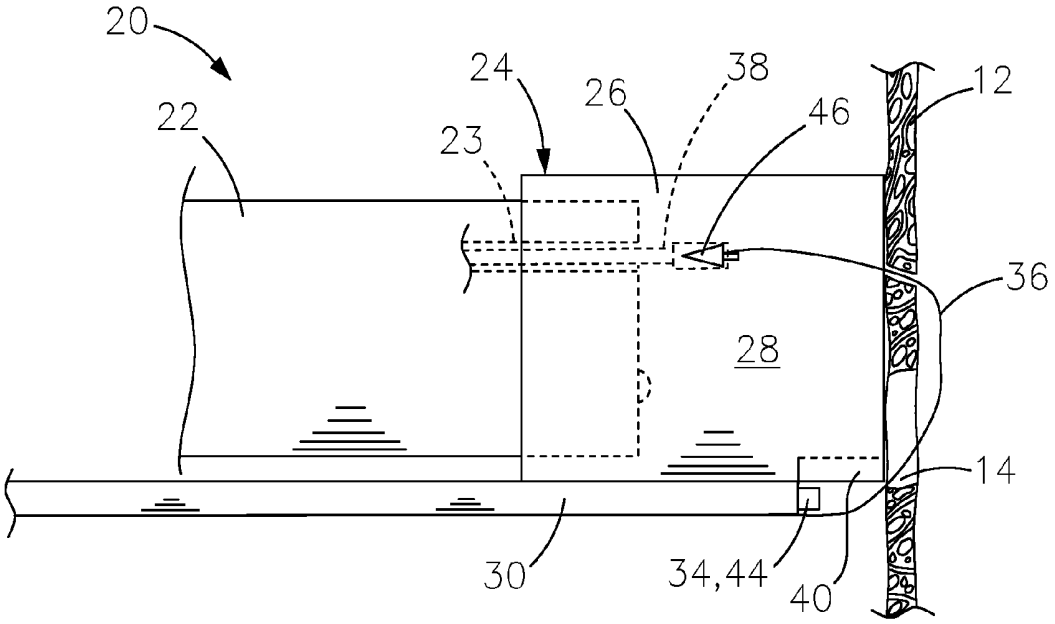
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FIG. 14

