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(54) LAPAROSCOPY TROCAR

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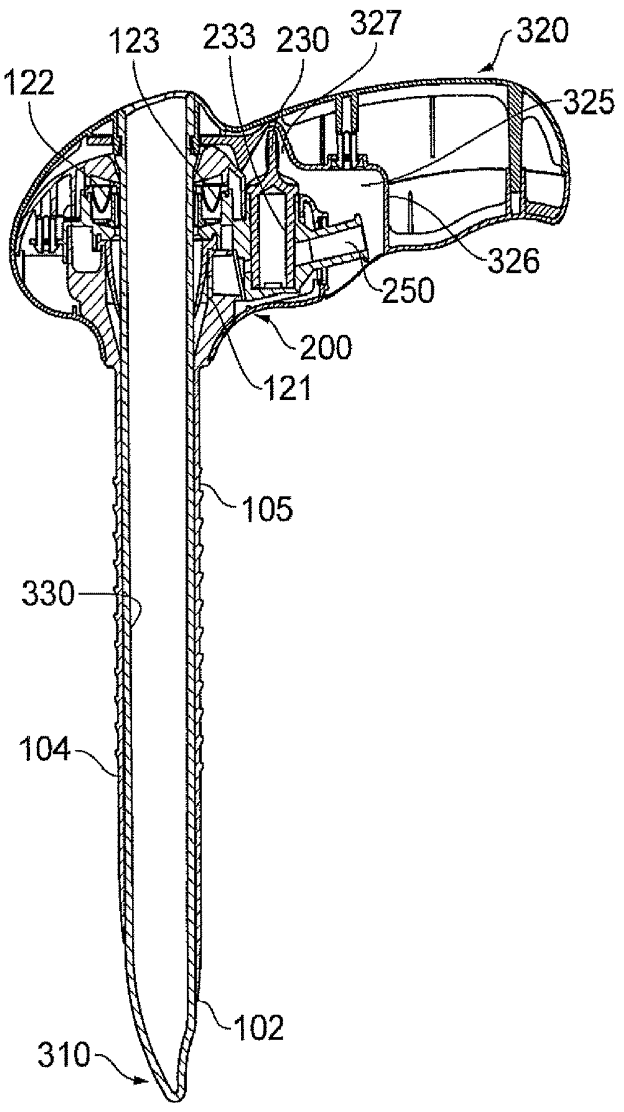
(57) **ABSTRACT**

There is disclosed a laparoscopy trocar, having a cannula and an obturator for use in inserting the cannula into the abdominal cavity of a patient. The cannula comprises a fluid control valve for opening and closing a fluid flow path from outside the bore of the cannula into the bore of the cannula and the obturator comprises a control means configured to cause the fluid control valve to move between its open and closed positions upon insertion of the obturator into the cannula. A novel tip for the obturator is disclosed comprising a concave bladed front edge formed between a pair of concave tip faces.



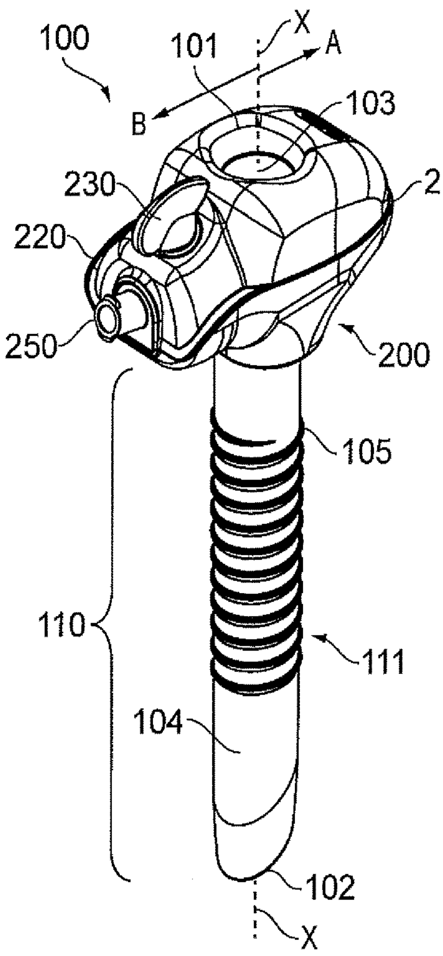

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FIG. 1A

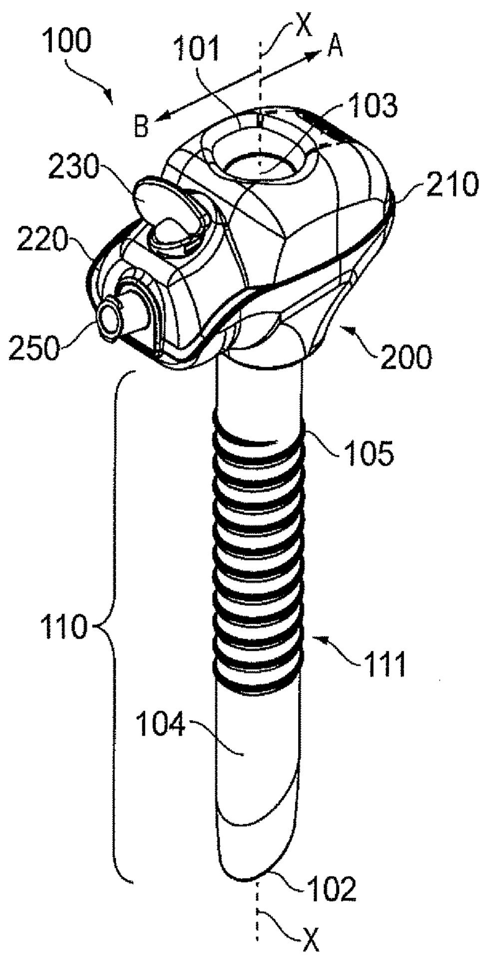
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FIG. 1B

