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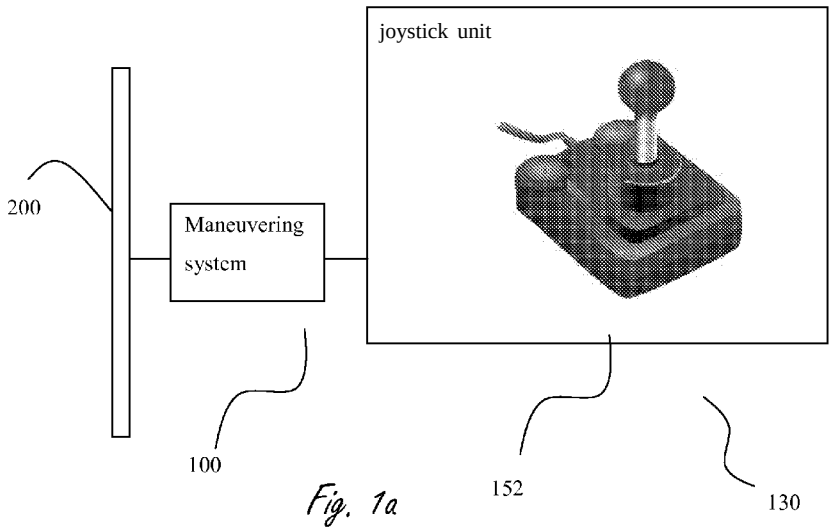



Fig. 1a

**(57) Abstract:** The present invention provides a system for maneuvering an endoscope (SFME) during a medical procedure, comprising a. at least one maneuvering system, adapted to maneuver said endoscope in at least two degrees of freedom (DOF); and, b. at least one joystick unit in communication with said maneuvering system, adapted to operate said maneuvering system; wherein opera - tion of said joystick results in movement of said endoscope by means of said maneuvering system.

# MANUAL CONTROL SYSTEM FOR MANEUVERING AN ENDOSCOPE

## FIELD OF THE INVENTION

The present invention generally relates to means and methods for simply maneuvering an endoscope by an endoscope user. Moreover, this present invention discloses a compact configuration of devices used for different manual actions upon the endoscope.

## BACKGROUND OF THE INVENTION

Laparoscopic surgery is becoming increasingly popular with patients because the scars are smaller and the 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 is 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 an 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).

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 since the surgeon must perform the operation using both hands. The surgeon's 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 that it is difficult both for the assistant to keep the endoscope in the right spatial position, and for the assistant 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, difficult to install, uncomfortable to use, limit the dexterity of the surgeon and have physical dimensions much larger that all the other operating tools. Relative to the required action, they also require a large region to be kept free for their movement and have several arms, moving around different axes.

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 to, or be very close to, the patient's skin. This ring occupies a place over the patient's body, thus limiting the surgeon's activities: other trochars can not be placed there, whether or not the surgeon would prefer this, possibly changing the surgeon's usual method of carrying our the procedure, and sometimes forcing the setup process to be as long as 40 minutes. Also, the LER has only 3 degrees of freedom and is unable to control the orientation of the picture shown to surgeon (the LER cannot rotate the endoscope around its longitudinal axis).

However, even the improved technologies still limit the dexterity of the surgeon and fail to provide the necessary four degrees of freedom. Another disadvantage of these technologies is that they lack the ability to control fully both the spatial position of the endoscope tube and its orientation during the laparoscopic surgery, so that the surgeon may view any desired area within the working envelope in the body being operated on.

Therefore, there is still a long felt need for a camera holder that will hold the endoscope steady and that will allow full control of the endoscope in all four degrees of freedom, without limiting the dexterity of the surgeon. Furthermore, there is also a long felt need for a camera holder that will provide the ability to control the spatial orientation of an endoscope tube, so that the surgeon may reach any desired area within the working envelope in operated body and may view that area from any desired angle.

## SUMMARY OF THE INVENTION

An object of the invention is to disclose a system for maneuvering an endoscope **(SFME)** during a medical procedure comprising (a) at least one maneuvering system unit, adapted to maneuver the endoscope in at least two degrees of freedom **(DOF);** and (b) at least one joystick unit in communication with the maneuvering system unit, adapted to operate the maneuvering system unit; wherein operation of said joystick unit results in movement of said endoscope by means of said maneuvering system.

It is another object of the invention to disclose the system as defined above, wherein the joystick unit is wearable by a user of the system.

It is another object of the invention to disclose the system as defined above, wherein the joystick unit is coupled to at least one surgical tool used in the medical procedure.

It is another object of the invention to disclose the system as defined above, wherein the at least one surgical tool is an endoscope.

It is another object of the invention to disclose the system as defined above, wherein the movement of the joystick is proportional to the movement of the endoscope.

It is another object of the invention to disclose the system as defined above, wherein the joystick unit is a force joystick.

It is another object of the invention to disclose the system as defined above, wherein the joystick unit comprises a base and lever coupled to the base, such that movement of the lever results in movement of the endoscope; further wherein the movement of the lever is proportional to the movement of the endoscope.

It is another object of the invention to disclose the system as defined above, wherein the joystick unit comprises a base and a button jointly connected to the base, such that movement of the button results in movement of the endoscope; further wherein the movement of the button is proportional to the movement of the endoscope.

It is another object of the invention to disclose the system as defined above, wherein the joystick unit comprises a touchscreen, such that a touch and a movement on the touchscreen results in movement of the endoscope; further wherein the touch and movement on the touchscreen is proportional to the movement of the endoscope.

It is another object of the invention to disclose the system as defined above, wherein the joystick unit comprises at least one sound sensor, adapted to sense predetermined sound patterns; the joystick unit adapted to operate the maneuvering system based on the predetermined sound patterns.

It is another object of the invention to disclose the system as defined above, wherein the SFME additionally comprises means adapted to restrain the velocity of the endoscope, such that when the means are activated, the velocity of the endoscope is restrained.

It is another object of the invention to disclose the system as defined above, wherein the joystick unit additionally comprises *n* sensors, where *n* is an integer larger than one.

It is another object of the invention to disclose the system as defined above, wherein the sensors are selected from a group consisting of a motion sensor, a heat sensor, an electric sensor, a sound sensor, a pressure sensor, an optical sensor and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein at least one of the *n* sensors is activated in case of power failure.

It is another object of the invention to disclose the system as defined above, wherein at least one of the *n* sensors is activated when the system is connected to power.

It is another object of the invention to disclose the system as defined above, wherein the joystick unit is characterized by an external surface.

It is another object of the invention to disclose the system as defined above, wherein the at least one motion sensor detects motion upon the external surface of the joystick unit.

It is another object of the invention to disclose the system as defined above, wherein the at least one motion sensor detects motion perpendicular to the external surface of the joystick unit.

It is another object of the invention to disclose the system as defined above, wherein, if the joystick unit's speed of motion is above a predetermined value, the endoscope's speed is at a predetermined value.

It is another object of the invention to disclose the system as defined above, wherein the at least one heat sensor is adapted to sense temperature in the range of about 35 to about 42 degrees.

It is another object of the invention to disclose the system as defined above, wherein the system is adapted to enable maneuvering of the endoscope at such times as the at least one heat sensor senses temperatures in the range of about 35 to about 42 degrees.

It is another object of the invention to disclose the system as defined above, wherein the at least one heat sensor is adapted to provide a thermal image, and where the at least one heat sensor is coupled to a processing unit adapted to provide the endoscope user with the thermal image.

It is another object of the invention to disclose the system as defined above, wherein the system is adapted to enable maneuvering of the endoscope at such times as analysis of the image by the processing system detects a human hand; further wherein the system is adapted to prevent maneuvering of the endoscope at such times when the analysis of the image by the processing unit fails to detect an image of a human hand.

It is another object of the invention to disclose the system as defined above, wherein at least one electric sensor is adapted to sense power failure.

It is another object of the invention to disclose the system as defined above, wherein at least one electric sensor is adapted to sense electric conductivity of a subject's body.

It is another object of the invention to disclose the system as defined above, wherein the system is adapted to enable maneuvering of the endoscope at such times when the sensor senses the conductivity of the subject's body; further wherein the system is adapted to prevent maneuvering of the endoscope at such times as the sensor fails to sense the conductivity of the subject's body.

It is another object of the invention to disclose the system as defined above, wherein at least one sound sensor is adapted to sense predetermined sound patterns.

It is another object of the invention to disclose the system as defined above, wherein the endoscope is maneuverable according to the at least one predetermined sound pattern sensed by the at least one sound sensor.

It is another object of the invention to disclose the system as defined above, wherein at least one pressure sensor is adapted to sense pressure applied to the joystick unit.

It is another object of the invention to disclose the system as defined above, wherein the pressure sensed by at least one pressure sensor affects the SFME in a manner selected from a group consisting of: when the pressure sensed by the at least one pressure sensor is above a predetermined threshold, the SFME is activated, when the pressure sensed by the at least one pressure sensor is above a predetermined threshold, the SFME is de-activated, and when the pressure sensed by the at least one pressure sensor is below a predetermined threshold, the SFME is de-activated.

It is another object of the invention to disclose the system as defined above, wherein at least one optical sensor is adapted to sense visual changes according to at least one predetermined visual pattern.

It is another object of the invention to disclose the system as defined above, wherein the endoscope is maneuverable according to at least one predetermined visual pattern.

It is another object of the invention to disclose the system as defined above, additionally comprising an interface system adapted to enable communication between the joystick unit and the maneuvering system unit.

It is another object of the invention to disclose the system as defined above, wherein the communication means comprises a member selected from a group consisting of a wired communication means, a wireless communication means and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein the SFME comprises at least one second joystick unit adapted to zoom the endoscope by means of the maneuvering system unit.

It is another object of the invention to disclose the system as defined above, wherein the second joystick unit is wearable by a system user.

It is another object of the invention to disclose the system as defined above, wherein the second joystick unit is coupled to at least one surgical tool.

It is another object of the invention to disclose the system as defined above, wherein the at least one surgical tool is an endoscope.

It is another object of the invention to disclose the system as defined above, wherein the at least one joystick unit is adapted to control and to direct the endoscope via the maneuvering system on a surgical tool.

It is another object of the invention to disclose the system as defined above, wherein selection of the at least one surgical tool is obtained by activating the at least one joystick unit; further wherein the activation of the at least one joystick unit is obtained by depression of the joystick

unit, voice activating the same, prolonged depression on the same, double clicking on the same and any combination thereof.

It is another object of the invention to disclose the system as defined above, additionally comprising

(a) at least one wearable operator comprising at least one wireless transmitter, adapted to transmit a signal once the at least one wearable operator is activated; the at least one wearable operator is either wire or wirelessly in communication with at least one surgical instrument;

(b) at least one wireless receiver; adapted to receive the signal sent by the transmitter;

(c) at least one laparoscopy computerized system, in communication with the wireless receiver, adapted to provide a visual onscreen depiction of the at least one instrument to be selected following the activation of the at least one wearable operator; and,

(d) at least one video screen; wherein the system is adapted to control and to direct the endoscope via the laparoscopy computerized system and the maneuvering system on the instrument to be selected following the activation of the at least one wearable operator.

It is another object of the invention to disclose the system as defined above, wherein the communication between the at least one of the wearable operators and the instrument is either wire or wirelessly coupling.

It is another object of the invention to disclose the system as defined above, wherein the wearable operator is worn by the surgeon on a predetermined body part.

It is another object of the invention to disclose the system as defined above, wherein the predetermined body part is selected from a group consisting of: the hand of the surgeon, at least one of the fingers of the surgeon, the thigh of the surgeon, the neck of the surgeon, at least one of the legs of the surgeon, the knee of the surgeon, the head of the surgeon and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein the shape of the wearable operator is selected from a group consisting of a ring, a bracelet and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein the wearable operator is coupled to a predetermined location on the instrument by means of an adaptor.

It is another object of the invention to disclose the system as defined above, wherein the wearable operator is adjustable so as to fit the predetermined location of the different instruments, each of which is characterized by a different size and shape.

It is another object of the invention to disclose the system as defined above, wherein the wearable operator comprises a body having at least two portions at least partially overlapping each other; the two portions are adapted to grasp and hold either the instrument or the predetermined body part there-between, such that a tight-fit coupling between the two portions and the instrument or the predetermined body part is obtained.

It is another object of the invention to disclose the system as defined above, wherein one of the two portions is rotationally movable relative to the other, such that when the wearable operator is coupled to the instrument, fine-tuned movement of the two body portions is obtainable so as to provide the tight-fit coupling between the two portions and the instrument or the predetermined body part.

It is another object of the invention to disclose the system as defined above, wherein the two portions are rotationally movable relative to each other, such that when the wearable operator is coupled to the instrument, fine-tuned movement of the two body portions is obtainable so as to provide the tight-fit coupling between the two portions and the instrument or the predetermined body part.

It is another object of the invention to disclose the system as defined above, wherein the wearable operator comprises (a) at least one flexible and stretchable strip; and (b) loop-closing means adapted to close a loop with the at least one flexible and stretchable strip; the at least one flexible and stretchable strip and the loop-closing means are provided so as to fit the wearable operator to at least one selected from a group consisting of (a) the predetermined location of the different instruments; (b) the predetermined body part of the surgeon, each of which is characterized by a different size and shape.

It is another object of the invention to disclose the system as defined above, wherein the flexible and stretchable strip is made of material selected from a group consisting of silicone, rubber and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein the wireless transmitter is adapted to locate the position of at least one of the instruments.

It is another object of the invention to disclose the system as defined above, wherein selection of the at least one instrument is obtained by activating the at least one wearable operator; further wherein the activation of the at least one wearable operator is obtained by depression on a predetermined location in the wearable operator, voice activating the same, prolonged depression on the same, double clicking on the same and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein the laparoscopy computerized system directs the endoscope by using image information shown on the video screen without the help of assistants.

It is another object of the invention to disclose the system as defined above, wherein the conventional laparoscopy computerized system comprises at least one surgical instrument spatial location software, adapted to locate the 3D spatial position of the at least one instrument; further wherein the conventional laparoscopy computerized system comprises at least one automated assistant maneuvering system; the automated assistant maneuvering system is coupled to the endoscope and is adapted to direct the endoscope to the at least one instrument, the instrument selected following the activation of the at least one wearable operator.

It is another object of the invention to disclose the system as defined above, wherein each transmitted signal from the wearable operator and the wireless transmitter is matched to at least one of the instruments.

It is another object of the invention to disclose the system as defined above, wherein the at least one joystick unit is adapted to control and to direct the endoscope via the maneuvering system on the surgical instrument to which the activated wearable operator is coupled.

It is another object of the invention to disclose the system as defined above, wherein selection of the at least one instrument is obtained by activating the at least one joystick unit; further wherein the activation of the at least one joystick unit is obtained by depression of the joystick unit, voice

activating the same, prolonged depression on the same, double clicking on the same and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein said at least one joystick unit is adapted to control and to direct said endoscope via said maneuvering system on a surgical tool.

It is another object of the invention to disclose the system as defined above, wherein selection of said at least one surgical tool is obtained by activating said at least one joystick unit; further wherein the activation of said at least one joystick unit is obtained by depression of said joystick unit, voice activating the same, prolonged depression on the same, double clicking on the same and any combination thereof.

It is another object of the invention to disclose the system as defined above, additionally comprising (a) at least one wearable operator comprising at least one wireless transmitter, adapted to transmit a signal once said at least one wearable operator is activated; said at least one wearable operator is either wire or wirelessly in communication with at least one surgical instrument; (b) at least one wireless receiver; adapted to receive said signal sent by said transmitter; (c) at least one laparoscopy computerized system, in communication with said wireless receiver, adapted to provide a visual onscreen depiction of said at least one instrument to be selected following the activation of said at least one wearable operator; and, (d) at least one video screen; wherein said system is adapted to control and to direct said endoscope via said laparoscopy computerized system and said maneuvering system on said instrument to be selected following the activation of said at least one wearable operator.

It is another object of the invention to disclose the system as defined above, wherein said communication between said at least one of said wearable operators and said instrument is either wire or wirelessly coupling.

It is another object of the invention to disclose the system as defined above, wherein said wearable operator is worn by said surgeon on a predetermined body part.

It is another object of the invention to disclose the system as defined above, wherein said predetermined body part is selected from a group consisting of: the hand of said surgeon, at least one of the fingers of said surgeon, the thigh of said surgeon, the neck of said surgeon, at least one

of the legs of said surgeon, the knee of said surgeon, the head of said surgeon and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein the shape of said wearable operator is selected from a group consisting of a ring, a bracelet and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein said wearable operator is coupled to a predetermined location on said instrument by means of an adaptor.

It is another object of the invention to disclose the system as defined above, wherein said wearable operator is adjustable so as to fit said predetermined location of said different instruments, each of which is characterized by a different size and shape.

It is another object of the invention to disclose the system as defined above, wherein said wearable operator comprises a body having at least two portions at least partially overlapping each other; said two portions are adapted to grasp and hold either said instrument or said predetermined body part there-between, such that a tight-fit coupling between said two portions and said instrument or said predetermined body part is obtained.

It is another object of the invention to disclose the system as defined above, wherein one of said two portions is rotationally movable relative to the other, such that when said wearable operator is coupled to said instrument, fine-tuned movement of said two body portions is obtainable so as to provide said tight-fit coupling between said two portions and said instrument or said predetermined body part.

It is another object of the invention to disclose the system as defined above, wherein said two portions are rotationally movable relative to each other, such that when said wearable operator is coupled to said instrument, fine-tuned movement of said two body portions is obtainable so as to provide said tight-fit coupling between said two portions and said instrument or said predetermined body part.

It is another object of the invention to disclose the system as defined above, wherein said wearable operator comprises (a) at least one flexible and stretchable strip; and (b) loop-closing means adapted to close a loop with said at least one flexible and stretchable strip; said at least one flexible and stretchable strip and said loop-closing means are provided so as to fit said

wearable operator to at least one selected from a group consisting of (a) said predetermined location of said different instruments; (b) said predetermined body part of said surgeon, each of

It is another object of the invention to disclose the system as defined above, which is characterized by a different size and shape.

It is another object of the invention to disclose the system as defined above, wherein said flexible and stretchable strip is made of material selected from a group consisting of silicone, rubber and any combination thereof.

wherein said wireless transmitter is adapted to locate the position of at least one of said instruments.

It is another object of the invention to disclose the system as defined above, wherein selection of said at least one instrument is obtained by activating said at least one wearable operator; further wherein the activation of said at least one wearable operator is obtained by depression on a predetermined location in said wearable operator, voice activating the same, prolonged depression on the same, double clicking on the same and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein said laparoscopy computerized system directs said endoscope by using image information shown on said video screen without said help of assistants.

It is another object of the invention to disclose the system as defined above, wherein said conventional laparoscopy computerized system comprises at least one surgical instrument spatial location software, adapted to locate the 3D spatial position of said at least one instrument; further wherein said conventional laparoscopy computerized system comprises at least one automated assistant maneuvering system; said automated assistant maneuvering system is coupled to said endoscope and is adapted to direct said endoscope to said at least one instrument, said instrument selected following the activation of said at least one wearable operator.

It is another object of the invention to disclose the system as defined above, wherein each transmitted signal from said wearable operator and said wireless transmitter is matched to at least one of said instruments.

It is another object of the invention to disclose the system as defined above, wherein a single device comprises the joystick unit and the second joystick unit.

It is another object of the invention is to disclose the system as defined above, additionally comprising:

1. a first mechanism, comprising:
   a. at least one first coaxial transmission means 101; the first coaxial transmission means 101 defines a first plane and is characterized by a first axis of rotation which is substantially orthogonal to the first plane;
   b. at least one second coaxial transmission means 102; the second coaxial transmission means 102 defines a second plane and is characterized by a second axis of rotation; the second axis of rotation is substantially orthogonal to the second plane; additionally, it is rotatably connected to the first coaxial transmission means 101; where the second plane is substantially orthogonal to the first plane; and
   c. at least one first means 106 adapted to rotate the first coaxial transmission means 101 around the first axis of rotation;

   where the first coaxial transmission means transmits rotation to the second coaxial transmission means 102; and,

2. a second mechanism, comprising:
   a. at least one third coaxial transmission means 103 which defines a third plane and is characterized by a third axis of rotation; the third axis of rotation is substantially orthogonal to the third plane;
   b. at least one fourth coaxial transmission means 104 which defines a fourth plane and is characterized by a fourth axis of rotation, the fourth axis of rotation is substantially orthogonal to the fourth plane; and is rotatably connected to the third coaxial transmission means 103; where fourth plane is substantially orthogonal to the third plane;
   c. at least one fifth coaxial transmission means 105 which defines a fifth plane and a fifth axis of rotation; the fifth axis of rotation is substantially orthogonal to the fifth plane; fifth coaxial transmission means 105 is rotatably connected to the fourth coaxial transmission means 104 and is substantially orthogonal to the fourth plane;

d. at least one second means adapted to rotate the third coaxial transmission means 103 around the third axis of rotation;

where the third coaxial transmission means 103 transmits rotation to the fourth coaxial transmission meansl04; the fourth coaxial transmission means 104 transmit rotation to the fifth coaxial transmission means 105;

wherein the first mechanism and the second mechanism are adapted to rotate the endoscope around at least one second axis of rotation being substantially orthogonal to the second plane; and around at least one fifth axis of rotation being substantially orthogonal to the fifth plane, such that the second axis of rotation and the fifth axis of rotation are positioned at an angle A relative to each other.

It is another object of the invention to disclose the system as defined above, wherein A is in the range of about 0 degrees to about 180 degrees.

It is another object of the invention to disclose the system as defined above, additionally comprising at least one pivoting support 111 pivotally attached to the endoscope; the pivoting support adapted to enable the endoscope to pivot around the pivoting support.

It is another object of the invention to disclose the system as defined above, wherein the pivoting support is a gimbal.

It is another object of the invention to disclose the system as defined above, additionally comprising at least one third mechanism in communication with the first mechanism and the second mechanism, the third mechanism comprising (i) at least one pivoting support adapted to be pivotally attached to the endoscope; the pivoting support adapted to enable the endoscope 200 to pivot around the pivoting support; and (ii) at least one joint 114 the joint mechanically connected to the pivoting support 111, thereby enabling the endoscope 200 to rotate freely in two orthogonal axes around an insertion point;

the endoscope pivotally attached to the joint and the pivoting support can pivot at the insertion point independent of the distance between the pivoting support, the joint, and the insertion point;

where the third mechanism is coupled at its distal end to the endoscope 200 and at its proximal end the same is coupled to at least one mechanism selected from a group consisting of the first mechanism, the second mechanism and any combination thereof;

wherein the second joint is located at a predetermined distance from the first joint.

It is another object of the invention to disclose the system as defined above, wherein the pivoting support comprises a gimbal.

It is another object of the invention to disclose the system as defined above, wherein the joint comprises a gimbal.

It is another object of the invention to disclose the system as defined above, additionally comprising at least one zoom mechanism, adapted to maneuver the endoscope along the main longitudinal axis of the same.

It is another object of the invention to disclose the system, wherein the zoom mechanism comprises clasping means adapted to enable reversible reciprocating movement along the main longitudinal axis of the endoscope **200.**

It is another object of the invention to disclose the system as defined above, wherein the zoom mechanism is operable by at least one motor.

It is another object of the invention to disclose the system as defined above, where the third mechanism comprises a plurality of *q* joints, at least one of which is coupled to the pivoting support, and at least one of which is coupled to the second mechanism; where *q* is an integer greater than or equal to one.

