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(54) **OPTICAL SWITCH**

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Description

Field of the Invention

[0001] The present invention relates to optical switches, especially those used with fibre optic cables. Moreover, the optical switch finds application in various fields, including surgical retractors with lights, for example that found in the disclosure of International Patent Application No PCT/GB2009/000097.

Background of the Invention

[0002] Fibre optics are used in a variety of industries including aerospace, telecommunications, lasers and medical devices. A common problem involves switching lights on or off and switching light between paths or combinations of paths. A variety of solutions have been developed to fulfil these requirements including (i) beam splitters, (ii) shuttles, (iii) optical shutters and (iv) variation of the shutter concept, the twisted-nematic liquid crystal shutter.

[0003] A beam splitter in its most common form is a cube made from two triangular glass prisms, which are glued together at their base using Canada balsam. The thickness of the resin layer is adjusted such that for a certain wavelength half of the light incident through one "port" i.e. face of the cube is reflected and the other half is transmitted due to frustrated total internal reflection.

[0004] A shuttle will usually include an input pipe which moves to align with one of the outputs. A key feature of this switch is that all outputs are exclusive, so it cannot select more than one at a time. Whilst it is possible to create an intermediate position for the shuttle such that it shines light into two outputs, considerable light will be lost at this junction owing to differences in the geometry of the input and outputs. As it stands, there is no "off" position. If one were needed separate from the light source itself, it would either have to separate, or include a dummy switch position.

[0005] Common shutter mechanisms include a blade, which may be introduced into a light path to block the transmission of light or rotated out of the light path to allow transmission. The shutter may be spring loaded and attached to a driver such as a rotary solenoid such that the blade moves to the energized position when it receives an operating voltage and returns to its resting position when the voltage is removed. Alternatively, manual operation of the shutter is possible.

[0006] The shutter mechanism relies entirely upon a simple mechanical beam blocking effect. It is inefficient as this light is "lost". Furthermore, the "lost" light may be converted to heat, which is undesirable in some applications. Excessive local accumulation of heat can lead to burns in medical device applications where the device is in contact with the patient or user.

[0007] Liquid crystal displays provide for another type of shutter: the Twisted-Nematic Liquid Crystal Shutter.

[0008] The twisted nematic effect (TN-effect) is the breakthrough that made liquid crystal displays practical in portable devices and allowed them to replace technologies such as light emitting diodes and electroluminescence from most electronics.

[0009] TN-cells do not require a current to flow for operation and use low operating voltages suitable for use with batteries. The twisted nematic effect is based on the precisely controlled realignment of liquid crystal molecules between different ordered molecular configurations under the action of an applied electric field. This is achieved with little power consumption and at low operating voltages.

[0010] In one example, a TN-cell in the OFF state, i.e., when no electrical field is applied, a twisted configuration of nematic liquid crystal molecules is formed between two glass plates, which are usually separated by several spacers and coated with transparent electrodes.

[0011] The electrodes themselves are coated with alignment layers that precisely twist the liquid crystal by 90° when no external field is present. When light shines on the front of the LCD, light with the proper polarization will pass through the first polarizer and into the liquid crystal, where it is rotated by a helical structure. The light is then properly polarized to pass through the second polarizer set at 90° to the first. The light then passes through the back of the cell and the image appears transparent.

[0012] In the ON state, i.e., when a field is applied between the two electrodes, the crystal realigns itself with the external field. This "breaks" the careful twist in the crystal and fails to re-orient the polarized light passing through the crystal. In this case the light is blocked by the rear polarizer and the image appears opaque.

[0013] The degree of opacity can be controlled by varying the voltage; at voltages near the threshold only some of the crystals will re-align, and the display will be partially transparent, but as the voltage is increased more of the crystals will re-align until it becomes completely "switched". A voltage of about 1 V is required to make the crystal align itself with the field, and no current passes through the crystal itself. Thus the electrical power required for that action is very low.

[0014] The obvious advantage such TN-cell shutters have is that they may be operated at very high switching speeds and with low operating voltage. For example switch speed of less than 0.3 milliseconds is typical at room temperature with an applied voltage of only 10V.

[0015] Furthermore, activation or switching speed can be enhanced via use of higher operating voltages.

[0016] However, the technology has several limitations. Notably, for unpolarised light with 500nm wavelength (the approximate mid-point of the visible spectrum), transmission of light does not exceed 35% in the ON position, meaning that considerable light is lost. Furthermore, when the device is in the OFF position there is still some light transmitted. Even although the amount of light transmitted is typically less than 0.5% it is not

completely blocked as with a purely mechanical shutter mechanism.

[0017] Moreover, a long term DC component in the voltage will stimulate impurity ion migration and eventual failure of the device. Therefore such devices have a finite useful lifetime.

[0018] Further, caution must be exercised in the handling and cleaning as it is easy to accidently damage the polariser surface or its components, by accidental scratching, use of inappropriate cleaning materials or even simple over-exposure to sunlight.

Summary of the Invention

[0019] According to a first aspect of the present invention there is provided an optical switch comprising a light input, a plurality of light outputs and at least one light pathway, and said light pathway may be selectively moved from a first position, where a light communication path is formed between the light input and a first light output and a second position where a light communication path is formed between the light input and a plurality of light outputs.

[0020] Preferably said light pathway is selectively movable to further positions wherein it allows communication between said light input and at least one of said further light outputs.

[0021] Preferably there is a plurality of light pathways, either separately or formed with common parts such as a branched arrangement.

[0022] Preferably there is a plurality of light inputs, and more preferably said light pathway is selectively movable to further positions wherein it allows communication between at least one of said further light inputs and at least one of said further light outputs.

[0023] Preferably said light pathway is selectively movable to an off position wherein light communication between at least one of said light inputs and all of said light outputs is prevented.

[0024] Preferably said selective movement of said light pathway is performed by a rotational coupling. It will be appreciated that the light pathway way rotate, or the light pathway may be static and either said light input and/or light output may rotate, or preferably there is provided a rotatable mask between said light input or light output and said light pathway.

