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(54) **SYSTEM FOR POSITIONING ON A PATIENT AN OBSERVATION AND/OR INTERVENTION DEVICE**

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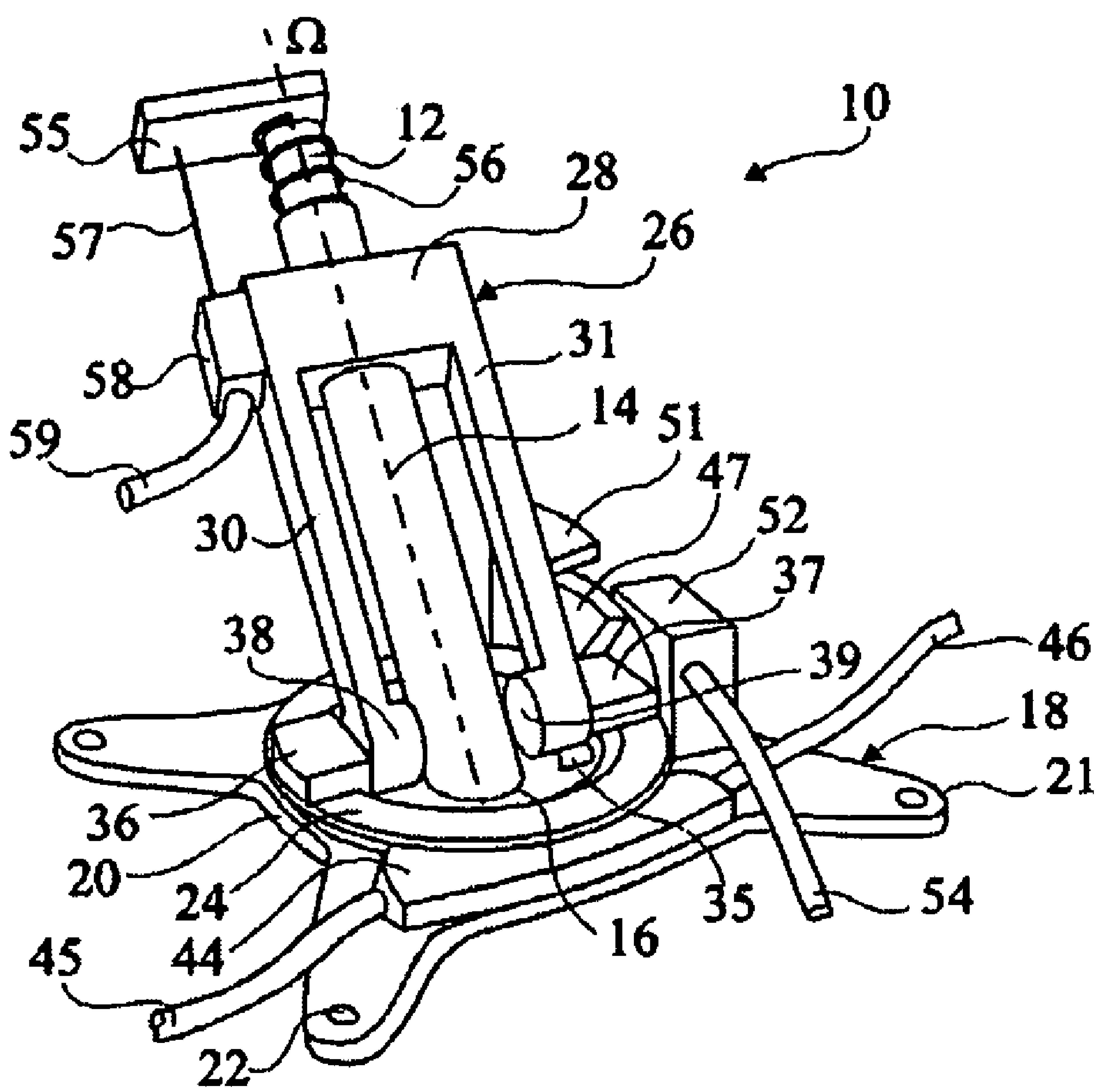
(57) **ABSTRACT**

The present invention relates to a system for positioning with respect to a patient's body an observation and/or intervention device having a portion penetrating into the patient's body comprising a base laid on the patient's body; a means for supporting the device formed of a first portion movably assembled on the base according to a connection with one degree of freedom, and of a second portion movably assembled on the first portion according to a connection with one degree of freedom and connected to the device; and means for actuating the first portion with respect to the base, and the second portion with respect to the first portion, in which the base surrounds at a distance at least partially the device, said device being detachably connected to the second portion to enable removal of the positioning system while leaving in place the device.



