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Remarks:
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(54) Device and methods of improving laparoscopic surgery

(57) The present invention discloses a camera holder device and mechanism for laparoscopic surgery. The camera holder device is easily installed and disassembled, comfortable to use, not limiting the dexterity of the surgeon, having small physical dimension and inexpensive. Furthermore, the present invention relates to means and methods for improving the interface between the surgeon and the operating medical assistant or between the surgeon and an endoscope system for laparoscopic surgery.. Moreover, this present invention discloses a device useful for controlling an endoscope system for laparoscopic surgery, in which the endoscope is inserted through a small incision into the body's cavities.

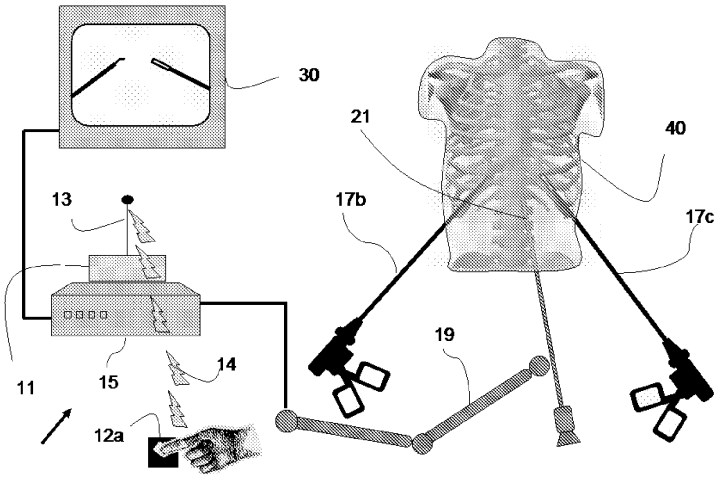

Fig. 33

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Description

FIELD OF THE INVENTION

[0001] The present invention discloses a camera holder device and mechanism for laparoscopic surgery. The camera holder device is easily installed and disassembled, comfortable to use, not limiting the dexterity of the surgeon, having small physical dimension and inexpensive. Furthermore, the present invention relates to means and methods for improving the interface between the surgeon and the operating medical assistant or between the surgeon and an endoscope system for laparoscopic surgery.. Moreover, this present invention discloses a device useful for controlling an endoscope system for laparoscopic surgery, in which the endoscope is inserted through a small incision into the body's cavities.

BACKGROUND OF THE INVENTION

[0002] In laparoscopic surgery, the surgeon performs the operation through small holes using long instruments and observing the internal anatomy with an endoscope camera. The endoscope is conventionally held by a camera assistant (i.e. operating medical assistant) since the surgeon must perform the operation using both hands. The surgeon performance is largely dependent on the camera position relative to the instruments and on a stable image shown at the monitor; also the picture shown must be in the right orientation. The main problem is the difficulty for the operating medical assistant to keep the endoscope in the right spatial position, to hold the endoscope steadily, keeping the scene in the right orientation. To overcome these problems, several new technologies have been developed, using robots to hold the endoscope while the surgeon performs the procedure, e.g., Lapman, Endoassist etc. But these technologies are expensive, difficultly installed, uncomfortable to use, limiting the dexterity of the surgeon and having physical dimension much bigger that all operating tools. Relatively to the required action, they also move in big bounds with several arms movement. Another robot, LER (which was developed by the TIMC-GMCAO Laboratory) US. Patent application No. 200/6100501 Consists of a compact camera-holder robot that rests directly on the patient's abdomen and an electronic box containing the electricity supply and robot controllers. LER has relatively small dimensions but has a 110 mm diameter base ring that must be attached, or be very close to patient skin. This ring occupies place over the patient body limiting the surgeon activities: choosing the place of the other trocars, changing the surgeon to usual way of making the procedure, forcing sometimes the setup process to be as long as 40 minutes. Also the LER has only 3 degrees of freedom and have no ability to control the orientation of the picture shown to surgeon (the LER can not rotate the endoscope around its longitudinal axis).

[0003] Reference is made now to figures 1a, 1b, 1c, presenting a schematic illustration of the prior art which describes these technologies.

[0004] Laparoscopic surgery is becoming increasingly popular with patients because the scars are smaller and their period of recovery is shorter. Laparoscopic surgery requires special training of the surgeon or gynecologist and the theatre nursing staff. The equipment is often expensive and not available in all hospitals. During laparoscopic surgery it is often required to shift the spatial placement of the endoscope in order to present the surgeon with the optimal view. Conventional laparoscopic surgery makes use of either human assistants that manually shift the instrumentation or alternatively robotic automated assistants (such as JP patent No. 06063003).

[0005] Furthermore, even the improved technologies are still limiting the dexterity of the surgeon and failing to provide four degrees of freedom. Another disadvantage of those technologies is the lack of ability to control the spatial position of an endoscope tube to any orientation during said laparoscopic surgery, such that the surgeon reaches any desired area within the working envelope in operated body.

[0006] Therefore, there is still a long felt need for a camera holder that would allow holding and controlling the endoscope steadily without limiting the dexterity of the surgeon and that will provide four degrees of freedom. Furthermore, there is still a long felt need for a camera holder that will provide the ability to control the spatial position of an endoscope tube to any orientation during said laparoscopic surgery, such that the surgeon reaches any desired area within the working envelope in operated body.

[0007] Another patent literature relates to the field of automated assistants. Automated assistants utilize interfaces that enable the surgeon to direct the mechanical movement of the assistant, achieving a shift in the camera view.

[0008] US patent 6,714,841 discloses an automated camera endoscope in which the surgeon is fitted with a head mounted light source that transmits the head movements to a sensor, forming an interface that converts the movements to directions for the mechanical movement of the automated assistant. Alternative automated assistants incorporate a voice operated interface, a directional key interface, or other navigational interfaces. The above interfaces share the following drawbacks:

a. Single directional interface that provide limited feedback to the surgeon.

b. Cumbersome serial operation for starting and stopping movement directions that requires the surgeon's constant attention, preventing the surgeon from keeping the flow of surgical procedure.

[0009] Research has suggested that these systems divert the surgeons focus from the major task at hand. Therefore technologies assisted by magnets and image

processing have been developed to simplify interfacing control. However these improved technologies still fail to address another complicating interface aspect of laparoscopic surgery, they do not allow the surgeon to signal to both the automated assistant and to human assistants or to surgical colleagues, which instrument his attention is focused on.

[0010] Hence, there is still a long felt need for a improving the interface between the surgeon and an endoscope system, surgical colleagues or human assistants for laparoscopic surgery.

SUMMARY OF THE INVENTION

[0011] It is one object of the invention to disclose a camera holder, useful for laparoscopic surgery; wherein said camera holder is provided with means of manipulation in four degrees of freedom; further wherein said camera holder is provided with means of controlling the spatial position of an endoscope tube to any orientation during said laparoscopic surgery, such that said endoscope reaches any desired area within the working envelope in an operated body.

[0012] It is another object of the invention to disclose the camera holder as defined above, wherein said camera holder is adapted to have small physical dimension.

[0013] It is another object of the invention to disclose the camera holder as defined above, wherein said camera holder comprises:

a. a housing (309); said housing is adapted to be connected and disconnected to said endoscope; said housing comprises:

i. at least one zoom mechanism;
ii. at least one endoscope rotation mechanisms;

b. rotating DF (304); and

c. sliding DF (305).

[0014] It is another object of the invention to disclose the camera holder as defined above, wherein said camera holder additionally comprises:

a. motor house;

b. means adapted to transmit movement to said zoom mechanism;

c. means adapted to transmit movement to said endoscope rotation mechanism;

d. means adapted to transmit movements to said endoscope rotating DF;

e. means adapted to transmit movements to the sliding DF.

[0015] It is another object of the invention to disclose the camera holder as defined above, wherein said zoom mechanism is adapted to provide a zoom action; further wherein said endoscope rotation mechanism is adapted to rotate said endoscope about its long axis; further wherein said endoscope rotation mechanism and/or said zoom mechanism and/or said rotating DF and/or said sliding DF are adapted to be independent of other moving parts of said camera holder mechanism.

[0016] It is another object of the invention to disclose the camera holder as defined above, wherein said camera holder is disposable.

[0017] It is another object of the invention to disclose the camera holder as defined above, wherein said camera holder additionally comprises a quick release handle adapted to disassemble said endoscope out of said housing without changing any of said degrees of freedom.

[0018] It is another object of the invention to disclose the camera holder as defined above, wherein said camera holder additionally comprising a telescopic guide; said telescopic guide is adapted to provide said endoscope movement along said endoscope longitudinal axis.

[0019] It is another object of the invention to disclose the camera holder as defined above, additionally comprising:

a. a zoom ring (1);

b. orientation ring (3);

c. at least two cables 4a and 4b; said cables 4a and 4b are characterized by having length of L_1 and L_2;

d. a spring (5); said spring is characterized by having a resistance K; and

e. a basis ring (6);

wherein lengths of L_1, L_2 are changeable in conjunction with said spring's resistance K, thereby said orientation ring is moved relatively to said basis ring.

[0020] It is another object of the invention to disclose the camera holder as defined above, wherein said rotation mechanism comprises at least one cable; at least one worm gear; said cable is adapted to rotate said worm gear such that said endoscope is rotated.

[0021] It is another object of the invention to disclose the camera holder as defined above, wherein said rotation mechanism comprises at least one pulley block; said pulley block are adapted to control the spatial angular position of said endoscope.

[0022] It is another object of the invention to disclose the camera holder as defined above, wherein said camera holder additionally comprising means such that said camera holder is adapted to be portable.

[0023] It is another object of the invention to disclose the camera holder as defined above, wherein said means

comprising (a) at least one adjustable arm; and (b) a basis comprising at least one motor; said adjustable arm couples said camera holder and said basis.

[0024] It is another object of the invention to disclose the camera holder as defined above, wherein said zoom mechanism is selected from a group comprising adjustment cable mechanism, parallelogram rods mechanism, a spring mechanism, a reduction force mechanism, rotating cable mechanism and a two springs zoom mechanism.

[0025] It is another object of the invention to disclose the camera holder as defined above, wherein said camera holder comprising a manipulating endoscope mechanism (1); a force carriage system (2); and a force source (3).

[0026] It is another object of the invention to disclose the camera holder as defined above,
wherein said manipulating endoscope mechanism comprises:

a. at least one cable;

b. at least one spring; and

c. at least one rod;

said force carriage system comprises:

a. at least one cable;

b. at least one chain; and

c. at least one rod;

said force source comprises

a. at least one motor; and/or at least one actuator; at least one piston.

[0027] It is another object of the invention to disclose a method for controlling the spatial position of endoscope tube to any orientation in laparoscopic surgery, such that the surgeon reaches any desired area within the working envelope in operated body. The method comprises step selected inter alia from (a) obtaining a camera holder as defined above; (b) assembling said endoscope to said housing; and (c) controlling and manipulating said endoscope such that an optimal field view is obtained; wherein said step of controlling and manipulating said endoscope is providing said endoscope movement in four degrees of freedom.

[0028] It is another object of the invention to disclose the method as defined above, additionally comprising the step of zooming in and/or zooming out of said desired area such that more precisions is obtained.

[0029] It is another object of the invention to disclose the method as defined above, wherein said step of zooming in and/or zooming out additionally comprises the step of moving said endoscope along said endoscope longitudinal axis.

[0030] It is another object of the invention to disclose the method as defined above, additionally comprising the step of rotating said endoscope.

[0031] It is another object of the invention to disclose the method as defined above, additionally comprising the step of disassembling said endoscope to said housing.

[0032] It is another object of the invention to disclose the method as defined above, additionally comprising the step of controlling the rotation angle of said endoscope along said endoscope long axis.

[0033] It is another object of the invention to disclose the method as defined above, additionally comprising the step of selecting said zoom mechanism from a group comprising adjustment cable mechanism, parallelogram rods mechanism, a spring mechanism, a reduction force mechanism, rotating cable mechanism and a two springs zoom mechanism.

[0034] It is another object of the invention to disclose the method as defined above, additionally comprising the step of adjusting said camera holder to be portable.

[0035] It is another object of the invention to disclose the method as defined above, additionally comprising the step of disassembling the endoscope out of the zoom mechanism without changing any degree of freedom of the spatial position of said endoscope, by activating said endoscope independently of other moving parts of the mechanism, such that the entire system does not have to be re-positioned.

[0036] It is object of the present invention to disclose a device useful for the surgeon and the automated assistant interface, and/or said surgeon and the operating medical assistant interface, during laparoscopic surgery; wherein said device is adapted to control and/or direct said automated endoscope assistant to focus said endoscope on the desired instrument of said surgeon; further wherein said device is adapted to focus said operating medical assistant on said desired instrument of said surgeon.

[0037] It is another object of the present invention to disclose the device as defined above, wherein said device additionally comprising:

a. at least one wireless transmitter with at least one operating key;

b. at least one wireless receiver;

c. at least one conventional laparoscopy computerized system; said conventional laparoscopy computerized system is adapted to load a surgical instrument spatial locating software, and an automated assistant maneuvering software; said locating software enables a visual response to the depression of said at least one key on said wireless transmitter; said maneuvering software enables the movement of said endoscope; and

d. at least one video screen.

[0038] It is another object of the present invention to disclose the device as defined above, wherein each said instrument is fitted with a wireless transmitter.

[0039] It is another object of the present invention to disclose the device as defined above, wherein said wireless transmitter is freestanding.

[0040] It is another object of the present invention to disclose the device as defined above, wherein said wireless transmitter is adapted to locate the position of each instrument.

[0041] It is another object of the present invention to disclose the device as defined above, wherein said selection of said desired instrument is confirmed by clicking on said at least one key.

[0042] It is another object of the present invention to disclose the device as defined above, wherein said selection of said desired instrument is confirmed by depression of said at least one key on said wireless transmitter.

[0043] It is another object of the present invention to disclose the device as defined above, wherein said depression of said at least one key is a prolonged depression.

[0044] It is another object of the present invention to disclose a method useful for surgeon and the automated assistant interface, and/or said surgeon and the operating medical assistant interface, during laparoscopic surgery. The method comprises step selected inter alia from (a) obtaining a device as defined above; (b) selecting said desired instrument; and (c) displaying said desired instrument on a screen; wherein said device controlling and/or directing said automated endoscope assistant and thereby focusing said endoscope on said desired instrument of said surgeon.

[0045] It is another object of the present invention to disclose the method as defined above, additionally comprising the step of confirming by the selection of said desired instrument.

[0046] It is another object of the present invention to disclose the method as defined above, additionally comprising the step of extracting said desired instrument form said screen.

[0047] It is another object of the present invention to disclose the method as defined above, additionally comprising the step of instructing said automated assistant to focus said endoscope on said desired instrument.

[0048] It is another object of the present invention to disclose the method as defined above, wherein said step of selecting said desired instrument additionally comprising the steps of (a) depressing of said at least one key on said wireless transmitter; (b) transmitting a generic code to said receiver; (c) communicating said signal to the computer.

[0049] It is another object of the present invention to disclose the method as defined above, wherein said step of selecting said desired instrument additionally comprising the step confirming the selection of said desired instrument by clicking on said at least one key.

[0050] It is another object of the present invention to disclose the method as defined above, wherein said step of selecting said desired instrument additionally comprising the step confirming the selection of said desired instrument by a prolonged depression on said at least one key.

[0051] It is another object of the present invention to disclose the method as defined above, additionally comprising the step of re-selecting said desired instrument until said desired instrument is selected.

[0052] It is another object of the present invention to disclose the method as defined above, additionally comprising the step of identifying each of said instrument to said computerized system.

[0053] It is another object of the present invention to disclose the method as defined above, additionally comprising the step of attaching said wireless transmitter to said surgical instrument.

[0054] It is another object of the present invention to disclose the method as defined above, additionally comprising the step of matching each transmitted code from said depressed wireless transmitter to said surgical instrument.

[0055] It is another object of the present invention to disclose the method as defined above, wherein said step of matching each transmitted code additionally comprising the step of storing said matching database on a computer.

[0056] It is another object of the present invention to disclose the method as defined above, additionally comprising the step of signing said surgical instrument by a temporary onscreen graphic symbol and presenting upon the onscreen depiction of the surgical instrument.

[0057] It is another object of the present invention to disclose the method as defined above, additionally comprising the step of continuously displaying said selection graphic symbol.

[0058] It is still an object of the present invention to disclose the method as defined above, wherein the selection of the surgical instrument is signified by a continuous onscreen graphic symbol presented upon the onscreen depiction of the surgical instrument.

[0059] It is lastly an object of the present invention to disclose the method as defined above, additionally comprising the step of calculating the position of each said instrument.

BRIEF DESCRIPTION OF THE FIGURES

[0060] In order to understand the invention and to see how it may be implemented in practice, and by way of non-limiting example only, with reference to the accompanying drawing, in which

FIG. 1a, 1b, 1c present a schematic illustration of prior art technologies;

FIG. 2 is a schematic view of the camera holder;

FIG. 3 is a schematic cut view of the camera holder;

FIG. 4 schematically illustrates a mechanism with only one curved guide;

FIG.5 schematically illustrates the four degrees of freedom of the mechanism;

FIGS. 6 and 7 are schematic view of the telescopic guide;

FIG. 8a, 8b, 8c schematically present an illustrating example of a camera holder mechanism for laparoscopic surgery;

FIG. 9 illustrates the way in which the endoscope is inserted through a small incision in the abdomen or chest;

FIG. 10 presents a schematic and illustrated drawing of the entire system according to one embodiment of the present invention which comprises three main parts a manipulating endoscope mechanism (1); a force carriage system (2); and a manipulating system actuator (3);

FIG. 11 presents a schematic illustration of the camera holder according to another embodiment of the present invention;

FIG. 12 is a schematic view of the camera holder illustrating the motion of the orientation ring relatively to the basis ring;

FIG. 13 is a schematic view of the orientation ring different position;

FIG. 14 is a schematic view of the "adjustment cable" zoom mechanism according to one embodiment of the present invention;

FIG. 15 presents a schematic description of the rotation mechanism;

FIG. 16 represents the portable feature of the mechanism;

FIG. 17 is a schematic view of the mechanism placed beside a bed;

FIG. FIG. 18a, 18b, 19a, 19b, 20 represent three different options for the zoom mechanism: 18 a and 18b with "parallelogram rods mechanism"; 19a and 19b with a "spring mechanism"; and 20 with a "reduction force device";

FIG. 21 presenting a schematic section view of the pulley blocks located on the endoscope motion mechanism;

FIG. 22 is a three-dimension schematic view of figure 21;

FIG. 23 is a schematic view of the "rotating cable" zoom mechanism obtained by rotating cable which turns a central screw with joins in different directions;

FIG. 24 presents a schematic and illustrated drawing of the entire system according to one embodiment of the present invention which comprises three main parts a manipulating endoscope mechanism (1); a force carriage system (2); and a manipulating system actuator (3);

FIG. 25 presents a schematic illustration of the manipulating endoscope mechanism (1);

FIG. 26 presents a schematic cut view along the sliding links 11a, 11b, 11c of figure 25;

FIG. 27 presents the zoom mechanism, according to another embodiment of the present invention (the "two springs zoom mechanism");

FIG. 28a, 28b and 28c schematically present the rotation mechanism according to another embodiment of the present invention;

FIG. 29 schematically presents the envelope of the endoscope range of movement;

FIG. 30 schematically presents the way the mechanism acts to controls one angle of the endoscope by changing the total length of the telescopic arm;

FIG. 31 schematically presents the way the mechanism acts to controls another angle (β) of the endoscope by rotating telescopic arm;

FIG. 32a schematically presents the portable feature of the mechanism; and,

FIG. 32b schematically presents an upper view of the position abilities of the system: the rotation angle γ, and the horizontal position X slider.