[0025] Preferably said light pathway is deployed within a pathway housing, said pathway housing having a rotational coupling with respect to either said light input and/or light output.

[0026] Preferably said rotational coupling is movable from a first extreme position to a second extreme position, and any point there between, rotation beyond said two extreme being resisted by a stopping mechanism. Preferably said stopping mechanism comprises a protrusion and semicircular indentation arrangement.

[0027] Preferably said rotational coupling includes a plurality of detents, said detents allowing rotation of the rotational coupling to progress in a controlled and stepwise fashion.

[0028] Preferably sequential rotation of the rotational coupling results in a predetermined sequential selection of light communication paths being formed between one or more light inputs and one or more light outputs.

[0029] Preferably said pathway housing is circular, and more preferably an exterior surface of said pathway housing includes one or more markings indicating the position of said light pathway at different rotational steps.

[0030] Preferably said pathway housing is rotatably coupled with said rotatable mask, such that rotation of the pathway housing causes rotation of the rotatable mask.

[0031] The rotational coupling may be manually actuated or actuated by some form of motorised actuation means or simply a motor. Programming means may also be included, such as a microchip or microcomputer, so that the optical switch may be programmed to perform a sequence of discrete rotational steps, for uniform or non-uniform time periods.

[0032] According to a second aspect of the present invention there is provided a light source including an optical switch according to the first aspect of the present invention.

[0033] According to a third aspect of the present invention there is provided a surgical retractor unit including either a light source according to the second aspect of the present invention or an optical switch according to the first aspect of the present invention.

Brief description of the drawings

[0034] Reference will now be made, by way of example only, to the accompanying drawings, in which:

Fig. 1 is an isometric view of an optical switch according to a first aspect of the present invention;

Fig. 2 is an isometric view of the optical switch of Fig. 1 with its housing removed;

Fig. 3 is an isometric view of the optical switch of Fig. 1 shown mounted on a retractor back assembly of a surgical retractor, according to the third aspect of the present invention;

Fig. 4 is a rear isometric exploded view of the retractor back assembly of

Fig. 3;

Fig. 5 is an isometric view of a base plate of the optical switch of Fig. 1;

Figs. 6 & 7 are two isometric views from either side of a light pathway plate of the optical switch of Fig. 1; and

Figs. 8 & 9 are two views of a housing of the optical switch of Fig. 1.

Detailed description of the preferred embodiments

[0035] An optical switch **10** according to a first aspect of the present invention is depicted in Fig. 1. Fig. 3 shows the optical switch as a component part of a surgical retractor **100** according to a third aspect of the present invention.

[0036] As can be best seen from Fig. 4, the optical switch 10 comprises a base plate **12,** a light pathway plate **14** and a housing **16.** These three "major" components are attached together via an axle **18** and fixing bolts **20.**

[0037] The base plate 12 is generally circular, or to be more accurate is a cylinder with its facial diameter far exceeding its height.

[0038] The base plate 12 has a number of bores running through it, and these bores define a light input **12a** and a plurality of light outputs **12b.** Although a single light input 12a is described in the present embodiment, it will be understood that a plurality of light inputs is a possibility, as is a singular light output 12b, or combinations thereof.

[0039] There is a base plate central bore **12c** which enables assembly and rotation. A further indentation **12d** is provided at a location on the circumference of the base plate 12. This allows for the proper orientation of base plate 12 when it cooperates with a corresponding feature on retractor back **104.**

[0040] The light pathway plate 14 is of a generally similar formation to the base plate 12, being a generally circular plate, and likewise includes various bores running through its depth. Four of these bores define light pathway inputs **14a,** whereas several others define light pathway outlets **14b.** Further, there is a pathway central bore **14c** and two bolt holes **14d** which enable assembly and rotation.

[0041] One surface of the light pathway plate 14 is a preferably polished smooth, and this surface forms a rotational mating surface with the corresponding surface of the base plate 12.

[0042] On the opposite surface is a plurality of light pathways **14e.** The light pathways 14e are composed of several strands of fibre optic cable, each forming light pathways between one of the light pathway inputs 14a and one or more of the light pathway outputs 14b. Some light pathways 14e connect from a single light pathway input 14a, to a single light pathway output 14b; whereas some connect from a single light pathway input 14a, to multiple light pathway outputs 14b. Collectively, the light pathways 14e form a pathway bundle **14f.**

[0043] Although generally circular, the light pathway plate 14 is effectively two semi-circles of material, of two different radii: a smaller radius side **14g** and a larger radius side **14h.** The two junctions of these two sides around the circumference of the light pathway plate 14, meet at stop lips **14i.** Effectively, a stop indentation **14j** is formed around a portion of the circumference of the light pathway plate 14.

[0044] The stop lips 14i and stop indentation cooperate with a corresponding protrusion (not shown) on whatever member or substrate the optical switch is mounted to, which limits rotation. The corresponding protrusion is mounted through the stop indentation 14j, whereby rotation to the extent of the circumference of the stop indentation 14j is allowed as the protrusion and stop indentation 14j pass over one another. However, at either extreme of allowable rotation, the stop lips 14i interfere with the protrusion such that further rotation is resisted. These limits of rotation preferably correspond to OFF positions of the optical switch i.e. where light entering the device is not presented with a light pathway to move through the optical switch 10.

[0045] The housing 16 is cup-shaped and comprises an outer surface **16a,** an inner surface **16b** and two housing sockets **16c.** The outer surface 16a is itself composed of two discrete surfaces: a fascia **16d** and a side-wall **16e.** To aid operation, ergonomically knurled grips **16f** are indented on the side-wall 16e. The distal edge of the side-wall 16e from the fascia 16d is formed in the pattern of multiple interconnecting chevrons, so that a "zigzag" pattern is formed i.e. the relative height of the projection of the side-wall 16e away from the fascia 16d varies in a regular pattern from a minimum to a maximum.

