PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A61N 5/02 | A1

(11) International Publication Number: WO 96/29115

(43) International Publication Date: 26 September 1996 (26.09.96)

(21) International Application Number: PCT/US96/03582

(22) International Filing Date: 15 March 1996 (15.03.96)

(30) Priority Data:
08/407,508 20 March 1995 (20.03.95) US

(71) Applicant: ESCALON MEDICAL CORP. [US/US]; Suite 1, 4520 Executive Drive, San Diego, CA 92121-3028 (US).

(72) Inventors: SPEAKER, Mark; Apartment 4C, 30 E. 65th Street, New York, NY 10021 (US). MARCHI, Vicenzo; Via Bruzelies, 79, I-00198 Roma (IT). JUHASZ, Tibor; 22 Newton Court, Irvine, CA 92715-4038 (US). GISEL, Heinz; 310 Nautilus Street, La Jolla, CA 92037 (US).

(74) Agent: NYDEGGER, Neil, K.; Nydegger & Associates, Suite 950, 4350 La Jolla Village Drive, San Diego, CA 92122 (US).

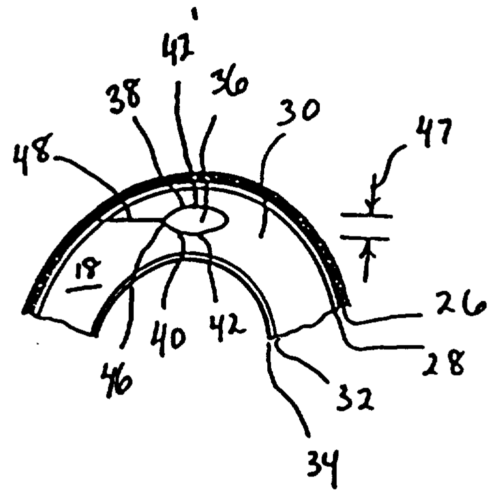
(81) Designated States: JP, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: METHOD FOR CORNEAL LASER SURGERY

(57) Abstract

A method for corneal laser surgery includes directing the focal point of a focused laser beam at a start point in the stroma. The focal point is then moved along a predetermined path (42, 42') in the stroma to photodisrupt tissue in an anterior surface (42) of a tissue lentoid (36) and in a posterior surface (42') of the lentoid (36). A channel is created in the stroma (48) to provide for extra-corporal access to the lentoid and the lentoid is then removed or retrieved through the channel. The diminished stromal tissue reshapes the cornea in a manner which improves the vision of the patient.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgystan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic			SE	Sweden
CG	Congo	KR	Republic of Korea	SG	Singapore
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LR	Liberia	SZ	Swaziland
CS	Czechoslovakia	LT	Lithuania	TD	Chad
CZ	Czech Republic	LU	Luxembourg	TG	Togo
DE	Germany	LV	Latvia	TJ	Tajikistan
DK	Denmark	MC	Monaco	TT	Trinidad and Tobago
EE	Estonia	MD	Republic of Moldova	UA	Ukraine
ES	Spain	MG	Madagascar	UG	Uganda
FI	Finland	ML	Mali	US	United States of America
FR	France	MN	Mongolia	UZ	Uzbekistan
GA	Gabon	MR	Mauritania	VN	Viet Nam

METHOD FOR CORNEAL LASER SURGERY

FIELD OF THE INVENTION

The present invention pertains generally to ophthalmic surgery which is useful for correcting vision deficiencies. More particularly, the present invention pertains to methods which surgically correct the vision of a patient by removing portions of the stroma to reshape the cornea. The present invention is particularly, but not exclusively useful as a method for using a laser beam to photodisrupt a surface surrounding and containing the predetermined volume of stromal tissue which needs to be removed to correct the vision of the patient.

BACKGROUND OF THE INVENTION

Vision impairment can occur for many reasons, and be the result of many causes. One, all too common, cause for vision impairment results from a defective condition of the eye which occurs when the refractive characteristics of the cornea do not cause parallel rays of light to focus on the retina. When the eye is at rest, and the rays of light focus in front of the retina, the condition is known as myopia (i.e. near-sightedness). On the other hand, when the rays of light focus behind the retina, the condition is known as hypermetropia or hyperopia (i.e. far-sightedness). Both myopic and hyperopic conditions result in varying degrees of vision impairment and, as is well known, in most cases the conditions are correctable.