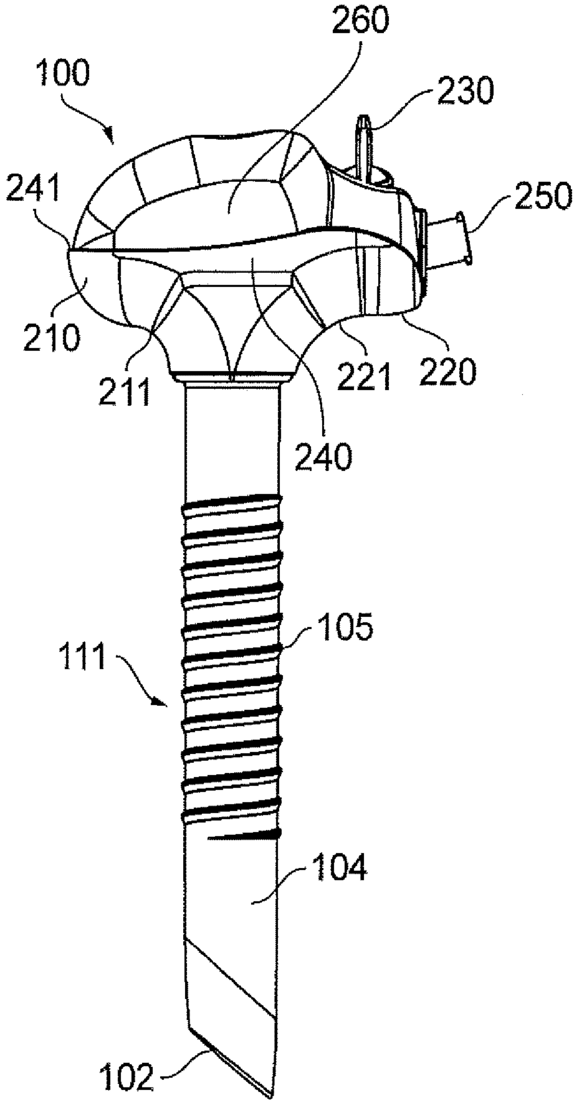


FIG. 1C

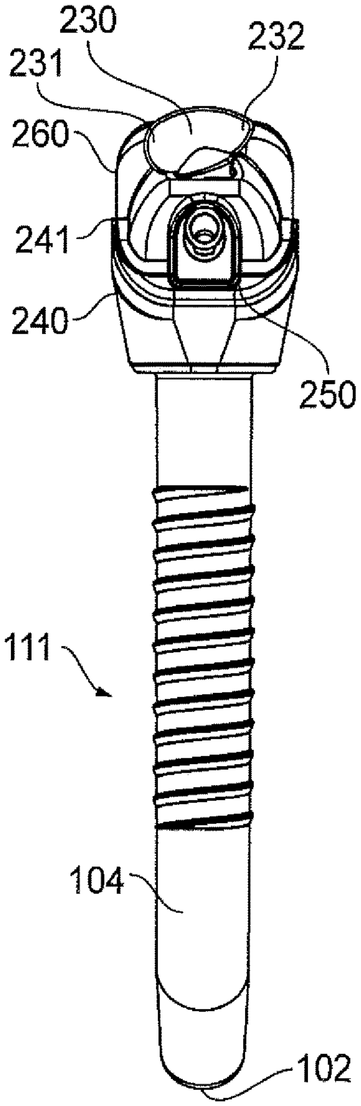


FIG. 1D

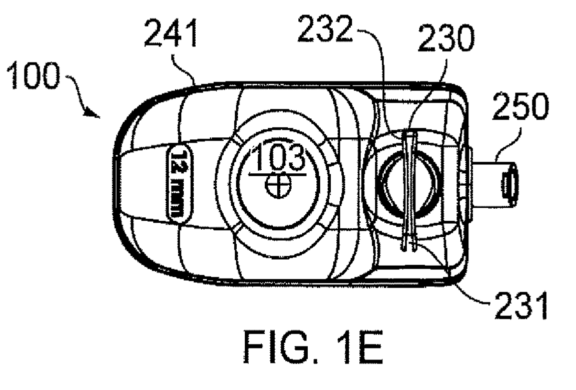


FIG. 1E

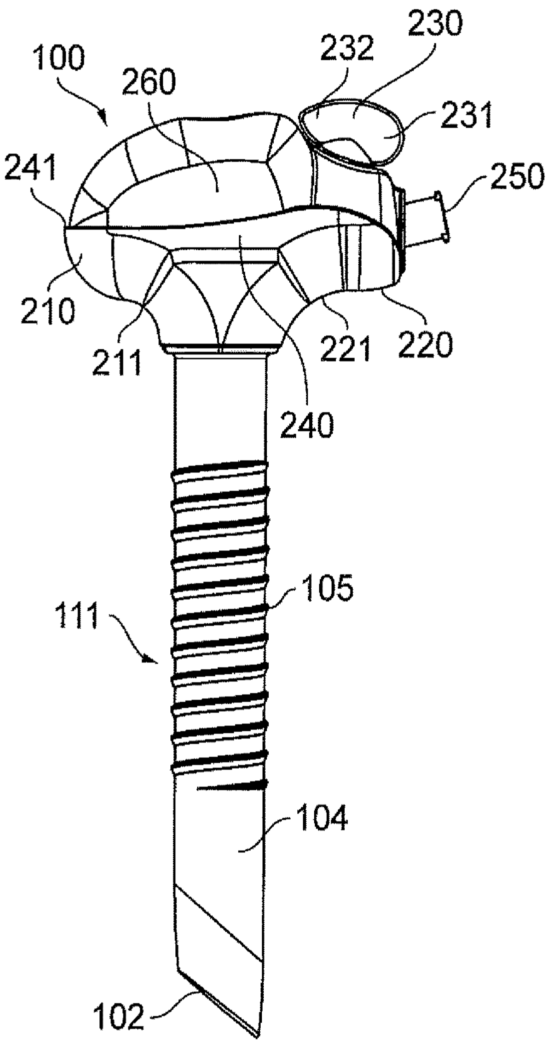


FIG. 1F

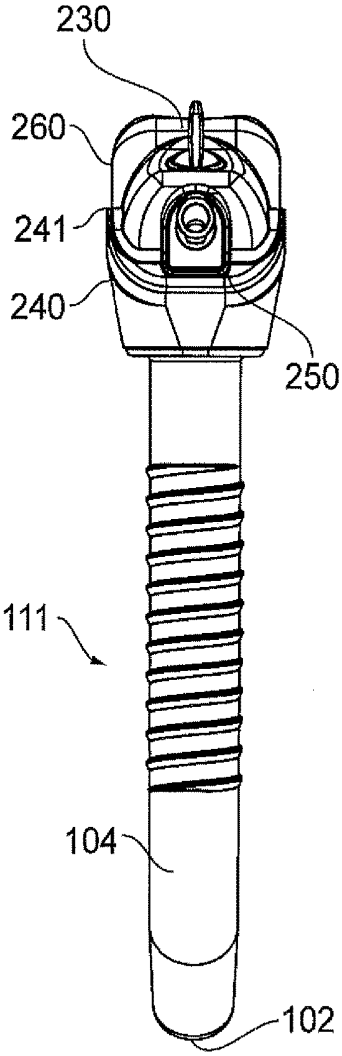


FIG. 1G

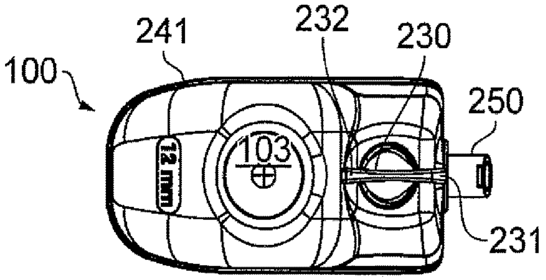


FIG. 1H

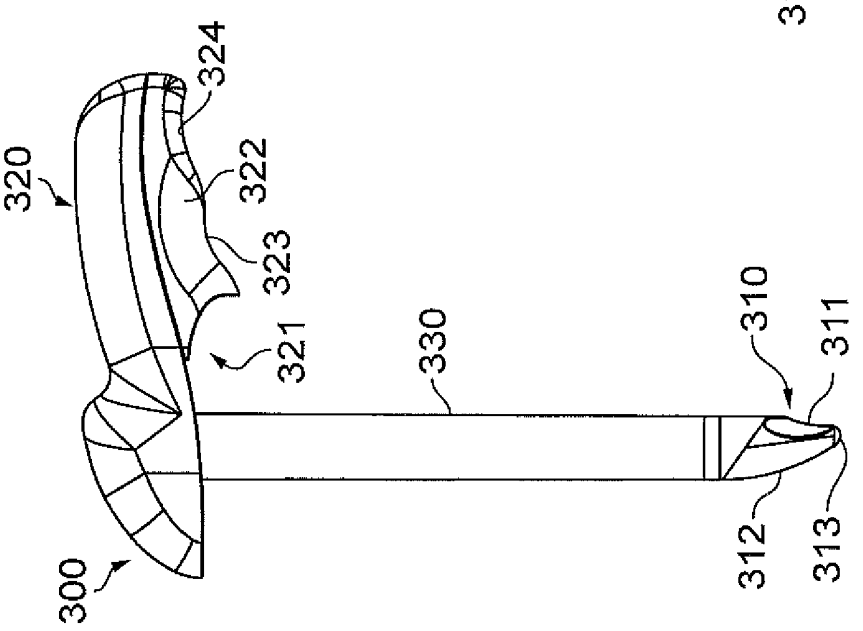