[0046] The fascia 16d includes an indented rim **16g** adjacent the outer circumference of the fascia. Within the indented rim 16g are four indicator knobs **16h.** The indicator knobs 16h act as gauges to determine the degree of rotation of the switch 10, and act in conjunction with some form of corresponding pointer, in this case an arrow **102** provided on retractor back 104. This provides a simple passive scale, but may be replaced with a more active device, such as lights or the like.

[0047] The assembly of optical switch 10 can be best seen in Fig. 4. The light pathway plate 14 is sandwiched between the base plate 12 and the housing 16. The axle 18 runs through the light pathway plate 14 and base plate 12, whilst the bolts 20 connect the light pathway plate 14 to the housing 16. Thus, the base plate 12 and the combination of light pathway plate 14 and housing 16 may rotate with respect to one another.

[0048] The optical switch 10 is attached to a surgical retractor having lights, similar to that described in International Patent Application No. PCT/GB2009/000097.

[0049] The surgical retractor has a main body **101** and a retractor back 104. The retractor back 104 is a substantially plastic component which acts as a main structural component for the surgical retractor. The retractor back 104 includes within it a socket **106.** The socket 106 is adapted to receive the optical switch 10, via the base plate 12. The side-wall 106a of the socket 106 has a similar interconnecting chevron-like profile to that of the side-wall 16e of the housing 16. These cooperating surfaces ensure that rotation of the light pathway plate 14/housing 16 assembly (which are locked and therefore

rotate together) relative to the base plate 12/retractor back 104 proceeds in a controllable and step-wise fashion.

[0050] The axle 18 connects through an aperture **108** which passes through the retractor back 104. The axle is retained using a spring **110** and a locking clip **112.**

[0051] A protrusion (not shown) projects from the retractor back 104 to limit rotation of the light pathway plate 14 by the mechanism described above.

[0052] Optical fibres **114** are provided which channel light away from, the optical switch 10. Light is provided by an external light source (not shown) via a light guide (not shown) which attaches to the top of the retractor back 104. Prisms **116,118** and lenses **120,122** are also provided for further control of light that passes into and through the optical switch 10, and out of the surgical retractor via optical fibres 114. Inlet prism 118 receives light from the external light source (not shown) and bends this through 90° before entry into a light input 12a.

[0053] In use, light from an external source (not shown) is directed into the optical switch 10, passing through the base plate 12 via a light input 12a. The optical switch 10 will have a particular setting, defined by the relative rotation of the light pathway plate 14 / housing 16 assembly with respect to the base plate 12/ retractor back 104.

[0054] Light continues through the optical switch 10 passing through a light pathway input 14a, into one or more light pathways 14e defined as part of a pathway bundle 14f to the light pathway output 14b and on through to a light output or light outputs 12b. Finally, the light passes back through one or more of the optical fibres 114 and out of the device and onto, for example, a lighting rig (not shown) for illuminating part of a patient (not shown). In this particular example, it will be assumed that the optical switch 10 is selected in a switching position to receive a single light input and provide a single light output, for example providing light to a single external light source.

[0055] The user, who may be a surgeon or other medical professional in an operating theatre, may then rotate the light pathway plate 14 / housing 16 assembly with respect to the base plate 12 / retractor back 104 to a second switching position.

[0056] In this situation, a different a light pathway input 14a is presented to the light input 12a, and consequently the light passes into a different light pathway 14e defined as a further part of the pathway bundle 14f, and onto a different light pathway output or outputs 14b, and further on through to a different light output or light outputs 12b.

[0057] In this second example, it will be assumed that the second light pathway branches into two separate light pathways on the fibre bundle 14e, and onto two light pathway outputs 14b, and further on through two light outputs 12b. Thus, two beams of light exit through to the optical fibres 114 and may be channelled, for example, to two separate external light sources. Thus the user may select to illuminate two separate portions of a patient, or simply provide a more diffuse light source over a greater area.

[0058] It will be understood that further selections are possible, such as branching from one light source to three or more, or indeed from several light sources to a single, or indeed the same or different amounts of light outputs. For example, during an operation which comprises three or more steps, the specific lighting requirements may be set within three or more selections preselected within the optical switch. Thus, the user may start the operation with the first selection which, for example, may provide optical illumination for a first surgical task such as entering a chest cavity, moving to the second selection which, for example, may provide optical illumination for a second surgical task such as operating on a particular human organ or major blood vessel within the chest cavity, and onto the third selection which, for example, may provide optical illumination for a third surgical task such as operating inside a human organ or major blood vessel.

[0059] Furthermore, programming means may be used to allow for controlled and automatic rotation of the optical switch 10 to different switch positions in a particular programmed sequence, or indeed there may be a remote control device, voice activation, ambient light sensor, or other form of control means adapted to move to different switching positions.

[0060] Although described with respect to the medical field, it will be apparent that the optical switch 10 may find application in other fields.

[0061] It should be further noted that various adjustments and reconfigurations are possible to the illustrated embodiment as described above within the scope of the invention as will be apparent to those skilled in the art.

Claims

1. An optical switch (10) comprising a base plate (12) which has a number of bores running through it, and a light pathway plate (14) including various bores running through its depth and a pathway bundle (14f) defining a plurality of light pathways (14e), each light pathway having a light pathway input (14a) and at least one light pathway output (14b), and at least one light pathway (14e) is branched, wherein said light pathway plate (14) is selectively movable with respect to the base plate (12) from a first position wherein a light pathway input (14a) receives light and communicates the light to a first light pathway output(14b), and at least a second position wherein a light pathway input receives light and communicates the light to at least one further light pathway output (14b) or to multiple light pathway outputs (14b).

2. An optical switch as claimed in claim 1, wherein the at least one light pathway (14e) branches into two separate light pathways (14e).

3. An optical switch as claimed in claim 1, wherein a

light input (14a) is connectable with multiple light pathway outputs (14b).

4. An optical switch as claimed in any one of claims 1 to 3, wherein there is a plurality of light pathway inputs (14a).

5. An optical switch as claimed in any one of claims 1 to 4, wherein said light pathway plate (14) is selectively movable to an off position wherein light communication between at least one of said light pathway inputs (14a) and all of said light pathway outputs (14b) is prevented.

