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(71) Applicant: KOC UNIVERSITESI [TR/TR]; Rumelifen-  
eri Yolu, Sariyer, 34450 Istanbul (TR).

(72) Inventors: CANADINC, Demircan; Koc Universitesi,  
Muhendislik Fakultesi, Sariyer, Istanbul (TR). CARILLI,  
Senol Ibrahim; Amerikan Hastanesi Genel Cerrahi  
Bolumu, Nisantasi, Istanbul (TR).

(74) Agent: ANKARA PATENT BUREAU LIMITED; Be-  
stekar Sokak No: 10, Kavaklidere, 06680 Ankara (TR).

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(54) Title: A MONOLITHIC TROCAR HEAD WITH VALVES

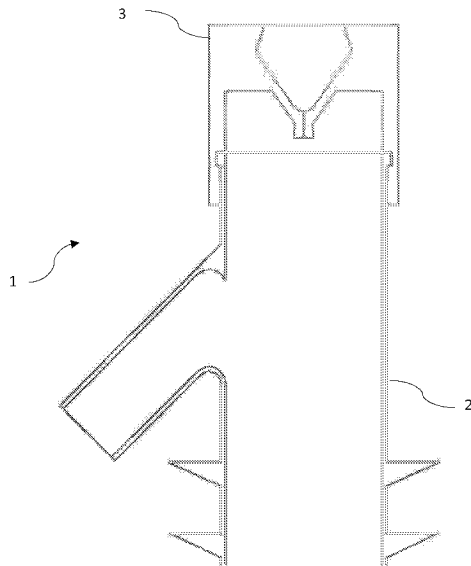


Figure 1

(57) Abstract: The present invention relates to a trocar, more particularly to a trocar head and valve which isolates the internal body cavity from external environment while a laparoscopic instrument is inserted into the body cavity through the trocar as well as while no laparoscopic instrument is inserted through the trocar. A trocar (1), which is used in various laparoscopic and other minimal invasive surgeries and through which the instruments and/or devices to be used during operation and/or surgery are passed and are inserted inside the patient's body, comprises at least one trocar body (2) at least a part of which enters inside the patient's body, at least one monolithic head (3) consisting of, an outer surface (35) at least a part of which has an increased frictional coefficient to prevent slipping and enabling better gripping, an inner surface (36) with reduced frictional coefficient to enhance slipping ability of medical instrument inside the head (3), at least one passageway (31) for receiving medical instrument, at least one diaphragm seal (32) monolithically formed inside the head (3) isolating interior of the patient's body from exterior while no medical instrument is introduced, at least one subsidiary seal (33) monolithically formed inside the head (3) forming a seal around the medical instrument.

## A MONOLITHIC TROCAR HEAD WITH VALVES

### Field of the Invention

5 The present invention relates to a trocar, more particularly to a trocar head with valves formed inside the head which isolates the internal body cavity from external environment while a laparoscopic instrument is inserted into the body cavity through the trocar as well as while no laparoscopic instrument is inserted through the trocar.

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### Background of the Invention

Surgical instruments such as but not limited to camera and scissors used during closed surgeries are inserted inside the abdominal cavity through the apparatus called trocar. The trocars placed inside the incisions made on the abdominal wall have various valve mechanisms in order to prevent the gases constituting the intra-abdominal pressure from going out of the body. Therefore valve mechanism is a vital part of a trocar. Conventional trocars consists a head portion which encapsulates the valve mechanism. Said head portion means the part of the trocar that stays out of the patients' body and internal cavity. Most of the times valve mechanisms of trocars consist of multiple elements in order to prevent gas flow from internal cavity of a patient to outside when both a laparoscopic instrument is inserted through the trocar and no laparoscopic instrument are inserted. Complexity and multi-part construction of these valves makes them prone to failures. In addition, trocars including multi-part valves have relatively large head portions to provide sufficient space for the valve mechanism. A large head portion provides increased handling capability to operator; nevertheless, larger head portions cause loss of maneuverability ability especially when trocars placed close to each other.