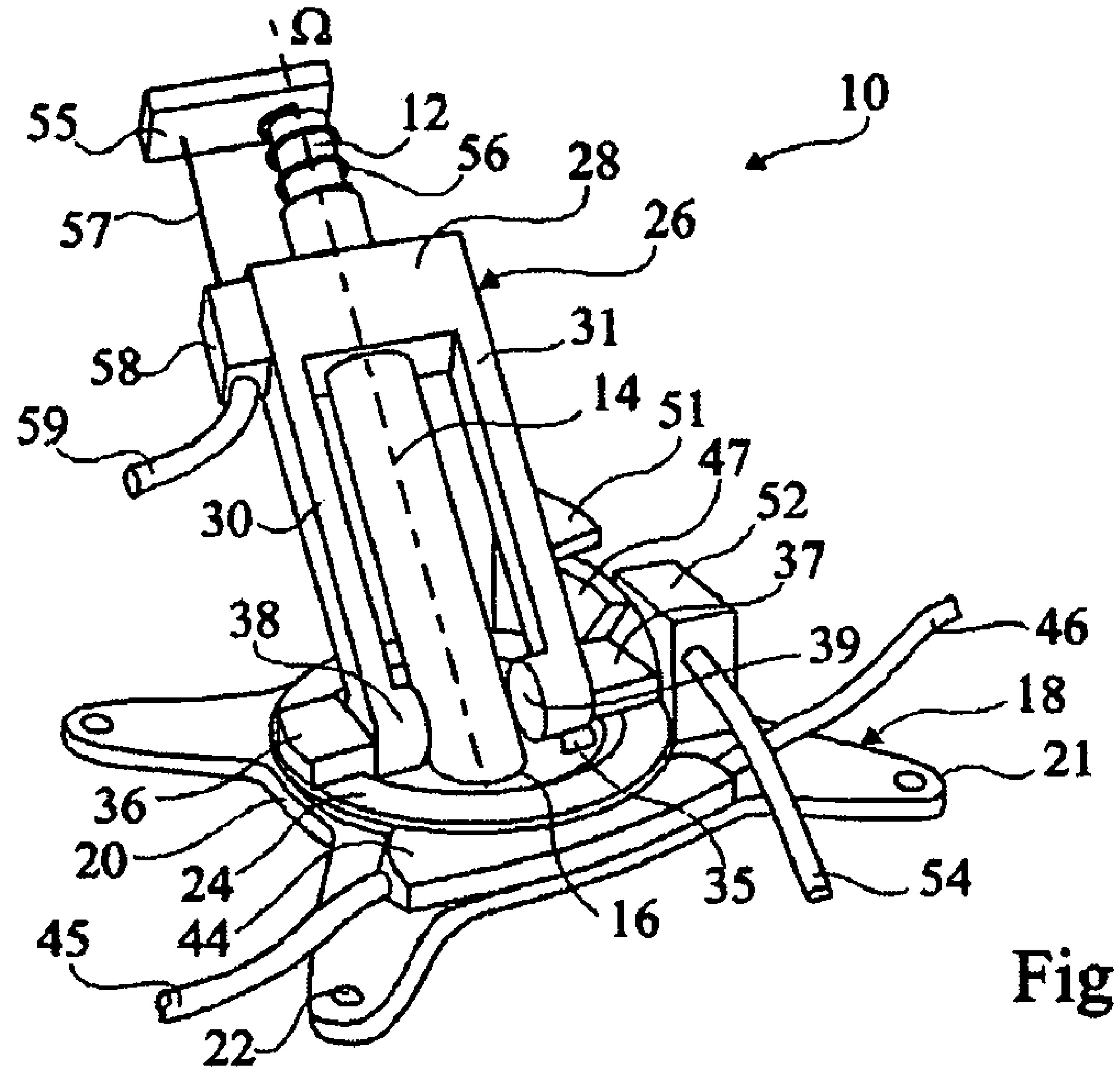


Fig 1A

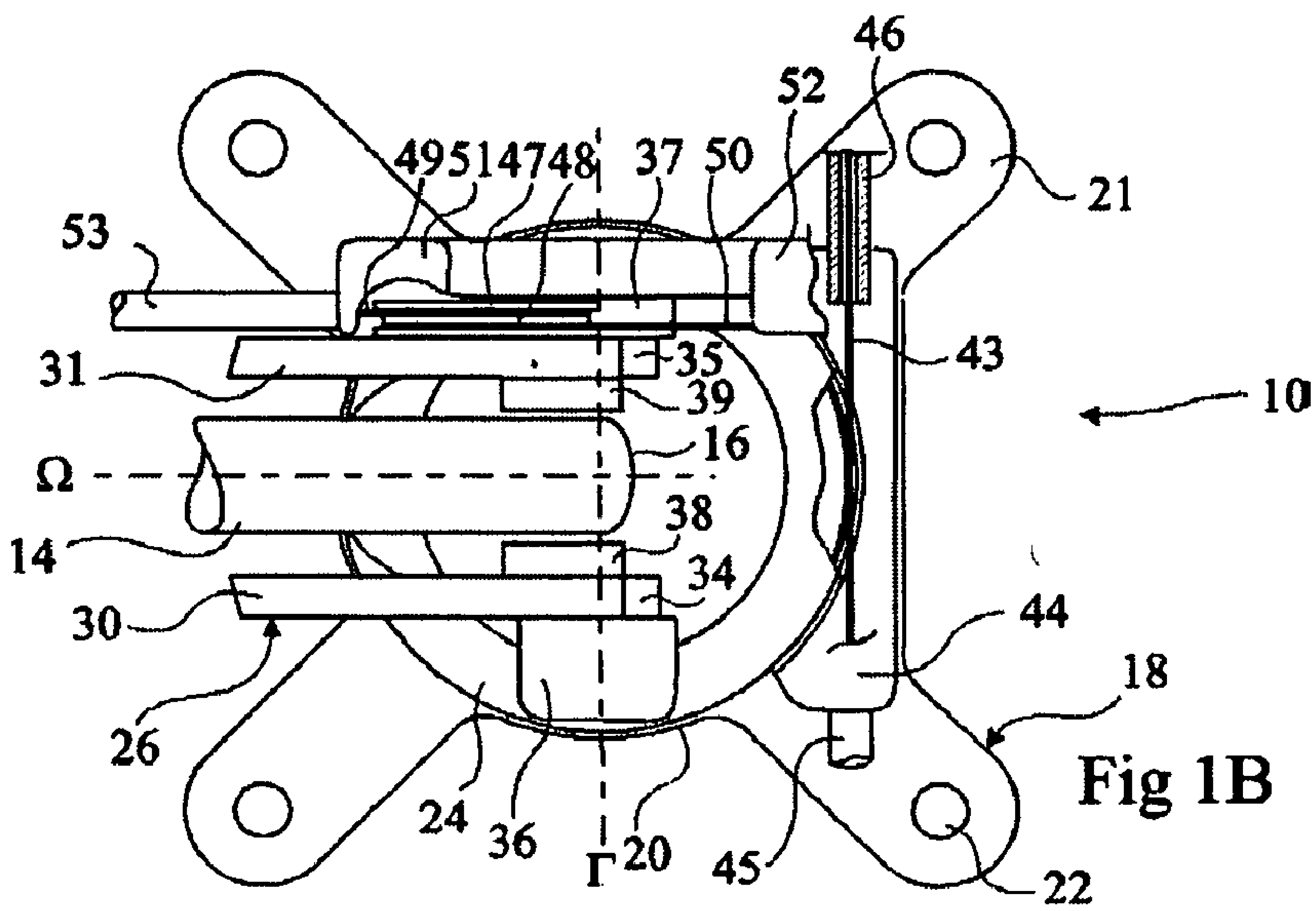


Fig 1B

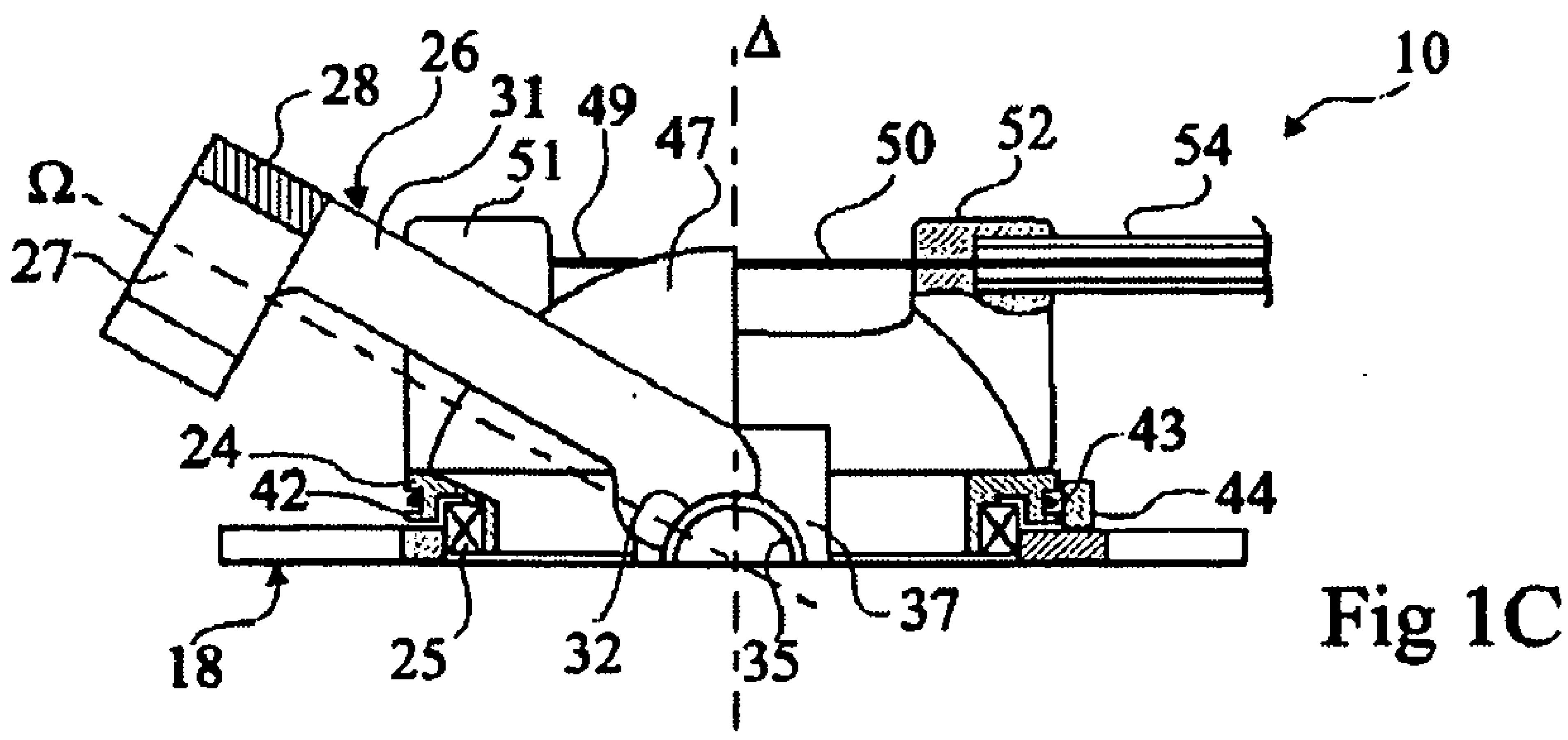


Fig 1C

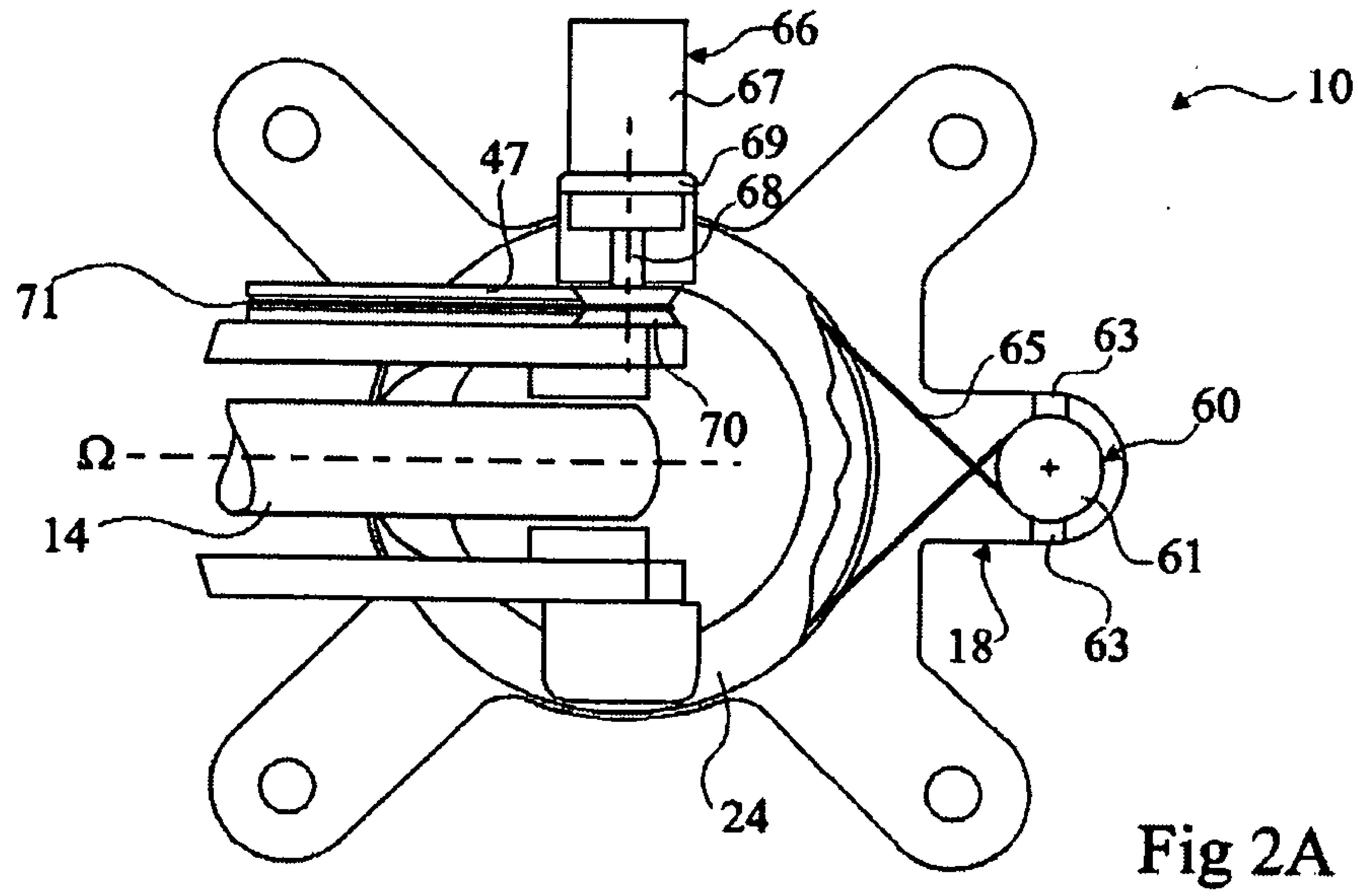