6. An optical switch as claimed in claim 1, wherein said selective movement of said light pathway is performed by a rotational coupling.

7. An optical switch as claimed in claim 6, wherein said rotational coupling is movable from a first extreme position to a second extreme position, and any point there between, rotation beyond said two extremes being resisted by a stopping mechanism.

8. An optical switch as claimed in claim 7, wherein said rotational coupling includes a plurality of detents, said detents allowing rotation of the rotational coupling to progress in a controlled and step-wise fashion.

9. An optical switch as claimed in claim 8, wherein rotation of the rotational coupling sequentially results in a predetermined sequential selection of light communication paths being formed between one or more light inputs and one or more light outputs.

10. An optical switch as claimed in any one of claims 1 to 9, wherein the optical switch (10) comprises a base plate (12), a light pathway plate (14), and a housing (16) mounted for rotation upon an axle (18), the housing (16) being cup-shaped with a crenelated edge of side wall (16e) for engaging a corresponding edge of a mounting socket (106).

11. An optical switch as claimed in any one of claims 1 to 10, wherein the optical switch comprises a generally circular light pathway plate (14) which has two circumferential side portions (14g, 14h) defined by different radii to form relative to one another, a smaller radius side, and a larger radius side, wherein these two circumferential side portions meet at two junctions and define stop lips (14i) configured to cooperate with a stop member (14j) to limit the range of rotation of the generally circular light pathway plate.

12. An optical switch as claimed in any one of claims 1 to 11, wherein the housing (16) comprises a fascia (16d) including an indented rim (16g) adjacent the outer circumference of the fascia including mutually spaced indicator knobs (16h) serving to determine the degree of rotation of the switch relative to a reference point beyond the housing.

Patentansprüche

1. Ein optischer Schalter (10), beinhaltend eine Grundplatte (12), durch welche eine Anzahl von Bohrungen verläuft, und eine Lichtwegplatte (14), die unterschiedliche Bohrungen einschließt, welche durch ihre Tiefe verlaufen, und ein Wegbündel (14f), das eine Vielzahl von Lichtwegen (14e) definiert, wobei jeder Lichtweg einen Lichtwegeingang (14a) und mindestens einen Lichtwegausgang (14b) aufweist, und wobei mindestens ein Lichtweg (14e) verzweigt ist, wobei die Lichtwegplatte (14) hinsichtlich der Grundplatte (12) selektiv von einer ersten Position, in der ein Lichtwegeingang (14a) Licht empfängt und das Licht an einen ersten Lichtwegausgang (14b) kommuniziert, und mindestens einer zweiten Position, in der ein Lichtwegeingang Licht empfängt und das Licht an mindestens einen weiteren Lichtwegausgang (14b) oder an mehrere Lichtwegausgänge (14b) kommuniziert, bewegbar ist.

2. Optischer Schalter gemäß Anspruch 1, wobei sich der mindestens eine Lichtweg (14e) in zwei separate Lichtwege (14e) verzweigt.

3. Optischer Schalter gemäß Anspruch 1, wobei ein Lichteingang (14a) mit mehreren Lichtwegausgängen (14b) verbindbar ist.

4. Optischer Schalter gemäß einem der Ansprüche 1 bis 3, wobei eine Vielzahl von Lichtwegeingängen (14a) vorhanden ist.

5. Optischer Schalter gemäß einem der Ansprüche 1 bis 4, wobei die Lichtwegplatte (14) selektiv in eine Aus-Position bewegbar ist, wobei die Lichtkommunikation zwischen mindestens einem der Lichtwegeingänge (14a) und allen der Lichtwegausgänge (14b) verhindert wird.

6. Optischer Schalter gemäß Anspruch 1, wobei die selektive Bewegung des Lichtwegs durch eine Drehkupplung durchgeführt wird.

7. Optischer Schalter gemäß Anspruch 6, wobei die Drehkupplung von einer ersten Extremposition in eine zweite Extremposition und jeden beliebigen Punkt zwischen diesen bewegbar ist, wobei die Drehung über diese beiden Extreme hinaus von einem Anschlagmechanismus abgefangen wird.

8. Optischer Schalter gemäß Anspruch 7, wobei die

Drehkupplung eine Vielzahl von Arretierungen aufweist, wobei die Arretierungen die Drehung der Drehkupplung ermöglicht, um auf eine kontrollierte und stufenweise Art und Weise fortzufahren.

9. Optischer Schalter gemäß Anspruch 8, wobei die Drehung der Drehkupplung sequentiell in einer vorbestimmten sequentiellen Auswahl der Lichtübertragungswege, die zwischen einem oder mehreren Lichteingängen und einem oder mehreren Lichtausgängen gebildet werden, resultiert.

10. Optischer Schalter gemäß einem der Ansprüche 1 bis 9, wobei der optische Schalter (10) eine Grundplatte (12), eine Lichtwegplatte (14) und ein Gehäuse (16), das zur Drehung um eine Achse (18) montiert ist, beinhaltet, wobei das Gehäuse (16) schalenförmig mit einem zinnenartigen Rand der Seitenwand (16e) zum Eingreifen in einen entsprechenden Rand eines Montagesockels (106) ist.

11. Optischer Schalter gemäß einem der Ansprüche 1 bis 10, wobei der optische Schalter eine im Allgemeinen kreisförmige Lichtwegplatte (14) beinhaltet, die zwei Umfangsseitenabschnitte (14g, 14h) aufweist, die durch unterschiedliche Radien definiert sind, um relativ zueinander eine kleinere Radiusseite und eine größere Radiusseite zu bilden, wobei diese beiden Umfangsseitenabschnitte an zwei Verbindungsstellen aufeinandertreffen und Anschlaglippen (14i) definieren, die konfiguriert sind, um mit einem Anschlagelement (14j) zusammenzuwirken, um den Bereich der Drehung der im Allgemeinen kreisförmigen Lichtwegplatte einzuschränken.