Spectacles or eyeglasses are commonly used to correct myopic or hyperopic conditions. For various reasons, however, many persons who suffer with these conditions prefer not to wear eyeglasses. Fortunately for these individuals, it is known that surgical procedures can be employed which will reshape the cornea in ways that are effective in changing its refractive characteristics. For example, U.S. Patent NO. 4,665,913 which issued to L'Esperance for an invention entitled "Method for Ophthalmological Surgery", and U.S. Patent No. 4,669,466 which issued to L'Esperance for an invention entitled "Method and Apparatus for Analysis and correction of Abnormal Refractive Errors of the Eye" both disclose a laser system which photoablates corneal tissue from the anterior surface of the eye. In a different manner, U.S. Patent No. 4,988,348 which issued to Bille for an invention entitled "Method for Reshaping the Cornea", and which is assigned to the same assignee as the present invention, discloses a procedure whereby corneal tissue is first removed to correct vision, and then the newly created surface is smoothed.

Rather than remove and reshape portions of the anterior portion of the eye to correct refractive defects, some procedures for reshaping the cornea have suggested intrastromal photoablation for removal of only stromal tissue. As an example of such a procedure, U.S. Patent No. 4,907,586, which issued to Bille et al. for an invention entitled "Method for Reshaping the Eye" discloses an intrastromal photodisruption technique for reshaping the cornea. Another example of a procedure which is intended to essentially remove only stromal tissue is the so-called "flap and zap" procedure. For this procedure, an anterior portion of the cornea is removed and a portion of the exposed stroma is then photoablated. The previously removed anterior portion of the cornea is then repositioned on the cornea to cover the photodisruption. This procedure, like the procedure disclosed in Bille et al. '586, has as its objective the removal of only stromal tissue with the consequent preservation of anterior corneal tissue. A significant downside for the "flap and zap" procedure, however, is the possibility that the previously removed anterior portion of the cornea may again become detached. While the intrastromal procedure disclosed by

Bille et al. does not lead to this detachment problem it can, in some cases, require extensive laser photodisruption and be time consuming.

The use of laser systems for ophthalmic surgical procedures, such as the procedure contemplated for the present invention, is particularly appropriate due to the extreme precision required when corneal tissue is to be removed. Specifically, depending on the diameter and the general shape of the tissue volume to be removed, it is known that the removal of a layer of stromal tissue which is only approximately ten microns thick will result in a one diopter change. More practically, by way of example, the removal of a lens shaped volume of tissue which is four millimeters in diameter and approximately fifty microns thick at its center will result in a refractive correction of approximately four diopters. In almost all cases, for precise vision corrections which can stay within a one diopter accuracy, the surgical procedure employed must be capable of removing corneal tissue having a thickness which is accurate to within less than ten microns. Furthermore, this degree of accuracy applies for any refractive correction regardless of the total amount of correction required.

It happens that the correction of myopia requires removal of a differently shaped volume of corneal tissue than does the correction of hyperopia. Also, the limits of potential correction are different. Specifically, for a myopic correction it is known that a lentoid or lens shaped volume of stromal tissue needs to be removed. At the present time, myopic corrections of up to approximately thirty diopters can be reasonably expected. On the other hand, corrections of hyperopic conditions can be made up to only about fifteen diopters. Furthermore, for a hyperopic correction a generally doughnut shaped volume of stromal tissue, rather than a lens or lentoid shaped volume, needs to be removed.

In light of the above, it is an object of the present invention, to provide a method for corneal laser surgery which corrects the refractive characteristics of the cornea by removing only stromal tissue with minimal photodisruption of the tissue. Another object of the present invention is to provide a method for corneal laser surgery which essentially maintains the structural integrity of corneal tissue. Still another object of the present invention is to provide a method for corneal laser surgery which can be accomplished with a high level of precision when cutting corneal tissue by photodisruption. Yet another object of the present invention is to provide a method for corneal laser surgery which is relatively easy to practice and comparatively cost effective.

