Abstract: Intraocular lens (IOL) cartridge for storing an intraocular lens (IOL) and enabling safe and convenient removal of same by an extractor tool for subsequent implantation in a human eye. The IOL cartridge includes a generally planar base member and a cover pivotal thereon for manual rotation from an initial closed position to an open position for enabling removal of the IOL. The IOL cartridge is intended for one handed operation to its open position thereby freeing a user’s other hand for holding the extractor tool for removing the IOL.
INTRAOCULAR LENS (IOL) CARTRIDGE

Field of the Invention

The invention pertains to intraocular lens (IOL) cartridges for IOL storage purposes.

5 Background of the Invention

IOL implantations into human eyes involve making incisions. Incisions are preferably as small as possible to reduce trauma and speed healing. IOLs are preferably inserted folded to reduce the size of an incision for implanting same. Some IOLs are required to be implanted in a particular orientation to function correctly.

IOL cartridges for holding an intraocular lens for removal therefrom by an extractor tool, for example, forceps, and the like, for implantation purposes are illustrated and described in *inter alia* US Patent No. 4,205,747 to Gilliam et al., US Patent No. 4,269,307 to LaHaye, US Patent No. 4,736,836 to Alongi et al., US Patent No. 5,281,227 to Sussman, US Patent No. 6,622,855 to Callahan et al., US Patent No. 6,786,911 to Mitomo et al., and the like.

Summary of the Invention

The present invention is directed towards intraocular lens (IOL) cartridges for storing intraocular lenses (IOLs) and enabling their safe and convenient removal by an extractor tool, for example, forceps, and the like, for subsequent implantation in a human eye. The IOL cartridges include a generally planar base member and a cover manually pivotal thereon from an initial closed position to an open position for enabling removal of the IOL. The IOL cartridges are intended for one handed operation to their open position thereby freeing a user's other hand for holding the extractor tool for removing an IOL. The IOL cartridges can be equally used by left and right hand users.
The IOL cartridges of the present invention are suitable for storing a wide range of IOLs of either fixed Diopter strength or continuously variable Diopter strength in accordance with commonly owned US Patent No. 7,220,279 to Ben Nun, the contents of which are incorporated herein by reference. The IOL cartridges of the present invention are particularly suitable for storing an IOL with a haptics system for positioning the IOL in a human eye. Moreover, the IOL cartridges of the present invention are particularly suitable for storing an accommodating intraocular lens (AIOL) with a haptics system for self-anchoring in a human eye's ciliary sulcus in accordance with commonly owned PCT International Application No. PCT/IL2005/000456 entitled Accommodating Intraocular Lens Assemblies and Accommodation Measurement Implant published under PCT International Publication No. WO 2005/104994, the contents of which are incorporated herein by reference.

**Brief Description of the Drawings**

In order to understand the invention and to see how it can be carried out in practice, a preferred embodiment will now be described, by way of a non-limiting example only, with reference to the accompanying drawings in which similar parts are likewise numbered, and in which:

Fig. 1 is a perspective view of an intraocular lens (IOL) including an annular haptics main body;

Fig. 2 is a perspective view of the haptics main body being squeezed into an oval shape for implantation into a human eye;

Fig. 3 is a perspective view of an intraocular lens (IOL) cartridge in a closed position, the IOL cartridge including an IOL holder for holding an IOL;

Fig. 4 is a perspective view of the IOL cartridge in an open position;

Fig. 5 is an exploded view of the IOL cartridge including its IOL;

Fig. 6 is a close up perspective view of the IOL holder holding the IOL;

Fig. 7 is a close up perspective view of the IOL holder with its IOL removed;
Fig. 8 is a top plan view of the IOL cartridge in its closed position;
Fig. 9 is a cross section view of the IOL cartridge along line A-A in Figure 8;
Fig. 10 is a close up view of the circled area denoted C in Figure 9 showing the IOL holder holding the IOL;
Fig. 11 is a perspective view of a forceps in its open state;
Fig. 12 is a perspective view of the forceps in its closed state;
Fig. 13 is a side view of the forceps;
Fig. 14 is a close up perspective view of the forceps jaws;
Fig. 15 is a perspective view of the forceps lightly gripping an IOL;
Fig. 16 is a close up perspective view of the forceps jaws lightly gripping the IOL;
Fig. 17 is a perspective view of the forceps squeezing an IOL into an oval shape for implantation into a human eye;
Fig. 18 is a close up perspective view of the forceps jaws squeezing the IOL into an oval shape;
Fig. 19 is a perspective view showing an IOL cartridge and a forceps;
Fig. 20 is a perspective view showing the forceps being inserted into the IOL cartridge;
Fig. 21 is a perspective view showing the IOL cartridge being opened for removal of the IOL; and
Fig. 22 is a perspective view showing the forceps removing the IOL from the IOL cartridge.