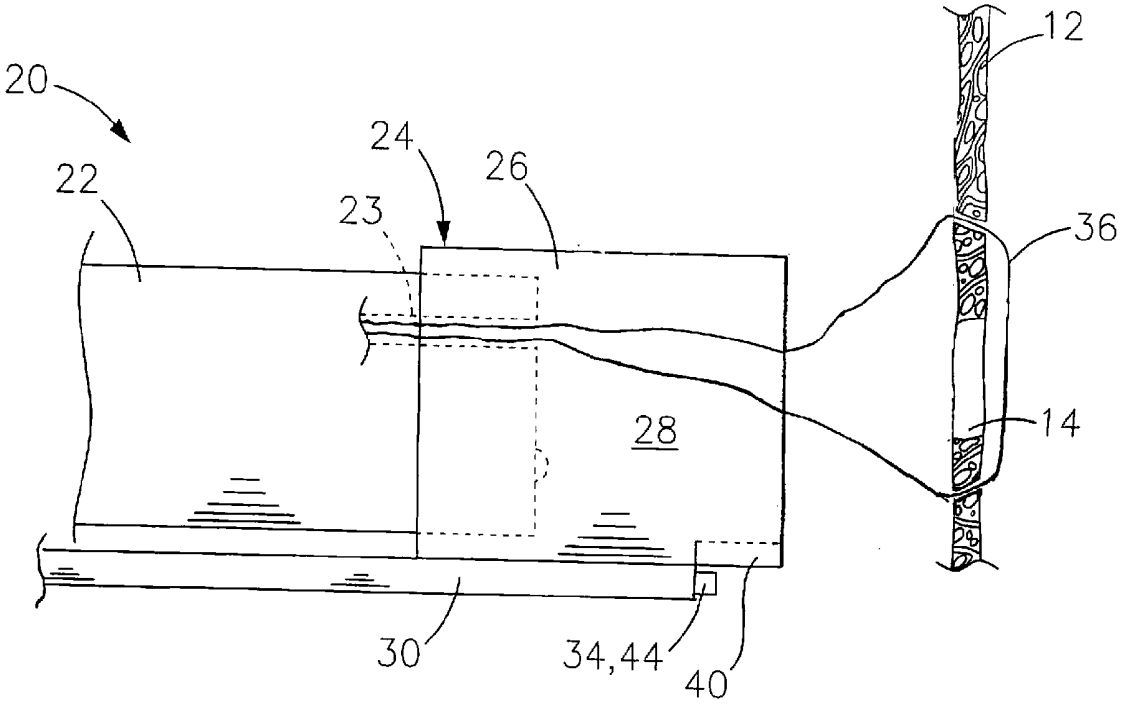


FIG. 15

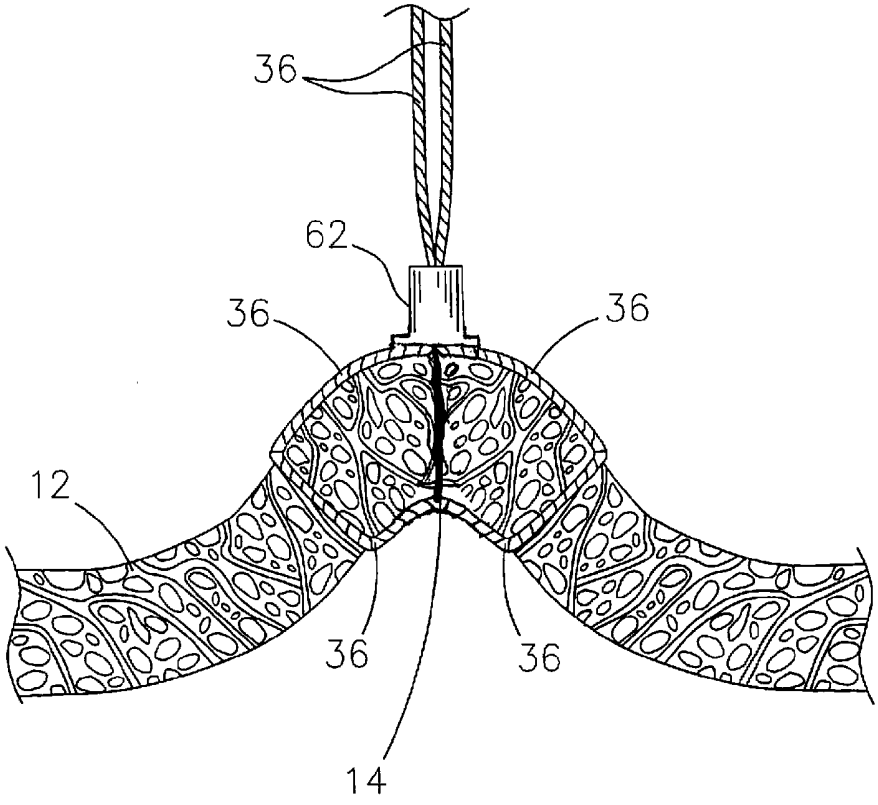


FIG. 16

# MEDICAL SYSTEMS, DEVICES AND METHODS FOR SUTURING PERFORATIONS

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application Ser. No. 61/174,583 filed on May 1, 2009, entitled "MEDICAL SYSTEMS, DEVICES AND METHODS FOR SUTURING PERFORATIONS," the entire contents of which are incorporated herein by reference.

## FIELD OF THE INVENTION

The present invention relates generally to medical systems, devices and procedures for suturing perforations, and more particularly to endoscopically suturing perforations.

## BACKGROUND OF THE INVENTION

Openings or perforations in the walls of internal organs and vessels may be naturally occurring, or formed intentionally or unintentionally. In order to permanently close these perforations and allow the tissue to properly heal, numerous medical devices and methods have been developed employing sutures, adhesives, clips, tissue anchors and the like. One such class of devices aims to endoscopically close perforations, such as those within the gastrointestinal tract. Accordingly, various medical devices have been proposed that attach to the endoscope to facilitate perforation closure. Some of these medical devices employ suction to orient the tissue for suturing or anchor placement, while others require the use of tissue graspers or other devices to orient the tissue.