Fig 2A

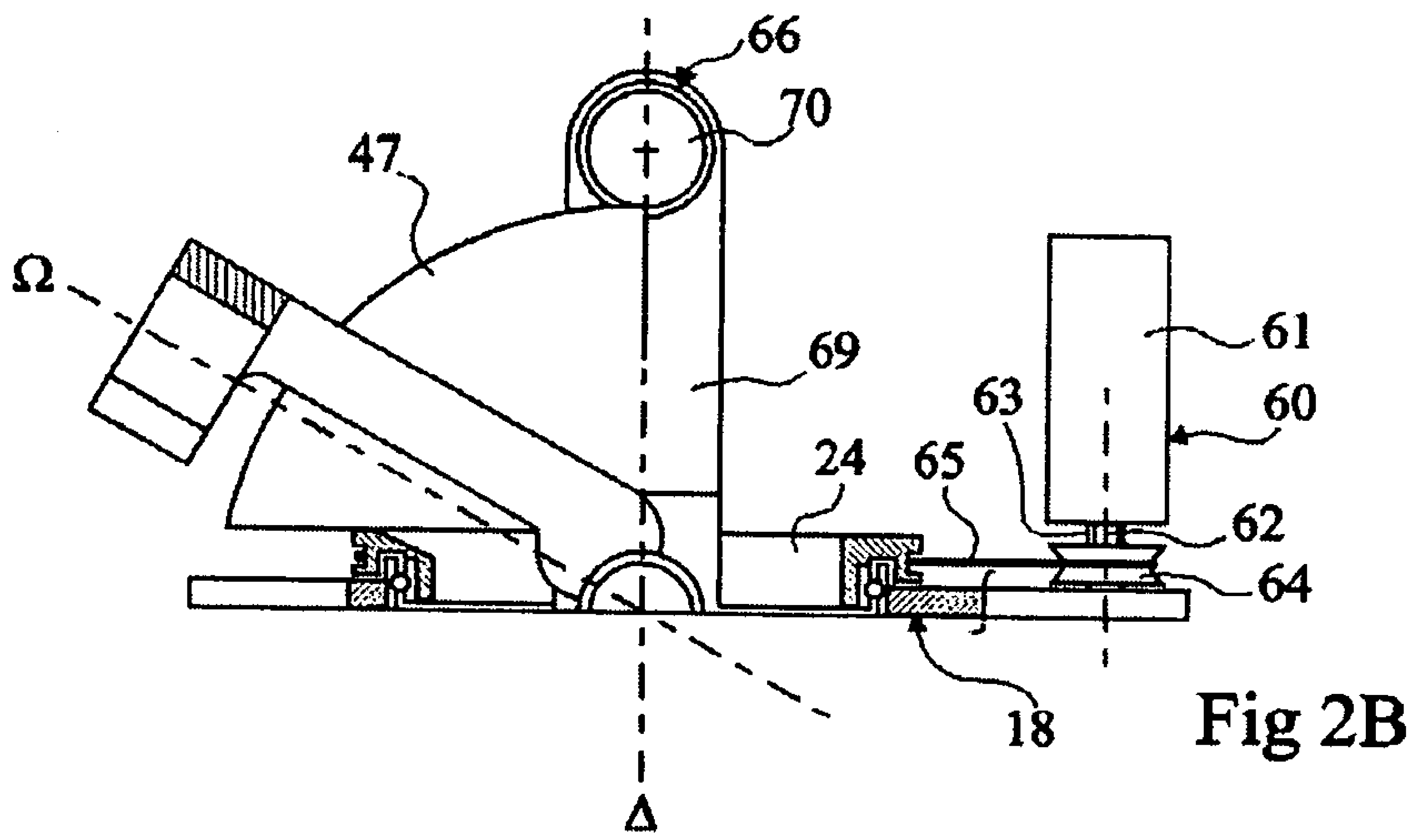


Fig 2B

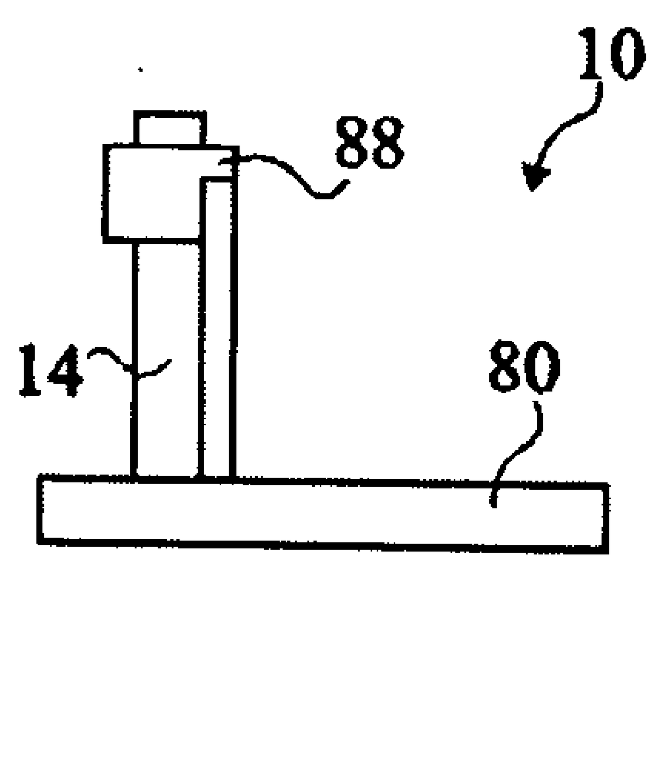


Fig 3A

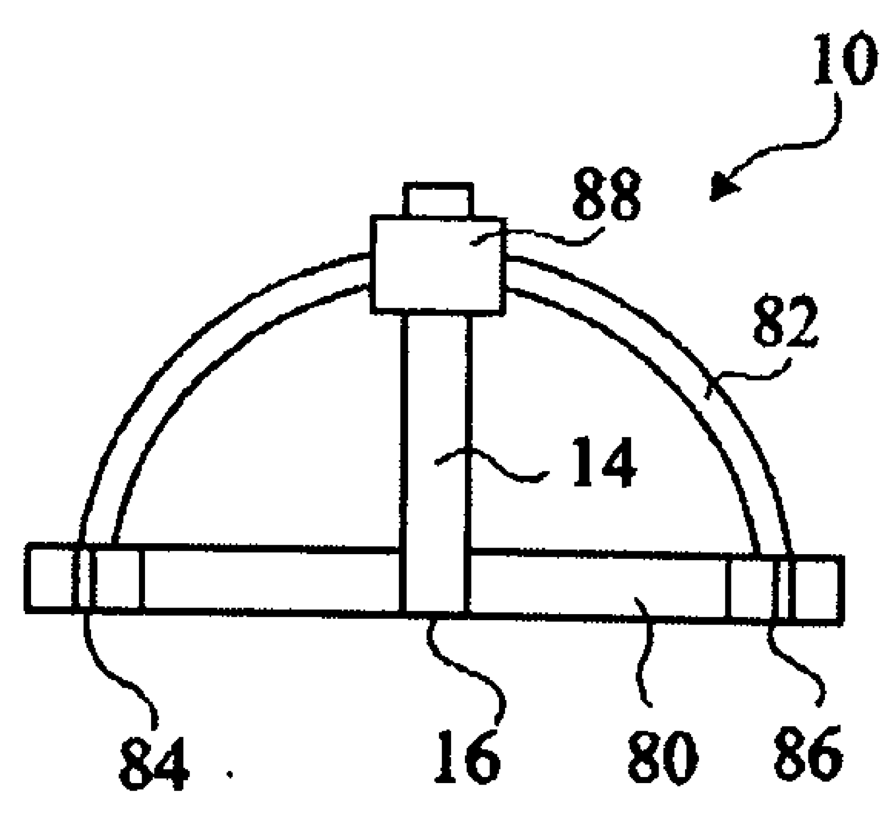


Fig 3B