12. Optischer Schalter gemäß einem der Ansprüche 1 bis 11, wobei das Gehäuse (16) eine Blende (16d) beinhaltet, einschließlich eines mit Einkerbungen versehenen Kranzes (16g) neben dem Außenumfang der Blende, einschließlich zueinander beabstandete Anzeigeknöpfe (16h), die dazu dienen, den Grad der Drehung des Schalters relativ zu einem Referenzpunkt über das Gehäuse hinaus zu bestimmen.

Revendications

1. Un commutateur optique (10) comprenant une plaque de base (12) qui présente un certain nombre d'alésages la traversant, et une plaque de voies de cheminement de lumière (14) incluant divers alésages la traversant dans la profondeur et un faisceau de voies de cheminement (14f) définissant une pluralité de voies de cheminement de lumière (14e), chaque voie de cheminement de lumière ayant une entrée de voie de cheminement de lumière (14a) et au moins une sortie de voie de cheminement de lumière (14b), et au moins une voie de cheminement de lumière (14e) est ramifiée, dans lequel ladite plaque de voies de cheminement de lumière (14) peut être déplacée de manière sélective par rapport à la plaque de base (12) d'une première position dans laquelle une entrée de voie de cheminement de lumière (14a) reçoit de la lumière et communique cette lumière à une première sortie de voie de cheminement de lumière (14b), et au moins une deuxième position dans laquelle une entrée de voie de cheminement de lumière reçoit de la lumière et communique cette lumière à au moins une sortie de voie de cheminement de lumière (14b) supplémentaire ou à des sorties de voies de cheminement de lumière (14b) multiples.

2. Un commutateur optique tel que revendiqué dans la revendication 1, dans lequel cette au moins une voie de cheminement de lumière (14e) se ramifie en deux voies de cheminement de lumière (14e) distinctes.

3. Un commutateur optique tel que revendiqué dans la revendication 1, dans lequel une entrée de lumière (14a) peut être raccordée à de multiples sorties de voies de cheminement de lumière (14b).

4. Un commutateur optique tel que revendiqué dans l'une quelconque des revendications 1 à 3, dans lequel il y a une pluralité d'entrées de voies de cheminement de lumière (14a).

5. Un commutateur optique tel que revendiqué dans l'une quelconque des revendications 1 à 4, dans lequel ladite plaque de voies de cheminement de lumière (14) peut être déplacée de manière sélective à une position fermée dans laquelle la communication de lumière entre au moins une desdites entrées de voies de cheminement de lumière (14a) et la totalité desdites sorties de voies de cheminement de lumière (14b) est empêchée.

6. Un commutateur optique tel que revendiqué dans la revendication 1, dans lequel ledit déplacement sélectif de ladite voie de cheminement de lumière est effectué grâce à un couplage rotatif.

7. Un commutateur optique tel que revendiqué dans la revendication 6, dans lequel ledit couplage rotatif peut être déplacé d'une première position extrême à une deuxième position extrême, et tout point entre celles-ci, un mécanisme d'arrêt opposant une résistance à la rotation au-delà desdits deux extrêmes.

8. Un commutateur optique tel que revendiqué dans la revendication 7, dans lequel ledit couplage rotatif inclut une pluralité de crans, lesdits crans permettant à la rotation du couplage rotatif de progresser de façon contrôlée et par paliers.

9. Un commutateur optique tel que revendiqué dans la revendication 8, dans lequel la rotation du couplage rotatif résulte séquentiellement en ce qu'une sélection séquentielle prédéterminée de voies de communication de lumière est formée entre une ou plusieurs entrées de lumière et une ou plusieurs sorties de lumière.

10. Un commutateur optique tel que revendiqué dans l'une quelconque des revendications 1 à 9, le commutateur optique (10) comprenant une plaque de base (12), une plaque de voies de cheminement de lumière (14) et un logement (16) montés pour rotation sur un axe (18), le logement (16) étant en forme de coupelle avec un bord crénelé de paroi de côté (16e) pour se mettre en prise avec un bord correspondant d'une douille de montage (106).

11. Un commutateur optique tel que revendiqué dans l'une quelconque des revendications 1 à 10, le commutateur optique comprenant une plaque de voies de cheminement de lumière (14) généralement circulaire qui présente deux portions de côté circonférentielles (14g, 14h) définies par des rayons différents afin de former, l'une relativement à l'autre, un côté de rayon plus petit, et un côté de rayon plus grand, dans lequel ces deux portions de côté circonférentielles se rejoignent au niveau de deux jonctions et définissent des lèvres de butée (14i) configurées pour coopérer avec un organe de butée (14j) afin de limiter la gamme de rotation de la plaque de voies de cheminement de lumière généralement circulaire.

12. Un commutateur optique tel que revendiqué dans l'une quelconque des revendications 1 à 11, dans lequel le logement (16) comprend un bandeau (16d) incluant un rebord indenté (16g) adjacent à la circonférence externe du bandeau incluant des boutons indicateurs (16h) mutuellement espacés servant à déterminer le degré de rotation du commutateur relativement à un point de référence au-delà du logement.