SUMMARY OF THE INVENTION

In accordance with the present invention, a method for corneal laser surgery includes the step of first determining a volume of stromal tissue which needs to be removed in order to correct the vision of the patient. This volume of stromal tissue which is to be removed is formed as a lentoid that is defined by an anterior surface and a posterior surface. Accordingly, these surfaces are situated relative to each other so that the lentoid shaped volume of tissue to be removed is positioned therebetween.

A pulsed laser beam is focused to position its focal point at a preselected start point on the posterior surface of the lentoid. The focal point is then moved over the posterior surface to photodisrupt tissue on this surface and separate the lentoid from surrounding tissue. The same process is repeated for the anterior surface and the result is that the lentoid of stromal tissue to be removed is completely surrounded by photodisrupted tissue and thereby free of attachments to surrounding tissue.

In one embodiment of the present invention, looking at the eye in the direction from anterior to posterior, the posterior surface is shaped as a concave plate and the anterior surface is shaped as a convex plate. The removal of the resultant lens shaped tissue lentoid or disc is specifically intended to correct myopia. For the particular embodiment of the present invention wherein the correction of myopia is the desired result, it will be appreciated that the anterior surface or the posterior surface, or both, can be substantially flat. Also, the concave posterior surface could be modified to be a convex surface and thus have a curved surface which is similar to the anterior surface. On the other hand, in another embodiment of the present invention, the posterior surface is shaped as a concave annular surface and the anterior surface is shaped as a convex annular surface. In this instance the stromal tissue to be removed is a ring shaped or doughnut shaped volume which is specifically intended to correct hyperopia.

Regardless whether the volume is lens shaped or ring shaped, the method of the present invention also contemplates the creation of a channel through the stroma which provides for extracorporeal access to the encapsulated portion of the stroma. The encapsulated portion of the stroma can then be accessed, gripped, and removed or retrieved from the stroma through the channel. As intended for the present invention, with the removal of the lentoid volume of stromal tissue, the cornea is appropriately reshaped to correct the particular vision defect of the patient.

As intended for the present invention, the laser system to be used for accomplishing the methods will incorporate a beam of sequential laser pulses. Further, it is contemplated that the duration of laser pulses in the beam will be in the nanosecond, picosecond or femtosecond ranges.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features of this invention, as well as the invention itself, both as to its structure and its operation will be best understood from the accompanying drawings, taken in conjunction with the accompanying description, in which similar reference characters refer to similar parts, and in which:

Figure 1 is a perspective view of a patient being treated with the method of the present invention;

Figure 2 is a perspective view of an eye;

Figure 3 is a cross sectional view of the cornea of the eye as seen along the line 3-3 in Figure 2 showing a representative portion of stromal tissue to be removed for the correction of myopia;

Figure 3A is a cross-sectional view of a lentoid having a convex anterior surface and a concave posterior surface;

Figure 3B is a cross-sectional view of a lentoid having a convex anterior surface and a concave posterior surface which are separated by a contiguous flat annular surface therebetween;

Figure 3C is a cross-sectional view of a lentoid having a flat anterior surface and a flat posterior surface which are separated by a contiguous flat annular surface therebetween;

Figure 4 is a plan view of the cornea of the eye as seen in the direction of the line 4-4 in Figure 2 showing a representative path for movement of the laser beam focal point to prepare the portion of stromal tissue shown in Figure 3 for removal from the cornea;

Figure 5 is a cross sectional view of the cornea of the eye as seen along the line 3-3 in Figure 2 showing a representative portion of stromal tissue to be removed for the correction of hyperopia;

Figure 6 is a plan view of the cornea of the eye as seen in the direction of the line 4-4 in Figure 2 showing a representative path for movement of the laser beam focal point to prepare the portion of stromal tissue shown in Figure 5 for removal from the cornea;

Figure 7 is a cross sectional view of the cornea of the eye as seen along the line 3-3 in Figure 2 showing the gripping of the portion of stromal tissue to be removed; and

Figure 8 is a cross sectional view of the cornea of the eye as seen along the line 3-3 in Figure 2 showing the retrieval of the portion of stromal tissue to be removed.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring initially to Figure 1, an apparatus 10 for generating a laser beam 12 is shown. Specifically, the laser beam 12 is shown being directed onto an eye 14 of a patient 16. For purposes of the present invention, the apparatus 10 is capable of generating a pulsed laser beam 12 having physical characteristics similar to those of the laser beams generated by a laser system as disclosed and claimed in U.S. Patent No.4,764,930, which is also assigned to the assignee of the present invention. Furthermore, the present invention contemplates the use of a pulsed laser beam 12 which has pulses with durations as long as a few nanoseconds or as short as only a few femptoseconds.