In these medical devices, the particular orientation of the tissue can require the folding of tissue or the overlapping of two or more layers of tissue. To accomplish such tissue orientation and suturing, many of these medical devices are complex and include a host of moving parts, thereby complicating manufacture and increasing the cost of the devices. At the same time, use of these devices by the medical professional can also be complicated and time consuming, resulting in increased procedure times.

## BRIEF SUMMARY OF THE INVENTION

The present invention provides medical systems, devices and methods for suturing a perforation in tissue, that may be used endoscopically and/or laparoscopically, and that offer simple, reliable and controllable placement of sutures around a perforation for complete closure thereof. One embodiment of a medical system, constructed in accordance with the teachings of the present invention, generally includes an endoscope, an endcap, an elongated side tube, a needle, a suture and a retrieval device. The endcap is fitted to a distal end of the endoscope. The elongated side tube defines a side channel and is connected to the endcap. The needle has a shaft and a needle tip detachably connected to a distal end of the shaft. The needle is sized to be translated through the side channel of the side tube. The suture is attached to the needle tip. The retrieval device is sized to be translated through a working channel of the endoscope.

According to more detailed aspects, the needle is operable to a deployed configuration wherein the needle tip is laterally spaced from the side tube. The distal end of the needle shaft bends along a curved path in the deployed configuration, and preferably retroflexes. The needle shaft is preferably formed of a resilient material and is biased to the deployed configuration. The needle tip and retrieval device are radially aligned relative to a central axis of the endoscope in the deployed configuration. The distal end of the needle shaft has a curvature such that the needle tip faces proximally in the deployed configuration. One construction of the retrieval device includes a resilient sleeve having teeth, and the sleeve defines an interior passageway sized to receive the needle tip. The needle tip defines a gripping surface, and the teeth are sized and structured to engage the gripping surface. The needle tip may be frictionally fitted to the needle shaft, and may further include an aperture for receiving the suture.



One embodiment of a medical device, constructed in accordance with the teachings the present invention, generally includes an endcap, an elongated side tube, a needle, a suture, and a retrieval device. The endcap defines an interior space sized to receive a distal end of the endoscope. The side tube defines a side channel and is connected to the endcap. The needle has a needle shaft and a needle tip detachably connected to a distal end of the needle shaft. The needle is sized to be translated to the side channel. The needle is operable to a deployed configuration wherein the needle tip is laterally spaced from the side tube. The suture is attached to the needle tip, and the retrieval device is sized to be translated through a working channel of the endoscope for retrieval of the suture and needle tip.

According to more detailed aspects of the medical device, the interior space is sized to provide selective frictional engagement between the endcap and the endoscope. A distal portion of the endcap includes a slot circumferentially aligned with the side tube. The distal portion of the endcap includes a flange extending radially to define a tissue support surface. The flange is positioned proximate the needle when the needle is in the deployed configuration. The needle is further operable to a delivery configuration wherein the needle tip is aligned with the side tube. The needle tip and retrieval device are preferably radially aligned relative to a central axis of the endoscope in the deployed configuration.

A method for suturing a perforation tissue is also provided in accordance with the teachings of the present invention. One embodiment of the method generally includes providing an endoscope having a working channel, and providing a medical device such as the medical device described above. The endcap is fitted to the distal end of endoscope. The endoscope and medical device are introduced to a position proximate the tissue. The needle is operated from the delivery configuration to the deployed configuration such that the needle passes through the tissue. The retrieval device is operated to engage the needle tip, and the needle tip is detached from the shaft.

According to more detailed aspects of the method, the retrieval device is retracted to withdraw the suture through the working channel of the endoscope. The step of introducing the endoscope and medical device may include positioning the side tube proximate the perforation in the tissue. The step of operating the needle includes passing the needle through the tissue in a retrograde manner. The step of operating the needle may include passing the needle through the perforation and then passing the needle through the tissue. The step of detaching the needle tip may include pulling the needle in a proximate direction to assist in detaching the needle tip from the shaft.

## BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings incorporated in and forming a part of the specification illustrate several aspects of the present invention, and together with the description serve to explain the principles of the invention. In the drawings:

FIG. **1** is a perspective view of a medical system constructed in accordance to the teachings of the present invention;

FIG. **2** is a side view of the medical system depicted in FIG. **1**;

FIG. **3** is a end view of the medical system depicted in FIG. **1**;

FIG. **4** is a cross-sectional view of a needle forming a portion of the medical system depicted in FIG. **1**

FIG. **5** is a cross-sectional view of an alternate embodiment of the needle depicted in FIG. **4**;

FIG. **6** is a cross-sectional view of a retrieval device from a portion of the medical system depicted in FIG. **1**;

FIG. **7** is a side-view of the retrieval device depicted in FIG. **6**;

FIG. **8** is a side-view, partially and cross-section, of an alternate embodiment of the retrieval device depicted in FIG. **6**;

FIGS. **9** and **10** are cross-sectional views showing different stages of interaction between the needle and retrieval device depicted in FIGS. **4** and **6**;

FIGS. **11-15** are side views, partially and cross-section, illustrating a method of employing the medical system depicted in FIG. **1**; and

FIG. **16** is a cross-sectional view showing closure of a perforation by the medical system depicted in FIG. **1**.

## DETAILED DESCRIPTION OF THE INVENTION

Turning now to the figures, FIGS. **1-3** depict a medical system **20** for suturing closed a perforation **14** in tissue **12** (shown in FIGS. **11-16**), constructed in accordance with the teachings of the present invention. The medical system **20** generally comprises an endoscope **22** and a medical device **24** adapted for use with the endoscope **22**. The endoscope **22** generally defines a central axis **10** which extends in a longitudinal direction. The medical device **24** includes an endcap **26** to defining an interior cavity **28** sized to be fitted on a distal end of the endoscope **22**. The endcap **26** may be structured to frictionally engage the endoscope **22** for selective retention of the endcap **26** on the endoscope **22**, although other means for connecting the endcap **26** to the endoscope **22** may be employed as is known in the art. The endoscope **22** and medical device **24** are therefore adapted to be traversed through the body of a patient in this connected configuration shown in the figures.

The medical device **24** further includes an elongated side tube **30** connected to the endcap **26** and defining a side channel **32**. A needle **34** is provided for passing a suture **36** through the tissue **12** to close the perforation **14**. The side tube **30** initially guides the needle **34**, which is sized to be translated through the side channel **32** of the side tube **30**. A retrieval device **38** is sized to be translated through a working channel **23** of the endoscope **22**, and is further adapted for cooperating with the needle **34** to retrieve the suture once is has been passed through the tissue **12** proximate the perforation **14**. Further details of these components of the medical device **24** will be described hereinbelow.

As shown in FIGS. **1-3**, the side tube **30** has been attached to the outer periphery of the endcap **26**. It will be recognized that, alternatively, the side tube **30** could be connected to any portion of the endcap **26**, including configurations where the endcap **26** defines a channel to which the side channel **32** of the side tube **30** is fitted for communication therebetween. The side tube **30** is preferably connected to the endcap **26** using adhesives, mechanical connectors, plastic welding, or other boding techniques. Alternatively, the endcap **26** and side tube **30** may be unitarily and integrally formed. The side tube **32** extends proximally along the endoscope **22**, and therefore has a length similar to the length of the endoscope **22**. The endoscope **22** may generally be any scope known to those skilled in the art, and therefore may have various lengths, diameters and functionality.

As will be described in more detail hereinbelow, the needle **34** is generally structured to retroflex in a deployed configuration (generally shown in FIGS. **1-3**), thereby allowing the suture **36** to be passed through the tissue **12** in a manner that also places the distal tip **46** of the needle **34** and the suture **36** in a position for retrieval by the retrieval device **38**. As shown in FIG. **3**, the endcap **26** is structured to facilitate this retroflexing of the needle **34**, its passage through the tissue, and its interaction with retrieval device **38** for retrieving the suture **36** from the needle **34** once it has passed through the tissue **12**. For example, the endcap **26** defines a slot **40** at its distal end to allow the needle **34** to pass through the slot **40** and into the interior space **28** defined by the endcap **26**. Preferably, the slot **40** is circumferentially aligned with the side tube **30** for receiving the needle **34** therein. As best seen in FIG. **3**, the endcap **26** further includes one or more flanges **42** (two being shown in the figures) which extend radially outwardly to a position proximate the curved path which is followed by the needle **34** as it retroflexes. The flanges **42** provide support to the tissue **12** for easier puncturing of the tissue **12** by the needle **34**, although the flanges **42** need not be employed. The endcap **26** is preferably constructed from a plastic such as polyvinylchloride, polytetrafluoroethylene, polyethylene ether ketone, polycarbonate or other thermoplastics, although other materials such as metals and alloys may readily be employed.