FIG. 33 is a general schematic view of an enhanced interface laparoscopic system that relies on a single wireless code signal to indicate the instrument on which to focus the endoscope constructed in accordance with the principles of the present invention in a preferred embodiment thereof;

FIG. 34 is a general schematic view of an enhanced

interface laparoscopic system that relies on at least two wireless signals to indicate the instrument on which to focus the endoscope;

FIG. 35 is a schematic view of the method in which the single wireless code signal choice instrumentation focus is represented on the viewing apparatus;

FIG. 36 is a schematic view of the method in which multiple wireless code signal choice of instrumentation is operated;

FIG. 37 represents the relative position of each tool in respect to the mechanism;

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0061] The following description is provided, alongside all chapters of the present invention, so as to enable any person skilled in the art to make use of the invention and sets forth the best modes contemplated by the inventor of carrying out this invention. Various modifications, however, will remain apparent to those skilled in the art, since the generic principles of the present invention have been defined specifically to provide a camera holder mechanism for laparoscopic surgery.

[0062] The present invention provides a camera holder, useful for laparoscopic surgery. The camera holder is provided with means of manipulation in four degrees of freedom. The camera holder is provided with means of controlling the spatial position of an endoscope tube to any orientation during the laparoscopic surgery, such that the endoscope reaches any desired area within the working envelope in an operated body.

[0063] The present invention also provides a method for controlling the spatial position of endoscope tube to any orientation in laparoscopic surgery, such that the surgeon reaches any desired area within the working envelope in operated body. The method comprises step selected inter alia from (a) obtaining a camera holder mechanism as defined above; (b) assembling the endoscope to the housing; and (c) controlling and manipulating the endoscope such that an optimal field view is obtained;

[0064] The step of manipulating the endoscope is provided in four degrees of freedom.

[0065] The present invention can be also utilized to improve the interface between the surgeon and the operating medical assistant and/or the surgeon colleagues. Moreover, the present invention can be also utilized to control and/or direct an automated endoscope assistant to focus the endoscope to the desired instrument of the surgeon. Furthermore, the device is adapted to focus the operating medical assistant on the desired instrument of the surgeon.

[0066] The term **"pulley"** refers herein after to a wheel with a groove between two flanges around its circumference, the groove normally locates a rope, cable or belt. Pulleys are used to change the direction of an applied force, transmit rotational motion, or realize a mechanical advantage in either a linear or rotational system of motion.

[0067] The term **"gimbal"** refers herein after to a pivoted support that allows the rotation of an object about a single axis.

[0068] The term **"small physical dimension"** refers hereinafter to the physical dimensions of a human palm.

[0069] The term **"four degrees of freedom"** refers herein after to the four independent degrees of freedom illustrated in figure 5.

[0070] The term **"adjustment cable mechanism"** refers herein after to the zoom mechanism described in figure 14;

[0071] The term **"parallelogram rods mechanism"** refers herein after to the zoom mechanism described in figures 18a and 18b;

[0072] The term **"spring mechanism"** refers herein after to the zoom mechanism described in figures 19a and 19b;

[0073] The term **"a reduction force mechanism"** refers herein after to the zoom mechanism described in figure 20;

[0074] The term **"rotating cable mechanism"** refers herein after to the zoom mechanism described in figure 23;

[0075] The term **"two springs zoom mechanism"** refers herein after to the zoom mechanism described in figure 27;

[0076] The term **"zoom leading bars"** refers herein after to the bars described in figure 25.

[0077] Reference is made now to figures 2 and 3 which illustrate the camera holder device 100.

[0078] The term **"conventional laparoscopy computerized system"** refers herein to system or/software conventionally used in the market such as Lapman, Endo assist or AESOP.

[0079] As can be seen from figure 2, the camera holder 100 comprises a mechanism allowing degrees of freedom (DF) in the rotational direction (denotes herein after as rotating DF) 304, a mechanism allowing degrees of freedom (DF) in sliding (denotes herein after as sliding DF) 305 and housing 309. The housing 309 comprises a rotation and a zoom mechanism. The rotating DF 304, sliding DF 305 and housing 309 can be disposable. Camera 308, endoscope 307 and Trocar 306 can also be seen in figure 2. Figure 2 illustrates the mechanism of the camera holder 100. The camera holder consists two main components: the first part has an arc shape in which the endoscope can be driven back and forth and at the same time can be move from side to side (the sliding DF and the rotating DF); the second part 309 is characterized by zoom and endoscope rotation properties. The mechanism allows the moving and the positioning of the endoscope in the angles of 0°-90° back and forth and 0°-180° side to side.

[0080] As mention above, the camera holder consists of arc shape housing which moves a gimbal mechanism

along an arc shape guide. The base of the arc includes a housing containing a lead screw (15) that moves a nut (10) back and forth. The moving nut is connected to the gimbal with links (20) that transfer the linear nut movement to the gimbals mechanism resulting its movement back and forth along the arc shape guide (the sliding DF). The lead screw housing (back forth screw housing 30) is connected to another mechanism (the rotating DF) which rotates the first part from side to side around the longitudinal axis of the lead screw. This mechanism may also supply at the same time the movements needed to rotate the lead screw. This design allows the motors that move the first part to be connected from a distance preferably by flexible or articulated shafts. The separation is a very useful feature due to the fact that the presence of the mechanism becomes minor.

[0081] The zoom and rotation mechanisms:

The zoom mechanism and the endoscope rotation mechanism are located in a same housing 309. This housing is connected to the gimbals that slide in the arc. A spring is connected to the gimbals at one end and to the mechanisms housing at the other end not allowing the housing to move down. A wire is also connected to the gimbals at one end and to the mechanisms housing at the other end keeping a desired distance between the gimbals and the housing.

These mechanisms may be operated by flexible shaft that are coupled to the motors located in the motor box, or by motors attached directly to the mechanisms axles.

The endoscope rotation mechanism

[0082] A flexible shaft couples a motor located in motor box to an axle of a worm gear which rotating a cog wheel. The aforesaid cog wheel has a centered passage for a proximal portion of the endoscope. A locking sub-mechanism (not shown) is adapted to fixate and release the endoscope 307.

The zoom mechanism

[0083] A flexible shaft is connected to an axle of a worm gear. During zoom down the drum mechanically connected to the worm gear winds the wire up, so that the distance between the drum and the muff becomes shorter. When the motor stops moving, the spring keeps tension of the wire. The structure of the worm gear prevents the spring 185 from unsanctioned displacement of the transmission box. During zoom out movement the motor rotates in the opposite direction. The unwrapped wire lets the spring to extend. As a result the zoom box transmission rises.

[0084] The spring may be a part of the Telescopic Guide shown in figures 3c, 5, 6.

[0085] Reference is made now to figure 3 illustrating a cut view of the first part. Rotating the lead screw cause the linear movement of the moving nut. In the case where the moving nut 10 moves forward, it pushes the chain of links 20 that are connected to gimbal. The link movement is guided by tiny wheels that are placed in the curved guide way 40. The movement of the link is passed to the outer gimbal 50 directly via a connector 60 or like in fig. 2 via another link 20. There is no principal limit to number of links except the physical dimensions of the mechanism.

[0086] Reference is now made to figure 3 a which schematically illustrate the camera holder which additionally comprises sterilizes sleeve 131 which covers the camera 308.

[0087] Reference is made now to figures 3b illustrating different view of the entire mechanism. Figure 3c additionally displays telescopic guide 55 in its stretched position.

[0088] Reference is made now to figure 4 illustrating another realization of the mechanism using only one curved guide way 311, and a single chain of links 312. This structure has some more advantages: the whole mechanism is thinner and tinier and allows a faster connection and disconnection of the endoscope from the mechanism, for example in a case when cleaning of the endoscope lens is needed.

[0089] Reference is made now to figure 5 illustrating the mechanism's four degrees of freedom: rotation e1 (provided by the rotating DF), rotation e2 (provided by the sliding DF), rotation about e3 (provided by endoscope rotation mechanism) and zoom along e3.

[0090] Reference is made now to figures 6 and 7, illustrating the mechanism of the telescopic guide 55. The telescopic guide mechanism enables the movement of the endoscope to move in "a zoom movement", where the endoscope moves along its longitudinal axis. Reference is made now to figure 6. Figure 6 illustrates the connection between the housing 309 and the arc mechanism (shown for example in figure 3). The telescopic guide 55 connects the housing 309 to the inner gimbal 62. As explained before the gimbal slides along the arc, also the gimbal moves with the arc, when the arc rotates from side to side. While keeping a rigid connection with the inner gimbal 62, the telescopic guide enables the movement of the endoscope 307 in a zoom movement, where the endoscope moves along its longitudinal axis.

[0091] The endoscope 307 is locked in housing 309 and passes through the inner gimbal 62.

[0092] A quick release handle 61 adapted to disassemble said endoscope out of said housing 309 without changing any of said degrees of freedom.

[0093] The zoom mechanism components are explained in Figure 7.

[0094] Figure 7 shows the components of the zoom mechanism. Worm 1 (denotes as 71) that may be rotate clockwise or counter clockwise, by a flexible shaft (not shown in this figure - 303 in figures 8) or directly by tiny motor. When worm 1 rotates it rotates also cog wheel 1

(denotes as 72).

[0095] Cog wheel 1 (denotes as 72) have the same axle with drum 1 (denotes as 73), when cog wheel 1 rotates, drum 1 rotates also and winds or unwinds (depends on the direction of the rotation) the wire 75 that is wrapped around the drum.

[0096] When the rotation of the results unwinding of the wire, spring 185 contained in the telescopic guide 55 expands and pushes the housing up, increasing the distance between the gimbal 62 and the housing 309 resulting "zoom out" movement.

[0097] When the rotation of the results winding, shortening the distance between the gimbal 62 and the housing 309 resulting "zoom in" movement.

[0098] Figure 7 also shows the components of the mechanism that rotates the endoscope around its longitudinal axis. This mechanism comprises of worm 2 (denotes as 76) and cog wheel 2 (denotes as 77).

[0099] Worm 2 (denotes as 76) that may be rotate clockwise or counter clockwise, by a flexible shaft (not shown in this figure - 303 in figures 8) or directly by tiny motor. When worm 2 (denotes as 76) rotates it rotates also cog wheel 2 (denotes as 77). In one embodiment of this invention cog wheel may be attached directly to the endoscope, by the force of friction. When cog wheel 2 (denotes as 77) rotates the endoscope rotates also in the same directions

[0100] In another embodiment of this invention, as shown in figure 28b, cog wheel 2 (denotes as 77) may rotate via pin that passes through a hole in a ring that is attached directly to the endoscope, by the force of friction. When cog wheel 2 (77) rotates, the ring rotates and the endoscope rotates also in the same directions.

[0101] Reference is made now to figures 8a, 8b, 8c illustrating an example of a camera holder mechanism for laparoscopic surgery. The camera holder comprises a motor house 301 and a zoom and rotation mechanism 309 , a sliding DF, a rotating DF, arms for polling the slider (300) and tubes with flexible wire that transmit the rotation moment to the component of the zoom mechanism (303).

[0102] The present invention generally relates to means and methods of controlling an endoscope system for laparoscopic surgery, in which the endoscope (into which a camera 308 is coupled) is inserted through a small incision in the abdomen as illustrated in figure 9.

[0103] It is another object of the present invention to present a novel means for controlling the spatial position of endoscope tube in laparoscopic surgery. The present device is cheap, easily install and disassemble, comfortable to use, not limiting the dexterity of the surgeon and having small physical dimension.

[0104] The small size of present invention is achieved by applying the following steps:

1. separating the moving parts from the motors and transmitting the motor power by cable and/or shafts means;

2. applying a linear zoom mechanism, allowing a full range zoom action, independent of other moving parts in the mechanism, e.g. not like other robots that achieve the linear zoom action, by a combined movement of the robot arms;

3. obtaining a rotational mechanism that rotates the endoscope about its long axis, independently of other moving parts of the mechanism, e.g., not like other robots that does not have the ability to compensate un wanted rotational movements (for example LER), or by a combined movement of the robot arms that produce big movements in order to achieve small rotations (AESOP Endoassist LapMan).

[0105] Reference is now made to figure 10 which schematically represent the entire system according to one embodiment of the present invention. According to that embodiment, the system comprises three main parts:

a manipulating endoscope mechanism (1); a force carriage system (2); and a force source (3). The manipulating endoscope mechanism may comprise cables, springs and rods. The force carriage system may comprise cables, chains, rods. The force source comprises motors or/and may comprise actuators and pistons.

[0106] Reference is made now to figure 11, presenting a schematic illustration of the camera holder according to another embodiment of the present invention. The camera holder comprises a zoom ring 1; zoom mechanism 2; orientation ring 3; three cables, 4a, 4b and 4c having length of L_1, L_2 and L_3 respectively; a spring 5; and a basis ring 6. 7 describes the pinhole in the operated body. When the lengths of L_1 and L_2 are changed in conjunction with the spring resistance, the orientation ring is moved relatively to the basis ring and get to an equilibrium point as illustrated in fig.12. Although a zoom action can be obtained by coordinated shortening of the cables L_1, L_2 and L_3 the mechanism includes an additional zoom option that acts independently of cable lengths L_1, L_2 and L_3.

[0107] The different lengths of the cables when tensed, fix the place of the orientation ring as illustrated in figure 13. The mechanism controlling the cables length allows a shifting of the orientation cable and an inclination of the endoscope to a wanted angle. The endoscope has to rotate around its length axis whereas the surgeon operates without changing the orientation.

[0108] Figure 14 schematically displays an "adjustment cable" zoom mechanism 1400 according to one embodiment of the present invention (alternative zoom mechanisms are displayed in figures 18a, 18b, 19a, 19b, 20, 23 and 27). The zoom action is the endoscope movement in front and backward without changing the orientation. As can be seen from figure 14 the zoom mechanism additionally comprises an adjustment cable 141, 4

closed bar linkage R1, R2, R3, R4 with the pivots $P_{1,2}$, $P_{2,3}$, $P_{3,4}$, $P_{1,4}$ with a linear spring containing the adjustment cable with a first end at pivot $P_{1,4}$ and the second end at pivot $P_{2,3}$.

[0109] The couple Spring 142 and the adjustment cable determines the distance between pivots $P_{1,2}$ and $P_{1,4}$ hence determines the Zoom position of the endoscope.

[0110] Reference is made now to figure 15 presenting a schematic description of the rotation mechanism. As can be seen from figure 15, a rotating cable 151 is coupled to a worm gear 152 which is connected to the endoscope ring. When the cable rotates the worm gear 152, the cog which is connected to the endoscope ring 153, rotates and the endoscope passing through and rotates at the same amount.

[0111] Reference is made now to the portable feature of the camera holder as described in figure 16. As shown in figure 16 the camera holder additionally comprises an adjustable arm 161 and a basis 162 including motors. The mechanism can be placed beside a bed using a track 171, as described in figure 17.

[0112] Reference is now made to figures 18a, 18b, 19a, 19b, and 20 which display different zoom mechanisms:

(1) "parallelogram rods mechanism" (see figure 18a, 18b);

(2) "a spring mechanism". The spring connects the ring zoom and the orientation ring mechanism (see figures 19a, 19b); and

(3) a "reduction force mechanism" (see figure 20).

[0113] A tiny motor wraps the Z cable. The stake system allows on one hand a reduction of the required force that compress the spring, and on the other hand an augmentation of the zoom movement sensibility. In order to obtain a small zoom movement, many windings are required.

[0114] Reference is now made to figures 18a and 18b which schematically display the zoom mechanism according to the "parallelogram rods mechanism".

[0115] As can be seen from figures 18a and 18b the zoom mechanism comprises parallelogram rods 25, a spring 22, zoom ring 21, orientation ring 23 and a driving z cable 20.

[0116] At the first stage (figure 18a), the spring 22 is compress. When the Z cable 20 is pulled the compressed spring 22 is released (see figure 18b) and the distance between the zoom ring 21 and the orientation ring 23 is reduced. In this manner the zoom movement is produced and the endoscope 307 is moved from position h_0 to position h_1. Releasing and pulling the driving Z cable 20 allows continually the deep fixing of the zoom.

[0117] Reference is now made to figures 19a and 19b which schematically display another zoom mechanism - "a spring mechanism". As can be seen from figure 19a and 19b the zoom mechanism comprises a ring zoom 21, an orientation ring 23 and a spring 24 which connects the ring zoom 21 and the orientation ring 23.

[0118] When the z-cable 20 is pulled spring 24 is compressed (as can be seen in figure 19b) and the distance between the ring zoom 21 and the orientation ring 23 is reduced.

[0119] Reference is now made to figure 20 which schematically display another zoom mechanism - "reduction force mechanism". As can be seen from figure 20, the zoom mechanism comprises a motor 27, a ring zoom 21, an orientation ring 23 and a reduction force device 28 which connects the ring zoom 21 and the orientation ring 23.

[0120] Reference is now made to figure 21 and 22 which display another alternative to change the cable's length. According to figures 21 and 22 another alternative is to base the cable length change is on pulley blocks 70 motion. The pulley blocks are located on the endoscope motion mechanism. Figure 21 presents a schematic section view of this. The pulley block 70 contains a drum with an axle and a wire. The pulley block may be operated by any kind of shaft rigid or flexible. This kind of structure demonstrates another embodiment using the same principle: controlling the spatial angular position of the endoscope by using a combination of the wires lengths. The pulley block may have some advantages in respect to the mechanisms of wrapping the wires that pass through the adjusting arm as described before.

[0121] In figure 22, a three-dimension description is proposed, showing also the wire 80 that activates the rotation mechanism.

[0122] Reference is now made to figure 23 which display the "rotating cable" zoom mechanism. Realization of the zoom mechanism can be done by rotating cable which turns a central screw comprised of two different screws with an opposite direction: screw R 231 and screw L 232 when the central zoom is rotated to a first direction; say clockwise the nuts become closer and the endoscope moves in a zoom up movement. When the central zoom is rotated to a second direction, counterclockwise the distance between the nuts increase and the endoscope moves in a zoom down movement as illustrated in figure 23.

[0123] Reference is made now to figures 24 and 25, presenting a schematic and illustrated drawing of the entire device according to another embodiment of the present invention. As can be seen from figure 24 the device comprises inter alia a manipulating endoscope mechanism (1); a force carriage system (2); and a manipulating system actuator or a force source (3). Figure 25 presents a schematic illustration of the manipulating endoscope mechanism (1). The mechanism comprises inter alia from a rotating link (12); linear links (11a, b, c, d); gimbals ring mechanism (14); zoom leading bars (15); zoom and rotation endoscope mechanism (16); cables tubes (13). The pinhole in the operated body is illustrated by 7, where the endoscope 4 passes through into the

abdomen cavity.