It is another object of the invention to disclose the system as defined above, wherein the first coaxial transmission means **101,** the second coaxial transmission means **102,** the third coaxial transmission means **103,** the fourth coaxial transmission means **104,** and the fifth coaxial transmission means **105** are selected from a group consisting of gearwheels, wheels, crown gears, bevel gears, spur gears, belts, and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein the system comprises attaching means adapted to reversibly couple the maneuvering system unit to a hospital bed.

It is another object of the invention to disclose the system as defined above, wherein the attaching means is selected from a group consisting of mechanical means, magnetic means and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein the mechanical attaching means is selected from a group consisting of a clip, a fastening element, non-adhesive tape, adhesive tape, a snap fastener, a button and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein the magnetic attaching means comprises at least one magnet, the magnet selected from a group consisting of a ferromagnet, a paramagnet and any combination thereof; where the magnetic means is attached to any selected from a group consisting of hospital bed, a maneuvering system unit, and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein the rotation of the SFME in the second plane of the SFME defines an angle Θ.

It is another object of the invention to disclose the system as defined above, wherein the angle Θ varies between 0 and about 360 degrees, preferably between 0 and about 160 degrees.

It is another object of the invention to disclose the system as defined above, wherein rotation in the fifth plane of the SFME defines an angle ψ.

It is another object of the invention to disclose the system as defined above, wherein the angle ψ varies between 0 and about 360 degrees, preferably between 0 and 140 degrees.

It is another object of the invention to disclose the system as defined above, wherein the SFME enables control of rotation in angle ψ and angle Θ.

It is another object of the invention to disclose the system as defined above, wherein movement of the joystick unit in any direction selected from a group consisting of ψ, Θand any combination thereof, enables control of movement of the endoscope in same direction as the movement of the joystick unit, the movement being proportional to one selected from a group consisting of the movement of the joystick unit, the speed of movement of the joystick unit, and any combination thereof.

It is another object of the invention to disclose the maneuvering system unit as defined above, additionally comprising a quick release handle adapted to disassemble the endoscope from the maneuvering system unit.

It is another object of the invention to disclose the system as defined above, wherein the first mechanism additionally comprises locking means adapted, upon power failure, to maintain in a predetermined orientation and to prevent any rotational movement of at least one selected from a group consisting of the first coaxial transmission means **101,** the second coaxial transmission means **102** and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein the second mechanism additionally comprises locking means adapted, upon power failure, to maintain in a predetermined orientation and to prevent any rotational movement of at least one selected from a group consisting of the third coaxial transmission means **103,** the fourth coaxial transmission means **104,** the fifth coaxial transmission means **105,** and any combination thereof.

It is another object of the invention to disclose the system as defined above, wherein the endoscope is adapted to acquire real-time images of a surgical environment within the subject's body.

It is another object of the invention to disclose a method for maneuvering an endoscope during a medical procedure, comprising steps of:

1. providing at least one endoscope;
2. providing a system for maneuvering an endoscope (SFME) during a medical procedure, the SFME comprising:
    a. at least one maneuvering system unit, adapted to maneuver the endoscope in at least two degrees of freedom (DOF); and
    b. at least one joystick unit in communication with the maneuvering system, adapted to operate the maneuvering system;
3. coupling the endoscope to maneuvering system unit;
4. maneuvering the joystick unit;

thereby maneuvering the endoscope and controlling the movements of the same.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of adapting the joystick unit to be worn by the system user.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of coupling the joystick unit to at least one surgical tool used in a medical procedure.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of selecting the surgical tool to be an endoscope.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of adapting the SFME such that the movement of the joystick is proportional to the movement of the endoscope.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of selecting the joystick unit to be a force joystick.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of selecting the joystick unit such that the joystick unit comprises a base and lever coupled to the base, such that movement of the lever results in movement of the endoscope; further wherein the movement of the lever is proportional to the movement of the endoscope.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of selecting the joystick unit such that the joystick unit comprises a base and a button jointly connected to the base, such that movement of the button results in movement of the endoscope; further wherein the movement of the button is proportional to the movement of the endoscope.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of selecting the joystick unit such that the joystick unit comprises a touchscreen, such that a touch and a movement on the touchscreen results in movement of the endoscope; further wherein the touch and movement on the touchscreen is proportional to the movement of the endoscope.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of selecting the joystick unit comprising at least one sound sensor, adapted to sense predetermined sound patterns; the joystick unit adapted to operate the maneuvering system based on the predetermined sound patterns.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing means adapted to restrain the velocity of the endoscope such that when the means are activated, the velocity of the endoscope is restrained.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing the joystick unit with *n* sensors, where *n* is an integer larger than one.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of selecting the sensors from a group consisting of a motion sensor, a heat sensor, an electric sensor, a sound sensor, a pressure sensor, an optical sensor and any combination thereof.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of activating at least one of the *n* sensors in case of power failure.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of activating at least one of the *n* sensors when the system is connected to power.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of characterizing the joystick unit by an external surface.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of using at least one motion sensor to detect motion upon the external surface.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of using at least one pressure sensor to detect motion perpendicular to the external surface.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of setting the motion of the endoscope to a predetermined value if the speed of the motion as commanded by the joystick unit is above a predetermined value.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of adapting the at least one heat sensor to sense temperatures in the range of about 35 to about 42 degrees.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of enabling maneuvering the endoscope when at least one heat sensor senses temperatures in the range of about 35 to about 42 degrees.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of adapting at least one heat sensor to provide a thermal image, where the at least one heat sensor is coupled to a processing unit adapted to provide the maneuvering system user with the thermal image.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of enabling maneuvering the endoscope upon analysis of the image by the processing system and detection of a human hand; further comprising a step of preventing maneuvering of the endoscope at such times as the analysis of the image by the processing unit fails to detect an image of a human hand.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of adapting at least one electric sensor to sense power failure.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of adapting at least one electric sensor to sense the electric conductivity of the subject's body.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of maneuvering the endoscope upon sensing the conductivity of the subject's body by at least one electric sensor; further comprising a step of preventing maneuvering of the endoscope at such times as the sensor fails to sense the conductivity of the subject's body.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of adapting at least one sound sensor to sense at least one predetermined sound pattern.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of maneuvering the endoscope according to at least one predetermined sound pattern detected by at least one sound sensor.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of adapting at least one pressure sensor to sense pressure applied to the joystick unit.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of altering the activation state of the SFME in a manner selected from a group consisting of: activating the SFME when the pressure sensed by the at least one pressure sensor is above a predetermined value, de-activating the SFME, when the pressure sensed by the at least one pressure sensor is above a predetermined value, and de-activating the SFME when the pressure sensed by the at least one pressure sensor is below a predetermined threshold.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of adapting at least one optical sensor to sense visual changes according to at least one predetermined visual pattern.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of maneuvering the endoscope according to at least one predetermined visual pattern.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing an interface system adapted to enable communication between a joystick unit and a maneuvering system unit.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing a communication means comprising a member of a group consisting of a wired communication means, a wireless communication means and any combination thereof.

It is another object of the invention to disclose the method as defined above, .additionally comprising a step of providing the SFME comprising at least one second joystick unit adapted to zoom the endoscope by means of the maneuvering system unit.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of wearing the second joystick unit by the maneuvering system user.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of coupling the second joystick unit to at least one surgical tool.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of selecting the at least one surgical tool to be an endoscope.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of adapting the at least one joystick unit to control and to direct the endoscope via the maneuvering system on the surgical instrument to which the activated wearable operator is coupled.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of enabling selection of the at least one instrument is obtained by activating the at least one joystick unit; further wherein the activation of the at least one joystick unit is obtained by depression of the joystick unit, voice activating the same, prolonged depression on the same, double clicking on the same and any combination thereof.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of:

a. providing at least one wearable operator comprising at least one wireless transmitter, adapted to transmit a signal once the at least one wearable operator is activated; the at least one wearable operator is either wire or wirelessly in communication with at least one surgical instrument;
b. providing at least one wireless receiver; adapted to receive the signal sent by the transmitter;
c. providing at least one laparoscopy computerized system, in communication with the wireless receiver, adapted to provide a visual onscreen depiction of the at least one instrument to be selected following the activation of the at least one wearable operator; and,
d. providing at least one video screen; wherein the system is adapted to control and to direct the endoscope via the laparoscopy computerized system and the maneuvering system on the instrument to be selected following the activation of the at least one wearable operator.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of providing communication between the at least one of the wearable operators and the instrument via either wire or wirelessly coupling.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of wearing the wearable operator by the surgeon on a predetermined body part.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of selecting the predetermined body part from a group consisting of: the hand of the surgeon, at least one of the fingers of the surgeon, the thigh of the surgeon, the neck of the surgeon, at least one of the legs of the surgeon, the knee of the surgeon, the head of the surgeon and any combination thereof.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of selecting the shape of the wearable operator from a group consisting of a ring, a bracelet and any combination thereof.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of coupling the wearable operator to a predetermined location on the instrument by means of an adaptor.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of providing the wearable operator adjustable so as to fit the predetermined location of the different instruments, each of which is characterized by a different size and shape.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of providing the wearable operator comprising a body having at least two portions at least partially overlapping each other; the two portions are adapted to grasp and hold either the instrument or the predetermined body part there-between, such that a tight-fit coupling between the two portions and the instrument or the predetermined body part is obtained.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of providing one of the two portions rotationally movable relative to the other, such that when the wearable operator is coupled to the instrument, fine-tuned movement of the two body portions is obtainable so as to provide the tight-fit coupling between the two portions and the instrument or the predetermined body part.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of providing the two portions rotationally movable relative to each other, such that when the wearable operator is coupled to the instrument, fine-tuned movement of the two

body portions is obtainable so as to provide the tight-fit coupling between the two portions and the instrument or the predetermined body part.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of providing the wearable operator comprising (a) at least one flexible and stretchable strip; and (b) loop-closing means adapted to close a loop with the at least one flexible and stretchable strip; the at least one flexible and stretchable strip and the loop-closing means are provided so as to fit the wearable operator to at least one selected from a group consisting of (a) the predetermined location of the different instruments; (b) the predetermined body part of the surgeon, each of which is characterized by a different size and shape.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of making the flexible and stretchable strip of material selected from a group consisting of silicone, rubber and any combination thereof.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of adapting the wireless transmitter to locate the position of at least one of the instruments.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of selecting the at least one instrument by activating the at least one wearable operator; further wherein the activation of the at least one wearable operator is obtained by depression on a predetermined location in the wearable operator, voice activating the same, prolonged depression on the same, double clicking on the same and any combination thereof.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of the directing the endoscope by the laparoscopy computerized system by using image information shown on the video screen without the help of assistants.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of providing the conventional laparoscopy computerized system comprising at least one surgical instrument spatial location software, adapted to locate the 3D spatial position of the at least one instrument; further wherein the conventional laparoscopy computerized system comprises at least one automated assistant maneuvering system; the automated assistant maneuvering system is coupled to the endoscope and is adapted to direct the endoscope to the at

least one instrument, the instrument selected following the activation of the at least one wearable operator.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of matching each transmitted signal from the wearable operator and the wireless transmitter to at least one of the instruments.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing a single device comprising the joystick unit and the second joystick unit.

It is another object of the invention to disclose the method as defined above, additionally comprising steps of:

1. providing a maneuvering system comprising:
    a. a first mechanism, comprising:
        i. at least one first coaxial transmission means **101;** the first coaxial transmission means **101** defines a first plane; the first coaxial transmission means **101** is characterized by a first axis of rotation; the first axis of rotation is substantially orthogonal to the first plane;
        ii. at least one second coaxial transmission means **102;** the second coaxial transmission means **102** defines a second plane and a second axis of rotation; the second axis of rotation is substantially orthogonal to the second plane; the second coaxial transmission means **102** is rotatably connected to the first coaxial transmission means **101;** where the first plane is substantially orthogonal to second plane; and
        iii. at least one first means **106** adapted to rotate the first coaxial transmission means **101** around the first axis of rotation;
    b. a second mechanism, comprising:
        i. at least one third coaxial transmission means **103;** the third coaxial transmission means **103** defines a third plane; the third coaxial transmission

means **103** is characterized by a third axis of rotation; the third axis of rotation is substantially orthogonal to the third plane;

ii. at least one fourth coaxial transmission means **104;** the fourth coaxial transmission means **104** defines a fourth plane and a fourth axis of rotation; the fourth axis of rotation is substantially orthogonal to the fourth plane; the fourth coaxial transmission means **104** is rotatably connected to the third coaxial transmission means; where the fourth plane is substantially orthogonal to the third plane;

iii. at least one fifth coaxial transmission means **105;** the fifth coaxial transmission means **105** defines a fifth plane and a fifth axis of rotation; the fifth axis of rotation is substantially orthogonal to the fifth plane; the fifth coaxial transmission means **105** is rotatably connected to the fourth coaxial transmission means **104;** where the fifth plane is substantially orthogonal to the fourth plane;

iv. at least one second means **107** adapted to rotate the third coaxial transmission means **103** around third axis of rotation;

2. positioning the first coaxial transmission means **101** orthogonally to the second coaxial transmission means **102;** the positioning enables transmission of rotation between the first coaxial transmission means **101** and the second coaxial transmission means **102;**
3. positioning the third coaxial transmission means **103** orthogonally to the fourth coaxial transmission means **104;** the positioning enables transmission of rotation between the third coaxial transmission means **103** and the fourth coaxial transmission means **104;**
4. positioning the fourth coaxial transmission means **104** orthogonally to the fifth coaxial transmission means **105;** the positioning enables transmission of rotation between the fourth coaxial transmission means **104** and the fifth coaxial transmission means **105;**
5. coupling the second coaxial transmission means **102** to the endoscope **200** and the fifth coaxial transmission means **105** to the endoscope **200;** the coupling enables

rotation of endoscope **200** proportional to rotation of the second coaxial transmission means **102** and the fifth coaxial transmission means **105;** and

6. maneuvering the endoscope **200** in at least two degrees of freedom (DOF); maneuvering of the endoscope **200** in at least two degrees of freedom are in the second axis of rotation and in the fifth axis of rotation;

wherein maneuvering in a first DOF of the at least two DOF is performed by rotating the first coaxial transmission means **101** thereby transmitting rotation to the endoscope **200;** wherein maneuvering in a second DOF of at least two DOF is performed by rotating the third coaxial transmission means **103** thereby transmitting rotation to the endoscope **200,** such that the angle between the second axis of rotation and the fifth axis of rotation is an angle A.

It is another object of the invention to disclose the method as described above, additionally comprising a step of defining angle A to be in the range of about 0 degrees to about 180 degrees.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing at least one third mechanism in communication with the first mechanism and the second mechanism, the third mechanism comprising (i) at least one pivoting support adapted to be pivotally attached to the endoscope; the pivoting support adapted to enable the endoscope **200** to pivot around the pivoting support; and (ii) at least one joint **114** mechanically connected to the pivoting support **111,** thereby enabling the endoscope **200** to rotate freely in two orthogonal axes around an insertion point; the endoscope pivotally attached to the joint and the pivoting support can pivot at the insertion point independent of the distance between the pivoting support, the joint, and the insertion point; the third mechanism coupled at its distal end to the endoscope **200** and at its proximal end the same is coupled to at least one mechanism selected from a group consisting of the first mechanism, the second mechanism and any combination thereof; and the second joint is located at a predetermined distance from the first joint.

It is another object of the invention to disclose the method as defined above additionally comprising a step of providing the pivoting support comprising a gimbal.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing the joint 114 comprising a gimbal.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing at least one zoom mechanism adapted to maneuver the endoscope along the main longitudinal axis of the same.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing the zoom mechanism **200** comprising clasping means adapted to enable reversible reciprocating movement along the main longitudinal axis of the same.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of operating the zoom mechanism by at least one motor.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing the third mechanism with a plurality of $q$ joints, at least one of which is coupled to the pivoting support, and at least one of which is coupled to the second mechanism; where $q$ is an integer greater than or equal to one.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of selecting the first coaxial transmission means **101,** the second coaxial transmission means **102,** the third coaxial transmission means **103,** the fourth coaxial transmission means **104,** and the fifth coaxial transmission means **105** from a group consisting of gearwheels, wheels, crown gears, bevel gears, spur gears, belts, and any combinations thereof.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing the system with attaching means adapted to reversibly couple the maneuvering system unit to a hospital bed.

It is another object of the invention to disclose the system as defined above, additionally comprising a step of selecting the attaching means from a group consisting of mechanical means, magnetic means and any combination thereof.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of selecting the mechanical attaching means from a group consisting of clip, a fastening element, non-adhesive tape, adhesive tape, a snap fastener, a button and any combination thereof.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing magnetic attaching means with at least one magnet, the at least one magnet selected from a group consisting of a ferromagnet, a paramagnet, and any combination thereof; where the magnetic means is attached to one selected from a group consisting of a hospital bed, a maneuvering system unit, and any combination thereof.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of defining an angle Θfor the rotation in the second plane of the.maneuvering system unit.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of defining angle Θof the SFME to vary between 0 and about 360 degrees, preferably between 0 and about 160 degrees.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of defining an angle ψ for the rotation in the second plane of the. maneuvering system unit.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of defining angle ψ of the SFME to vary between 0 and about 360 degrees, preferably between 0 and about 140 degrees.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing the SFME to control rotation of the maneuvering system unit in angle ψ and angle Θ.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of enabling control of movement of the joystick unit in any direction selected from a group consisting of ψ, Θ, and any combination thereof, such that movement of the endoscope is in same direction as the movement of the joystick unit and the movement is proportional to one selected from a group consisting of the movement of the joystick unit, the speed of movement of the joystick unit and any combination thereof.

It is another object of the invention to disclose the method, additionally comprising a step of providing the system with a quick release handle adapted to disassemble the endoscope from the maneuvering system unit.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing the first mechanism with locking means adapted to maintain in a predetermined orientation upon power failure; and to prevent any rotational movement of at least one selected from a group consisting of the first coaxial transmission means **101,** the second coaxial transmission means **102** and any combination thereof.

It is another object of the invention to disclose the method as defined above, additionally comprising a step of providing the second mechanism with locking means adapted to maintain in a predetermined orientation upon power failure; and to prevent any rotational movement of at least one selected from a group consisting of the first coaxial transmission means **101,** the second coaxial transmission means **102** and any combination thereof.

## BRIEF DESCRIPTION OF THE FIGURES

In order to understand the invention and to see how it may be implemented in practice, a few preferred embodiments will now be described, by way of non-limiting example only, with reference to be accompanying drawings, in which

**Fig. l a** and **l b** present a system for controlling an endoscope in different configurations;

**Fig. 2a-d** present wearable operators and a free-standing operator;

**Figs. 2e-h** present the fastener for a wearable operator;

**Fig. 3** presents a maneuvering system unit for maneuvering an endoscope;

**Fig. 4a** and **4b** show two configurations of a maneuvering system unit for maneuvering an endoscope additionally attached to a rotating means and the endoscope;

**Figs 5a-c, 6a-b** and **7a-b** demonstrate more configurations of a maneuvering system unit for maneuvering an endoscope.

**Fig. 8** presents an endoscope attached to a pivoting support;

**Figs. 9a** and **9b** depict a zoom mechanism in two configurations;

**Fig. 10** presents a configuration of a maneuvering system unit with a hospital bed and an endoscope;

**Fig. 11-14** shows different configurations for the motors of a maneuvering system unit for maneuvering an endoscope;

**Fig. 15** shows an examining room configuration adapted to use a maneuvering system unit for maneuvering an endoscope;

**Fig. 16** depicts another configuration of a maneuvering system unit in an operating room with an emphasis on movement range;

Fig. **17** presents a means adapted to rotate the endoscope around itself;

Fig. **18** presents another embodiment of the maneuvering system unit in which clips for enabling fast engagement and disengagement between the endoscope and the system are provided; and

Fig. **19** illustrates an articulating endoscope.

## DETAILED DESCRIPTION OF THE INVENTION

Before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is applicable to other embodiments or of being practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for the purpose of description and should not be regarded as limiting.

The present invention discloses a system for maneuvering an endoscope **(SFME)** for maneuvering an endoscope, comprising (a) at least one maneuvering system unit, adapted to maneuver an endoscope in at least two degrees of freedom **(DOF);** and (b) at least one joystick unit in communication with the maneuvering system unit, adapted to operate the maneuvering system unit; wherein at least one of the movement of the joystick unit and movement on the joystick unit results in movement of the endoscope by means of the maneuvering system unit.

The present invention additionally provides a method for maneuvering an endoscope comprising steps of:

a. providing at least one endoscope;

b. providing a system for maneuvering an endoscope **(SFME),** the **SFME** comprising:

i. at least one maneuvering system; and

ii. at least one joystick unit in communication with the maneuvering system, adapted to operate the maneuvering system;

c. , coupling the endoscope to the SFME; and

d. maneuvering the joystick unit,

thereby maneuvering the endoscope and controlling the movements of the same.

The term '**non-human animal**' refers hereinafter to any living animal, including, but not limited to, mammals, birds, reptiles, amphibians and fish.

The term '**region of interest**' refers hereinafter to any region within the body of a subject which may be of interest for the operator of the system of the present invention. The region of interest may be, for example, an organ to be operated on, a restricted area which a surgical instrument should avoid approaching, or any other region within the human body or body of another living animal.

The term '**surgical environment**' refers hereinafter to any anatomical part within the body of a subject which may be in the surroundings of a surgical instrument. The environment may comprise: organs, body parts, walls of organs, arteries, veins, nerves, a region of interest, or any other anatomical part of the human body.

The terms '**surgical instrument**' and '**surgical tool**' refer hereinafter to any device used by medical personnel, including, but not limited to, a scalpel, a retractor, a clamp, a swab, a needle, an endoscope, and any other medical tool or instrument.

The term '**endoscope**' refers hereinafter to any means adapted for looking inside the body for medical reasons. This may be any instrument used to examine the interior of a hollow organ or cavity of the body. The endoscope may also refer to any kind of a laparoscope.

The term '**spatial position**' refers hereinafter to a predetermined spatial location and/or orientation of an object (e.g., the spatial location of the endoscope, the angular orientation of the endoscope, and any combination thereof).

The term **'degrees of freedom' (DOF)** refers hereinafter to a set of independent displacements that specify completely the displaced position of the endoscope or laparoscope as defined above.

The term **'insertion point'** refers hereinafter to the point where the endoscope enters the human body.

The term **'joystick unit'** refers hereinafter to a motion and position sensitive device enabled to control the motion of another device, with the motion and position information including, but not limited to, the direction of motion (in 1, 2 or 3 dimensions) and the speed of the motion and the changes in direction and speed as a function of time. Joystick units may, for example, in a non-limiting manner, be shaped like a rod or lever; which is bent, twisted, depressed or slid, the direction of the bend, twist, depression or sliding relatable to the direction of motion and the magnitude thereof relatable to the speed of the motion. Joystick units can comprise a button which is depressed, slid or rocked, wherein the direction of the depression, sliding or rocking is related to the direction of motion and the magnitude thereof is related to the speed of the motion. They can comprise a surface along which a finger or fingers or a hand or an implement slides, wherein the direction of the motion on the surface is related to the direction of motion and the speed of the motion along the surface is related to the speed of motion of the controlled device.

The term **"about"** refers hereinafter to a range of +-25% of the discussed quantity.