Further details of the needle **34** and retrieval device **38**, as well as their cooperative interaction, will now be described with reference to FIGS. **4-10**. As shown in FIG. **4**, the needle **34** generally includes a shaft **44** and a needle tip **46** which is selectively connected to a distal end of the shaft **44**. The needle tip **46** generally includes a tapered head **48** for piercing the tissue and a stem **50** connected to the head **48**. The shaft **44** defines a needle lumen **52** which is sized to receive the stem **50** of the needle tip **46**. Preferably, the stem **50** and needle lumen **52** are sized relative to one another to provide a frictional fit and permits a selective connection and disconnection of needle tip **46** to the shaft **44**, although other mechanical means for selectively connecting the needle tip **46** to the shaft **44** may be employed as will be recognized by those skilled in the art.

The needle tip **46** is further connected to the suture **36**. Preferably, the suture **36** is connected to the stem **50** of the needle tip, although it can be connected to any portion of the needle tip **46**. The suture can be connected by tying, or by using adhesives, mechanical connectors (adjustable loops, clamps, etc.), bonding techniques such as plastic welding, melting, heat bonding and the like. Similarly, either the stem **50** or the suture **36** may be mechanically deformed, such as by crimping or using other techniques, to interconnect the suture **36** and needle tip **46**.

The needle **34** is preferably constructed of a material providing sufficient flexibility to traverse the body of a patient through the side tube **30** and along the endoscope **22**. At the same time, the needle **34**, or at least the distal end of the shaft **44**, formed of a flexible but resilient material, thereby enabling the retroflexing of the needle **34** to a deployed configuration as shown in FIGS. **1-3**. Preferably, the distal end of the shaft **44** is biased to this deployed configuration, although the distal end of shaft may have shape memory that is temperature dependent and can be activated through the use of

fluids or body heat, as is known in the art. Suitable materials for the needle **34** generally include metals such as stainless steel, alloys such as nitinol, plastics such as polyvinylchloride, polyimide, polyamide, polyetherketone and others known to those skilled in the art.

Similarly, the side tube **30** guides the needle **34**, and when the needle's shaft **44** is biased to the deployed configuration, the side tube straightens out the needle into its delivery configuration (FIG. **11**). Accordingly, the side tube **30** is preferably formed of polytetrafluorethylene (PTFE), expanded polytetrafluorethylene (EPTFE), polyethylene ether ketone (PEEK), polyvinylchloride (PVC), polycaerbonate (PC), polyamide including nylon, polyimide, polyurethane, polyethylene (high, medium or low density), and elastomers such as Santoprene™, including multi-layer or single layer constructions with or without reinforcement wires, coils or filaments. The shaft **44** of the needle **34** generally has a sufficient length to pass through the side tube **30** and exit a proximal end thereof (not shown) for manipulation by the medical professional. The side tube has a suitable length for extending from the endcap **26** and along the endoscope **22** to a proximal end thereof (not shown), where a proximal end of the side channel **32** may be accessed by the medical professional for inserting, manipulating and withdrawing the needle **34** therefrom.

Many variations of the needle **34** will be readily apparent to those skilled in the art, one such variation being depicted in FIG. **5**. Generally, the needle **134** includes a solid shaft **144** and a hollow needle tip **146**. The head **148** of the needle tip **146** is tapered to promote piercing of the tissue **12**. An interior lumen **150** of the needle tip **146** is size relative to the shaft **144** to provide a friction fit and selective connection and disconnection of the needle tip **146** from the shaft **144**, such as described above with regard to the embodiment of FIG. **4**. A through-hole **152** is also provided in the needle tip **146**, thereby allowing the suture **36** to be passed through the hole **152** and crimped, knotted, melted or otherwise deformed to connect the suture **36** to the needle tip **146**.