FIG. 2A

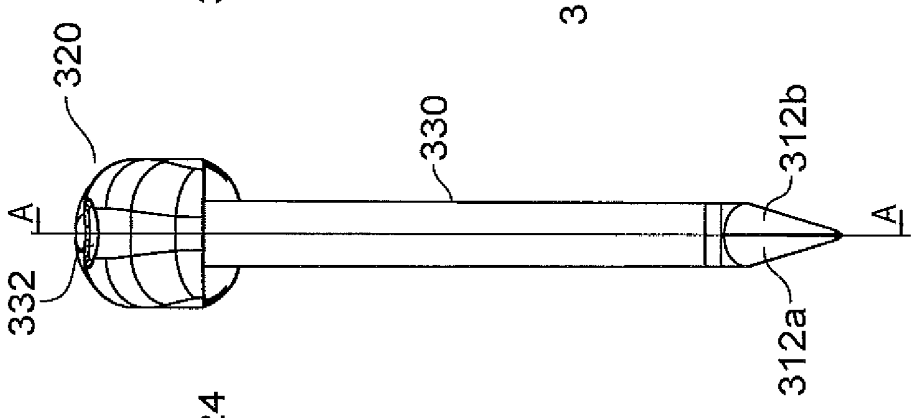


FIG. 2B

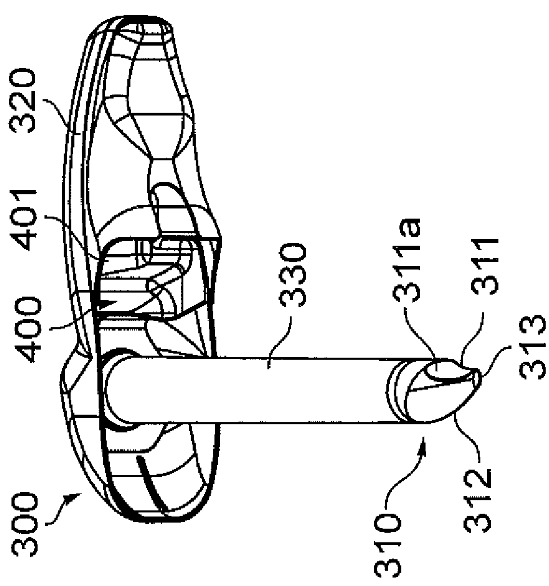


FIG. 2C

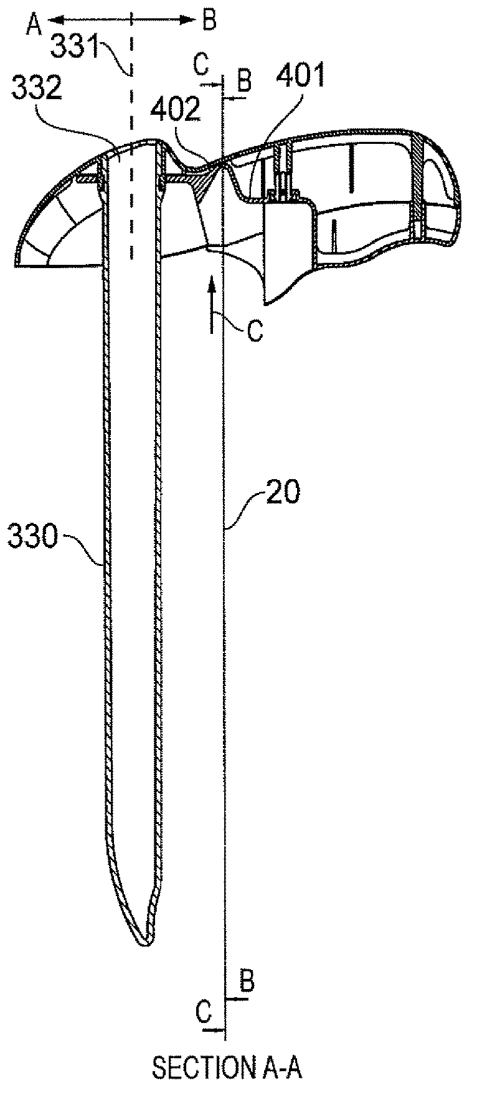


FIG. 2D

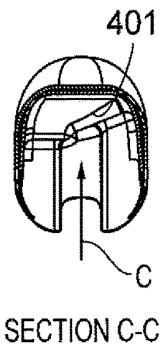


FIG. 2E

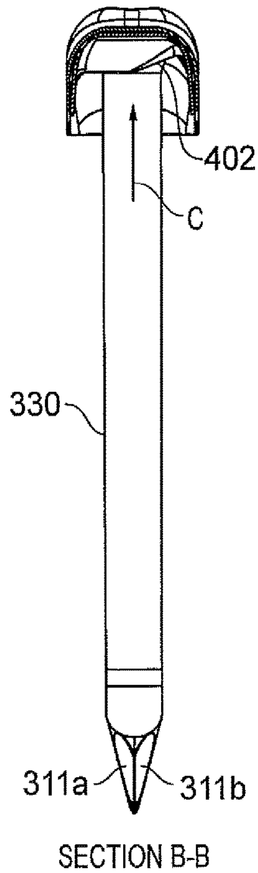


FIG. 2F

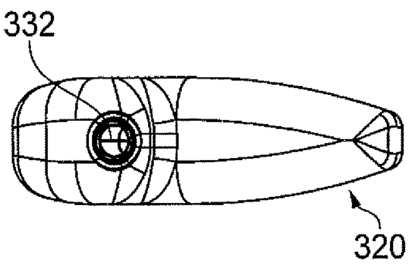
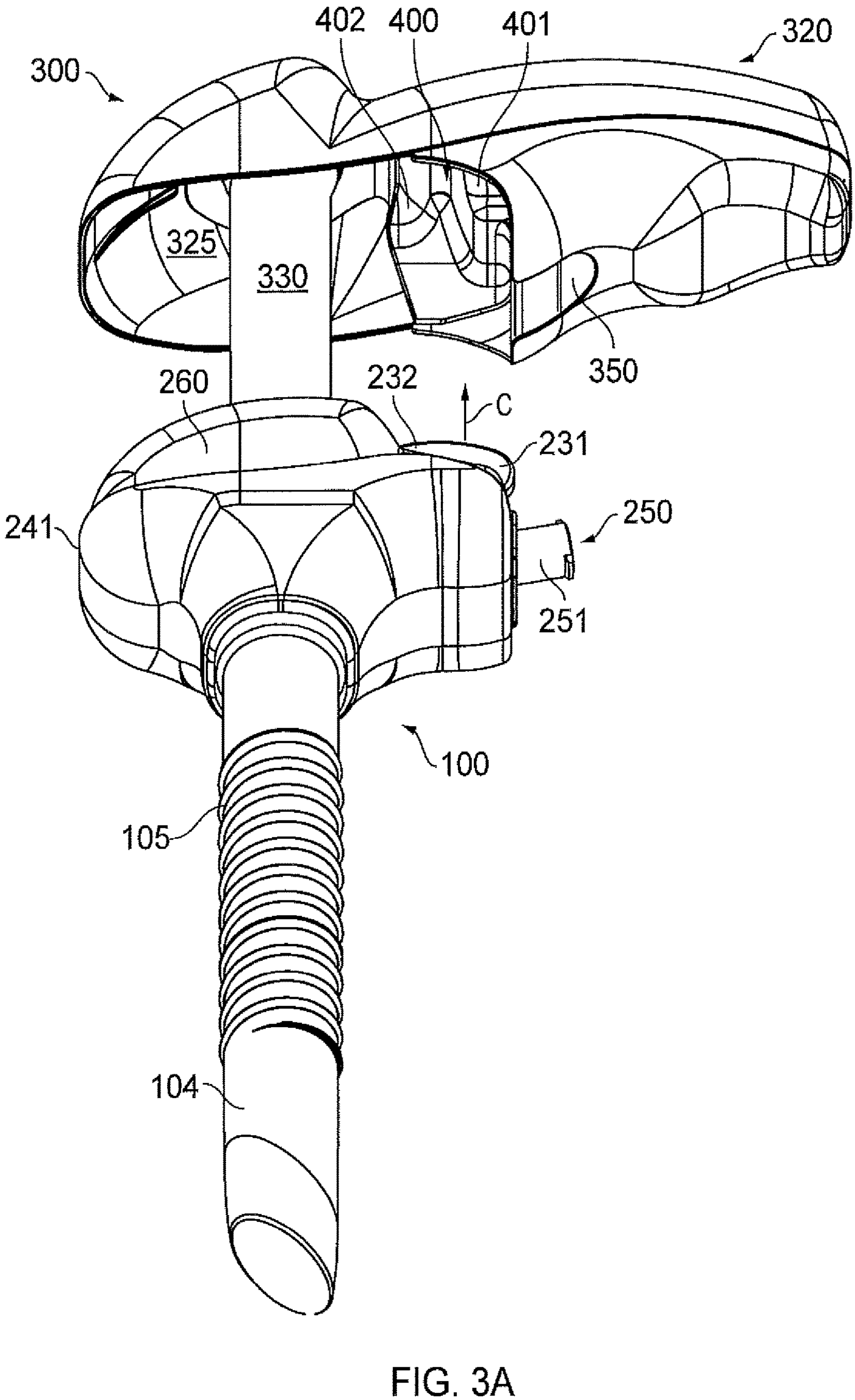