[0124] Reference is made now to figure 26, presenting a schematic cut view along the sliding links 11a,b,c. The cable head 17 is mounted in a hole at the head of link 11a. When the links 11a is pulled by cable 18 it slide into links 11b against the pushing force of springs 19 a, b and therefore the distance between the center of the gimbals 14 and the center of the rotating link 12 becomes shorter. When the cable 18 is released, spring 19a push links 11a out of links 11b and 11b out of links 11c, and the distance between the center of the gimbals 14 and the center of the rotating link 12 becomes longer, in both cases the gimbals is moved relatively to the pinhole and changes the orientation of the endoscope. When the cable does not move, equilibrium is kept at every point by the pushing forces of the springs that tend to push the link outward, and the cable tension. The zoom action is essential in laparoscopic surgery. Changing the zoom enables the surgeon to see important details of the operated organs e.g. "zoom in", and to examine the general situation of the operation status when moving the endoscope away from the scenery e.g. "zoom out". Another important feature is the ability to make a zoom movement while keeping the center of the picture without movement. This could be achieved if the zoom movement is done without changing the endoscope orientation.

[0125] Reference is made now to figure 27, presenting the two springs zoom mechanism (270), fulfilling the needs mentioned above. The zoom action is the endoscope movement into (zoom in) and out of the abdomen cavity (zoom out), without changing the endoscope orientation. The "zoom in" action is obtained by shortening cable 16a, and the "zoom out" action is obtained by extending the length of cable 16a. The springs 19a and 19b tend to increase the angle between the pair of links 15a 15b, and the pair 15c 15d and so to produce the "zoom out" movement. The length of cable 16a determines the amount of the "zoom in". When the endoscope does not move, there is equilibrium between the springs force and the cable tension. Box 16 contains two separate mechanisms that control the linear movement of the endoscope e.g. "zoom in", "zoom out" and the rotation angle of the endoscope along the long axis.

[0126] Reference is made now to figure 28a, 28b and 28c presenting schematically another principle mechanism that controls the linear movement of the endoscope e.g. "zoom in", and "zoom out".

[0127] The ability to rotate along the endoscope long axis is essential in laparoscopic surgery. While rotating the endoscope through the insertion point 7 in order to change the endoscope orientation e.g. combination of angle α and angle β shown at figure 29, a component of the angular change may be not along the long axis of the endoscope. This angular component may cause undesirable rotation of the endoscope, which in result, cause annoying rotating movement of the picture as viewed on the surgeon's video screen. In a traditional laparoscopic operation, the person that holds the endoscope, intuitively, makes the needed changes to keep the operation scenery without un desirable rotation e.g., keeping the moving picture parallel to it self at all time.

[0128] Figures 28a, 28b and figure 28c present the rotation mechanism (80), filling the needs mentioned above, and also allowing fast removal of the endoscope in order to clean its lens. The cog-wheel 163 allows the endoscope rod 307 to cross through its center and to make roll and sliding movements. The peg 164 arises from cog-wheel 163 upper surface. A disk 165 is tightened to the endoscope rod 4. While assembling the endoscope, the upper wall of the box 16 is opened and the endoscope is entered through cog-wheel 163 center, into a hole in the lower wall and through ring e.g. gimbals 14 until the peg 164 is threaded into aperture 166 of disk 165. Then the upper wall of box 16 is closed, keeping the endoscope from moving out of box 16, to ensure coupling between the endoscope and the entire zoom mechanism. The rotation of the endoscope along is achieved by rotating the screw 162 that moves cog-wheel 163 and the endoscope 307 via coupled disk 165. The source of the movement of screw 162 can be a rotating cable transmitting the rotation movement from "remote" motor or small motor placed in or near box 16. When needed, the mechanism described above allows quick disassembling of the endoscope out of the zoom mechanism without changing any degree of freedom of its spatial position. This property is important because the surgeon does not have to deal with re-positioning of the system. This property is achieved because the endoscope 307 does not have any role in keeping the position of the entire zoom mechanism. The equilibrium between links 15, springs 19 and cable 16a maintain depth of the zoom and constrain of relation between the peg 164 and hole 166 keeps the angle of rotation. When the endoscope is assembled again, the endoscope retrieves its original spatial position.

[0129] While executing the operation the surgeon must be able to move the endoscope to any desired orientation. The envelope of the endoscope range of movement is shown in figure 29.

[0130] Reference is made now to figure 30, presenting schematically the way the mechanism acts to controls one angle of the endoscope by changing the total length of the telescopic arm. Figure 30 shows the angular movement of endoscope 307 that was at starting position P0 e.g. α=0. Activating the sliding mechanism causes the movement of gimbals rings 14 from point A to point B causing endoscope 4 to rotate about the insertion point 70, to a desired position P1. While the combined shortening of links 11 a, b, c, the distance between gimbals 14 and the insertion point 7 changes, causing an undesired zoom movement. The distance of this movement can be calculated and compensated by a controlled zoom motion.

[0131] Reference is made now to figure 31, schematically presenting the way the mechanism acts to controls another angle e.g. β of the endoscope by rotating tele-

scopic arm. Figure 31 shows the angular movement of endoscope 307 that was at starting position P_0. Activating the rotating mechanism causes the movement of gimbals rings 14 in a radial movement, from point A to point B e.g. angle ψ, causing endoscope 307 to rotate about the insertion point 7, by angle β, to a desired position P1. While the rotating of arm 11, the distance between gimbals 14 and the insertion point 7 changes, causing an undesired zoom movement. The distance of this movement can be calculated and compensated by a controlled zoom motion. The combination of the two independent movements of the mechanism arm enables the surgeon to move the endoscope to any orientation, and reach any desired point within the working envelope.

[0132] Reference is made now to the portable feature of the mechanism as described in figure 32a. The mechanism is placed beside a bed, on track 201, and can be placed at any point along track 201 by moving slider 202; in order to achieve the necessary position the surgeon can also rotate the system around pivot 203 and to change the height by sliding the system along house 204. Figure 32b shows schematically from upper view, the position abilities of the system: the rotation angle γ, and the horizontal position X slider.

[0133] As mention, the present invention can be also utilized to improve the interface between the surgeon and the operating medical assistant and/or the surgeon colleagues. Moreover, the present invention can be also utilized to control and/or direct an automated endoscope assistant to focus the endoscope to the desired instrument of the surgeon. Furthermore, the device is adapted to focus the operating medical assistant on the desired instrument of the surgeon.

[0134] In preferred embodiment of the invention a single wireless emission code is utilized and choice is achieved by a visible graphic representation upon the conventional viewing screen.

[0135] In another preferred embodiment each instrument is fitted with a unique code wireless transmitter, and selection is achieved by depressing its button.

[0136] The present invention discloses also a device joined with conventional camera assisted laparoscopic surgery systems comprising at least one wireless transmitter that may or may not be attached to the maneuvering control end of surgical instruments.

[0137] Upon depression of at least one button on the transmitters either a generic or a unique code is transmitted to a receiving device connected to a computer that presents (e.g. displays) the selected surgical tool on a connected video screen. Confirmation of the selection by the depression of at least one button on wireless transmitter transmits a code to the receiver connected to the computer that instructs the automated surgical assistant to move the endoscope achieving a view on the screen that is focused on the selected instrument area.

[0138] It would thus be desirable to achieve a device that allows the surgeon to identify to the laparoscopic computing system as well as to surgical colleagues to which surgical instrument attention is to be directed. By identifying the surgical instrument by the laparoscopic computing system the endoscope directs the view to the selected focus of attention.

[0139] Therefore, in accordance with a preferred embodiment of the present invention an enhanced interface laparoscopy device is provided. The device comprising:

a. At least one wireless transmitter with at least one operating key.

b. At least one wireless receiver.

c. at least one conventional laparoscopy computerized system; said conventional laparoscopy computerized system is adapted to load a surgical instrument spatial locating software, and an automated assistant maneuvering software; said locating software enables a visual response to the depression of said at least one key on said wireless transmitter; said maneuvering software enables the movement of said endoscope.

d. At least one video screen.

e. At least one automated assistant.

[0140] In a preferred embodiment of the enhanced interface laparoscopy device the wireless transmitter or transmitters are either freestanding or attached to the maneuvering end of the surgical instruments and emit the same single code that upon the depression of at least one key on them emits a signal to the receiver that communicates with the connected computer that displays a graphic symbol upon a random choice of one of the onscreen surgical instruments depicted or extracted by the computer on the screen. If needed the surgeon repeats the depression of at least one key resulting in a shift in the displayed graphic designator from one onscreen depiction of surgical instrument to another until the desired instrument is reached and thereby selected. Subsequently the computer directs the automated assistant to focus the endoscope on the desired instrument area.

[0141] In a further preferred embodiment the selection of the instrument requires confirmation by varying the form of click on at least one key, such as a prolonged depression. Only upon confirmation is the computer authorized to instruct the automated assistant to focus the endoscope on the desired instrument area.

[0142] In another preferred embodiment of the invention each relevant surgical instruments is fitted at its maneuvering control end with a wireless transmitter with at least one key that transmits a unique code. In the initial stage of the procedure the surgeon identifies each of the instruments to the computerized system by depressing at least one key on each of the wireless transmitters fitted to the surgical instruments and matching their characteristics with a prepared database, thereby forming within

the computerized system a unique signature for each of the transmitters. Thereon, upon depression of at least one key on the wireless transmitter attached to each surgical instrument, the receiver receives the unique code communicates it to the computer that identifies it with the preprogrammed signature and instructs the automated assistant to move the endoscope so as to achieve the desired focus.

[0143] In another preferred embodiment of the invention each relevant surgical instruments is fitted at its maneuvering control end with a wireless transmitter with at least one key that transmits a unique code. While performing the surgery procedure, whenever the surgeon inserts, a surgical instrument at the first time, he signals by depressing at least one key on each of the wireless transmitters fitted to the surgical instruments.

[0144] Then the computer software identifies the instrument, while it is being inserted, analyzes the characteristics of the surgical instrument and keeps it in a database, thereby forming within the computerized system a unique signature for each of the transmitters. Thereon, upon depression of at least one key on the wireless transmitter attached to each surgical instrument, the receiver receives the unique code, communicates it to the computer that identifies it with the signature stored at the insertion step and instructs the automated assistant to move the endoscope so as to achieve the desired focus.

[0145] In a further preferred embodiment the selection is signified on the connected screen by displaying a graphic symbol upon the onscreen depiction of the surgical.

[0146] In a further preferred embodiment the selection is confirmed by an additional mode of depression of at least one key on the wireless transmitter, such as a prolonged depression of the key, authorizing the computer to instruct the automated assistant to change view provided by the endoscope.

[0147] The device of the present invention has many technological advantages, among them:

- Simplifying the communication interface between surgeon and mechanical assistants.
- Seamless interaction with conventional computerized automated endoscope systems.
- Simplicity of construction and reliability.
- User-friendliness
- Additional features and advantages of the invention will become apparent from the following drawings and description.

[0148] Reference is made now to figure 33, which is a general schematic view of an enhanced interface laparoscopic system comprising one or more button operated wireless transmitters 12a, that may or may not be attached to the maneuvering end of surgical instruments 17b and 17c, which once depressed aerially transmit a single code wave 14 through aerial 13 to connected receiver 11 that produces a signal processed by computer 15 thereby assigning a particular one of two or more surgical instruments 17b and 17c as the focus of the surgeons attention. Accordingly a conventional automated endoscope 21 is maneuvered by means of conventional automated arm 19 according to conventional computational spatial placement software contained in computer 15 .

[0149] Reference is made now to figure 34, which is a general schematic view of an enhanced interface laparoscopic system comprising one or more button operated wireless transmitters 12b and 12c are attached respectfully to the maneuvering means at the end of surgical instruments 17b and 17c, which once depressed aerially, each transmit a unique code wave 14b and 14c through aerial 13 to connected receiver 11 that produces a signal processed by computer 15 thereby assigning a particular one of two or more surgical instruments 17b and 17c as the focus of the surgeons attention. Accordingly a conventional automated endoscope 21 is maneuvered by means of conventional automated arm 19 according to conventional computational spatial placement software contained in computer 15.

[0150] Reference is made now to figure 35, which is a schematic view of the method in which single wireless signal code choice of instrumentation focus is achieved, by means of video representation, 35b and 35c of the actual surgical instruments (not represented in fig. 35) displayed by graphic symbols. Wherein a light depression of the button on generic code emitting wireless transmitter 12a transmits a code that is received by receiver aerial 13 communicated through connected receiver 11 to computer 15 that shifts the graphically displayed symbol of choice 35b on video screen 30 from instrument to instrument until the required instrument is reached. A prolonged depression of the button on transmitter 12a confirms the selection thereby signaling computer 15 to instruct the automated mechanical assistant (not represented in fig. 36) to move the endoscope (not represented in fig. 35) and achieving a camera view of the instrument area on screen 30.

[0151] Reference is made now to figure 36, which is a schematic view of the method in which multiple wireless signal code choice of instrumentation focus is achieved, by means of video representation 35b and 35c of the actual surgical instruments (not represented in fig. 36) displayed by graphic symbols. Wherein when buttons on unique code emitting wireless transmitters 12b and 12c attached respectfully to actual operational instruments (not represented in fig. 36) displays graphic symbol 35b on respectful video representation 37b. A prolonged depression of the button on transmitter 12b and 12c confirms the selection thereby signaling computer 15 to instruct the automated mechanical assistant (not represented in fig. 36) to move the endoscope (not represented

in fig. 36) and achieving a camera view of the instrument area on screen 30.

[0152] In another embodiment of this invention, when a prolonged depression of the buttons on transmitter 12b and 12c confirms the selection, the computer software analyze the characteristics of the surgical instrument and stores it in a database, thereby forming within the computerized system, a database, used for matching between each transmitting code and a surgical instrument.

[0153] From now on, when the surgeon presses again on this button, the receiver that receives the transmitted code, communicates it to the computer software that identifies the code as a "known" code and matching it, to the known parameters that were stored earlier in database of the surgical tools, and extracts the surgical tool tip. When the position tool tip is known, then the tracking software instructs the automated assistant to move the endoscope so as to achieve the desired focus.

[0154] Reference is made now to figures 37 illustrating the relative position of each tool. While performing the surgery, the surgeon often changes the position of his tools and even their insertion point. The wireless switches then may be use to locate the relative angle in which each tool is being held in respect to the camera holder mechanism. This is another advantage of the system that is used to calculate the position of the tool in the frame captured by the video camera. In that manner the surgeon does not have to inform the system where the insertion point of every tool is. The exact location of the wireless switch is not measured: the information about the relative positions of the tools in respect to each other contains in most cases enough data for the software to maintain the matching between the switches and the tools. In this figure the positioning sensors of the system are placed near or on the camera holder so the signals they receive can be utilize in order to calculate the vectors V1 V2 ... Vn representing the range and the 3 angles needed to define a point in a 3D space.

[0155] In order to realize a position and range system, many well known technologies may be used. For example if the switches emit wireless signals then an array of antennas may be used to compare the power of the signal received at each antenna in order to determine the angle of the switch and it's approximate range to the camera holder mechanism. If the switch emits ultra sound wave then US microphones can be used to triangulate the position of the switch. The same is for light emitting switch.

Claims

1. A device useful for the interface between a surgeon and an automated assistant, comprising:

    a. an endoscope, mechanically interconnected to said automated assistant;
    b. at least one wireless transmitter with at least one operating key;
    c. at least one wireless receiver;
    d. at least one conventional laparoscopy computerized system loaded with (i) conventional surgical instrument spatial location software; (ii) conventional automated assistant maneuvering software; (iii) and, a software that enables a visual response to the depression of said at least one operating key on said wireless transmitter, so as to achieve movement of the endoscope; and,
    e. at least one video screen;

    wherein said device is adapted to control and to direct said endoscope via said automated assistant on a desired instrument of said surgeon.

2. The device according to claim 1, wherein said wireless transmitter is freestanding.

3. The device according to claim 1, wherein each said instrument is fitted with a wireless transmitter.

4. The device according to claim 3, wherein said wireless transmitter is adapted to locate the position of each instrument.

5. The device according to claim 1, wherein said selection of said desired instrument is confirmed by clicking on said at least one operating key.

6. The device according to claim 1, wherein a selection of said desired instrument is confirmed by depression of said at least one key on said wireless transmitter.

7. The device according to claim 6 wherein said depression of said at least one key is a prolonged depression.

8. A method useful for the interface between a surgeon and an automated assistant; said method comprising the step of:

    a. obtaining a device comprising:

        i. an endoscope, mechanically interconnected to said automated assistant;
        ii. at least one wireless transmitter with at least one operating key;
        iii. at least one wireless receiver;
        iv. at least one conventional laparoscopy computerized system loaded with (i) conventional surgical instrument spatial location software; (ii) conventional automated assistant maneuvering software; (iii) and, a software that enables a visual response to the depression of said at least one operating key on said wireless transmitter, so as to

achieve movement of the endoscope; and,
v. at least one video screen;

b. selecting said desired instrument; and
c. displaying said desired instrument on a screen;

wherein said device controlling and/or directing said automated assistant; thereby focusing said endoscope on a desired instrument of said surgeon.

9. The method according to claim 8, additionally comprising step of confirming by the selection of said desired instrument.

10. The method according to claim 8, wherein said step of selecting said desired instrument additionally comprising the steps of (a) depressing of said at least one key on said wireless transmitter; (b) transmitting a generic code to said receiver; (c) communicating said signal to the computer.

11. The method according to claim 8, wherein said step of selecting said desired instrument additionally comprising step confirming the selection of said desired instrument by clicking on said at least one key.

12. The method according to claim 8, wherein said step of selecting said desired instrument additionally comprising the step confirming the selection of said desired instrument by a prolonged depression on said at least one key.

13. The method according to claim 8, additionally comprising the step of identifying each of said instrument to said computerized system.

14. The method according to claim 8, additionally comprising the step of attaching said wireless transmitter to said surgical instrument.

15. The method according to claim 8, additionally comprising the step of matching each transmitted code from said depressed wireless transmitter to said surgical instrument.

