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(54) **SELF-CONTAINED DISSECTOR/HARVESTER DEVICE**

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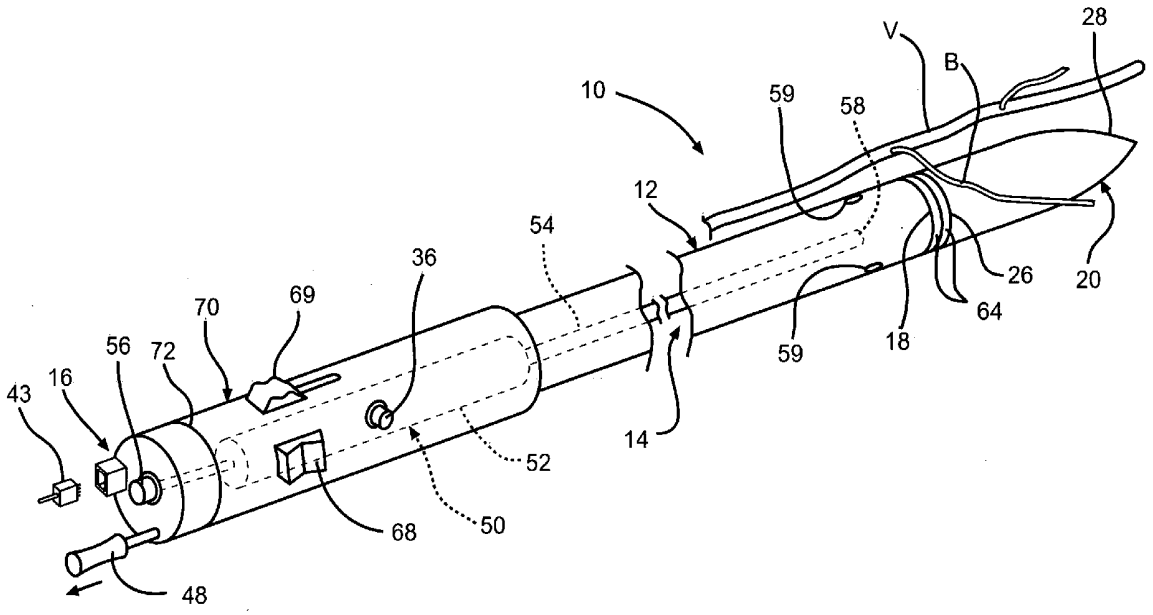
(57) **ABSTRACT**

A self-contained device for dissecting and/or harvesting a vessel includes a self-contained light source and a self-contained imaging system positioned within the sheath.