FIG. 2G


402
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401
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300
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C
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104

FIG. 3A

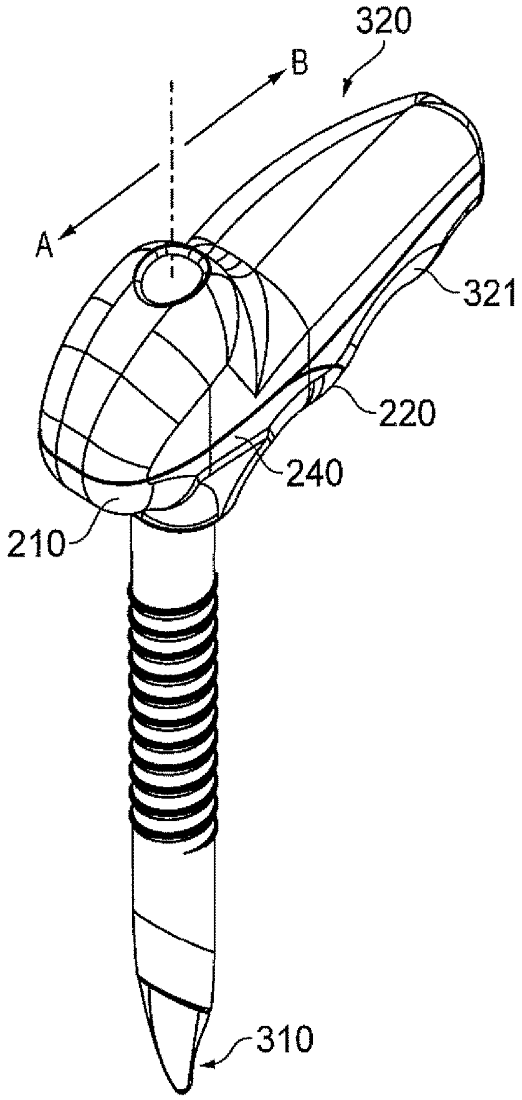


FIG. 3B

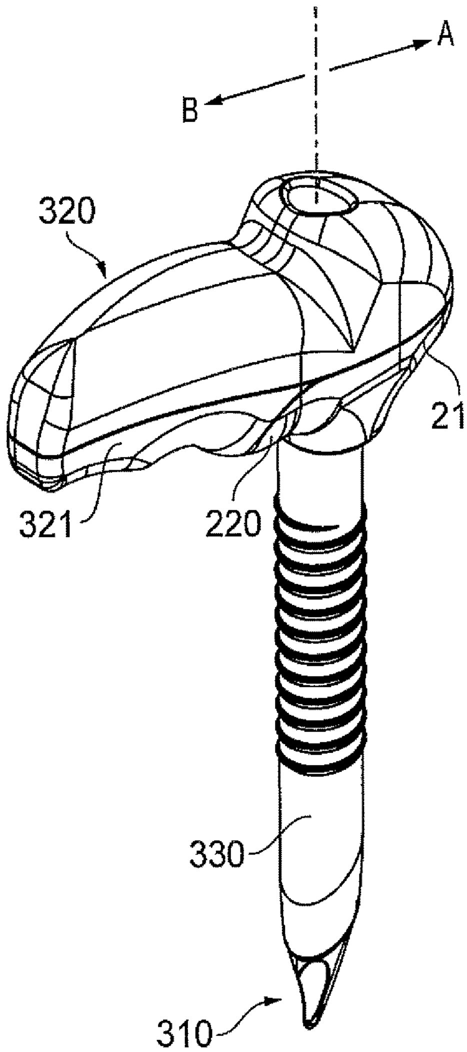
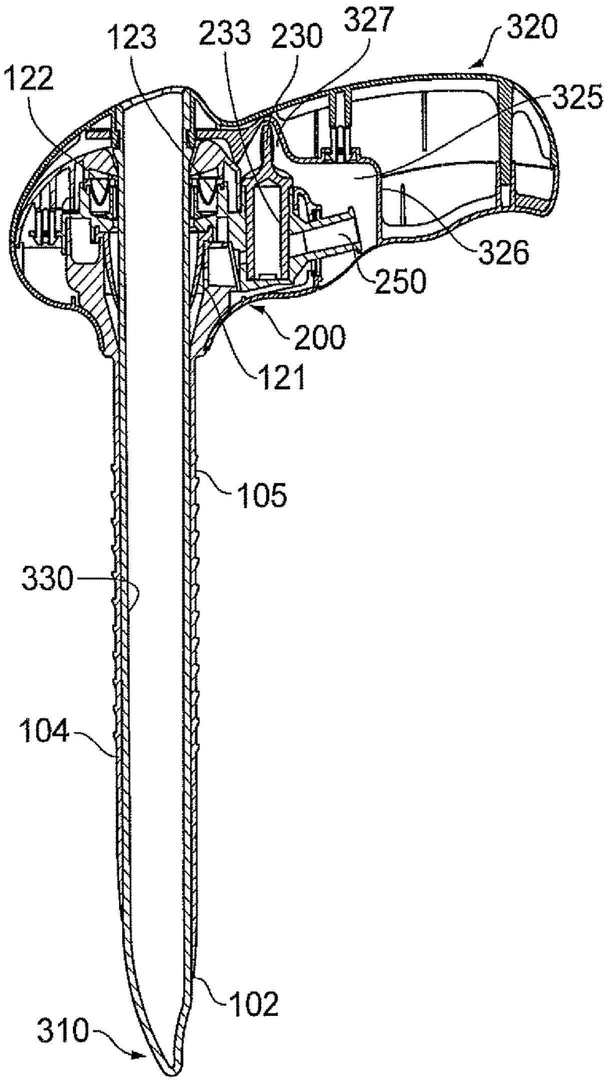


FIG. 3C


122
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327
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250
200
121
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330
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102
310

FIG. 3D

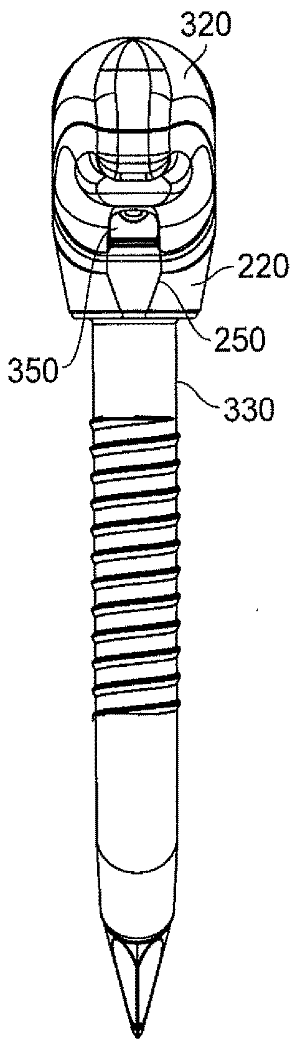
320
220
250
350
330

FIG. 3E

LAPAROSCOPY TROCAR

FIELD OF THE INVENTION

[0001] The present invention relates to a laparoscopy trocar for minimally invasive surgical procedures. In particular the invention relates to an improved disposable laparoscopy trocar for use in accessing the abdominal cavity of a patient.