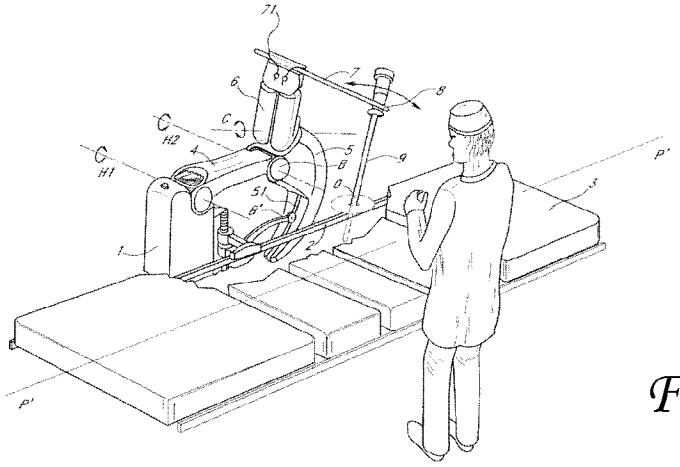


Fig. 1a

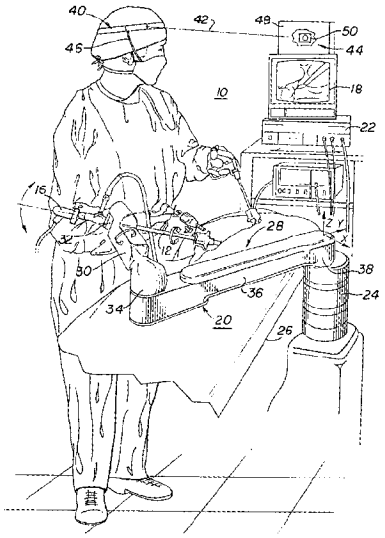


Fig. 1c

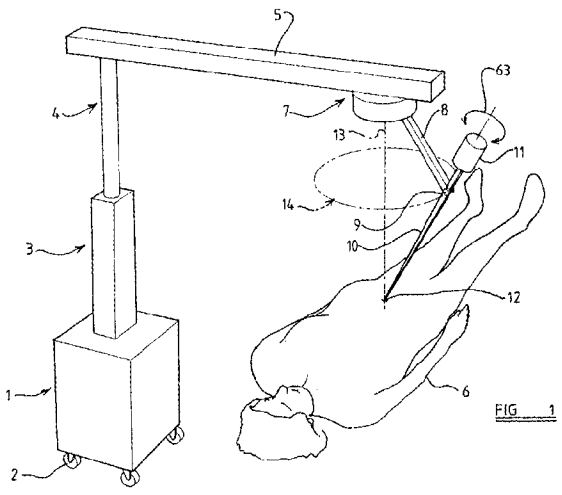


Fig. 1b

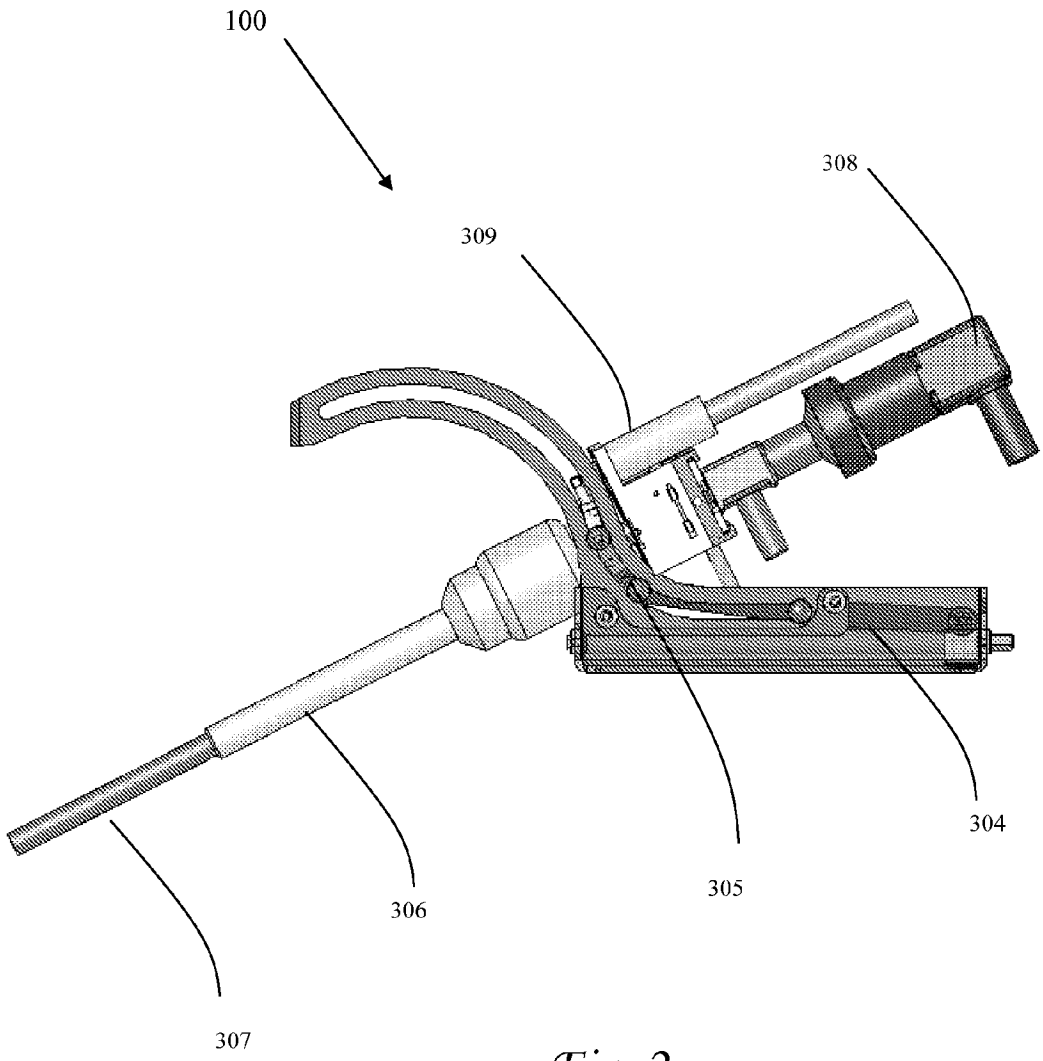


Fig. 2

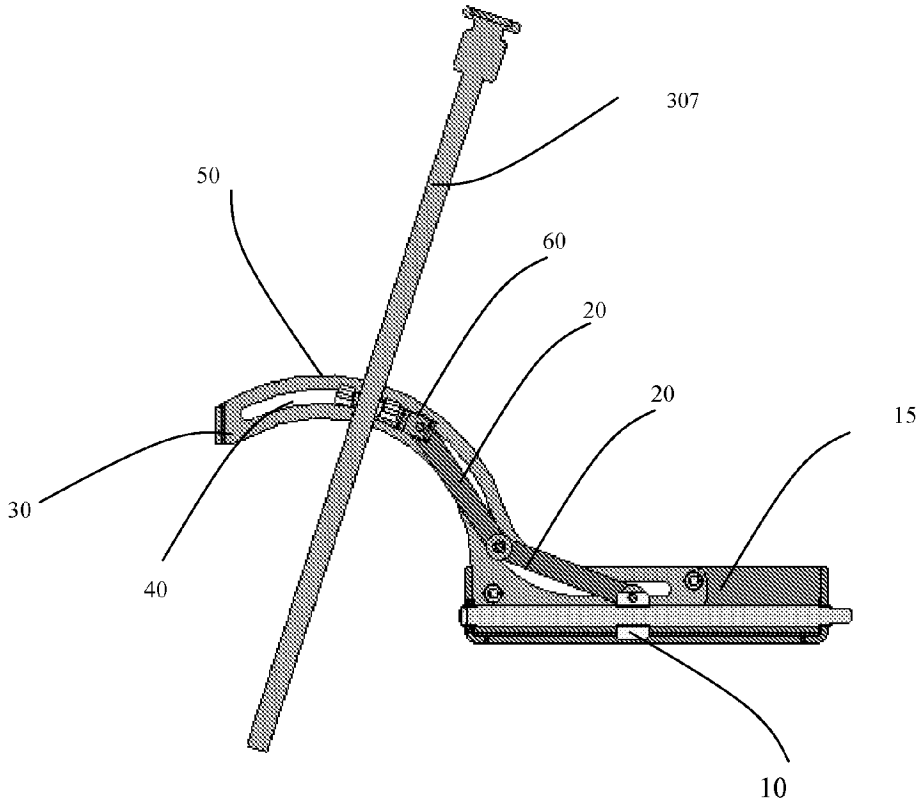


Fig. 3

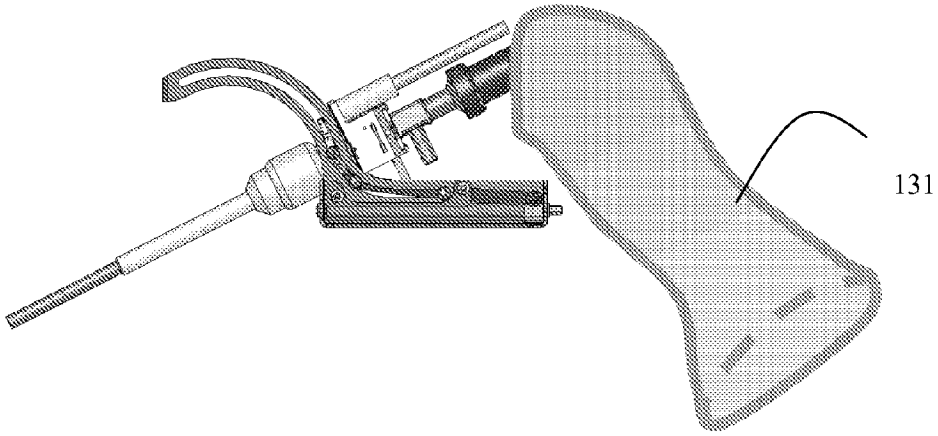


Fig. 3a

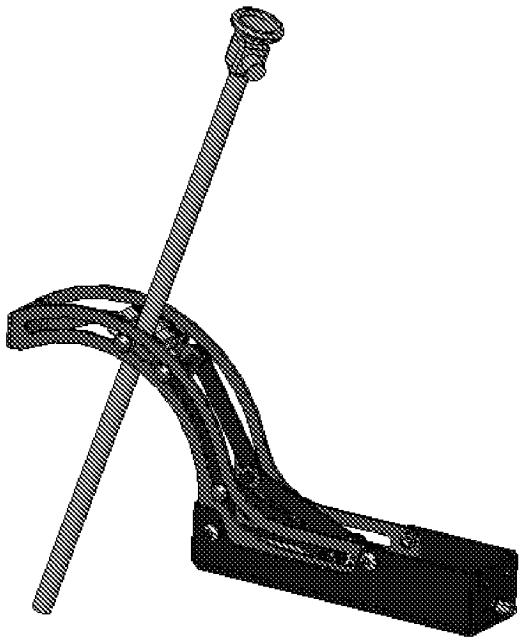


Fig. 3b

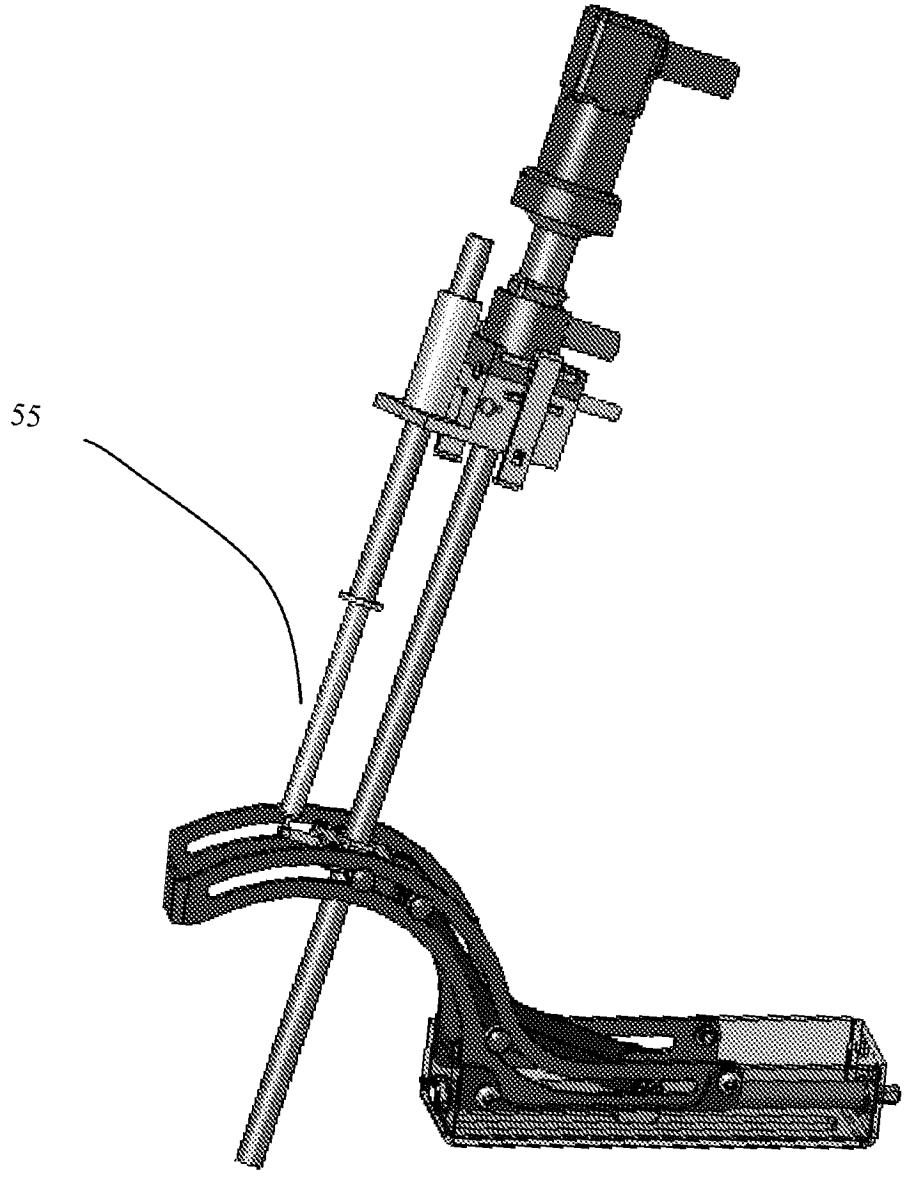


Fig. 3c

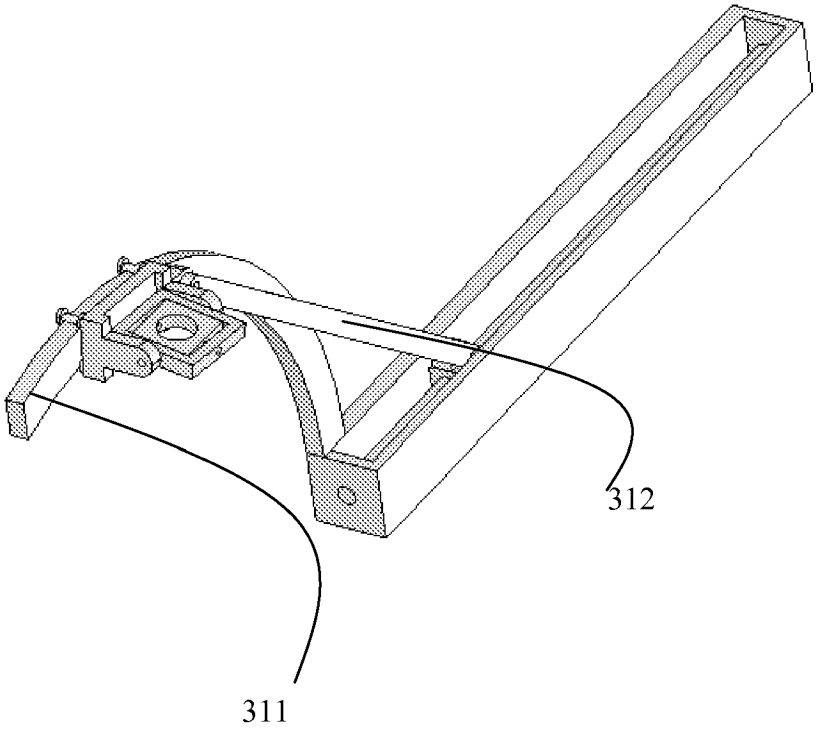


Fig. 4

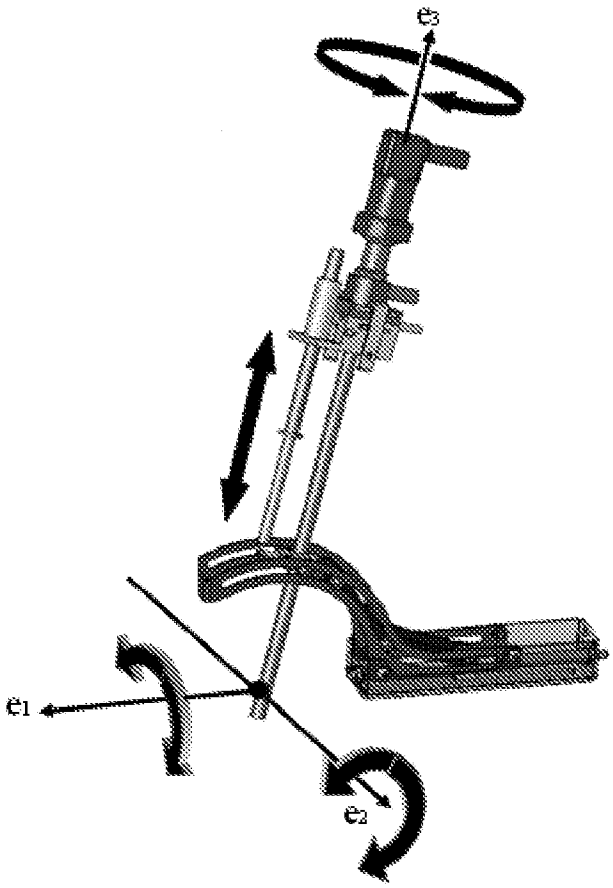
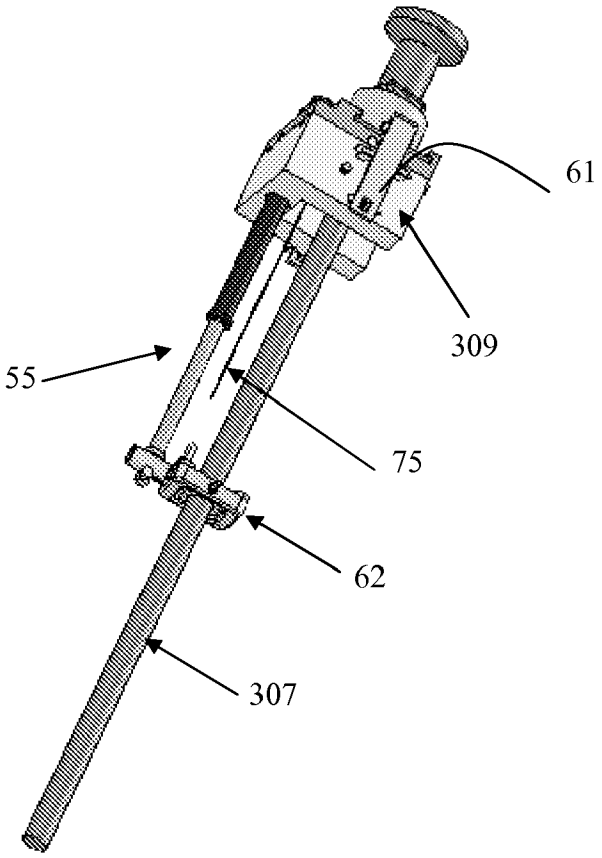