FIGS. **6** and **7** depict one embodiment of a retrieval device **38** forming a portion of the medical device **24** and medical system **22**. The retrieval device **38** generally includes an elongated member **56** sized to be translated through the working channel **23** of the endoscope **22**. As such, the elongated member **56** has a sufficient length to pass fully through to the working channel **23** of the endoscope **22** and exit a proximal end thereof (not shown) for manipulation by the medical professional. A grasping tip **58** is connected to a distal end of the elongated member **56** for selectively engaging the needle tip **46** of the needle **34**. In this embodiment, the grasping tip **58** has been shown as a tubular sleeve **59** that opens at its distal end. The sleeve **59** defines an interior passageway **61** sized to receive the needle tip **46**. The distal end of the grasping tip **58** further define one or more teeth **60** for engaging a gripping surface **54** formed on the needle tip **46**. As best seen in the side view of FIG. **7**, the grasping tip **58** generally includes one or more slots **62** which allow the inner diameter of the sleeve **59** to expand for receiving the needle tip **46**. Accordingly, the grasping tip **58** is preferably formed of a resilient material having some flexibility, such as metals, alloys (preferably super-elastic alloys such as nitinol) or suitable plastics. The elongated member **56** is preferably formed of a flexible material that can bend along with the endoscope **22** as it traverses the body of a patient and may be formed of metals, alloys such as nitinol, or suitable plastics.

Many different retrieval devices may be employed to form a portion of the medical system **20** and medical device **24** of the present invention. For example, forceps, snares, wire loops, graspers and magnets may be employed to engage the needle tip **46** for retrieval thereof and the suture **36**. As one example, FIG. **8** depicts an alternate embodiment of a retrieval device **138** having a flexible elongated sheath **156** and a control member **157**. Grasping arms **158** are attached to a distal end thereof. The grasping arms **158** define teeth **160**, and are a generally biased radially outwardly as shown in the figure. The control wire **157** may be formed by a plurality of wound or braided wires, the distal ends of which may be used to form the grasping arms **158**. The size and position of the grasping arms **158** is structured relative to the elongated sheath **156** such that translation of the control wire **157** relative to the sheath **156** controls operation of the grasping arms **158** between open and closed configurations. That is, a distal end of the sheath **156** will press on the grasping arms **158** to draw them together and grasp an object such as the needle tip **46**. This and many other types of retrieval devices, both passive and actively operated, may be employed within the scope of the present invention.

FIGS. **9** and **10** show two stages of operating the retrieval device **38** to retrieve the needle tip **46** of the needle **34**. In FIG. **9**, the retrieval device **38** has been translated relative to the needle **34** such that the open distal end of the grasping tip **58** passes over the needle head **48**. The teeth **60** on the resilient sleeve **59** draw around the needle head **48** and engage the gripping surface **54** defined thereby. As shown in FIG. **10**, the retrieval device **38** may again be translated relative to the needle **34**, and in particular the shaft **44**, such that the friction between the post **50** and needle lumen **52** is overcome and the needle tip **46** is disengaged from the shaft **44**. It will be recognized that the relative movement between the needle **34** and retrieval device **38** as shown in FIGS. **9** and **10** may be accomplished through translation of the retrieval device **38** or translation of the needle **34** or translation of both the needle **34** and retrieval device **38**.

As will now be described with reference to FIGS. **11-15**, a method for employing the medical system **20** and medical device **24** for suturing a perforation **14** in tissue **12** is also provided in accordance with the teachings of the present invention. As shown in FIG. **11**, the method includes providing an endoscope **22** and medical device **24**, such as one of the medical devices described above. The endcap **26** of the medical device **24** is fitted to a distal end of the endoscope **22**. The endoscope **22** and medical device **24** are introduced together into the body of a patient, preferably through a natural orifice such as the mouth, anus or vagina, and are translated to a position proximate the tissue **12**. In procedures where a perforation in the tissue **12** is not already formed but is desired, an appropriate surgical tool such as a needle-knife or other electrocautery device, or cutting instrument may be employed through the working channel **23** or another channel of the endoscope **22** for forming the perforation **14**. The endoscope **22** and medical device **24** are manipulated such that the side tube **30** is positioned proximate the perforation **14**. The side tube **30** may not be visible via the endoscope **22**, however its location may be identified by visualizing the slot **40** formed in the endcap **26**. When no slot **40** is employed, the interior surface of the endcap **26** may include visual markings for identifying the location of the side tube **30**.