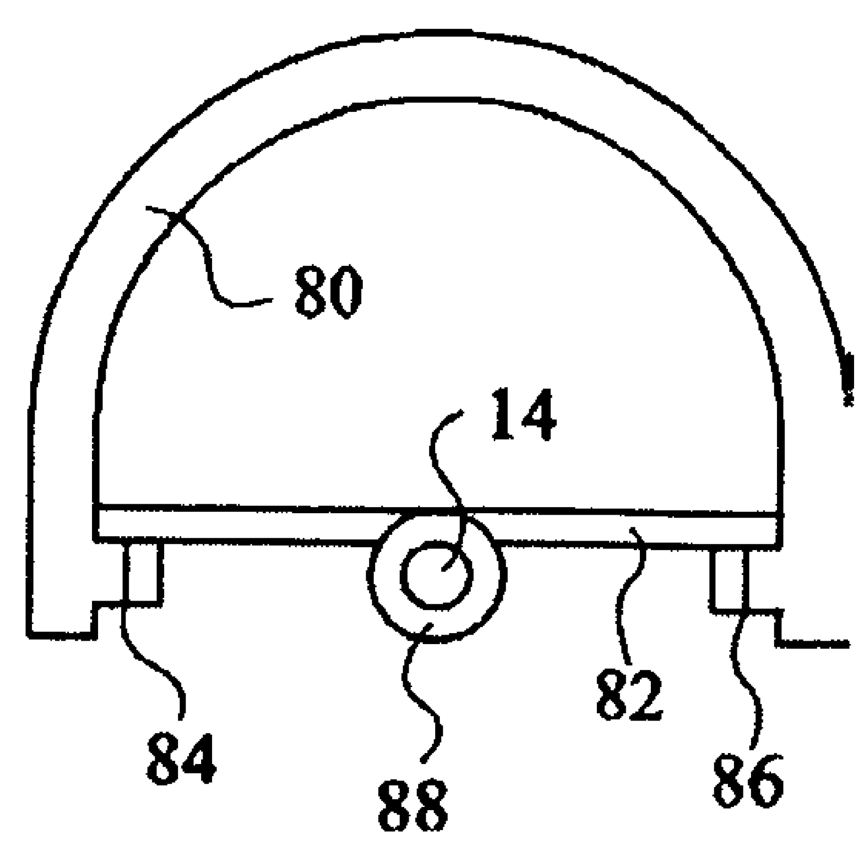
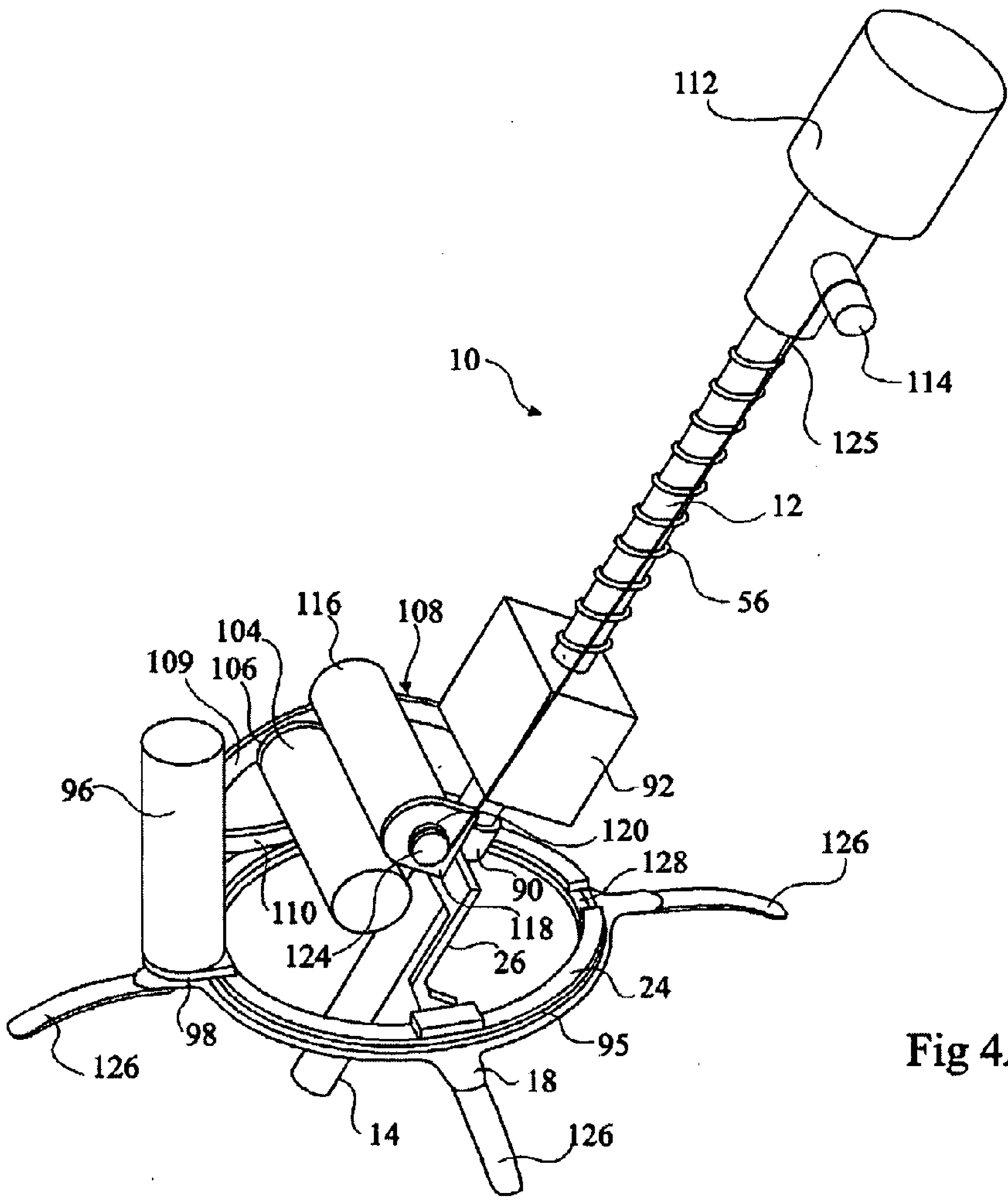


Fig 3C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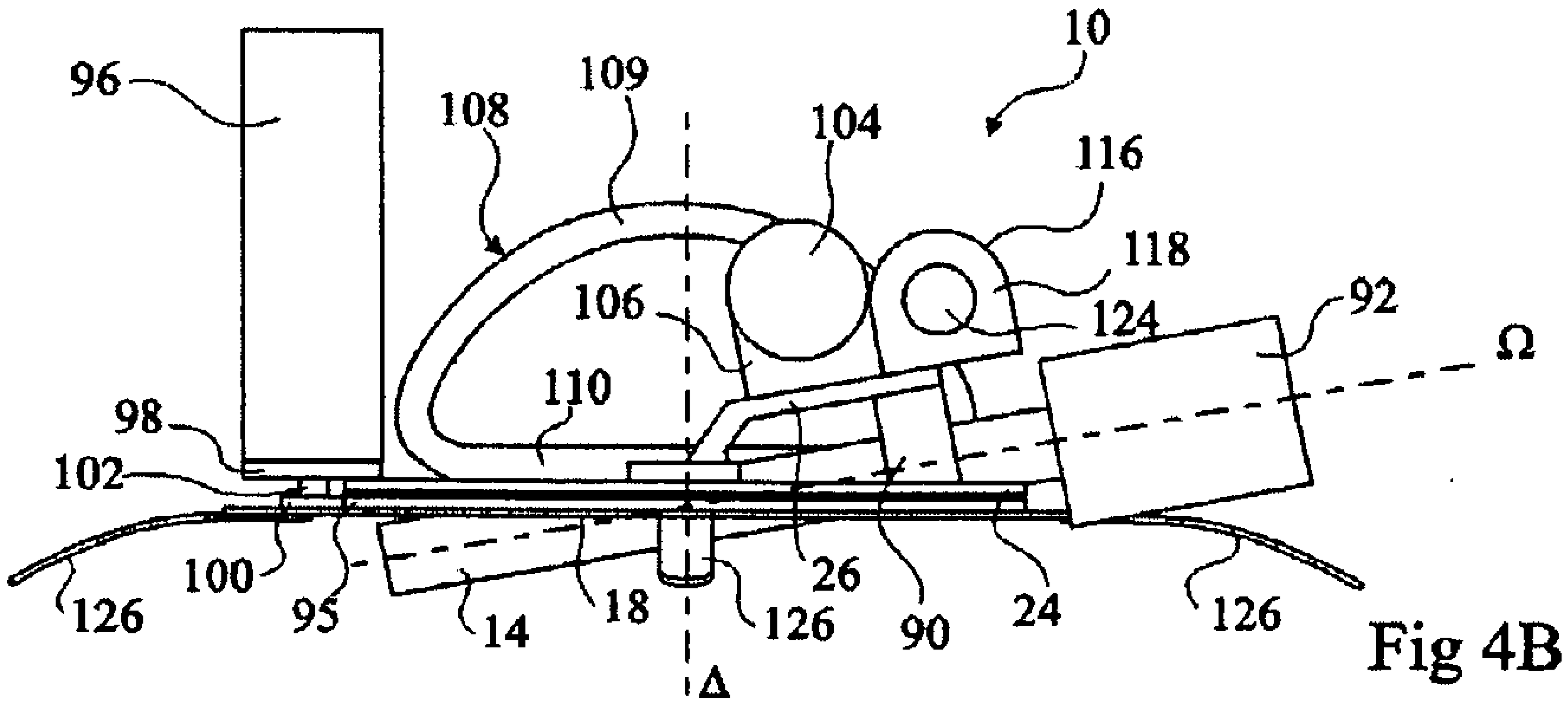
126