Figure 2 shows the anatomical structure of eye 14 and, specifically, that the cornea 18 is anterior to the pupil 20, the iris 22, and the sclera 24. Additionally, Figure 2 indicates that the optical axis 26 of eye 14 passes through the cornea 18. Consequently, the tissue of cornea 18 is transparent to visible light.

In Figure 3 it can be seen that the cornea 18 includes five anatomically definable layers of tissue. Going in a direction from anterior to posterior in Figure 3, the tissue layers of the cornea are: epithelium 26, Bowman's membrane 28, stroma 30, Decemet's membrane 32 and endothelium 34. Of these, the stroma 30 is of most importance for the present invention as it contains the only tissue which is to be removed for correction of the patient's vision.

As indicated above, the correction of a myopic condition can be accomplished by the removal of a predetermined volume of stromal tissue. As also indicated above, the particular volume of stromal tissue to be removed for the correction of myopia will depend on the amount of correction required and will be a lens or lentoid shaped volume. Such a lentoid volume 36 is shown in cross section in Figures 3 and 3A. As shown, it is to also be appreciated that the lentoid volume 36 will be defined by an anterior surface 38 and a posterior surface 40. Together, the anterior surface 38 and the posterior surface 40 will completely enclose or encapsulate the lentoid volume 36 of stromal tissue 30 which is to be removed. To obtain the lens shape of the lentoid volume 36 it will be understood and further appreciated that, when considering lentoid volume 36 in a direction from anterior to posterior, the anterior surface 38 may be convex in shape and the posterior surface 40 may be concave in its shape.

It is to be appreciated that the actual shape for lentoid 36 may vary according to the needs and desires of the physician. For example, several possible shapes for lentoid 36 are shown in Figures 3A, 3B and 3C. Specifically, the lentoid 36 shown in Figure 3A is as suggested above where the anterior surface 38 is convex and the posterior surface 40 is concave. Figure 3B shows a variation from this shape wherein the anterior concave surface 38' is separated from the posterior concave surface 40' by a substantially flat annular surface 41. As shown, the flat annular surface 41 is contiguous with both the anterior surface 38' and the posterior surface 40'. Figure

3C shows yet another variation for lentoid 36 wherein both the anterior surface 38" and the posterior surface 40" are flat. Again, the anterior surface 38" and the posterior surface 40" are separated by the contiguous flat annular surface 41.

The creation of the anterior surface 38 and posterior surface 40 of lentoid volume 36 will, perhaps, be best appreciated with cross reference between Figure 3 and figure 4. In Figure 4, a predetermined start point 42 is shown, which is preferably on the posterior surface 40. The laser beam 12 is then focused initially on the predetermined start point 42 and, subsequently, the focal point of the laser beam 12 is moved according to computer programmed instructions along the spiral path 44. The spiral projection of the laser beam's focal point continues along spiral path 44 to create the concave posterior surface 40 until it reaches a point 46. Upon reaching the point 46 for the first time, the laser beam 12 is focused at a start point 42' on the anterior surface 38 of lentoid volume 36. The focal point of the laser beam 12 is then moved, again according to computer programmed instructions along a spiral path 42' to create the convex anterior surface 38 until the focal point again arrives at the point 46. With these actions the lentoid volume 36 is encapsulated and surrounded by photodisrupted tissue in the surfaces 38 and 40. For most applications the maximum distance 47 between the surfaces 38 and 40 will not exceed two hundred and fifty microns.