All temperatures referred to herein are temperatures in degrees Celsius.

The following abbreviations are used throughout the disclosure:

**DOF** refers to degree(s) of freedom;

**SFME** refers to System For Maneuvering an Endoscope, a system for enabling an operator to maneuver the endoscope as disclosed hereinbelow;

**FCTM** refers to first coaxial transmission means;

**SCTM** refers to second coaxial transmission means;

**TCTM** refers to third coaxial transmission means;

**FOCTM** refers to fourth coaxial transmission means; and,

**FTCTM** refers to fifth coaxial transmission means.

Reference is now made to Figs. **l a** and **lb,** which present in a non-limiting manner the system for maneuvering an endoscope (SFME) **130** according to the present invention.

The system for maneuvering an endoscope **130** comprises at least one joystick unit **152** and at least one communication means. At least one of the at least one communication means is adapted to connect at least one joystick unit **152** to any standard maneuvering system **100** for maneuvering an endoscope **200.** Different joystick units can control different aspects of the endoscope's motion, for non-limiting example, a joystick unit to control lateral movement of the endoscope, a joystick unit to control zooming and a joystick unit to control articulation of the endoscope tip.

The communication means can comprise a wireless communication means, a wired communication means and any combination thereof.

The connection between the joystick unit **152** and the maneuvering system **100** (or other control system) enables control of the maneuvering system **100** by the joystick unit **152,** thereby enabling an operator to control the movement of the endoscope **200** by controlling the joystick unit **152.**

Furthermore, the communication means is adapted to disconnect the joystick unit **152** from the maneuvering system **100,** thereby preventing the endoscope **200** from being moved by the joystick unit **152.** Disconnection of the joystick unit **152** prevents the situation of unwanted movement of the endoscope **200** due to inadvertent joystick unit **152** motion. Thus, in such a situation, movement of the joystick unit **152** will not result in movement of the endoscope **120.**

Fig. **l b** illustrates a closer view of the joystick unit **152.** Upon pressing the joystick unit **152** in the direction of arrow **1521,** the endoscope moves forward or backward. Upon pressing the joystick unit **152** in the direction of arrow **1522,** the endoscope moves left or right.

In the best embodiments, movement of the endoscope is proportional to movement of the joystick unit, unless the speed of the endoscope tip in a given direction would be above a predetermined value. In these embodiments, movement of the endoscope at speeds greater than the predetermined value is prevented. In preferred embodiments, if a speed above the predetermined value is commanded, the endoscope will continue moving, but with a speed at or

just below the predetermined value. In some embodiments, if a speed above the predetermined value is commanded, movement of the endoscope is prevented.

According to another embodiment of the present invention, the **SFME 130** may be wearable, either by a user or by an instrument. Reference is now made to Figs. **2a-2d** which depict, in a non-limiting manner, a wearable operator. **Figs. 2a** and **2b** depict the at least one joystick unit **152** mounted in a operator **150,** here a ring wearable by a user, while **Fig. 2c** depicts the at least one joystick unit **152** mounted on a operator **150** attached to an exemplary surgical instrument and **Fig. 2d** depicts a operator **150** to be held in the hand. The operator **150** can be attached to any surgical instrument, can be attached to or mounted on the endoscope, or, as shown in **Fig. 2d,** can be a free-standing unit which can sit on, for example, the operating table, a side table or stand, or on a hospital bed.

Referring again to **Figs. 2a-d, Figs. 2a** and **2c** depict embodiments of operator **150** with a single joystick unit **152,** while **Fig. 2b** and **2d** depict embodiments of the operator with two joystick units **152.** In preferred embodiments of devices such as **Figs. 2a** and **2c** with a single joystick unit, the joystick unit **152** controls maneuvering of the endoscope. In less-preferred embodiments, the joystick unit controls zoom of the endoscope. In embodiments of the operator **150** such as **Fig. 2b** and **2d** with two joystick units, one joystick unit **152** controls maneuvering of the endoscope, while the other joystick unit **152** controls zoom of the endoscope.

Referring again to **Figs. 2a-2b,** according to some embodiments, the wearable operator **150** is adjustable by means of flexible and stretchable silicone and/or rubber strip **154** and a loop-closing means **156.** The loop-closing means **156** is adapted to close a loop with the flexible and stretchable strip. Together, the flexible and stretchable strip and the loop-closing means are provided so as to fit the wearable operator to at least one selected from a group consisting of (a) said predetermined location of said different instruments; (b) said predetermined body part of said surgeon, each of which is characterized by a different size and shape.

As will be disclosed hereinafter, the loop-closing means **156** can be e.g., a unidirectional catch, a rack, a peg or any other mechanism known in the art.

According to another embodiment, the silicone and/or rubber strip **154** is passed through a unidirectional catch (e.g., ratchet **156),** such that, when the physician wears the wearable

operator **150,** he adjusts the same by pulling the silicone and/or rubber strip **154** through the ratchet **156.**

According to another embodiment, the silicone and/or rubber strip **154** is rotated around rack or peg **156** such that, when the physician wears the wearable operator **150,** he adjusts the same by pulling the silicone and/or rubber strip **154** around the peg **156.**

According to this embodiment, the silicone and/or rubber strip **154** is characterized by a varied width along its length. More specifically, at least a portion of the silicone and/or rubber strip **154** is characterized by a greater width, such that when the same is twisted/rotated around peg **156** and reaches the wider portion, the same is fixedly secured to the wearable operator **150.**

According to another embodiment, the silicone and/or rubber strip **154** is characterized by different surface roughnesses along its length. More specifically, at least a portion of the silicone and/or rubber strip **154** is characterized by e.g., an abrasive or rough surface such that when the same is twisted/rotated around peg **156** and reaches the rougher portion, the same is fixedly secured to the wearable operator **150.**

Referring again to **Fig. 2c** illustrating an embodiment of the wearable operator **150** attached to a surgical tool via fastener **155.** Some embodiments of fastener **155** are shown in **Figs. 2e-2i.**

According to the embodiment shown in **Fig. 2e,** the wearable operator **150** comprises a unidirectional coupling (e.g., ratchet **1510).**

Once the wearable operator **150** is secured to the surgical tool, the wearable operator **150** is adjusted to the size and dimensions of the surgical tool by means of a unidirectional catch (e.g., ratchet **1510).**

According to another embodiment, the wearable operator **150** comprises a body having at least two portions **1520** and **1521** (see **Fig. 2f).** Said portions are adapted to 'grasp' the surgical tool such that when the wearable operator **150** is coupled to the surgical tool, fine-tuned movement of the two body portions is obtainable so as to provide said tight-fit coupling between said two portions and said instrument.

According to another embodiment (Fig. **2g),** one of the two portions (either **1520** or **1521)** is rotationally movable relative to the other, such that when said wearable operator is coupled to

said instrument, fine-tuned movement of said two body portions is obtainable so as to provide said tight-fit coupling between said two portions and said instrument.

According to another embodiment **(Fig. 2h),** the two portions **(1521** and **1520)** are rotationally movable relative to each other, such that when the wearable operator is coupled to said instrument, fine-tuned movement of said two body portions is obtainable so as to provide said tight-fit coupling between said two portions and said instrument.

In reference to **Fig. 2h,** the movement of either portion **1520** or portion **1521** relative to the other is obtained by fixating the position of either portion **1520** or portion **1521** and coupling the other portion to e.g., a unidirectional catch (e.g., ratchet) **1510** or a two-way directional catch **1510** on the body of the wearable operator.

According to another embodiment, the movement of either portion **1520** or portion **1521** relative to the other is obtained by providing one portion, e.g., portion **1521** with cog-like teeth **1511** and the body of the wearable operator with cog-like teeth **1512** matching with cog-like teeth **1511** (see **Fig. 2i).** In such a way portion **1521** can be linearly moved relative to portion **1520.**

Referring again to **Fig. 2d,** this embodiment of operator **150** depicts joystick unit **152a,** which controls maneuvering of the endoscope, comprising a force joystick, while joystick unit **152b,** which controls zooming, comprises a pressable button. Button **156** is an emergency off button; pressing button **156** quickly stops all motion. Light **158** is a fault light, illuminating when a fault is detected in the system.

In some embodiments, a single control is used for both lateral maneuvering of the endoscope and zooming of the endoscope. In some variants of these embodiments, lateral movement of the joystick unit or lateral movement of a hand on the joystick unit is translated into lateral maneuvering of the endoscope, for non-limiting example, as described above for Fig. lb, while pressure on the joystick unit, either continuous pressure or clicking the joystick unit, is translated into zooming of the endoscope, as described hereinbelow.

In other embodiments, two joystick units are used, one for lateral maneuvering of the endoscope, and one for zooming.

In yet other embodiments, two joystick units are used, one for maneuvering, both lateral maneuvering and zoom, and the other for directing the endoscope to focus on a desired tool. In these embodiments, on the display screen showing the field of view of the endoscope, a symbol indicates the tool on which the endoscope is focused. This symbol can be a shape or it can be highlighting. When a user clicks on the second joystick unit, the new tool to be focused on is indicated, either by moving the symbol or highlighting to the new tool, or by a second symbol or a second color of highlighting. The user can repeat clicking until the desired tool is indicated. In some embodiments, ceasing to click on the second joystick unit indicates that the current tool is the desired tool; in other embodiments, a longer pressure on the second joystick unit indicates that the current tool is the desired tool. Once the desired too has been selected, the endoscope redirects to the desired tool.

Operation of the zoom mechanism can be by clicking on a joystick unit or by a continuous pressure on a joystick unit. Some non-limiting examples of embodiments of methods of zoom control include:

1. A single click to select zoom in, a double click to select zoom out, and continuous pressure to zoom at a predetermined rate in the selected direction.
2. A double click to select zoom in, a single click to select zoom out, and continuous pressure to zoom in the selected direction.
3. A single click to change the direction of zoom and continuous pressure to zoom at a predetermined rate in the selected direction.
4. A single click to change the direction of the zoom, a double click to zoom by a predetermined amount in the selected direction.
5. A double click to change the direction of the zoom, a single click to zoom by a predetermined amount in the selected direction.
6. A single click to change the direction of zoom and a double click to zoom by a predetermined amount in the selected direction.

7. A single click to change the direction of zoom, a double click to zoom by a predetermined amount in the selected direction, and continuous pressure to zoom at a predetermined rate in the selected direction.

In embodiments in which continuous pressure is used to zoom in the selected direction, in some variants of these embodiments, continuous pressure above a predetermined minimum pressure (a minimum which can be zero) zooms the endoscope at a predetermined zoom rate. In other variants of embodiments in which continuous pressure is used to zoom in the selected direction, if the pressure is above a predetermined minimum pressure, which can be zero, the greater the pressure, the greater the zoom rate, until a predetermined maximum rate is reached, above which the zoom rate is the predetermined maximum rate.

In embodiments wearable by the user, the operator 150 can be worn as a ring on a finger; as a wristband on the wrist; an armband on an arm; on the chest, either supported around the chest or supported around the neck; or on the head, supported by a headband, by a helmet or by a helmet frame.

The communication means connecting the maneuvering system to the operator 150 can be a wireless communication means, a wired communication means, and any combination thereof.

In other embodiments of the current invention, SFME 130 additionally comprises, in a non-limiting manner, means for controlling movement of endoscope 200 adapted to restrain the endoscope's velocity.

In other embodiments of the current invention, SFME 130 additionally comprises, in a non-limiting manner, *n* sensors, where *n* is an integer greater than or equal to one. The sensors may be adapted to activate in case of power failure or to activate when connected to power. The sensors are selected in a non-limiting manner from a group consisting, for example, of motion sensors, heat sensors, electric sensors, sound sensors, pressure sensors, optical sensors, and any combination thereof.

In other embodiments of the current invention, joystick unit 152 is characterized in a non-limiting manner by an external surface.

In other embodiments of the current invention, at least one motion sensor detects motion of joystick unit **152.** Furthermore, detection of motion is used for deactivation of the motion of endoscope **200** if the requested speed of the motion is above a predetermined threshold.

In other embodiments of the current invention, at least one motion sensor detects, in a non-limiting manner, motion on the external surface of joystick unit **152.** Furthermore, endoscope **200** then moves in response to the motion on the external surface of joystick unit **152.** Additionally, detection of motion above a predetermined threshold speed on joystick unit **152** will deactivate motion of endoscope **200.**

In other embodiments of the current invention, at least one heat sensor is adapted in a non-limiting manner to sense temperatures in the range of about 35 to about 42 degrees. The at least one heat sensor is adapted to sense whether a human hand/fingers are activating (i.e., touching) the joystick unit **152.**

Furthermore, at least one heat sensor enables in a non-limiting manner the activation of SFME **130** when the at least one heat sensor senses temperatures in the range of about 35 to about 42 degrees.

Additionally, at least one heat sensor is adapted in a non-limiting manner to provide a thermal image, where the at least one heat sensor is coupled to a processing unit adapted to provide the endoscope user with the thermal image, and a processing unit enables the activation of SFME **130** upon analysis of the image and detection of human hand.

In other embodiments of the current invention, at least one electric sensor is adapted in a non-limiting manner to detect, for example, a power failure, the electric conductivity of the subject's body, and any combination thereof. Additionally, the conductivity of the subject's body sensed by the at least one electric sensor enables the activation of the SFME.

In other embodiments of the current invention, at least one sound sensor is adapted in a non-limiting manner to sense predetermined sound patterns. Furthermore, the predetermined sound patterns sensed by the at least one sound sensor enables the activation of SFME **130.** Additionally, at least one sound sensor is used to operate endoscope **200** according to predetermined sound patterns (e.g., the human voice, predetermined movement commands).

In other embodiments of the current invention, at least one pressure sensor is adapted in a non-limiting manner to sense pressure applied to SFME 130.

Additionally, in some embodiments, the pressure sensed by the at least one pressure sensor is used to activate SFME 130. In some embodiments, when the pressure sensed by the at least one pressure sensor is above a predetermined threshold, SFME 130 is activated. In other embodiments, when the pressure sensed by the at least one pressure sensor is below a predetermined threshold, SFME 130 is de-activated. In other embodiments, when the pressure sensed by the at least one pressure sensor is below a predetermined threshold, SFME 130 is activated.

An example of pressure above a pre-determined threshold activating SFME 130 is a pressure sensor in the joystick unit, which is activated when the pressure of a hand or fingers or an appropriated implement is sensed. SFME 130 would be deactivated if the above pressure was below a pre-determined threshold.

An example of pressure above a pre-determined threshold de-activating SFME 130 is a joystick unit where pressure is used to set the speed of motion of a scalpel. If the pressure is above the pre-determined threshold, the scalpel would move too rapidly, so SFME 130 is de-activated if pressures above the pre-determined threshold are sensed. SFME 130 would then be activated if pressures are below a pre-determined threshold.

In other embodiments of the current invention, at least one optical sensor is adapted in a non-limiting manner to sense visual changes according to predetermined visual patterns. Furthermore, the at least one optical sensor enables the activation of SFME 130 according to predetermined visual patterns. Additionally, at least one optical sensor is used to operate endoscope 200 according to predetermined visual patterns.

In some embodiments, SFME 130 is adapted to sense power failure by any means known in the art, including the sensors described herein. In some embodiments, SFME 130 responds to power failure by instructing the maneuvering system to keep the endoscope and any other controlled instruments in the position and at the angle held by them immediately before the power failure. In some embodiments, the system further comprises means by which the endoscope can be manually switched to manual control in the event of power failure, so that the

operation can continue safely with an operating assistant maneuvering the endoscope during the period of power failure.

In some embodiments, the system comprises battery backup such that, in the event of power failure, the system switches automatically to battery power, enabling the SFME to continue to control movement of the endoscope during power outages.

Reference is now made to Fig. 3, which shows, in a non-limiting manner, a maneuvering system 100 for maneuvering an endoscope 200 (endoscope not shown; at top). The system comprises a first mechanism 1100 for maneuvering an endoscope in one DOF. The first mechanism 1100 comprises (i) at least one first coaxial transmission means (FCTM) 101, FCTM is characterized by a first axis of rotation and a first plane substantially orthogonal to the first axis of rotation; (ii) at least one second coaxial transmission means (SCTM) 102, SCTM is characterized by a second axis of rotation 141 and a second plane substantially orthogonal to the second axis of rotation 141, additionally, the SCTM is rotatably connected to the FCTM; and (iii) at least one first means 106 adapted to rotate FCTM 101 around a first axis of rotation. The FCTM 101 transmits the rotation to the SCTM 102. Additionally, the system also comprises a second mechanism 1200 for maneuvering an endoscope 200 in a second DOF. The second mechanism 1200 comprises (i) at least one third coaxial transmission means (TCTM) 103, TCTM 103 is characterized by a third axis of rotation and a third plane substantially orthogonal to the third axis of rotation; (ii) at least one fourth coaxial transmission means (FOCTM) 104, the FOCTM is characterized by a fourth plane, a fourth axis of rotation substantially orthogonal to fourth plane and rotatably connected to the TCTM 103, where the connection is such that the fourth plane is substantially orthogonal to the third plane; (iii) at least one fifth coaxial transmission means (FTCTM) 105. The FTCTM 105 defines a fifth plane, a fifth axis of rotation 142 substantially orthogonal to fifth plane and rotatably connected to FOCTM 104. The connection is such that the fifth plane is substantially orthogonal to the fourth plane; and (iv) at least one second means 107 adapted to rotate TCTM 103 around the third axis of rotation. The TCTM 103 transmits rotation to FOCTM 104, the FOCTM 104 then transmits rotation to the FTCTM 105. The system than maneuvers the endoscope 200 by adapting the first mechanism to rotate the endoscope 200 in one DOF substantially orthogonal to the second plane *(i.e.* second axis of rotation 141), and adapting the second mechanism to rotate the endoscope 200 in a second DOF

substantially orthogonal to the fifth plane *(i.e.* fifth axis of rotation **142).** The two **DOF** define two axes of rotation with angle A between them. The angle A is in the range of 0° to 180°.

Reference is now made to **Figs. 4a** and **4b,** which present, in a non-limiting manner, a rotating means in communication with first mechanism **1100** and second mechanism **1200. Fig. 4a** illustrates the rotating means from the side, while **Fig. 4b** illustrates it from above. The rotating means comprises at least one third mechanism **112** for rotating the endoscope **200** independently around two orthogonal axes, the third mechanism **112** comprising at least one pivoting support **111** adapted to be pivotally attached to endoscope **200,** pivoting support **111** adapted to enable endoscope **200** to pivot around pivoting support **111;** and at least one joint **114** mechanically connected to pivoting support **111** and coupled to a mechanism selected from a group consisting of the first mechanism, the second mechanism and any combination thereof, thereby enabling endoscope **200** to rotate around at least two orthogonal axes and to rotate in the at least two orthogonal axes about the insertion point in the body of a subject.

Joint **114** is coupled to pivoting support **111** by means of a rod, an arm, or *n* joints (n being an integer greater than or equal to 0).

Joint **114** is located at a predetermined distance **180** from pivoting support **111.**

Each of the joints is adapted to provide rotation to pivoting support **111** in at least one of the orthogonal axes, thereby providing flexibility of rotation to endoscope **200.**

In the best embodiment, gimbals, pivoting supports or other joint mechanisms at joint **114** and pivoting support **111** enable endoscope **200** to remain fixed at the insertion point and to pivot about its insertion point in the body of the patient without applying force on the patient at the insertion point, especially if the line of application of force to move the endoscope is not completely collinear with the axis of the endoscope.

It should be emphasized that the addition of joint mechanism **114** ensures that no force is applied on the penetration point when the system's center of movement is misaligned with the penetration point.

It should be emphasized that according to a preferred embodiment of the present invention, joint mechanisms **114** and pivoting support **111** are gimbals.

In one embodiment, each of joint mechanisms **114** and pivoting support **111** has one DOF, preferably rotations about axes substantially perpendicular to each other. A non-limiting example

of such a pair of rotations is shown in **Figs. 4a** and **4b,** where joint mechanism **114** rotates about an axis parallel to second axis of rotation **141** and pivoting support **111** rotates about an axis of rotation perpendicular to this and parallel to the base of zoom mechanism **115.** However, this embodiment is less preferred because of the possibility of pressure on the penetration point in a direction perpendicular to the third axis of rotation.

In preferred embodiments, one of pivoting support **111** and joint mechanism **114** is enabled to rotate about two substantially perpendicular axes of rotation, while the other joint mechanism rotates about a third axis of rotation, substantially perpendicular to both of the other axes of rotation. In some variants, pivoting support **111** can rotate about two substantially perpendicular axes of rotation, while joint mechanism **114** rotates about the third axis of rotation, substantially perpendicular to the other two, thereby enabling rotation of the endoscope about all three axes of rotation and preventing pressure on the penetration point. In other variants, joint mechanism **114** can rotate about two perpendicular axes of rotation, while pivoting support **111** rotates about the third axis of rotation, substantially perpendicular to the other two, thereby enabling rotation of the endoscope about all three axes of rotation and preventing pressure on the penetration point.

It should be further emphasized that while moving (rotating) the first mechanism (which comprises the first transmission means **101** and the second transmission means **102),** the second mechanism (which comprises the third transmission means **103,** the fourth transmission means **104** and the fifth transmission means **105)** is moved (rotated) in the opposite direction and vice versa. Such reverse movement is highly important to compensate any unwanted /parasitic movement that would be created when moving only one mechanism.

Zoom mechanism **115** is connected to endoscope **200** and mechanically connected to pivoting support **111.**

Reference is now made again to **Fig. 4a** which demonstrates in a non-limiting manner another object of the present invention.

In this figure is presented a mechanism forming a parallelogram for transferring rotational movement to the endoscope. As can be seen in the figure, the parallelogram comprises rod **172,** adapted to transmit rotation around the second axis of rotation **141** to the endoscope, two rods **171** adapted to transmit rotation around the fifth axis of rotation **142,** and rod **173** adapted to

transmit motion of rods **171** and **172** to endoscope **200,** wherein the two rods **171** are connected to rod **172** at one end and rod **173** at the other. Rods **171, 172** and **173** form a parallelogram.

Reference is now made to **Figs. 5a** and **5b,** which illustrate in a non-limiting manner an embodiment of the parallelogram described above. **Fig. 5a** illustrates an embodiment in which ribs **171** have straight sides, while **Fig. 5b** illustrates an embodiment in which the ribs **171** comprise a dent (i.e., groove) **175.**

Fig. **5a** demonstrates the failure of rods **171** with straight sides to achieve a maximum 180 degree angle with respect to rod **172.** This failure is the result of the collision between ribs **171.**

In Fig. **5b** a solution is suggested in a form of a dent **175** in rods **171** which enables a larger angular movement of ribs **171.** By providing the dent (i.e., groove) **175,** a greater angular extension is achievable.

Reference is now made to Fig. **6a, 6b** and **6c,** which illustrate in a non-limiting manner a parallelogram adapted to communicate between the different coaxial transmission means and the endoscope. In the figures, the above mentioned parallelogram is characterized by having at least one non-straight rib. As can be seen, at least one rib **(171)** is shaped like a circular arc.

According to the best embodiment of the present invention, the parallelogram with at least one arced side, an embodiment of which is illustrated in **Fig. 6a, 6b** and **6c,** provides the endoscope with a wider range of angular movements and maneuverability than a parallelogram with only straight sides. A comparison of the embodiment with straight sides shown in **Figs. 5a** and **5b** with the embodiment with an arced side shown in **Figs. 6a, 6b** and **6c** shows how this improved flexibility and maneuverability is achieved: the arc enables the rods **171** to move past each other and prevents them from colliding.