[0002] BACKGROUND TO THE INVENTION

[0003] Laparoscopy is a well-known surgical procedure in which one or more small incisions is made in the abdominal cavity, and a pressurised gas, usually carbon dioxide, is used to inflate the abdominal cavity. This act can be commonly referred to as insufflation. Insufflation creates a cavity in which the surgeon can more freely access and view the internal organs. A cannula is inserted through an incision to provide a path into the abdominal cavity. A laparoscope is inserted through the cannula to view the internal cavity and organs during the surgical procedure, which allows the surgeon to view inside the cavity. The cannula generally comprises an elongate tube which traverses the abdominal wall and comprises at least one valve seal, through which instruments can be introduced into the cavity, and which seals around the shaft of the instruments to maintain the pressurised gas within the cavity during the procedure. Second valve seals can be included to improve the sealing function in both the presence of, and in the absence of, surgical tools or instruments within the cannula.

[0004] An obturator is used inside the cannula, during insertion of the cannula, in order to drive the cannula through the incision made by the surgeon. The obturator generally has a pointed end in order to drive the sides of the incision apart, to accommodate the cannula. In most cases, the obturator is inserted into the cannula in the same manner as a surgical tool would be inserted, and so is accommodated in the bore of the cannula. The obturator generally has some form of tapered point, which acts to separate the wall as the cannula is introduced. The obturator can be hollow in order to accommodate a laparoscope. Further, at least the tip can be transparent, so that when introducing the trocar through the incision, it is possible for the surgeon to view the layers of the abdominal wall during insertion of the obturator into the abdominal cavity.

[0005] The cannula is provided with a source of pressurised fluid, generally a substantially inert gas such as CO_2. The source of gas is controlled via a valve situated on the cannula, which can be opened to allow gas into the abdomen and closed to stop the flow of gas into the abdomen. The fluid valve on the cannula is generally operated manually by the user to release fluid into the abdominal cavity, or prohibit the fluid from entering the abdominal cavity under pressure. Conversely, the valve can be opened to release fluid from the cavity and closed to retain fluid within the cavity when no pressurised fluid source is connected.

SUMMARY OF THE INVENTION

[0006] There is disclosed a laparoscopy trocar, having a cannula and an obturator for use in inserting the cannula into the abdominal cavity of a patient. The cannula comprises a fluid control valve for opening and closing a fluid flow path from outside the bore of the cannula into the bore of the cannula, and the obturator comprises a control means configured to cause the fluid control valve to move between its open and closed positions upon insertion of the obturator into the cannula. A novel tip for the obturator is disclosed comprising a concave bladed front edge formed between a pair of concave tip faces.

[0007] The present invention provides a laparoscopy trocar, comprising:

[0008] a cannula comprising:

[0009] first and second ends and a bore extending therebetween;

[0010] at least one flexible seal disposed in the bore, for inhibiting the passage of pressurised gas from the first end to the second end of the cannula; and

[0011] a fluid control valve configured to selectively open and close a fluid communication path for carrying fluid from a point external to the bore, into the bore of the cannula;

[0012] and

[0013] an obturator, comprising:

[0014] a tip, a body, and a shaft connecting the tip to the body, wherein the body of the obturator comprises control means configured to cause the fluid control valve to move between its open and closed positions.

[0015] The control means may be configured to cause the fluid control valve to close when the obturator is inserted into the cannula.

[0016] The control means may comprise mechanical means configured to mechanically actuate the fluid control valve.

[0017] The control means may be configured to actuate a manipulable handle of the fluid control valve.

[0018] The control means may be configured to prevent actuation of the fluid control valve when the obturator is placed in full engagement with the cannula.

[0019] The control means may be disposed in a handle portion of the obturator.

[0020] The fluid control valve may be disposed in a handle portion of the cannula.

[0021] The respective handle portions of the cannula and the obturator may be configured to align with one another when the obturator is fully inserted in the cannula, the handle of the cannula being at least partially received, optionally fully received, in the handle of the obturator.

[0022] The respective handle portions of the cannula and the obturator may be configured to enclose an input portion of the fluid control valve to prevent external actuation of the input portion.

[0023] The control means may comprise at least one sloped portion provided in the handle portion of the obturator, the sloped portion being configured to drive the input portion of the fluid control valve laterally relative to the axis of the bore of the cannula, to actuate the fluid control valve.

[0024] The sloped portion may be configured to rotate the input portion of the fluid control valve to actuate the fluid control valve.

[0025] The control means may comprise a pair of sloped portions configured to engage opposite sides of the input portion to actuate the fluid control valve.

[0026] In a further aspect, the invention provides a laparoscopy trocar, comprising:

[0027] a cannula comprising first and second ends and a bore extending therebetween; and

[0028] an obturator, comprising a tip, a body, and a shaft connecting the tip to the body, wherein the tip of the obturator comprises:

[0029] a pair of concave front surfaces meeting at an acute angle to form an acutely angled front edge in a plane substantially parallel to a longitudinal axis of the shaft.

[0030] The tip of the obturator may further comprise a convex rear face substantially opposite the front edge.

[0031] The rear face may be oriented so as to be convex in a direction away from the longitudinal axis of the shaft

[0032] The plane of the front edge of tip may be oriented in a first direction away from a longitudinal axis of the shaft, the first direction being substantially parallel to a longitudinal axis of the handle portion of the obturator.

[0033] A cannula of a laparoscopy trocar of the invention is also provided. An obturator of a laparoscopy trocar of the invention is also provided.

[0034] The invention further provides a method of manufacturing a product, the product being a laparoscopy trocar according to the invention, a cannula of the invention or an obturator according of the invention, comprising the steps of:

[0035] providing a computer-readable storage medium having data thereon representing a three-dimensional model suitable for use in manufacturing the product; and

[0036] manufacturing the product using instructions contained in the three-dimensional model.

[0037] The invention further provides a computer-readable medium having data thereon representing a three-dimensional model suitable for use in manufacturing a laparoscopy trocar, cannula or obturator of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] Embodiments of the invention will now be described with reference to the accompanying drawings, in which:

[0039] FIGS. **1**A to **1**H illustrate a cannula of the laparoscopy trocar of the invention;

[0040] FIGS. **2**A to **2**F illustrate an obturator of a laparoscopy trocar according to one embodiment of the invention;

[0041] FIGS. **3**A to **3**E illustrate the process of assembling the cannula and obturator together, and the trocar in its assembled state.

DETAILED DESCRIPTION OF EMBODIMENT(S)

[0042] FIGS. **1**A to **1**H illustrate a cannula suitable for use in embodiments of a laparoscopy trocar. The cannula has a first open end **101** and a second open end **102**. An open bore **103** extends between the first **101** and second **102** ends. The bore **103** is surrounded by a cannula wall **104**. The cannula wall **104** can be provided with external ridges **105**, which may be of a ring form, or helical as illustrated, but generally extend circumferentially with respect to the wall **104**. These ridges assist with securely locating the cannula **100** in the abdominal wall once the cannula has been inserted in an incision in the abdominal wall. The cannula **100** comprises a handle portion **200**. The handle portion **200** is located toward the first end **101** of the cannula. The handle portion **200** generally has an outer diameter which is greater than the outer diameter of the cannula wall **104** has in the region of the tubular portion **110** of the cannula **100**. The handle portion **200** extends laterally to a longitudinal axis X of the bore **103** in two substantially opposing directions, generally indicated by arrows A and B. The direction of arrow A can generally be considered a rearward direction, while the direction of arrow B can be considered a forward direction, although this terminology is not intended to be limiting and its use is merely illustrative of the two different directions, as will be appreciated upon a full reading of the subsequent description. The handle **200** therefore has a rearward extending handle portion **210** and a forward extending handle portion **220**. The cannula **100** also comprises a fluid inlet **250**. The fluid inlet **250** is generally configured to permit a fluid, normally a pressurised gas such as CO_2, to enter the bore **103** of the cannula **100** through a wall **104** of the cannula. The fluid inlet **250** can be opened or closed by valve means, which can take any known form. The illustrated embodiment generally takes the preferred form of a rotatable tap, which can be switched on or off to open or close the fluid path from the fluid inlet **250** to the bore **103** of the cannula. This item can therefore be generally termed a fluid control valve. The fluid control valve may be provided with a manipulable handle **230**. The handle **230** can be manipulated to move the fluid control valve from an open position to a closed position. As such, a user of the cannula **100** can manually switch a fluid flow path from the fluid inlet **250** to the bore **103** on and off. A source of pressurised CO_2 is commonly attached to a fluid inlet such as fluid inlet **250**, to inflate the abdominal cavity of a patient once the cannula **100** has been inserted through an incision in the abdomen of the patient. FIG. **1**B illustrates the handle **230** of the fluid control valve having been rotated through substantially **90** degrees, to move the fluid control valve to a closed configuration, thus sealing the fluid path between the fluid inlet **250** and the bore **103**, to prevent fluid flow through the fluid inlet **250**. As will be appreciated, the fluid inlet **250** can of course act as a fluid outlet when gas is being vented from the abdominal cavity and merely acts as an inlet when fluid is being provided to the bore **103** through the inlet **250** from a suitably pressurised fluid source. More generally, inlet **250** may therefore be termed a fluid port.

