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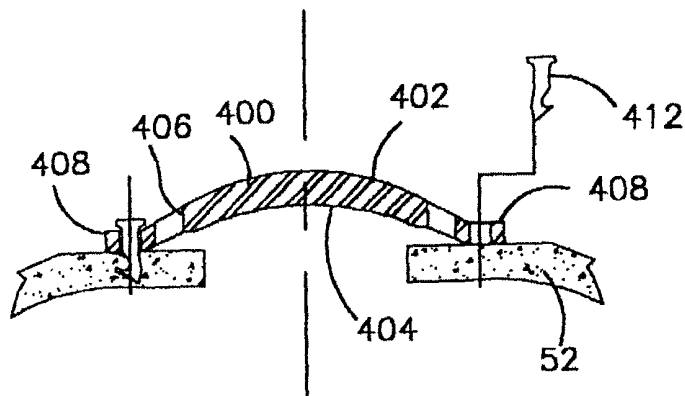
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(54) Title: REFRACTIVE INTRAOCULAR IMPLANT LENS AND METHOD



(57) Abstract: A refractive intraocular lens (104) and method of locating the lens within the eye and attaching the lens to the iris. The refractive intraocular lens (104) may be attached via a staple (230), a fastener (312), an anchor (412) or by the tip of the haptic (118).



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REFRACTIVE INTRAOCULAR IMPLANT LENS AND METHOD

FIELD OF THE INVENTION

This invention relates generally to the field of intraocular implant lenses and
5 more particularly, to intraocular implant lenses for use in refractive vision correction.

BACKGROUND OF THE INVENTION

It has long been a goal of ophthalmic surgeons to provide patients with
alternatives to eyeglasses. Witness the development of the contact lens, radial
10 keratotomy and lasik or laser vision correction surgery. It is estimated that in the
year 2000, over two million lasik procedures will be performed. Notwithstanding the
popularity of laser surgery, it is not without its drawbacks and deficiencies. For
example, recent data has shown that approximately 5-10% of the patients
undergoing laser refractive surgery will have suboptimal results such as, a final
15 vision correction which still requires some sort of optical correction or the patient will
experience cataract-like "halos". In addition, it has been estimated that up to 50%
of the patients post laser surgery experience dry eye symptoms on an ongoing
basis.

In response to the foregoing, ophthalmic surgeons have turned to intraocular
20 implant surgery in an effort to advance the art of refractive vision correction. For
example, United States patent number 5,192,319 to Worst discloses an intraocular
refractive lens which is surgically positioned in the anterior chamber and is used in
addition to the natural lens to correct for refraction error. The lens comprises an
optical portion (the optic) having an inner concave and an outer convex shape.

Attached to the outer periphery of the optic is one or more pairs of flexible pincer arms which are adapted to pinch a small portion of the anterior surface of the iris to maintain the implant in place. Notwithstanding the foregoing, the Worst lens has not been widely adopted. This is because the lens requires a hard, non-flexible material to fixate to the iris, thus requiring a large 6mm or more incision. In addition, the Worst lens is difficult to implant and requires a two handed ambidextrous surgical technique to insert and attach to the iris, skills, which are found in relatively few ophthalmologists.

Other anterior chamber implants have also been attempted without success. For example, United States patent number 4,575,374 to Anis discloses an anterior chamber lens comprising an optic and four haptics, each of which flexes independently of the others. United States patent number 4,166,293 also to Anis discloses an anterior chamber implant for cataract replacement having an optic and three loops that extend downward and are adapted to fit behind the iris. A fourth loop overlies on of the other loops and overlies the iris when the implant is in place within the eye. The implant is held in place by an attachment member, which connects the fourth loop with the underlying loop by penetrating through the iris. Another anterior chamber implantable lens is disclosed in United States patent number 4,177,526 to Kuppinger wherein a pair of opposing arms are attached to the optic. The respective arms are inserted behind the iris and pinch the rear of the iris to hold the implant in place. Another anterior chamber implant lens is disclosed in United States patent number 5,047,052 to Dubroff, which teaches an optic, and four haptics extend outwardly therefrom. The haptics are flexible and independently movable. Further, once the implant is inserted and positioned by conventional

means, the ends of the haptics are adapted to rest within the optical angle, i.e., the intersection of the cornea and the iris. It is notable that none of the foregoing implant lenses have been widely adopted and in fact only one of the lens (i.e., Worst Lens) is currently in limited use in the European market, as they all
5 experienced surgical or clinical failures including, lens insertion and attachment problems, intraocular or iris bleeding, inflammation, tissue deformation, potential lens induced glaucoma.

Accordingly, it is an object of the present invention to provide an improved refractive implant, which solves the aforementioned problems.

10 A further object of the present invention is to provide an improved refractive implant, which is minimally surgically invasive.

Another object of the present invention is to provide an improved refractive implant having reduced side-effects, for example dry eyes and inflammation.

An additional object of the present invention is to provide an improved
15 refractive implant, which is easily implantable and removable, if necessary.

A still further object of the present invention is to provide an improved refractive implant, which accurately corrects vision, thus obviating the need for subsequent surgeries.

A correlated object of the present invention is to provide an improved
20 refractive implant, which is easy to manufacture.

Yet another object of the present invention is to provide an improved refractive implant, which does not require expensive equipment, such as lasers.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided a refractive intraocular lens that is adapted to be implanted within the eye and which is supported by the iris. The lens is characterized by its ability to be easily inserted and removed with minimal trauma to the eye tissues. The lens comprises an optic for producing a preselected optical effect having an anterior side, a posterior side and an outer peripheral edge. The lens may be foldable or deformable. A haptic is connected to the optic and extends outwardly therefrom. The haptic includes a proximal end, a distal end and an intermediate segment positioned therebetween. The proximal end is connected to the optic and the intermediate segment projects downwardly and away from the posterior side of the optic and the distal end terminates in a pointed tip. The intermediate segment includes a shoulder for supporting the lens on the iris. The distal end of the haptic includes an iris fixation means for attaching the lens to the iris wherein the tip is constructed and arranged to penetrate the iris.

In a second embodiment of the invention, the refractive intraocular lens is attached to the iris by means of a staple, which is adapted to overlie and straddle a portion of the haptic. The staple is compressible from a first relaxed state to a second expanded state such that when the staple is expanded and placed in an overlying straddling relation to the haptic and is released, the staple contracts and attaches the iris, thereby fixing the position of the intraocular lens thereon. Additionally, the staple could be attached to the iris in the reverse manner from that which is described above.

In a third embodiment of the invention, at least one of the haptics includes

a hole defining an opening. A fastener is adapted to be received within the opening and to expandingly grip the iris tissue. More specifically, the fastener comprises a shaft having a top end and a bottom end. The bottom end includes includes a flexible barb and the top has a diameter that is greater than the diameter of the opening such that when the fastener is inserted in the opening, the barb is retracted and the fastener slides in the opening and when the barb exits the bottom of the opening, the iris is hooked and the barb becomes embedded therein, thus attaching the intraocular lens to the iris.

BRIEF DESCRIPTION OF THE DRAWINGS

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the following detailed description and appended claims, and upon reference to the accompanying drawings.

Figure 1 is a cross section of a human eye.

Figure 2 is a cross section of a human eye with an implant according to the present invention affixed to the iris.

Figure 3 is a perspective view of an implant lens according to the present invention.

Figure 4 is a plan view of an implant lens according to the present invention.

Figure 5 is an end view of an implant lens according to the present invention.

Figure 6 is an end view of an implant lens according to the present invention.

Figure 7 is a plan view of an implant lens according to the present invention and having a second arrangement of tips.

Figure 8 is an end view of an implant lens according to the present invention and having a second arrangement of tips.

Figure 9 is a plan view of a second embodiment of the implant lens according to the present invention.

5 Figure 10 is a sectional view taken along line A-A of the embodiment of the implant lens of figure 9.

Figure 11 is a plan view of the second embodiment of the implant lens according to the present invention and having a different haptic arrangement.