Fig. 5



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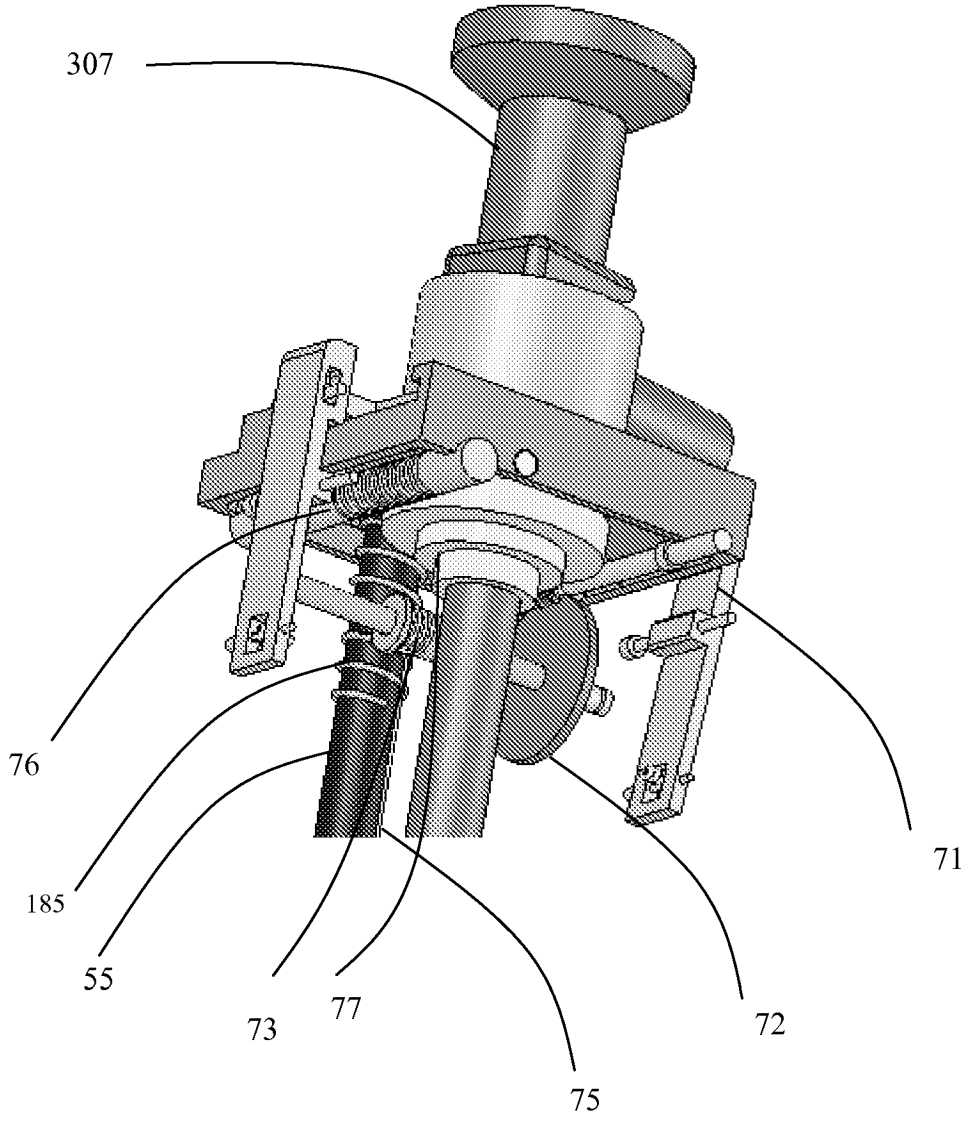


Fig. 7

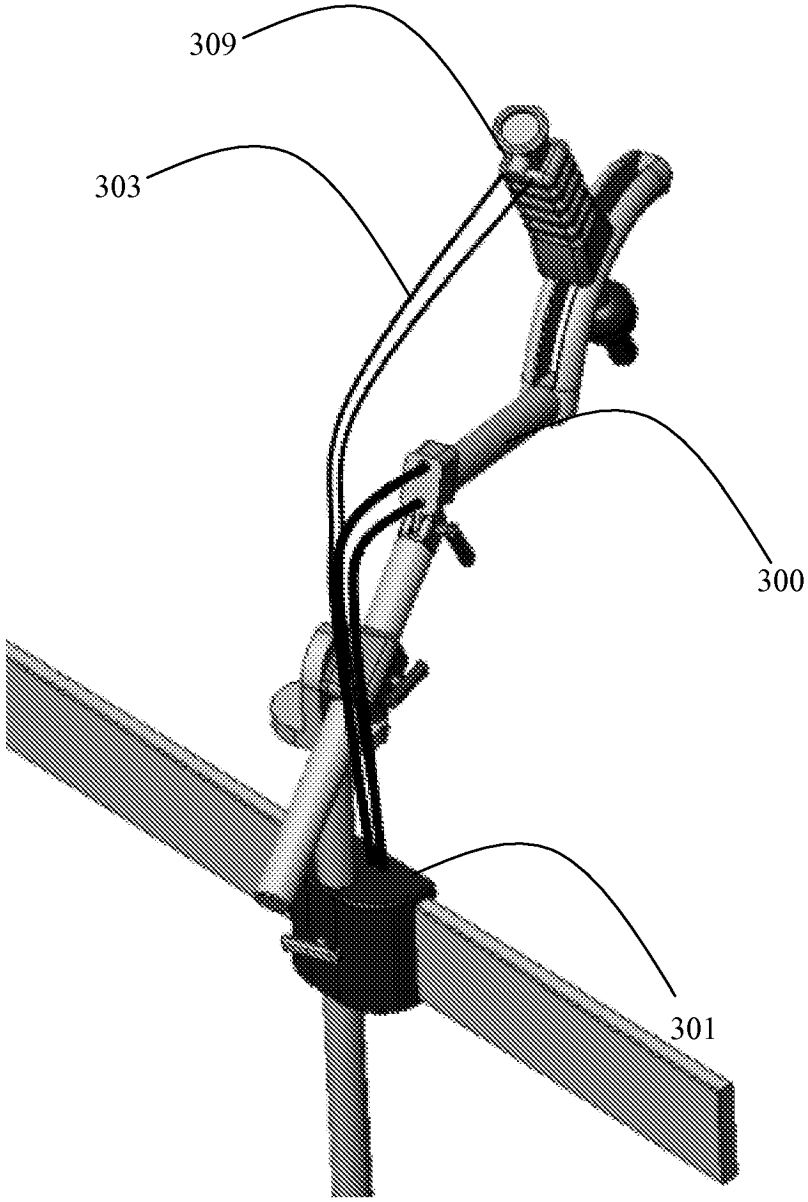


Fig. 8a

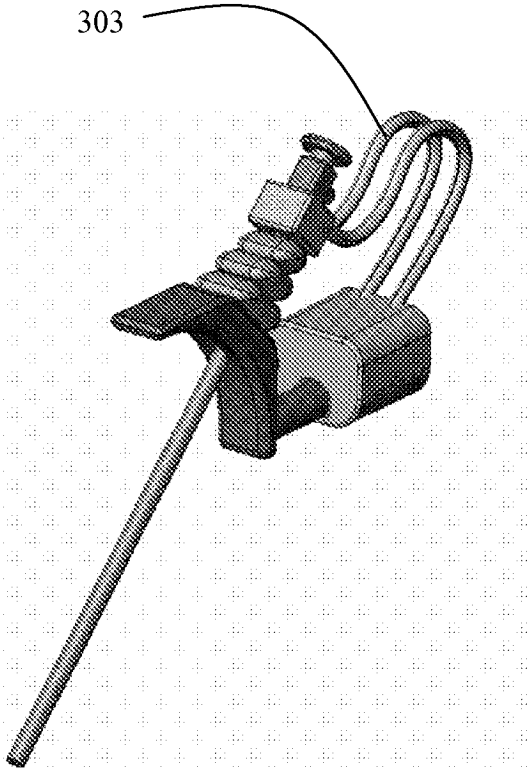


Fig. 8a

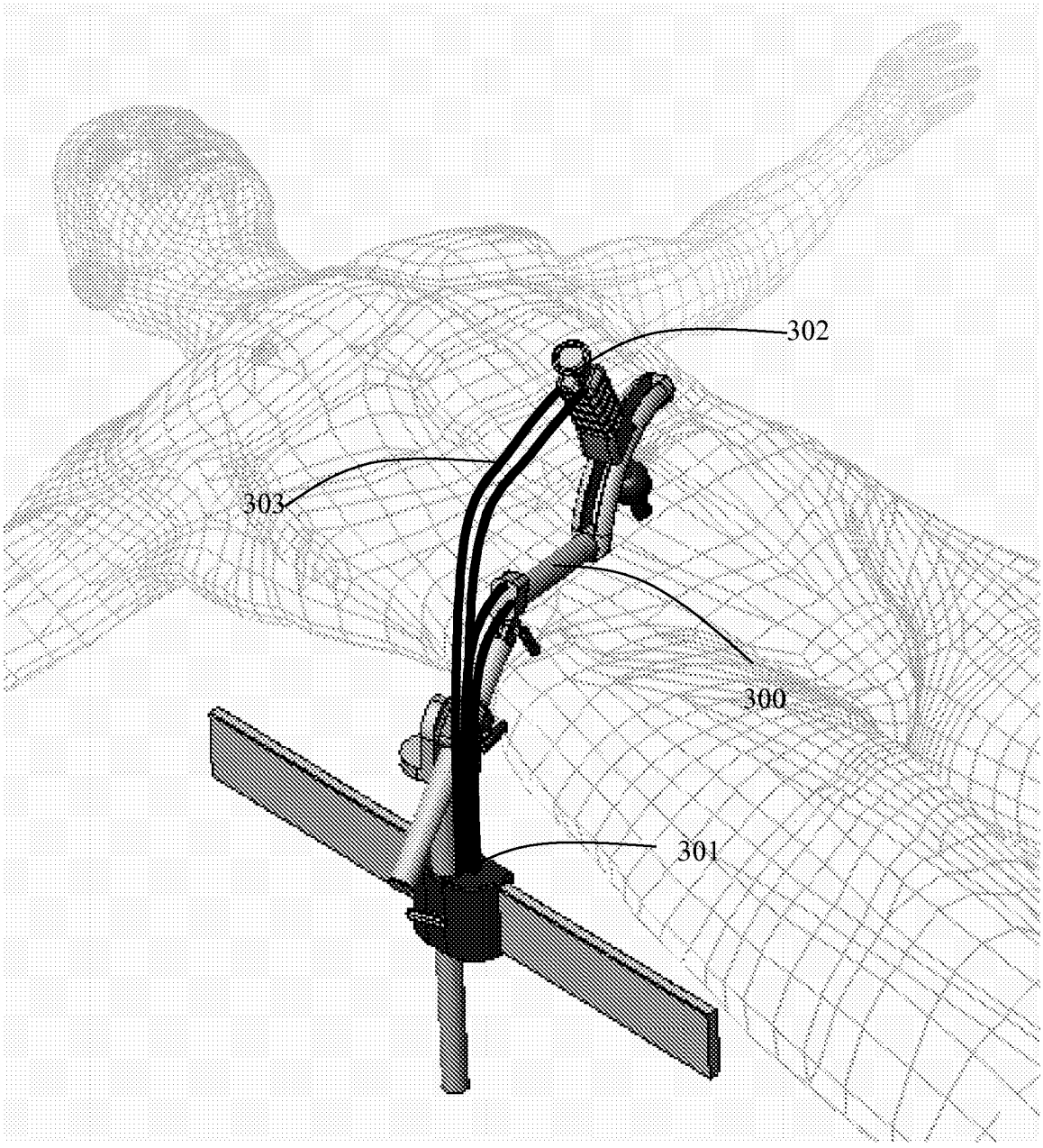


Fig.8c

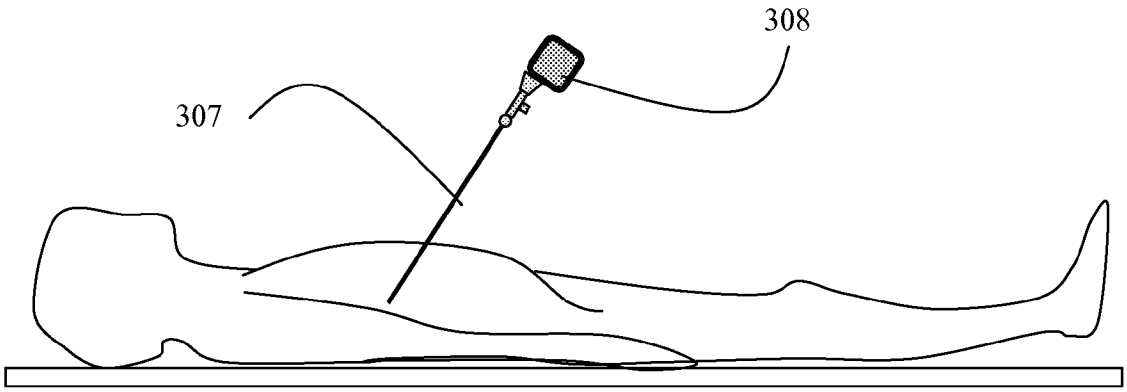


Fig. 9

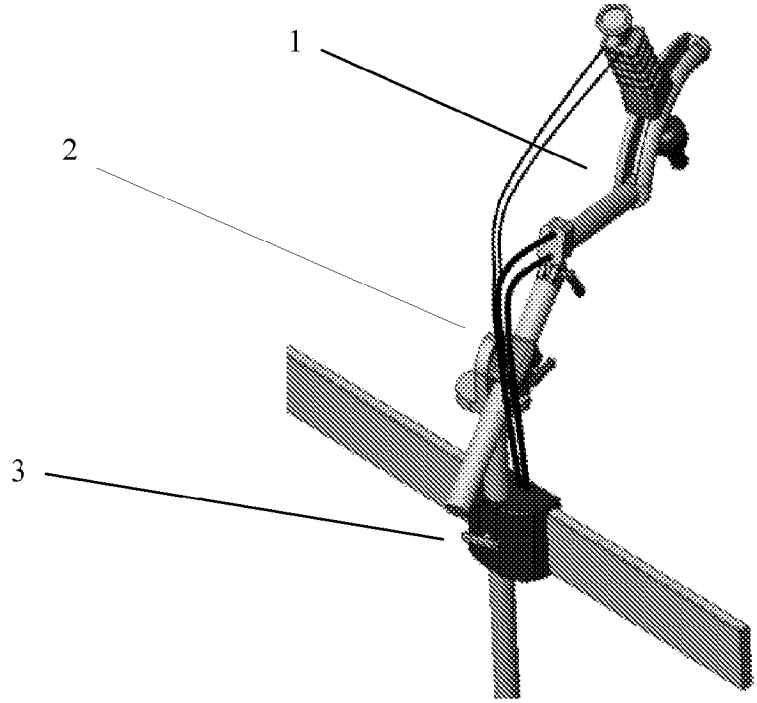


Fig.10

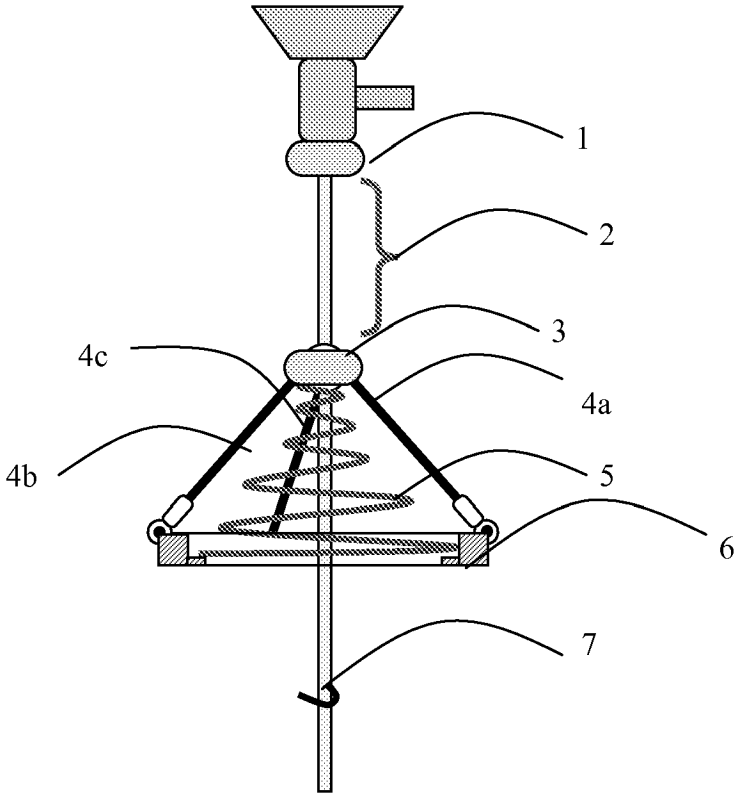
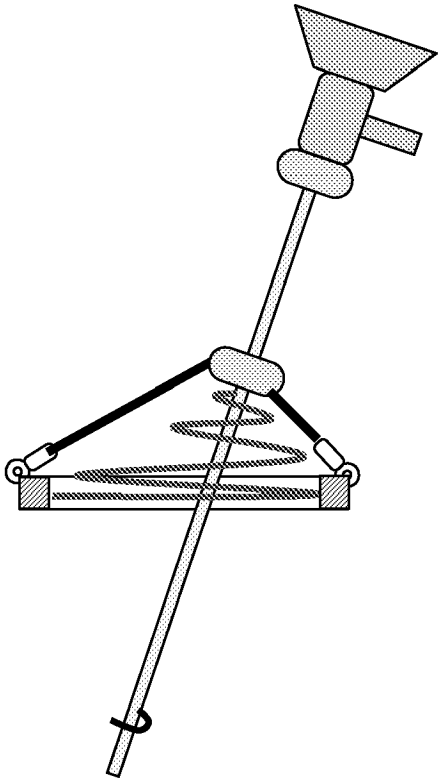


Fig. 11



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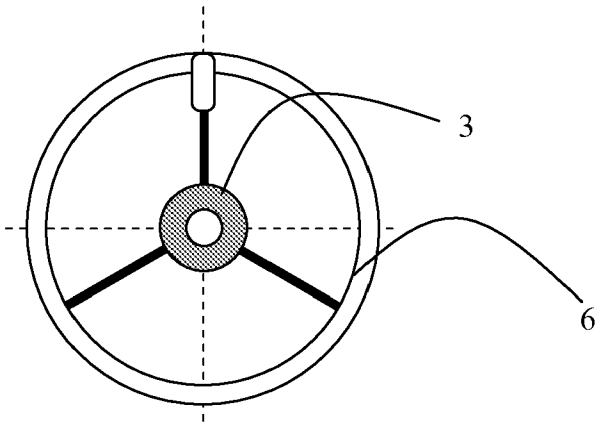