[0043] FIG. **1**C shows a side view of the cannula **100** with the fluid control valve in the closed position of FIG. **1**B. As can be more clearly seen in FIG. **1**C, the rearward **210**, and forward **220**, sections of the handle portion **200** can provide concave portions **211** and **221**, which can accommodate fingers of a user, so that fingers can grip the handle portion **200** on either side of the tube portion **111** of the cannula **100**. The lower or distal portion **240** of the handle portion **200**, located adjacent the tube section **111**, may be provided with a slightly larger outer dimension than an upper, or proximal portion **260**, which is located proximal to the hand of a user holding the device, and located at an opposite side of the distal portion **240** from the tube portion **111**.

[0044] These two distal and proximal portions **240** and **260** may be separated by a step, ridge or other, optionally graduated, change in outer dimension of the handle portions **200**, **210**, **220**.

[0045] As will be appreciated in relation to later figures, this can allow distal portion **260** of the handle portion **200** to be received in a handle portion of an obturator when the two items are combine, as will be described in relation to later figures. FIG. **1**E illustrates a top view of the cannula

100, i.e. when viewed from a direction of the first open end **101**. In this view, as can be seen, the handle **230** of the fluid control valve is oriented with its principal axis, i.e. that extending between its first **231** and second **232** ends, substantially at a right-angle to an axis of the fluid flow path passing from the fluid inlet **250** to the bore **103** of the cannula **100**.

[0046] FIGS. **1**F to **1**H illustrate the same views as shown in FIGS. **1**C to **1**E, but with the valve handle **230** in an open position, in which the principal axis of the handle **230** is substantially aligned with the direction of a flow path flowing from the fluid inlet **250** to the bore **103** of the cannula **100**.

[0047] FIGS. **2**A to **2**F show an obturator for a laparoscopy trocar in accordance with embodiments of the invention. The obturator **300** generally comprises a tip **310**, a body **320** and a shaft **330** extending between the two. The shaft **330** is generally configured to pass within the bore **103** of the cannula **100** of FIGS. **1**A to **1**H, i.e. by having an outer diameter smaller than the inner diameter of the bore **103**. Preferably, the outer diameter of the shaft **330** is a close fit with the inner wall of the bore **103** so as to steady the shaft **330** within the bore **103**. The shaft is preferably hollow, having an opening **332** at a proximal end through which a laparoscope can be introduced and inserted into the bore of the shaft **330**. Any part of either or both of the shaft **330** and/or the tip **310** of the obturator can be made from a transparent material. This can be a clear thermoplastic material. Therefore, when the trocar is passing through the incision it is possible for the surgeon to visualize the different tissue layers of the abdominal wall via the laparoscope inserted into the bore of the shaft **330**. It is preferable for the laparoscope to be inserted into the bore as close as possible to the tip **310** so that the image taken by it is of the best quality and clarity for the surgeon to view.

[0048] The body **320** in the illustrated example forms a handle portion of the obturator. As will be described in further detail in relation to later figures, when the obturator **300** is combined with the cannula **100**, the handle portion **200** of the cannula **100** and the body **320** of the obturator **300** combine to form an integrated handle portion of the laparoscopy trocar.

[0049] The handle portion **320** generally comprises a receiving area **321** for receiving a handle portion **200** of the cannula. An extension portion **322** of the handle portion **320** extends away from the receiving area **321**, such that when the handle portion **200** of the cannula and the handle portion **320** of the obturator **300** are combined, an extended handle portion is provided to the overall trocar assembly comprising the obturator **300** and the cannula **100**. The extension portion **322** may comprise convex portions **323** and **324** configured to accommodate the fingers of a user when grasping the overall handle of the trocar.

[0050] FIGS. **2**C to **2**F in particular illustrate one embodiment illustrating a way in which control means for actuating the fluid control valve of the cannula can be implemented. However, a number of different ways in which such control means can be implemented can be envisaged. The general concept devised by the applicant relates to any form of control means being integrated into the obturator so as to cause the fluid control valve of the cannula to switch between its open and closed positions. The preferred principal function of the control means is to cause the fluid control valve to be switched to a closed position when the obturator is inserted into the cannula. This is because it can be advantageous for the fluid control valve to be maintained in a closed position during insertion of the cannula into the abdominal cavity. Therefore, it can be advantageous to cause the combination of the obturator, which is used during the insertion procedure, with the cannula, to cause closure of the fluid control valve. Although the main example illustrated herein comprises a mechanical means for actuation of the fluid control valve by the obturator, it may be envisaged that other means, such as electronic means, be incorporated into the two parts of the device to achieve this aim. For example, sensing means may be provided, in the form of magnets and hall sensors, or RFID transmitters and receivers, or any other form of means for electronically sensing the placement of the obturator in the cannula. Those sensors may transmit a signal to a controller, which then actuates the fluid control valve in response to input from those sensors detecting the presence of the obturator in the cannula.

[0051] However, it can be advantageous for the laparoscopy trocar to be manufactured as a disposable single use item. In such cases, it can be preferable to manufacture all components from materials which can be manufactured at low costs, for example by 3D printing, or by injection moulding at high volume, to create a low cost disposable assembly. In these instances, it may be preferable to omit complex electronic components and so a mechanical means for controlling the fluid control valve when the obturator is introduced into the cannula can be preferred, as is illustrated in the embodiments shown in the figures.

[0052] In FIG. **2**C, mechanical control means for the fluid control valve are illustrated in an example where they are provided internally to the handle portion **320** of the obturator **300**. A first sloped surface **401** is provided and this can be configured to engage at least a first end **231** of the handle **230** of the fluid control valve. When the handle **230** is partially engaged by the control means **400**, i.e. not completely closed neither completely opened, the slope **401** will engage the handle **230** in between the centre or axis of rotation of the handle **230**, and the first end **231**. Preferably, at the same time, the slope **402** will engage the handle **230** in between its centre or axis of rotation and the second end **232**.

[0053] The internal workings of the fluid control valve are conventional and so are not illustrated in detail herein in the interests of efficiency of the disclosure. A skilled reader will be familiar with the types of fluid control valve required to switch on and off a CO_2 feed to the internal bore **103** of the cannula **100**.

[0054] In FIG. **2**D, the sloped surface **401** is cut through in cross section at the location illustrated by section line A-A in FIG. **2**B. As can be seen in the figure, sloped surface **401** is located substantially to a forward side, in the direction of arrow B, of an axis of rotation of the fluid control valve. A second sloped surface **402** can be provided in addition to, or alternatively to, the sloped surface **401**. However, best operation may be achieved by having both of sloped surfaces **40** and **402** in combination.