As also shown in FIG. **11**, the needle **34** is loaded within the side channel **32**. The needle **34** is generally operable between a delivery configuration, such as shown in FIG. **11**, and a deployed configuration such as is shown in FIG. **12** (and previously in FIGS. **1-3**). In the delivery configuration of the needle **34**, the needle tip **46** is generally aligned with the side tube **30**. The needle tip **46** moves laterally between the delivery configuration and the deployed configuration, and more particularly the distal end of the needle shaft **44** bends along

a curved path and preferably retroflexes such that it is radially aligned with the retrieval device **38** and the working channel **23** of the endoscope **22**. Although shown rotating about 180 degrees, the needle **34** may rotate less than or more than 180 degrees in the deployed configuration. Preferably, the needle shaft **44** is retroflexed in the deployed configuration such that the needle tip **46** faces proximally.

The needle **34** is operated from the delivery configuration to the deployed configuration as shown in FIG. **12**. The needle **34** is translated distally relative to the side tube **30**, and is first passed through the perforation **14** and then through the tissue **12**. That is, the needle **34** is passed through the tissue **12** in a retrograde manner, i.e. from a distal side to a proximal side of the tissue **12**. As shown in FIG. **12**, the suture **36** attached to the needle tip **46** is likewise passed through the perforation **14** and tissue **12** for retrieval by the retrieval device **38**.

As shown in FIG. **13**, the retrieval device **38** is operated to engage the needle tip **46**. In particular, and as previously described with reference to FIGS. **9** and **10**, the grasping tip **58** encapsulates the needle tip **46** for engagement therebetween. This interconnection may be made through distal translation of either or both the retrieval device **38** and the needle **34**. As shown in FIG. **14**, the needle tip **46** is then detached from the shaft **44** of the needle **34**. As also previously discussed, this may be accomplished through proximal translation of either or both the retrieval device **38** and needle **34** to overcome the friction between the needle tip **46** and shaft **44**. Accordingly, it can be seen that the retrieval device **38** has not only engaged the needle tip **46**, but has also engaged the suture **36**. As such, the retrieval device **38** may be retracted through the endoscope **22** where it and the suture **36** can be further manipulated by the medical professional.

Upon detachment of the needle tip **46**, the needle **34** (and in particular the needle shaft **44**) may be withdrawn proximally through the side tube **30**. The shaft **44** may be completely withdrawn through the proximal end of the side channel **32** and reloaded with a second needle tip **46** located at a second end (i.e. the formerly proximal end) of the suture **36**. Since the suture **36** already extends through the side tube **30**, the reloaded needle **34** and second needle tip **46** may be delivered through the side tube **30**. The needle **34** and second needle tip **46** are passed through the tissue **12** in a retrograde manner as described above, and preferably on an opposite side of the perforation **14** as shown in FIG. **15**. With reference to FIG. **16**, the two ends of the suture **36** may be drawn together and tied to close the perforation **14**, such as utilizing endoscopic tying techniques including passing knots, or through the use of a suture lock **62** as shown. Exemplary suture locks are described in U.S. patent application Ser. Nos. 12/125,525 and 12/191,001, the disclosures of which are hereby incorporated by reference in their entirety. Preferably, the ends of the suture **36** are placed on opposite sides of the perforation **14** and/or spaced around the perforation **14** to draw the tissue **12** together and securely close the perforation **14** to promote healing of the tissue **12**.

In alternate methods, the suture **36** could initially be positioned outside of the side tube **30**. In one such method, once the first end of the suture **36** is placed through the tissue **12** in a retrograde manner (as described above) the entire endoscope **22** and medical device **24** may be removed from the accessed bodily lumen of the patent. Upon removal, the second end of the suture **36** (having a detachable needle tip **46**) may be loaded on the distal end of the needle **34**, and the endoscope **22** and device **24** replaced into the bodily lumen for placement of the second end of the suture **36**. In another such method, after the first end of the suture **36** has been placed, the second end of the suture **36** could simply be retained outside of the patient. A second suture **36** having a detachable needle tip **46** can be loaded onto the needle **34** and the second suture **36** may be placed as described above.