Fig 4A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126
Δ

Fig 4B

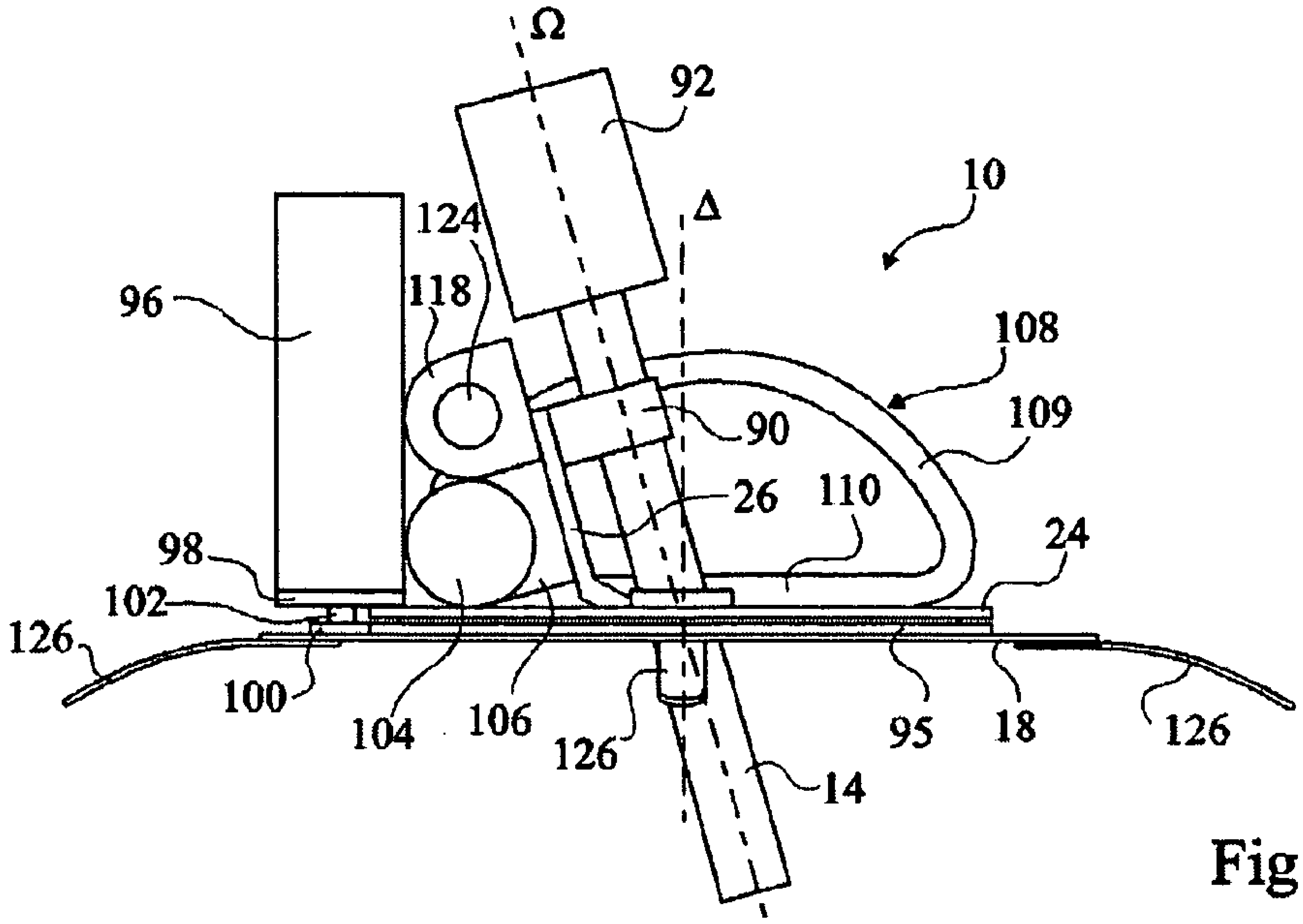
Ω
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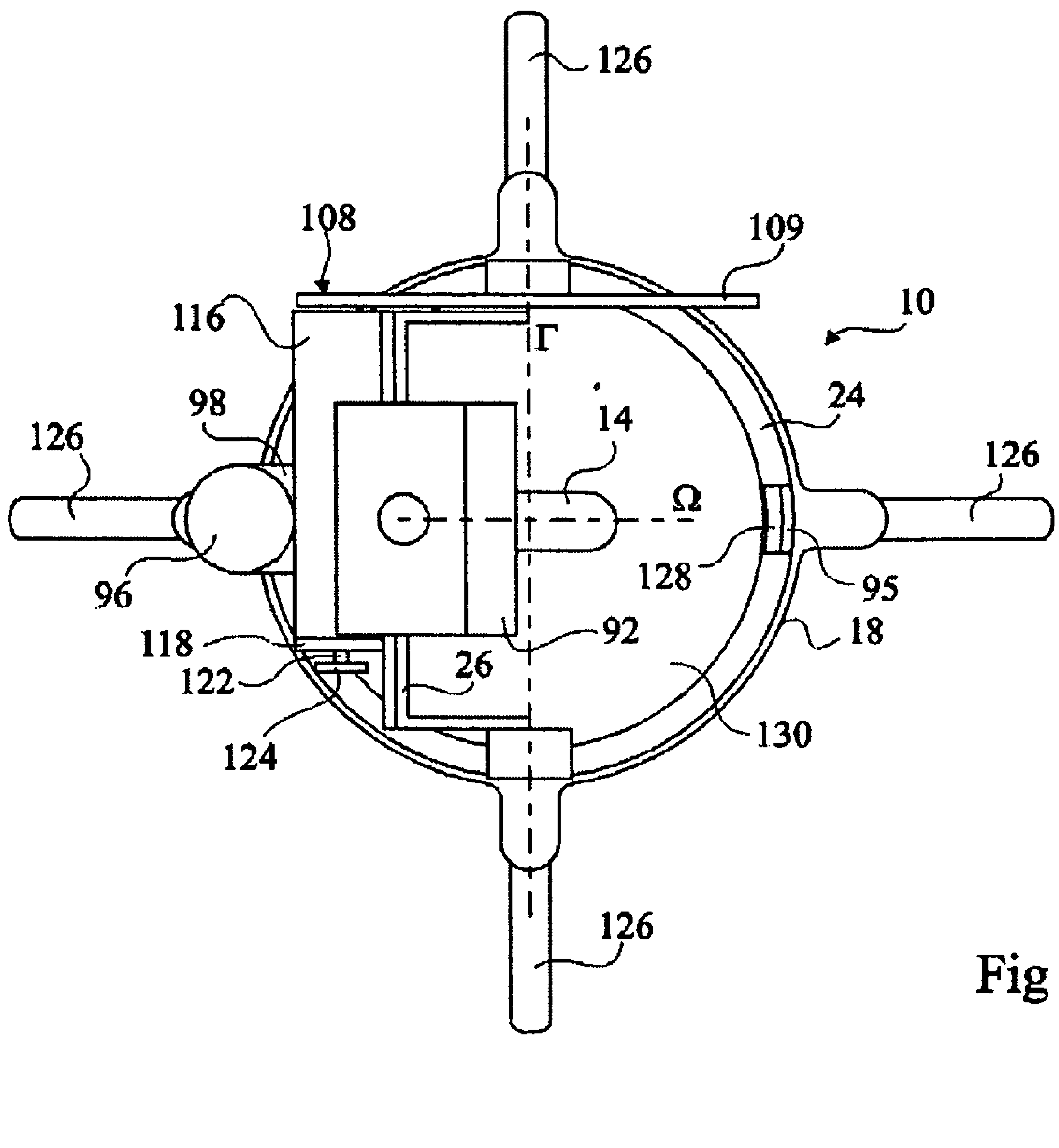
Fig 4C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124
130
126

Fig 4D

SYSTEM FOR POSITIONING ON A PATIENT AN OBSERVATION AND/OR INTERVENTION DEVICE

[0001] The present invention relates to a system for positioning on a patient an observation and/or intervention device having a portion penetrating into the patient's body. It for example applies to medical analysis systems, such as endoscopic systems, and it will more specifically be described in the case of a use of an endoscope in a laparoscopy.