In addition, Fig. **6a** describes two additional (and 'intermediate') coaxial means **191, 192** constructed upon second coaxial transmission means **102** and fifth coaxial transmission means **105,** adapted to rotate the endoscope about two orthogonal axes.

It is within the best embodiment of the present invention to provide the first and second mechanisms having at least one first coaxial transmission means **101** (but it could be several interconnected transmissions); at least one second coaxial transmission means **102** (but it could

be several communicating transmissions); at least one third coaxial transmission means **103** (but it could be several communicating transmissions); at least one second fourth transmission means **104** (but it could be several communicating transmissions); at least one fifth coaxial transmission means **105** (but it could be several communicating transmissions) and any combination thereof.

Reference is now made to Figs. **7a** and **7b,** which illustrates in a non-limiting manner two different pre-determined distances **180.**

Fig. **7a** illustrates a relatively small predetermined distance **180,** short enough that it limits the range of motion of the endoscope **200;** Fig. **7b** illustrates a larger predetermined distance **180,** wherein the full range of motion of the endoscope **200** is enabled. In **Fig. 7a,** the predetermined distance **180** is small enough that, within the normal range of motion of zoom mechanism **115** and endoscope **200,** the endoscope **200** or the zoom mechanism **115** are able to collide with rod **173** and/or first mechanism **101,** whereas, as illustrated in **Fig. 7b,** the larger predetermined distance **180** is large enough that such collisions are impossible and the full range of motion of endoscope **200** is enabled.

In another embodiment of the present invention, maneuvering system **100** is characterized in a non-limiting manner by at least two configurations: an automatic configuration, in which system **100** is motorized; and a wholly manual configuration in which system **100** is maneuvered without mechanical assistance by a user of the system.

In the best embodiments, the **SFME** comprises switching means for reversibly switching from the manual configuration to the automatic configuration. The switching means can be manual or automatic. A non-limiting example of manual switching is the operator instructing the system, using any means known in the art, to begin automatic operation at the start of an operation. A non-limiting example of automatic switching is switching to manual operation in the event of a power failure. Manual switching means include, but are not limited to, switches, knobs, buttons and voice commands while automatic switching means include, but are not limited to, a response to a change in a sensor such as, for example, the loss of (or appearance of) the image of a human hand from a heat sensor or the loss of (or appearance of) the conductivity of a human hand from a conductivity sensor.

In another embodiment of the present invention, maneuvering system **100** comprises in a non-limiting manner a rotating means as described in Fig. **4a** without pivoting support **111.**

Reference is now made to Fig. **8** which illustrates, in a non-limiting manner, pivoting support **111** as a gimbal coupled to endoscope **200.**

Figs. **9a-9b** illustrate, in a non-limiting manner, one embodiment of a method whereby the zoom mechanism **115,** which enables the endoscope **200** to translate along its main longitudinal axis, can be coupled to the pivoting support **111.**

Reference is now made to Fig. **9a** which illustrates a closer view of the zoom mechanism **115.** According to this embodiment, the zoom mechanism **115** comprises (i) at least one first coupling means **121** slidably attached to endoscope **200;** (ii) at least one first connecting means **122** reversibly coupled to endoscope **200** at a first coupling position; (iii) at least one second connecting means **123** reversibly coupled to first coupling means **122** at a second coupling position. Coupling between first connecting means **122,** second connecting means **123** and endoscope **200** enables first connecting means **122** and second connecting means **123** to (i) pivot around the main longitudinal axis of endoscope **200;** and, (ii) to move along the longitudinal axis of the endoscope **200.**

Reference is now made to Figs. **9a-9b** which illustrate in a non-limiting manner, the zoom mechanism **115** as described above in two different positions of the first **122** and second **123** connecting means.

According to another embodiment of the current invention, zoom mechanism **115** comprises clasping means adapted to enable reversible reciprocating movement along the main longitudinal axis of endoscope **200.**

In another embodiment of the current invention, first connecting means **122** and second connecting means **123** are connected to one another by means of a joint.

In another embodiment of the current invention, zoom mechanism **115** further comprises, in a non-limiting manner, *m* coupling means adapted to couple first connecting means **122** to second connecting means **123;** where *m* is an integer greater than or equal to one.

In another embodiment of the current invention, *m* coupling means are rotatably coupled to each other.

In another embodiment of the current invention, coupling means are selected in a non-limiting manner from a group consisting, for example, of joints, rods, other zoom mechanisms and any combination thereof.

In another embodiment of the current invention, coupling of first connecting means 122 to endoscope 200 is obtained by means selected in a non-limiting manner from a group consisting, for example, of mechanical means, magnetic means and any combination thereof.

In another embodiment of the current invention, coupling of second connecting means 123 to endoscope 200 is obtained by means selected in a non-limiting manner from a group consisting, for example, of mechanical means, magnetic means and any combination thereof.

In another embodiment of the current invention, the mechanical coupling means are selected in a non-limiting manner from a group consisting, for example, of a clip, a fastening element, non-adhesive tape, adhesive tape, a snap fastener, a button and any combination thereof.

In another embodiment of the current invention, the magnetic coupling means comprises in a non-limiting manner at least one ferromagnet, at least one paramagnet and any combination thereof.

According to another embodiment of the present invention the zoom mechanism can be operated manually, automatically and any combination thereof.

According to another embodiment of the present invention the zoom mechanism can be operated by means of at least one motor.

In another embodiment of the current invention, third mechanism 112 additionally comprises in a non-limiting manner a plurality of *q* joints, at least one of which is coupled to pivoting support 111, and at least one of which is coupled to the second mechanism; where *q* is an integer greater than or equal to one.

In another embodiment of the current invention, third mechanism 112 without the gimbal also additionally comprises in a non-limiting manner a plurality of *q* joints, at least one of which is

coupled to pivoting support **111,** and at least one of which is coupled to the second mechanism; where *q* is an integer greater than or equal to one.

In another embodiment of the current invention, **FCTM 101, SCTM 102, TCTM 103, FOCTM 104** and **FTCTM 105** are selected in a non-limiting manner from a group consisting, for example, of gearwheels, wheels, crown gears, bevel gears, spur gears, belts, and any combination thereof.

In another embodiment of the current invention, the second plane defines in a non-limiting manner an angle Θand the fifth plane defines in a non-limiting manner an angle ψ. The angle Θ varies between about 0 and about 360 degrees, preferably between about 0 and about 160 degrees,. Additionally, the angle ψ varies between about 0 and about 360 degrees, preferably between about 0 and 140 degrees.

**SFME 130** comprises a communication means and at least one joystick unit **152** coupled to endoscope **200,** used to manually maneuver endoscope **200** in any direction defined by either one of ψ and Θas defined above and in any combination thereof.

In another embodiment of the current invention, **SFME 130** additionally comprises in a non-limiting manner means for controlling movement of endoscope **200,** adapted to restrain the angular velocities of the endoscope in angular directions Θand ψ.

Reference is now made to **Fig. 10,** which presents, in a non-limiting manner, attaching means adapted to reversibly couple maneuvering system **100** to a hospital bed. Attaching means are selected in a non-limiting manner from a group consisting, for example, of mechanical means, magnetic means and any combination thereof. Fig. **10** also illustrates the best embodiment of the invention, which enables the utilization of the endoscope substantially tangential to the treated organ (e.g. the abdominal cavity).

The mechanical attaching means are selected in a non-limiting manner from a group consisting, for example, of a clip, a fastening element, adhesive tape, non-adhesive tape, a snap fastener, a button and any combination thereof.

The magnetic attaching means are selected in a non-limiting manner from a group consisting, for example, of a ferromagnet, a paramagnet and any combination thereof. The magnetic means is

attached to one selected from a group consisting of a hospital bed, a maneuvering system, and any combination thereof.

In another embodiment of the current invention, maneuvering system 100 additionally comprises, in a non-limiting manner, a quick release handle adapted to disassemble endoscope **200** from maneuvering system **100.**

In another embodiment of the current invention, the first mechanism additionally comprises, in a non-limiting manner, locking means adapted to maintain at least one selected from a group consisting, for example, of **FCTM 101, SCTM 102** and any combination thereof in a predetermined orientation upon power failure; and to prevent any rotational movement of the same.

In another embodiment of the current invention, the second mechanism additionally comprises in a non-limiting manner locking means adapted to maintain at least one selected from a group consisting, for example, of **TCTM 103, FOCTM 104, FTCTM 105** and any combination thereof in a predetermined orientation upon power failure; and to prevent any rotational movement of the same.

Reference is now made to Figs. **11a** and **lib** both illustrating, in a non-limiting manner and from different points of view, first mechanism 1100 and second mechanism 1200 assembled in a horizontal configuration.

Reference is now made to Figs. **12a** and **12b** both illustrating in a non-limiting manner different points of view of first mechanism **1100** and second mechanism **1200** assembled in a vertical configuration.

Reference is now made to Figs. **13a** and **13b** both illustrating, in a non-limiting manner and from different points of view, first mechanism **1100** and second mechanism **1200** assembled in a compact vertical configuration.

Reference is now made to Fig. **14** which depicts, in a non-limiting manner, one configuration of first mechanism **1100** and second mechanism **1200,** where first rotation means **106** and second rotation means **107** (shown in **Fig. 3)** are unified to a single rotation means **500.**

Said single rotation means **500** is provided with means adapted to switch between rotating first coaxial transmission means **101** and third coaxial transmission means **103** by a clutch **501.**

In another embodiment of the current invention, the endoscope is adapted in a non-limiting manner to acquire real-time images of a surgical environment within a human body.

Reference is now made to **Figs. 15** and **16** which present, in a non-limiting manner, possible configurations of the system, maneuvering system **100,** endoscope **200,** zoom mechanism **115,** and hospital bed **150.** As illustrated in **Fig. 15,** the system of the present invention enables the operation of the endoscope while the same is substantially perpendicular to the treated organ (e.g., the abdominal cavity) while **Fig. 16** illustrates how the system of the present invention enables the operation of the endoscope while the same is substantially parallel to the treated organ (e.g., the abdominal cavity).

Reference is now made to **Fig. 16** which presents in a non-limiting manner, a possible angle of the endoscope **200,** in which the same is almost parallel to hospital bed **150.**

Reference is now made to **Fig. 17,** which illustrates, in a non-limiting manner, means **600** adapted to rotate an endoscope around the endoscope's main longitudinal axis.

Means **600** comprises at least one transmission means **601** in communication with the endoscope **200;** a second transmission means **602** in communication with first transmission means **601,** and a motor **603** in communication with second transmission means **602,** adapted to activate second transmission means **602.**

Once the motor **603** is activated, second transmission means **602** is actuated and first transmission means **601** rotates. Once first transmission means **601** is activated, the endoscope is rotated around its main longitudinal axis.

According to another embodiment of the present invention, the **SFME** as described by any combination of the above embodiments may be employed on any non-human living being.

In the foregoing description, embodiments of the invention, including preferred embodiments, have been presented for the purpose of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise form disclosed. Obvious modifications or variations are possible in light of the above teachings. The embodiments were chosen and

described to provide the best illustration of the principals of the invention and its practical application, and to enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth they are fairly, legally, and equitably entitled.

CLAIMS

1. A system for maneuvering an endoscope (SFME) during a medical procedure, comprising

   a. at least one maneuvering system, adapted to maneuver said endoscope in at least two degrees of freedom (DOF); and,

   b. at least one joystick unit in communication with said maneuvering system, adapted to operate said maneuvering system;

   wherein operation of said joystick results in movement of said endoscope by means of said maneuvering system.

2. The system according to claim 1, wherein said joystick unit is wearable by a user of said system.

3. The system according to claim 1, wherein said joystick unit is coupled to at least one surgical tool used in said medical procedure.

4. The system according to claim 3, wherein said at least one surgical tool is said endoscope.

5. The system according to claim 1, wherein said movement of said joystick is proportional to said movement of said endoscope.

6. The system according to claim 1, wherein said joystick unit is a force joystick.

7. The system according to claim 1, wherein said joystick unit comprises a base and lever coupled to said base, such that movement of said lever results in movement of said endoscope; further wherein said movement of said lever is proportional to said movement of said endoscope.

8. The system according to claim 1, wherein said joystick unit comprises a base and a button jointly connected to said base, such that movement of said button results in movement of said endoscope; further wherein said movement of said button is proportional to said movement of said endoscope.

9. The system according to claim 1, wherein said joystick unit comprises a touchscreen, such that a touch and a movement on said touchscreen results in movement of said endoscope; further wherein said touch and movement on said touchscreen is proportional to said movement of said endoscope.

10. The system according to claim 1, wherein said joystick unit comprises at least one sound sensor, adapted to sense predetermined sound patterns; said joystick unit adapted to operate said maneuvering system based on said predetermined sound patterns.
11. The system according to claim 1, additionally comprising means adapted to restrain the velocity of said endoscope, such that when said means are activated, the velocity of said endoscope is restrained.
12. The system according to claim 1, wherein said joystick unit additionally comprises *n* sensors, where *n* is an integer larger than one.
13. The system according to claim 12, wherein said sensors are selected from a group consisting of a motion sensor, a heat sensor, an electric sensor, a sound sensor, a pressure sensor, an optical sensor and any combination thereof.
14. The system according to claim 12, wherein at least one of said *n* sensors is activated in case of power failure.
15. The system according to claim 12, wherein at least one of said *n* sensors is activated when said system is connected to power.
16. The system according to claim 12, wherein said joystick unit is characterized by an external surface.
17. The system according to claim 16, wherein said at least one motion sensor detects motion upon said external surface.
18. The system according to claim 16, wherein said at least one motion sensor detects motion perpendicular to said external surface.
19. The system according to claim 12, wherein, if said joystick unit's speed of motion is above a predetermined value, said endoscope's speed is at a predetermined value.
20. The system according to claim 12, wherein said at least one heat sensor is adapted to sense temperatures in the range of about 35 to about 42 degrees.

21. The system according to claim 20, wherein said system is adapted to enable maneuvering of said endoscope at such times as said at least one heat sensor senses temperatures in the range of about 35 to about 42 degrees.

22. The system according to claim 20, wherein said at least one heat sensor is adapted to provide thermal image; said at least one heat sensor is coupled to a processing unit adapted to provide said system user with said thermal image.

23. The system according to claim 20, wherein said system is adapted to enable maneuvering of said endoscope at such times as analysis of said image by said processing unit detects the image of a human hand; further wherein said system is adapted to prevent maneuvering of said endoscope at such times when said analysis of said image by said processing unit fails to detect an image of a human hand.

24. The system according to claim 12, wherein said at least one electric sensor is adapted to sense power failure.

25. The system according to claim 12, wherein said at least one electric sensor is adapted to sense electric conductivity of a human body.

26. The system according to claim 25, wherein said system is adapted to enable maneuvering of said endoscope at such times when said sensor senses the conductivity of said subject's body; further wherein said system is adapted to prevent maneuvering of said endoscope at such times as said sensor fails to sense the conductivity of said subject's body.

27. The system according to claim 12, wherein said at least one sound sensor is adapted to sense at least one predetermined sound pattern.

28. The system according to claim 27, wherein said endoscope is maneuverable according to said at least one predetermined sound pattern sensed by said at least one sound sensor.

29. The system according to claim 12, wherein said at least one pressure sensor is adapted to sense pressure applied to said joystick unit.

30. The system according to claim 29, wherein said pressure sensed by said at least one pressure sensor affects the SFME in a manner selected from a group consisting of: when said pressure sensed by said at least one pressure sensor is above a predetermined value,

said SFME is activated; when said pressure sensed by said at least one pressure sensor is above a predetermined value, said SFME is de-activated; and when said pressure sensed by said at least one pressure sensor is below a predetermined value, said SFME is de-activated.

31. The system according to claim 12, wherein said at least one optical sensor is adapted to sense visual changes according to at least one predetermined visual pattern.

32. The system according to claim 31, wherein said endoscope is maneuverable according to said at least one predetermined visual pattern.

33. The system according to claim 1, additionally comprising an interface system adapted to enable communication between said joystick unit and said maneuvering system.

34. The system according to claim 33, wherein said communication means comprises a member selected from a group consisting of a wired communication means, a wireless communication means and any combination thereof.

35. The system according to claim 1, wherein said SFME comprises at least one second joystick unit adapted to zoom the endoscope by means of said maneuvering system.

36. The system according to claim 35, wherein said second joystick unit is wearable by said system user.

37. The system according to claim 35, wherein said second joystick unit is coupled to at least one surgical tool.

38. The system according to claim 37, wherein said at least one surgical tool is said endoscope.

39. The system according to claim 1, wherein said at least one joystick unit is adapted to control and to direct said endoscope via said maneuvering system on a surgical tool.

40. The system according to claim 37, wherein selection of said at least one surgical tool is obtained by activating said at least one joystick unit; further wherein the activation of said at least one joystick unit is obtained by depression of said joystick unit, voice activating the same, prolonged depression on the same, double clicking on the same and any combination thereof.

41. The system according to claim 1, additionally comprising

(a) at least one wearable operator comprising at least one wireless transmitter, adapted to transmit a signal once said at least one wearable operator is activated; said at least one wearable operator is either wire or wirelessly in communication with at least one surgical instrument;

(b) at least one wireless receiver; adapted to receive said signal sent by said transmitter;

(c) at least one laparoscopy computerized system, in communication with said wireless receiver, adapted to provide a visual onscreen depiction of said at least one instrument to be selected following the activation of said at least one wearable operator; and,

(d) at least one video screen; wherein said system is adapted to control and to direct said endoscope via said laparoscopy computerized system and said maneuvering system on said instrument to be selected following the activation of said at least one wearable operator.

42. The system according to claim 41, wherein said communication between said at least one of said wearable operators and said instrument is either wire or wirelessly coupling.

43. The system according to claim 41, wherein said wearable operator is worn by said surgeon on a predetermined body part.

44. The system according to claim 43, wherein said predetermined body part is selected from a group consisting of: the hand of said surgeon, at least one of the fingers of said surgeon, the thigh of said surgeon, the neck of said surgeon, at least one of the legs of said surgeon, the knee of said surgeon, the head of said surgeon and any combination thereof.

45. The system according to claim 44, wherein the shape of said wearable operator is selected from a group consisting of a ring, a bracelet and any combination thereof.

46. The system according to claim 41, wherein said wearable operator is coupled to a predetermined location on said instrument by means of an adaptor.

47. The system according to claim 46, wherein said wearable operator is adjustable so as to fit said predetermined location of said different instruments, each of which is characterized by a different size and shape.

48. The system according to claim 41, wherein said wearable operator comprises a body having at least two portions at least partially overlapping each other; said two portions are adapted to grasp and hold either said instrument or said predetermined body part there-between, such that a tight-fit coupling between said two portions and said instrument or said predetermined body part is obtained.

49. The system according to claim 48, wherein one of said two portions is rotationally movable relative to the other, such that when said wearable operator is coupled to said instrument, fine-tuned movement of said two body portions is obtainable so as to provide said tight-fit coupling between said two portions and said instrument or said predetermined body part.

50. The system according to claim 48, wherein said two portions are rotationally movable relative to each other, such that when said wearable operator is coupled to said instrument, fine-tuned movement of said two body portions is obtainable so as to provide said tight-fit coupling between said two portions and said instrument or said predetermined body part.

51. The system according to claim 41, wherein said wearable operator comprises (a) at least one flexible and stretchable strip; and (b) loop-closing means adapted to close a loop with said at least one flexible and stretchable strip; said at least one flexible and stretchable strip and said loop-closing means are provided so as to fit said wearable operator to at least one selected from a group consisting of (a) said predetermined location of said different instruments; (b) said predetermined body part of said surgeon, each of which is characterized by a different size and shape.

52. The system according to claim 51, wherein said flexible and stretchable strip is made of material selected from a group consisting of silicone, rubber and any combination thereof.

53. The system according to claim 41, wherein said wireless transmitter is adapted to locate the position of at least one of said instruments.

54. The system according to claim 41, wherein selection of said at least one instrument is obtained by activating said at least one wearable operator; further wherein the activation of said at least one wearable operator is obtained by depression on a predetermined location in said wearable operator, voice activating the same, prolonged depression on the same, double clicking on the same and any combination thereof.

**55.** The system according to claim 41, wherein said laparoscopy computerized system directs said endoscope by using image information shown on said video screen without said help of assistants.

**56.** The system according to claim 41, wherein said conventional laparoscopy computerized system comprises at least one surgical instrument spatial location software, adapted to locate the **3D** spatial position of said at least one instrument; further wherein said conventional laparoscopy computerized system comprises at least one automated assistant maneuvering system; said automated assistant maneuvering system is coupled to said endoscope and is adapted to direct said endoscope to said at least one instrument, said instrument selected following the activation of said at least one wearable operator.

**57.** The system according to claim 41, wherein each transmitted signal from said wearable operator and said wireless transmitter is matched to at least one of said instruments.

**58.** The system according to claim **35** wherein a single device comprises said joystick unit and said second joystick unit.

**59.** The system according to claim 1, wherein said maneuvering system comprises:

a. a first mechanism, comprising:

i. at least one first coaxial transmission means **101;** said first coaxial transmission means **101** defines a first plane; said first coaxial transmission means **101** is characterized by a first axis of rotation; said first axis of rotation is substantially orthogonal to said first plane;

ii. at least one second coaxial transmission means **102;** said second coaxial transmission means **102** defines a second plane; said second coaxial transmission means **102** is characterized by a second axis of rotation; said second axis of rotation is substantially orthogonal to said second plane; said second coaxial transmission means **102** is rotatably connected to said first coaxial transmission means **101;** where said second plane is substantially orthogonal to said first plane; and

iii. at least one first means **106** adapted to rotate said first coaxial transmission means **101** around said first axis of rotation;

where said first coaxial transmission means 101 transmits rotation to said second coaxial transmission means 102; and

b. a second mechanism, comprising:

i. at least one third coaxial transmission means 103; said third coaxial transmission means 103 defines a third plane; said third coaxial transmission means 103 is characterized by a third axis of rotation; said third axis of rotation is substantially orthogonal to said third plane;

ii. at least one fourth coaxial transmission means 104; said fourth coaxial transmission means 104 defines a fourth plane; said forth coaxial transmission means 104 defines a fourth axis of rotation; said fourth axis of rotation is substantially orthogonal to said fourth plane; said fourth coaxial transmission means 104 is rotatably connected to said third coaxial transmission means 103; where said fourth plane is substantially orthogonal to said third plane;

iii. at least one fifth coaxial transmission means 105; said fifth coaxial transmission means 105 defines a fifth plane; said fifth coaxial transmission means 105 defines a fifth axis of rotation; said fifth axis of rotation is substantially orthogonal to said fifth plane; said fifth coaxial transmission means 105 is rotatably connected to said fourth coaxial transmission means 104; where said fifth plane is substantially orthogonal to said fourth plane;

iv. at least one second means 107 adapted to rotate said third coaxial transmission means 103 around said third axis of rotation;

where said third coaxial transmission means 103 transmit rotation to said fourth coaxial transmission means 104; where said fourth coaxial transmission means 104 transmits rotation to said fifth coaxial transmission means 105,

wherein said first mechanism and said second mechanism are adapted to rotate said endoscope around at least one said second axis of rotation being substantially orthogonal to said second plane; and around at least one said fifth axis of rotation being substantially orthogonal to said fifth plane, such that said second axis of rotation and said fifth axis of rotation are positioned at an angle A relatively to each other.

