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(54) Laparoscopic training apparatus

(57) The present invention relates to a laparoscopic apparatus (10). In particular, it relates to an apparatus for the training of medical professionals, particularly those engaged in the field of laparoscopic surgery. The apparatus (10) comprises a housing; a joint (32) in operative association with the housing and adapted to substantially accommodate a laparoscopic tool (42), in use,

through the joint (32), the joint (32) permitting movement of the laparoscopic tool (42), in use; and resistance means in operative association with the joint (32), adapted to adjust resistance to movement of the laparoscopic tool (42), in use. Accordingly, the present invention provides a realistic surgical experience by mimicking the sensation of carrying out surgical techniques on a patient.

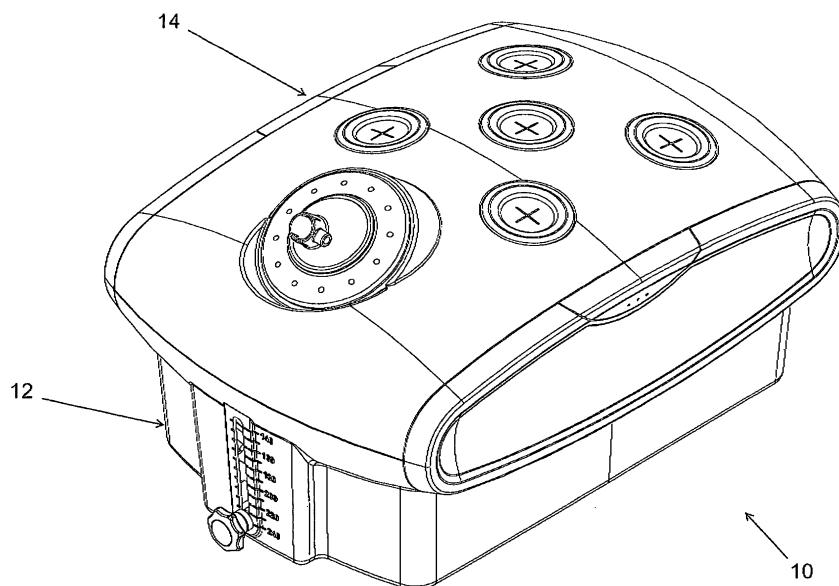


Figure 1

Description**Field of the Invention**

[0001] The present invention relates to a laparoscopic apparatus. In particular, the invention finds utility as a training apparatus for laparoscopic surgery techniques.

Background

[0002] Laparoscopic surgery is a modern surgical technique performed through small incisions, which involves the visualisation of body cavities using telescopes with attached camera systems. Trocars or cannulae are inserted through the incisions to facilitate the smooth passage of telescopes and slender long instruments into these cavities. A fundamental feature of laparoscopic surgery is the use of a laparoscope: a telescopic rod lens system that is usually connected to a visual acquisition device, such as a camera. Most typically, a fibre optic cable system connected to a 'cold' light source such as halogen or xenon is used to illuminate the operative field. The internal appearances of the body cavities are visualised on visual display monitors. The monitor image is 2-dimensional, and the movement of the instruments is seen in parallax. These combined features mean that surgeons training in this field of surgery not only have to learn individual surgical procedures, they must also become comfortable working in a 3-dimensional environment which has been translated to a 2-dimensional output.

[0003] The restricted vision, the difficulty in handling of the instruments, the acquisition of new hand-eye co-ordination skills, the lack of tactile perception and the limited working area are factors which add to the technical complexity of this surgical approach. For these reasons, minimally invasive surgery has emerged as a highly competitive new sub-specialty within various fields of surgery. Surgical residents, who wish to focus on this area of surgery, gain additional training during one or two years of fellowship after completing their basic surgical residency. Accordingly, the use of a simulator allows the trainee surgeon not only to learn the skills that when eventually combined, become a procedure, but they can also experience the unique appreciation of 2-dimensional visualisation of the 3-dimensional surgical field.

[0004] A simulator replicating the laparoscopic environment as experienced in an operating theatre, is superior to other inanimate simulators. Any learned procedure is a combination of several different skills, in other words all procedures can be broken down into individual component skills. These skills include the ability to correctly orientate a camera, manipulate objects in 3 dimensions, cut tissue, and suture (stitch). The simulator facilitates the trainee in attaining proficiency at these tasks prior to actually entering the operating room environment.

[0005] Once a surgical trainee or surgeon acquires a skills set, they can then move on to performing a variety

of surgical procedures. It is estimated that individual skills have to be repeated up to 30 times before a surgeon is considered proficient. This also applies to entire procedures. A simulator can also help simulate an entire procedure, where the skills are combined on a suitable model, again without endangering a patient. For example a laparoscopic cholecystectomy (removal of a gall bladder), the most common laparoscopic procedure performed, is a combination of grasping, dissection, clipping and cutting. All these skills can be simulated and indeed the procedure itself can then be performed on a simple model.

[0006] It is an object of the present invention to provide a laparoscopic apparatus for the training of medical professionals, particularly those engaged in the field of laparoscopic surgery. In particular, it is envisaged that the present invention will provide a realistic surgical experience by mimicking the sensation of carrying out surgical techniques on a patient.

Summary of the Invention

[0007] According to a first aspect of the present invention, there is provided a laparoscopic apparatus comprising a housing; a joint in operative association with the housing and adapted to substantially accommodate a laparoscopic tool, in use, through the joint, the joint permitting movement of the laparoscopic tool, in use; and resistance means in operative association with the joint, adapted to provide resistance to movement of the laparoscopic tool, in use.

[0008] Preferably, the housing comprises a base and a lid.

[0009] Preferably, the lid is generally curved in form, to substantially mimic the form of a human torso.

[0010] Preferably, the laparoscopic tool is a visual acquisition device.

[0011] Preferably, the joint further comprises a substantially hollow generally cylindrical tube, which is open at both ends.

[0012] Preferably, the joint permits concurrent movement of the laparoscopic tool (for example, the visual acquisition device) in all three axes. Further preferably, the joint is a rotatable joint.

[0013] Preferably, the joint is adapted to simulate the resistive forces experienced during laparoscopic surgical techniques.