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Although some patent applications showing relatively small head portions exist, they have ring like structures attached to the head to serve better grasping. It would be very difficult to pull the trocar out of the patient's body if there were no ring like protrusions since the body of the trocar is made of hard and slippery material.

International patent application no PCT/IB12/052677 discloses a trocar with an enhanced maneuver capability. Outer diameter of the upper body of said trocar is almost the same as outer diameter of the lower body. A simple valve mechanism is placed in said upper body. But, PCT/IB12/052677 is silent about how the operator would hold the trocar and pull out it. A skilled person in the art would place a head portion to the upper body to hold the trocar and pull the trocar out of the body. Another drawback of PCT/IB12/052677 is that valve mechanism is inside the upper body. Valve mechanism inside upper body decreases effective inner diameter of upper body, therefore; limits the diameter of laparoscopic instrument that can be placed.

The United States patent document no US 2007/0232988, another application known in the state of the art, discloses a trocar-cannula device. Two ring like structures are added to upper end of the cannula for better grasping. Although said rings are useful for better grasping, they causes discomfort to the operator. Another drawback of said application is its complicated valve mechanism. The valve mechanism is placed inside the upper part of the cannula; hence, making the inner diameter of upper part less efficient (see figure 20 of US 2007/0232988). It is necessary to construct a larger upper part to eliminate the ineffective usage of inner diameter, which automatically causing problems when multiple trocars are present close to each other.

The United States patent document no US 5330437, another application known in the state of the art, discloses a self sealing elastomeric valve and a trocar assembly incorporating it. Elastomeric valve placed inside the head portion of the trocar;

therefore, inner and outer diameters of the trocar are increased at the upper body as best seen in figures 9 and 10 of US 5330437. A handle housing is placed at the head portion. Handling portions hamper multiple trocars to be placed close to each other.

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### **Summary of the Invention**

The objective of the present invention is to provide a trocar with a monolithic head with valves.

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Another objective of the present invention is to provide a trocar that has an improved handling ability without need of a large head portion or ring like protrusions.

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A further objective of the present invention is to provide a trocar and head which enables effective use of inner diameter of the trocar body.

Yet another objective of the present invention is to provide a head with valves which enables the placement of multiple trocars close to each other.

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Yet another object of the present invention is to provide a head with valves that is simple and easy to produce.

### **Detailed Description of the Invention**

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“A monolithic trocar head with valves” realized to fulfill the objectives of the present invention is illustrated in the accompanying figures, in which:

Figure 1 is the cross-section view of the trocar with monolithic head with valves

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Figure 2 is the cross-section view of the inventive monolithic trocar head with valves.

The components in the figures are numbered individually, where the numbers refer to the following:

1. Trocar
2. Trocar body
- 5 3. Head
  31. Passageway
  32. Diaphragm seal
  33. Subsidiary seal
  34. Housing
  - 10 35. Outer surface
  36. Inner surface
  37. Point gate

A trocar (1), which is used in various laparoscopic and other minimal invasive surgeries and through which the instruments and/or devices to be used during operation and/or surgery are passed and are inserted inside the patient's body, comprises

- at least one trocar body (2) at least a part of which enters inside the patient's body,
- 20 - at least one monolithic head (3) consisting of,
  - an outer surface (35) at least a part of which has an increased frictional coefficient to prevent slipping and enabling better gripping,
  - an inner surface (36) with reduced frictional coefficient to enhance slipping ability of medical instrument inside the head (3),
- 25 - at least one passageway (31) for receiving medical instrument,
- at least one diaphragm seal (32) monolithically formed inside the head (3) isolating interior of the patient's body from exterior while no medical instrument is introduced,
- at least one subsidiary seal (33) monolithically formed inside the head
- 30 (3) forming a seal around the medical instrument.

The inventive trocar (1) comprises at least one trocar body (2) defining a cannula for placing the medical instrument within the patient's body. In a preferred embodiment of the invention both inner and outer surface of the trocar body (2) has a decreased coefficient of friction. There can be a penetrating tip at one end of the trocar body (2). The penetrating tip is used to penetrate through the abdominal wall or other tissue of the patient where the trocar (1) will be placed. The trocar body (2) can be any kind of medical grade plastics especially hard plastics or appropriate metals. The trocar body (2) can optionally have one or more protrusions that prevent the trocar (1) from moving through the patient's body further by leaning the abdominal wall.