A channel 48 is next formed into the cornea 18 to provide for extracorporeal access to the lentoid volume 36. Specifically, the channel 48 will be created by the photodisruption of stromal tissue 30 in a manner similar to that used for the creation of anterior surface 38 and posterior surface 40. To accomplish this, a complete or a partial, or interrupted, spiral path 50 is followed by the focal point of laser beam 12. As can be appreciated by reference to Figure 4, for a partial spiral path 50 the activation of laser beam 12 can be interrupted and turned off during the excursion of its focal point through an arc of predetermined magnitude. In Figure 4 the arc in which the laser beam 12 is inactivated is shown as the space 52 and is estimated to be approximated two hundred and seventy degrees. On the other hand, the laser beam 12 is activated and the channel 48 is created over the remaining approximately ninety degrees of travel for the laser beam 12 focal point.

As implied above, it may be preferable to generate a complete spiral path 50, rather than the partial spiral path 50 shown in Figure 4. To do this, laser beam 12 remains activated during photodisruption of stromal tissue during each complete 360° sweep of laser beam 12 along path 50. Thus, no space 52 is created and, instead, the spiral path 50 creates a layer of photodisrupted tissue. With this complete spiral path 50 pattern, it is subsequently possible to create an access channel 48 to the lentoid volume 36 from any direction. Additionally, the tissue of stroma 30 which is photodisrupted by each complete 360° sweep of laser beam 12 is symmetrically disposed around the lentoid volume 36. In some cases, this symmetrical disposition of photodisrupted tissue may be necessary in order to prevent a later development of irregular astigmatism.

Turning now to Figure 5, a procedure for the treatment of hyperopia is indicated. As shown, the annular tissue volume 54 to be removed from stroma 30 in this procedure has a slightly different shape than is required for the treatment of myopia. Specifically, the annular tissue volume 54 is annular shaped. One way to create this annular tissue volume 54 is to initially focus the laser beam 12 to a predetermined start point 56 on annular tissue volume 54. The posterior surface 58 of annular tissue volume 54 is then created by moving the focal point of laser beam 12 along a depth variable spiral path 60 until it reaches a point 62 to create a concave posterior surface 58. The focal point is then returned to the start point 56 and again moved along a spiral path 60' of variable depth to create the convex anterior surface 64 for annular tissue volume 54. Upon reaching the point 62 for the second time, a channel 48 can be created in substantially the same manner as disclosed above for the procedure to create a myopic condition.

In addition to the creation of the annular tissue volume 54, the procedure for creating the annular tissue volume 54 of stromal tissue 30 also requires that the annular tissue volume 54 be severed on a plane 66 which is between and generally perpendicular to the anterior surface 64 and the posterior surface 58. As will be appreciated by the skilled artisan, this severance of annular tissue volume 54 along plane 66 allows for removal of the annular tissue volume 54 through the channel 48. Additionally, if desired to further facilitate removal of the annular tissue volume 54 from cornea 18, the annular tissue volume 54 can also be severed along a plane 68 which is generally diametrically opposite from the plane 66 and which, like plane 66, is between and generally perpendicular to the surfaces 58 and 64.

Once the lentoid volume 36 or the annular tissue volume 54 of stromal tissue 30 has been created, as disclosed above, a device 70 can be inserted through channel 48, as shown in Figure 7, to grip and then remove the particular volume from stroma 30, as shown in Figure 8. For purposes of the present invention, the device 70 can be any instrument known in the pertinent art, such as a tweezers or a suction probe.

While the particular Method for Corneal Laser Surgery as herein shown and disclosed in detail is fully capable of obtaining the objects and providing the advantages herein before stated, it is to be understood that it is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the details of the construction or design herein shown other than as defined in the appended claims.

We claim:

1. A method for corneal laser surgery which comprises the steps of:

directing the focal point of a focused laser beam at a start point in the stroma;

moving the focal point along a predetermined path in the stroma to photodisrupt tissue to encapsulate a portion of the stroma;

creating a channel in the stroma to provide for extracorporeal access to the encapsulated portion of the stroma; and

removing the encapsulated portion from the stroma through the channel.

2. A method as recited in claim 1 wherein said predetermined path comprises an anterior surface and a posterior surface with the encapsulated portion of the stroma therebetween.

3. A method as recited in claim 2 wherein said anterior surface is shaped as a convex plate and said posterior surface is shaped as a concave plate.

4. A method as recited in claim 3 wherein said predetermined path for the focal point is a first spiral path for the anterior surface and is a second spiral path for the posterior surface.

5. A method as recited in claim 4 wherein the anterior surface is distanced from the posterior surface by as much as two hundred and fifty microns.