10 Figure 12 is a sectional view taken along line A-A of the embodiment of the implant lens of figure 11.

Figure 13 is a plan view of the second embodiment of the implant lens according to the present invention and having a third haptic arrangement.

Figure 14 is a sectional view taken along line A-A of the embodiment of the implant lens of figure 13.

15 Figure 15 is a plan view of a third embodiment of the implant lens according to the present invention.

Figure 16 is a sectional view taken along line A-A of figure 15 of the implant lens according to the present invention.

20 Figure 17 is a side view of the fastening means according to the present invention being pushed downward through the haptic and into the iris.

Figure 18 is a perspective view of the staple insertion tool according to the present invention.

Figure 19 is an exploded view of the staple insertion tool according to the present invention.

Figure 20 is a perspective view of a portion of the staple insertion tool according to the present invention.

Figure 21 is a perspective view of the trap lock and gripping fingers portion of the staple insertion tool according to the present invention.

5 Figure 22 is a side view of the gripping fingers portion of the staple insertion tool in the open staple releasing position.

Figure 23 is a side view of the gripping fingers portion of the staple insertion tool in the closed staple gripping position.

10 Figure 24 is a perspective view of the staple insertion tool according to the present invention in the closed staple gripping mode.

Figure 25 is a detailed perspective view, partially broken away, of the gripping portion of the tool as illustrated in figure 24.

Figure 26 is a perspective view of the staple insertion tool according to the present invention in the open staple releasing mode.

15 Figure 27 is a detailed perspective view, partially broken away, of the gripping portion of the tool as illustrated in figure 26

Figure 28 is a plan view of a forth embodiment of the implant lens according to the present invention.

20 Figure 29 is a sectional view taken along line A-A of figure 28 of the implant lens according to the present invention.

Figure 30 is a perspective view of the forth embodiment of the fastening means according to the present invention.

Figure 31 is a plan view of a fifth embodiment of the implant lens according to the present invention.

Figure 32 is a sectional view taken along line A-A of figure 31 of the implant lens according to the present invention.

Figure 33 is a perspective view of the fifth embodiment of the fastening means according to the present invention.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

While the present invention will be described more fully hereinafter with reference to the accompanying drawings, in which particular embodiments are shown, it is to be understood at the outset that persons skilled in the art may modify the invention herein described while still achieving the favorable results of this invention. Accordingly, the description which follows is to be understood as a broad teaching disclosure directed to persons of skill in the appropriate arts and not as limiting upon the present invention.

15 Referring now to the drawings and particularly to figure 1 in which a human eye is schematically illustrated. The structures of the eye include the cornea 50, iris 52, sclera 54, vitreous 56, anterior chamber 58, chamber angle 60, trabecular meshwork 62, posterior chamber 64 and human crystalline lens 66. While the description makes specific reference to the human eye, it will be understood that the invention may be applied to various animals with only minor modifications. For example, mammals such as dogs, cats and horses and the like may suffer injuries when their eyesight deteriorates with age and vision correction surgery as contemplated by this invention may prevent injury and thus extend their useful life.

20

Turning now to figures 2 through 8, a first embodiment of the invention is

there illustrated. The intraocular lens generally indicated at 100 is adapted to be implanted within the eye and includes an optical means or optic 102 and a single or a plurality of haptic means or haptics 110. The optic is generally circular and has an anterior side 104, a posterior side 106 and an outer peripheral edge 108. The diameter of the optic 102 is in the range of approximately 5 mm to 6 mm. In addition, the optic 102 will have varying anterior and posterior curvatures, depending on whether myopia or hyperopia is being corrected. Further curvature variations are added for the correction of cylinder (Astigmatism), presbyopia, bifocal or multi-focal. The characteristics of the particular optic 102 selected are left to the surgical judgement of the ophthalmologist performing the implant procedure. In addition, the optic 102 and the haptics 110 must be made of a material, which is biologically inert and the optic 102 must additionally be made of a material, which satisfies the necessary optical and surgical insertion requirements. The term "biologically inert" is generally understood in the art to be a material which is not absorbed by the body fluids and which does not cause any adverse reaction when implanted. Commonly used materials alone or in combination for intraocular lenses are silicone, acrylic, collagen, hydrogel and polymethylmethacrylate. Other suitable materials may include ophthalmic glass, quartz and other polymeric materials.

A single or a plurality of haptics 110 are connected to the optic 100. The haptics extend outward from the optic and are spaced apart from each other. Each of haptics 110 include a proximal end 112 which is connected to the outer peripheral edge 108 of the optic, an intermediate segment 114, and a distal end 116. The haptics also include a riser means or riser for maintaining the optic in spaced relation from the iris. In the illustrated embodiment, the intermediate

segment 114 includes the riser and it projects downwardly and away from the posterior side of the optic 102 in order to "vault" or provide spacing between the underside of the implant and the surface of the iris. In addition, the intermediate segment 114 includes a shoulder 115 which is adapted to support the implant 100 on the surface of the iris 52. The distal end 116 has at its terminating end, an iris fixation means for attaching the intraocular lens to the iris in the form of a pointed tip 118 which is adapted to penetrate the iris. In the preferred embodiment, penetration is a portion of, but less than the entire iris, and in the preferred embodiment is approximately one half the thickness of the iris. The amount of penetration will vary with the mass of the implant, the number and structure of haptics and other factors. It will be noted that the haptics are of sufficient length so as to avoid interfering with the muscles that control the opening and closing of the pupil. Alternatively, the staple may be designed such that it pinches, but does not necessarily penetrate the iris, thereby attaching the intraocular lens. With respect to the embodiment illustrated in figures 2 through 6, four haptics are shown. They are divided into two pairs, each of which extends outwardly and away from the optic at opposite ends thereof. In addition, the respective pointed tips 118 of each pair face inwardly towards each other. The embodiment as shown in figures 7-8 is essentially identical as that just discussed, however the respective pointed tips 118 are in opposing relation or facing outwardly. Either arrangement will adequately anchor the implant 100 on the iris.

In operation, an incision on the order of 4.0 mm is made in the cornea or sclera by the ophthalmic surgeon. Using forceps or intraocular lens insertion instruments, the implant 100 may be folded, deformed or rolled to reduce the overall

insertion size, inserted into the eye and centered over the pupillary opening. Each of the haptics is then manipulated such that the tips penetrate the iris. It will be noted that the respective intermediate segments 114 of the haptics 110 include a shoulder portion, which rests on the iris and limits the depth to which the tips 118 can penetrate.

A second embodiment of the invention is illustrated in figures 9 through 14 wherein an optical implant 200 is adapted to be implanted within the eye and to be attached to the iris. The implant comprises an optical means or optic 202 for producing a preselected optical effect. The optic 202 has an anterior side 204, a posterior side 206 and an outer peripheral edge 208. A single or plurality of haptic means or haptics 210 are connected to the optic 202. A staple means or staple 230 is adapted to straddle a portion of said haptic 210. The staple 230 is adapted to be manipulated from a relaxed state to a tensioned state whereupon it is released and attaches to the iris. In the illustrated embodiment, the staple in the relaxed state is expanded. It is then compressed (with an insertion tool discussed hereinbelow), placed in overlying straddling relation to the respective haptic(s), and upon release, expands to substantially return to its original state, thereby fixing the position of the optical implant thereon. It will be noted that the tensioned and relaxed states could be reversed with equal efficacy. As with the embodiment shown in figures 9-14, the staple is dimensioned such that it penetrates a portion of, but less than the entire iris, preferably, approximately one-half the thickness of the iris. The reader will appreciate that the dimensions and degree of iris penetration will vary with the particular type of optical implant used. For example; in figures 9 and 10, optical implants having a pair of vaulted loop-type haptics

located on opposite sides of the optic is shown with staples. In figures 11-12 an optical implant having four vaulted loop-type haptics is shown with staples. Further, the haptics are configured such that the optic is in spaced relation from the iris. In figures 13-14 an optical implant with flexible curved haptics is shown with staples
5 230. In this embodiment, the staple(s) could be located such that the intraocular lens expands and contracts with the dilation of the iris sphincter muscle.