[0014] Preferably, the joint comprises a ball-and-socket joint.

[0015] Preferably, the socket is generally annular in form, and shaped and dimensioned to accommodate the ball therein.

[0016] Preferably, the ball is generally conoid in form. Although, it will be seen that the ball can be any form that permits triaxial rotation within the socket.

[0017] Preferably, the socket comprises a first section and a second section, spaced apart, shaped and dimensioned to house the ball therebetween.

[0018] Preferably, the first section can be removably mounted to the housing of the laparoscopic apparatus. Preferably, the first section is mounted by a plurality of clips.

[0019] Preferably, the first and second sections are biased towards one another by the resistance means.

[0020] Preferably, the distance between the first and second sections of the socket is adjusted by a spring in operable association with one or both of the first and second sections.

[0021] Preferably, the resistance is adjustable, by altering the distance between the first and second sections of the socket.

[0022] Preferably, the resistance means further comprises at least one screw fixing, which facilitates the adjustment of the relative distance between the first and second sections.

[0023] Preferably, the spring is loaded by a screw fixing.

[0024] Optionally, a buffer is provided between the first and second sections of the socket. Preferably, the buffer is formed from a deformable material, such as rubber.

[0025] Optionally, the housing of the laparoscopic apparatus further comprises one or more apertures through each of which a laparoscopic tool can pass, in use; the aperture being overlaid by a membrane to at least partially resist the laparoscopic tool, when the laparoscopic tool is applied thereto. It will be appreciated that when there are several apertures, the respective laparoscopic tools can be the same or different.

[0026] Preferably, the membrane comprises a synthetic skin. Further preferably, the membrane comprises a pad.

[0027] Preferably, the pad is adapted to simulate the resistive forces experienced during laparoscopic surgical techniques.

[0028] Preferably, the pad comprises an outer membrane, and a core. Preferably, the outer membrane at least partially surrounds the surface of the core.

[0029] Preferably, the outer membrane is formed from at least one synthetic material selected from the group including, but not limited to: synthetic latex, natural latex, a silicone elastomer, and a hydrocarbon solvent.

[0030] Preferably, the synthetic material is inert.

[0031] Preferably, the hydrocarbon solvent is a medium evaporating hydrocarbon solvent.

[0032] Preferably, the core comprises at least one silicone elastomer.

[0033] Preferably, the silicone elastomer is a pourable room temperature vulcanising silicone rubber. Further preferably, it holds a Shore A Hardness of about 14.

[0034] Optionally, the core further comprises a liquid silicone elastomer.

[0035] Preferably, the pad is flexible. Optionally, it is extensible.

[0036] Optionally, the housing defines an internal chamber having a platform. Preferably, the position of the platform relative to the opening is adjustable.

[0037] Optionally, the laparoscopic apparatus further comprises a moveable platform. Preferably, the movable platform is located within the base of the laparoscopic apparatus.

5 [0038] Preferably, the platform comprises a first side and second side, the position of at least one of the first side and the second being adjustable relative to the opening.

10 [0039] Further preferably, the position of each side of the platform can be altered independently of any other side.

[0040] Optionally, a drawer is provided in the laparoscopic apparatus to accommodate instruments or any similar implements.

15 [0041] For the purposes of this specification, what is meant by the term "laparoscopic tool" is any instrument that may be used during the course of a laparoscopic operation, and is intended to include, but is not limited to cannulae, telescopes, and trocars.

Brief Description of the Drawings

[0042] An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

30 **Figure 1** is a perspective view of a laparoscopic apparatus according to a preferred embodiment of the present invention;

Figure 2 is an exploded perspective view of a base section of the laparoscopic apparatus of **Figure 1**;

Figure 3 is a cross-sectional side view along the line A-B of **Figure 2**;

Figure 4 is a plan view of a lid section of the laparoscopic apparatus of **Figure 1**;

Figure 5 is an exploded perspective view of a rotatable joint of the lid section of **Figure 4**;

Figure 6 is a cross-sectional side view of the rotatable joint of **Figure 4** in use;

Figure 7A is a cross-sectional view of an incision aperture of the lid of **Figure 4**; and

Figure 7B is an exploded perspective view of an incision aperture of **Figure 7A**.

Detailed Description of the Drawings

[0043] Referring now to **Figure 1** of the drawings, there is shown a laparoscopic apparatus 10 according to a preferred embodiment of the present invention. The laparoscopic apparatus 10 comprises a base section 12, and a lid section 14.

50 [0044] **Figure 2** is an exploded perspective view of the base section 12 of the laparoscopic apparatus 10. The base section 12 comprises a hollow substantially parallelepiped-shaped body 16, with an open, in use, uppermost face. A generally planar platform 18 is located within the body 16, and is of similar size to a, in use, bottom face of the body 16. A generally obround-shaped elong-

gate aperture 20 is provided on at least one face of the body. Each elongate aperture 20 is substantially perpendicular to the longitudinal axis of the body 16. A hinge projection 22 is provided, which is cooperably attached to at least one side of the platform 18. The hinge projection 22 facilitates relative rotational motion between the platform 18 and the hinge projection 22. A screw threaded fixing bolt 26 is provided, which locates through the elongate aperture 20, and engages with the hinge projection 22 (See Figure 3). An annular washer 24 is provided, which locates between the face of the body 16 and the fixing bolt 26, and engages with a numerical scale rule 25 to facilitate accurate quantitative placement of the hinge projection 22 relative to the elongate aperture 20. Adjusting the position of the fixing bolt 26 relative to the elongate aperture 20 can thereby temporarily alter the relative height of the side of the platform 18. A generally planar elliptical-shaped mount 28 is provided on each of two respective opposing sides of the body 16, and each is substantially parallel to and continuous with the respective sides of the body 16.

[0045] Figure 4 is a plan view of the lid section 14 of the laparoscopic apparatus 10. The lid section 14 is generally rectangular in shape, and curved in form, Figure 1. A number of apertures 34 are provided through the lid section 14. A joint 32 is provided through which, a laparoscopic tool 42, Figure 6, can be mounted.