Fig. 13

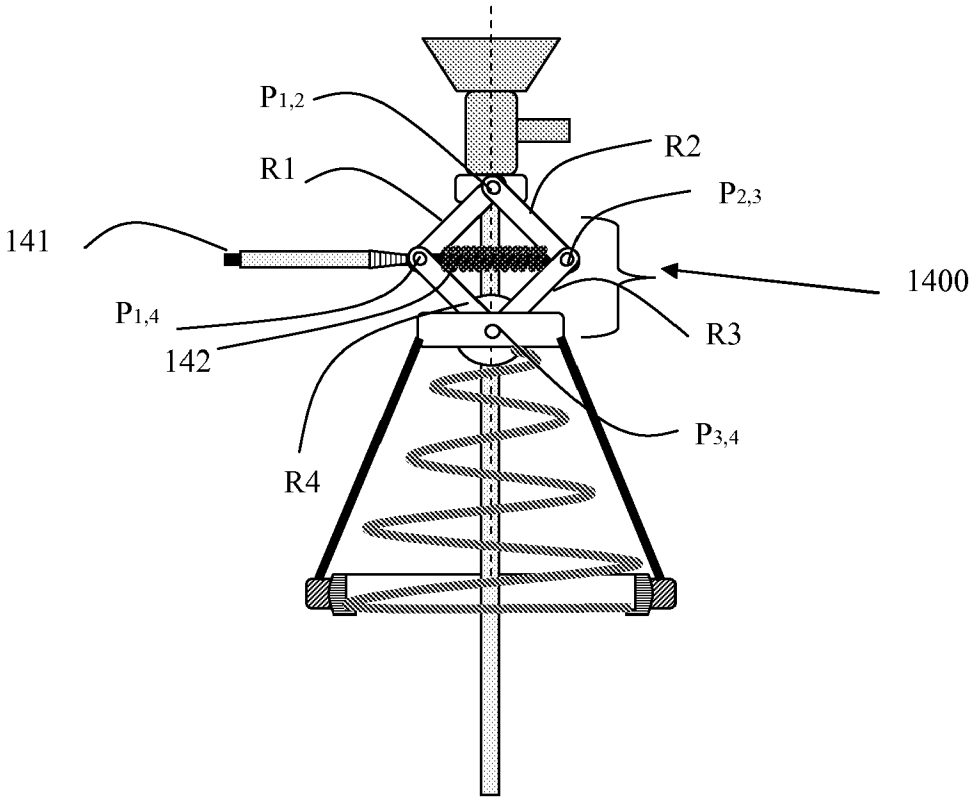


Fig. 14

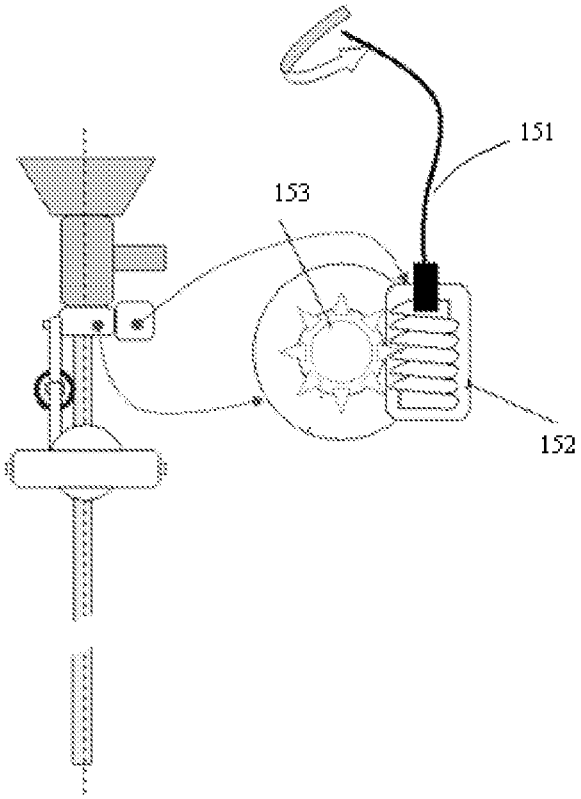


Fig. 15

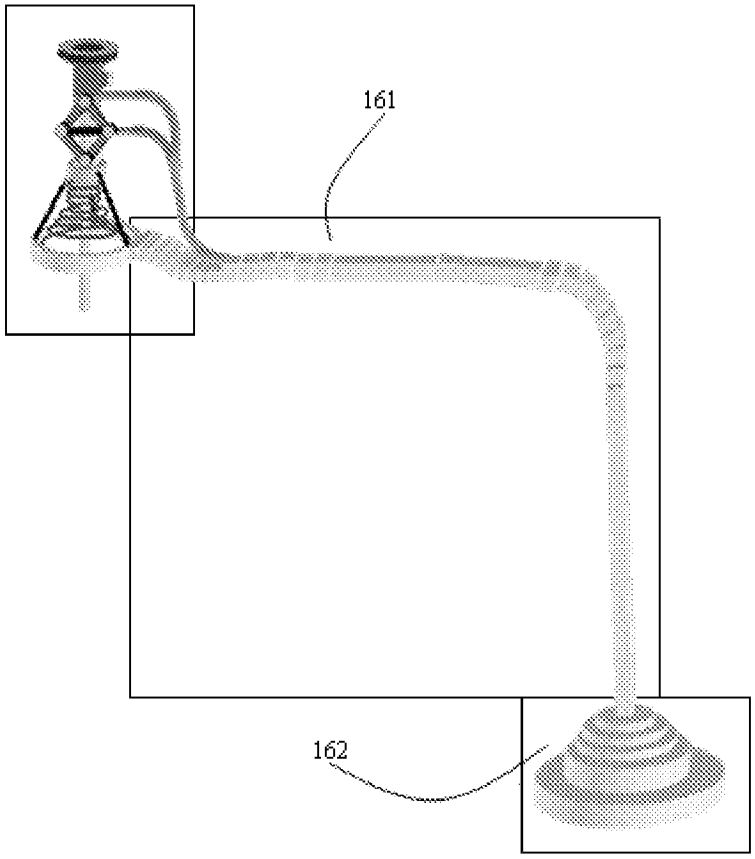


Fig. 16

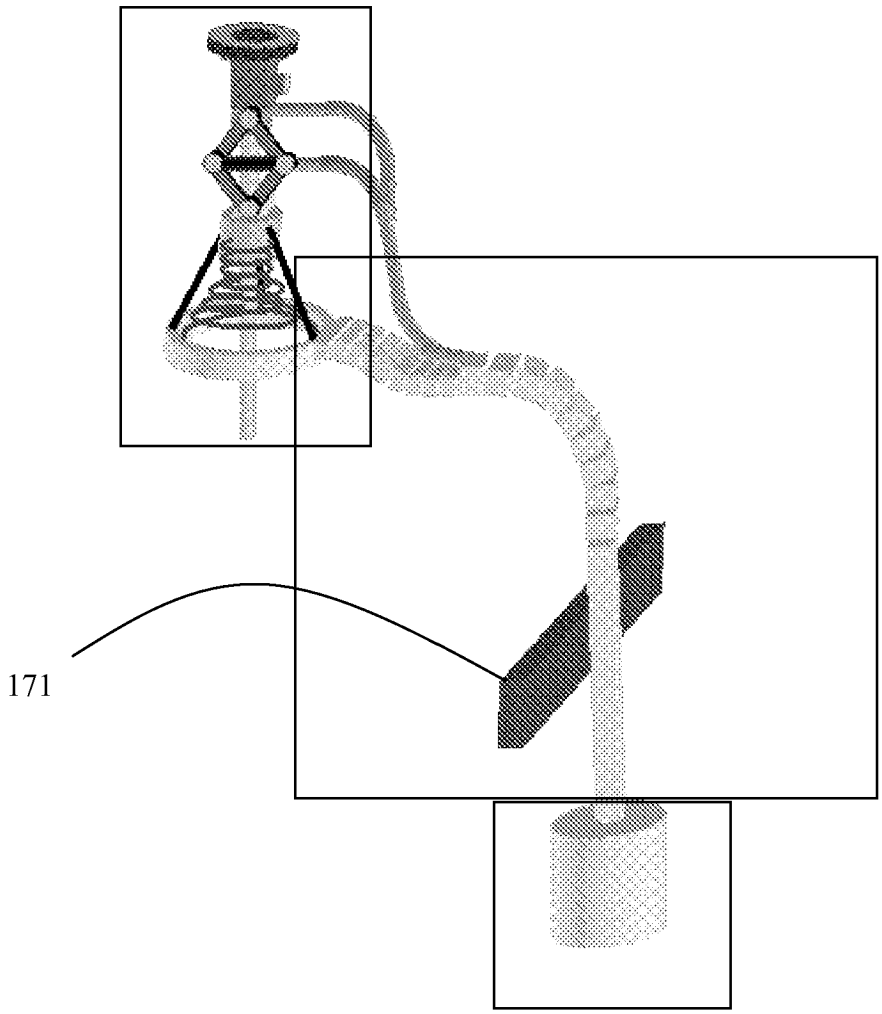


Fig. 17

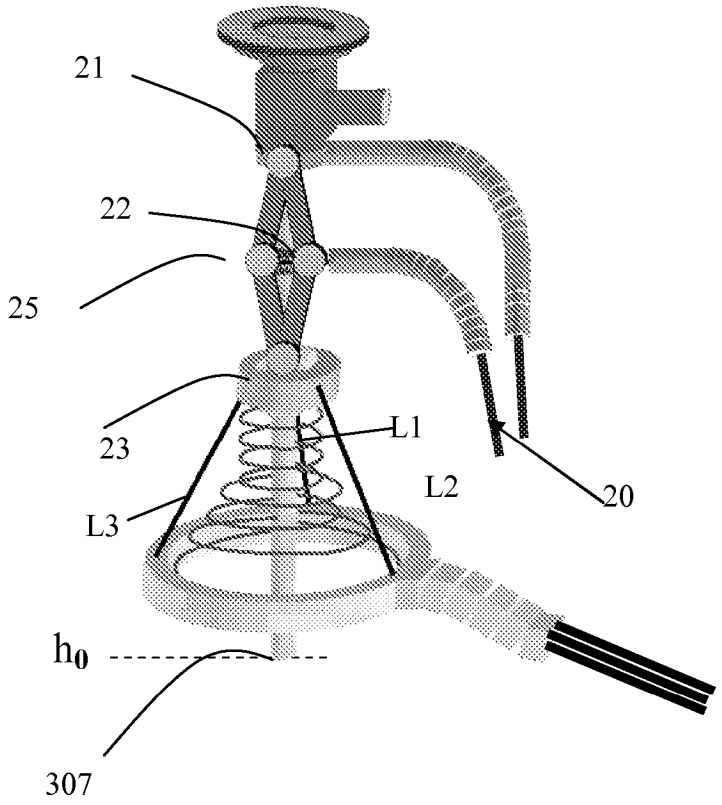


Fig. 18a

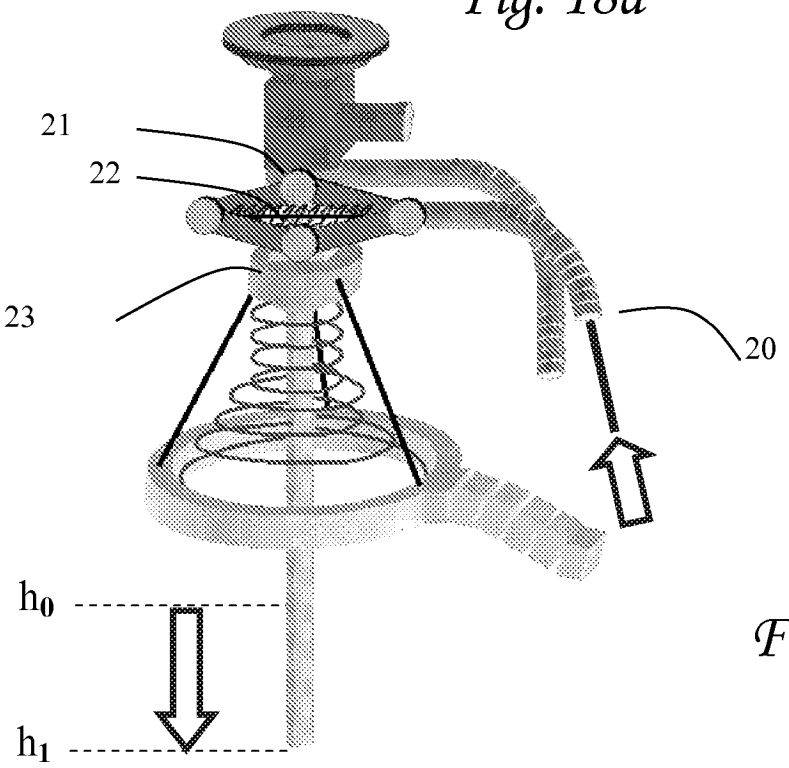


Fig. 18b

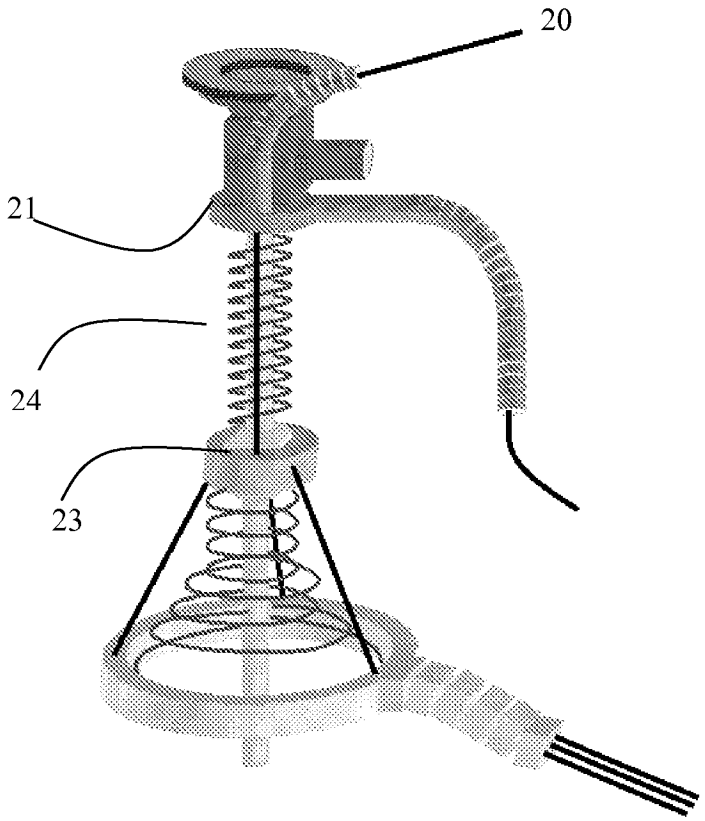


Fig. 19a

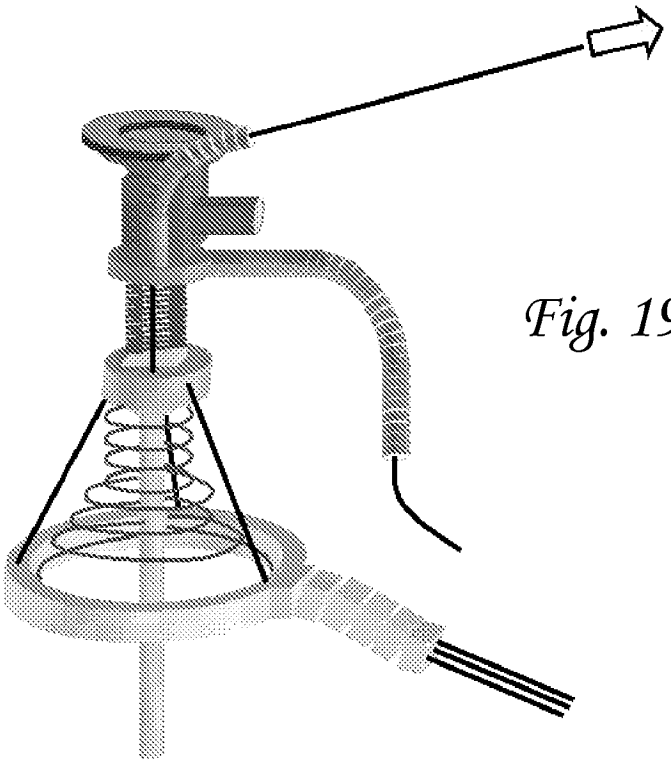


Fig. 19b

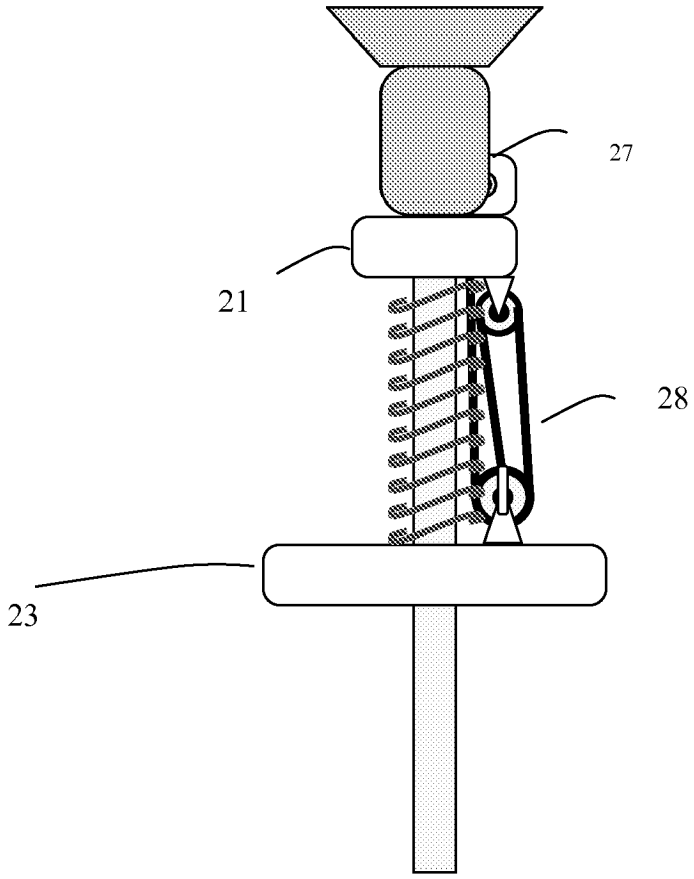


Fig. 20

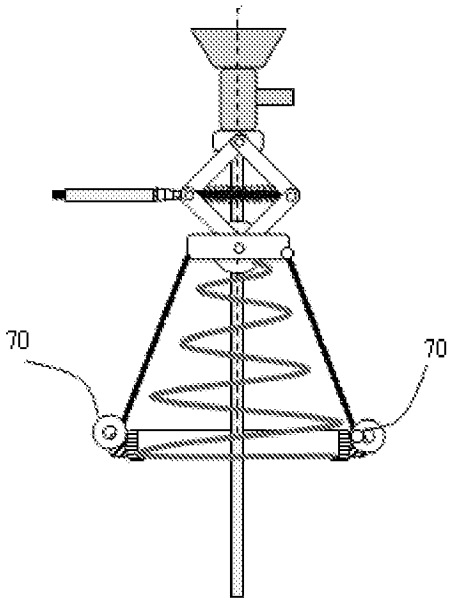


Fig. 21

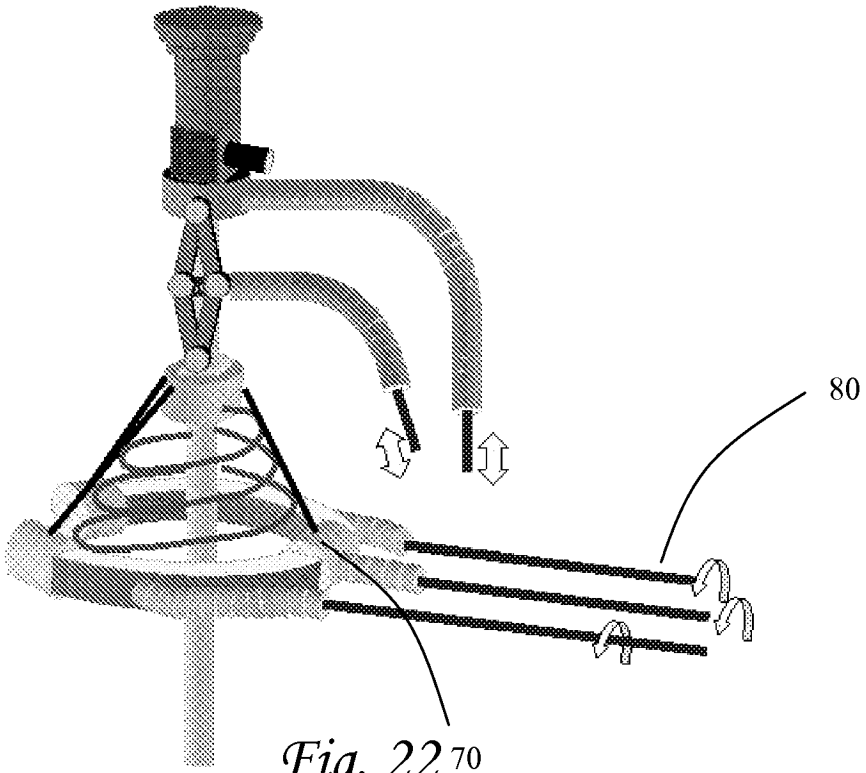


Fig. 22

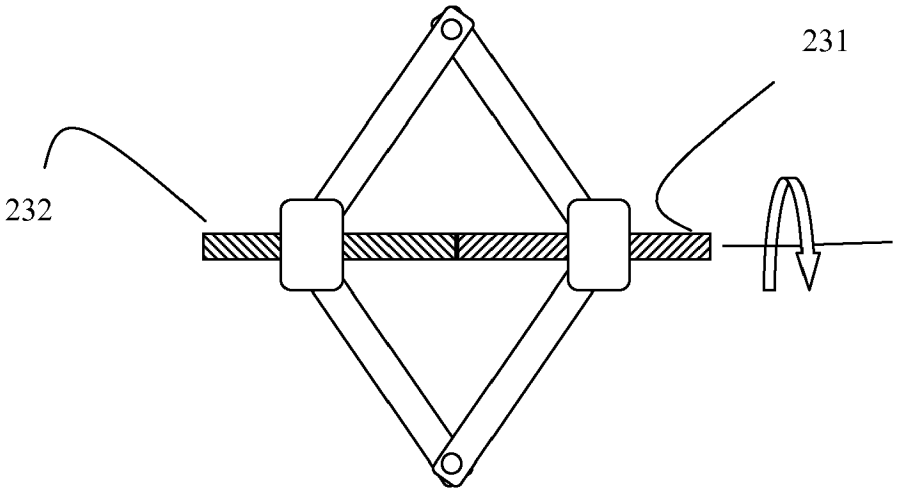


Fig. 23

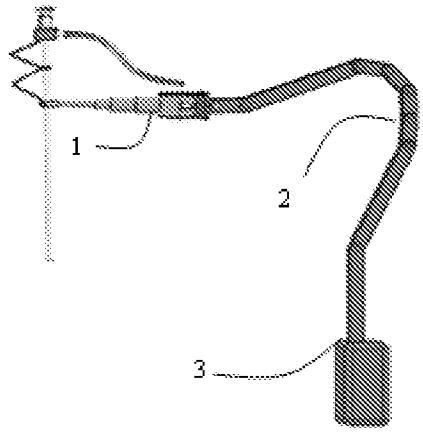


Fig. 24

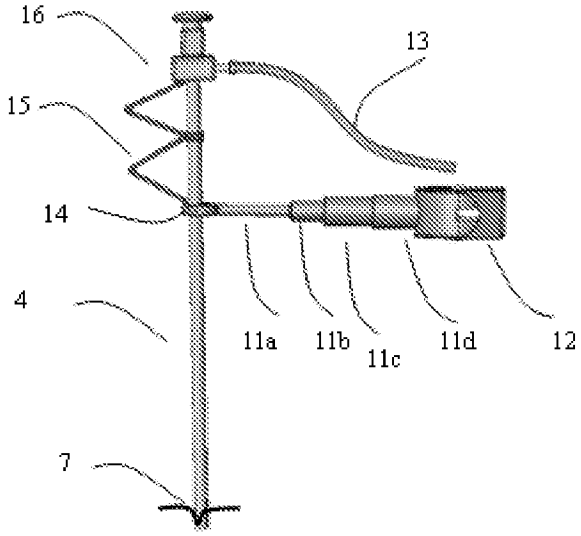