It will be recognized by those skilled in the art that the medical systems, devices and methods of the present invention facilitate improved closure of perforations. The medical systems and devices are simple to operate, and the methods may be performed endoscopically and/or laparoscopically. The devices and methods offer reliable and controllable placement of sutures around a perforation for complete closure thereof.

It will also be recognized by those skilled in the art that, while the methods described above generally include placing the tissue devices in tissue through an internal bodily lumen, it will be recognized that the systems, devices and methods may be used on any layer of material (e.g. fabrics, cloth, polymers, elastomers, plastics and rubber) that may or may not be associated with a human or animal body and a bodily lumen. For example, the systems, devices and methods can find use in laboratory and industrial settings for placing devices through one or more layers of material that may or may not find application to the human or animal body, and likewise closing holes or perforations in layers of material that are not bodily tissue. Some examples include sewing or stitching and related manufacturing, working with synthetic tissues, connecting or repairing polymeric sheets, animal studies, and post-mortem activities.

The foregoing description of various embodiments of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise embodiments disclosed. Numerous modifications or variations are possible in light of the above teachings. The embodiments discussed were chosen and described to provide the best illustration of the principles of the invention and its practical application to thereby enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly, legally, and equitably entitled.

The invention claimed is:

**1**. A medical device for use with an endoscope to suture a perforation in tissue, the medical device comprising:

an endcap having a side wall defining an interior space sized to receive a distal end of the endoscope;

an elongated side tube defining a side channel, the side tube directly connected to the exterior of the endcap;

a needle having a shaft and a needle tip detachably connected to a distal end of the shaft, the needle sized to be translated through the side channel, the needle being operable to a deployed configuration, the needle tip being laterally spaced from the side tube in the deployed configuration;

a distal end of the endcap opening longitudinally and having a flange extending radially inward to define a tissue support surface that is sized and positioned to support the tissue adjacent the needle as it moves to the deployed configuration, the tissue support surface being co-planar with a distal end surface of the end cap;

a suture attached to the needle tip; and

a retrieval device sized to be translated through a working channel of the endoscope for retrieval of the suture and needle tip.

2. The medical of claim 1, wherein the distal end of the needle shaft bends along a curved path in the deployed configuration.

3. The medical device of claim 1, the endoscope defining a central axis, and wherein the needle tip and retrieval device are radially aligned relative to the central axis in the deployed configuration.

4. The medical device of claim 3, wherein the distal end of the needle shaft has a curvature such that the needle tip faces proximally in the deployed configuration.

5. The medical device of claim 1, wherein the retrieval device includes a resilient sleeve having teeth, the sleeve defining an interior passageway sized to receive the needle tip.

6. The medical device of claim 5, wherein the needle tip defines a gripping surface, and wherein the teeth are sized and structured to engage the gripping surface.

7. The medical device of claim 1, wherein the interior space is sized to provide selective frictional engagement between the endcap and the endoscope.

8. The medical device of claim 1, wherein a distal portion of the endcap includes a slot extending through the sidewall to the exterior and circumferentially aligned with the side tube.

9. The medical device of claim 1, wherein the flange is positioned proximate the needle when the needle is in the deployed configuration.

10. The medical device of claim 1, wherein the needle is operable to a delivery configuration, the needle tip being aligned with the side tube in the delivery configuration.

11. The medical device of claim 1, wherein the side tube extends along the exterior of the endoscope.

12. The medical device of claim 1, wherein the side tube is connected to the endcap on a first side of the endcap, and wherein the flange extends inward from a second side of the endcap opposite the first side.

13. The medical device of claim 1, wherein the retrieval device is elongated and structured to longitudinally slide through the working channel.

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摘要(译)

公开了用于在组织中缝合穿孔的医疗系统，装置和方法，其可以在内窥镜和/或腹腔镜中使用，并且提供围绕穿孔的缝线的简单，可靠和可控的放置以完全闭合。医疗系统的一个实施例通常包括内窥镜，端盖，细长侧管，针，缝合线和取出装置。端盖安装在内窥镜的远端。细长侧管限定侧通道并连接到端盖。针具有轴和可拆卸地连接到轴的远端的针尖。针的尺寸设计成通过侧管的侧通道平移。缝合线连接到针尖。取回装置的尺寸设计成通过内窥镜的工作通道平移并取回针尖。