[0046] Figure 5 is an exploded perspective view of the joint 32, which comprises a socket 35 and a ball 39. The socket 35 comprises an annular second section 36, which is inter-engaging with an annular first section 36'. The ball 39 comprises a generally hemi-spherical outer member 40' and a generally hemi-spherical outer member 40. A generally hollow cylindrical tube 41, is provided through each of the hemi-spherical members 40,40', and, in use, is substantially coaxial with the socket 35. When in use, the socket 35 interengages with the ball 39, facilitating rotation of the ball 39 through multiple planes relative to the socket 35.

[0047] Figure 6 is a cross-sectional side view of the joint 32, in use, with a laparoscopic tool 42 mounted thereto. The first section 36' of the socket 35 is attached to the lid section 14, Figure 4, by a set of clips 37. The second section 36 of the socket 35 is attached to the first section 36' by four spring biased screws 38, surrounding the hemi-spherical members 40,40' of the ball 39. The ball 39 is positioned between the first section 36' and the second section 36 of the socket 35. The spring biased screws 38 allow the level of friction to be adjusted between the first section 36' and the second section 36 of the socket 35, resultantly adjusting the friction between the socket 35 and the ball 39. The laparoscopic tool 42 is a telescope comprising a camera 44, which is mounted within the telescope body. An optical connection 46 transmits visual graphics from the camera 44 to a visual display unit (not shown).

[0048] Figure 7A is a cross-sectional view of an aperture 34 of the lid section 14 of the laparoscopic apparatus

10. The aperture 34 comprises an annular housing 52 and a pad 50. The pad 50 is generally cylindrical in shape. The annular housing 52 is generally annular in form and is shaped and dimensioned to accommodate the pad 50, within the inner edge of the annular housing 52. The annular housing 52 locates in a recessed opening 48 in the housing 30 of the lid section 14 of the laparoscopic apparatus 10. Preferably, the pad 50 is formed from a material that is deformable under a first given pressure, but is severable under a second higher given pressure, so as to provide a realistic response representative of skin, when an instrument is applied with force against the pad 50.

[0049] The present invention finds utility in the training of medical professionals, such as trainee surgeons. In particular, the present invention finds utility as an affordable and portable platform that effectively demonstrates or trains laparoscopic skills and techniques by providing a realistic physical experience with real-time interaction outside of the operating room. The present invention allows a trainee surgeon to master the skills required to compensate for the narrow field of view, limitation of work space, and the lack of depth sensation associated with this field of surgery. The shape and dimension of the apparatus offers a realistic semblance to the human torso; and the integrated adaptable joint allows for a variety of laparoscopic instruments, including canulae, trocars and telescopes, to be used in a realistic fashion to augment both basic and advanced laparoscopic experiences, and ultimately to develop the coordination, technique, and precision of the trainee surgeon. The incision pads also lend to the realistic experience by mimicking the response of human skin to the application of a surgical instrument. Use of the invention in cooperative association with a visual display system also affords the user the opportunity to become acquainted with visualising a 3-dimensional operative field as a 2-dimensional output, and the imposition associated therewith. Moreover, the simple and lightweight design makes the apparatus easy to assemble and transport. Taken together, the present invention provides a realistic surgical experience, by simulating the response of an actual human torso, without endangering patients or animal models.

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Claims

1. A laparoscopic apparatus (10) comprising a housing; a joint (32) in operative association with the housing and adapted to substantially accommodate a laparoscopic tool (42), in use, through the joint (32), the joint (32) permitting movement of the laparoscopic tool (42), in use; and resistance means in operative association with the joint (32), adapted to adjust resistance to movement of the laparoscopic tool (42), in use.
2. A laparoscopic apparatus (10) as described in claim

1, wherein the joint (32) comprises a ball-and-socket joint.

3. A laparoscopic apparatus as described in claim 2, wherein the socket (35) comprises a first section (36) and a second section (36'), spaced apart, shaped and dimensioned to house the ball (39) therebetween. 5

4. A laparoscopic apparatus (10) as described in claim 3, wherein the resistance means is adjustable, by altering the distance between the first (36) and second (36') sections of the socket (35). 10

5. A laparoscopic apparatus (10) as described in claim 3 or 4, wherein the distance between the first (36) and second (36') sections of the socket (35) is adjusted by a spring (38) in operable association with one or both of the sections. 15

6. A laparoscopic apparatus (10) as described in claim 5, wherein the spring (38) is loaded by a screw fixing. 20

7. A laparoscopic apparatus (10) as described in any previous claim, wherein the housing defines an internal chamber having a platform (18), the position of the platform (18) relative to the opening being adjustable. 25

8. A laparoscopic apparatus (10) as described in claim 7, wherein the platform (18) comprises a first side and second side, the position of at least one of the first side and the second being adjustable relative to the opening. 30

9. A laparoscopic apparatus (10) as described in any previous claim, wherein the housing further comprises at least one aperture (34), the aperture (34) overlaid by a membrane (50). 35