[0055] The second sloped surface **402** is provided to a rearward side of the axis of rotation **20** of the handle **230**. As can be seen in FIG. **2**D second sloped surface **402** is located substantially between the axis of rotation of the fluid control valve, which coincides substantially with the section line **20** shown in FIG. **2**D and the axis **331** of the shaft **330**. A sloped surface **402**, for engaging the fluid control valve can therefore be located substantially between the axis of the shaft

330 and the axis of rotation **20** of the fluid control valve. In the preferred arrangement illustrated, the sloped surfaces **401** and **402**, as seen on FIG. **2**D, are located substantially on opposite sides of the axis of the rotation **20** of the handle **230**.

[0056] Sloped surface **401** may be provided additionally, or alternatively, to sloped surface **402**. Sloped surface **401** can be positioned on an opposite side of the axis of rotation **20** of the fluid control valve to the shaft **330**. In such an arrangement, the axis **20** of the fluid control valve falls between the axis **331** of the shaft **330** and the sloped surface **401** when the trocar is assembled.

[0057] As will be appreciated, therefore, when the handle **230** of the fluid control valve of the cannula **100** is brought into engagement with one and/or the other of the first **401** and second **402** sloped surfaces, the handle **230** will be caused to rotate around its axis **20**. In the preferred arrangement illustrated, the control means **400** will engage simultaneously both ends **231** and **232** of the handle **230**, on the sloped surfaces **401** and **402** respectively.

[0058] This can cause the fluid control valve to be switched between its open and closed configurations. This switching can occur when the cannula is introduced in a direction of arrow C.

[0059] Details of the tip **310** of the obturator **300** shown in FIGS. **2**A to **2**G will be discussed in further detail later.

[0060] FIG. **3**A illustrates a perspective view of the obturator **300** being introduced into the cannula **100**. As can be seen in FIG. **3**A, the proximal portion **260** of the handle portion **200** of the cannula **100**, which has a reduced lateral dimension relative to the distal portion **240** can be received in the cavity **325** of the handle portion **320** of body of the obturator **300**.

[0061] The handle portion **320** can also be configured to include an opening **350** to allow the connector portion **251** of the fluid port **250** to pass at least partially within the handle portion **320** of the obturator. As shown in the preferred embodiment illustrated, the fluid port **250** may be completely housed in the cavity **325** of the handle portion **320**, as can be seen in FIG. **3**D. This will prevent the connector port **250** from interfering with the fingers of the user when holding the assembled trocar and thus prevents the port **250** disrupting the ergonomics of the handle of the trocar. This can also help to ensure that the fluid source connected to the connector portion **251** is not inadvertently connected to the cannula prior to the insertion of the cannula into the abdominal cavity. The enclosing of the fluid inlet **250** by the handle portion **320** can also be seen in FIG. **3**E.

[0062] As can be seen, when the handle **230** of the fluid control valve is introduced towards the mechanical control means **400**, the first **401** and/or second **402** sloped surfaces engage one or the other (preferably both) of the first **231** and/or second **232** ends of the handle **230** of the fluid control valve to actuate the fluid control valve as described above.

[0063] FIGS. **3**B and **3**C show perspective views of the laparoscopy trocar with the obturator **300** fully inserted into the cannula **100**. As can be seen, the extension portion **321** provides an extended handle portion which extends beyond the extent of the handle portion **200** of the cannula in a direction of arrow B, i.e. a forward direction.

[0064] FIG. **3**D shows a cross section through the assembled laparoscopy trocar. This figure illustrates how the shaft **330** of the obturator is received within the cannula wall **104**, with the tip **310** protruding from the second open end **102** of the cannula. The open end is distal from the handle portion **200**. Fluid inlet **250** of the cannula can be seen, received in the handle portion **320** of the obturator. A wall **326** of the cavity **325** of the handle portion **320** is located in relatively close proximity to the open end of the fluid inlet **250**, which helps prevent damage to the fluid inlet **250** when the obturator **300** is located in the cannula **100** and improves general ergonomic function of the handle by protecting the user's fingers from the inlet **250**.

[0065] Partial internal detail of the fluid control valve **233** can be seen. However, the full internal workings of the valve are not explained in detail, since these are conventional for a rotational fluid control valve as used in known cannulas. As can be seen in the figure, the handle **230** of the fluid control valve **233** is received in a cavity **327**, which encloses the handle portion **230**, such that it cannot rotate to its open position. Although the embodiment shown in FIG. **3**D includes a rotational fluid control valve, embodiments can be envisaged in which other forms of mechanical fluid control valve are moved by, and their movement restricted by, the handle portion **320** of the obturator **300**. For example, a linear action fluid control valve could be implemented, which could be driven linearly between open and closed positions by introduction of the obturator **300** into the cannula **100**. This linear movement can be restricted by suitably configured features of the body or handle portion **320** of the obturator **300**. For example, if the cannula **100** is introduced in a linear direction of arrow C, then the linear valve may be directly driven in an opposite direction of arrow C by features of the handle **320** impacting the control valve. Alternatively, sloped surfaces may be used to drive a linear valve substantially laterally relative to the direction C of introduction of the cannula to move it between open and closed positions.

[0066] As is conventional, the cannula **100** further comprises one or more valve seals located in the bore **103**. The illustrated example comprises two valve seals. A first valve seal **121** is conventionally configured to seal the bore **103** in the absence of any obturator or surgical instrument being present in the bore **103**. The second seal **122** is also conventional and is configured to seal around the obturator **300**, or any other instrument inserted into the bore **103**, while bellows **123**, located around the central part of the seal **122**, permit some lateral movement of the instrument within the bore **103** whilst allowing a sealing edge of the valve seal **122** to maintain a fluid-tight seal around the outer surface of the inserted instrument. Such first **121** and second **122** seals are conventional in the art and so detail of them is not described herein and any such suitable seal or seals can be used in the cannula **100** of embodiments of the present invention.

[0067] A further novel aspect of the laparoscopy trocar described herein, is the form of the tip **310** of the obturator **300**. The form of the tip can be seen throughout FIGS. **2**A to **2**F and **3**B to **3**E. The tip **310** comprises a front edge **311** and a rear edge or face **312**. The tip may further comprise an end **313** which may be substantially rounded or dome-shaped. The front edge **311** is formed where a pair of concave faces **311**A and **311**B meet at an acute angle. The concavity of the faces causes the front edge **311** to also have a concave form when viewed from a point substantially perpendicular to its plane of curvature, as seen in FIG. **2**A. The front edge **311** is therefore concave with respect to the longitudinal axis **331** of the obturator **300**, bowing inwardly toward the axis **331**. The front edge may be sharp so as to form a blade, which may be configured to cut through layers of the abdominal wall upon insertion into an initial incision made by a surgeon during insertion of the obturator tip **310**.

[0068] The rear edge or face **312** of the tip **310** of the obturator is configured so as not to have any sharp edge which would cut the abdominal wall. The rear face is preferably convex, as shown in FIGS. **2**A and **2**C in particular, i.e. convex with respect to the longitudinal axis **331** of the obturator, or bowing outwardly away from that axis. The rear edge or face **312** may still comprise first and second faces **312**A and **312**B, or may be formed of a single substantially smooth convex surface. However, if comprising two or more faces, it is preferred that such faces meet at a greater internal angle than the front faces **311**A and **311**B, so that no bladed edge is created at the rear edge or face **312**. If any edge is created, then this is generally formed at least at a greater internal angle than the acute internal angle of the front edge **311** formed by the first and second concave faces **311**A and **311**B.

[0069] A tip configured in such a manner can reduce the amount of friction, and therefore the amount of force, required to insert the obturator into the abdominal cavity. The bladed front face **311** is configured in such a manner that it will can at least partially cut through the layers of the abdominal wall upon insertion. Therefore, a little more trauma may be caused by the tip **310** than if no bladed edge **311** were provided. However, in certain situations blunt edges can cause greater friction and tearing of the abdominal wall depending upon the hardness, or lack thereof, of the abdominal wall. Therefore providing one sharp edge to the obturator can reduce the overall level of trauma caused in certain situations. However, the form of the tip allows a lesser degree of force to be used, which reduces the risk of the trocar penetrating the cavity wall in a less controlled manner and thus decreasing the possibility of injury of internal organs, vessels or other internal abdominal structures by the trocar tip on insertion of the obturator **300** and cannula **100**.

