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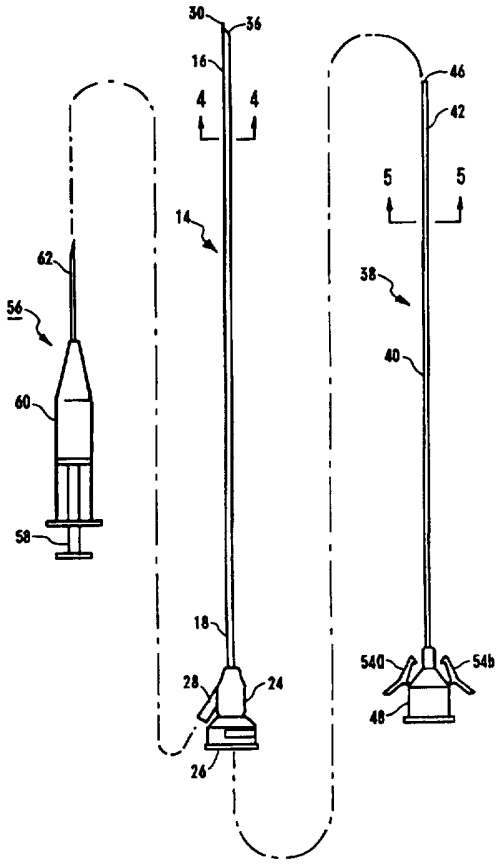
(54) Title: ARTIFICIAL INSEMINATION SYSTEM

(57) Abstract

An artificial insemination system and its use requires a sheath (14) which has a first lumen (20) for receiving and holding an endoscope (38), and a second lumen (22) through which semen can be injected into the uterus of the animal to be inseminated. Additionally, the sheath includes a blunt guide probe (30) which extends distally from the distal end of the sheath and a window (36) covering the distal end. When using the system, the endoscope (38) is initially inserted into the first lumen of the sheath (14). The combination of the sheath and endoscope are then inserted into the vagina of the animal, and, using the endoscope, the guide probe is directed through cervix os into the cervix until the distal end of the second lumen is positioned in the uterus. An injector filled with semen is used to inject semen into the uterus through the second lumen.



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ARTIFICIAL INSEMINATION SYSTEM

FIELD OF INVENTION

The present invention pertains generally to devices and methods useful for the artificial insemination of mammals. More particularly, the present invention pertains to devices which may be used for non-surgical placement of spermatozoa into the uterus of a subject animal. The present invention is particularly, but not exclusively useful for the non-surgical artificial insemination of ewes.

BACKGROUND OF THE INVENTION

In recent years, effective application of artificial insemination has become established as a proven method for improving the production of domestic livestock. Generally, such techniques provide livestock managers with an enhanced ability to selectively breed a single male to a large number of females. Selective breeding, of course, allows the production of livestock with improved genetic traits. Artificial insemination techniques also decrease the chance of diseases and physical injury formerly associated with the natural breeding process. As a result of these and other advantages, the use of artificial insemination has become a widespread technique in the management of many forms of domestic livestock.

Not surprisingly, then, a large number of varying techniques have been developed for the artificial insemination of livestock. The simplest and most common of these techniques is known as vaginal artificial insemination, or VAI. VAI has the advantage of being relatively inexpensive. VAI also requires little operator expertise or training. Unfortunately, VAI techniques are generally effective only when used in combination with relatively large amounts of freshly collected semen. In particular, VAI techniques have proven to be relatively

ineffective when applied to sheep, especially when frozen semen is utilized.

Transcervical artificial insemination, or TAI, has been developed as an alternative to VAI techniques. When compared to VAI, TAI offers an alternative procedure for using frozen or fresh semen. TAI techniques also generally require fewer spermatozoa than VAI methods. Unfortunately, TAI techniques are more expensive and require more training than traditional VAI methods and present extremely variable results. Additionally, TAI techniques also present a risk of trauma to the subject animal.

Laparoscopic artificial insemination, or LAI, is another technique developed as an alternative to more traditional insemination techniques. In comparison to VAI, or TAI, LAI, offers the highest rate of pregnancy. LAI also requires the smallest number of spermatozoa per procedure. LAI is, however, an invasive and traumatic surgical procedure requiring a highly trained and licensed veterinarian. LAI also has the highest trauma risk potential.