The head (3) isolates the body cavity of the patient from the exterior when both there is a medical instrument inside the trocar (1) and there is no medical instrument inside the trocar (1). The head (3) can be any kind of medical grade polymers especially elastomeric ones. Therefore interior diameter of the head (3) can expand when a medical instrument is present. At least a part of the outer surface (35) of the head (3) has an increased coefficient of friction to prevent slipping and enable better gripping while pulling the trocar (1) out of the patient's body. Increased coefficient of friction can be achieved by roughening the outer surface (35). Alternatively outer surface (35) of the head (3) can be coated with a material that has relatively higher coefficient of friction. In the preferred embodiment of the invention, interior surface (36) of the head (3) has a housing (34) for the trocar body (2) in such a way that at least a part of the outer surface of the trocar body (2) is in contact with at least a part of the interior surface (35) of the head (3). In other words, at least a part of upper side of the trocar body (2) with respect to the patient's body stays inside the head (3). Since the head (3) wraps around outer surface of the trocar body (2), inner diameter of the trocar body (2) can be effectively used by a medical instrument. The head (3) can be adhered to the trocar body (2) by medical glue, heat sealing or the like. In an alternative, but discouraged embodiment of the invention at least a part of the

head (3) can be placed inside the trocar body (2) in such a way that outer surface of the head (3) becomes in contact with the inner surface of the trocar body (2).

The head (3) has at least one passageway (31) to receive the medical instrument.

5 The passageway (31) preferably extends along the same axis with the trocar body (2). At least one diaphragm seal (32) is located at the passageway (31). The diaphragm seal (32) is monolithic with the head; therefore, it is made of the same material with the head. The diaphragm seal (32) is preferably has a conical nature whose vertex extends towards the penetrating tip of the trocar body (2) and has a  
10 point gate (37) at the vertex that stays closed while there is no medical instrument or another object within the passageway (31). In another embodiment of the invention, the vertex of the diaphragm seal (32) extends towards the upper part of the head (3) with respect to patient's body. The point gate (37) expands when a medical instrument or object is introduced, since the diaphragm seal (32) is  
15 elastomeric like head (3). Therefore it isolates the interior of the internal cavity of patient's body while there is no instrument inside or there are objects that have relatively small diameters like wire for example. In addition to diaphragm seal (32) preferably, at least one ring like subsidiary seal (33) is located at the passageway (31). Although ring like subsidiary seal (33) is preferred, any kind of  
20 shape that permit the passage of the medical instrument can be used as long as the shape overlaps the medical instrument. Inner surface of the subsidiary seal (33) engages with a medical instrument in order to seal the medical instrument whose size is greater than those could be sealed by the diaphragm seal (32) or whose shape is not suitable for diaphragm seal (32). Inner surface of the head (3) and all  
25 surfaces of all elements at the passageway (31) preferably have reduced coefficient of friction in order to allow the medical instruments easily slip. Reduces coefficient of friction can be achieved by coating these surfaces with a non-toxic materials that have low frictional coefficients or polishing or any other suitable technique known in the art. In the preferred embodiment the head (3),  
30 diaphragm seal (31) and subsidiary seal (32) are manufactured by injection molding and monolithic. In other words diaphragm seal (31) and subsidiary seal

(32) are formed or shaped on the inner surface of the trocar head (3) by injection molding therefore the trocar head (3) is realized as a one piece block. For such a trocar head, the terms “monolithic trocar head” or “monolithic head” is used herein.

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The inventive monolithic head (3) and trocar (1) comprising said monolithic head (3) is used during laparoscopic or other minimal invasive surgeries to insert the medical instrument inside the patient's body. Medical instruments are received by the passageway (31) located along longitudinal axis of the head (3). The head (3) is placed at the upper end of the trocar body (3) with respect to the patient's body. In the preferred embodiment, at least a part of the upper end of the trocar body (3) stays inside the lower part of the head (3). In other words, the trocar body (3) stays in the lower portion of the passageway (31) with respect to patient's body. When the trocar (1) is placed to the patient's body the diaphragm seal (32) protects the air inside the patient's body cavity from going outside of the body while there is no instrument inside the trocar (1). The diaphragm seal (32) also can effectively seal small sized instruments like wires. Subsidiary seal (33), on the other hand; engages with the medical instruments that have relatively large diameters so as to seal them.