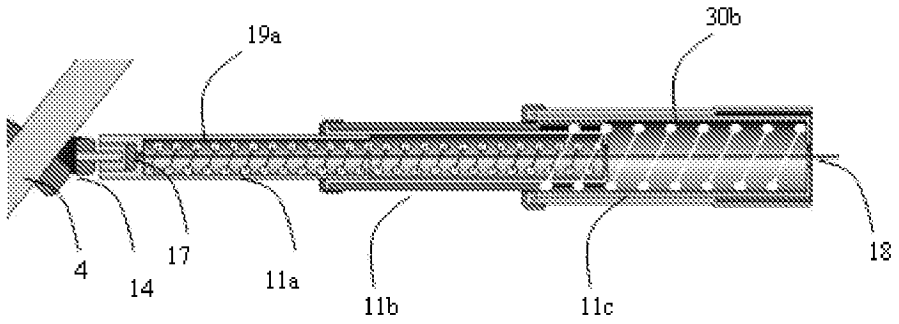


Fig.25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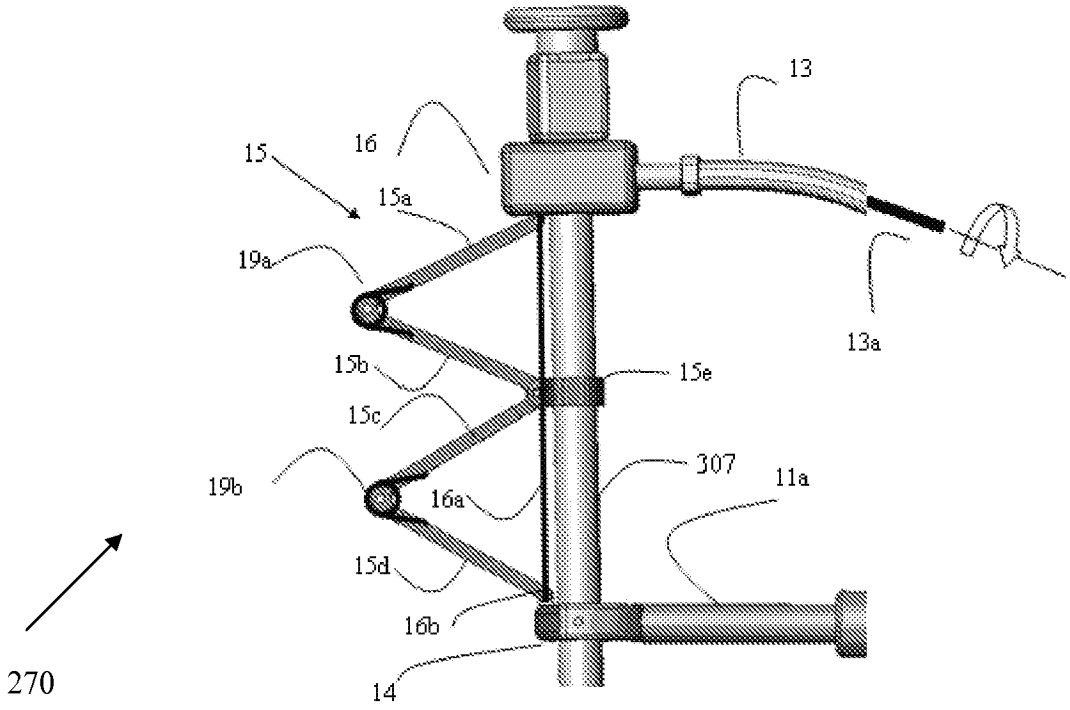
30b
4
14
17
11a
11b
11c
18

Fig. 26


13
16
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16a
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14
270

Fig.27

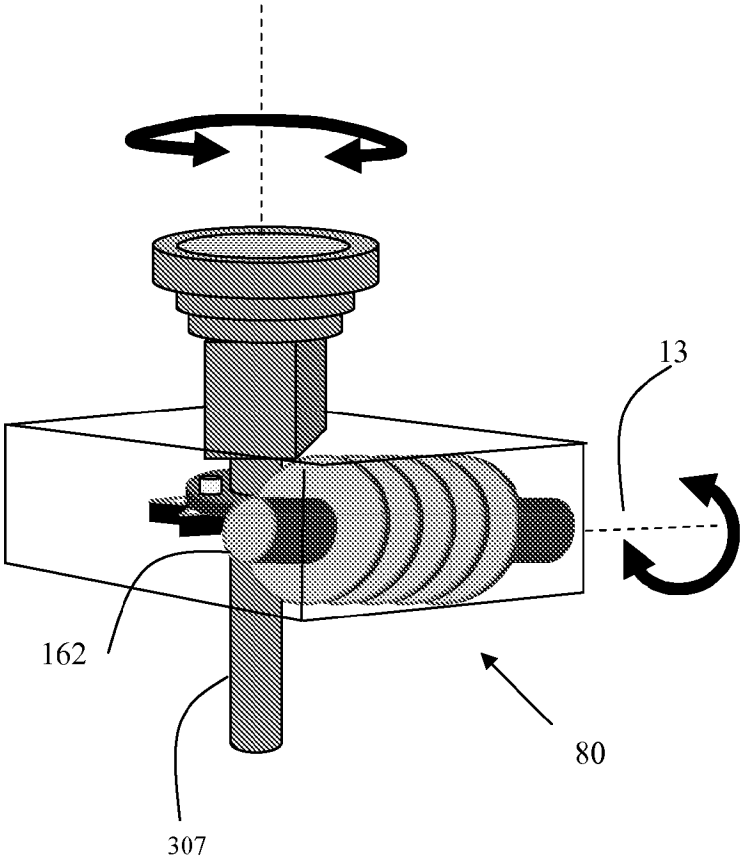


Fig. 28a

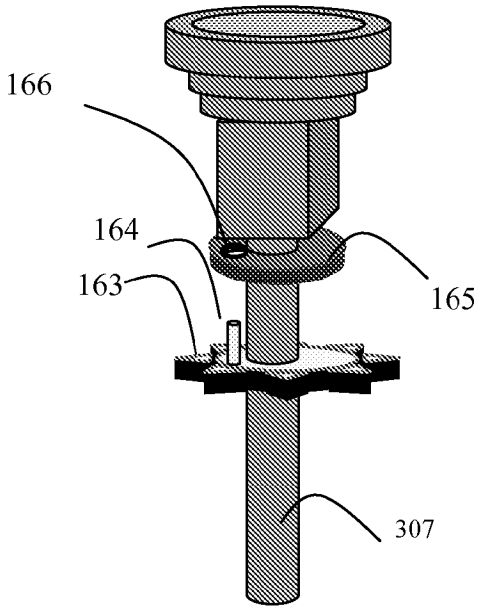


Fig.28b

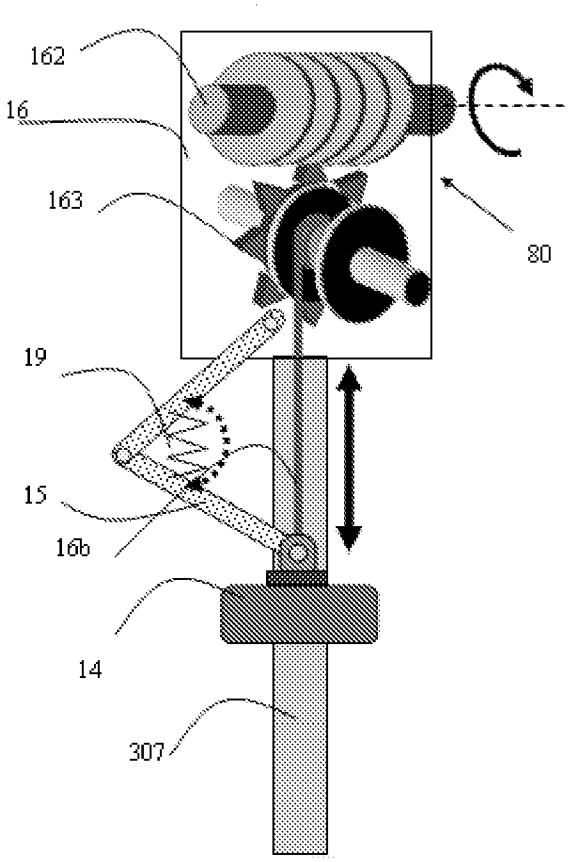


Fig. 28c

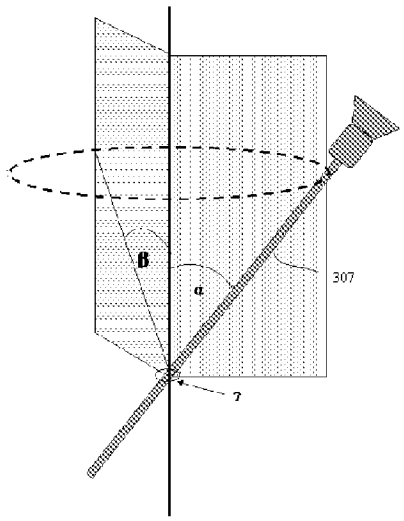


Fig. 29

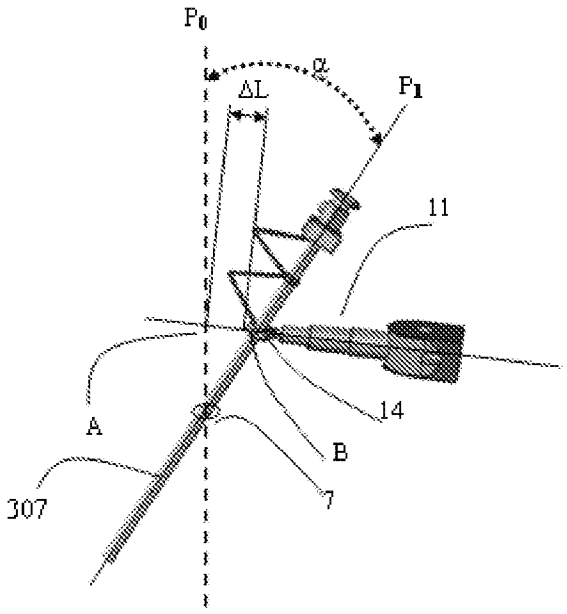


Fig. 30

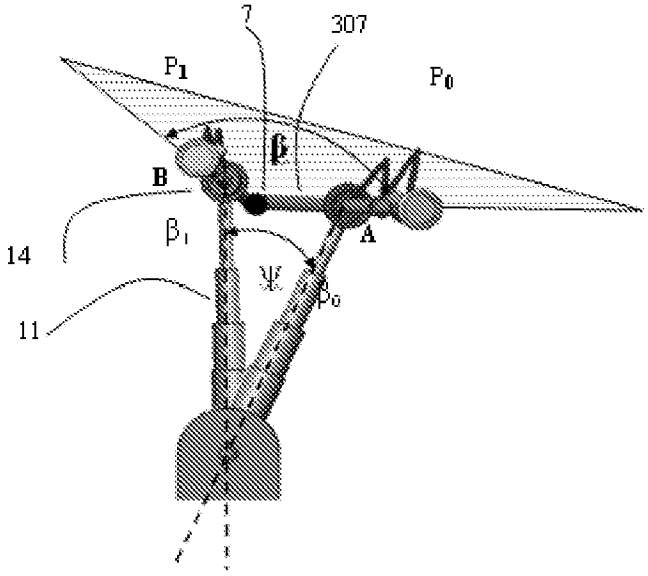


Fig. 31

Fig.32a

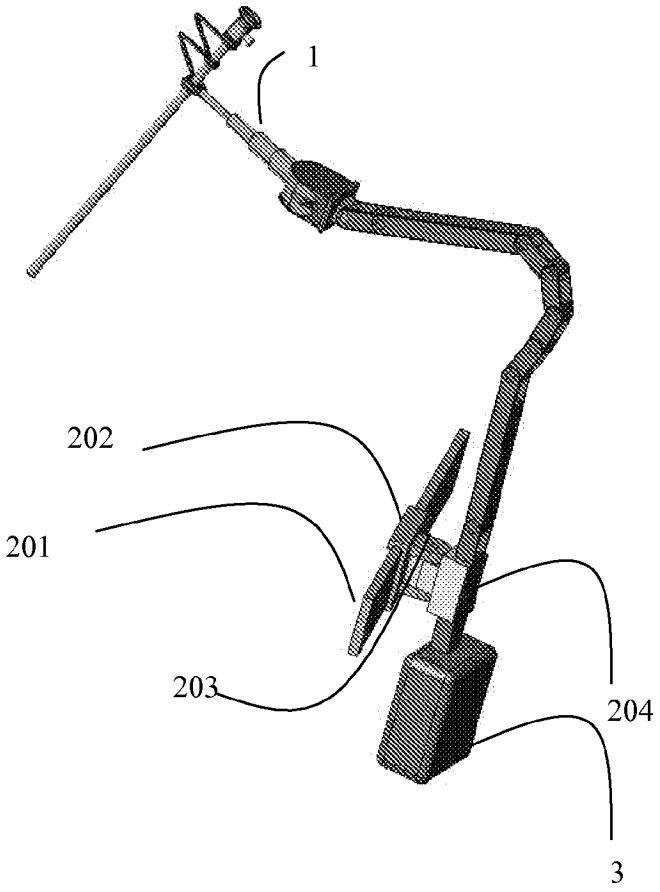
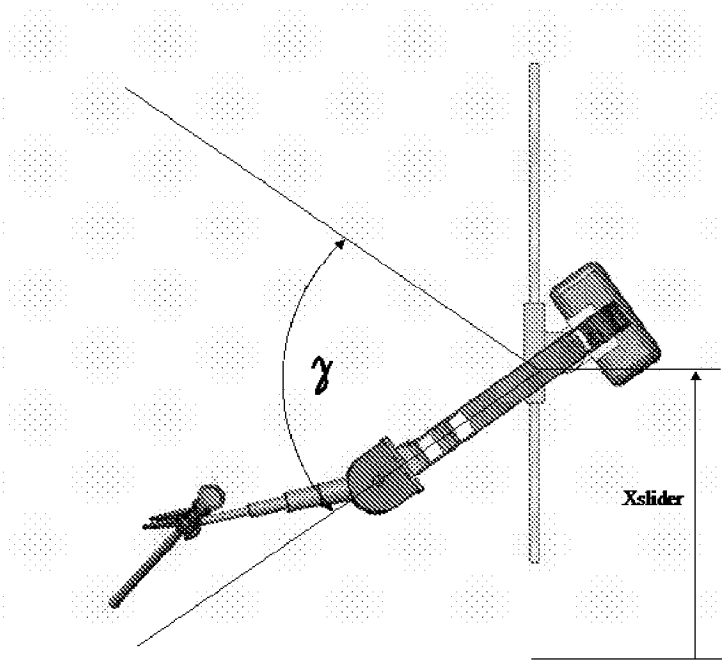