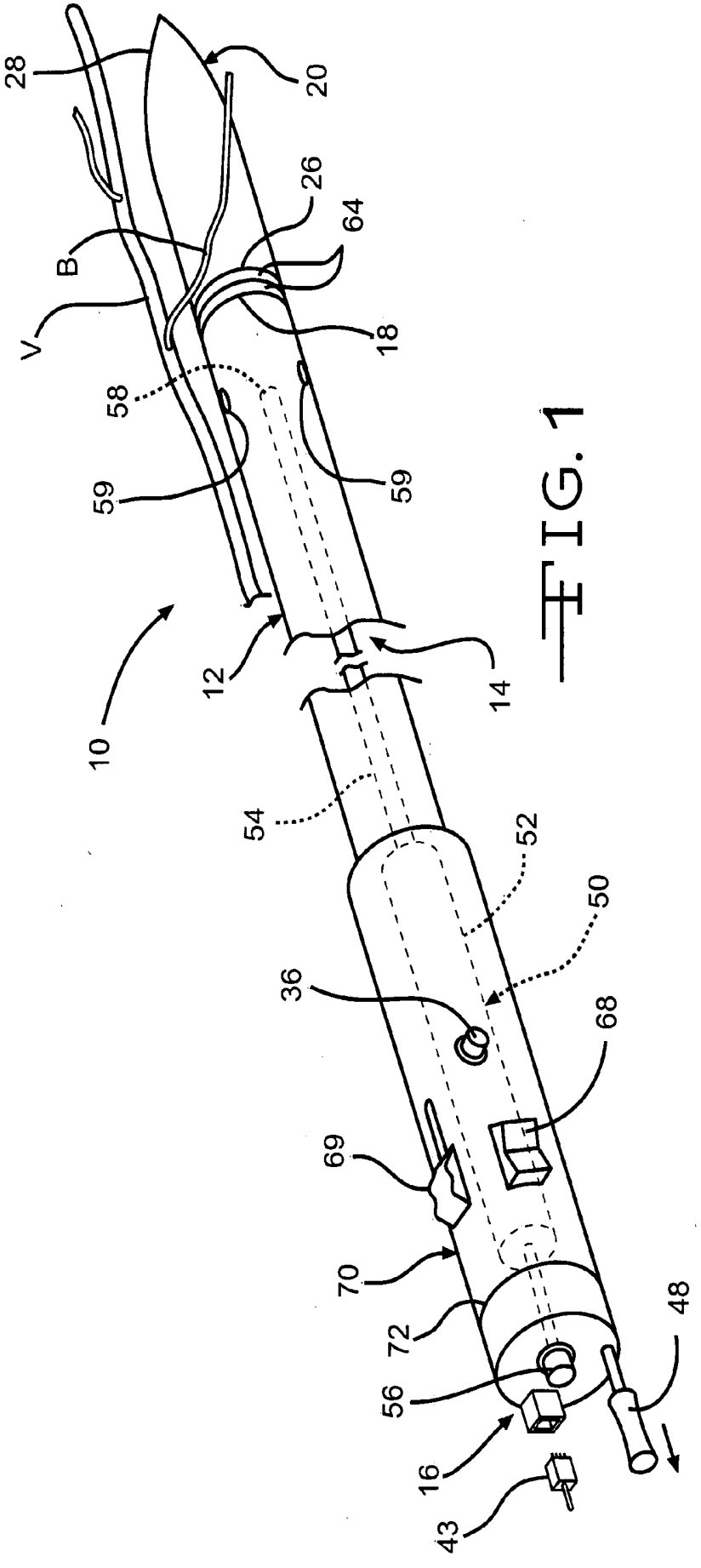


FIG. 1

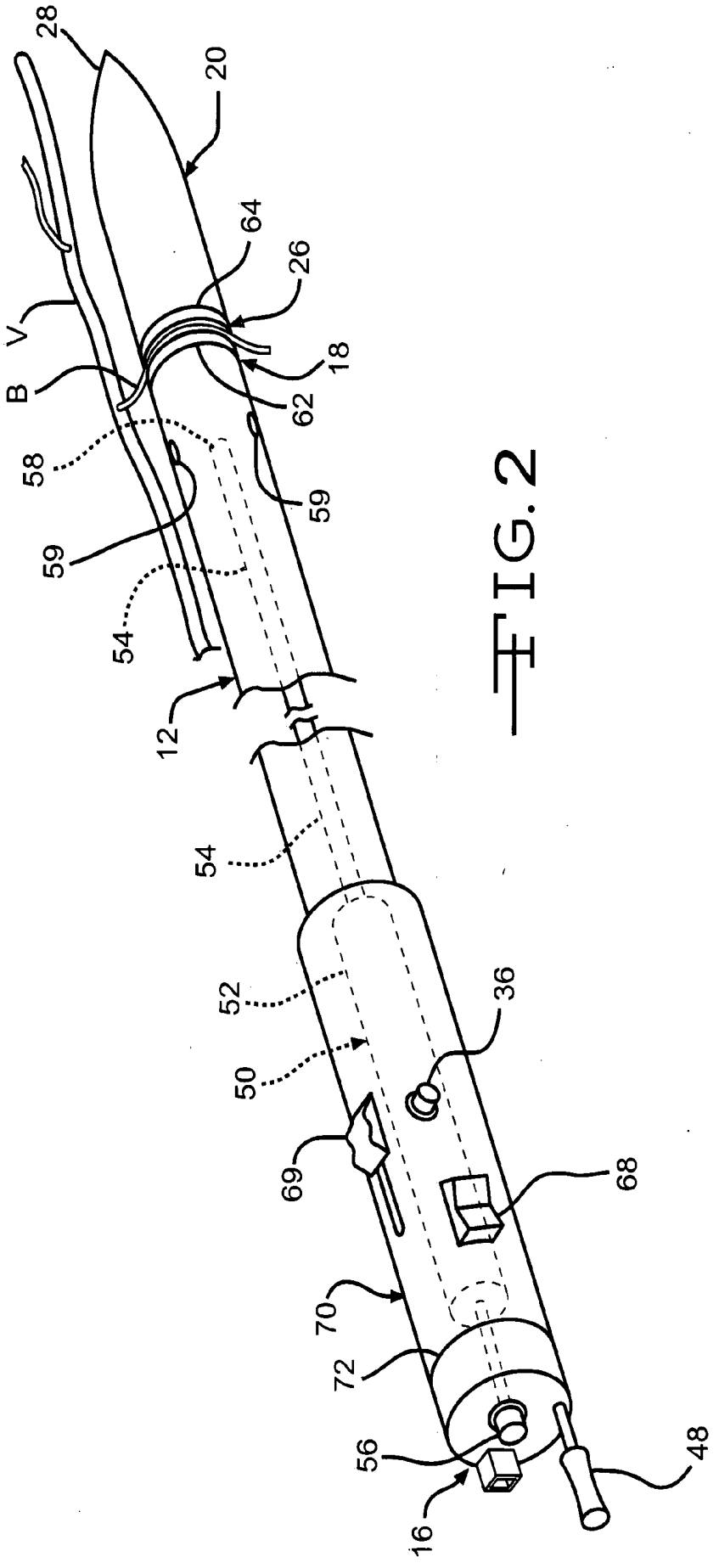


FIG. 2

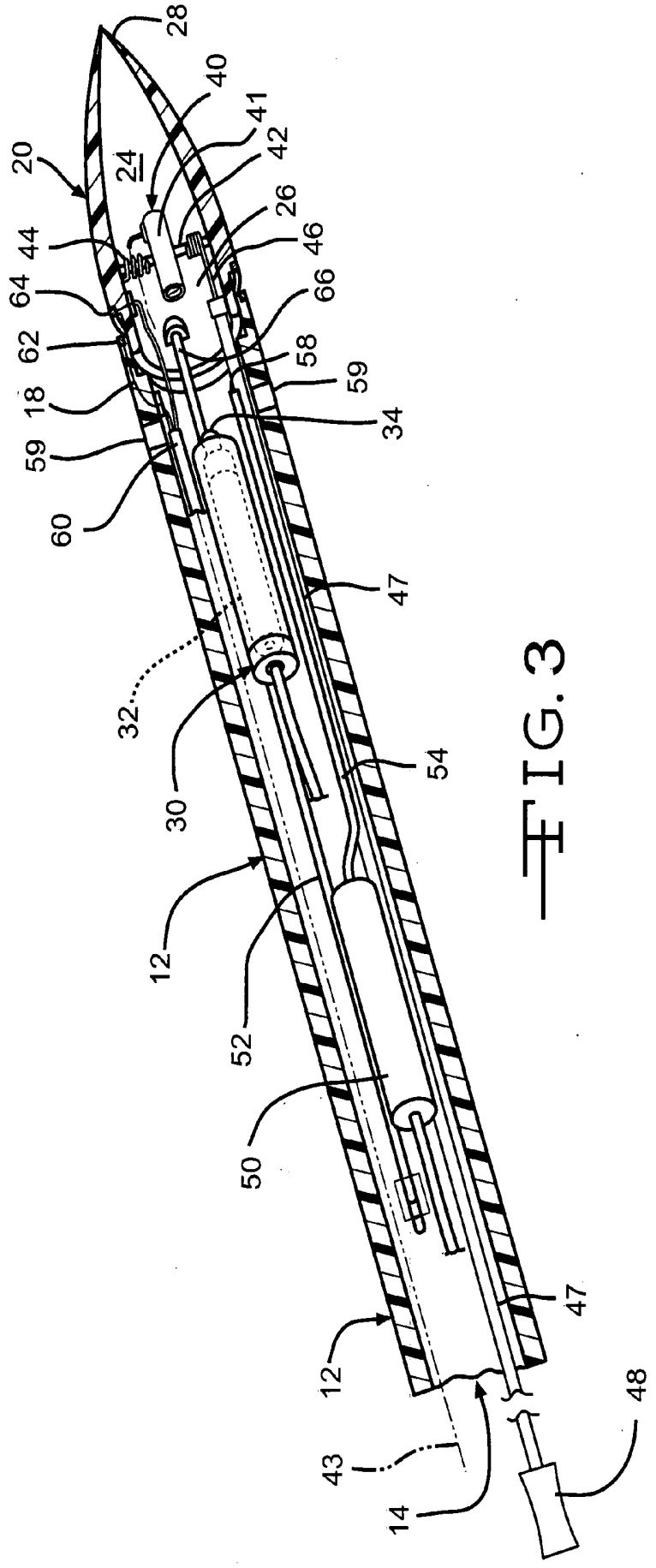