The staples 230 employed in the above-noted embodiment are inserted using an insertion instrument generally indicated at 240 as illustrated in figures 18 through 27. It will be noted that prior to insertion, the staple must be transported by
10 the surgeon within the eye, and further, that once within the eye, is not susceptible to adjustment. Thus, the instrument, which is described in detail hereinbelow, is designed with safety features such that it is difficult to accidentally release the staple and further, once released, the staple automatically contracts and grippingly attaches to the iris. With the foregoing in mind, the instrument comprises a pair of
15 manipulating rods or handles 242 having respective finger loops 244 at one end which assist the surgeon in one-handed operation during insertion of the instrument tip into the eye. The opposite ends of the respective handles divide into a U shaped bracket, which supports a block 246. In the center of the block 246 is a hole defining an opening 248. A finger 250 depends downward and inward and
20 terminates in a gripping tab 252. Also provided is a locking plate 254 which includes a U-shaped block having an elongate bore 256 therein which allows it to be placed in alignment with the other blocks 246 when pivot pin 258 is aligned therein. A rectangular plate 260 is attached to the underside of the block as best shown in figure 19. The plate 260 establishes the limit of vertical travel staple 230

in the instrument.

In operation, the instrument handles are spread apart to spread the fingers 250 and locking plates 254. The staple 230 is then inserted such that the arched mid-section abuts plate 260 and the legs are situated between opposing pairs of gripping tabs 252. The handles are then moved together which causes the staple to be caught between locking plate 254, gripping tabs 252 and plate 260. Continued pressure causes the staples opening to become expanded. The instrument is then inserted in the eye such that the staples overlies in straddling relation the haptic. The manipulating rods are then moved apart from each other which causes the locking plate 254 to move outward, which in turn permits the staple 230 to slide out from between the gripping fingers and to contract into the iris.

A third embodiment of the invention is illustrated in figures 15 through 17. In that embodiment an optical means or implant 300 for producing a preselected optical effect on light entering the eye and adapted to be implanted in overlying relation to the iris 52 is employed. The implant 300 includes an anterior side 302 and a posterior side 304 and an outer peripheral edge 306. A single or plurality of haptic means or haptics 308 are connected to the implant 300 such that at least one includes a hole defining an opening 310. A fastening means 312 for fixing the position of the intraocular lens on the iris is provided.

The fastening means or fastener 312 is adapted to be inserted within the opening 310 and to expandingly grip the iris tissue. More specifically, the fastening means 312 comprises a shaft having a top end 314 and a bottom end 316. Located at the bottom end 316 is a flexible barb 318 and the top end 314 has a diameter that is greater than the diameter of opening 310. As illustrated in figure 17, the

barbs are arranged to point outwardly when relaxed.

In operation, the implant 300 is centered over the iris. Then fastener 312 is gripped with forceps (not shown) such that the barbs 318 are compressed. The fastener 312 is then guided into the opening 310 and downward pressure is then gently exerted to push the staple 312 through opening 310. As the barbs exit the opening on the anterior side 304, they contact the iris tissue and begin to expand. When the top end 314 contacts the upper surface of the haptic 308, the barbs penetrate the iris (approximately one-half of the thickness of the iris in the illustrated embodiment) and the position of the implant 300 is fixed in the eye. The foregoing procedure is repeated for each haptic and the number of fasteners employed will depend on the geometry of the specific implant 300 chosen by the surgeon.

A fourth embodiment of the invention is illustrated in figures 28 through 30. In that embodiment an optical means or implant 400 for producing a preselected optical effect on light entering the eye and adapted to be implanted in overlying relation to the iris 52 is employed. The implant 400 includes an anterior side 402, a posterior side 404 and an outer peripheral edge 406. A single or plurality of haptic means or haptics 408 are connected to the implant 400 such that at least one includes a hole defining an opening 410. A fastening means or fastener 412 for fixing the position of the intraocular lens on the iris is provided. The fastener 412 comprises a shaft 413 having a top end 414 and an iris fixation end or bottom end 416. The bottom end terminates in an edge 415. Located proximate the edge 415 is a cutout portion which forms a flexible hook or barb 418. The top end 414 has a diameter that is greater than the diameter of opening 410. It will be noted that the opening 410 in the haptic is circular and shaft 413 is rectangular. Also, while not

illustrated, the fastener 412 may be molded to be integral with the haptic 408 and to extend downwardly therefrom. Alternatively, the fastener 412 may be fabricated as a separate unit and press fit within opening 410 so that it slides therein so that the entire intraocular lens/fastener can be inserted within the eye in a single motion.

5 In operation, the implant 400 is centered over the iris. Then the fastener 412 is gripped with forceps (not shown) and is guided into opening 410 and downward pressure is then gently exerted to push the edge into the iris. Continued downward pressure engages the barb such that it becomes barbingly embedded within the iris thereby anchoring the intraocular lens on the iris. The foregoing procedure is
10 repeated for each haptic and the number of fasteners employed will, of course, depend on the geometry of the specific implant chosen by the surgeon. In a related embodiment, shown in figures 31 through 33, the fastener 512, rather than being linear, is U-shaped as best illustrated in figure 33. The fastener 512 has a top end 514 which is adapted to be inserted within opening 510 of the haptic 508 on
15 intraocular lens 500. The bottom end terminates in an edge 515. Located proximate the edge 515 is a cutout portion which forms a flexible hook or barb 518. Attachment is substantially similar to the embodiment shown in figures 28-30, but differing in that the fastener straddles the haptic.

20 The present invention, of course may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention. The present invention is therefor, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and range of the appended claims are intended to be embraced therein.

THAT WHICH IS CLAIMED IS:

1. An intraocular lens adapted to be inserted and fixated in the eye, the intraocular lens being characterized by its ability to be easily inserted and removed with minimal trauma to the eye tissues, and comprising:

5 an optical means for producing a preselected optical effect, said optical means having an anterior side, a posterior side and an outer peripheral edge;

a haptic means connected to said optical means, said haptic means extending outward from said optical means and including a fixation means being adapted to penetrate at least a portion of, but less than the entire thickness of the iris;

10

whereby the intraocular lens may be easily implanted in the eye upon penetration of the fixation means into the iris.

2. An intraocular lens according to claim 1 further including a plurality of flexible haptic means connected to said optical means, said haptic means extending outward from said optical means and being spaced apart from each other, and wherein at least one of said haptic means includes a proximal end and a distal end, said proximal end being connected to said optical means, said distal end terminating in a pointed tip and further wherein said haptic means includes a riser means for maintaining said optical means in spaced relation from the iris;

15

20

whereby the intraocular lens may be easily implanted in the eye upon penetration of the haptic means tip into the iris.

3. An intraocular lens according to claim 2 wherein said haptic means includes an intermediate segment positioned between the proximal end and the distal end and wherein the intermediate segment includes a shoulder means for supporting the intraocular lens on the iris.

5

4. The intraocular lens according to claim 1 wherein said iris fixation means is constructed and arranged to penetrate about one half the thickness of the iris.

10

5. The intraocular lens according to claim 1 further including two pairs of haptic means extending oppositely from said optical means and wherein said respective distal ends of each pair extend inwardly in a facing relation.

15

6. The intraocular lens according to claim 1 further including two pairs of haptic means extending oppositely from said optical means and wherein the respective distal ends of each pair extend outwardly away from each other.

20

7. The intraocular lens according to claim 1 wherein the optical means is foldable,
whereby the intraocular lens may be inserted with small incision techniques which, cause less trauma to the eye tissues.

8. An intraocular lens adapted to be implanted within the eye and to be attached to the iris, the intraocular lens characterized by its ability to be easily inserted and removed with minimal trauma to the eye tissues, and comprising in combination:

5 an optical means for producing a preselected optical effect, said optical means having an anterior side, a posterior side and an outer peripheral edge;
 at least one haptic means connected to said optical means; and
 a staple means adapted to overly and straddle a portion of said haptic means; whereby the intraocular lens may be easily implanted in the eye upon
10 attachment of the staple means onto the iris.