10. A laparoscopic apparatus (10) as described in claim 9, wherein the membrane (50) comprises a synthetic skin. 40

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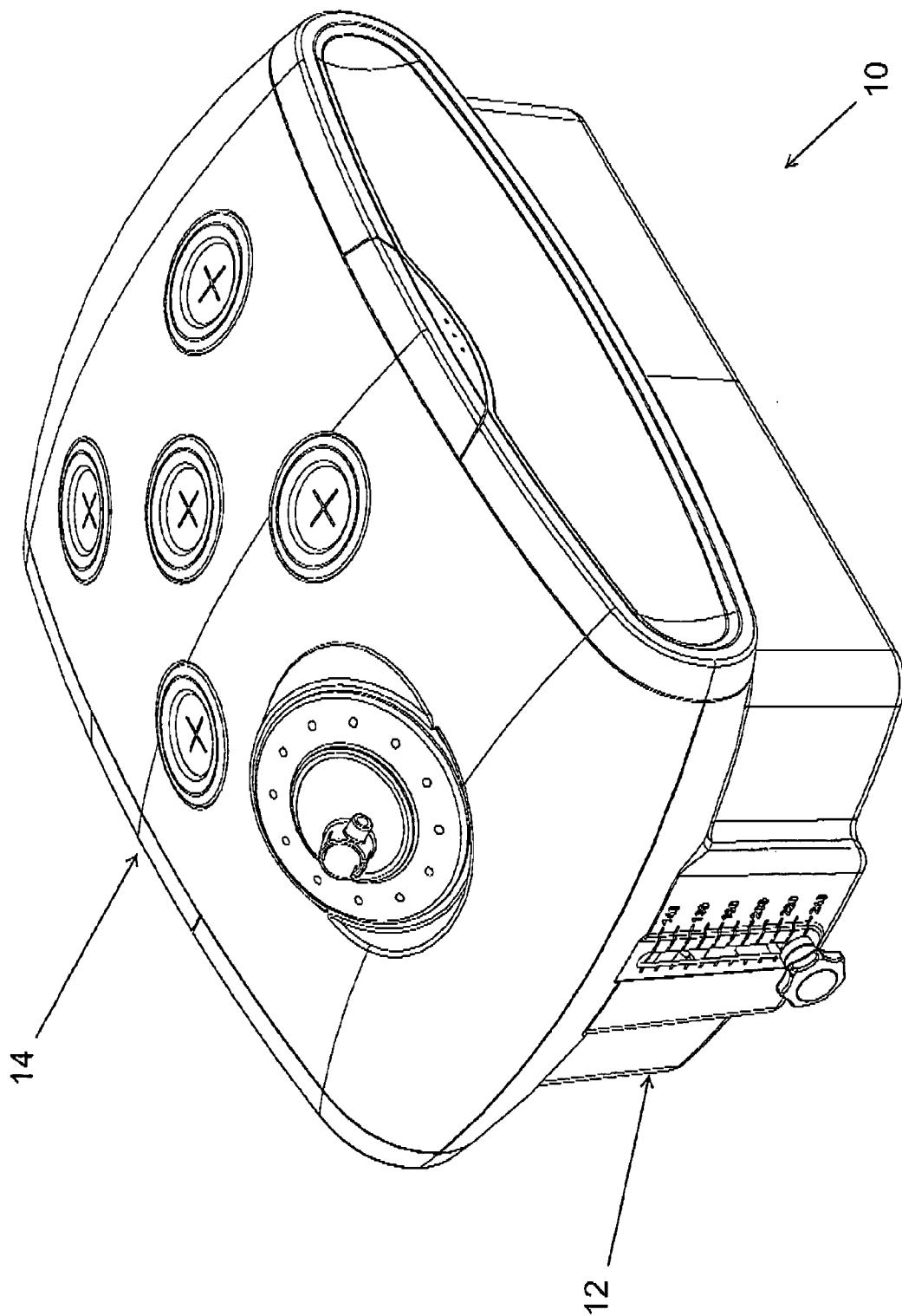