6. A method as recited in claim 2 wherein the anterior surface and the posterior surface are separated by a flat annular surface contiguous therewith and located therebetween.

7. A method as recited in claim 6 wherein the anterior surface and the posterior surface are substantially flat.

8. A method as recited in claim 1 wherein the laser beam comprises a sequence of pulses and the duration of each laser pulse in the sequence is less than one picosecond.

9. A method as recited in claim 1 wherein the laser beam comprises a sequence of pulses and the duration of each laser pulse in the sequence is in the range of from one pico second to one nano second.

10. A method for removing a lentoid of stromal tissue from the cornea of an eye to correct the vision of a patient which comprises the steps of:

defining an anterior surface for the lentoid and an posterior surface for the lentoid;

moving the focal point of a focused laser beam over the anterior surface and the posterior surface of the lentoid to photodisrupt the tissue at the respective surfaces; and

retrieving the lentoid to diminish stromal tissue in the cornea to improve the vision for the patient.

11. A method as recited in claim 10 further comprising the step of creating a channel in the stroma to provide for extracorporeal access to the lentoid.

12. A method as recited in claim 11 wherein said anterior surface is shaped as a convex plate and said posterior surface is shaped as a concave plate.

13. A method as recited in claim 12 wherein said predetermined path for the focal point is a first spiral path for the anterior surface and is a second spiral path for the posterior surface.

14. A method as recited in claim 12 wherein the anterior surface is distanced from the posterior surface by as much as two hundred and fifty microns.

15. A method as recited in claim 12 wherein the anterior surface and the posterior surface are separated by a flat annular surface contiguous therewith and located therebetween.

16. A method as recited in claim 15 wherein the anterior surface and the posterior surface are substantially flat.

17. A method as recited in claim 10 wherein the laser beam comprises a sequence of pulses and the duration of each laser pulse in the sequence is less than one pico second.

18. A method as recited in claim 10 wherein the laser beam comprises a sequence of pulses and the duration of each laser pulse in the sequence is in the range of from one pico second to one nano second.