In general, each of the preceding techniques has been applied to a number of differing types of livestock. For example, VAI, TAI and LAI methods been utilized for sheep as well as goat applications. It should be appreciated, however, that each of the preceding techniques may be more, or less, effective when utilized for a particular species. Practice has also shown that applications involving sheep are particularly problematic. In particular, female sheep, or ewes, have a cervical anatomy which includes four to six cervical rings. The rings function as partial seals for the cervical canal making traversal of the canal during an artificial insemination procedure problematic and often, ineffective. The presence of the cervical rings also increases the risk of traumatic injury during the artificial insemination procedure.

A second difficulty associated with the artificial insemination of sheep is caused by chemical incompatibility between the cervical secretions of a ewe and cryoprotectants used to preserve spermatozoa. In more detail, it is generally the case that spermatozoa are combined with a cryoprotectant and frozen prior to implantation during an artificial insemination procedure. Freezing, of course, allows the spermatozoa to be stored for long periods of time without loss in potency. Freezing can only be accomplished, however, if a cryoprotectant is added to preserve the spermatozoa during the freezing process. Unfortunately, the cryoprotectants generally available are chemically incompatible with the chemical environment present in the cervix of a sheep. The resulting chemical reaction destroys the majority of the implanted spermatozoa defeating the object of the insemination procedure.

In light of the above, it is an object of the present invention to provide a system and method for artificial insemination which minimizes the risk of trauma to the subject undergoing insemination. Another object of the present invention is to provide a system and method for artificial insemination which minimizes the level of skill and training required for successful operation. Yet another object of the present invention to provide a system and method for artificial insemination which maximizes the rate of successful insemination. Another object of the present invention to provide a system and method for artificial insemination which minimizes the amount of spermatozoa required for successful insemination. Another object of the present invention is to provide a non-surgical system and method for artificial insemination which is adaptable to the insemination of female sheep. Still another object of the present invention is to provide a system and method for artificial insemination which is relatively simple to use, easy to manufacture, and cost effective.

SUMMARY OF THE INVENTION

A system for artificially inseminating an animal essentially includes a sheath, an endoscope and a semen injector. More specifically, the endoscope is insertable into the sheath and useable there for visually positioning the sheath into the uterus of the animal. Further, the semen injector is connectable with the sheath for injecting semen through the sheath and into the uterus. As intended for the present invention, the sheath may be discarded after use.

The sheath for the system of the present invention is elongated and has both a first lumen and a second lumen which run substantially the entire length of the sheath. Additionally, a guide probe extends from the distal end of the sheath and a window is positioned to cover the distal end of the first lumen. The sheath also has a proximal connector which is engageable with the endoscope and with the injector.

In addition to its optical components, the endoscope for the system of the present invention includes a housing which is engageable with the proximal end of the sheath. With specific regard to its optical components, the endoscope includes a fiber optic bundle and an illumination guide. A lens is mounted on the distal end of the fiber optic bundle, and a viewing system which is mounted on the housing is optically connected to the proximal end of the fiber optic bundle. A light source, also mounted on the housing, is connected to the proximal end of the illumination guide. As intended for the present invention, the fiber optic bundle and the illumination guide are substantially the same length and are dimensioned to position the lens immediately proximal to the window when the endoscope has been inserted into the first lumen of the sheath.

In the operation of the artificial insemination system of the present invention, the endoscope is initially inserted into the first lumen of the sheath. The proximal connector on the sheath is then engaged with the housing of the endoscope. With this engagement, as indicated above, the lens of the endoscope is positioned immediately proximal to the window. Next, the sheath is guided through the vagina and cervix of the animal and into the uterus. This guidance is done by continuously viewing the guide probe with the endoscope to guide and steer the sheath through the anatomical passageways. Further, due to the relative stiffness of the endoscope and sheath, it is possible to guide the sheath by manual manipulation of the endoscope.