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It is possible to develop various embodiments of the inventive “A MONOLITHIC TROCAR HEAD WITH VALVES”. The invention cannot be limited to the examples described herein and it is essentially as defined in the claims.

## CLAIMS

1. A trocar (1), which is used in various laparoscopic and other minimal invasive surgeries and through which the instruments and/or devices to be used during operation and/or surgery are passed and are inserted inside the patient's body, comprises
- at least one trocar body (2) at least a part of which enters inside the patient's body **characterized by**
  - at least one monolithic head (3) consisting of,
  - an outer surface (35) at least a part of which has an increased frictional coefficient to prevent slipping and enabling better gripping,
  - an inner surface (36) with reduced frictional coefficient to enhance slipping ability of medical instrument inside the head (3),
  - at least one passageway (31) for receiving medical instrument,
  - at least one diaphragm seal (32) monolithically formed inside the head (3) isolating interior of the patient's body from exterior while no medical instrument is introduced,
  - at least one subsidiary seal (33) monolithically formed inside the head (3) forming a seal around the medical instrument.
2. The trocar (1) according to claim 1 **characterized in that** inner and outer surface of the trocar body (2) has a decreased coefficient of friction.
3. The trocar (1) according to claims 1 or 2 **characterized in that** the trocar body (2) is made of medical grade hard plastics.
4. The trocar (1) according to any of the preceding claims **characterized in that** the trocar body (2) is made of a metal.
5. The trocar (1) according to any of the preceding claims **characterized in that** the head (3) is made of a medical grade elastomeric material.

6. The trocar (1) according to any of the preceding claims **characterized in that** at least a part of the outer surface of the head (3) has an increased frictional coefficient.
- 5 7. The trocar (1) according to any of the preceding claims **characterized in that** the head (3) is adhered to the trocar body (3).
8. The trocar (1) according to any of the claims 1 to 7 **characterized in that** at least a part of the head (3) wraps around at least a part of the upper side  
10 of the trocar body (2).
9. The trocar (1) according to any of the preceding claims **characterized in that** at least a part of the head (3) is placed inside the trocar body (2).
- 15 10. The trocar (1) according to any of the preceding claims **characterized in that** the diaphragm seal (32) has a conical nature whose vertex extends towards penetrating tip of the trocar body (2) and has a point gate (37) at the vertex that stays closed while there is no medical instrument or another object within the passageway (31).
- 20 11. The trocar (1) according to any of the claims 1 to 9 **characterized in that** the diaphragm seal (32) has a conical nature whose vertex extends towards upper side of the head (3) and has a point gate (37) at the vertex that stays closed while there is no medical instrument or another object within the  
25 passageway (31).
12. The trocar (1) according to claims 10 or 11 **characterized in that** the point gate (37) expands when a medical instrument or object is introduced.

13. The trocar (1) according to any of the preceding claims **characterized in that** the head (3), diaphragm seal (31) and subsidiary seal (32) are monolithic and made of a medical grade elastomeric material.
- 5 14. The trocar (1) according to any of the preceding claims **characterized in that** inner surface of the head (3) and all surfaces of all elements at the passageway (31) have reduced coefficient of friction.