9. An intraocular lens according to claim 8 wherein said staple means is adapted to be deformed from a first relaxed state to a second tensioned state;
 whereby when the staple is tensioned and placed in an overlying straddling
15 relation to said haptic and is released, the staple means relaxes and attaches to the iris and fixes the position of the intraocular lens thereon.

10. The intraocular lens according to claim 9 wherein the staple is compressed into a tensioned state, placed over the haptic and released,
20 whereby the staple expands, attaches to the iris and fixes the position of the intraocular lens thereon.

11. The intraocular lens according to claim 9 wherein the staple means penetrates approximately one-half the thickness of the iris.

12. The intraocular lens according to claim 8 further including a pair of opposing haptics extending outwardly from the optic.

5 13. The intraocular lens according to claim 9 wherein said haptic means includes a riser means for holding the optic in spaced relation from the iris.

14. The intraocular lens according to claim 9 wherein the optical means is foldable,
whereby the intraocular lens may be inserted with small incision techniques
10 which, cause less trauma to the eye tissues.

15 15. An intraocular lens adapted to be implanted within the eye and to be supported by the iris, the intraocular lens characterized by its ability to be easily inserted and removed with minimal trauma to the eye tissues, and comprising in combination:

an optical means for producing a preselected optical effect, said optical means having an anterior side, a posterior side and an outer peripheral edge;

a haptic means connected to said optical means and wherein said haptic means includes holes defining openings; and

20 a fastening means for fixing the position of the intraocular lens on the iris, said fastening means being adapted to be inserted within said openings and to expandingly grip the iris tissue.

16. The intraocular lens according to claim 15 wherein said fastening means comprises a shaft having a top end and a bottom end, said bottom end including a flexible barb and the top end having a diameter greater than the diameter of the opening,

5 whereby when the fastening means is inserted in the opening, the barb is retracted such that the fastening means slides in said opening and when the barb exits the opening it hooks the iris tissue and becomes embedded therein, thus attaching the intraocular lens to the iris.

10 17. The intraocular lens according to claim 16 wherein the fastening means further includes a pair of opposing barbs;

whereby when the fastening means is inserted in the opening, the barb is retracted such that the fastening means slides in said opening and when the fastening means is pushed down into said opening the barbs exit the opposite end and expand to hook the iris tissue and becomes embedded therein, thus attaching
15 the intraocular lens to the iris.

18. The intraocular lens according to claim 15 wherein said optic is foldable.

20 19, A method of locating on the iris an intraocular lens , the intraocular lens being characterized by its ability to be easily inserted and removed with minimal trauma to the eye tissues, and comprising the steps of:

locating an intraocular lens over the iris, the intraocular lens having an anterior side, a posterior side and an outer peripheral edge and a flexible haptic

connected to and optic, and wherein the haptic extends outward from the optic, and further wherein the haptic includes a proximal end, a distal end and an intermediate segment positioned therebetween, the proximal end being connected to the optic and projecting downwardly and away from the posterior side of the optic and wherein the distal end terminates in a pointed tip; and

manipulating the pointed tip such that it penetrates the iris;

whereby the intraocular lens may be easily implanted in the eye upon penetration of the haptic tip into the iris.

20. The method according to claim 19 wherein the haptic includes a riser for supporting the intraocular lens on the iris.

21. The method according to claim 19 wherein the pointed tip is constructed and arranged to penetrate at least a portion of, but less than the entire thickness of the iris.

22. The method according to claim 19 further including two pairs of haptics connected to the optic, each pair extending from opposite sides of the optic and wherein the respective distal ends of each pair extend inwardly in a facing relation.

23. The method according to claim 19 further including two pairs of haptics extending from opposite sides of the optic and wherein the respective distal ends of each pair extend outwardly away from each other.

24. The method according to claim 19 further including the step of folding the intraocular lens prior to inserting it within the eye.

25. A method of locating on the iris an intraocular lens, the intraocular lens being characterized by its ability to be easily inserted and removed with minimal trauma to the eye tissues, and comprising the steps of:

locating an intraocular lens over the iris, the intraocular lens having an optic for producing a preselected optical effect, the optic having an anterior side, a posterior side and an outer peripheral edge; a plurality of haptics being connected to said optic; and

inserting a staple into the iris such that the staple overlies and straddles a portion of the haptic;

whereby the intraocular lens may be easily implanted in the eye upon attachment of the staple onto the iris.

26. The method according to claim 25 wherein the staple is compressible from a first relaxed state to a second tensioned state;

whereby when the staple is tensioned and placed in an overlying straddling relation to said haptic and is relaxed, the staple attaches to the iris and fixes the position of the intraocular lens thereon.

27. The method according to claim 26 wherein the staple penetrates approximately one-half the thickness of the iris.

28. The method according to claim 25 wherein the intraocular lens further includes a pair of opposing haptics extending outwardly from the optic.

5 29. The method according to claim 25 further including the step of folding the intraocular lens prior to insertion within the eye.

30. A method of locating on the iris an intraocular lens , the intraocular lens being characterized by its ability to be easily inserted and removed with minimal trauma to the eye tissues, and comprising the steps of:

10 locating an optic on the iris, the optic having an anterior side, a posterior side and an outer peripheral edge; a plurality of haptics connected to the optic and wherein at least one of the haptics includes a hole defining an opening; and
inserting a fastener within the opening for fixing the position of the intraocular lens on the iris, such that the fastener expands as it exits the opening and
15 expandingly grips the iris tissue.

31. The method according to claim 30 wherein the fastener comprises a shaft having a top end and a bottom end, said bottom end including a flexible barb and the top end having a diameter greater than the diameter of the opening,

20 whereby when the fastener is inserted in the opening, the barb is retracted such that the fastener slides in the opening and when the barb exits the opening it hooks the iris tissue and becomes embedded therein, thus attaching the intraocular lens to the iris.

32. The method according to claim 31 wherein the fastener further includes a pair of opposing barbs;

whereby when the fastener is inserted in the opening, the barb is retracted such that the fastener slides in said opening and when the fastener is pushed down into said opening the barbs exit the opposite end and expand to hook the iris tissue and becomes embedded therein, thus attaching the intraocular lens to the iris.

33. The method according to claim 30 further including the step of folding the intraocular lens prior to insertion within the eye.

34. An instrument adapted to hold an iris fixation device and to release it at a preselected location, the instrument characterized by its ability to be used in conjunction with a single handed surgical technique, and comprising:

a handle means for gripping the instrument;

a means adapted to hold the iris fixation device it upon demand,

whereby the iris fixation device will be attached to the iris.

35. An intraocular lens adapted to be implanted within the eye and to be supported by the iris, the intraocular lens characterized by its ability to be easily inserted and removed with minimal trauma to the eye tissues, and comprising in combination:

an optical means for producing a preselected optical effect, said optical means having an anterior side, a posterior side and an outer peripheral edge;

a haptic means connected to said optical means; and

a fastening means for fixing the position of the intraocular lens on the iris, said fastening means being adapted to cooperate with said haptic means and to barbingly grip the iris tissue.

5 36. The intraocular lens according to claim 35 wherein said haptic means includes an opening and wherein said fastening means is adapted to be inserted within said opening.

10 37. The intraocular lens according to claim 36 wherein said fastening means comprises a shaft having a top end and a bottom end, said bottom end including a barb and the top end having a diameter greater than the diameter of the opening,

15 whereby when the fastening means is inserted and is lowered into the opening, the barb pierces the iris tissue and becomes embedded therein, thereby anchoring the intraocular lens to the iris.

20 38. The intraocular lens according to claim 36 wherein said fastening means comprises a shaft having a top end and a bottom end, said bottom end including a barb and the top end being curvilinear and being adapted to be inserted within said opening,

 whereby when the fastening means is inserted into the opening, the barb pierces the iris tissue and becomes embedded therein, thereby anchoring the intraocular lens to the iris.