Once the distal end of the sheath has been properly positioned in the uterus of the animal, the injector is connected into fluid communication with the proximal end of the second lumen. Semen from the injector is then injected through the second lumen and into the uterus. Following injection of the semen into the uterus, the system is withdrawn from the animal and, if desired, the sheath can be discarded before a subsequent use of the endoscope.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features of this invention, as well as the invention itself, both as to its structure and its operation will be best understood from the accompanying drawings, taken in conjunction with the accompanying description, in which similar reference characters refer to similar parts, and in which:

Figure 1 is a perspective view of the sheath and endoscope of the present invention, in combination as the sheath is being inserted through the cervix of a ewe;

Figure 2 is a plan view of the injector, sheath and endoscope components of the system of the present invention with connecting lines to show their respective cooperation;

Figure 3 is a plan view of the distal end of the sheath of the present invention;

Figure 4 is a cross-sectional view of the sheath of the present invention as seen along the line 4-4 in Fig. 2; and

Figure 5 is a cross-sectional view of the endoscope of the present invention as seen along the line 5-5 in Fig. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is a system and method for artificial insemination of animals. The system of the present invention is shown in Figure 1 and generally designated 10. More specifically, in Figure 1, the system 10 of the present invention is shown in its intended environment partially inserted into the cervix 12 of an animal, such as a ewe (not shown).

The structural details of the device 10 of the present invention may be better appreciated by reference initially to Figure 2. In Figure 2, it may be seen that the device 10 includes a long, narrow sheath 14 having a distal end 16 and a proximal end 18. Referring temporarily to Figure 4, it may be seen that the sheath 14 is formed to include a first lumen 20 and a second lumen 22. Although not shown, it may be appreciated that the first lumen 20 and second lumen 22 extend throughout the length of the sheath 14.

Returning to Figure 2, it may be seen that a proximal connector 24 is attached to the proximal end 18 of the sheath 14. The connector is formed to include a first port 26 and a second port 28. The first port 26 is attached in fluid communication with the first lumen 20. Similarly, the second port 28 is attached in fluid communication with the

second lumen 22. The second port 28 is fabricated as a quick-connect type connector.

The distal end 16 of the sheath 14 include several structural elements better appreciated by reference to Figure 3. In Figure 3, it may be seen that a guide probe 30 is connected to the distal end 16 of the sheath 14. In more detail, the guide probe 30 is formed as an extension of the second lumen 22. A knob 32 is formed at the distal end of the guide probe 30. Additionally, an exit port 34 is formed in the second lumen 22, just proximal to the knob 32. Functionally, it may be appreciated that fluid injected in to second lumen 22 at the second port 28 will pass the length of the sheath 14 and emerge at the exit port 34. Figure 3 also shows that the distal end 16 of the sheath 14 includes a window 36. The window 36 is optically transparent and prevents passage of fluid into the distal end of first lumen 20.

Referring again to Figure 2, it may be seen that the present invention also includes an endoscope generally designated 38. The endoscope 38 of the present invention is fabricated as an elongated rod 40 having a distal end 42 and a proximal end 44. An objective lens 46 is attached to the distal end 42 of the rod 40. Additionally, a housing 48 is attached to the proximal end 44 of the rod 40. The housing 48 is connectable to a light source and a viewing system, such as a video display (light source and viewing system not shown). Referring briefly to Figure 5, is may be seen that the rod 40 of the endoscope 38 surrounds a fiber optic bundle 50 and an illumination guide 52. For the purposes of the present invention, the fiber optic bundle 50 and the illumination guide 52 extend through the length of the rod 40. Additionally, both the fiber optic bundle 50 and the illumination guide 52 are connected between the objective lens 46 and the housing 48. Functionally, the illumination guide 52 functions as a means whereby light from a light source connected to the housing 48 may be

projected through the rod 38 and emitted from the distal end 42 of the rod 40 illuminating a field of view at the distal end 42 of the rod 40. Simultaneously, the fiber-optic bundle 50 functions as a means whereby an image of the illuminated field of view may be conveyed back through the rod 40 to a viewing system connected to the housing 48.

The rod 40 of the endoscope 38 is insertable through the second port 28 of the sheath 14. When inserted in this fashion, the rod 40 passes into the first lumen 20 until the objective lens 46 is positioned at the window 38 located at the distal end 16 of the sheath 14. As the endoscope 38 reaches the point of full insertion into the sheath 14, two quick-release connectors 54a and 54b engage the housing 48.