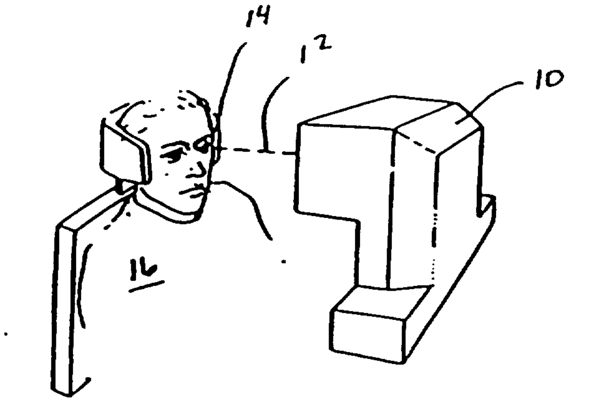


Fig. 1

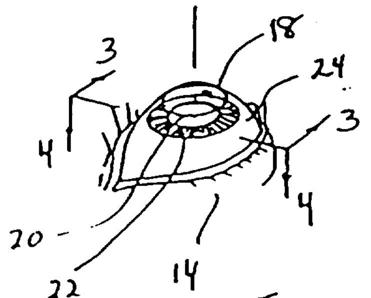


Fig. 2

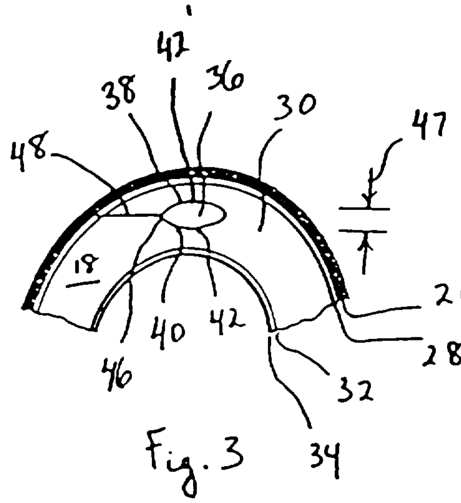


Fig. 3

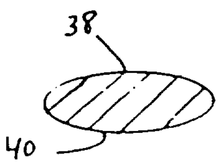


Fig. 3A

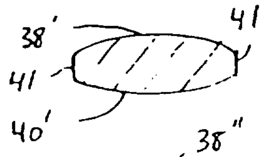


Fig. 3B

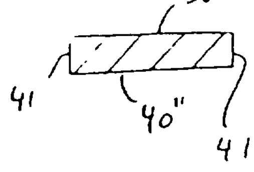


Fig. 3C

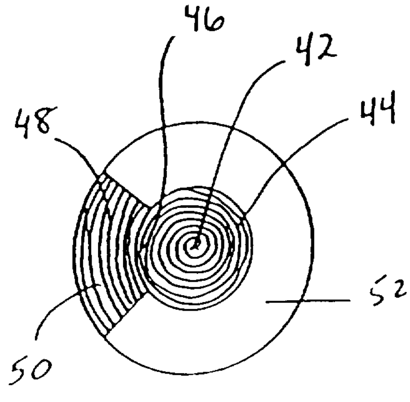


Fig. 4

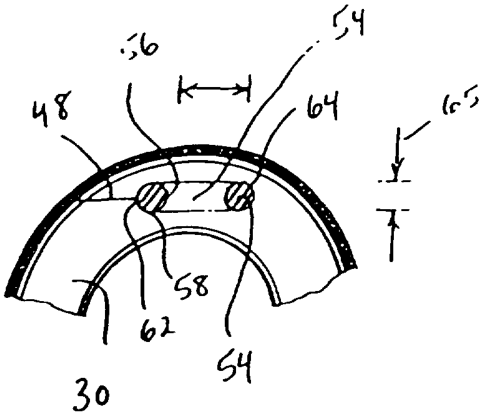


Fig.5

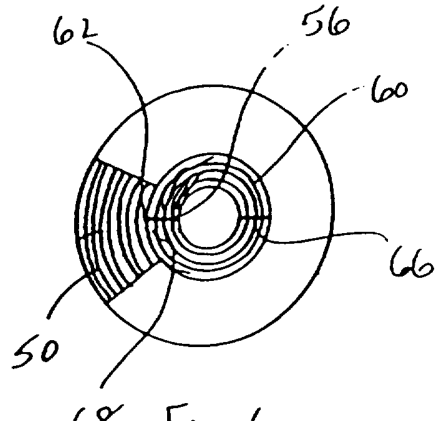


Fig.6

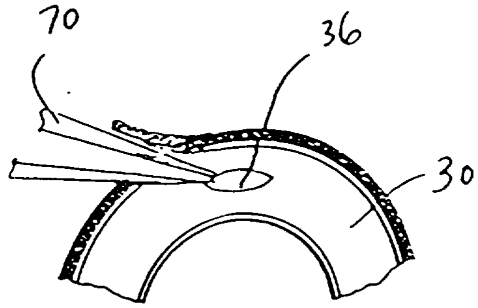


Fig.7

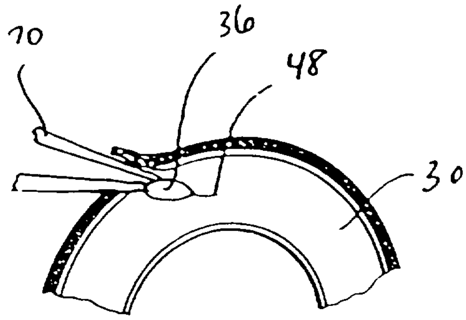


Fig.8

SUBSTITUTE SHEET (RULE 26)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/03582

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :A61N 5/02
US CL :606/2, 5, 10, 14
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
U.S. : 606/2, 3-18, 106, 107

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,907,586 (BILLE ET AL.) 13 March 1990, see the entire document.	1-18
Y	LAMELLAR CORNEAL STROMECTOMY, For the Operative Treatment of Myopia, (TADEUSZ KRWAWICA), Lublin, Poland, From the Eye Clinic, the Academy of Medicine, pp.828-833.	1-18

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be part of particular relevance

"E" earlier document 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	Date of mailing of the international search report
04 JUNE 1996	21 JUN 1996
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	Authorized officer DAVID SHAY
Facsimile No. (703) 305-3230	Telephone No. (703) 308-2215