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FIG. 3

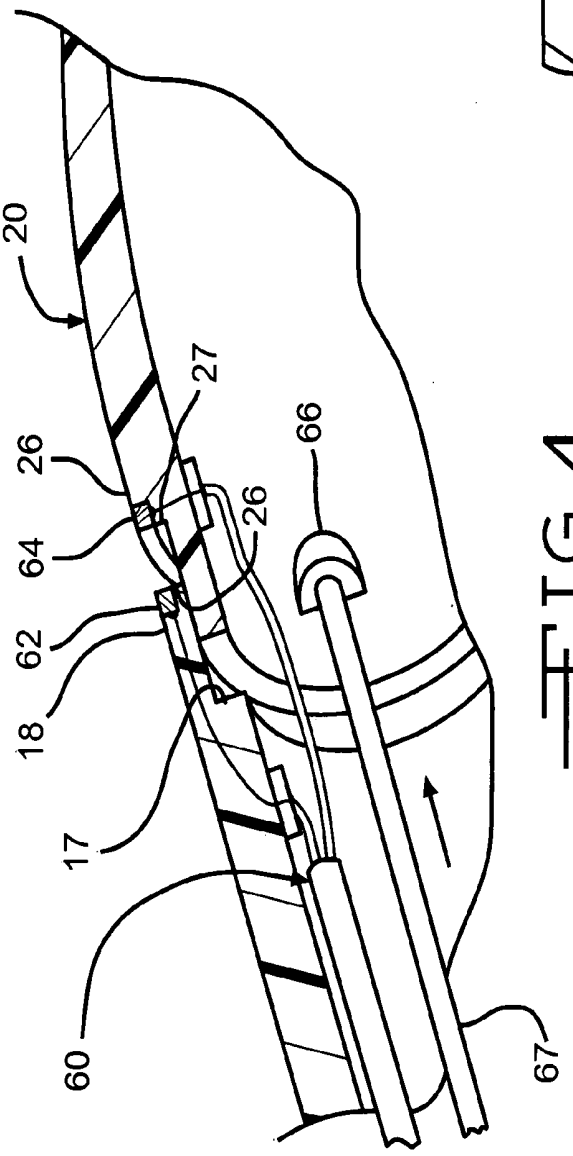

FIG. 4

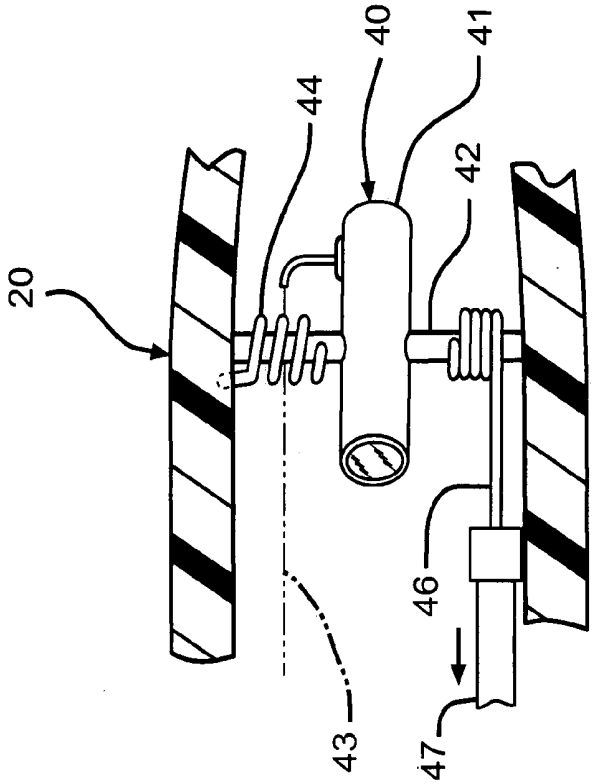

FIG. 5

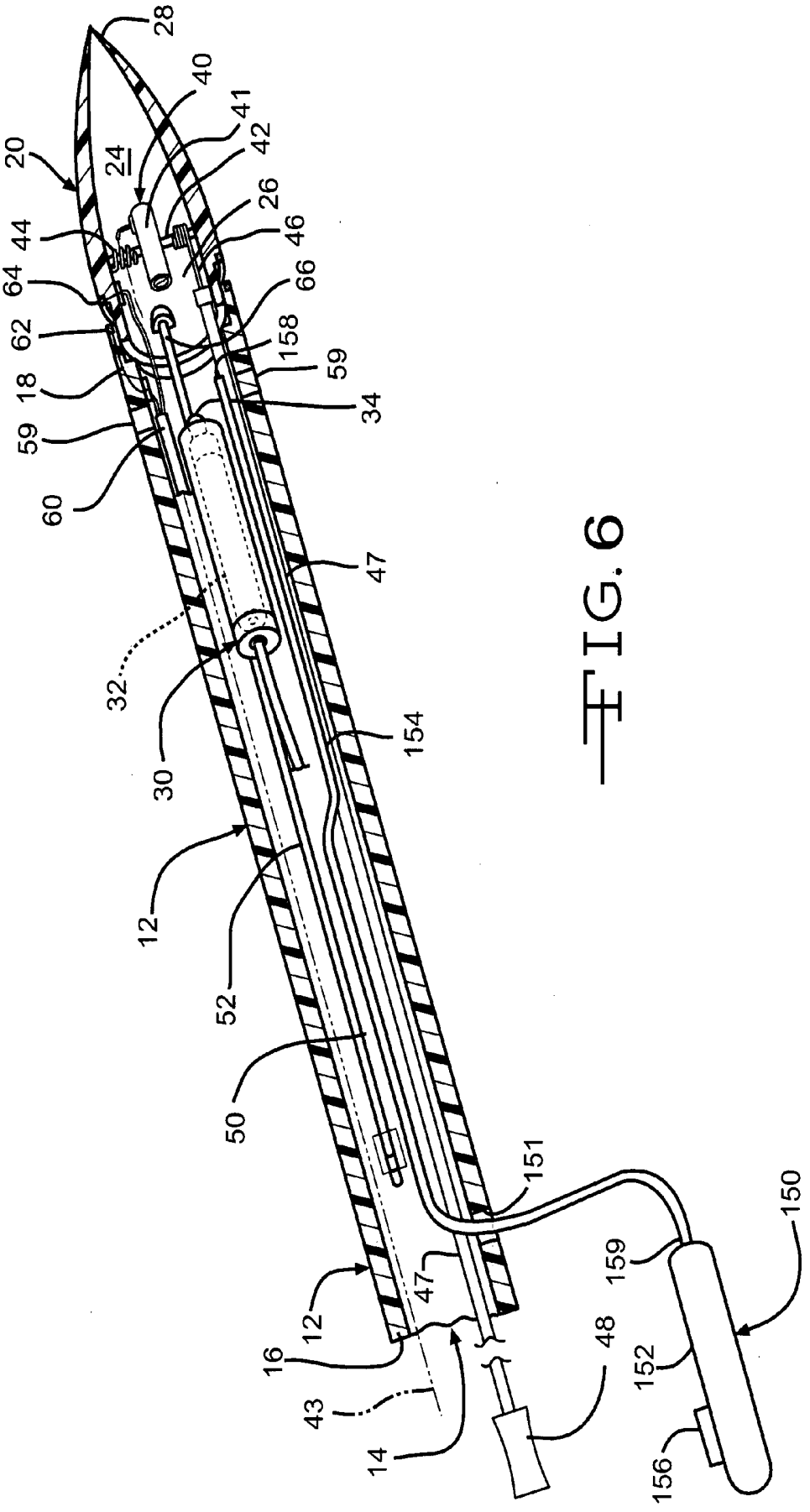