Continuing with Figure 2, it may be seen that the present invention includes an injector generally designated 56. Generally, the injector 56 may be of any type which is connectable to the second port 28 of the sheath 14 and which may be used to pass fluid into the second port 28 to be emitted at the exit port 34. For these purposes, the injector 56 shown in Figure 2 includes a syringe type body 58 and a plunger 60. An insemination straw, or needle 62 is connected to the distal end of the body 58.

OPERATION

Operation of the present invention begins with insertion of the endoscope 38 into the sheath 14. Once the endoscope 38 has been fully inserted into the sheath 14, the quick-release connectors 54a and 54b engage the connector 24 of the sheath 14 allowing the sheath 14 and endoscope 38 to be manipulated as a single unit. A light source and viewing system, such as a video display system, is then connected to the housing 48 of the endoscope 38. As shown in Figure 1, the distal end 16 of the sheath 14,

containing the endoscope 38 is then inserted through the cervical os 64 and into the cervix 12. As the sheath 14 is advanced through the cervix 12, an image is conveyed by the endoscope 38 to the viewing system. As may be appreciated by reference to Figure 1, this allows the guide probe 30, and thus the sheath 14, to be selectively steered past anatomical structures, such as the many fornia 66, that lie between the cervical os 64 and the body of the uterus 68. Once the distal end 16 of the sheath 14 has reached the body of the uterus 68, the injector 56, which will generally be prefilled with a solution containing spermatozoa, may be connected to the second port 28 of the sheath 14. The plunger 58 of the injector 56 is then advanced to cause the fluid in the injector to flow through the second lumen 22 and out of the exit port 34.

Once the spermatozoa have been introduced into the uterus 68, the entire device 10 may be withdrawn from the cervical os 64. The quick-release connectors 54a and 54b may then be manipulated to release the endoscope 38 from the sheath 14. The endoscope 38 is then removed from the sheath 14, allowing the endoscope 38 to be inserted into a second sheath of the same type as sheath 14 for insemination of another animal.

While the particular system and method for artificial insemination as herein shown and disclosed in detail is fully capable of obtaining the objects and providing the advantages herein before stated, it is to be understood that it is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the details of construction or design herein shown other than as described in the appended claims.

We claim:

1. An artificial insemination system which comprises:

a sheath having a distal end and a proximal end, said sheath being formed with a first lumen and a second lumen;

a guide probe extending from said distal end of said sheath;

a window positioned at said distal end of said sheath to cover said first lumen;

an endoscope insertable into said first lumen for viewing through said window in a distal direction from said distal end of said sheath; and

an injector engageable in fluid communication with said second lumen at said proximal end of said sheath for injecting fluid through said second lumen of said sheath and out said distal end thereof.

2. A system as recited in claim 1 wherein said guide probe and said window are formed as an integral unit, with said integral unit being attached to said distal end of said sheath.

3. A system as recited in claim 1 wherein said endoscope comprises:

a housing engageable with said proximal end of said sheath;

a viewing system mounted on said housing;

a lens;

a fiber optic bundle optically interconnecting said lens with said eyepiece for viewing distally from said sheath;

a light source mounted on said housing;

an illumination guide interconnecting said lens with said light source for illuminating beyond said distal end of said sheath.

4. A system as recited in claim 3 wherein said viewing system is an eyepiece.

5. A system as recited in claim 3 wherein said viewing system is a camera.

6. A system as recited in claim 3 further comprising means for stiffening said system to facilitate guiding and placement of said system into a body cavity of an animal.

7. A system as recited in claim 3 wherein said fiber optic bundle has a proximal end and a distal end with said viewing system connected to said proximal end of said fiber optic bundle and said lens mounted on said distal end of said fiber optic bundle.

8. A system as recited in claim 3 wherein said endoscope is dimensioned for insertion into said first lumen of said sheath to position said lens immediately proximal to said window.