60. The system according to claim 59, wherein said A is in the range of about 0 degrees to about 180 degrees.

61. The system according to claim 59, additionally comprising at least one third mechanism in communication with said first mechanism and said second mechanism, said third mechanism comprising (i) at least one pivoting support adapted to be pivotally attached to said endoscope; said pivoting support adapted to enable said endoscope **200** to pivot around said pivoting support; and (ii) at least one joint **114** said joint mechanically connected to said pivoting support **111,** thereby enabling said endoscope **200** to rotate freely in two orthogonal axes around an insertion point;

said endoscope pivotally attached to said joints can pivot at said insertion point independent of the distance between said pivoting support, said joint, and said insertion point;

where said third mechanism is coupled at its distal end to said endoscope **200** and at its proximal end the same is coupled to at least one mechanism selected from a group consisting of said first mechanism, said second mechanism and any combination thereof;

wherein said second joint is located at a predetermined distance from said first joint.

62. The system according to claim 61, wherein said pivoting support comprises a gimbal.

63. The system according to claim 61, wherein said joint comprises a gimbal.

64. The system according to claim 59, additionally comprising at least one zoom mechanism adapted to maneuver said endoscope along the main longitudinal axis of the same.

65. The system according to claim 64, wherein said zoom mechanism **115** comprises clasping means adapted to enable reversible reciprocating movement along said main longitudinal axis of said endoscope.

66. The system according to claim 64, wherein said zoom mechanism is operable by at least one motor.

67. The system according to claim 59, where said third mechanism comprises a plurality of *q* joints, at least one of which is coupled to said pivoting support, and at least one of which is coupled to said second mechanism; where *q* is an integer greater than or equal to one.

68. The device according to claim 59, wherein said first coaxial transmission means **101,** said second coaxial transmission means **102,** said third coaxial transmission means **103,** said fourth coaxial transmission means **104,** and said fifth coaxial transmission means **105** are selected from a group consisting of gearwheels, wheels, crown gears, bevel gears, spur gears, belts, and any combination thereof.

69. The system according to claim 59, wherein said maneuvering system comprises attaching means adapted to reversibly couple said maneuvering system to a hospital bed.

70. The system according to claim 69, wherein said attaching means is selected from a group consisting of mechanical means, magnetic means and any combination thereof.

71. The system according to claim 70, wherein said mechanical attaching means is selected from a group consisting of a clip, a fastening element, adhesive tape, non-adhesive tape, a snap fastener, a button and any combination thereof.

72. The system according to claim 70, wherein said magnetic attaching means comprises at least one magnet, said magnet selected from a group consisting of a ferromagnet, a paramagnet and any combination thereof; where said magnetic means is attached to one selected from a group consisting of a hospital bed, a maneuvering system, and any combination thereof.

73. The system according to claim 59, wherein said rotation in said second plane defines an angle Θ

74. The system according to claim 73, wherein said angle Θvaries between 0 and about 360 degrees, preferably between 0 and about 160 degrees.

75. The system according to claim 59 wherein said rotation in said fifth plane defines an angle ψ.

76. The system according to claim 75, wherein said angle ψ varies between 0 and about 360 degrees, preferably between 0 and 140 degrees.

77. The system according to claims 73 and 75, wherein said **SFME** enables control of rotation in said angle ψ and said angle Θ.

78. The system according to claims 73 and 75, wherein movement of said joystick unit in any direction selected from a group consisting of said ψ, said Θ, and any combination thereof, enables control of movement of said endoscope in same direction as the movement of the joystick unit, said movement proportional to one selected from a group consisting of the movement of the joystick unit, the speed of movement of the joystick unit and any combination thereof.

79. The system according to claim 59, wherein said maneuvering system additionally comprises a quick release handle adapted to disassemble said endoscope from said maneuvering system.

80. The system according to claim 59, wherein said first mechanism additionally comprises locking means adapted, upon power failure, to maintain in a predetermined orientation and to prevent any rotational movement of at least one selected from a group consisting of the first coaxial transmission means **101,** the second coaxial transmission means **102** and any combination thereof.

81. The system according to claim 59, wherein said second mechanism additionally comprises locking means adapted, upon power failure, to maintain in a predetermined orientation and to prevent any rotational movement of at least one selected from a group consisting of: said third coaxial transmission means **103,** said fourth coaxial transmission means **104,** said fifth coaxial transmission means **105,** and any combination thereof.

82. The system according to claim 1, wherein said endoscope is adapted to acquire real-time images of a surgical environment within a subject's body.

83. A method for maneuvering an endoscope during a medical procedure comprising steps of:

a. providing at least one endoscope;

b. providing a system for maneuvering an endoscope **(SFME)** during said medical procedure, said **SFME** comprising:

i. at least one maneuvering system, adapted to maneuver said endoscope in at least two degrees of freedom (DOF); and

ii. at least one joystick unit in communication with said maneuvering system, adapted to operate said maneuvering system;

c. coupling said endoscope to said SFME; and

d. maneuvering said joystick unit,

thereby maneuvering said endoscope and controlling the movements of the same.

84. The method according to claim 83, additionally comprising a step of adapting said joystick unit to be worn by said system user.

85. The method according to claim 83, additionally comprising a step of coupling said joystick unit to at least one surgical tool used in said medical procedure.

86. The method according to claim 68, additionally comprising a step of selecting said surgical tool to be an endoscope.

87. The method according to claim 83, additionally comprising a step of adapting said SFME such that said movement of said joystick is proportional to said movement of said endoscope.

88. The method according to claim 83, additionally comprising a step of selecting said joystick unit to be a force joystick.

89. The method according to claim 83, additionally comprising a step of selecting said joystick unit such that said joystick unit comprises a base and lever coupled to said base, such that movement of said lever results in movement of said endoscope; further wherein said movement of said lever is proportional to said movement of said endoscope.

90. The method according to claim 83, additionally comprising a step of selecting said joystick unit such that said joystick unit comprises a base and a button jointly connected to said base, such that movement of said button results in movement of said endoscope; further wherein said movement of said button is proportional to said movement of said endoscope.

91. The method according to claim 83, additionally comprising a step of selecting said joystick unit such that said joystick unit comprises a touchscreen, such that a touch and a movement on said touchscreen results in movement of said endoscope; further wherein said touch and movement on said touchscreen is proportional to said movement of said endoscope.

92. The method according to claim 83, additionally comprising a step of selecting said joystick unit comprising at least one sound sensor, adapted to sense predetermined sound patterns; said joystick unit adapted to operate said maneuvering system based on said predetermined sound patterns.

93. The method according to claim 83, additionally comprising a step of providing means adapted to restrain the velocity of said endoscope such that when said means are activated, the velocity of said endoscope is restrained .

94. The method according to claim 83, additionally comprising a step of providing said joystick unit with *n* sensors, where *n* is an integer larger than one.

95. The method according to claim 94, additionally comprising a step of selecting said sensors from a group consisting of a motion sensor, a heat sensor, an electric sensor, a sound sensor, a pressure sensor, an optical sensor and any combination thereof.

96. The method according to claim 94, additionally comprising a step of activating at least one of said *n* sensors in case of power failure.

97. The method according to claim 94, additionally comprising a step of activating at least one of said *n* sensors when said system is connected to power.

98. The method according to claim 94, additionally comprising a step of characterizing said joystick unit by an external surface.

99. The method according to claim 98, additionally comprising a step of using said at least one motion sensor to detect motion upon said external surface.

100. The method according to claim 98, additionally comprising a step of using said at least one pressure sensor to detect motion perpendicular to said external surface.

101. The method according to claim 94, additionally comprising a step of setting said motion of said endoscope to a predetermined value if the speed of said motion as commanded by said joystick unit is above a predetermined value.

102. The method according to claim 94, additionally comprising a step of adapting said at least one heat sensor to sense temperatures in the range of about 35 to about 42 degrees.

103. The method according to claim 102, additionally comprising a step of enabling maneuvering of said endoscope when said at least one heat sensor senses temperatures in the range of about 35 to about 42 degrees.

104. The method according to claim 102, additionally comprising a step of adapting said at least one heat sensor to provide a thermal image; said at least one heat sensor is coupled to a processing unit adapted to provide said system user with said thermal image.

105. The method according to claim 104, additionally comprising a step of enabling maneuvering of said endoscope upon analysis of said image by said processing unit and detection of a human hand; further comprising a step of preventing maneuvering of said endoscope at such times as said analysis of said image by said processing unit fails to detect an image of a human hand.

106. The method according to claim 94, additionally comprising a step of adapting said at least one electric sensor to sense power failure.

107. The method according to claim 94, additionally comprising a step of adapting said at least one electric sensor to sense electric conductivity of said subject's body.

108. The method according to claim 107, additionally comprising a step of maneuvering said endoscope upon sensing conductivity of said subject's body by said at least one electric sensor; further comprising a step of preventing maneuvering of said endoscope at such times as said sensor fails to sense the conductivity of said subject's body.

109. The method according to claim 94, additionally comprising a step of adapting said at least one sound sensor to sense at least one predetermined sound pattern.

110. The method according to claim 109, additionally comprising a step of maneuvering said endoscope according to said at least one predetermined sound pattern detected by said at least one sound sensor.

111. The method according to claim 94, additionally comprising a step of adapting said at least one pressure sensor to sense pressure applied to said joystick unit.

112. The method according to claim 111, additionally comprising a step of altering the activation state of said SFME in a manner selected from a group consisting of: activating said SFME upon sensing pressure above a predetermined value by said at least one pressure sensor, de-activating said SFME upon sensing pressure above a predetermined value by said at least one pressure sensor, and de-activating said SFME upon sensing pressure below a predetermined value by said at least one pressure sensor.

113. The method according to claim 94, additionally comprising a step of adapting at least one optical sensor to sense visual changes according to at least one predetermined visual pattern.

114. The method according to claim 113, additionally comprising a step of maneuvering said endoscope according to said at least one predetermined visual pattern.

115. The method according to claim 83, additionally comprising a step of providing an interface system adapted to enable communication between said joystick unit and said maneuvering system.

116. The method according to claim 115, additionally comprising a step of providing said communication means comprising a member of a group consisting of a wired communication means, a wireless communication means and any combination thereof.

117. The method according to claim 83, additionally comprising a step of providing said SFME comprising at least one second joystick unit adapted to zoom the endoscope by means of said maneuvering system.

118. The method according to claim 1117, additionally comprising a step of wearing said second joystick unit by said system user.

119. The method according to claim 117, additionally comprising a step of coupling said second joystick unit to said at least one surgical tool.

120. The method according to claim 119, additionally comprising a step of selecting said at least one surgical tool to be said endoscope.

121. The method according to claim 83, additionally comprising a step of adapting said at least one joystick unit to control and to direct said endoscope via said maneuvering system on said surgical instrument to which said activated wearable operator is coupled.

122. The method according to claim 105, additionally comprising a step of enabling selection of said at least one instrument by activating said at least one joystick unit; further wherein the activation of said at least one joystick unit is obtained by depression of said joystick unit, voice activating the same, prolonged depression on the same, double clicking on the same and any combination thereof.

123. The method according to claim 83, additionally comprising steps of:

a. providing at least one wearable operator comprising at least one wireless transmitter, adapted to transmit a signal once said at least one wearable operator is activated; said at least one wearable operator is either wire or wirelessly in communication with at least one surgical instrument;

b. providing at least one wireless receiver; adapted to receive said signal sent by said transmitter;

c. providing at least one laparoscopy computerized system, in communication with said wireless receiver, adapted to provide a visual onscreen depiction of said at least one instrument to be selected following the activation of said at least one wearable operator; and,

d. providing at least one video screen; wherein said system is adapted to control and to direct said endoscope via said laparoscopy computerized system and said maneuvering system on said instrument to be selected following the activation of said at least one wearable operator.

124. The method according to claim 123, additionally comprising steps of providing said communication between said at least one of said wearable operators and said instrument via either wire or wirelessly coupling.

125. The method according to claim 123, additionally comprising steps of wearing said wearable operator by said surgeon on a predetermined body part.

126. The method according to claim 125, additionally comprising steps of selecting said predetermined body part from a group consisting of: the hand of said surgeon, at least one of the fingers of said surgeon, the thigh of said surgeon, the neck of said surgeon, at least one of the legs of said surgeon, the knee of said surgeon, the head of said surgeon and any combination thereof.

127. The method according to claim 126, additionally comprising steps of selecting the shape of said wearable operator from a group consisting of a ring, a bracelet and any combination thereof.

128. The method according to claim 123, additionally comprising steps of coupling said wearable operator to a predetermined location on said instrument by means of an adaptor.

129. The method according to claim 128, additionally comprising steps of providing said wearable operator adjustable so as to fit said predetermined location of said different instruments, each of which is characterized by a different size and shape.

130. The method according to claim 123, additionally comprising steps of providing said wearable operator comprising a body having at least two portions at least partially overlapping each other; said two portions are adapted to grasp and hold either said instrument or said predetermined body part there-between, such that a tight-fit coupling between said two portions and said instrument or said predetermined body part is obtained.

131. The method according to claim 130, additionally comprising steps of providing one of said two portions rotationally movable relative to the other, such that when said wearable operator is coupled to said instrument, fine-tuned movement of said two body portions is obtainable so as to provide said tight-fit coupling between said two portions and said instrument or said predetermined body part.

132. The method according to claim 130, additionally comprising steps of providing said two portions rotationally movable relative to each other, such that when said wearable operator is coupled to said instrument, fine-tuned movement of said two body portions is obtainable so as to provide said tight-fit coupling between said two portions and said instrument or said predetermined body part.

133. The method according to claim 123, additionally comprising steps of providing said wearable operator comprising (a) at least one flexible and stretchable strip; and (b) loop-closing means adapted to close a loop with said at least one flexible and stretchable strip; said at least one flexible and stretchable strip and said loop-closing means are provided so as to fit said wearable operator to at least one selected from a group consisting of (a) said predetermined location of said different instruments; (b) said predetermined body part of said surgeon, each of which is characterized by a different size and shape.

134. The method according to claim 133, additionally comprising steps of making said flexible and stretchable strip of material selected from a group consisting of silicone, rubber and any combination thereof.

135. The method according to claim 123, additionally comprising steps of adapting said wireless transmitter to locate the position of at least one of said instruments.

136. The method according to claim 123, additionally comprising steps of selecting said at least one instrument by activating said at least one wearable operator; further wherein the activation of said at least one wearable operator is obtained by depression on a predetermined location in said wearable operator, voice activating the same, prolonged depression on the same, double clicking on the same and any combination thereof.

137. The method according to claim 123, additionally comprising steps of said directing said endoscope by said laparoscopy computerized system by using image information shown on said video screen without said help of assistants.

138. The method according to claim 123, additionally comprising steps of providing said conventional laparoscopy computerized system comprising at least one surgical instrument spatial location software, adapted to locate the 3D spatial position of said at least one instrument; further wherein said conventional laparoscopy computerized system comprises

at least one automated assistant maneuvering system; said automated assistant maneuvering system is coupled to said endoscope and is adapted to direct said endoscope to said at least one instrument, said instrument selected following the activation of said at least one wearable operator.

139. The method according to claim 123, additionally comprising steps of matching each transmitted signal from said wearable operator and said wireless transmitter to at least one of said instruments.

140. The method according to claim 117, additionally comprising a step of comprising said joystick unit and said second joystick unit in a single unit.

141. The method according to claim 83, additionally comprising steps of:

a. providing a maneuvering system comprising:

i. a first mechanism, comprising:

1. at least one first coaxial transmission means **101;** said first coaxial transmission means **101** defines a first plane; said first coaxial transmission means **101** is characterized by a first axis of rotation; said first axis of rotation substantially orthogonal to said first plane;

2. at least one second coaxial transmission means **102;** said second coaxial transmission means **102** defines a second plane; said second coaxial transmission means **102** defines a second axis of rotation; said second axis of rotation is substantially orthogonal to said second plane; said second coaxial transmission means **102** is rotatably connected to said first coaxial transmission means **101;** where said first plane is substantially orthogonal to said second plane; and

3. at least one first means **106** adapted to rotate said first coaxial transmission means **101** around said first axis of rotation;

ii. a second mechanism, comprising:

1. at least one third coaxial transmission means **103;** said third coaxial transmission means **103** defines a third plane; said third coaxial transmission

means **103** is characterized by a third axis of rotation; said third axis of rotation is substantially orthogonal to said third plane;

2. at least one fourth coaxial transmission means **104;** said fourth coaxial transmission means **104** defines a fourth plane; said fourth coaxial transmission means **104** defines a fourth axis of rotation; said fourth axis of rotation is substantially orthogonal to said fourth plane; said fourth coaxial transmission means **104** is rotatably connected to said third coaxial transmission means **103;** where said fourth plane is substantially orthogonal to said third plane;
3. at least one fifth coaxial transmission means **105;** said fifth coaxial transmission means **105** defines a fifth plane; said fifth coaxial transmission means **105** defines a fifth axis of rotation; said fifth axis of rotation is substantially orthogonal to said fifth plane; said fifth coaxial transmission means **105** is rotatably connected to said fourth coaxial transmission means **104;** where said fifth plane is substantially orthogonal to said fourth plane;
4. at least one second means **107** adapted to rotate said third coaxial transmission means **103** around said third axis of rotation;

b. positioning said first coaxial transmission means **101** orthogonal to said second coaxial transmission means **102;** said positioning enables transmission of rotation between said first coaxial transmission means **101** and said second coaxial transmission means **102;**

c. positioning said third coaxial transmission means **103** orthogonal to said fourth coaxial transmission means **104;** said positioning enables transmission of rotation between said third coaxial transmission means **103** and said fourth coaxial transmission means **104;**

d. positioning said fourth coaxial transmission means **104** orthogonal to said fifth coaxial transmission means **105;** said positioning enables transmission of rotation between said fourth coaxial transmission means **104** and said fifth coaxial transmission means **105;**

e. coupling said second coaxial transmission means **102** to said endoscope **200** and said fifth coaxial transmission means **105** to said endoscope **200;** said coupling enables rotation of said endoscope **200** proportional to rotation of said second coaxial transmission means **102** and said fifth coaxial transmission means **105;** and

f. maneuvering said endoscope **200** in at least two degrees of freedom; said maneuvering of said endoscope **200** in said at least two degrees of freedom are in said second axis of rotation and in said fifth axis of rotation;

wherein maneuvering in a first DOF of said at least two DOF is performed by rotating said first coaxial transmission means **101** thereby transmitting rotation to said endoscope **200;** wherein maneuvering in a second DOF of at least two DOF is performed by rotating said third coaxial transmission means **103** thereby transmitting rotation to said endoscope **200,** such that the angle between said second axis of rotation and said fifth axis of rotation is an angle A.

142. The method according to claim 141, additionally comprising a step of defining said angle A to be in the range of about 0 degrees to about 180 degrees.

143. The method according to claim 141, additionally comprising a step of providing at least one third mechanism in communication with said first mechanism and said second mechanism, said third mechanism comprising (i) at least one pivoting support adapted to be pivotally attached to said endoscope; said pivoting support adapted to enable said endoscope **200** to pivot around said pivoting support; and (ii) at least one joint **114** mechanically connected to said pivoting support **111,** thereby enabling said endoscope **200** to rotate freely in two orthogonal axes around an insertion point; said endoscope pivotally attached to said joint and said pivoting support can pivot at said insertion point independent of the distance between said pivoting support, said joint, and said insertion point; said third mechanism coupled at its distal end to said endoscope **200** and at its proximal end the same is coupled to at least one mechanism selected from a group consisting of said first mechanism, said second mechanism and any combination thereof; and said second joint is located at a predetermined distance from said first joint.

144. The method according to claim 141, additionally comprising a step of providing said pivoting support comprising a gimbal.

145. The method according to claim 141, additionally comprising a step of providing said joint **114** comprising a gimbal.

146. The method according to claims 141, additionally comprising a step of providing at least one zoom mechanism adapted to maneuver said endoscope along the main longitudinal axis of the same.

147. The method according to claim 146, additionally comprising a step of providing said zoom mechanism **200** comprising clasping means adapted to enable reversible reciprocating movement along said main longitudinal axis of the same.

148. The method according to claim 146, additionally comprising a step of operating said zoom mechanism by at least one motor.

149. The method according to claim 143, additionally comprising a step of providing said third mechanism with a plurality of $q$ joints, at least one of which is coupled to said pivoting support, and at least one of which is coupled to said second mechanism; where $q$ is an integer greater than or equal to one.

150. The device according to claim 141, additionally comprising a step of selecting said first coaxial transmission means **101,** said second coaxial transmission means **102,** said third coaxial transmission means **103,** said fourth coaxial transmission means **104,** and said fifth coaxial transmission means **105** from a group consisting of gearwheels, wheels, crown gears, bevel gears, spur gears, belts, and any combination thereof.

151. The method according to claim 141, additionally comprising a step of providing said maneuvering system with attaching means adapted to reversibly couple said maneuvering system to a hospital bed.

152. The method according to claim 151, additionally comprising a step of selecting said attaching means from a group consisting of mechanical means, magnetic means and any combination thereof.

153. The method according to claim 152, additionally comprising a step of selecting said mechanical attaching means from a group consisting of a clip, a fastening element, non-adhesive tape, adhesive tape, a snap fastener, a button and any combination thereof.

154. The method according to claim 152, additionally comprising a step of providing said magnetic attaching means with at least one magnet, said magnet selected from a group consisting of a ferromagnet, a paramagnet and any combination thereof; where said magnetic means is attached to a selected from a group consisting of a hospital bed, a maneuvering system, and any combination thereof.

155. The method according to claim 141, additionally comprising a step of defining an angle Θ for said rotation in said second plane.

156. The method according to claim 155, additionally comprising a step of allowing said angle Θ to vary between 0 and about 360 degrees, preferably between 0 and about 160 degrees.

157. The method according to claim 141 additionally comprising a step of defining an angle ψ for said rotation in said fifth plane.

158. The method according to claim 157, additionally comprising a step of allowing said angle ψ to vary between 0 and about 360 degrees, preferably between 0 and 140 degrees.

159. The method according to claim 155 and 157, additionally comprising a step of providing said SFME to control rotation of said maneuvering system in said angle ψ and said angle Θ.

160. The system according to claims 155 and 157, additionally comprising a step of enabling control of movement of said joystick unit in any direction selected from a group consisting of said ψ, said Θ, and any combination thereof, such that movement of said endoscope is in same direction as the movement of the joystick unit and said movement is proportional to one selected from a group consisting of the movement of the joystick unit, the speed of movement of the joystick unit and any combination thereof

161. The method according to claim 141, additionally comprising a step of providing said system with a quick release handle adapted to disassemble said endoscope from said maneuvering system.

162. The method according to claim 141, additionally comprising a step of providing said first mechanism with locking means adapted to maintain in a predetermined orientation upon power failure; and to prevent any rotational movement of at least one selected from a group

consisting of said first coaxial transmission means **101,** said second coaxial transmission means **102** and any combination thereof.

163. The method according to claim 141, additionally comprising a step of providing said second mechanism with locking means adapted to maintain in a predetermined orientation upon power failure and to prevent any rotational movement of at least one selected from a group consisting of said third coaxial transmission means **103,** said fourth coaxial transmission means **104,** said fifth coaxial transmission means **105,** and any combination thereof.