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FIG. 6

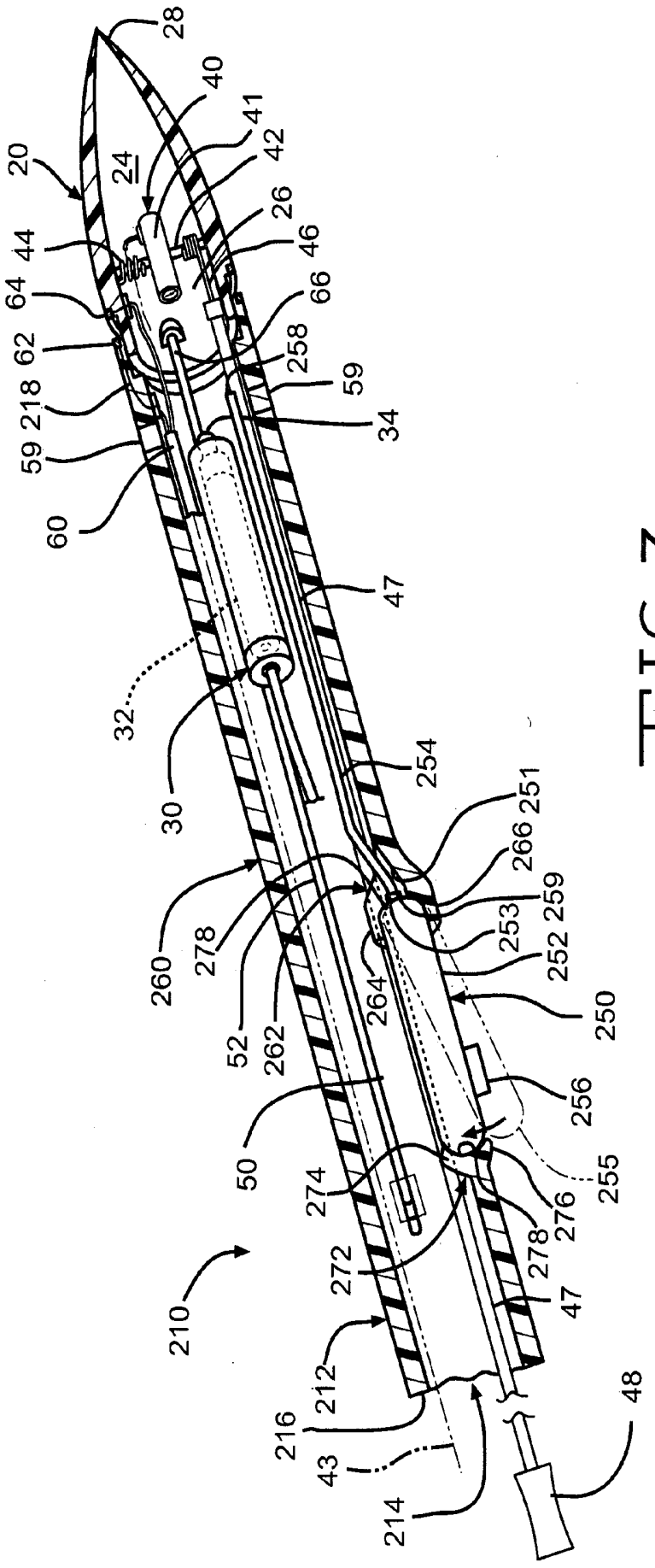
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FIG. 7