Figure 1

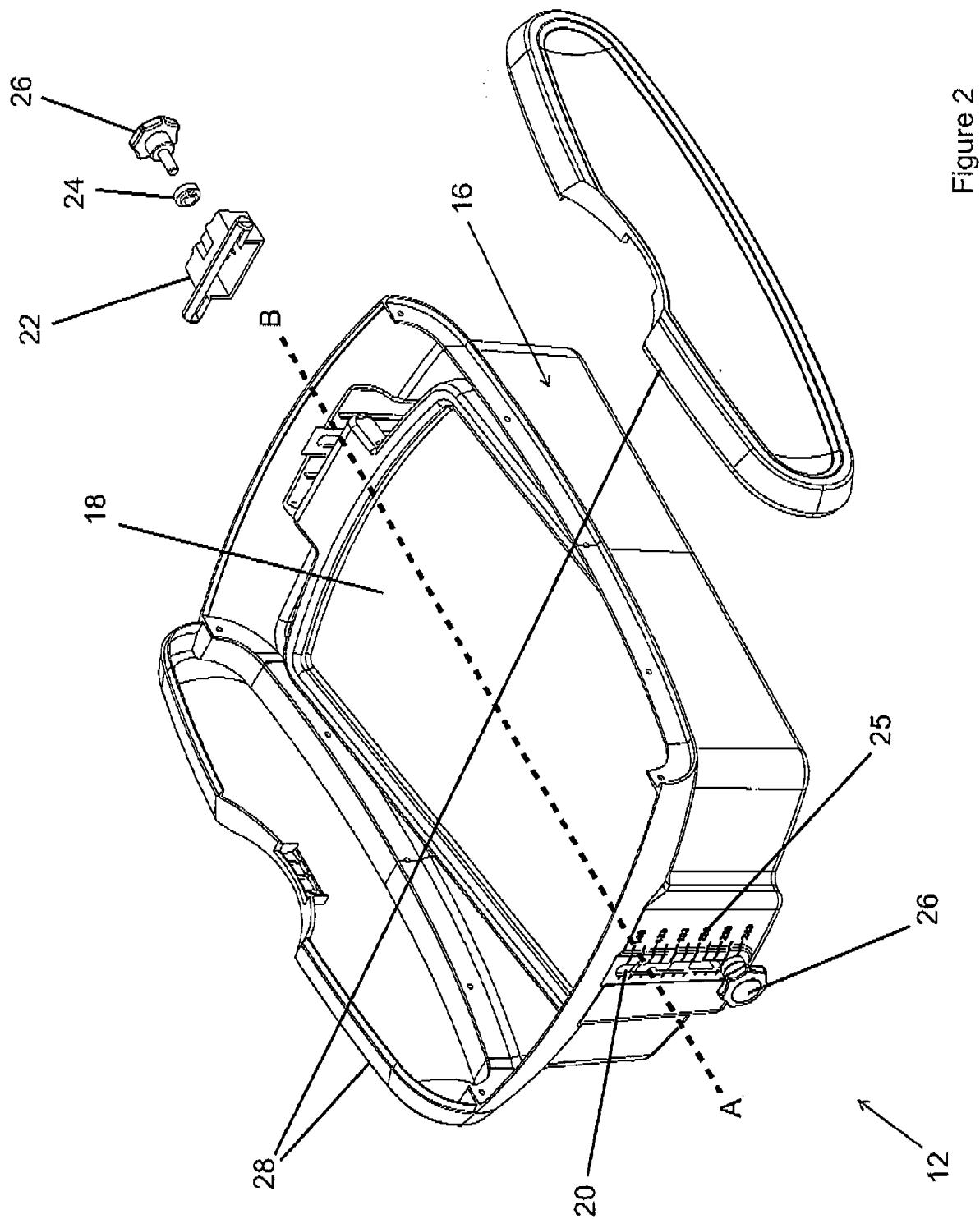


Figure 2

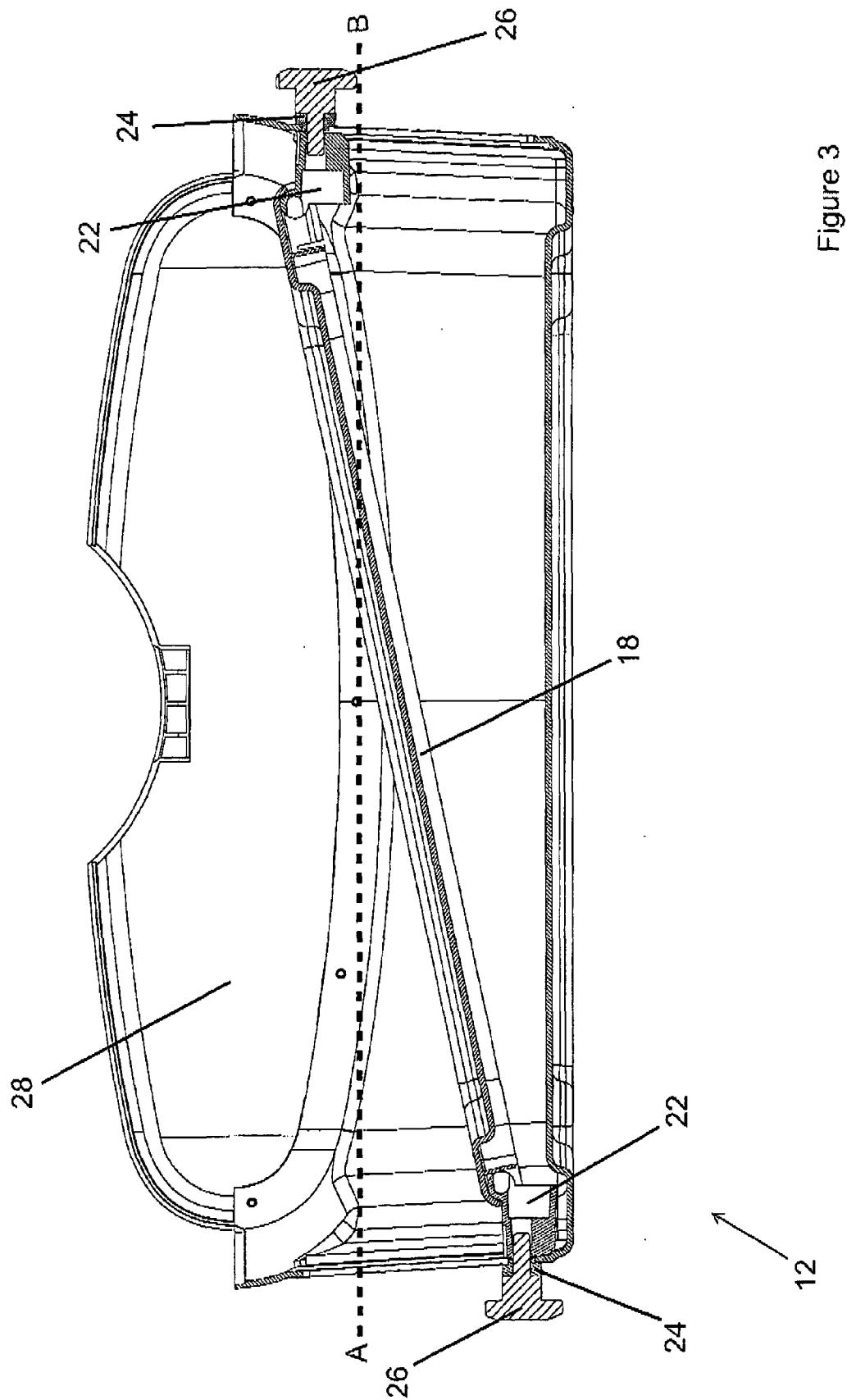


Figure 3