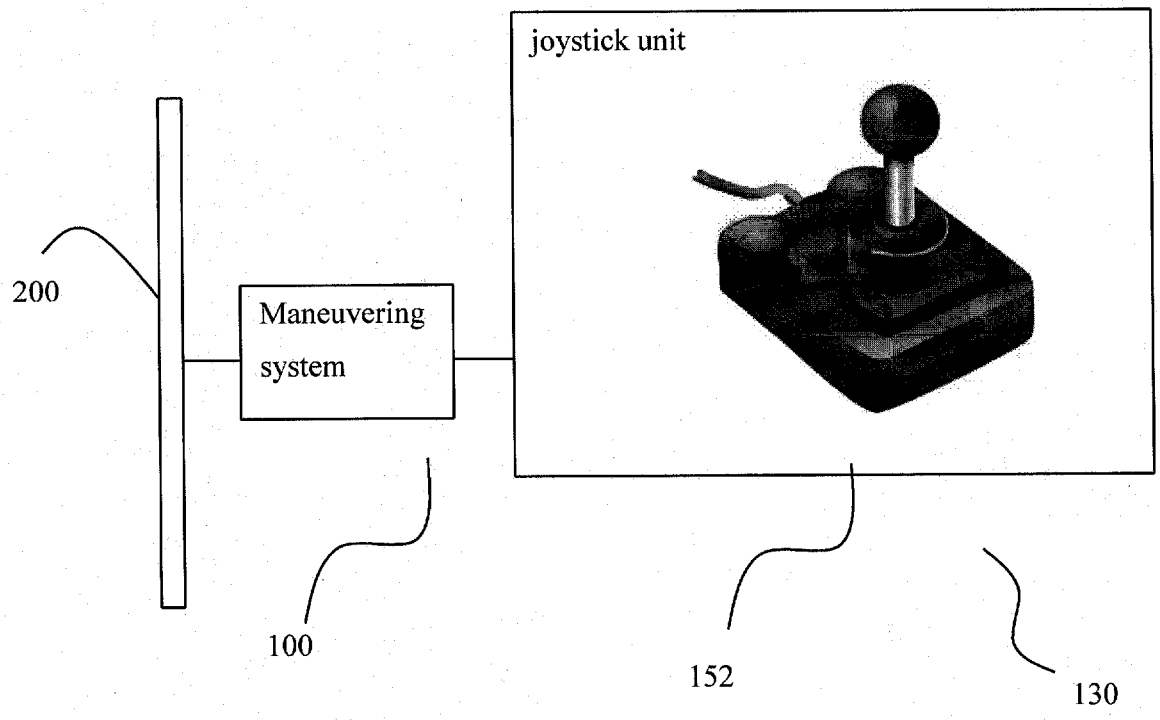



Fig. 1a

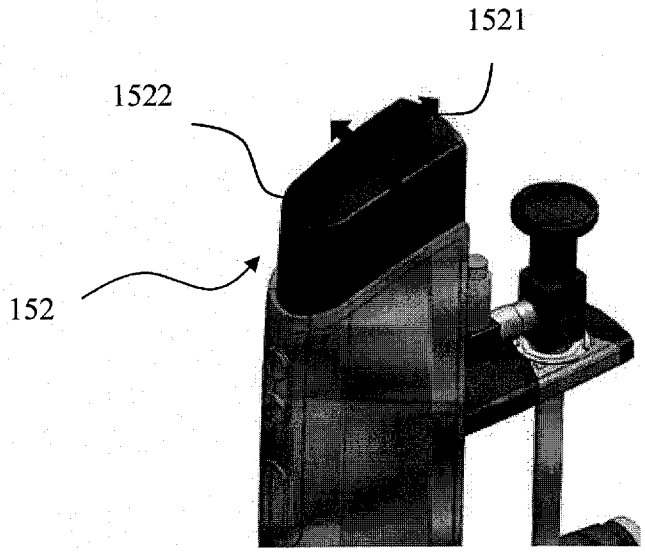



Fig. 1b

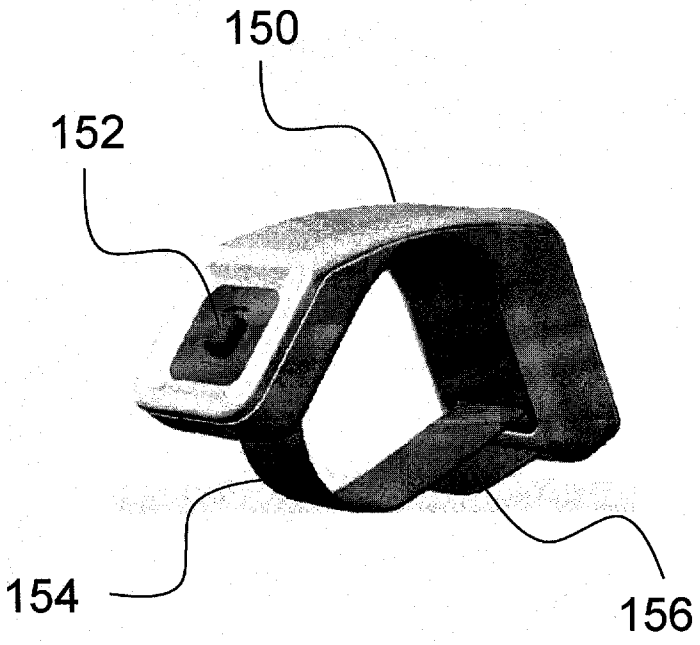



Fig. 2a

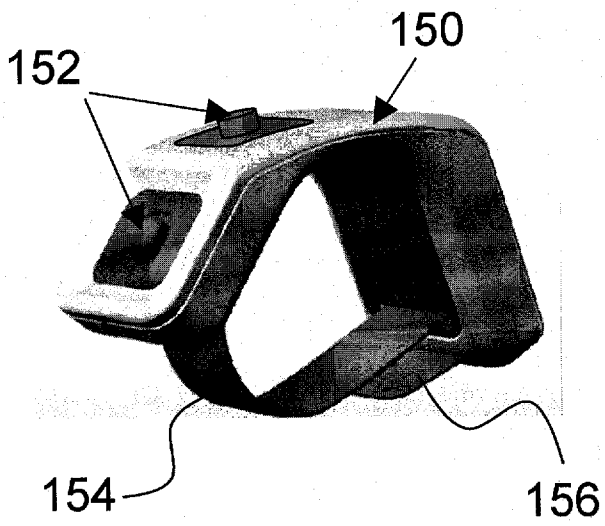



Fig. 2b

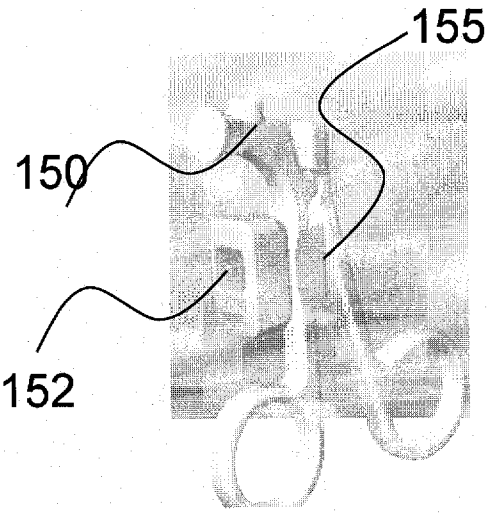



Fig. 2c

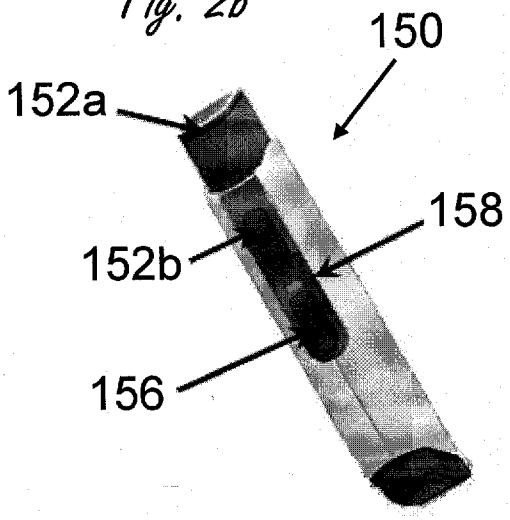



Fig. 2d

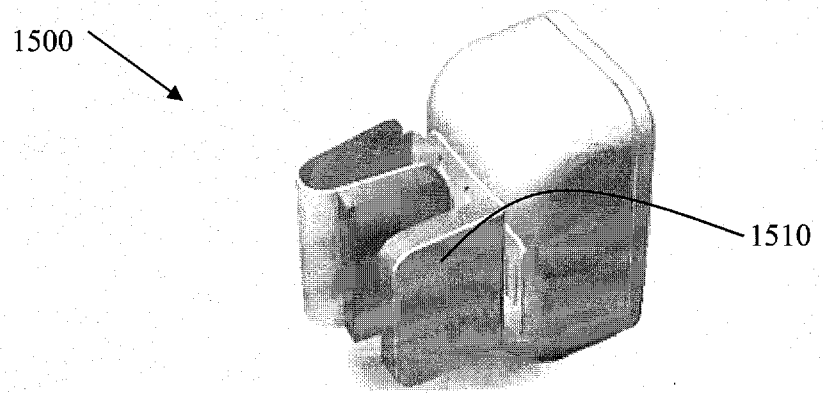



Fig. 2e

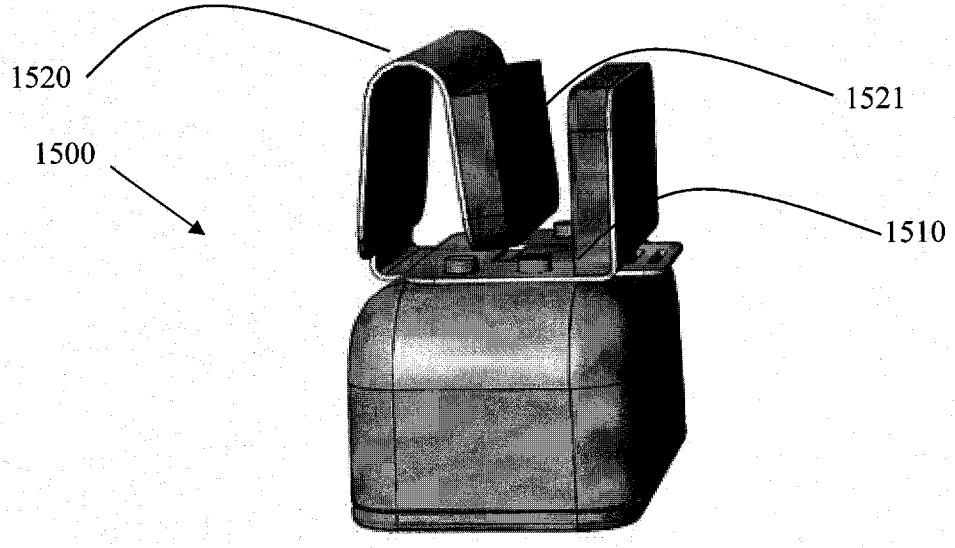



Fig. 2f

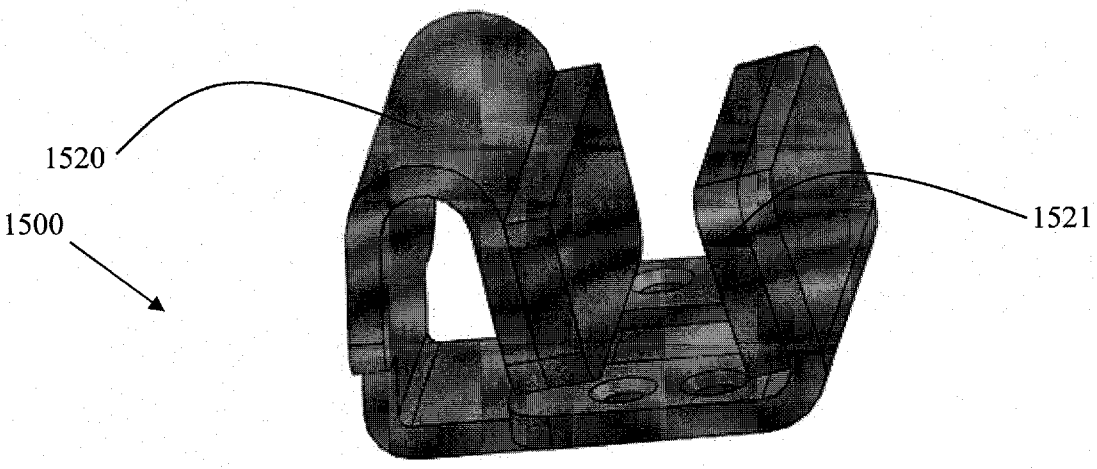



Fig. 2g

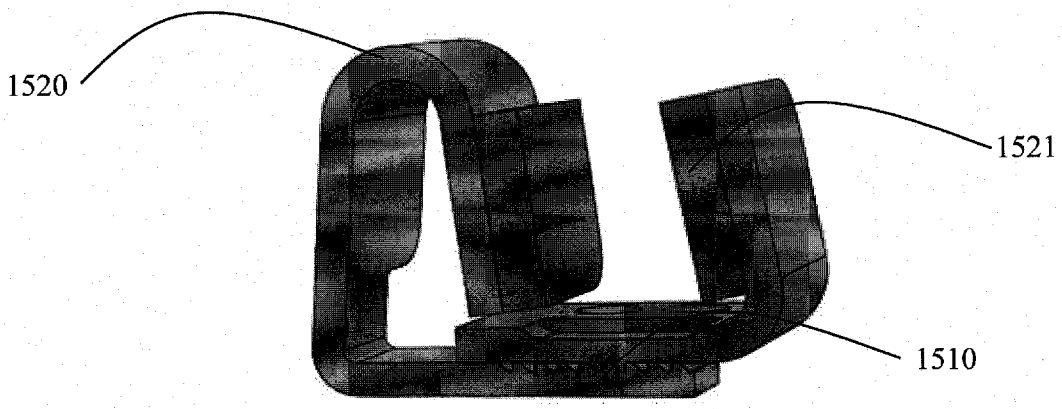



Fig. 2h

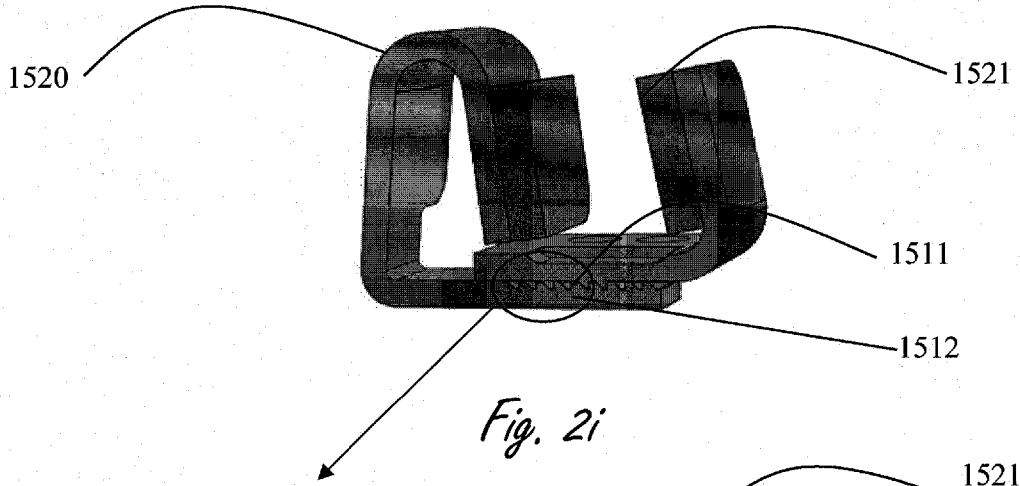
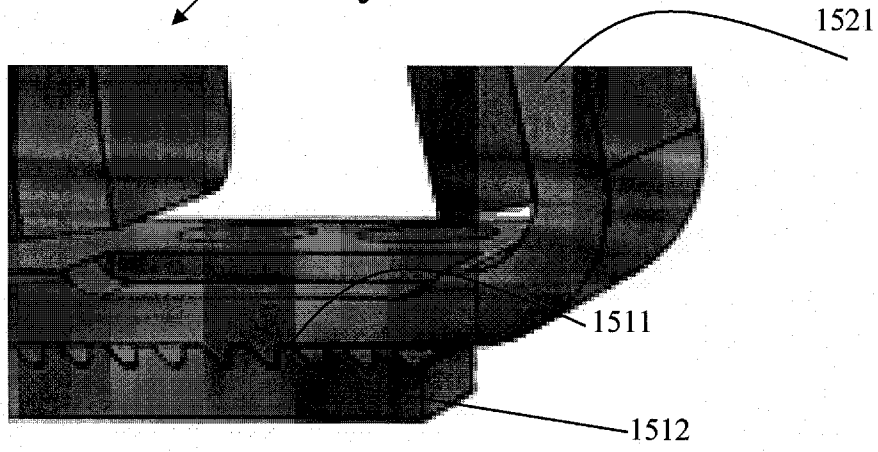