SELF-CONTAINED DISSECTOR/HARVESTER DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] Not applicable.

STATEMENT REGARDING SPONSORED RESEARCH

[0002] Not applicable.

BACKGROUND OF THE INVENTION

[0003] The present invention relates to the harvesting of blood vessels and, more particularly, to a method and apparatus for dissection and removal of sections of blood vessels.

[0004] The harvested vessels are used in many surgical procedures, including use as a coronary artery bypass graft, or in other cardiovascular procedures. As one example, in vascular and cardiovascular procedures, a blood vessel or vessel section, such as an artery or vein, is "harvested" (i.e., removed) from its natural location in a patient's body and is used elsewhere in the body. In coronary artery bypass grafting surgery, for example, the harvested blood vessel is used to form a bypass between an arterial blood source and the coronary artery that is to be bypassed. Among the preferred sources for the vessels to be used as the bypass graft are the saphenous vein in the leg and the radial artery in the arm.

[0005] Endoscopic surgical procedures for harvesting a section of a blood vessel (e.g., the saphenous vein) subcutaneously have been developed in order to avoid disadvantages and potential complications of harvesting of the blood vessel. In the past, the harvesting was done through a continuous incision (e.g., along the leg) that exposed the full length of the desired vein section. The continuous incision had been necessary in order to provide adequate exposure for visualizing the vein and for introducing the surgical instruments to sever, cauterize and ligate the tissue and side branches of the vessel.

[0006] A more recent development has been a minimally-invasive technique that employs a small incision for locating the desired vessel and for introducing one or more endoscopic devices into the small incision.

[0007] Commercially available products for performing the endoscopic blood vessel harvesting procedure include a number of separate devices that are each connected to remote or outside devices. Current devices use an insufflation device having plastic tubing to supply air or CO_2 device to insufflate the subcutaneous area, an endoscope having a camera and light cables in order to visualize both the dissection and harvesting procedures, and a harvester and/or dissector device having electrical or other lines to supply the dissecting and/or cauterizing of the vessel. In certain instances, the combination of wires, plastic tubing and fittings can be bulky and cumbersome for the person performing the vessel harvesting.

[0008] It would be desirable to have a dissector/harvester device that is more compact and does not require many external wires, cables or tubes.

SUMMARY OF THE INVENTION

[0009] In one aspect, there is provided a self-contained device for dissecting and/or harvesting a vessel and severing any branches extending therefrom The self-contained dissecting/harvesting device has a sheath for insertion in a body through a cut skin portion.

[0010] In one particular aspect, positioned within the sheath are a self-contained light source, a self-contained imaging system, and a severing device.

[0011] In certain embodiments, the severing device comprises a tip in an axial position over a distal end of the sheath, the tip being configured to be axially movable between an open position and a closed position configured to dissect the vessel and branch upon movement to the closed position.

[0012] In certain embodiments, the self-contained light source and the self-contained imaging system are removable from the device. Also, when present, the self-contained insufflation device can be removable from the device.

[0013] In certain embodiments, both the distal end of the sheath and a proximal end of the tip have at least one generally mating surface whereby, when the tip is adjacent to the sheath, the generally mating surfaces are configured to secure the vessel being harvested while a vessel branch is being severed. The tip and the sheath can include electrodes configured for being electrically energized to sever and cauterize a vessel branch.

[0014] In certain embodiments, the self-contained dissector/harvester device further includes a self-contained insufflation device to supply a gas subcutaneously to an area adjacent to the vessel.

[0015] In another aspect, there is provided a method of severing branches from a vessel during harvesting from a body by a self-contained dissector/harvester device which includes: inserting a distal end of the self-contained dissector/harvester device into the body alongside the vessel to form a cavity substantially surrounding the vessel; activating the self-contained light source to at least illuminate a portion of the branch; activating the self-contained imaging system to view at least a portion of the illuminated branch; and, moving the severing device to a position substantially adjacent to the branch and activating the severing device, whereby the vessel and branch are severed from the vessel. In certain embodiments, the method further includes supplying a gas subcutaneously to an area adjacent to the vessel to be dissected and harvested.

[0016] Various objects and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the preferred embodiment, when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. **1** is a structure diagram, partially in phantom, showing a handle portion and a tip or distal end of one embodiment of a self-contained dissector/harvester device in an open position.

[0018] FIG. **2** is a structure diagram, similar to the view in FIG. **1**, showing one embodiment of the self-contained dissector/harvester device in a closed, or grasping, position on a vessel.

[0019] FIG. **3** is a structure diagram, partially in phantom and partially in cross-section, showing one embodiment of the distal end of a self-contained dissector/harvester device.

[0020] FIG. **4** is a structure diagram of one embodiment of a portion of the distal end of the self-contained dissector/harvester device showing a self-contained severing device.