Detailed Description of Preferred Embodiment of the Present Invention

Description of Intraocular Lens (IOL)

Figures 1 and 2 show an intraocular lens (IOL) 10 have a longitudinal axis 11 intended to be co-directional with a human eye's visual axis on implantation in a human eye. The IOL includes a haptics system 12 for positioning the IOL in a predetermined position in a human eye and an optical element 13. The haptics
system 12 is made from suitable rigid bio-compatible transparent polymer material such as PMMA, and the like. The optical element 13 is made from suitable bio-compatible transparent material. The IOLs 10 are pre-assembled using conventional assembly techniques, for example, gluing, soldering, and the like. The haptics system 12 includes an annular haptics main body 14 with a pair of diametrically opposite elongated generally C-shaped haptics 16 extending in opposite directions in a plane perpendicular to the longitudinal axis 11. The haptics 16 are capable of being flexed around the haptics main body 14 as shown by the arrow labeled A. The haptics 16 terminate at a bifurcated attachment plate 17 having a pair of spaced apart puncturing members 18 and a throughgoing manipulation bore 19. The haptics main body 14 is intended to be squeezable into an oval shape on application of a compression force F for implantation through a small incision into a human eye.

Description of Intraocular Lens Cartridge

Figures 3 to 5 show an intraocular lens (IOL) cartridge 30 having a generally oval shape and a longitudinal axis 31 defining a leading end 32 and a trailing end 33 and dividing the IOL cartridge 30 into a right side 34 and a left side 36. The IOL cartridge 30 has an outer length L of about 80 mm and an outer width W of about 65 mm (see Figure 8). The IOL cartridge 30 includes a generally planar base member 37 and a cover 38 pivotal on the base member 37 about an axis of rotation 39 generally perpendicular to the base member 37 in a counter clockwise direction as denoted by arrow B from an initial closed position (see Figure 3) to an open position (see Figure 4).

The base member 37 includes a top surface 41, a bottom surface 42, and a peripheral surface 43. The top surface 41 is formed with a central upright support 44 with a throughgoing bore 46 for rotatably supporting the cover 38 about the axis of rotation 39. The top surface 41 is formed with an isosceles shaped platform 47 extending from the upright support 44 towards the peripheral surface 43 at the leading end 32. The platform 47 has a top surface 48, a left side
wall 49, and a peripheral surface 51 flush with the peripheral surface 43. The platform 47 is formed with an IOL holder 52 for holding an IOL 10.

The base member 37 is formed with a fixed finger grip 53 on its right side 34 having a leading raised platform 54 contiguous with the platform 47 and a trailing upright finger support 56 extending from the upright support 44 to the peripheral surface 43 at the trailing end 33 and separated from the platform 54 to leave a finger recess 57 shaped and dimensioned for receiving a user's digit. The platform 54 has a top surface 58 raised with respect to the platform's top surface 48. The top surface 41 is provided with a guide 59 on the left side 36 inward from the peripheral surface 43 for guiding the rotation of the cover 38 from its initial closed position to its open position.

The cover 38 includes a downward depending pin 62 for snap fit insertion into the upright support 44 whereupon the cover 38 is rotatable relative to the base member 37, a movable finger grip 63 similar to the fixed finger grip 53 and a transparent viewing pane 64 shaped and dimensioned to overlie the IOL holder 52 in the closed position of the cover 38 with respect to the base member 37. The viewing pane 64 is provided with ventilation holes 64A. The viewing pane 64 enables a user to view the IOL holder 52 and the IOL 10 for enabling safe removal of the IOL 10 from the IOL cartridge 30 as described below with reference to Figures 19 to 22 for implantation in a human eye.