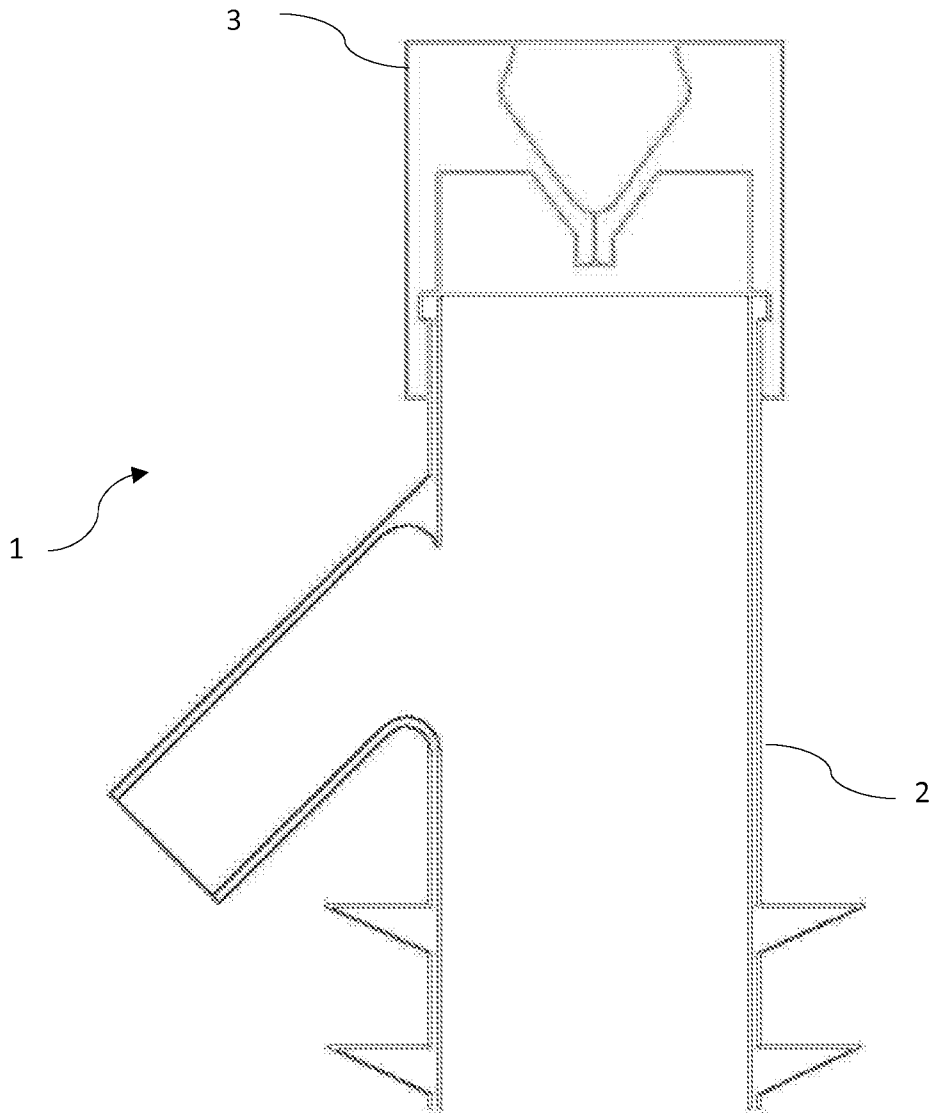


Figure 1

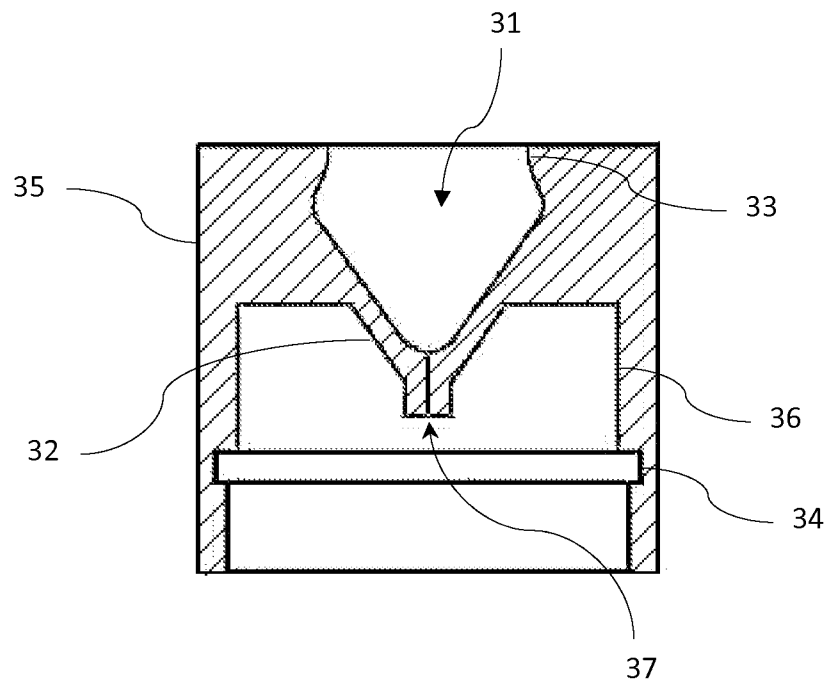


Figure 2

**INTERNATIONAL SEARCH REPORT**

International application No  
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<b>A. CLASSIFICATION OF SUBJECT MATTER</b> INV. A61B17/34 ADD.				
According to International Patent Classification (IPC) or to both national classification and IPC				
<b>B. FIELDS SEARCHED</b>				
Minimum documentation searched (classification system followed by classification symbols) A61M A61B				
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched				
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal				
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X	US 5 727 770 A (DENNIS) 17 March 1998 (1998-03-17) abstract; figures 1-4 column 2, line 35 - column 3, line 14 column 3, line 53 - column 4, line 65 -----	1-8, 10-14		
X	FR 2 727 849 A1 (ZOCCOLA ET AL.) 14 June 1996 (1996-06-14) abstract; figures page 6, line 1 - page 7, line 2 -----	1-7,9-14		
X	US 2012/221024 A1 (SUTTON ET AL.) 30 August 2012 (2012-08-30) abstract; figures -----	1,2,5, 9-14		
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<table style="width:100%; border:none;"> <tr> <td style="width:50%; border:none;"><input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.</td> <td style="width:50%; border:none;"><input checked="" type="checkbox"/> See patent family annex.</td> </tr> </table>			<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.	<input checked="" type="checkbox"/> See patent family annex.