[0070] As can be appreciated from the figures, a plane of the tip which is substantially aligned with the front edge **311** and the rear edge **312** is substantially parallel with both a longitudinal axis of the handle portion **320**, and also with a longitudinal axis **331** of the obturator itself. This fore-aft alignment of the tip **310** with the longitudinal dimension of the handle portion **320** means that the tip **310** and its front and rear edges **311** and **312** are better aligned with the hand of a user when gripping the body or handle portion **320** of the obturator, specifically when combined with the cannula **100**. This can improve the overall ergonomics of the laparoscopy trocar, facilitating insertion of the trocar into the abdominal cavity. It can be preferable to have the sharp or front edge **311** oriented in the direction described for the following reasons:

[0071] 1. When a user such as a surgeon is introducing the trocar into the abdominal cavity, the front of the trocar is always facing the surgeon.

[0072] 2. The surgeon will normally try to make the longitudinal axis of the trocar perpendicular to the body of the patient, as far as is practicable. In this way the trocar will pass through the least amount of abdominal wall and this reduces the amount of trauma caused to tissue. In practice, the users tend to have the longitudinal axis of the trocar slightly inclined towards themselves.

[0073] 3. In either case, the trocar introduced perpendicular to the body or with a small degree of inclination towards the user, the load generated by the surgeon on the trocar will be (slightly) higher on the front of the trocar tip than on the rear of the trocar tip.

[0074] 4. Thus, with the sharp edge, that has a cutting effect, on the front face of the tip, the insertion force needed to go through the abdominal wall is less than if this edge was on the rear face of the tip.

[0075] 5. Also, as the sharp edge is concave, the cutting of the wall will be reduced to a minimum.

[0076] Regarding the rear face **312**, the convex rear face is significantly elongated in comparison to the front edge, as this will reduce its angle of insertion and thus concur to minimize the insertion force.

[0077] Any part of the obturator, cannula or the laparoscopy trocar assembly described herein may be manufactured by automated manufacturing means and methods. Such means and methods can include material removal techniques, and/or additive manufacturing systems and techniques, which are commonly known as 3D-printing systems and techniques. Such manufacturing methods generally require the creation of a computer readable model of the product to be manufactured. From that virtual three-dimensional model, a computer can derive a set of instructions to instruct a 3D printer to manufacture the product, or indeed for a material removal device to "machine" the product from a block of material, by methods generally known as material removal techniques. Different materials having different properties can be better suited to either additive manufacture, or material removal techniques, but both generally start from a 3D model and generate instructions from the model to control a 3D printer or material removal device (often called a CNC-computer numerically controlled-machining device). Such devices are widely available and are not described herein in the interests of efficiency of the disclosure, but such devices will be well known to the person skilled in the art of such automated manufacturing techniques and apparatus'. Suitable 3D models for generating manufacturing instructions can be general 3D CAD (computer aided design) files and those themselves can be considered a computer programme product suitable for generating instructions for the manufacture of the product by automated manufacturing means. Such models can be interpreted by 3D printing software, or a 3D printer device, in order to manufacture the products. Further, metal removal, or CNC machining software can also interpret the CAD models to create instructions for a material removal device to create the product from a block of solid material. Further, such 3D CAD files can be used to create a form for a mould for manufacturing the device by moulding processes, such as injection moulding. Injection moulding can be the most efficient way of manufacturing the components described herein and so use of the described CAD files representing the product to create moulds for injection moulding of the product is included within the scope of this disclosure.

[0078] Although the invention has been described above with reference to one or more preferred embodiments, it will be appreciated that various changes or modifications may be made without departing from the scope of the invention as defined in the appended claims.

1. A laparoscopy trocar, comprising:
a cannula comprising:
first and second ends and a bore extending therebetween;
at least one flexible seal disposed in the bore, for inhibiting a passage of pressurised gas from the first end to the second end of the cannula; and
a fluid control valve configured to selectively open and close a fluid communication path for carrying fluid from a point external to the bore, into the bore of the cannula; and
an obturator, comprising;
a tip, a body, and a shaft connecting the tip to the body, wherein the body of the obturator comprises control means configured to cause the fluid control valve to move between its open and closed positions.

2. The laparoscopy trocar according to claim **1**, wherein the control means are configured to cause the fluid control valve to close when the obturator is inserted into the cannula.

3. The laparoscopy trocar according to claim **1**, wherein the control means comprises mechanical means configured to mechanically actuate the fluid control valve.

4. The laparoscopy trocar according to claim **1**, wherein the control means are configured to actuate a manipulate handle of the fluid control valve.

5. The laparoscopy trocar according to claim **1**, wherein the control means are configured to prevent actuation of the fluid control valve when the obturator is placed in the cannula.

6. The laparoscopy trocar according to claim **1**, wherein the control means is disposed in a handle portion of the obturator.

7. The laparoscopy trocar according to claim **6**, wherein the fluid control valve is disposed in a handle portion of the cannula.

8. The laparoscopy trocar according to claim **6**, wherein the respective handle portions of the cannula and the obturator are configured to align with one another when the obturator is fully inserted in the cannula, the handle of the cannula being at least partially received in the handle of the obturator.

9. The laparoscopy trocar according to claim **1**, wherein the respective handle portions of the cannula and the obturator are configured to enclose an input portion of the fluid control valve to prevent actuation of the input portion.

10. The laparoscopy trocar according to claim **6**, wherein the control means comprises at least one sloped portion provided in the handle portion of the obturator, the sloped portion being configured to drive the input portion of the fluid control valve laterally relative to the axis of the bore of the cannula, to actuate the fluid control valve.

11. The laparascopy trocar according to claim **10**, wherein the sloped portion is configured to rotate the input portion of the fluid control valve to actuate the fluid control valve.

12. The laparascopy trocar according to claim **10**, comprising a pair of sloped portions configured to engage opposite sides of the input portion to actuate the fluid control valve.

13. A laparoscopy trocar, comprising:
a cannula comprising first and second ends and a bore extending therebetween; and
an obturator, comprising a tip, a body, and a shaft connecting the tip to the body, wherein the tip of the obturator comprises:
a pair of concave front surfaces meeting at an acute angle to form an acutely angled front edge in a plane substantially parallel to a longitudinal axis of the shaft.

14. The laparascopy trocar according to claim **13**, wherein the tip of the obturator further comprises a convex rear face substantially opposite the front edge.

15. The laparascopy trocar according to claim **14**, wherein the rear face is oriented so as to be convex in a direction away from the longitudinal axis of the shaft.

16. The laparascopy trocar according to claim **13**, wherein the plane of the front edge of tip is oriented in a first direction away from the longitudinal axis of the shaft, the first direction being substantially parallel to a longitudinal axis of the handle portion of the obturator.

17. A cannula of the laparoscopy trocar according to claim **1**.

18. An obturator of the laparoscopy trocar of claim **1**.

19. A method of manufacturing a product, the product being the laparoscopy trocar according to claim **1**, the cannula according to claim **17** or the obturator according to claim **18**, comprising the steps of:
providing a computer-readable storage medium having data thereon representing a three-dimensional model suitable for use in manufacturing the product; and
manufacturing the product using instructions contained in the three-dimensional model.

20. A computer-readable medium having data thereon representing a three-dimensional model suitable for use in manufacturing the laparoscopy trocar according to claim **1**, the cannula according to claim **17** or the obturator according to claim **18**.

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摘要(译)

公开了一种腹腔镜套管针，其具有套管和闭塞器，用于将套管插入患者的腹腔中。套管包括流体控制阀，用于打开和关闭从套管的孔外部进入套管的孔的流体流动路径，并且闭塞器包括控制装置，该控制装置构造成使流体控制阀在其打开和关闭位置之间移动。在将填塞器插入套管中时。公开了一种用于闭塞器的新颖尖端，其包括形成在一对凹形尖端面之间的凹形叶片前边缘。