The movable finger grip 63 includes a platform 66 with a top surface 67 flush with the platform's top surface 58 and a right side wall 68 for juxatpositioning against the platform's left side wall 49 in the cover's closed position with the viewing pane 64 overlying the IOL holder 52. The movable finger grip 63 includes a trailing upright finger support 69 extending from the upright support 44 to the peripheral surface 43 at the trailing end 33 and separated from the platform 66 to leave a finger recess 71 shaped and dimensioned for receiving a user's digit of his same hand as his digit for placing in the finger recess 57. The finger recesses 57 and 71 assume an open scissor-like finger recess arrangement in the closed position.
Figures 6 to 10 show the IOL holder 52 includes an open box-like recess 72 having a bottom surface 73, an end wall 74, opposite and parallel left and right side walls 76, and a peripheral aperture 77 for enabling longitudinal insertion of an extractor tool, for example, forceps into the recess 72 for removing the IOL 10 from the IOL holder 52. The IOL holder 52 includes an upright throughgoing bore 78 deployed between a pair of spaced apart holders 79 and 81 aligned along the IOL cartridge's longitudinal axis 31 for each receiving one of the IOL's attachment plates 17 whereby the IOL's optical element 13 is suspended between the viewing pane 64 and the upright bore 78 in the cover's closed position, thereby ensuring that its optical surfaces do not contact another surface which may cause scratches, and the like. The holders 79 and 81 are each provided with a location pin 82 for insertion into a manipulation hole 19 for securing location of the IOL 10 within the IOL holder 52. The holder 81 is mounted on a stand 83 formed on a forceps support 84 formed on the bottom surface 73 and protruding beyond the peripheral surface 43.

The IOL cartridge 30 is provided with a securing mechanism 86 for requiring a user to perform an action to rotate the cover 38 from its initial closed position to its open position for precluding the cover 38 from inadvertently sliding from its initial closed position to its open position. The securing mechanism 86 is preferably implemented by a pin 87 downward depending from the cover 38 initially snap fitted between the guide 59 and a resiliently flexible upright member 88 formed on the top surface 41 opposite the guide 59 requiring a user to positively rotate the cover 38 to pull the pin 87 from between the opposing guide 59 and member 88. Alternatively, the securing mechanism 86 can be implemented by a clasp arrangement, and the like.

The IOL cartridge 30 together with the IOL 10 is inserted in a sterile hermetic transparent bag and undergoes a conventional sterilization process including gas sterilization. The ventilation holes 64A and the throughgoing bore 78 provide free passage of the gas around the IOL 10 for sterilization purposes.
Description of Forceps for Removing an IOL

Figures 11-18 show a forceps 90 including a shank 91 having a longitudinal axis 92 defining a trailing end 93 and a leading end 94. The shank 91 includes left and right shank members 96A and 96B joined at their trailing ends and terminating at a pair of forceps jaws 97A and 97B. The forceps jaws 97 include proximate sections 98 joined to the shank members 96, outwardly directed intermediate sections 99, and opposite and parallel distal sections 101. The forceps jaws 97 subtend an obtuse angle $\alpha$ of about $135^\circ$ to the shank members 96 in a side view of the forceps 90 (see Figure 13). The left distal section 101A is provided with inwardly directed top and bottom opposite and parallel elongated flanges 102 for ensuring an IOL 10 remains aligned lengthwise with the distal sections 101 on being gripped therebetween (see Figure 14). The right distal section 101B is formed with an elongated flange 103 for steadying purposes.

The forceps 90 have a nominal open position with their forceps jaws 97 spaced apart from one another to leave a first separation S1 slightly greater than an IOL's outer width (see Figure 11). The forceps 90 can be manually urged into a closed position stopped by the proximate sections 98 abutting against each other to leave a second separation S2 where $S2<S1$ (see Figure 12). The forceps 90 in their closed position squeeze an IOL into an oval shape for implantation in a human eye.

The use of the IOL cartridge 30 and the forceps 90 is now illustrated and described with reference to Figures 19 to 22. A right hand user typically uses his left hand to hold a closed IOL cartridge in its open scissor-like finger recess arrangement steady on a horizontal surface and his right hand to hold the forceps in its open state. The user places his thumb in the finger recess on the IOL cartridge's right side and his forefinger in the finger recess on the IOL cartridge's left side. The user places the forceps jaws onto the forceps support and slides them into IOL holder on either side of the IOL until they abut against the end
wall (see Figure 20). The user can view the advancement of the forceps jaws into the IOL holder by looking through the viewing pane. The user closes the forceps jaws onto the IOL for lightly gripping same and at the same time entrapping the IOL between the elongated flanges to prevent the IOL from slipping out. The user moves his forefinger towards his thumb to close the close the open scissor-like finger recess arrangement pivot the cover in the counter clockwise direction B to its open position (see Figure 21). The user lifts the IOL from the IOL holder and closes the forceps jaws to their closed position to squeeze the IOL into an oval shape for implantation in a human eye (see Figure 22).