[0002] In such a type of operation, an endoscope formed of a thin optical tube is inserted into the patient's abdomen through a small incision performed at the level of the patient's abdomen. The optical tube is generally connected to an external video camera. Other incisions may be performed to introduce surgical instruments handled by a surgeon. The endoscope is used to visualize the patient's internal organs and the surgical instruments. Since the surgeon generally has both hands occupied by the surgical instruments, an assistant is necessary to maintain the endoscope in a desired position.

[0003] Robotic systems have been developed to handle the endoscope instead of the assistant. Such systems are generally formed of massive, complex, and expensive robots comprising a base attached to the ground and an arm handling the endoscope. In the limited space of an operation table, the base of such a robot takes up a considerable place next to the patient. Further, the robot's arm maintaining the endoscope may hinder the access to the patient's abdomen.

[0004] It is thus desirable to provide a system for positioning on a patient an observation and/or intervention instrument taking up a small volume to limit the space required in the operation theatre and clear the access to the patient as much as possible.

[0005] International patent application WO0105319 assigned to the Universite Joseph Fourier describes, in an embodiment, a system for positioning an observation and/or intervention device, for example, an endoscope. The system comprises a mount placed on the patient's body, supporting a trocar in which the observation and/or intervention device slides, the trocar being likely to pivot with respect to the mount. An actuator assembly controls the trocar movement with respect to the mount. It may be formed of pneumatic or hydraulic actuators, each actuator being directly connected to the mount and to the trocar. It may also be formed of cables. Each cable then extends between the trocar and a guide attached on the mount, and is driven at its free end by an actuator placed at a distance from the patient.

[0006] A disadvantage of such a system is the difficulty to impose significant movements to the trocar. Indeed, in the case where the actuators are placed directly on the mount, the volume taken up by the actuators limits the trocar movements. In the case where the actuators are placed at a distance from the patient, the trocar movements are obtained by the application of tractions of different amplitudes on the cables connected to the trocar. A difficulty then results, in large movements, from the high flexion angles imposed to the cables at the level of the guides. This may result in a fast deterioration of the cables. Further, with such a system, the forces exerted by the cables or the actuators on the trocar are the origin of a pressure exerted by the trocar on the patient's abdomen that may be undesirable. Another disadvantage of such a system is that it is generally not possible to remove the positioning system while leaving in place the trocar and the observation and/or intervention devices.

[0007] The present invention provides a system, taking up a small volume, for positioning on a patient's body an observation and/or intervention device having a portion penetrating into the patient's body, enabling obtaining significant movements of the observation device and enabling removal of the positioning system while leaving in place the observation and/or intervention device.

[0008] The present invention also provides a positioning system limiting the application of pressure forces on the patient's abdomen.

[0009] To achieve these objects, the present invention provides a system for positioning with respect to a patient's body an observation and/or intervention device having a portion penetrating into the patient's body comprising a base laid on the patient's body; a means for supporting the device formed of a first portion movably assembled on the base according to a connection with one degree of freedom, and of a second portion movably assembled on the first portion according to a connection with one degree of freedom and connected to the device; and means for actuating the first portion with respect to the base, and the second portion with respect to the first portion, in which the base surrounds at a distance at least partially the device and in which the device is detachably connected to the second portion to enable removal of the positioning system with respect to the device while leaving in place the device with respect to the patient's body.

[0010] According to an embodiment of the present invention, the base delimits a circular opening around the device and the first portion is a mobile ring with an axis substantially perpendicular to the patient's body and with an inner diameter substantially corresponding to the circular opening, the mobile ring being rotatably assembled on the base around its axis.

[0011] According to an embodiment of the present invention, the second portion comprises a head connected to the device prolonging at least in an arm pivotally assembled on the mobile ring along an axis substantially tangent to the patient's body.

[0012] According to an embodiment of the present invention, the first portion comprises a semi-circular rail having its ends pivotally assembled on the base along an axis substantially tangent to the patient's body.

[0013] According to an embodiment of the present invention, the second portion comprises a carriage slidably assembled on the rail and connected to the device.

[0014] According to an embodiment of the present invention, the device is movably assembled on the second portion according to a connection with one degree of freedom.

[0015] According to an embodiment of the present invention, the motions of the first and second portions are controlled by cables driven by actuators located at a distance from the patient.

[0016] According to an embodiment of the present invention, the rotating motion of the mobile ring with respect to the base is controlled by an actuator attached to the mobile ring, the actuator extending to be substantially parallel to the mobile ring axis.

[0017] According to an embodiment of the present invention, the pivoting motion of the arm with respect to the mobile ring is controlled by an actuator attached to the second portion and extending to be substantially parallel to the pivoting axis of the arm with respect to the mobile ring.

[0018] According to an embodiment of the present invention, the device extends substantially longitudinally along a direction perpendicular to the pivoting axis of the arm with respect to the mobile ring and the device is movably assembled with respect to the second portion, to slide along said direction, the device sliding with respect to the second portion being controlled by an actuator attached to the second portion and extending to be substantially parallel to the pivoting axis of the arm with respect to the mobile ring.

[0019] The foregoing objects, features, and advantages, as well as others of the present invention will be discussed in detail in the following non-limiting description of specific embodiments in connection with the accompanying drawings, among which:

[0020] **FIG. 1A** shows a perspective view of a first embodiment of a positioning system according to the present invention;

[0021] **FIG. 1B** shows a partial top view with a partial cross-section view of the system of **FIG. 1A**;

[0022] **FIG. 1C** shows a partial lateral cross-section view of the system of **FIG. 1A**;

[0023] **FIG. 2A** shows a partial top view with a partial cross-section view of an alternative of the system according to the first embodiment;

[0024] **FIG. 2B** shows a partial lateral cross-section view of the system of **FIG. 2A**;

[0025] **FIG. 3A** shows a very simplified side view of a second embodiment of the system according to the present invention;

[0026] **FIG. 3B** shows a front view of the system of **FIG. 3A**;

[0027] **FIG. 3C** shows a top view of the system of **FIG. 3A**;

[0028] **FIG. 4A** shows a perspective view of an alternative of the first embodiment of a positioning system according to the present invention;

[0029] **FIGS. 4B and 4C** shows side views of the system of **FIG. 4A** at two different positions; and

[0030] **FIG. 4D** shows a top view of the system of **FIG. 4C**.

[0031] **FIGS. 1A** to **1C** show a first embodiment of a system **10** for positioning an endoscope **12** placed in a trocar **14**, endoscope **12** and trocar **14** penetrating into a patient's abdomen through a small incision **16**. Endoscope **12** has the aspect of a cylindrical tube of axis Ω of a length of some forty centimeters and of a diameter of a few centimeters. In **FIG. 1B**, a portion only of trocar **14** is shown. In **FIG. 1C**, only axis Ω of endoscope **12** is shown. A camera, not shown, is attached to the end of endoscope **12** external to the abdomen.

[0032] System **10** comprises a substantially planar base **18** comprising a planar ring-shaped central portion **20**, surrounding incision **16**, from which four arms **21** extend. A cylindrical opening **22** is formed at the end of each arm **21**. Openings **22** may be used to maintain base **18** on the patient's body via straps, cables, etc. attached to the table on which the patient is laid or directly attached to the patient. Base **18** may also be glued on the patient's abdomen.

[0033] Central annular portion **20** supports a mobile ring **24** of axis Δ substantially perpendicularly to the plane tangent to the abdomen at the level of incision **16**. Mobile ring **24** is rotatably assembled around axis Δ on central portion **20** via a bearing **25**.

[0034] A stirrup **26** is pivotally assembled on mobile ring **24** according to an axis Γ substantially perpendicular to axis Δ, and substantially comprised in the plane tangent to the abdomen at the level of incision **16**. Stirrup **26** comprises a head **28** on which is attached trocar **14** by any known attachment means, which enables simple and fast connection and separation of trocar **14** and of head **28**. Said means will for example be flexible tongues **27**. The inner diameters of mobile ring **24** and of ring-shaped central portion **20** are selected to enable removal of system **10** during an intervention without displacing trocar **14**, or to enable removal of trocar **14** from the patient's abdomen without displacing system **10**. Head **28** prolongs in two arms **30**, **31**, each comprising at one end a sliding surface **32**, corresponding to a cylindrical portion, likely to slide on a profile **34**, **35** shaped as a half-cylinder of axis Γ. Each profile **34**, **35** moves along with a base **36**, **37** attached on ring **24**, for example, by screwing. Each arm **30**, **31** comprises at its free end a cap **38**, **39** (not shown in **FIG. 1C**) which forms with sliding surface **32** of the associated arm **30**, **31** a housing receiving profile **34**, **35**.