39. A method of locating on the iris an intraocular lens, the intraocular lens being characterized by its ability to be easily inserted and removed with minimal trauma to the eye tissues, and comprising the steps of:

5 locating an optic on the iris, the optic having an anterior side, a posterior side and an outer peripheral edge; a haptic connected to the optic and wherein said haptic includes a hole defining an opening; and

10 inserting a fastener within the opening for fixing the position of the intraocular lens on the iris, such that the fastener barbingly grips the iris tissue as it is pushed into the iris.

40. The method according to claim 30 wherein the fastener comprises a shaft having a top end and a bottom end, said bottom end including a barb and the top end being adapted to be supported within the opening,

15 whereby when the fastener is inserted in the opening, the barb it hooks the iris tissue and becomes embedded therein, thus anchoring the intraocular lens to the iris.

41. A fastener adapted to cooperate with the haptic of an intraocular lens to fix the position of the intraocular lens on the iris of an eye and comprising:

20 a shaft having a top end and a bottom end, the top end adapted to be connected to the haptic and the bottom end terminating in an iris fixation end and wherein said iris fixation end terminates in an edge and includes a cutout portion proximate said edge and defines an elongate barb edge,

whereby when the elongate barb edge is pushed into the iris, the intraocular

lens is anchored thereon.

42. The fastener according to claim 40 wherein the haptic includes an opening and wherein the fastener is adapted to cooperate with the opening, thereby anchoring the haptic to the iris.