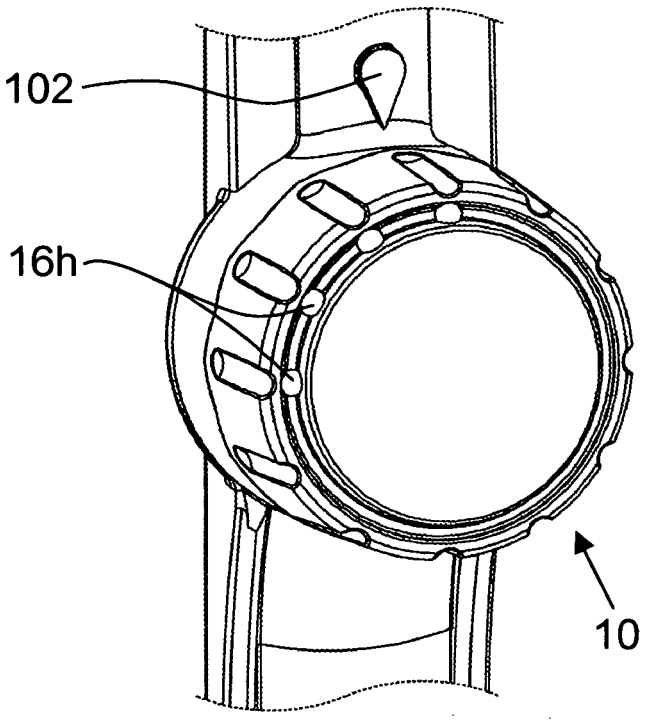

Fig 1

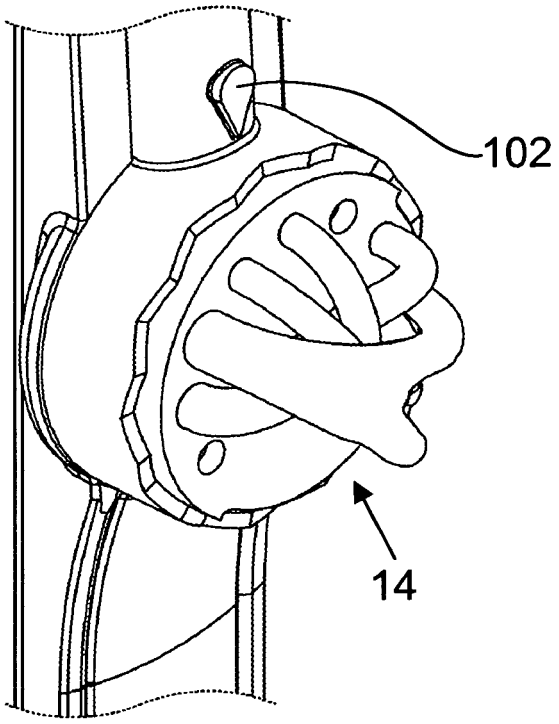

Fig 2

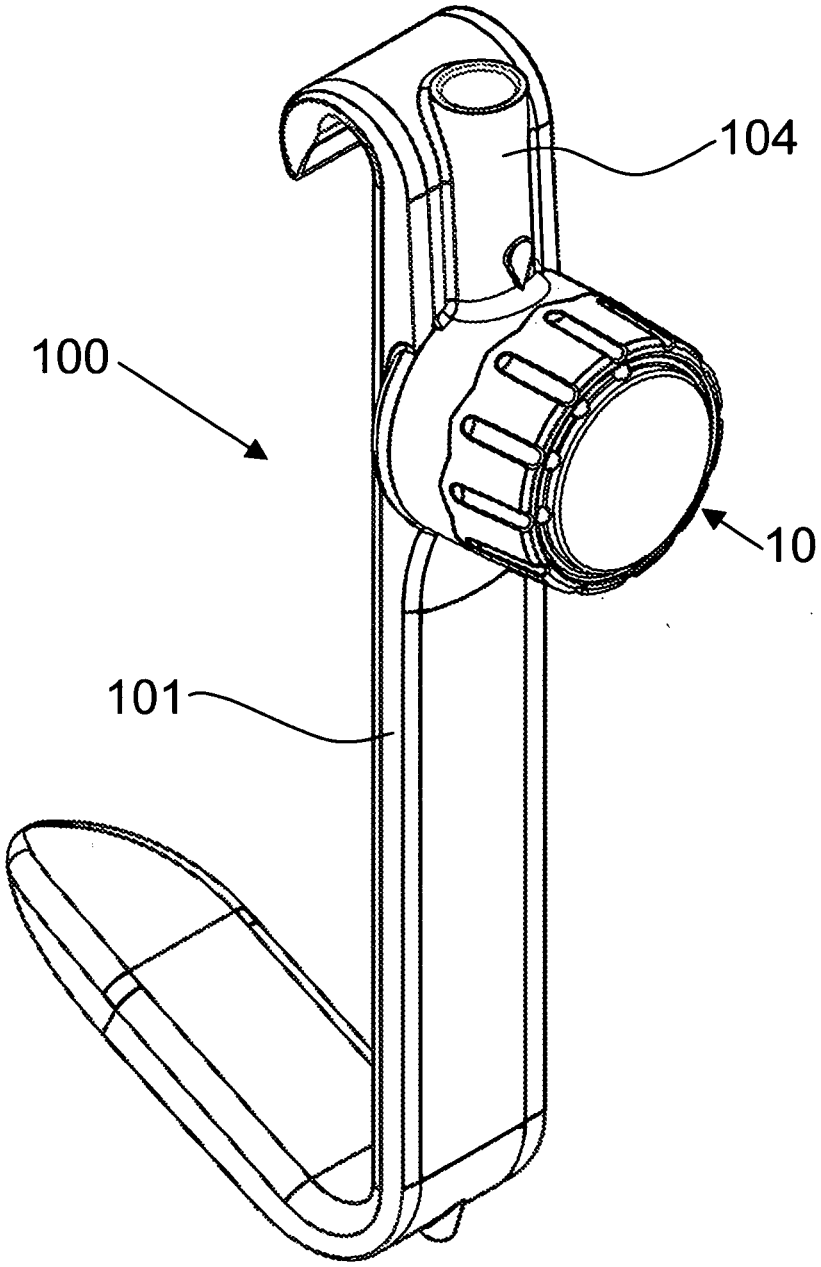

Fig 3

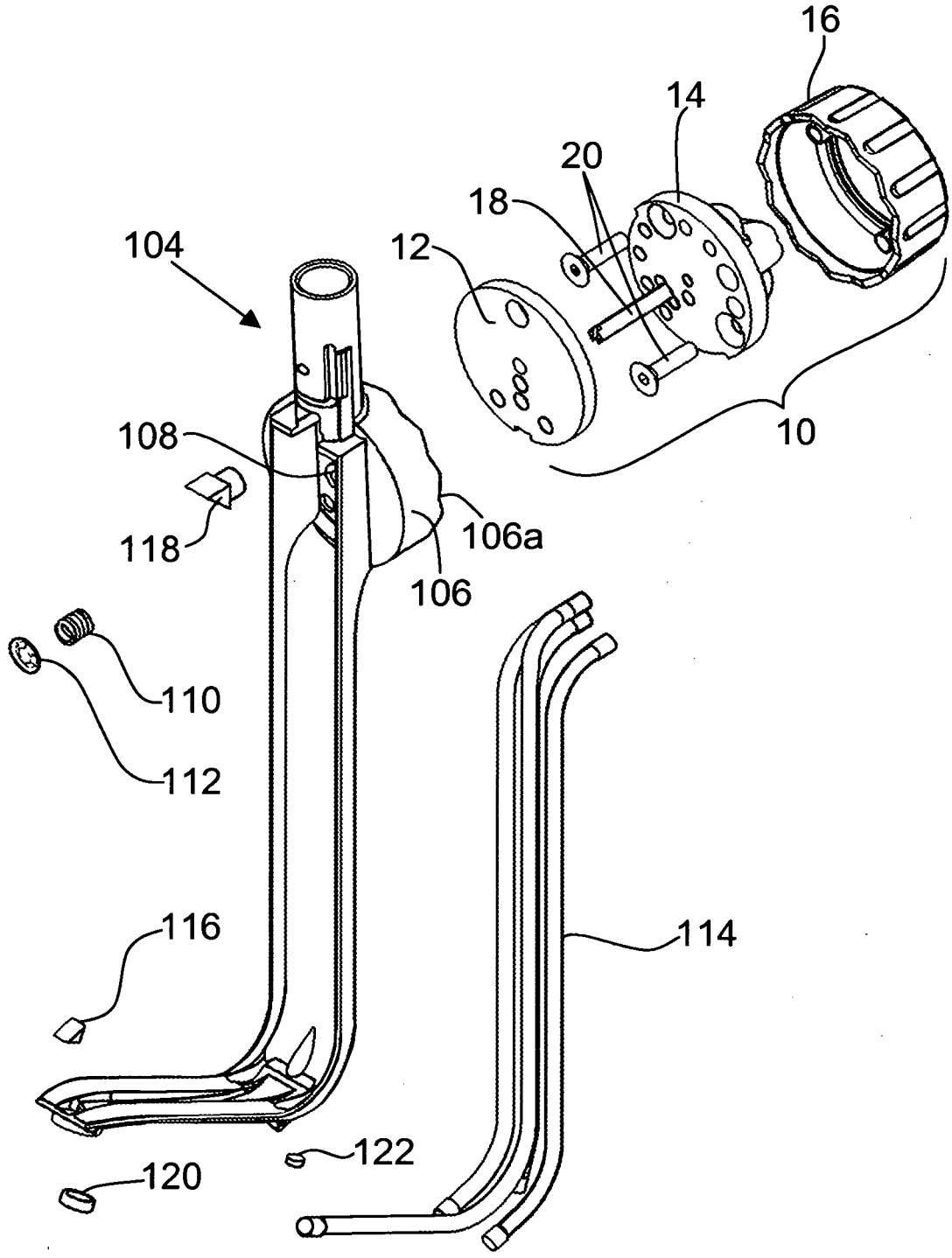

Fig 4

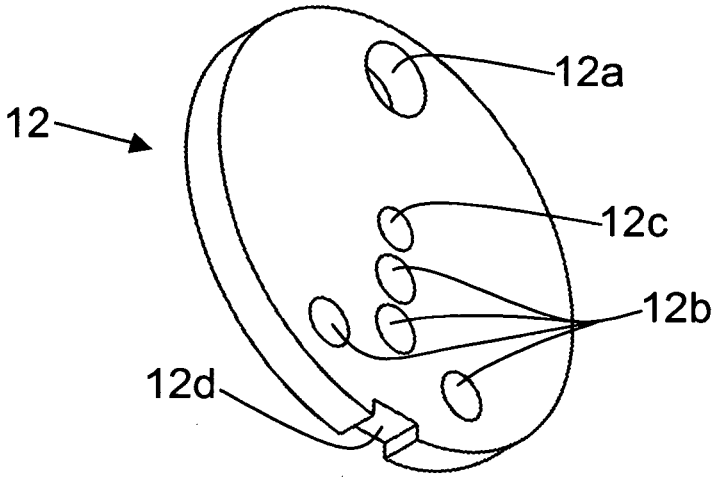

Fig 5

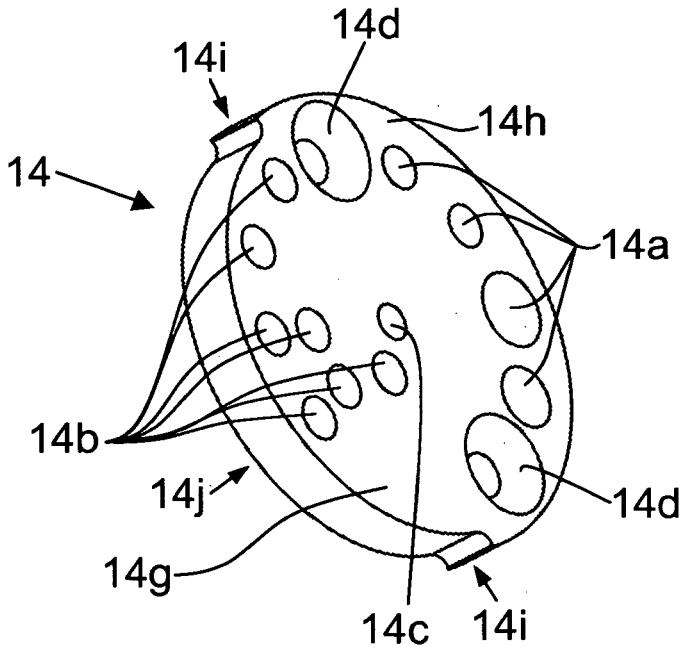

Fig 6

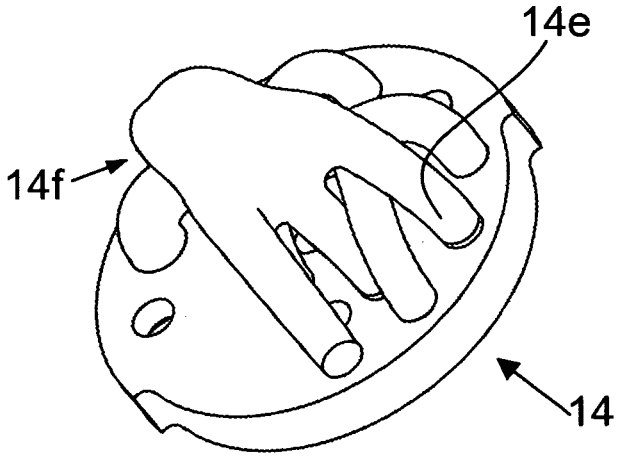

Fig 7

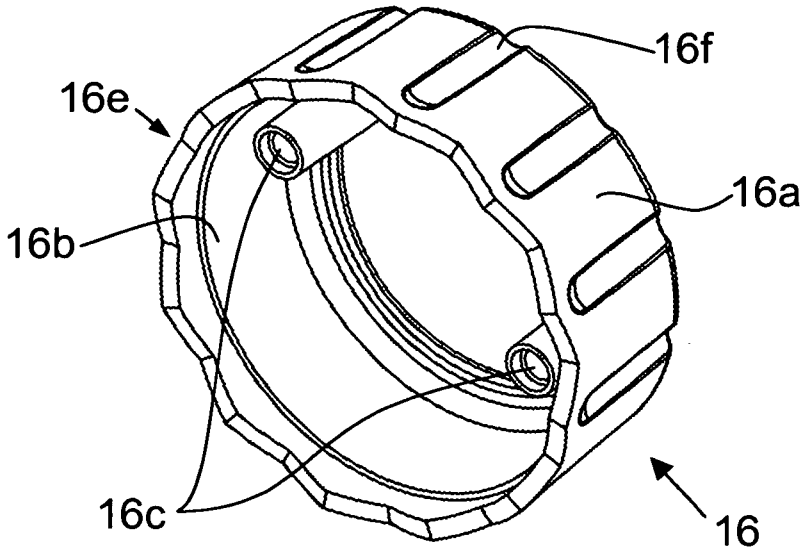

Fig 8

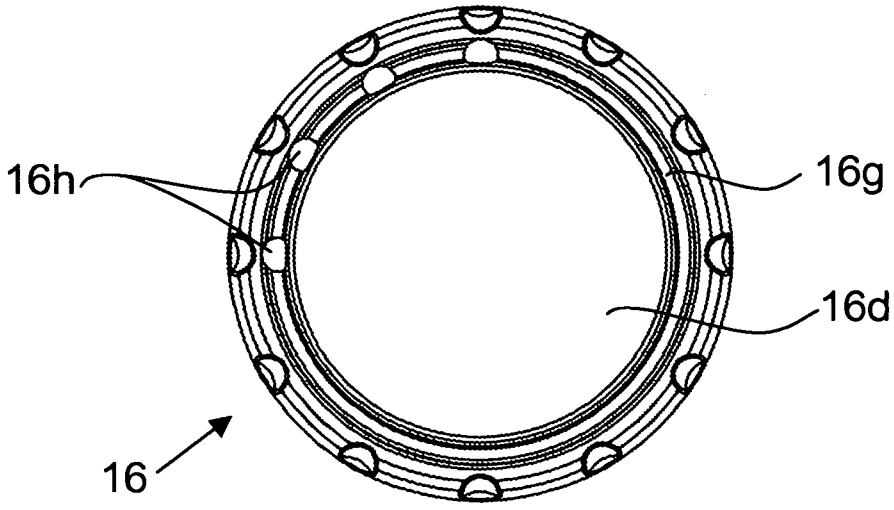