[0035] Mobile ring **24** comprises on its external cylindrical wall a groove **42** receiving a cable **43**. A guide **44** assembled on base **18** receives the ends of two sheaths **45**, **46** in which cable **43** slides. Guide **44** is arranged on base **18** so that cable **43**, as it comes out of one of sheaths **45**, **46**, is tangent to groove **42** of mobile ring **44**. The ends of cable **43** are connected to the ends of a rack (not shown) meshing in with the output shaft of an electric motor. The displacement of cable **43** by the motor rotates ring **24** with respect to central annular portion **20** around axis Δ.

[0036] A pulley sector **47**, substantially corresponding to a cylindrical sector, is attached to one of arms **31** of stirrup **26**. A groove **48** is formed on the lateral wall, corresponding to a cylinder portion of pulley sector **47**. Groove **48** receives two cables **49** and **50**, each cable **49**, **50** being attached to an opposite end of groove **48**. The other ends of cables **49**, **50** are connected to the ends of a rack (not shown) meshing in with the output shaft of an electric motor. Two supports **51**, **52** are attached to mobile ring **24** and each receives the end of a sheath **53**, **54** in which one of cables **49**, **50** slides. Supports **51**, **52** are arranged so that cables **49**, **50**, as they come out of sheaths **53**, **54** are substantially tangent to pulley sector **47**. When the electric motor displaces the rack, a traction is exerted on one of cables **49**, **50**, and a thrust is exerted on the other cable **49**, **50**. Cables **49**, **50** displace pulley sector **47** and, accordingly, stirrup **26**. The sliding surfaces **32** of arms **30**, **31** then slide on profiles **34**, **35** so that stirrup **26** generally pivots with respect to axis Γ.

[0037] Endoscope **12** is assembled to freely slide along axis Ω in trocar **14**. A hold element **55** is attached to endoscope **12**. A compression spring **56** bears at one end against hold element **55** and at the opposite end against trocar **14**. A cable **57** is connected at one end to hold element **55** and at its opposite end to a rack (not shown) meshing in with the output shaft of an electric motor. A guide **58** attached on head **28** of stirrup **26** receives the end of a protection sheath **59** in which cable **57** slides. A traction on cable **57** makes endoscope **12** slide in trocar **14** along axis Ω and compresses spring **56**. When cable **57** is released, spring **56** relaxes and brings endoscope **12** back to an idle position. Hold element **55** can easily be removed from endoscope **12** to enable removal of endoscope **12** from trocar **14**, for example, to clean its lens, or to replace it with another endoscope having a different length or viewing cone.

[0038] The three motors and the racks are for example arranged in a package distant from the patient. The motor control may be performed in any known fashion and will not be detailed hereafter. It may for example be a vocal control, a manual control by lever or buttons, a foot control, etc. The motor control may be performed in open or closed loop. For example, system **10** may also comprise a location means to detect the position and the orientation of incision **16**, of endoscope **12**, and of an intervention instrument handled by the surgeon. The location means may be connected to a calculator capable of controlling motors. The endoscope is then displaced to, for example, transmit an image permanently following the end of the intervention instrument.

[0039] The motors are preferably clutch releasable to enable the surgeon to manually displace positioning system **10**.

[0040] Cables **43**, **57** and cable assembly **49**, **50** each control a degree of freedom of endoscope **12**. Cables **43**, **49**, **50**, **57** are arranged not to undergo significant flexion angles. In particular, pulley sector **47** has a sufficiently large radius, preferably greater than 50 mm, to limit the curvature of cables **49**, **50**. This enables preventing fast deterioration of cables **43**, **49**, **50**, **57**.

[0041] Base **18** and stirrup **26** may be made of steel to increase their durability and ease their sterilization. Cables **43**, **49**, **50**, **57** may be formed of a material covered with Teflon and placed in Teflon sheaths **45**, **46**, **53**, **54**, **59**.

[0042] **FIGS. 2A and 2B** are similar, respectively, to **FIGS. 1B and 1C** and show an alternative of positioning system **10** according to the first embodiment. Only the differences with respect to the first embodiment will be described.

[0043] According to this alternative, the electric motors driving the actuating cables are directly arranged at the level of positioning system **10**. The motors are arranged to hinder as little as possible the movements of endoscope **12**. For example, a first motor **60**, comprising a cylindrical package **61** and an output shaft **62**, is assembled on a support **63** connected to base **18** so that output shaft **62** substantially extends along an axis parallel to axis Δ. Output shaft **62** rotates a pulley **64**. Pulley **64** is connected to mobile ring **24** by a cable **65** to drive mobile ring **24** similarly to the first embodiment.

[0044] A second motor **66**, comprising a cylindrical package **67** and an output shaft **68**, is assembled on a support **69** connected to mobile ring **24** so that output shaft **68** extends substantially along an axis perpendicular to axes Δ and Ω. Output shaft **68** rotates a pulley **70**. Pulley **70** is connected to pulley sector **47** by a cable **71** to drive pulley sector **47** similarly to the first embodiment. The supply and control means of motors **60**, **66** are not shown. Motors **60** and **66** may be controlled by any conventional device. In particular, packages **61**, **67** may comprise supply means and remote-control means. The sliding of endoscope **12** in trocar **14** may also be controlled by a third motor (not shown) directly placed at the level of hold element **55**.

[0045] The present alternative of the first embodiment enables completely freeing the patient's abdomen during the surgical intervention.

[0046] **FIGS. 3A** to **3**C very schematically show a second embodiment of system **10** for positioning trocar **14** in which the endoscope (not shown) slides, the trocar and the endoscope penetrating into the patient's abdomen through incision **89**.

[0047] According to the second embodiment, system **10** comprises a "C"-shaped base **80** resting on the patient's abdomen. A semi-circular rail **82** is pivotally assembled on base **80** around an axis substantially tangent to the patient's abdomen. The two ends of rail **82** are substantially connected to the two ends of base **80** by two pivotal connections **84**, **86**. A carriage **88** is slidably assembled on rail **82**. Carriage **88** supports trocar **14**.

[0048] The means for controlling the sliding of the endoscope in trocar **14** are not shown in **FIGS. 3A** to **3**C and may be identical to those of the first embodiment.

[0049] The sliding of carriage **88** on rail **82**, and the pivoting of rail **82** with respect to base **80**, may be controlled by cable driven by actuators placed at a distance from the patient as for the first embodiment, or by directly arranging the actuators at the level of positioning system **10** as for the previously-described alternative of the first embodiment.

[0050] According to an alternative of the present invention, the rotating motions of endoscope **12** in trocar **14** around its axis Ω may also be controlled by an actuator.

[0051] According to the second embodiment, the removal of the positioning system is eased by the fact that base **80** is "C" shaped.

[0052] **FIGS. 4A** to **4**D show views of an alternative of positioning system **10** according to the first embodiment. In **FIGS. 4A** to **4**D, the incision made on the patient for the placing of endoscope **12** has not been shown. In **FIGS. 4B** to **4**D, only axis Ω of endoscope **12** is shown.

[0053] According to the present alternative of the first embodiment, trocar **14** is maintained on stirrup **26** by a mounting flange **90**, for example, screwed on stirrup **26**. Trocar **14** comprises a protrusion **92** located on the side of mounting flange **90** opposite to ring-shaped base **18**. Protrusion **92** may represent handles, tightness valves, connectors, etc. A fixed ring **95** is arranged between ring-shaped base **18** and mobile ring **24**. Fixed ring **95** forms one piece with base **18**. Mobile ring **24** is rotatably assembled on fixed ring **95**. Fixed ring **95** comprises a peripheral toothing (not shown) on its external lateral surface.

[**0054**] A first electric motor **96**, intended to rotate mobile ring **24** with respect to fixed ring **95**, is assembled to move along with mobile ring **24** via a stage **98**. First motor **96** is controlled and supplied by means not shown, for example, by electric wires. A toothed wheel **100** is arranged at the end of shaft **102** of first motor **96**. Shaft **102** is substantially parallel to axis A of mobile ring **24**. Toothed wheel **100** meshes in with the toothing of fixed ring **95**. Since toothed wheel **100** cooperates with fixed ring **95**, the rotating of toothed wheel **100** by first motor **96** rotates mobile ring **24** with respect to fixed ring **95**. Motor **96** moves along with mobile ring **24** and thus remains fixed with respect to mobile ring **24** upon rotation thereof. Upon sole rotation of mobile ring **24**, there thus is no risk for trocar **14** and first motor **96** to collide. It is thus possible to pivot mobile ring **24** by more than 360 degrees.