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.	<input checked="" type="checkbox"/> See patent family annex.			
* 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  <p align="center">6 June 2013</p>	Date of mailing of the international search report  <p align="center">14/06/2013</p>			
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  <p align="center">Giménez Burgos, R</p>			

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/IB2013/052304

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 456 284 A (RYAN ET AL.) 10 October 1995 (1995-10-10) abstract; figures 1-5 column 3, line 25 - column 4, line 48 -----	1,2,5, 9-14
X	US 6 142 981 A (HECK ET AL.) 7 November 2000 (2000-11-07) abstract; figures -----	1,2,5, 9-14
X	US 4 649 904 A (KRAUTER ET AL.) 17 March 1987 (1987-03-17) the whole document -----	1,2,5-8, 10-14

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/IB2013/052304
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5727770	A	17-03-1998	NONE
FR 2727849	A1	14-06-1996	NONE
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申请(专利权)人(译)	KOC UNIVERSITESI		
当前申请(专利权)人(译)	KOC UNIVERSITESI		
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外部链接	<a href="#">Espacenet</a>		

#### 摘要(译)

本发明涉及一种套管针，更具体地涉及一种在腹腔镜器械通过套管针插入体腔中时以及在无腹腔镜器械通过套管针插入的同时将内部体腔与外部环境隔离的套管针头和阀。用于各种腹腔镜手术和其他微创手术中并且通过其在手术和/或手术期间使用的器械和/或装置穿过并插入患者体内的套管针(1)包括至少一个套管针(2)，其至少一部分进入患者体内;至少一个整体式头部(3)，其由至少一部分具有增大的摩擦系数的外表面(35)组成，以防止打滑并且能够更好地至少一个用于接收医疗器械的通道(31)，至少一个隔膜密封件(32)，所述隔膜密封件(32)整体形成在所述头部(3)内部，所述隔膜密封件(32)具有减小的摩擦系数以增强所述头部(3)内的医疗器械的滑动能力。头部(3)在没有引入医疗器械的情况下将患者身体的内部与外部隔离，至少一个在头部(3)内整体形成的辅助密封件(33)在医疗器械周围形成密封换货。