5

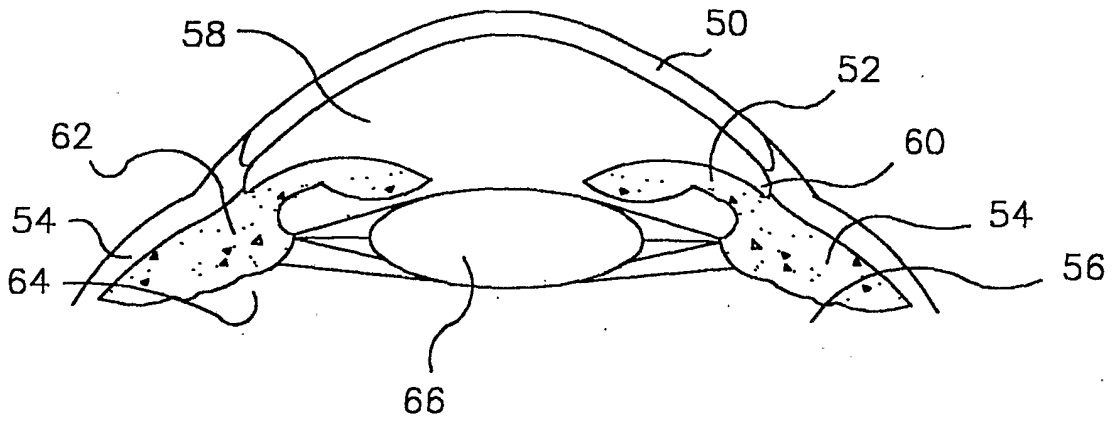


FIG. 1

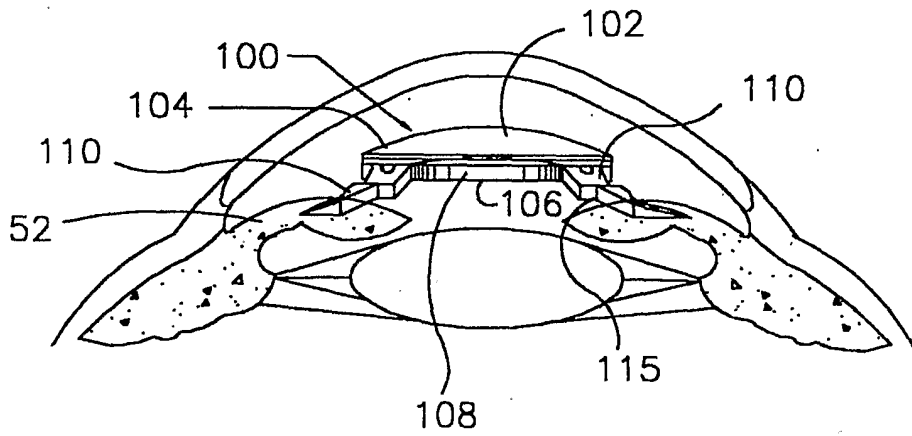


FIG. 2

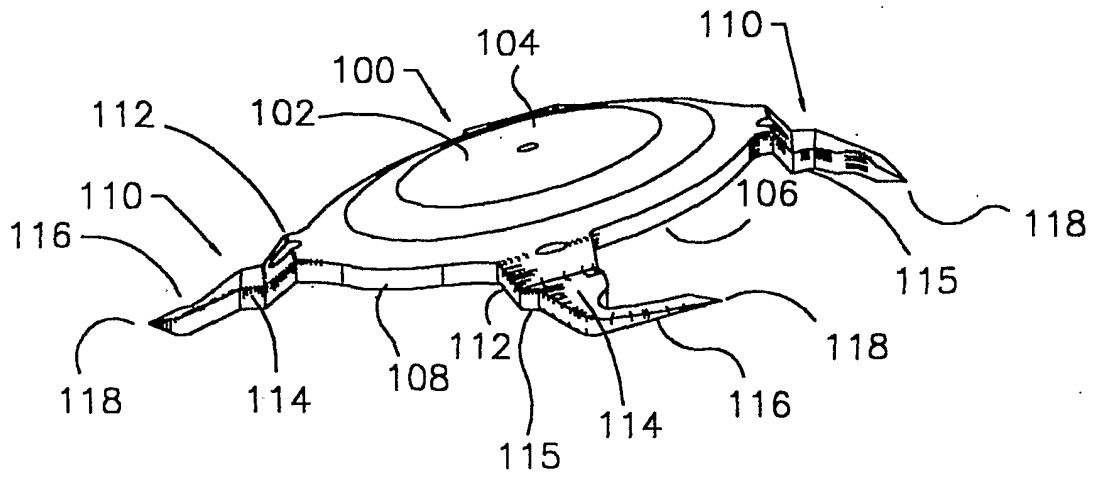


FIG. 3

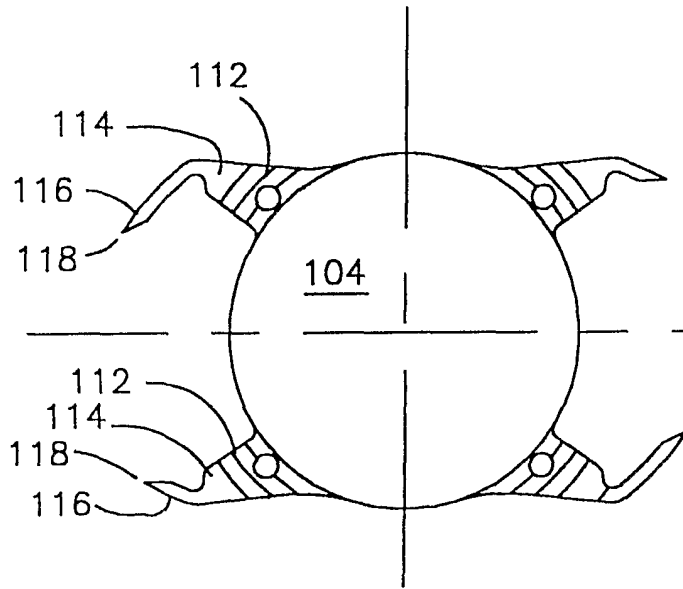


FIG. 4

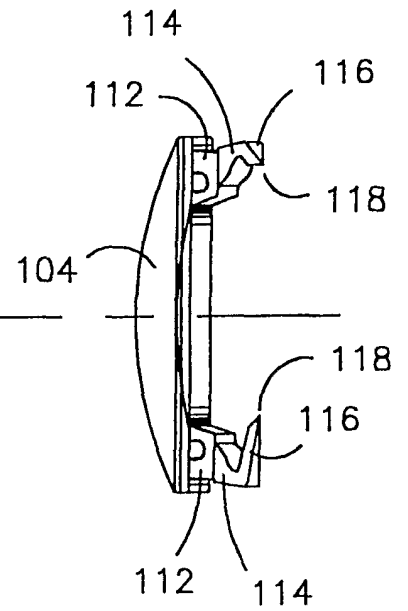


FIG. 6

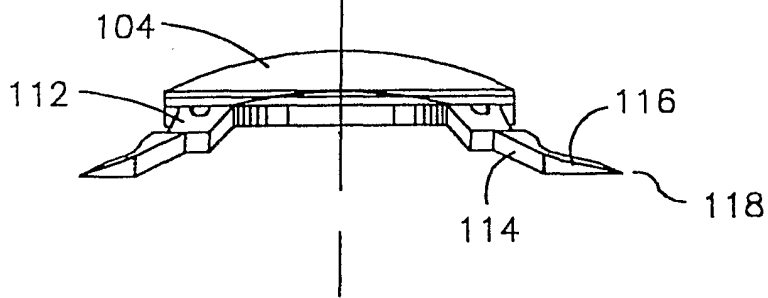


FIG. 5