Fig. 2i



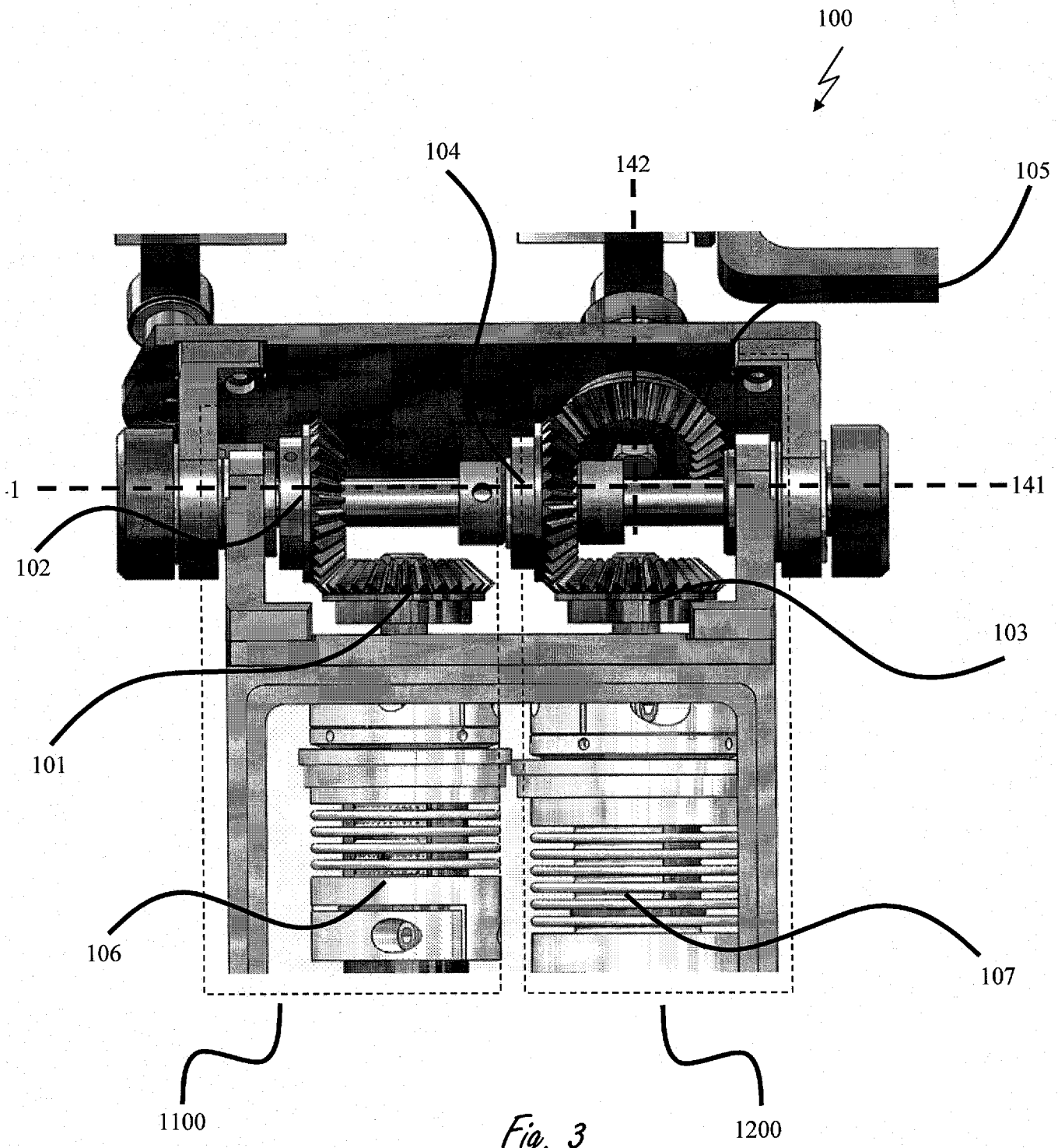



Fig. 3

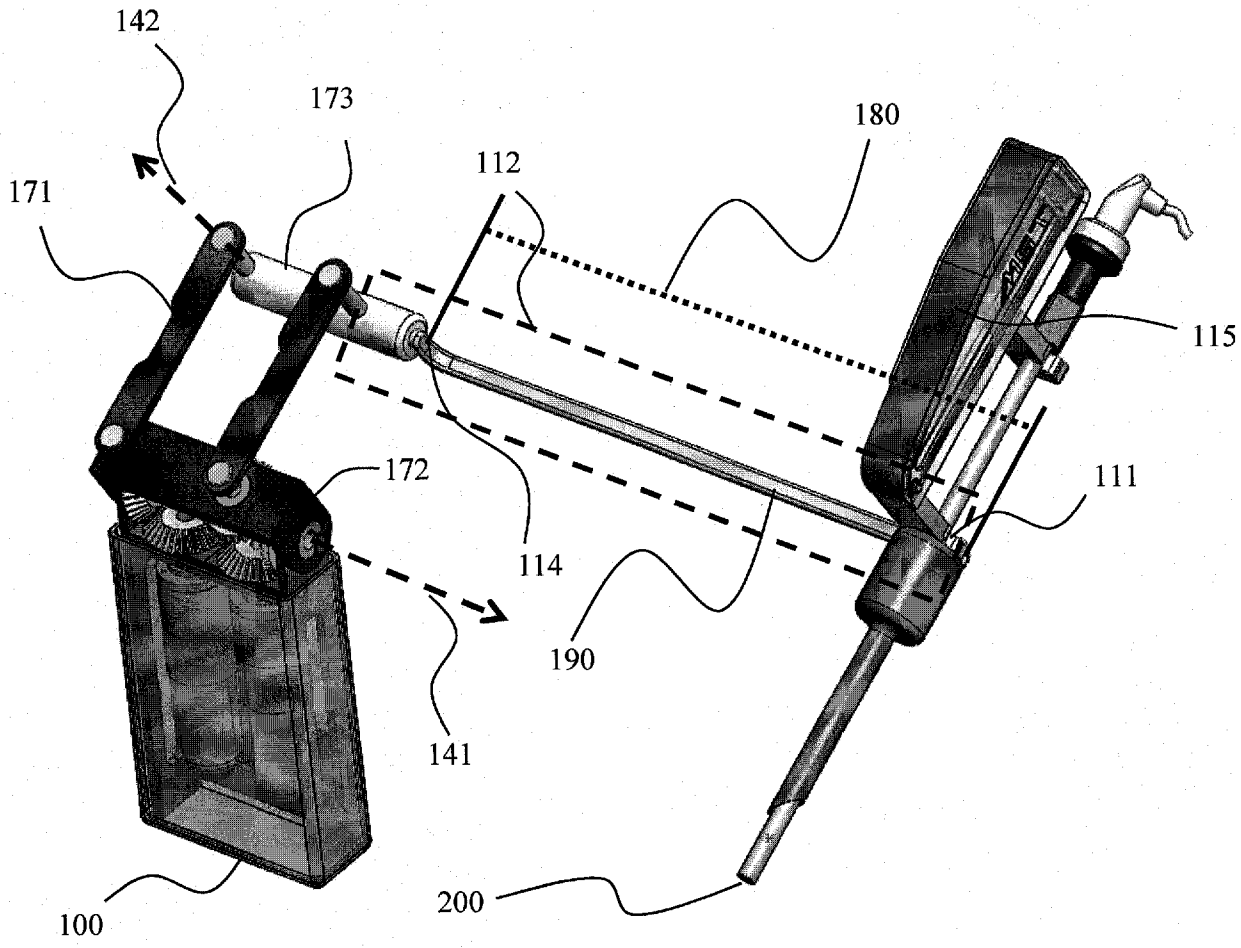



Fig. 4a

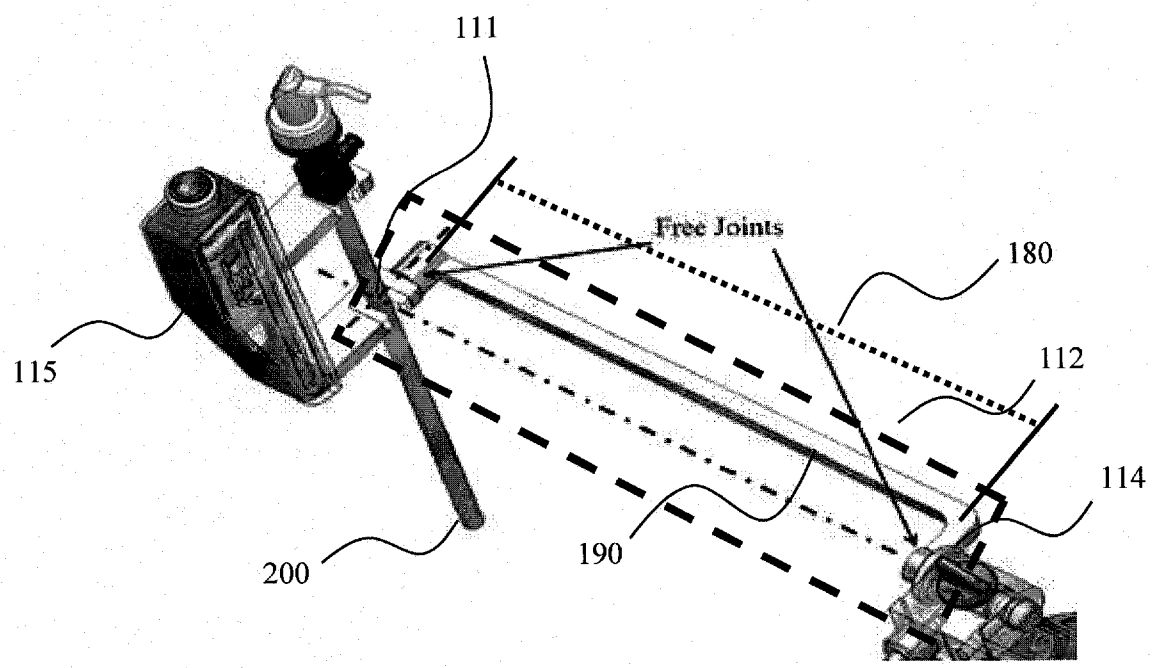



Fig. 4b

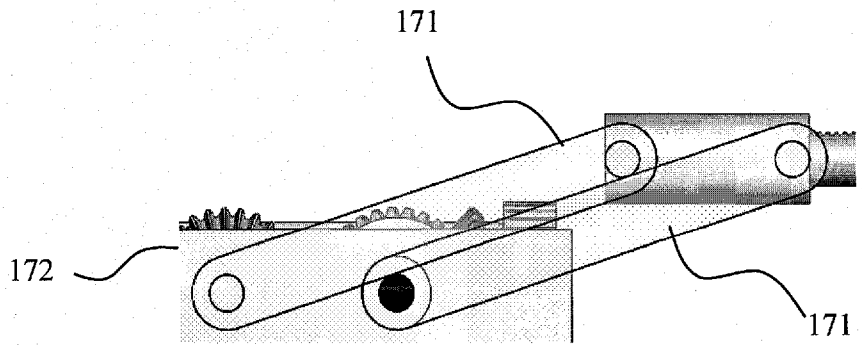



Fig. 5a

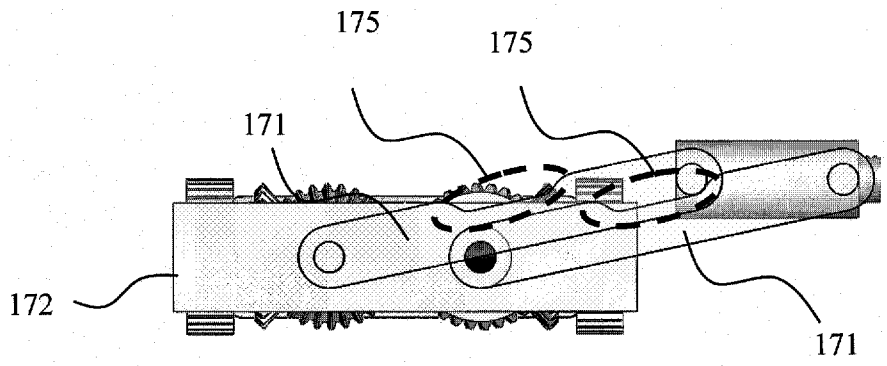



Fig. 5b

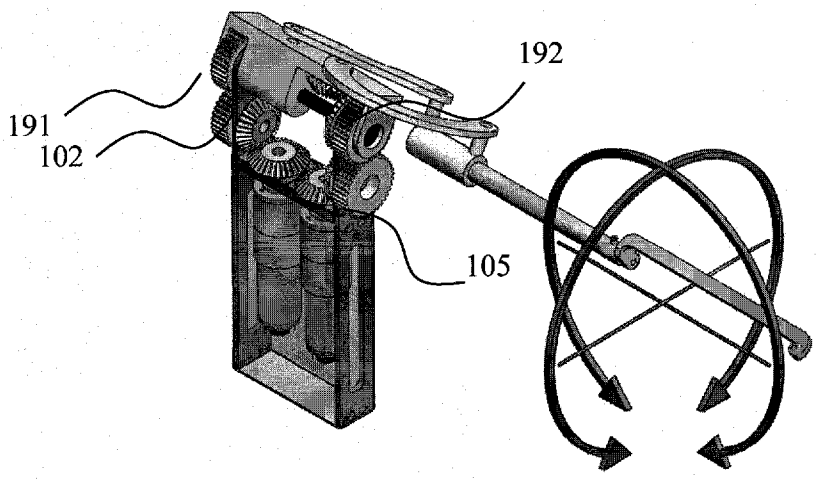



Fig. 6a

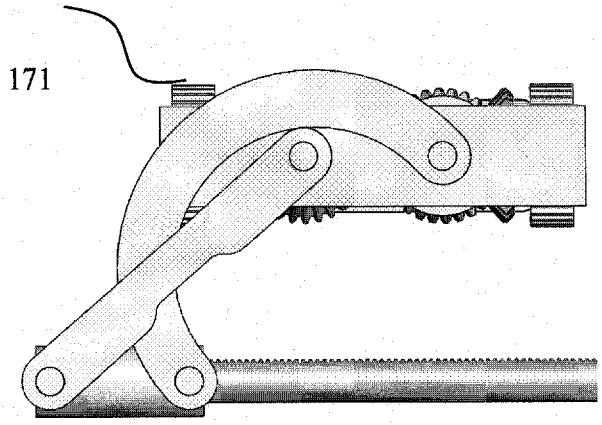



Fig. 6b

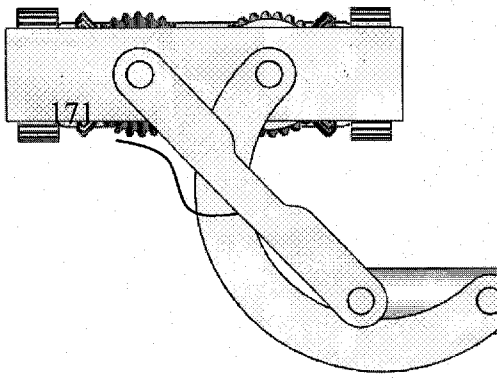



Fig. 6c

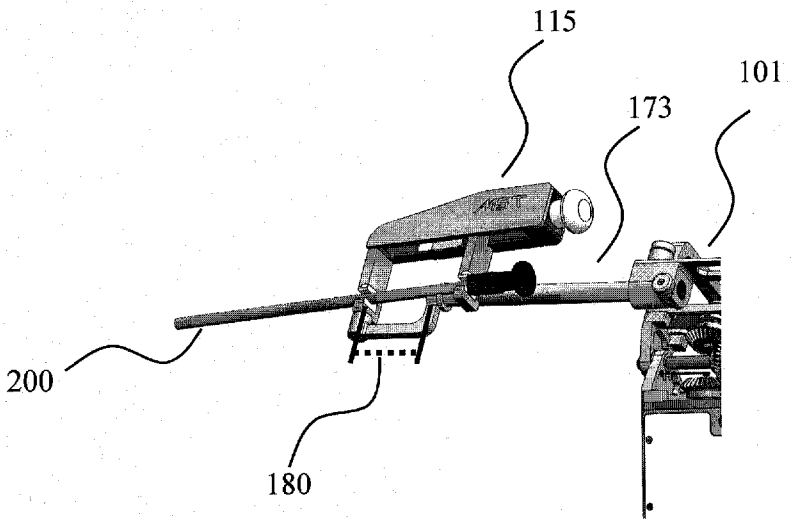



Fig. 7a

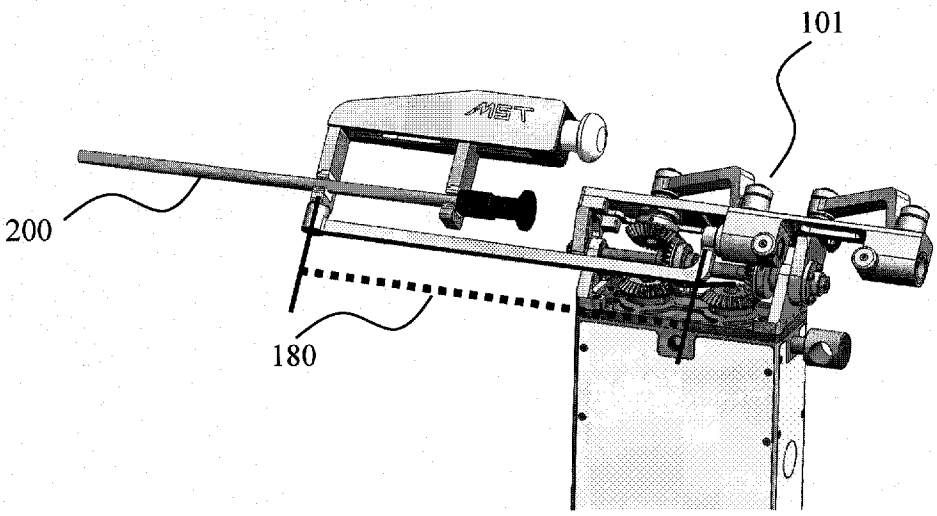



Fig. 7b

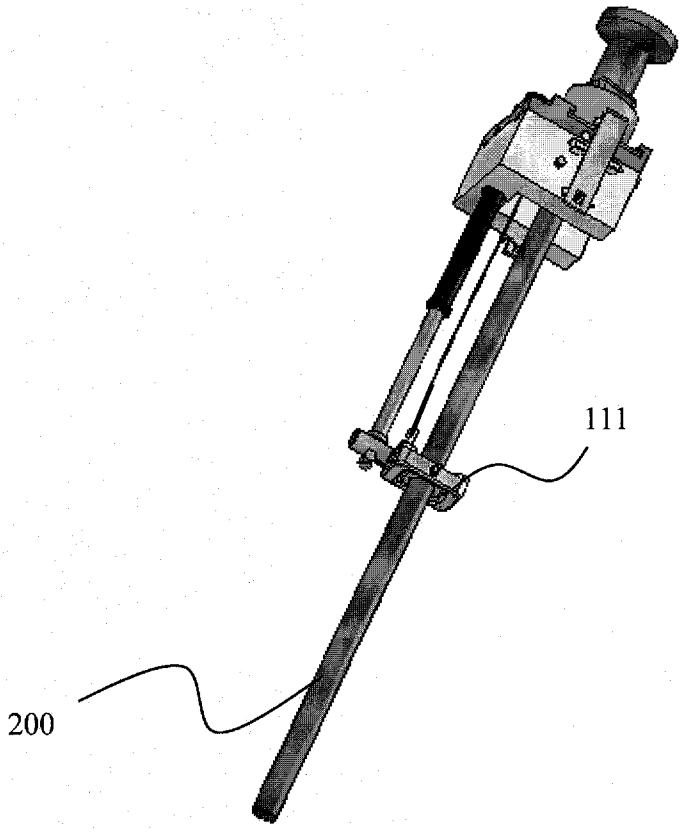



Fig. 8

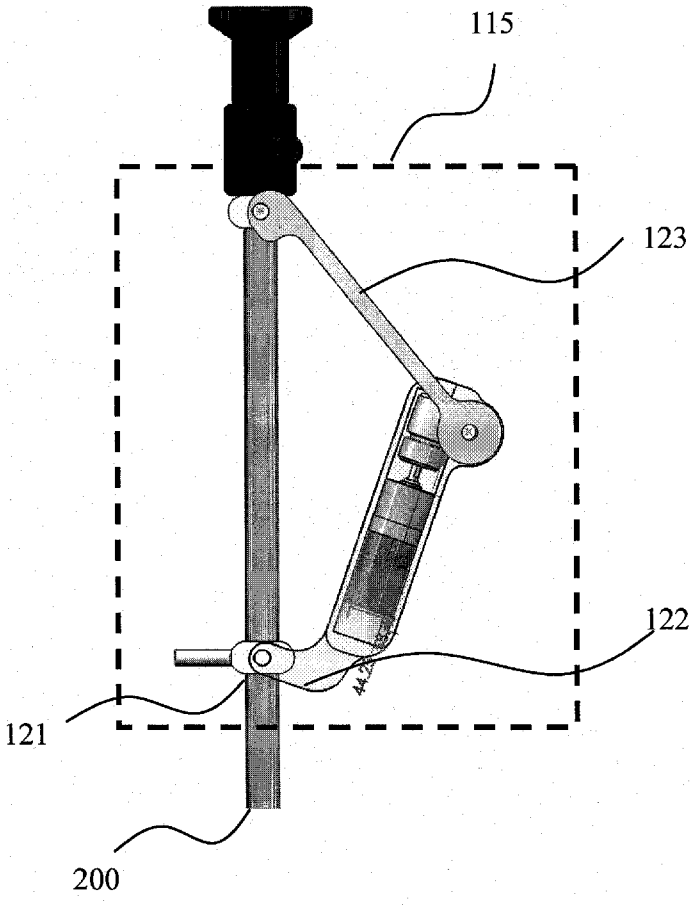



Fig. 9a

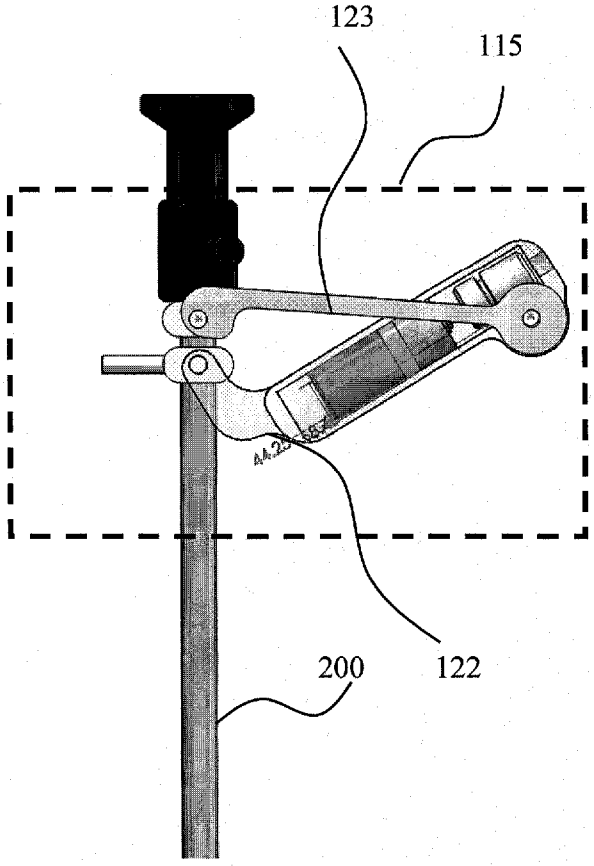



Fig. 9b

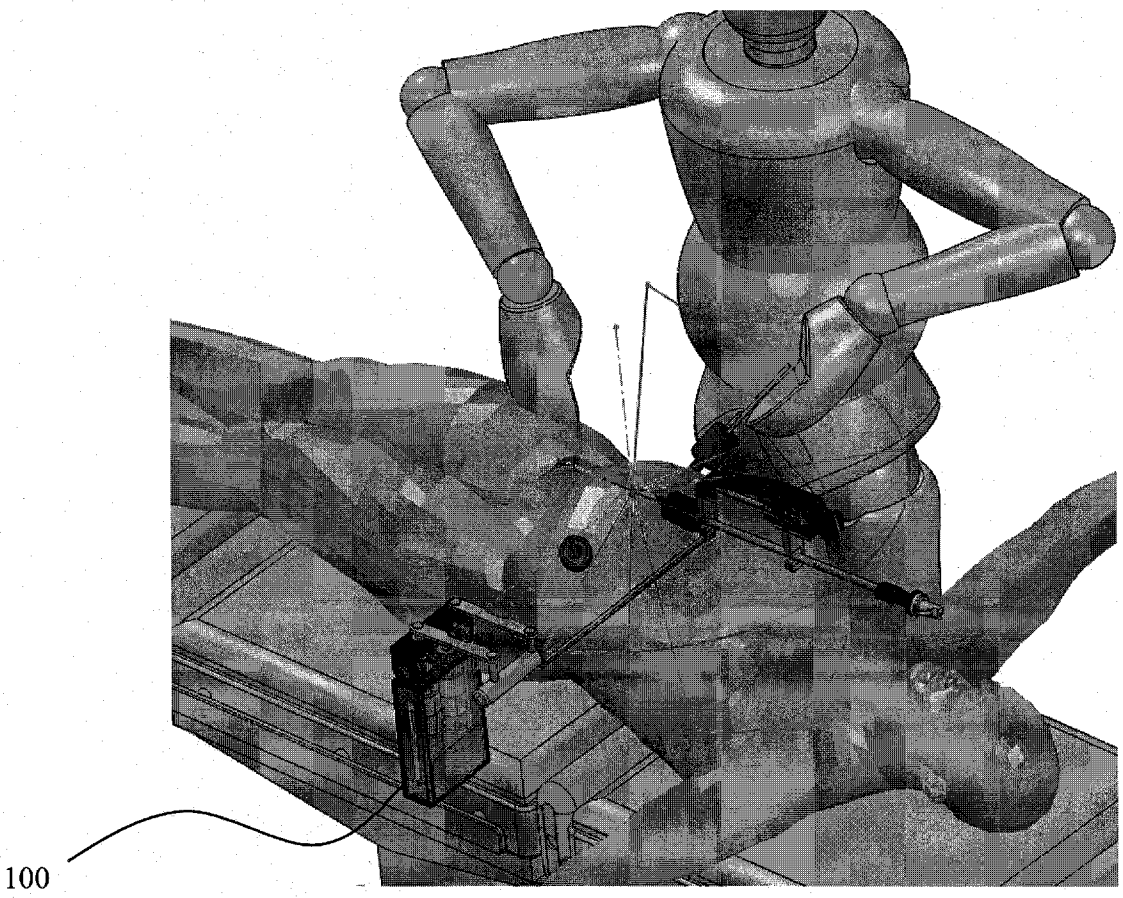



Fig. 10

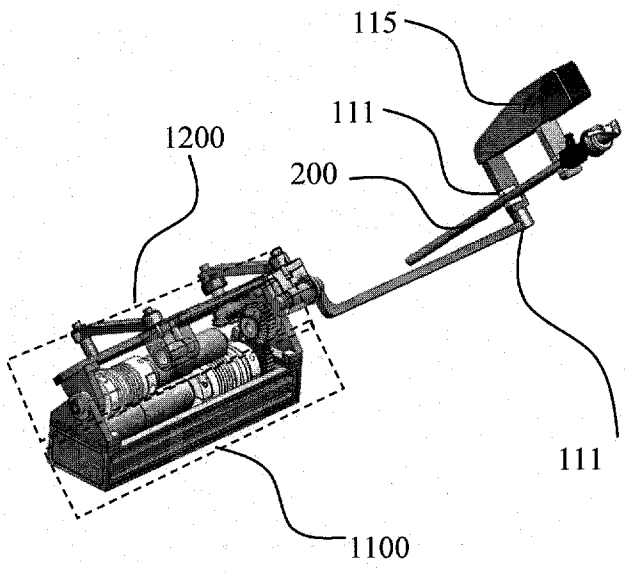



Fig. 11a

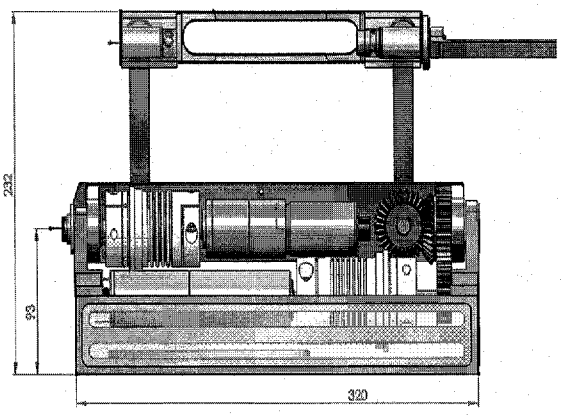



Fig. 11b

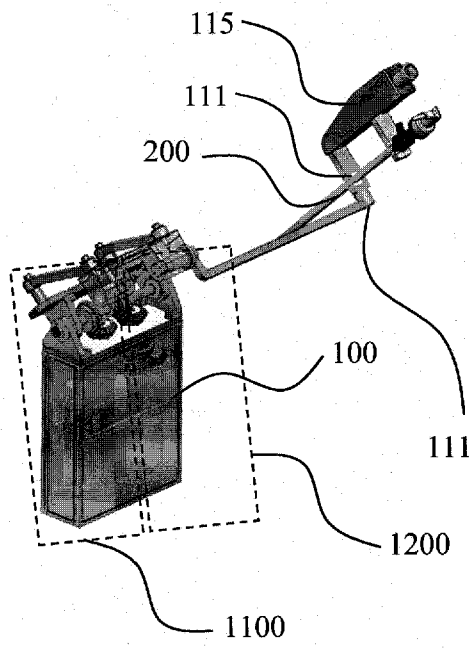



Fig. 12a

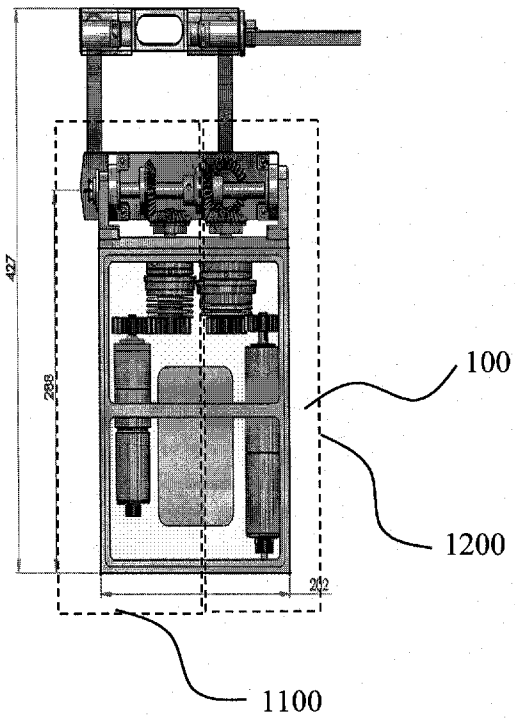



Fig. 12b

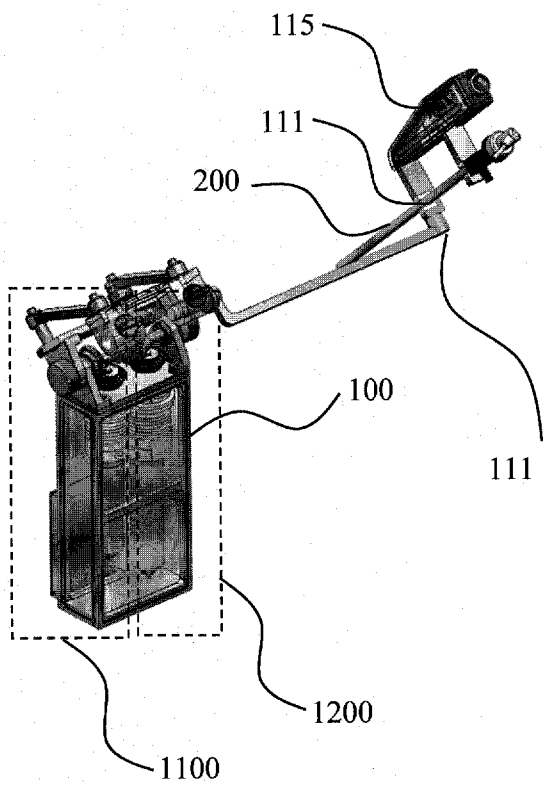



Fig. 13a

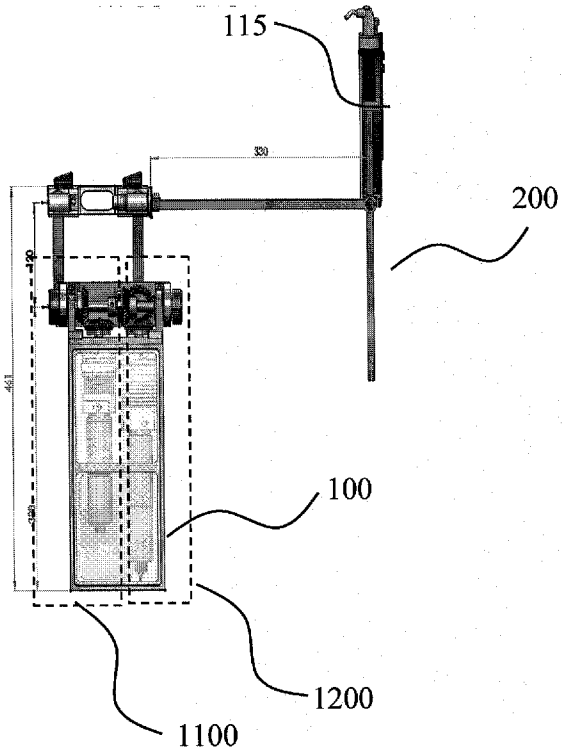



Fig. 13b

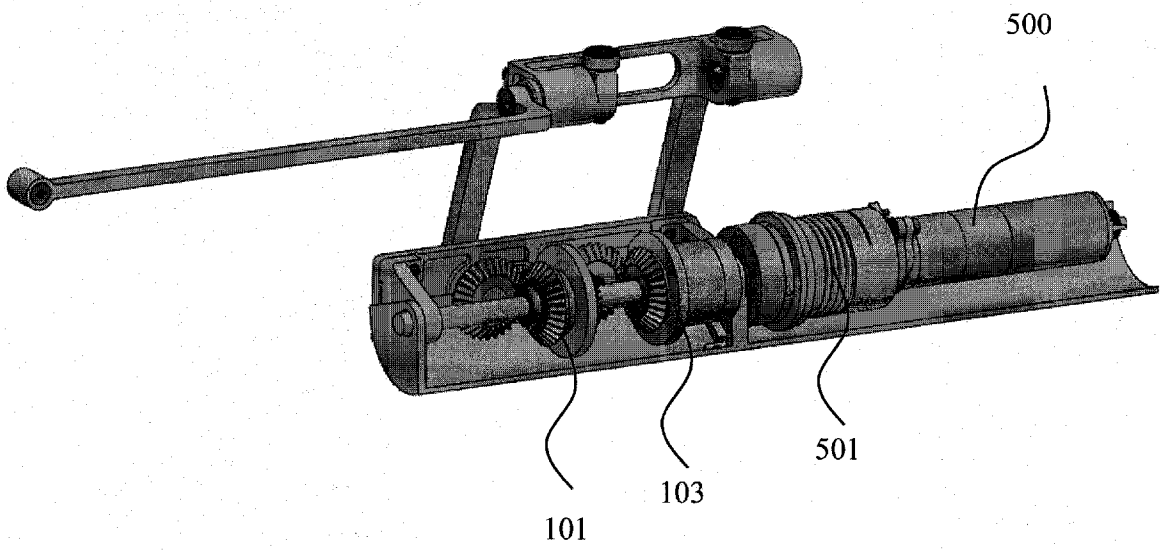



Fig. 14

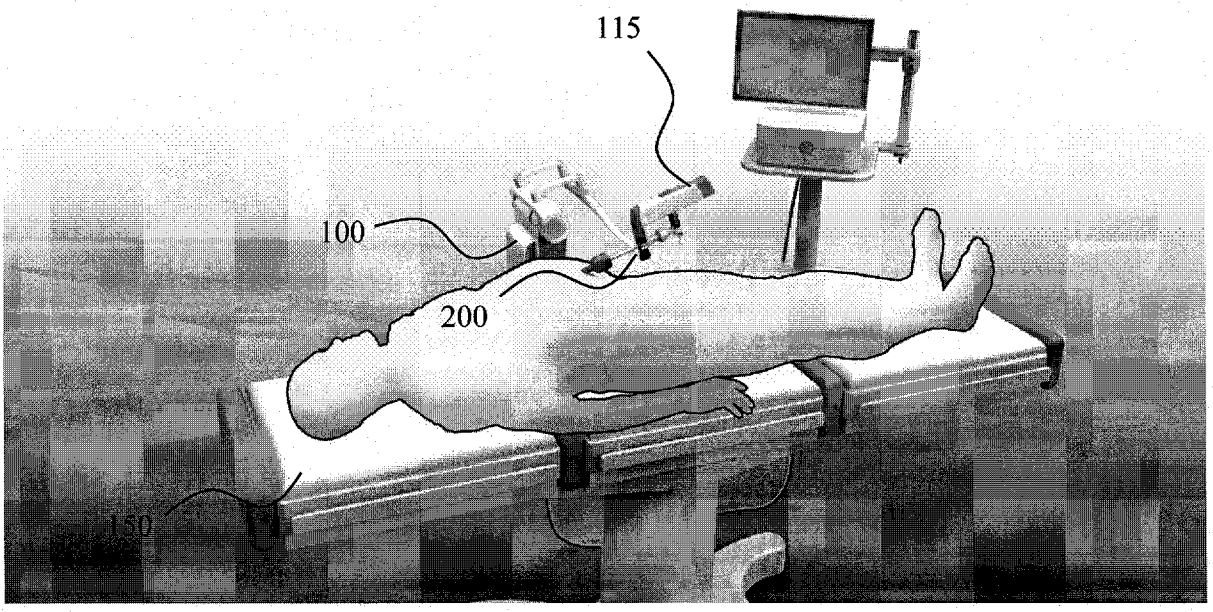



Fig. 15

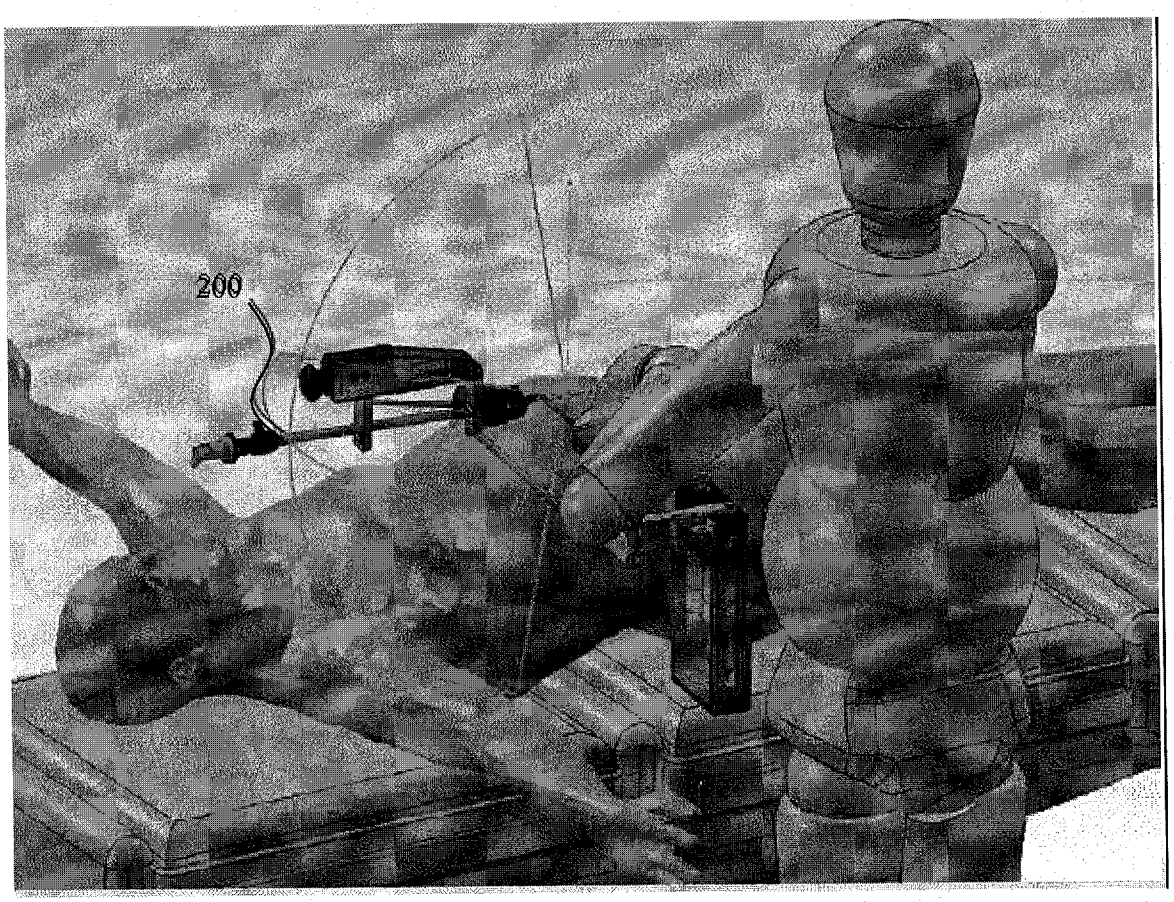



Fig. 16

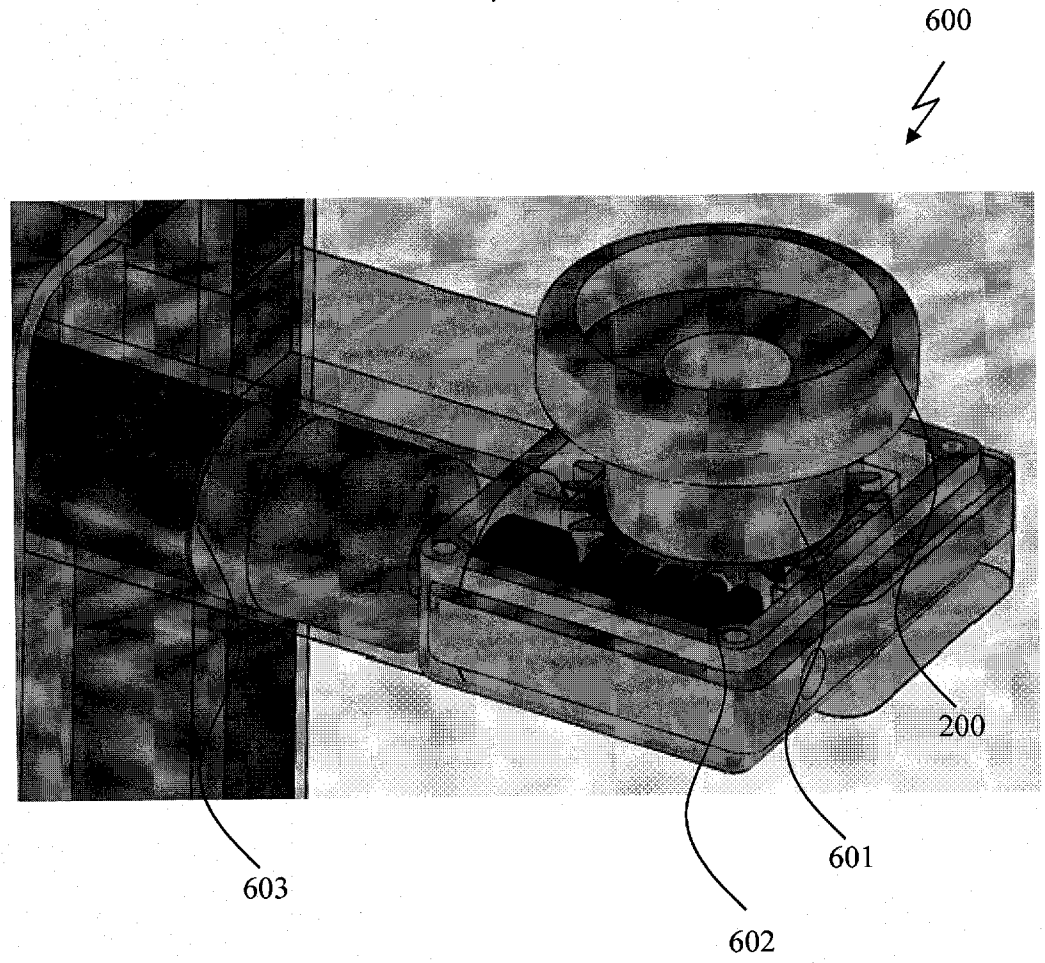



Fig. 17

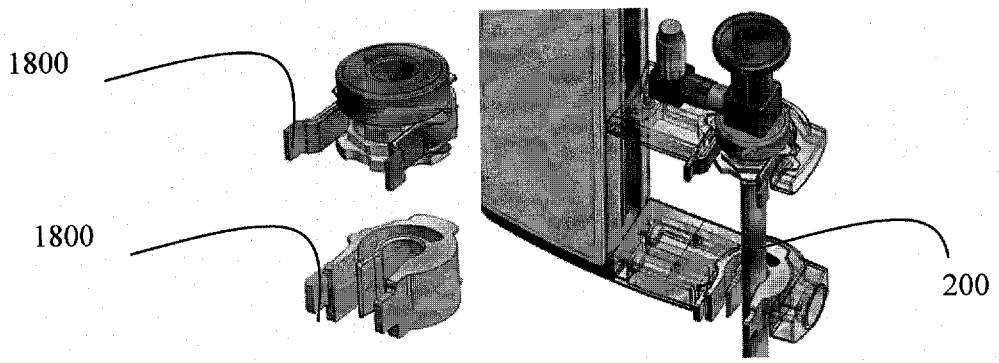



Fig. 18

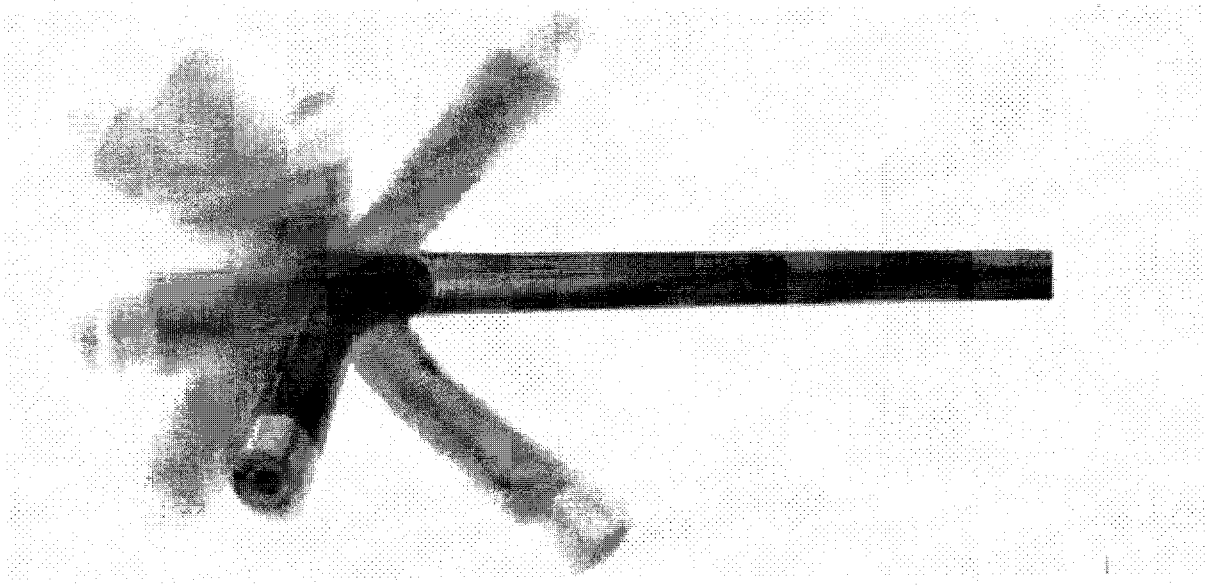


Fig. 19

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL2013/050183

**A. CLASSIFICATION OF SUBJECT MATTER**
IPC(8) - A61 B 19/00 (201 3.01 )
USPC - 606/1 30
**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)**
IPC(8) - A61B1/00, 1/005, 1/008, 1/01, 1/313, 19/00 (2013.01 )
USPC - 600/101, 104, 114, 117, 118, 146; 606/130

**Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched**
CPC - A61 B 1/00, 1/00131, 1/00133, 1/00147, 1/00149, 1/0016, 1/01, 1/313, 1/3132, 19/20, 19/22, 19/2203, 19/5244, 2019/22, 2019/2203, 2019/221 1, 2019/2269, 2019/2276, 2019/2292 (2013.01 )

**Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)**
Patbase, Google Patents, Google Scholar

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | US 5,553,198 A (WANG et al) 03 September 1996 (03.09.1996) entire document | 1,5,7-8,12-13,15-16, 29-30,33-34,39,82-83,87, 89-90,94-95,97-98,100, 111-112,115-116 |
| --- | | --- |
| Y | | 2-4,6,9-11,14,17-21, 24-25,27-28,35-38,40-45, 53-58,84-86,88,91-93,96, 99,101-103,106-107, 109-110,117-120, 123-127, 135-140 |
| Y | US 2004/0239631 A1 (GRESHAM) 02 December 2004 (02.12.2004) entire document | 2,35-38,40,58,84,117-120, 140 |