Fig. 32b



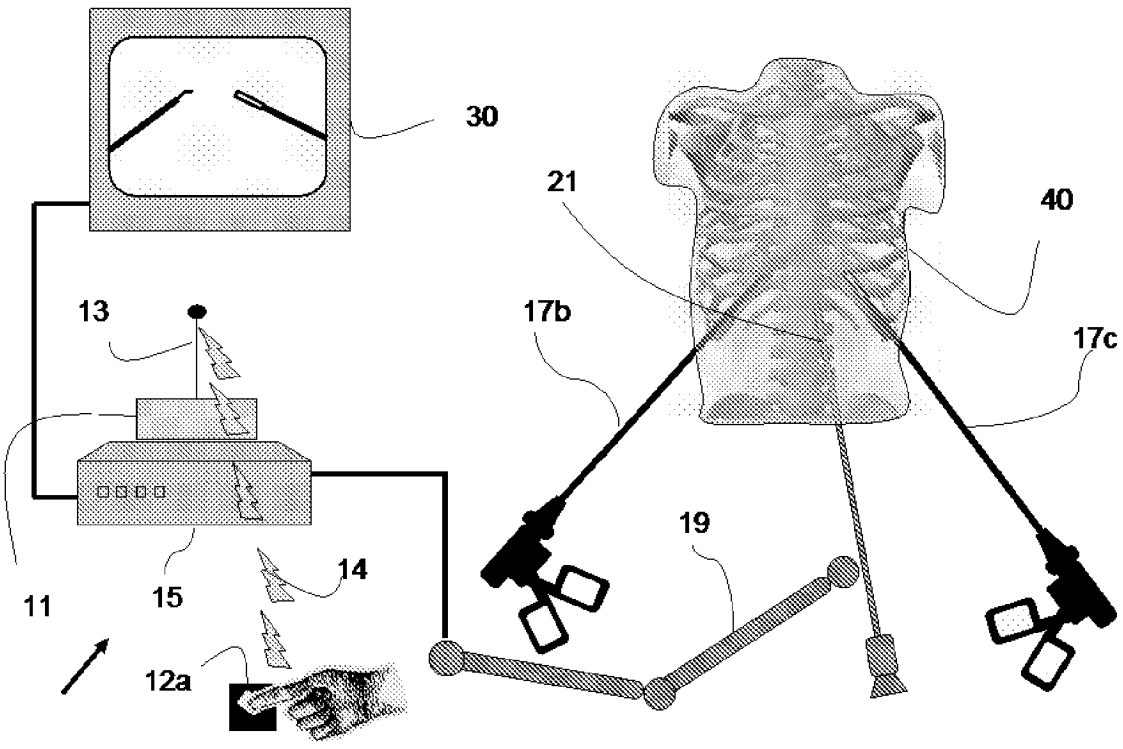


Fig. 33

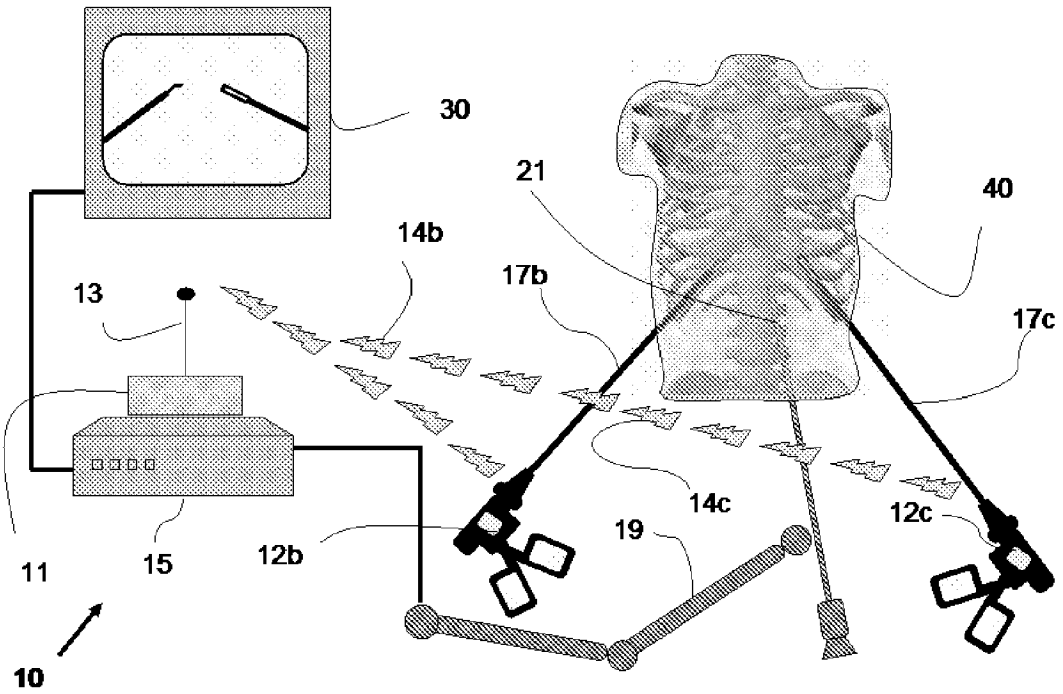


Fig. 34

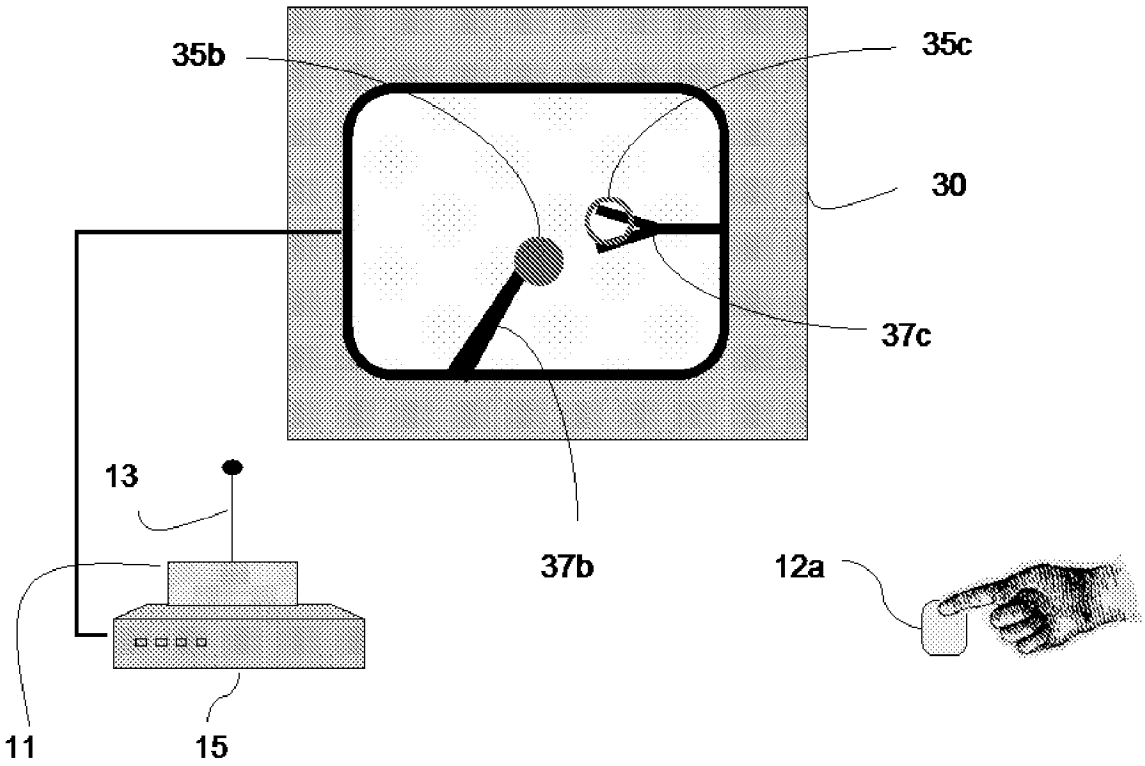


Fig. 35

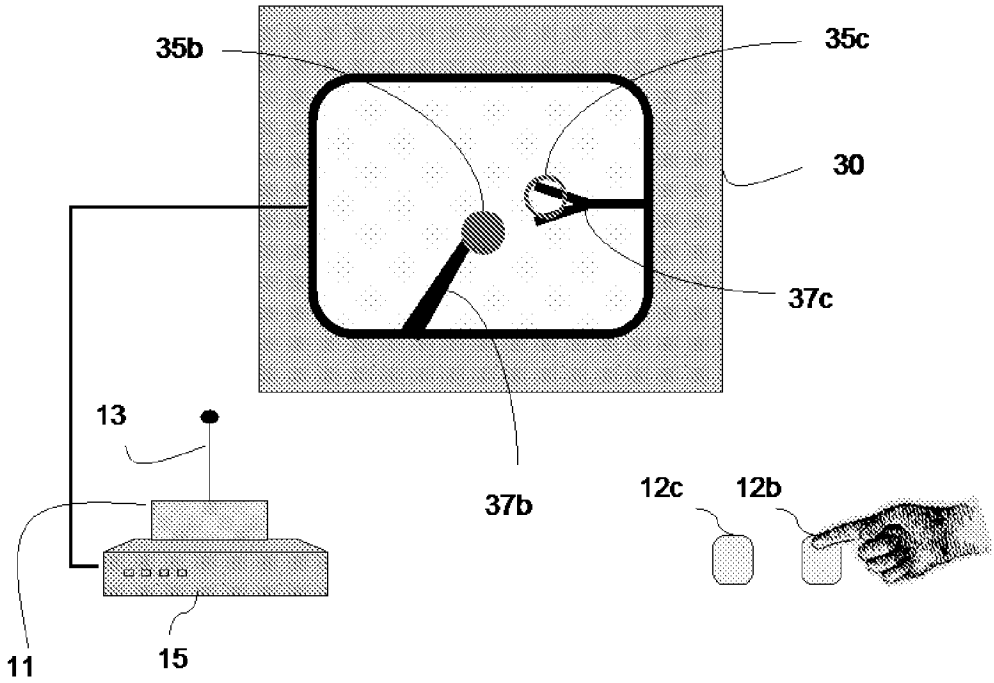


Fig. 36

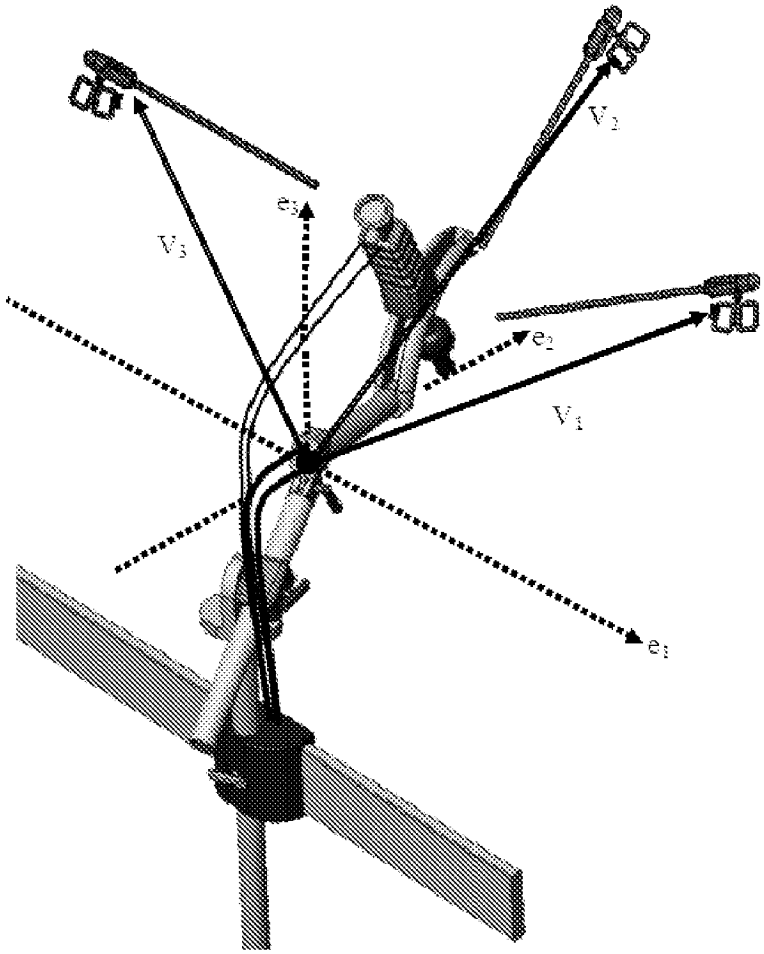


Fig. 37

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European Patent Office
Office européen des brevets

PARTIAL EUROPEAN SEARCH REPORT

Application Number EP 10 15 0239

which under Rule 63 of the European Patent Convention shall be considered, for the purposes of subsequent proceedings, as the European search report

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 5 279 309 A (TAYLOR RUSSELL HIGHSMITH [US] ET AL) 18 January 1994 (1994-01-18) * abstract * * column 20, line 31 - column 22, line 35 * * figure 10 * -----	1,3-4	INV. A61B1/313 A61B19/00 ADD. A61B17/00
A	US 5 749 362 A (FUNDA JANEZ [US] ET AL) 12 May 1998 (1998-05-12) * abstract * * column 4, line 17 - column 10, line 14 * * figures 1-4,8A * -----	1,3-4	
A	US 2004/015053 A1 (BIEGER JOHANNES [DE] ET AL) 22 January 2004 (2004-01-22) * abstract * * paragraph [0026] - paragraph [0032] * * figure 1 * -----	1,3-4	
A	US 2004/204627 A1 (FURUKAWA NOBUYUKI [JP]) 14 October 2004 (2004-10-14) * the whole document * ----- -/--	1-2,5	

TECHNICAL FIELDS SEARCHED (IPC)

A61B

INCOMPLETE SEARCH

The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC to such an extent that a meaningful search into the state of the art cannot be carried out, or can only be carried out partially, for these claims.

Claims searched completely :

Claims searched incompletely :

Claims not searched :

Reason for the limitation of the search:

see sheet C

Place of search	Date of completion of the search	Examiner
Munich	25 March 2010	Artikis, T

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

3

EPO FORM 1503 03.82 (P04E07)

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PARTIAL EUROPEAN SEARCH REPORT

Application Number
EP 10 15 0239

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
A	US 2002/156466 A1 (SAKURAI TOMOHISA [JP] ET AL) 24 October 2002 (2002-10-24) * abstract * * paragraph [0031] - paragraph [0081] * * figures 1-3,5 * -----	1,3,5-6
A,D	US 6 714 841 B1 (WRIGHT JAMES [US] ET AL) 30 March 2004 (2004-03-30) * the whole document * -----	1

CLASSIFICATION OF THE APPLICATION (IPC)

TECHNICAL FIELDS SEARCHED (IPC)

EPO FORM 1503 03.82 (P04C10)

Europäisches Patentamt
European Patent Office
Office européen des brevets

INCOMPLETE SEARCH
SHEET C

Application Number
EP 10 15 0239

Claim(s) completely searchable:
1-7

Claim(s) not searched:
8-15

Reason for the limitation of the search (non-patentable invention(s)):

Article 53 (c) EPC - Method for treatment of the human or animal body by surgery

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 15 0239

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The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

25-03-2010

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- JP 06063003 B **[0004]**
- US 6714841 B **[0008]**

专利名称(译)	改善腹腔镜手术的装置和方法		
公开(公告)号	EP2181645A1	公开(公告)日	2010-05-05
申请号	EP2010150239	申请日	2006-04-20
[标]申请(专利权)人(译)	M.S.T.医学外科技术有限公司		
申请(专利权)人(译)	M.S.T.医疗手术TECHNOLOGIES LTD		
当前申请(专利权)人(译)	M.S.T.医疗手术TECHNOLOGIES LTD		
[标]发明人	SHOLEV MORDEHAI		
发明人	SHOLEV, MORDEHAI		
IPC分类号	A61B1/313 A61B19/00 A61B17/00 A61B1/00 A61B8/00 A61B17/34		
CPC分类号	A61B1/00016 A61B1/00149 A61B1/3132 A61B17/00234 A61B34/25 A61B34/30 A61B34/70 A61B34/74 A61B90/361 A61B90/50 A61B2017/00221 A61B2017/00991 A61B2017/3409 A61B2034/305		
优先权	60/672010 2005-04-18 US 60/705199 2005-08-04 US 60/716951 2005-09-15 US 60/716953 2005-09-15 US		
其他公开文献	EP2181645B1		
外部链接	Espacenet		

摘要(译)

本发明公开了一种用于腹腔镜手术的相机保持器装置和机构。摄像机支架装置易于安装和拆卸，使用舒适，不限制外科医生的灵活性，具有小的物理尺寸和便宜。此外，本发明涉及用于改善外科医生与手术医疗助理之间或外科医生与用于腹腔镜手术的内窥镜系统之间的接口的装置和方法。此外，本发明公开了一种用于控制内窥镜系统的装置。腹腔镜手术，其中内窥镜通过小切口插入体腔。

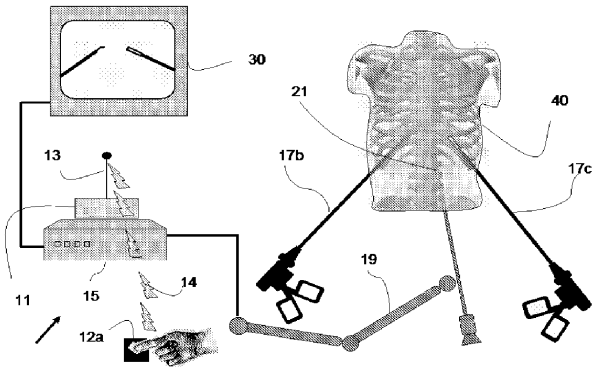

Fig. 33