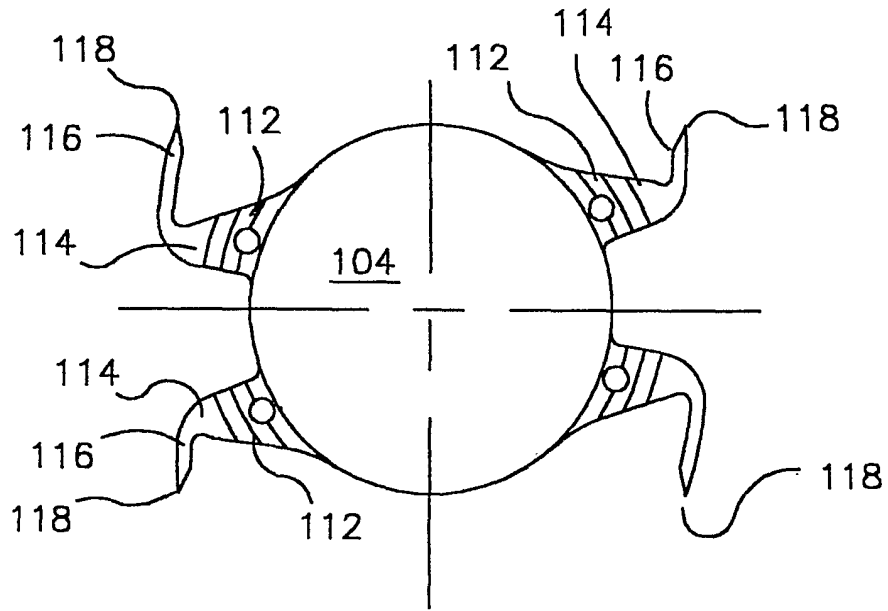


FIG. 7

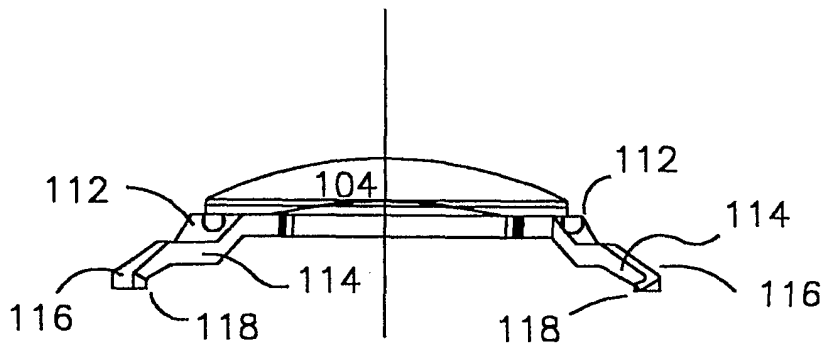


FIG. 8

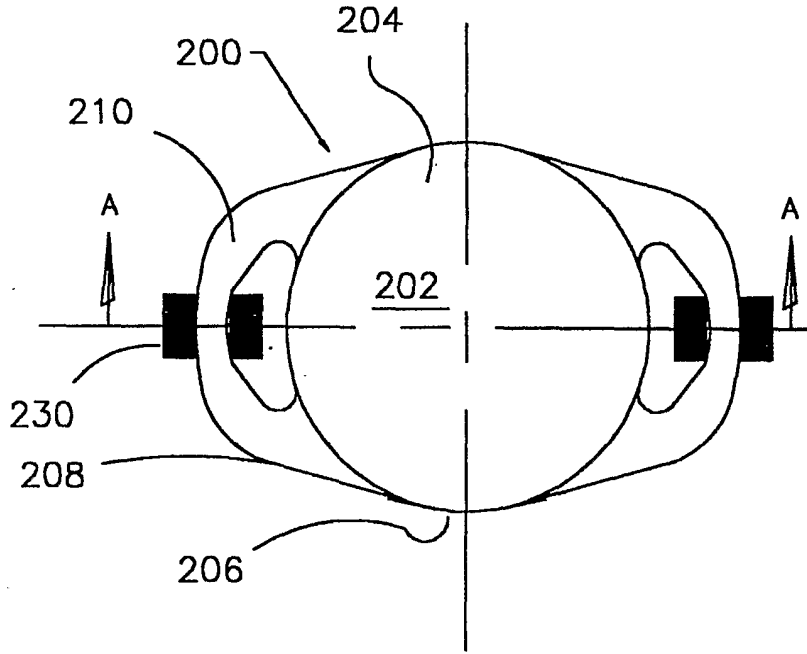


FIG. 9

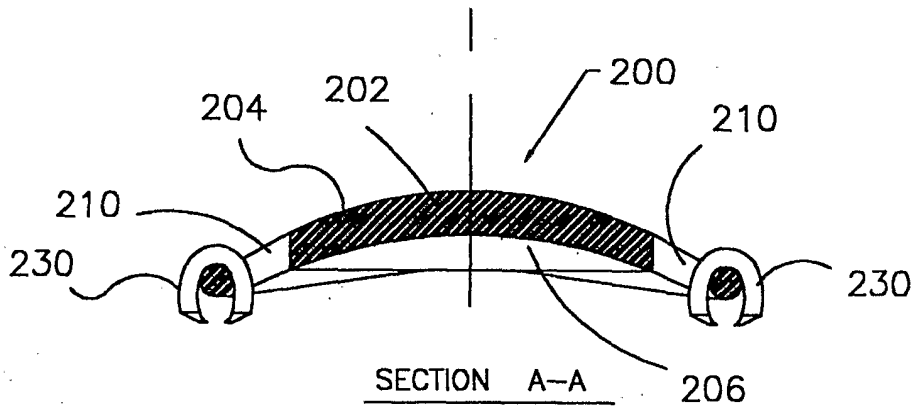


FIG. 10

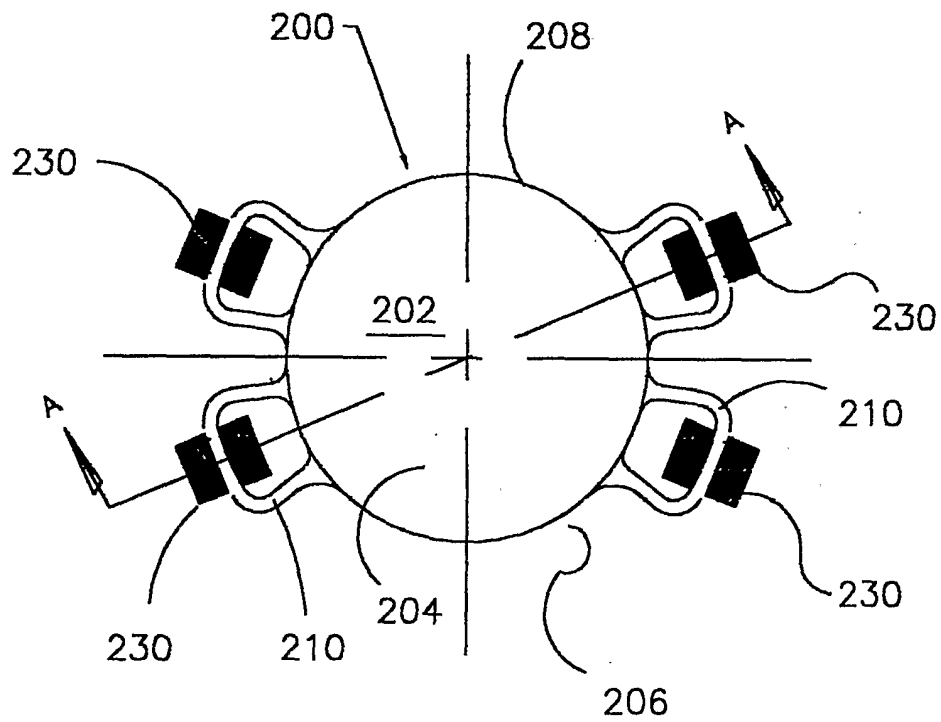


FIG. 11

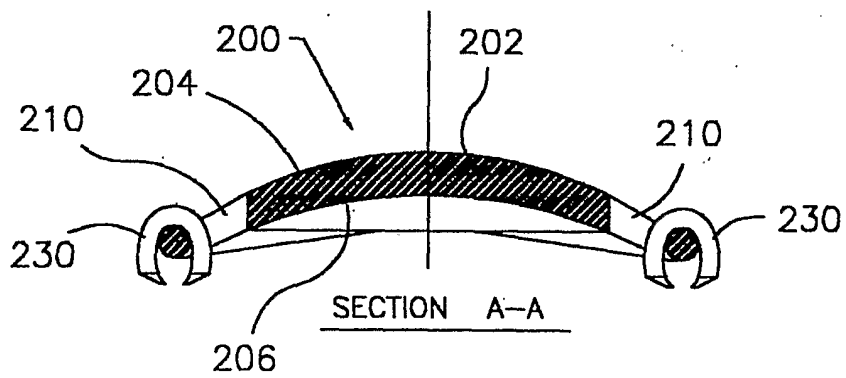


FIG. 12

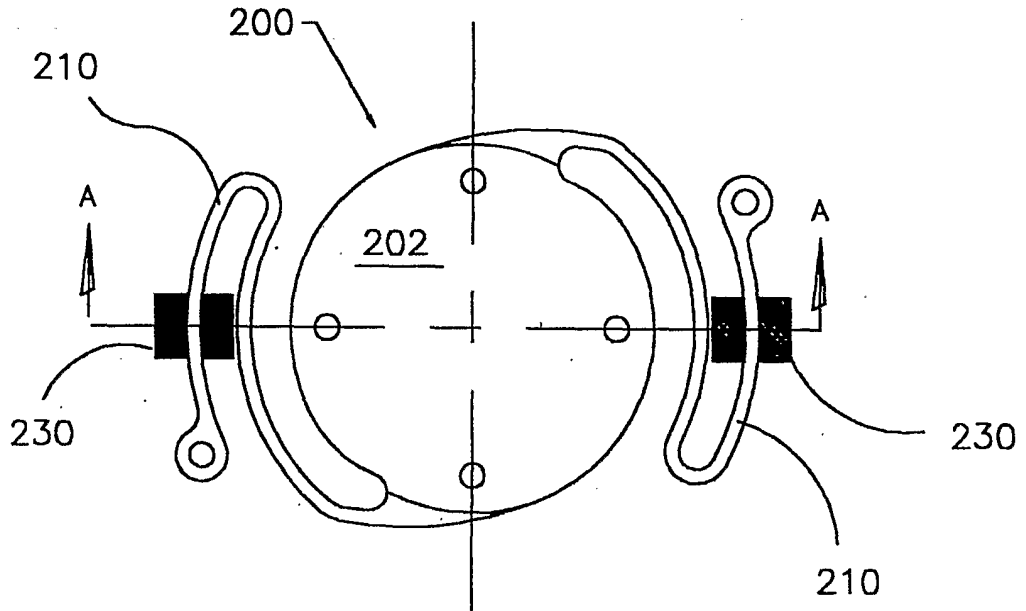