| Y | US 2005/0119527 A1 (BANIK et al) 02 June 2005 (02.06.2005) entire document | 3-4,6,37-38,40,85-86,88, 119-120 |
| Y | US 2011/0175989 A1 (ISLAM) 21 July 2011 (21.07.2011) entire document | 9-10,27-28,91-92, 109-110 |
| Y | US 2003/0195389 A1 (MOTOKI et al) 16 October 2003 (16.10.2003) entire document | 11, 19, 93, 101 |
| Y | US 2007/0142824 A1 (DEVENGENZO et al) 21 July 2007 (21.07.2007) entire document | 14, 24, 96, 106 |

☒ **Further documents are listed in the continuation of Box C.** ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"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
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 07 June 2013 | 28 JUN 2013 |
| **Name and mailing address of the ISA/US** | **Authorized officer:** |
| Mail Stop PCT, Attn: ISA/US, Commissioner for Patents<br>P.O. Box 1450, Alexandria, Virginia 22313-1450<br>Facsimile No. 571-273-3201 | Blaine R. Copenheaver<br>PCT Helpdesk: 571-272-4300<br>PCT OSP: 571-272-7774 |

**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/IL2013/050183

**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 77, 78, 159, and 160
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box No. Ill Observations where unity of invention is lacking (Continuation of item 3 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/IL20 13/050 183

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | US 2009/0312101 A1 (POPE) 17 December 2009 (17.12.2009) entire document | 17-18, 99 |
| Y | US 8,058,969 B1 (LAI et al) 15 November 201 1 (15.1 1.201 1) entire document | 20-21, 25, 102-103, 107 |
| Y | AU 2007234510 A1 (SHOLEV) 06 December 2007 (06.12.2007) entire document | 40-45,53-57,123-127, 135-139 |
| Y | US 201 1/01 18748 A1 (ITKOWITZ) 19 May 201 1 (19.05.201 1) entire document | 41-45,53-57,123-127, 135-139 |
| A | US 201 1/0144659 A1 (SHOLEV) 16 July 201 1 (16.07.201 1) entire document | 1-76, 79-158, 161-163 |

| | | | |
|---|---|---|---|
| 专利名称(译) | 用于操纵内窥镜的手动控制系统 | | |
| 公开(公告)号 | EP2819609A1 | 公开(公告)日 | 2015-01-07 |
| 申请号 | EP2013754731 | 申请日 | 2013-02-28 |
| [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 | ATAROT GAL<br>SHOLEV MORDEHAI | | |
| 发明人 | ATAROT, GAL<br>SHOLEV, MORDEHAI | | |
| IPC分类号 | A61B19/00 A61B1/00 A61B1/005 | | |
| CPC分类号 | A61B1/00006 A61B1/00133 A61B1/0016 A61B1/0051 A61B1/0052 A61B34/30 A61B2034/301 A61B2034/742 A61B1/00147 A61B34/35 A61B34/70 A61B34/74 A61B2034/302 | | |
| 优先权 | 61/604535 2012-02-29 US | | |
| 其他公开文献 | EP2819609A4 | | |
| 外部链接 | Espacenet | | |


摘要(译)

本发明提供一种用于在医疗过程期间操纵内窥镜（SFME）的系统，包括：a。至少一个操纵系统，适于在至少两个自由度（DOF）中操纵所述内窥镜;而且，b。至少一个与所述操纵系统连通的操纵杆单元，适于操作所述操纵系统;其中所述操纵杆的操作通过所述操纵系统导致所述内窥镜的移动。