[**0055**] A second electric motor **104** is attached to stirrup **26**, on the side of stirrup **26** opposite to mounting flange **90**, via a stage **106**. The shaft (not visible in the drawings) of second motor **104** is oriented along pivoting axis Γ of stirrup **26**. Stage **106** comprises an opening (not visible in the drawings) enabling passing of the shaft of second motor **104**. Second motor **104** is controlled and supplied by means not shown, for example, electric wires. A drive element **108** comprises a circular arc **109** having its ends connected by a rectilinear portion **110** attached to mobile ring **24**. Drive element **108** substantially extends in a plane perpendicular to the plane containing mobile ring **24**. The axis of circular arc **109** corresponds to pivoting axis Γ of stirrup **26**. The wall of circular arc **109** opposite to rectilinear portion **110** comprises a toothing (not shown). The shaft of second motor **104** supports a toothed wheel (not shown) which cooperates with the toothing of circular arc **109** so that, when the toothed wheel is rotated by second motor **104**, stirrup **26** is pivoted with respect to mobile ring **24**. The toothing is provided inside of drive element **108** for security reasons and to increase the compactness of positioning system **10**.

[**0056**] The free end of endoscope **12** comprises a cylindrical stop **112** from which a pin **114** projects. Compression spring **56** bears at one end against cylindrical stop **112** and at the opposite end against trocar **14**. A third electric motor **116** is attached to stirrup **26**, next to second motor **104**, via a stage **118**. Stage **118** comprises an opening **120** enabling passing of shaft **122** of third motor **116**. Shaft **122** of third motor **116** is oriented along pivoting axis Γ of stirrup **26**. Third motor **116** is controlled and supplied by means not shown, for example, by electric wires. A winding cylinder **124** is arranged at the free end of shaft **122**. A helical threading (not shown) is formed on the outer surface of winding cylinder **124**. A cable **125** (only shown in **FIG. 4A**) is connected at its ends to pin **114** and to cylinder **124** and wound around cylinder **124**. Third electric motor **116** is arranged between second motor **104** and protrusion **92** to avoid for cable **125** to contact second motor **104**. When third motor **116** rotates shaft **122**, cable **125**, guided by the threading of cylinder **124**, winds around cylinder **124** and brings cylindrical stop **112** closer to trocar **14**. Endoscope **12** then slides in trocar **14** along axis Ω and compresses spring **56**. When third motor **116** is no longer actuated, spring **56** relaxes and brings endoscope **12** back to an idle position. Cylindrical stop **112** may be disassembled from endoscope **12** to enable removal of endoscope **12** from trocar **14**. Cylindrical stop **112** may move along with endoscope **12**. The cable end connected to pin **114** can then be detached to release endoscope **12** from trocar **14**. Stages **106**, **118** may be directly integrated to stirrup **26** and/or be provided on a same side of stirrup **26**.

[**0057**] The rotating motions of endoscope **12** in trocar **14** around its axis Ω may also be controlled by an actuator.

[**0058**] In **FIGS. 4A** to 4D, ring-shaped base **18** is maintained on the patient via four curved tongues **126** radially extending from ring-shaped base **18**. A support arm, oriented by the surgeon before the beginning of the operation, may be provided to support positioning system **10** and avoid for the entire weight of positioning system **10** to be applied on the patient.

[**0059**] A notch **128** is provided at the level of mobile ring **24**, substantially in diametrically opposite position with respect to first electric motor **96**. Notch **128** is intended to receive a portion of trocar **14** when the latter is inclined to a maximum with respect to ring-shaped base **18**, as shown in **FIG. 4B**. A maximum inclination angle greater than in the absence of notch **128** has then been achieved. Notch **128** may be replaced by a hollow print performed in mobile ring **24** and the shape of which is complementary to the shape of trocar **14**.

[**0060**] In **FIGS. 4C and 4D**, trocar **14** is shown as inclined with respect to the plane of ring-shaped base **18** to a position where the second and third motors **104**, **116** thrust against first motor **96**. Trocar **14** being attached to stirrup **26** by mounting flange **90** on the side opposite to second and third motors **104**, **106**, it can then be easily released from positioning system **10**. Stirrup **26** being maintained in a thrust position against first motor **96**, an obstacle-free region **130** is freed between stirrup **26** and ring-shaped base **18**, enabling removal of positioning system **10** while leaving in place trocar **14**, the dimensions of the obstacle-free region being sufficient to enable removal of positioning system **10** despite the presence of protuberance **92** and cylindrical stop **112**.

[**0061**] The system according to the present invention has many advantages.

[**0062**] First, the positioning system according to the present invention takes up a small volume, is formed of a relatively simple structure, and has a small weight. As an example, the applicant has formed a positioning system according to the present invention comprised in a cylinder with a 70-mm diameter and with a 75-mm height, with a weight approximately smaller than 600 g (to which must be added the weights of the endoscope, of the trocar, and possibly of the camera). Several positioning systems according to the present invention may thus be placed simultaneously on a patient's body, each system enabling positioning an observation and/or intervention device.

[**0063**] Second, the pivoting axis of the endoscope with respect to the patient's body is substantially tangent to the patient's body, which enables reducing to a minimum the dimensions of the incision to be performed for the introduction of the trocar and of the endoscope into the patient's body.

[0064] Third, the positioning system according to the present invention enables obtaining movement angle of the endoscope between axes Ω and Δ greater than 80°, with a 0.5° accuracy and a pivoting axis on the order of 25°/s, and a sliding of endoscope **12** in trocar **14** along axis Ω greater than 200 mm, with a 5-mm accuracy and a sliding speed on the order of 25 mm/s.

[0065] Fourth, the system enables applying no force on the patient's abdomen at the level of the incision through which the endoscope penetrates into the abdomen.

[0066] Fifth, only three actuators are necessary to control the endoscope displacements. This enables simple and accurate control of the actuators.

[0067] Sixth, the system according to the present invention may easily be arranged on the patient's body and removed from the patient's body while maintaining in place the trocar and the endoscope.

[0068] Of course, the present invention is likely to have various alterations and modifications which will occur to those skilled in the art. In particular, the electric motors may be replaced with any type of actuators. Further, the system according to the present invention enables positioning devices other than an endoscope. It may be, for example, a separator, a clip, etc.

1. A system (**10**) for positioning with respect to a patient's body an observation and/or intervention device (**12**, **14**) having a portion penetrating into the patient's body comprising:

a base (**18**, **80**) laid on the patient's body;

means for supporting the device formed of a first portion (**24**, **82**) movably assembled on the base according to a connection with one degree of freedom, and of a second portion (**26**, **88**) movably assembled on the first portion according to a connection with one degree of freedom and connected to the device; and

means (**43**, **49**, **50**, **60**, **66**) for actuating the first portion with respect to the base, and the second portion with respect to the first portion,

characterized in that the base surrounds at a distance at least partially the device and in that the device is detachably connected to the second portion to enable removal of the positioning system with respect to the device while leaving in place the device with respect to the patient's body.

2. The system of claim 1, in which the base (**18**) delimits a circular opening around the device (**12**, **14**) and in which the first portion (**24**) is a mobile ring with an axis (Δ) substantially perpendicular to the patient's body and with an inner diameter substantially corresponding to the circular opening, the mobile ring being rotatably assembled on the base (**18**) around its axis.

3. The system of claim 2, in which the second portion (**26**) comprises a head (**90**, **28**) connected to the device (**12**, **14**) prolonging at least in an arm (**30**, **31**) pivotally assembled on the mobile ring (**24**) along an axis (Γ) substantially tangent to the patient's body.

4. The system of claim 1, in which the first portion (**82**) comprises a semi-circular rail having its ends pivotally assembled on the base (**80**) along an axis substantially tangent to the patient's body.

5. The system of claim 4, in which the second portion (**88**) comprises a carriage slidably assembled on the rail (**82**) and connected to the device (**12**, **14**).

6. The system of claim 1, in which the device (**12**) is movably assembled on the second portion (**28**, **88**) according to a connection with one degree of freedom.

7. The system of claim 1, in which the motions of the first (**24**, **82**) and second (**26**, **88**) portions are controlled by cables (**43**, **49**, **50**) driven by actuators located at a distance from the patient.

8. The system of claim 2, in which the rotation motion of the mobile ring (**24**) with respect to the base (**18**) is controlled by an actuator (**96**) attached to the mobile ring, the actuator extending to be substantially parallel to the mobile ring axis (Δ).

9. The system of claim 3, in which the pivoting motion of the arm (**30**, **31**) with respect to the mobile ring (**24**) is controlled by an actuator (**104**) attached to the second portion (**26**) and extending to be substantially parallel to the pivoting axis (Γ) of the arm (**30**, **31**) with respect to the mobile ring (**24**).

10. The system of claim 3, in which the device (**12**) extends substantially longitudinally along a direction perpendicular to the pivoting axis (Γ) of the arm (**30**, **31**) with respect to the mobile ring (**24**) and in which the device is movably assembled with respect to the second portion (**26**), to slide along said direction, the device sliding with respect to the second portion being controlled by an actuator (**116**) attached to the second portion and extending to be substantially parallel to the pivoting axis (Γ) of the arm (**30**, **31**) with respect to the mobile ring (**24**).

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