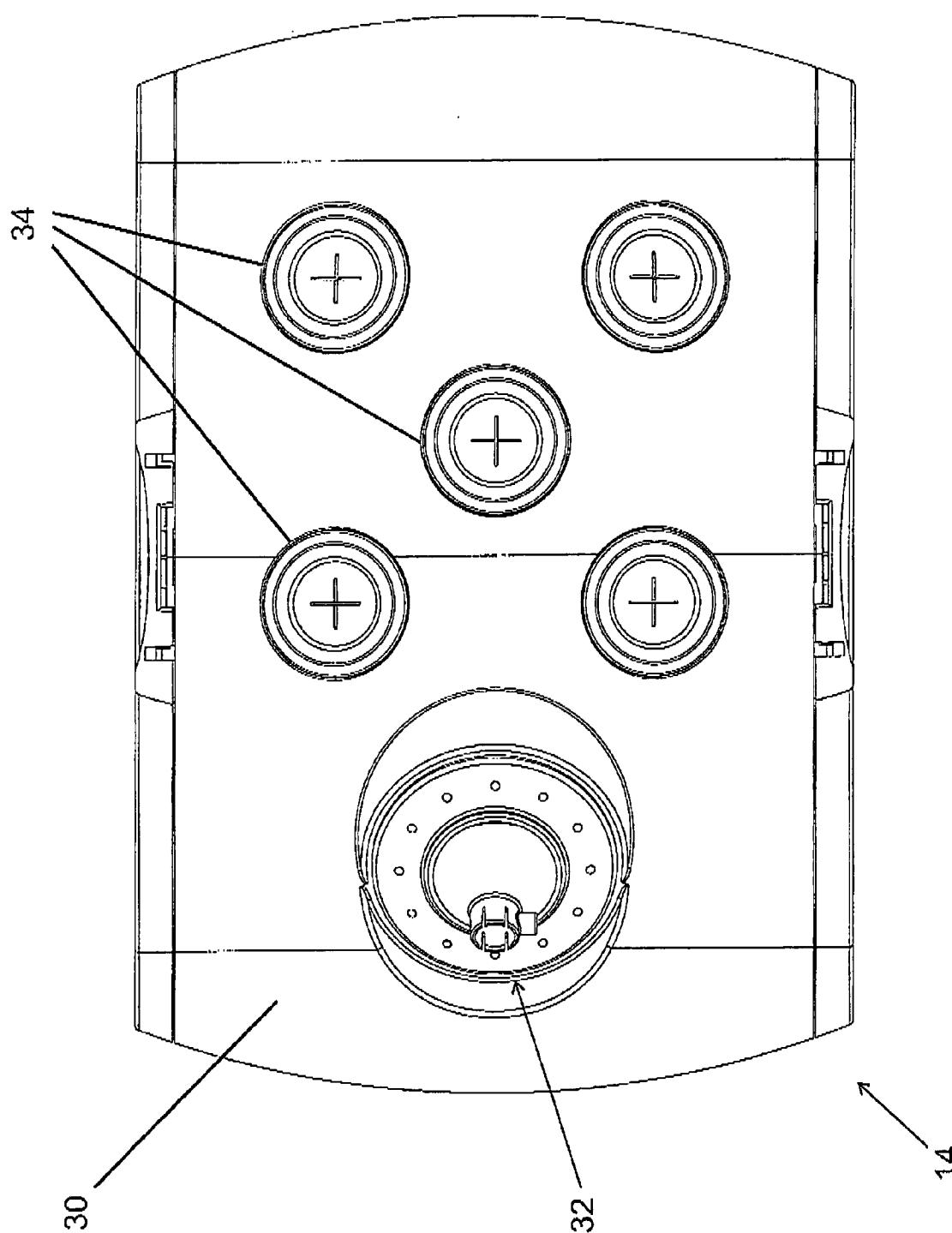


Figure 4

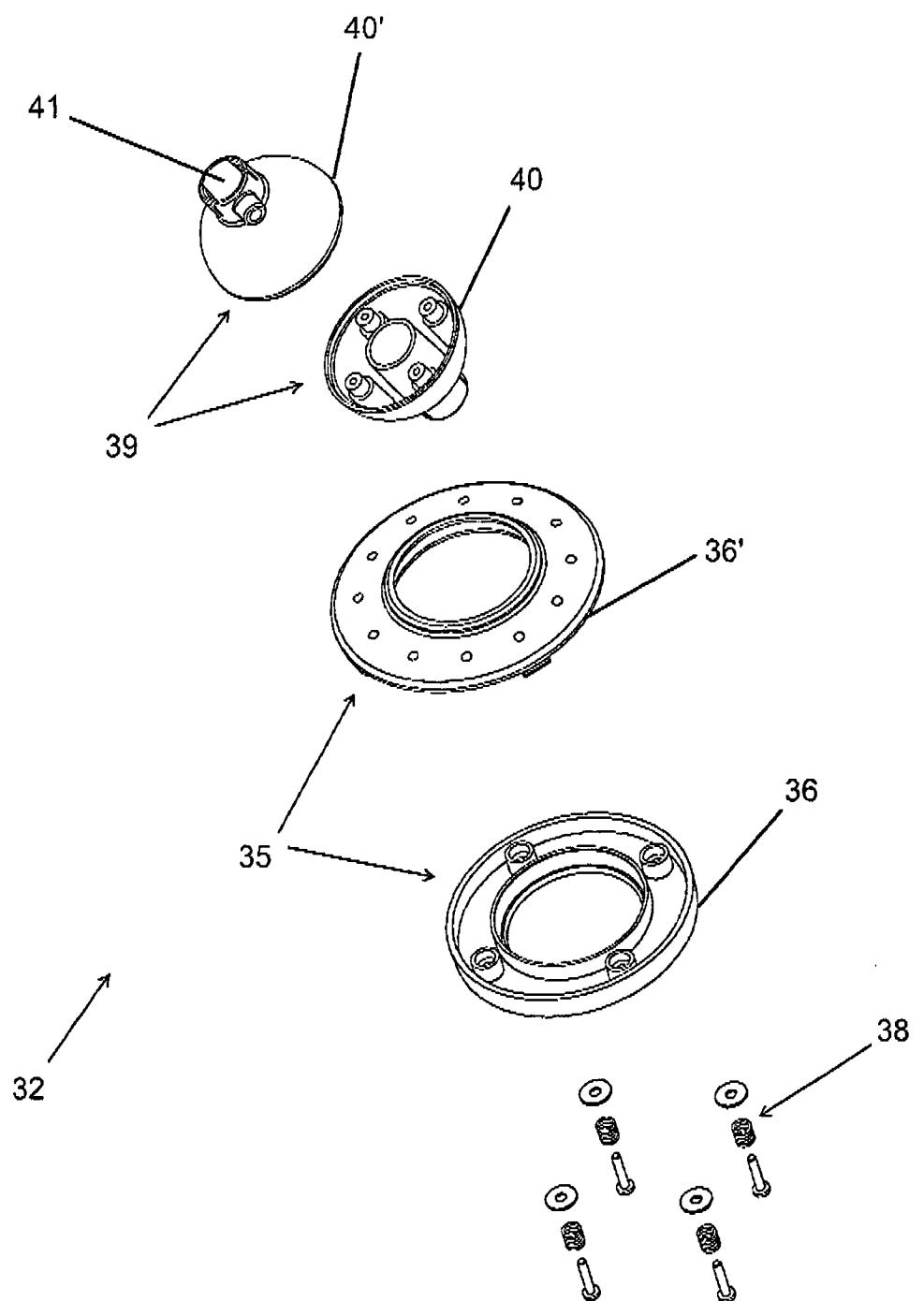


Figure 5