[0021] FIG. **5** is a structure diagram of one embodiment of a portion of a self-contained imaging system within the distal end of the self-contained dissector/harvester device.

[0022] FIG. **6** is a structure diagram, partially in cross-section and partially in phantom, of a self-contained imaging system having an external free-standing insufflation device tethered to the self-contained dissector/harvester device.

[0023] FIG. **7** is a structure diagram, partially in cross-section and partially in phantom, of a self-contained imaging system having an externally mounted insufflation device connected to a sheath of the self-contained dissector/harvester device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0024] FIG. **1** is a structure diagram of one embodiment of a self-contained dissector/harvester device **10** for dissecting and/or harvesting a vessel V and for severing branches B from the vessel. The dissector/harvester device **10** includes an elongated sheath **12** for at least partial insertion in a body through a cut skin portion. The sheath **12** defines an inner space **14** and has a proximal end **16** and a distal end **18**.

[0025] A tip **20** is axially positioned over the distal end **18** of the sheath **12**. At least a portion of the dissector tip **20** is transparent in order to allow visualization of the vessel V and the surrounding tissue, as further explained below. As best seen in FIG. **3**, the tip **20** defines an inner space **24** and has an open proximal end **26** and a closed distal end **28**. The tip **20** is axially movable between an open position and a closed position. When the tip **20** is in the closed position, the tip proximal end **26** is adjacent to the sheath distal end **18**. The distal end **28** of the tip **20** can have a conical or other tapered shape to aid in the harvesting of a vessel, as will further be explained below. In certain embodiments, as best seen in FIG. **4**, the proximal end **26** of the tip **20** can have a stepped edge **27** that allows the proximal end **26** to be co-axially aligned within the distal end **18** of the sheath **12**. Similarly, the distal end **18** can have a stepped edge **17** that allows the stepped edge **27** to be slidably received therein.

[0026] Referring again to FIG. **3**, the self-contained dissector/harvester device **10** includes a self-contained light source **30** that is axially positioned within inner space **14** of the sheath **12**. The light source **30** includes a power supply **32** and a light **34**. In certain non-limiting embodiments, the light **34** can be a LED or fiber-optic device. Also, in certain embodiments, the power supply **32** can be a suitable battery-type power source that can be remotely controlled to be in an "on" or illuminating mode, or in an "off" or non-illuminating mode. In certain embodiments, the light source is slidably positioned within the inner space **14** of the sheath **12** and can be removed from the sheath **12** if the power supply **30** must be replaced. In certain embodiments, as schematically illustrated in FIG. **1**, the power supply **30** is connected to a switch mechanism **36** to control the light **34**.

[0027] The self-contained dissector/harvester device **10** also includes a self-contained imaging system **40** that is axially positioned within inner space **24** of the tip **20**. It is to be understood, that in other embodiments, the self-contained imaging system **40** can be axially positioned within the inner space **14** of the sheath **12** is a spaced apart relationship to the tip **20**.

[0028] In the embodiment shown in FIGS. **3** and **5**, the imaging system **40** is positioned within the tip **20**. The imaging system **40** includes a suitable image receiving device **41** that converts images into signals for transmission, recording and/or storage, and/or takes photographs of such images; for ease of explanation herein such device is generally referred to as a camera.

[0029] The camera **41** that is pivotably mounted on a support **42** and can be oriented in a first, or proximal-viewing, direction toward the light source **30** or in a second, or distal-viewing, direction toward the tip **20**. In one non-limiting embodiment shown in the FIGURES herein, the self-contained imaging system **40** can include, for example, a spring mechanism **44** axially mounted on the support **42**. The spring mechanism **44** can include a tangentially extending end **46** that is operatively connected to a longitudinally extending member **47** which, in turn, is connected to a handle **48** for pivotably moving the camera **41** between the first and second directions.

[0030] It should be understood, that in other embodiments, other suitable mechanisms can be used for directing the movement of the camera **41** and/or for receiving the images from the imaging system **40**. For example, in the embodiment shown in FIG. **1**, the camera **41** is operatively connected to a suitable cable **43**. The cable **43** can be connected to a suitable viewing monitor (not shown). In other embodiments, the camera **41** can be a wireless device that transmits images.

[0031] In certain embodiments, the self-contained imaging system **40** and the self-contained light source **30** are in an opposed axial relationship where the self-contained imaging system **40** is configured to be directed in a direction towards the self-contained light source **30**. In other embodiments, the self-contained imaging system **40** and the self-contained light source **30** are in a parallel relationship and re generally configured to be directed in the same direction.

[0032] During use, the imaging system **40** is pivotably movable to the first, proximal-viewing direction so that an image of the inner space **14** of the sheath **12** is visible when the branch B is being severed from the vessel V. The imaging system **40** is pivotably movable to the second, distal-viewing direction so that an image through the tip **20** is visible when the vessel V is being harvested and separated from the surrounding tissue. In one non-limiting embodiment, the camera **41** is pivotably movable in an accurate manner along a longitudinal axis defined by the sheath **12**. In certain embodiments, the camera **41** is pivotably movable in an arc from about 0° to about 180°.

[0033] In certain embodiments, the self-contained dissector/harvester device **10** further includes a self-contained insufflation device **50**. The insufflation device **50** is axially positioned within the inner space **14** of the sheath **12**. The insufflation device **50** includes a cartridge **52** containing a supply of a suitable gas and a supply line **54** having a discharge end **58**. In certain embodiments, the discharge end **58** of the supply line **54** is located near the distal end **18** of the sheath **12**. The insufflation device **50** can be operatively connected to a release mechanism **56**, as shown in FIGS. **1** and **2**, to allow the gas to be discharged from the supply line **54**. The sheath **12** can include one or more discharge ports or holes **59** that are in communication with the inner space **14**. The gas escaping from the ports **59** enters the forming cavity and keeps the surrounding tissue away from the self-contained dissector/harvester device **10**. The self-contained insufflation device **50** allows gas to be delivered via the radially extending openings **59** in the distal end **18** of the sheath **14**. The gas is delivered in a suitable manner subcutaneously to an area adjacent to the vessel V to be dissected and harvested.