While the invention has been described with respect to a limited number of embodiments, it will be appreciated that many variations, modifications, and other applications of the invention can be made within the scope of the appended claims.
Claims:
1. An intraocular lens (IOL) cartridge for storing an intraocular lens (IOL) having a longitudinal axis intended to be co-directional with a human eye's visual axis on implantation in a human eye and an optical element, the IOL cartridge having a longitudinal axis defining a leading end and a trailing end, the longitudinal axis defining a right side and a left side of the IOL cartridge, the IOL cartridge comprising:

(a) a generally planar base member including an IOL holder for holding the IOL prior to being lifted therefrom for implantation purposes, said IOL holder being towards the IOL cartridge's leading end, said base member having a fixed finger grip on one side of the IOL cartridge, said fixed finger grip including a finger recess towards IOL cartridge's trailing end for receiving a user's first digit; and

(b) a cover pivotal on said base member about an axis of rotation generally perpendicular to said base member for manual rotation from an initial closed position to an open position respectively precluding and enabling lifting the IOL from said IOL holder for implantation purposes,

said cover including a viewing pane overlying the IOL in said IOL holder in said closed position for enabling the user to view same from a top plan view of the IOL cartridge,

said cover having a movable finger grip on the other side of IOL cartridge relative to said fixed finger grip, said movable finger grip including a finger recess towards the IOL cartridge's trailing end for receiving a user's second digit of the same hand as his first digit,

whereby said finger recesses of said fixed and movable finger grips assume an open scissor-like finger recess arrangement in said closed position whereupon the user approaches his second digit towards his first digit to close said open scissor-like finger recess arrangement for pivoting said cover to said open position.
2. The IOL cartridge according to claim 1 wherein said cover defines a leading aperture toward the IOL cartridge's leading end in said closed position for enabling longitudinal insertion of an extractor tool into said IOL holder for gripping the IOL held therein, said viewing pane enabling the user to view the gripping of the IOL from a top plan view of the IOL cartridge.

3. The IOL cartridge according to claim 2 wherein the IOL includes a haptics system for positioning the IOL in a human eye, the haptics system having a pair of diametrically opposite elongated haptics extending in opposite directions from the optical element in a plane perpendicular to the IOL's longitudinal axis, said IOL holder includes a pair of spaced apart holders aligned along the IOL cartridge's longitudinal axis for suspending the IOL by its haptics whereby a forceps like extractor tool is capable of gripping the IOL from opposite sides.

4. The IOL cartridge according to any one of claims 1 to 3 wherein said IOL holder includes an upright throughgoing bore underlying the optical element and said viewing pane includes ventilation holes whereby said throughgoing bore and said ventilation holes enable free passage of gas around the IOL for sterilization purposes.

5. The IOL cartridge according to any one of claims 1 to 4 and further comprising a securing mechanism for requiring a user to perform an action to pivot said cover from said initial closed position to said open position thereby precluding said cover from inadvertently sliding from said initial closed position to said open position.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. A61F2/16

According to International Patent Classification (IPC) and/or national classification and IPC:

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols):

A61F B65B A45C B65D

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 practical, search terms used):

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>FR 2 778 556 A1 (CHAUVIN OPSIA [FR]) 19 November 1999 (1999-11-19) page 14, line 23 - page 15, line 26; figures 1-5</td>
<td>1</td>
</tr>
</tbody>
</table>

D

Further documents are listed in the continuation of Box C

X 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 document 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 novel or 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.
  'A' - document member of the same patent family

Date of the actual completion of the international search: 16 July 2009

Date of mailing of the international search report: 27/07/2009

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

Neumann, Elisabeth
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 4205747 A</td>
<td>03-06-1980</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA 2332425 A1</td>
<td>25-11-1999</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE 69910765 D1</td>
<td>02-10-2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE 69910765 T2</td>
<td>17-06-2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ES 2207198 T3</td>
<td>16-05-2004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OP 2002515291 T</td>
<td>28-05-2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US 6537282 B1</td>
<td>25-03-2003</td>
</tr>
<tr>
<td>US 4736836 A</td>
<td>12-04-1988</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>