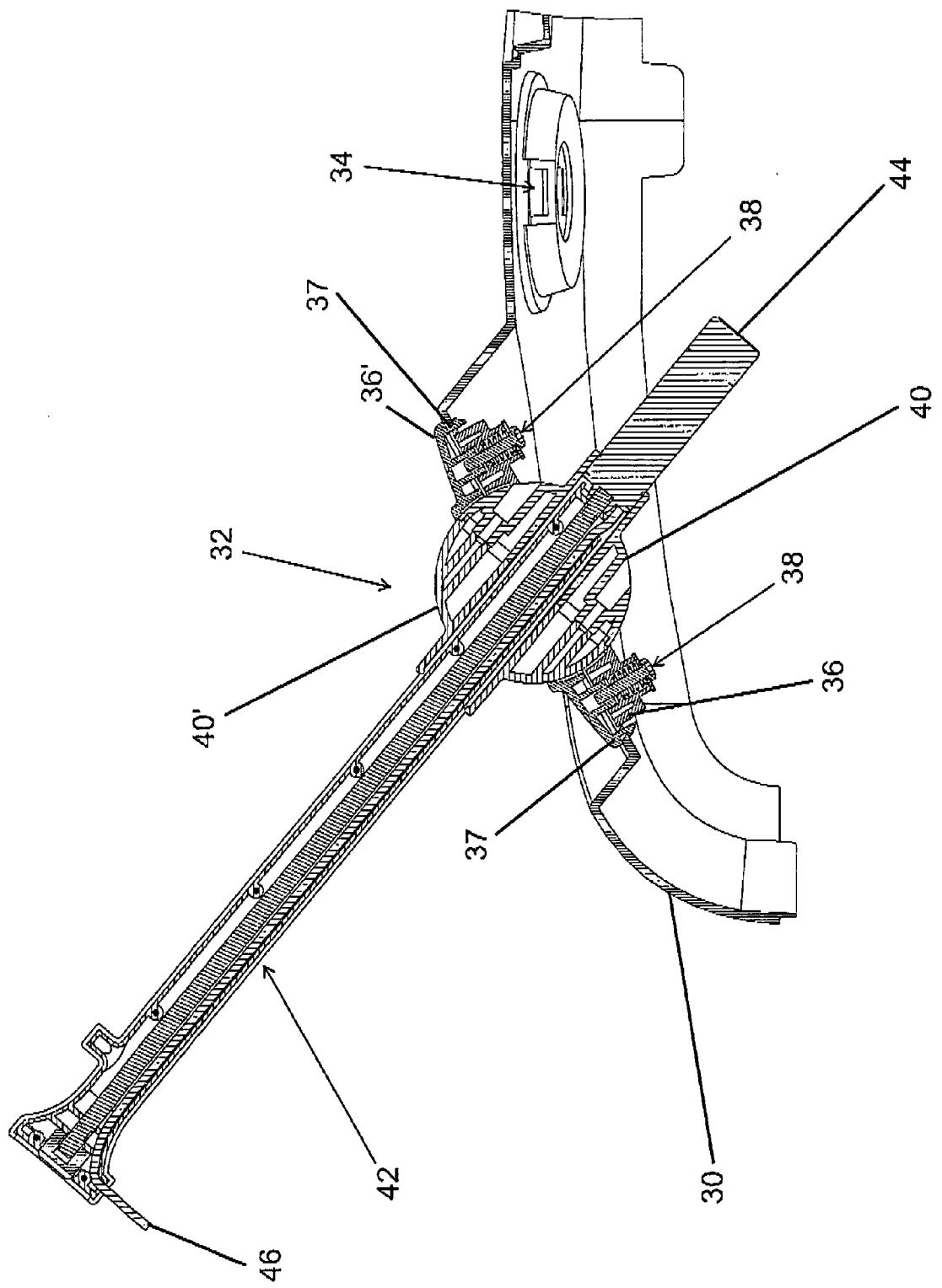
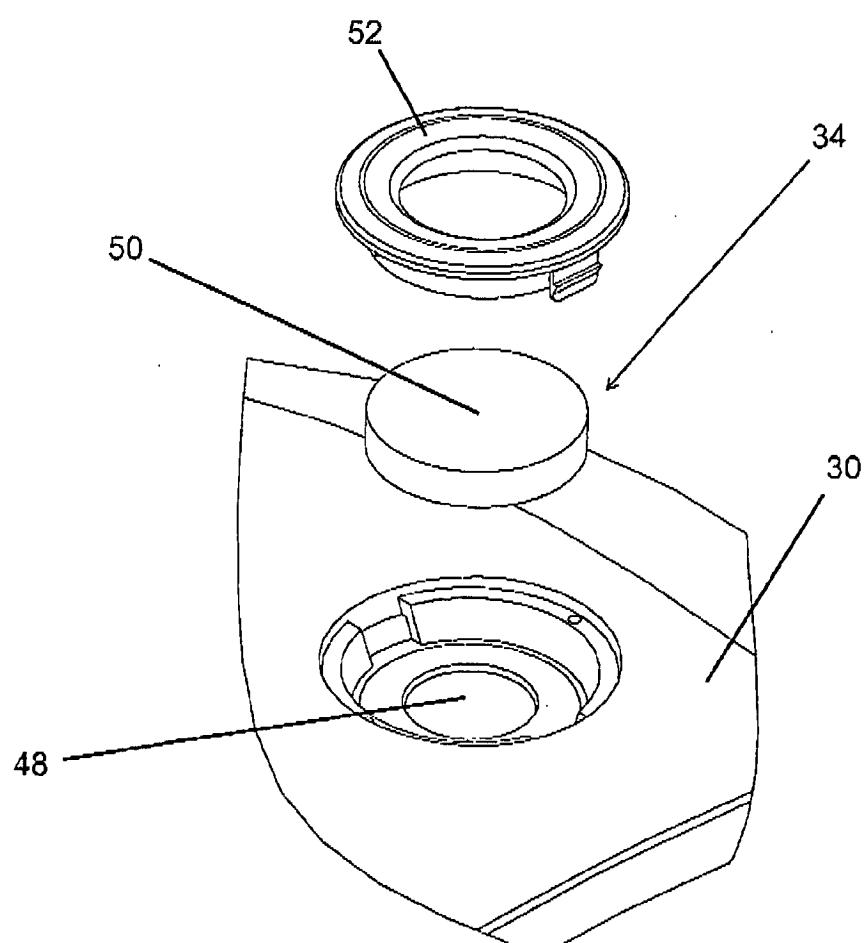
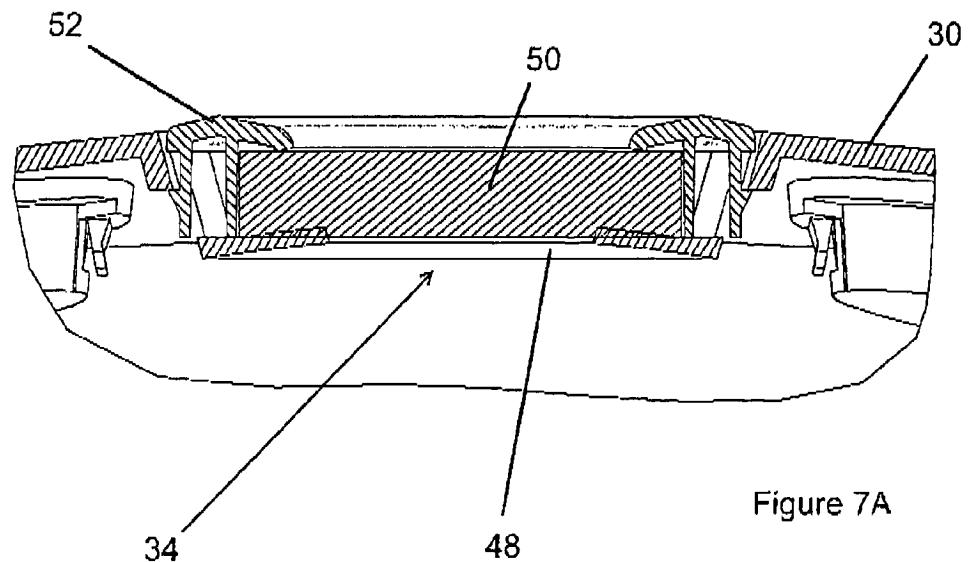