[0034] Also, in certain embodiments, the self-contained dissector/harvester device **10** further includes a self-contained severing device **60**. In one embodiment, the self-contained severing device **60** can comprise a bipolar electrocau-

tery tool or an ultrasonic cauterizing tool. In certain embodiments, the self-contained severing device **60** comprises a cauterizing tool where a first cauterizing member **62** is operatively mounted on the distal end **18** of the sheath **12** and a second cauterizing member **64** is operatively mounted on the proximal end **26** of the tip **20**.

[0035] The self-contained severing device **60** is activated by axially displacing the tip **20** in a direction away from the sheath **12**. The self-contained severing device **60** is maneuvered adjacent to the branch B such that the branch B is positioned between the distal end **18** of the sheath **12** and the proximal end **26** of the tip **20**. The tip **20** is then retracted to a position adjacent to the sheath **12**.

[0036] The self-contained severing device **60** is activated by axially moving the tip **20** in an axial direction toward the sheath **12**. The electrodes **62** and **64** are axially moved toward each other and are used to initially grasp the branch B being dissected. The electrodes **62** and **64** are activated, severing the branch B from the vessel V.

[0037] In certain embodiments, the self-contained severing device **60** also includes an axially displacing member **66** that is operatively connected to the tip **20** to move the tip **20** in the axial direction toward and away from the sheath **12**. The displacing member **66** can be connected to a displacing button **68** that advances and returns along the longitudinal direction. The advancing and returning force is transmitted to the displacing member **66** and the tip **20** is longitudinally moved.

[0038] Also, in certain embodiments, the proximal end **16** of the sheath **12** is operatively connected to a handle **70**. The handle **70** can include a removable closure device **72** so that one or more of the self-contained light source **30**, self-contained imaging system **40** and self-contained insufflation device **50** can be removed from the inner space **14** of the sheath **12**.

[0039] To begin the dissection procedure, the dissector tip **20** is inserted through an initial incision in the patient. In operation, the dissector tip **20** is pressed into the tissues surrounding the vessel, thereby forming a tunnel or cavity around the vessel. In certain embodiments, it is desired that the dissector tip **20** be pressed into the surrounding tissue generally along the direction of the vessel in order to separate the vessel from adjacent tissue without damage to the surrounding tissue.

[0040] Upon inserting the self-contained dissector/harvester device **10** under the patient's skin, it is possible to obtain an image illuminated by the illuminating light **34** from the self-contained light source **30**. The camera **41** in the imaging system **40** can be pivotably moved to the distal-viewing direction such that the vessel is viewed through the transparent tip **20**.

[0041] In certain embodiments, the self-contained insufflation device **50** is activated for inflating the area adjacent the vessel as the cavity is being formed.

[0042] The dissector tip **20** is used to perform an initial, or blunt, dissection of the vessel from the surrounding tissue. Also, the self-contained severing device **60** is engaged to sever any branches B extending from the vessel.

[0043] In certain other embodiments, as shown in FIG. **6** for example, the self-contained dissector/harvester device **10** further includes a free-standing insufflation device **150**. The insufflation device **150** includes a cartridge **152** containing a supply of a suitable gas and a supply line **154** having a discharge end **158**. The discharge end **158** of the supply line **154** is axially positioned within the inner space **14** of the sheath **12** near the distal end **18** of the sheath **12**. The supply line **154** also has a proximal end **156** that extends from an opening **15** in the sheath **12**. While the opening **151** is shown as being situated on a sidewall of the sheath **12**, the opening **151** can be situated at any suitable location on the sheath **12**, including by way of a non-limiting example, at the proximal end **16** of the sheath **12**. The supply line **154** has a proximal end **159** that extends through the opening **151** and is connected to the cartridge **152**. The insufflation device **150** can also include a release mechanism **156** to allow the gas to be discharged from the supply line **154**.

[0044] In certain other embodiments, as shown in FIG. **7** for example, a self-contained dissector/harvester device **10** further includes a sheath **212** having an externally mounted insufflation device **250**. For ease of explanation, features that are the same as in the earlier described embodiments have been given the same reference numerals and are not again described in detail with respect to the embodiment shown in FIG. **7**.

[0045] The insufflation device **250** includes a cartridge **252** containing a supply of a suitable gas and a supply line **254** having a discharge end **258**. The discharge end **258** of the supply line **254** is axially positioned within an inner space **214** of the sheath **212** near a distal end **218** of the sheath **212**.

[0046] The supply line **254** also has a proximal end **256** that extends through an opening **251** in the sheath **212**. The supply line **254** has a proximal end **259** that extends through the opening **251** and is operatively connected to the cartridge **152**. The insufflation device **150** can also include a release mechanism **256** to allow the gas to be discharged from the supply line **254**.

[0047] In the embodiment shown in FIG. **7**, the cartridge **252** is mounted on a sidewall **260** of the sheath **212**. While the opening **251** is shown as being situated on the sidewall **260** of the sheath **212**, the opening **251** can be situated at any suitable location on the sheath **212**, including by way of a non-limiting example, at a proximal end **216** of the sheath **212**. The sidewall **260** defines a distal detent **262** that includes an inner distal flange **264** that is at least partially within the inner space **214** of the sheath **212**, and an outer distal flange **266** that is at least partially extended in a radially outward direction from a plane formed by the sidewall **260**. The inner and outer distal flanges **264** and **266**, respectively, define a distal recess **278** that is configured to receive at least a first end **253** of the cartridge **252**. The recess **278** also has a suitable configuration that allows the proximal end **259** of the supply line **254** to be readily connected to a new cartridge, if needed. In such embodiments, the proximal end **259** comprises a suitable connection member that can allow for quick and easy manipulation of any such new cartridge.