Fig 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- GB 2009000097 W **[0001] [0048]**

专利名称(译)	光开关		
公开(公告)号	EP2619615B1	公开(公告)日	2016-10-12
申请号	EP2011760531	申请日	2011-08-30
[标]申请(专利权)人(译)	心臟精密儀器有限公司		
申请(专利权)人(译)	CARDIOPRECISION LTD.		
当前申请(专利权)人(译)	CARDIOPRECISION LTD.		
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发明人	SUTHERLAND, YING SUTHERLAND, FRASER WILLIAM HAVERN TARGELL, JOHN		
IPC分类号	G02B6/35 G02B5/00 A61B17/02 A61B1/00 A61B1/07 A61B5/00		
CPC分类号	G02B6/35 A61B1/00126 A61B1/07 A61B5/00 A61B17/02 A61B90/30 A61B2090/306 A61B2562/0233 G02B6/3504 G02B6/3574		
代理机构(译)	EDE，ERIC		
优先权	2010015746 2010-09-21 GB		
其他公开文献	EP2619615A1		
外部链接	Espacenet		

摘要(译)

光学开关（10）包括光输入（12a），多个光输出（12b）和至少一个可从第一位置移动的光路，其中光输入路径形成在光输入（14a）和第一位置之间光输出（14b）和第二位置，其中在光输入和多个光输出之间形成光通信路径。在开关内配置多个光路，并且可通过开关外壳部分的旋转来选择，从而能够顺序选择光通信路径。该开关可以用在手术装置上，以在手术期间控制手术区域的照射。

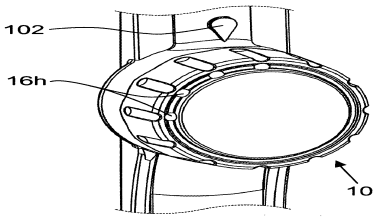

Fig 1

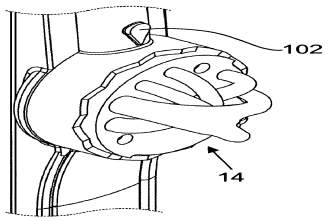

Fig 2