Figure 6





DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (IPC)						
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim							
X	US 2004/024418 A1 (IRION KLAUS M [DE] ET AL) 5 February 2004 (2004-02-05) * figures 1-5 * * paragraphs [0014], [0016], [0073], [0078] *	1-3	INV. G09B23/28						
Y	----- DE 103 04 736 B3 (KARLSRUHE FORSCHZENT [DE]) 30 September 2004 (2004-09-30) * figures 1,2 *	1-3	ADD. A61B17/00 A61B19/00						
X	US 6 377 011 B1 (BEN-UR ELA [US]) 23 April 2002 (2002-04-23) * figures 5-8 *	1							
Y	US 6 659 776 B1 (AUMANN ROBERT J [US] ET AL) 9 December 2003 (2003-12-09) * figure 1 *	1-3							

			TECHNICAL FIELDS SEARCHED (IPC)						
			G09B						
<p>3 The present search report has been drawn up for all claims</p>									
<table border="1"> <tr> <td>Place of search</td> <td>Date of completion of the search</td> <td>Examiner</td> </tr> <tr> <td>Munich</td> <td>20 May 2008</td> <td>Schießl, Werner</td> </tr> </table>				Place of search	Date of completion of the search	Examiner	Munich	20 May 2008	Schießl, Werner
Place of search	Date of completion of the search	Examiner							
Munich	20 May 2008	Schießl, Werner							
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>									

**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing claims for which payment was due.

Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-6

The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-6

A laparoscopic apparatus wherein the resistance means is adjustable by altering the distance between a first and a second section of the socket as defined in claim 4 in order to provide a mechanical resistance means independent of a power supply.

2. claims: 7,8

A laparoscopic apparatus the internal chamber of the housing has a platform, the position of which being adjustable with respect to an opening in the housing for variable heights of the internal chamber / working space.

3. claims: 9,10

A laparoscopic apparatus wherein the housing further comprises at least one aperture overlaid by a membrane to provide a realistic experience of the response of human skin to the application of a surgical instrument.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 07 02 3329

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

20-05-2008

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
US 2004024418	A1	05-02-2004	DE WO EP	10055294 A1 0237451 A2 1330809 A2		29-05-2002 10-05-2002 30-07-2003
DE 10304736	B3	30-09-2004		NONE		
US 6377011	B1	23-04-2002	WO	0154587 A1		02-08-2001
US 6659776	B1	09-12-2003		NONE		

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申请(专利权)人(译)	ENDOSIM有限公司		
当前申请(专利权)人(译)	ENDOSIM有限公司		
[标]发明人	BAILIE ROBERT NIBLOCK IAN PRENDIVILLE WALTER MAGUIRE KEVIN		
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IPC分类号	G09B23/28 A61B17/00 A61B19/00		
CPC分类号	G09B23/285 A61B34/76 A61B2017/00716		
代理机构(译)	奥尼尔BRIAN		
外部链接	Espacenet		

摘要(译)

腹腔镜装置技术领域本发明涉及腹腔镜装置 (10)。特别是，它涉及一种用于训练医疗专业人员的装置，特别是那些从事腹腔镜手术领域的医疗专业人员。装置 (10) 包括壳体;接头 (32) 与壳体可操作地连接并且适于在使用中通过接头 (32) 基本上容纳腹腔镜工具 (42)，接合部 (32) 允许腹腔镜工具 (42) 在使用中移动;阻力意味着与关节 (32) 可操作地关联，适于在使用中调节对腹腔镜工具 (42) 的运动的阻力。因此，本发明通过模仿对患者进行外科手术技术的感觉来提供真实的手术体验。

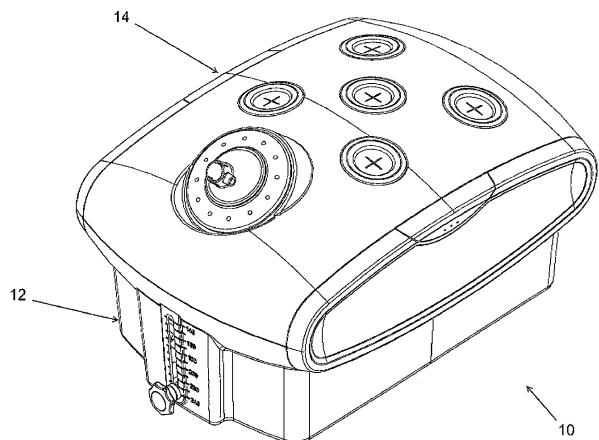


Figure 1