[0048] The sidewall **260** also defines a proximal detent **272** that includes an inner proximal flange **274** that is at least partially within the inner space **214** of the sheath **212**, and an outer distal flange **276** that at least partially extends in a radially outward direction from a plane formed by the sidewall **260**. The inner and outer distal flanges **274** and **276**, respectively, define a proximal recess **278** that is configured to receive at least a second end **255** of the cartridge **252**. The recess **278** also has a suitable configuration that allows the proximal end **255** of the cartridge **252** to be readily mounted on the sheath **212**. In one non-limiting embodiment, as shown in FIG. **7**, the outer proximal flange **276** is configured to allow the proximal end **255** of the cartridge **252** to be quickly and readily snapped into the proximal recess **278** so that there can be a quick and easy replacement of the cartridge **252**, if needed.

[0049] In another particular embodiment, the dissector/harvester device can include a sheath having a severing device therein, a free-standing light source having tether that is externally tethered to a power supply, and a free-standing imaging

system having a tether that is externally tethered to an image receiving system. In certain embodiments, the dissector/harvester device further includes a insufflation device to supply a gas subcutaneously to an area adjacent to the vessel. In a particular embodiment, the insufflation device can include a tether that is externally connected to a supply of gas. In another particular embodiment, at least a supply of the gas of the insufflation device can be externally mounted on the sheath.

[0050] While the invention has been described with reference to various and preferred embodiments, it should be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the essential scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed herein contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the claims.

What is claimed is:

1. A device for dissecting and/or harvesting a vessel and severing any branches extending therefrom comprises:
- a sheath configured to be at least partially inserted in a body through a cut skin portion;
- a self-contained light source positioned within the sheath;
- a self-contained imaging system positioned within the sheath; and,
- a severing device positioned within the sheath and configured to sever the vessel and branches.

2. The dissector/harvester device of claim **1**, further including an insufflation device configured to supply a gas subcutaneously to an area adjacent to the vessel.

3. The dissector/harvester device of claim **1**, wherein the severing device comprises a tip in an axial position over a distal end of the sheath, the tip being configured to be axially movable between an open position and a closed position configured to dissect the vessel and branch upon movement to the closed position.

4. The dissector/harvester device of claim **1**, wherein the severing device is configured to cauterize the severed branches and vessel.

5. The dissector/harvester device of claim **1**, wherein the self-contained imaging system and the self-contained light source are in an opposed axial relationship, whereby the self-contained imaging system is positioned to receive images in an area adjacent to the self-contained light source.

6. The dissector/harvester device of claim **3**, wherein the sheath is substantially stationary with respect to the tip.

7. The dissector/harvester device of claim **1**, wherein the light source includes an LED or optical fiber.

8. The dissector/harvester device of claim **1**, wherein the light source includes a battery-operated power supply.

9. The dissector/harvester device of claim **1**, wherein the self-contained imaging system is configured to be pivotably movable within the sheath.

10. The dissector/harvester device of claim **1**, wherein the self-contained imaging system comprises a wireless camera.

11. The dissector/harvester device of claim **3**, wherein the tip has a distal end configured to dissect the vessel from surrounding tissue.

12. The dissector/harvester device of claim **1**, wherein the severing device comprises an ultrasonic cauterizing tool or a bipolar electrocautery tool.

13. The dissector/harvester device of claim **1**, wherein the sheath includes at least one removable closure device at a proximal end thereof.

14. The dissector/harvester device of claim **1**, wherein one or more of the self-contained light source and the self-contained imaging system are removable from the device.

15. The dissector/harvester device of claim **1**, wherein the insufflation device is removable from the device.

16. The dissector/harvester device of claim **3**, wherein the distal end of the sheath and a proximal end of the tip each has at least one generally mating surface whereby, when the tip is adjacent to the sheath, the generally mating surfaces are configured to secure the vessel being harvested while a vessel branch is being severed.

17. The dissector/harvester device of claim **3**, wherein the tip and the sheath include electrodes configured for being electrically energized to sever and cauterize a vessel branch.

18. The dissector/harvester device of claim **1**, further including an insufflation device configured to supply a gas subcutaneously to an area adjacent to the vessel.

19. The dissector/harvester device of claim **18**, wherein the insufflation device is at least partially positioned within the sheath, and is removable therefrom.

20. The dissector/harvester device of claim **18**, wherein the insufflation device is axially positioned within the sheath, and is removable therefrom

21. A method of severing branches from a vessel during harvesting from a body by a self-contained dissector/harvester device, the self-contained dissector/harvester device having:
- a sheath configured to be inserted in a body through a cut skin portion;
- a self-contained light source positioned within the sheath;
- a self-contained imaging system positioned within the sheath; and,
- a severing device positioned within the sheath and configured to sever the vessel and branches;

the method comprising the steps of:
- inserting a distal end of the self-contained dissector/harvester device into the body alongside the vessel to form a cavity substantially surrounding the vessel;
- activating the self-contained light source to at least illuminate a portion of the branch;
- activating the self-contained imaging system to view at least a portion of the illuminated branch;
- moving the severing device to a position substantially adjacent to the branch and activating the severing device, whereby the vessel and branch are severed from the vessel.

22. The method of claim **21**, wherein the self-contained dissector/harvester device further includes an insufflation device, wherein the method further includes supplying a gas subcutaneously to an area adjacent to the vessel to be dissected and harvested.

23. The method of claim **21**, in which one or more of the self-contained light source and self-contained imaging system and/or insufflation devices can be removed and replaced.

24. The method of claim **21**, in which the insufflation device can be removed and replaced.

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专利名称(译)	独立式解剖器/收割机设备		
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摘要(译)

用于解剖和/或收获血管的独立装置包括独立的光源和位于护套内的独立成像系统。