9. A method for artificially inseminating an animal which comprises the steps of:

Providing a device, said device comprising a sheath having a distal end and a proximal end and formed with a first lumen and a second lumen, a guide probe extending from said distal end of said sheath with a window positioned at said distal end of said sheath to cover said first lumen, an endoscope having a lens insertable into said first lumen for viewing through said window in a distal direction from said distal end of said sheath, and an injector engageable in fluid communication with said second lumen at said proximal end of said sheath for injecting semen through said second lumen of said sheath and out said distal end thereof;

Inserting said endoscope into said first lumen;

Viewing said guide probe through said endoscope to pass said distal end of said sheath through the cervix and into the uterus of an animal;

Engaging said injector with said proximal end of said sheath; and

Injecting semen from said injector through said second lumen of said sheath to inseminate the animal.

10. A method as recited in claim 9 wherein said inserting step is accomplished by positioning said lens immediately proximal to said window.

11. A method as recited in claim 9 further comprising the step of discretionarily discarding said sheath after the animal has been inseminated.

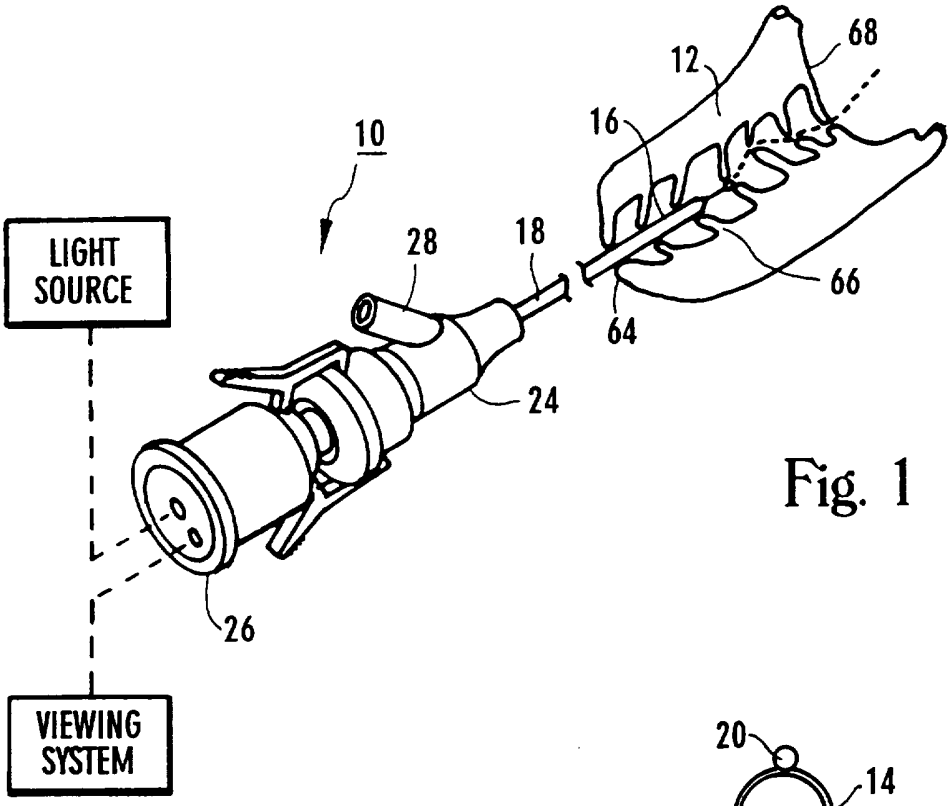

Fig. 1

Fig. 4

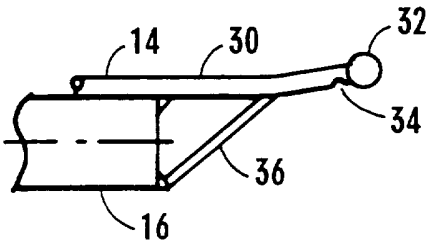

Fig. 3

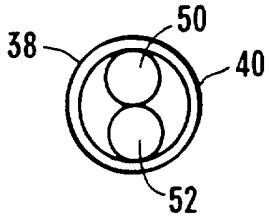

Fig. 5

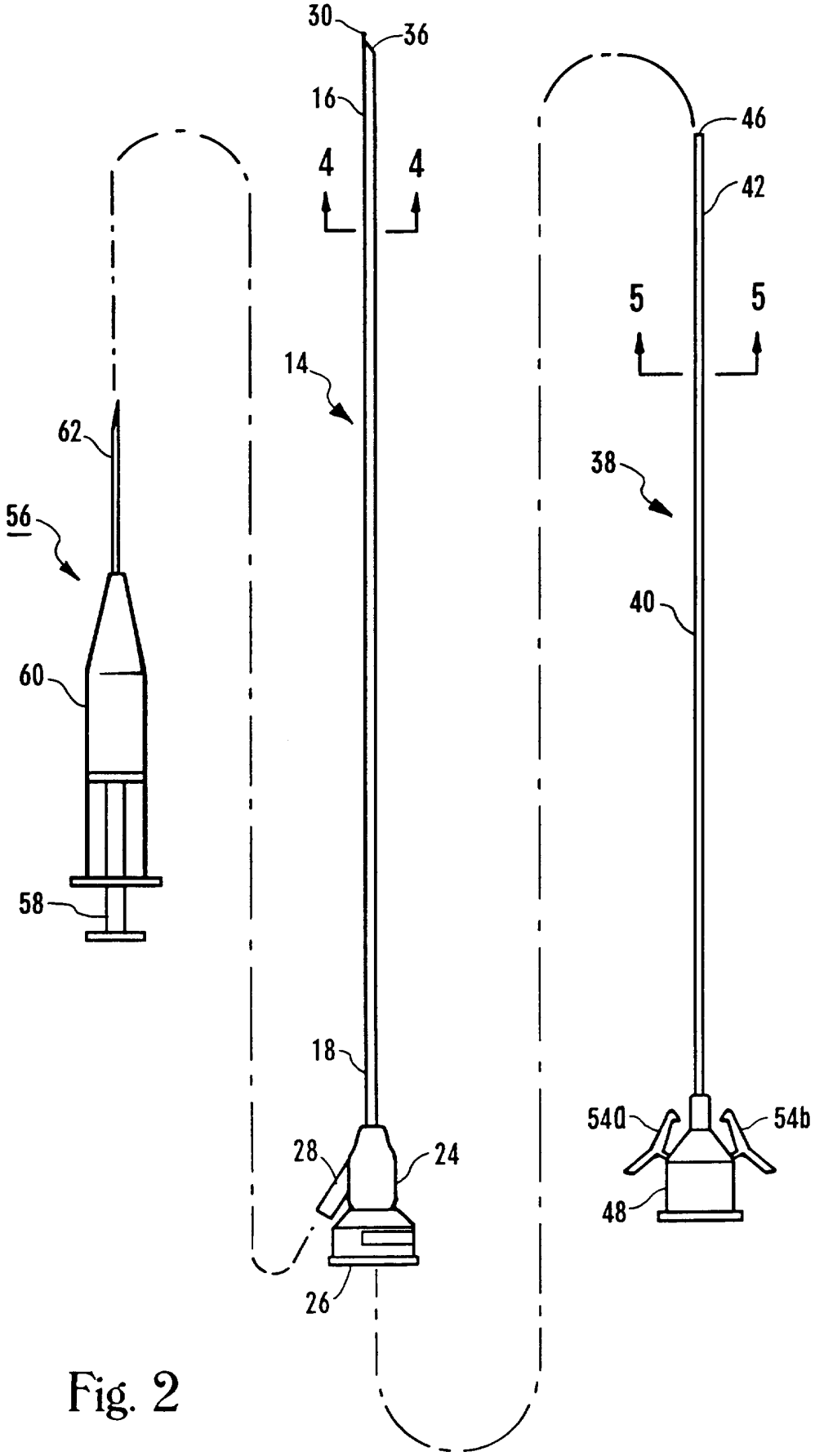

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/16775

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A61B 17/43
US CL :600/35

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 600/33-35, 144, 176; 604/55

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,389,089 A (BAUER et al) 14 February 1995, sheath with insertable scope.	1-11
Y,P	US 5,536,234 A (NEWMAN) 16 July 1996, sheath with scope and injection lumen.	1-11
Y	US 4,942,867 A (TAKAHASHI et al) 24 July 1990, use of windows in Fig. 11.	1-11
Y	US 5,374,247 A (LOWERY et al) 20 December 1994, use of injector (65) for delivering semen.	1-11
Y	US 5,188,093 A (LAFFERTY et al) 23 February 1993, endoscope construction and means for engaging it to a sheath (64).	3-8

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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