FIG. 13

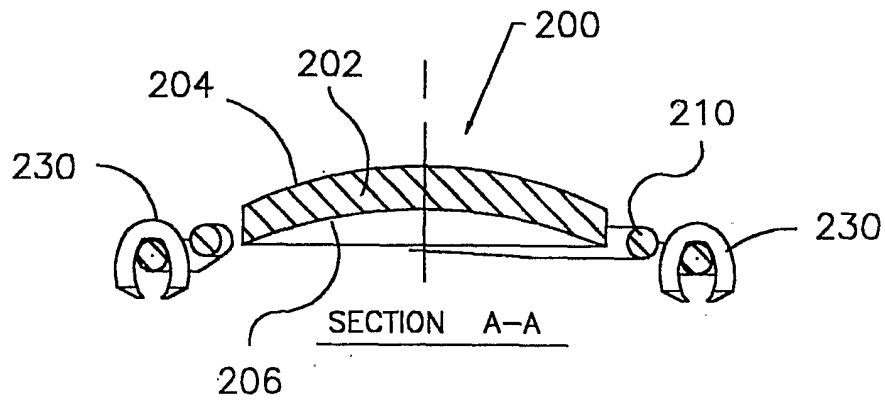


FIG. 14

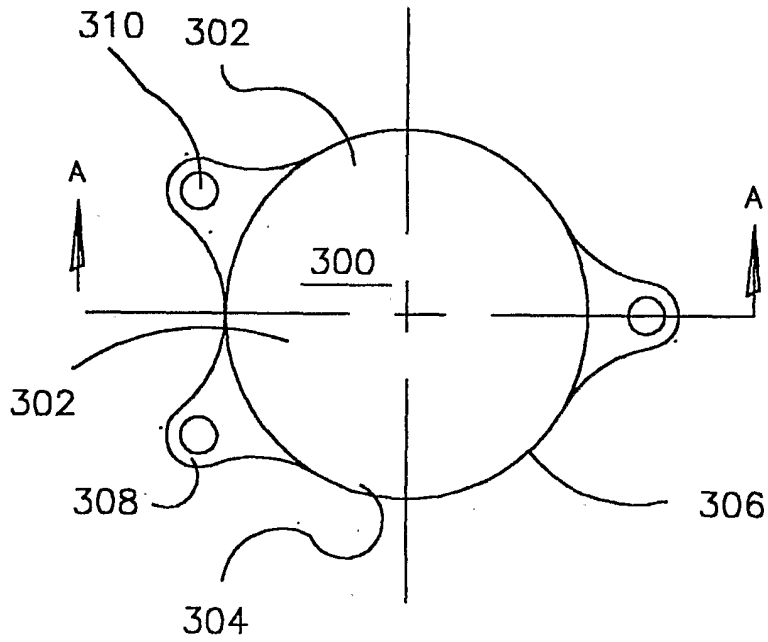


FIG. 15

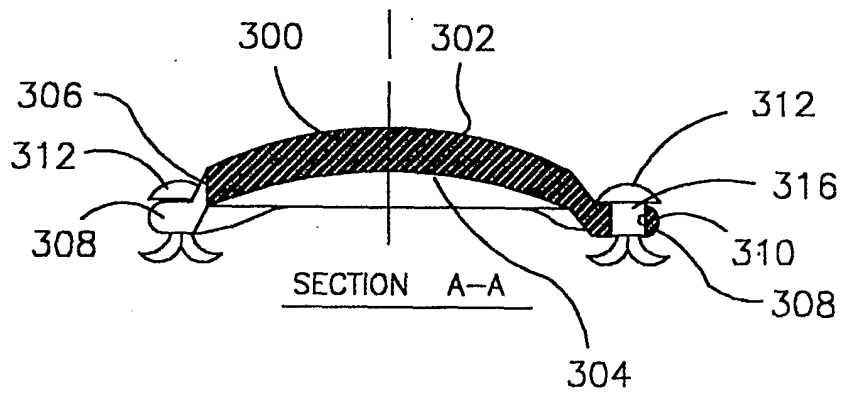


FIG. 16

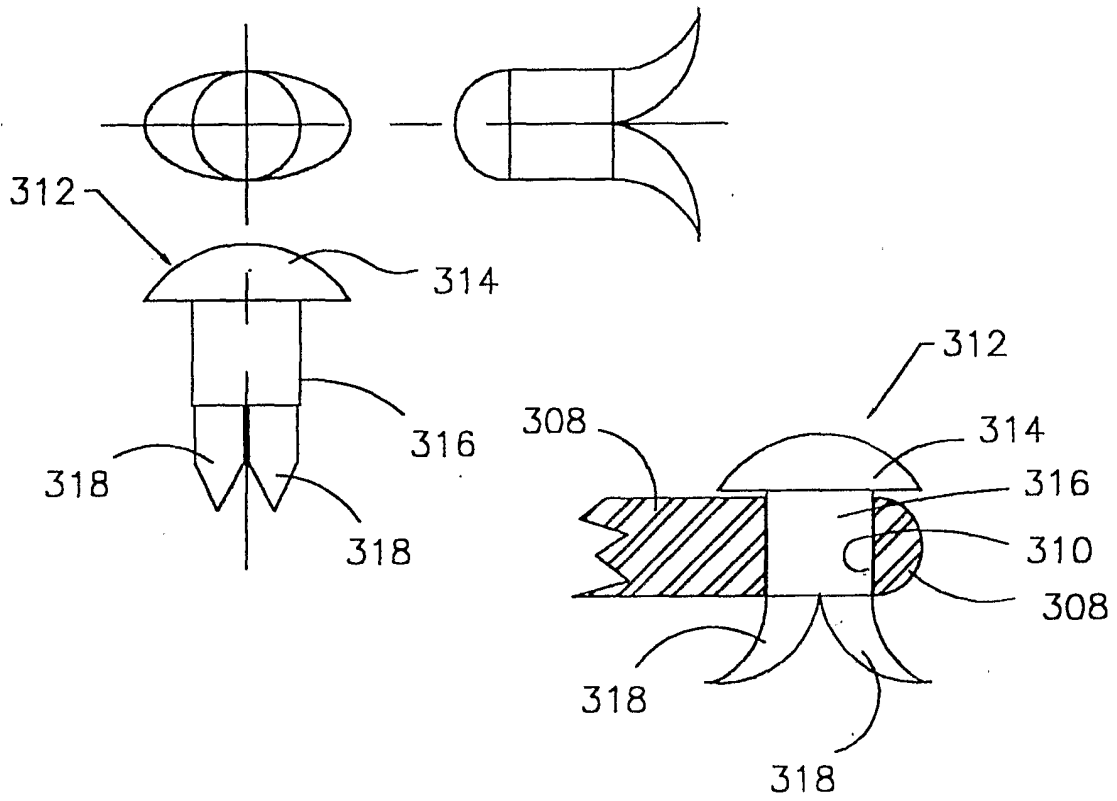


FIG.17

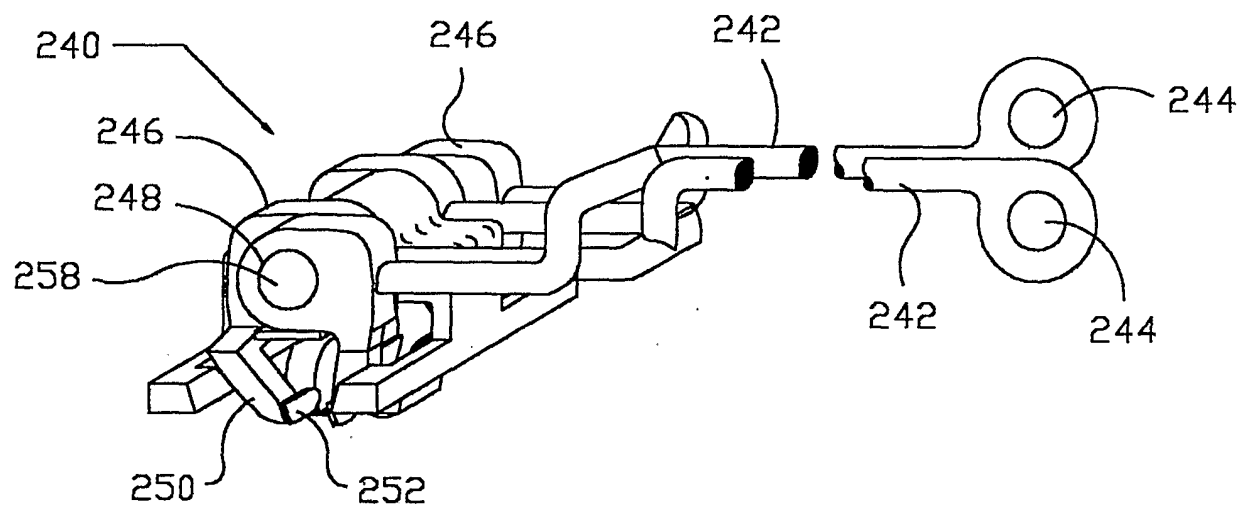


FIG. 18

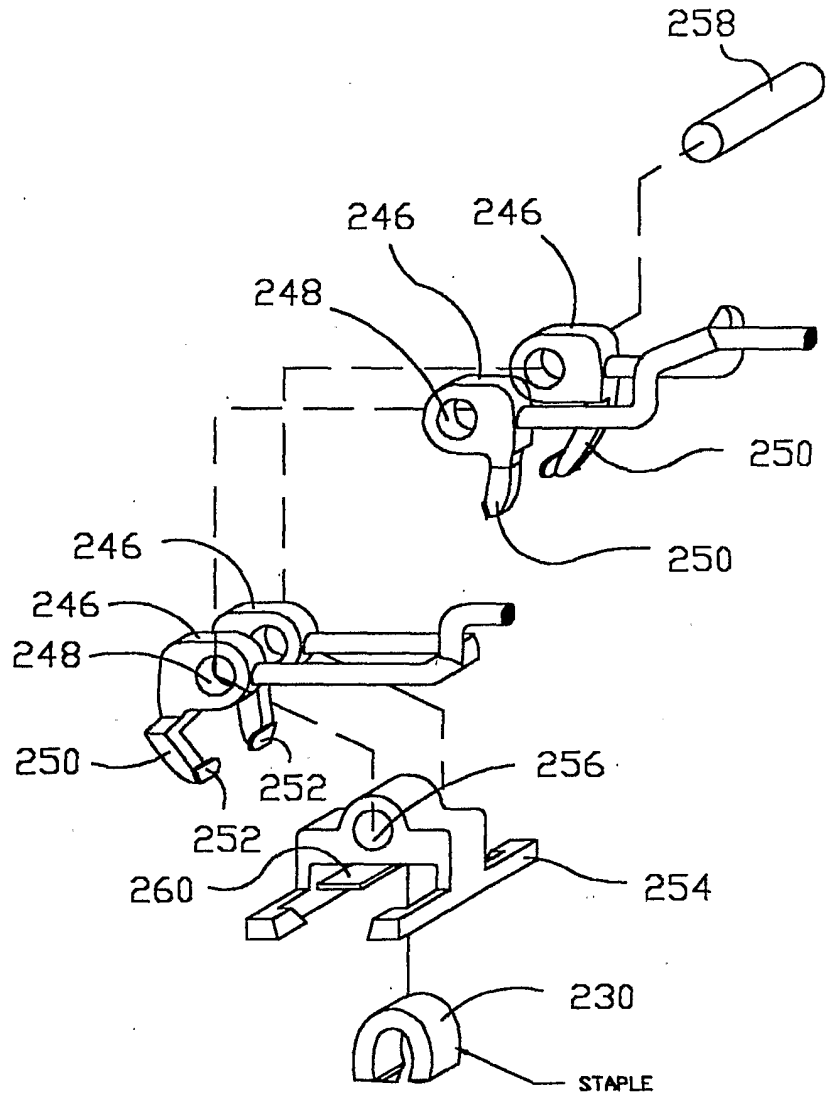


FIG. 19

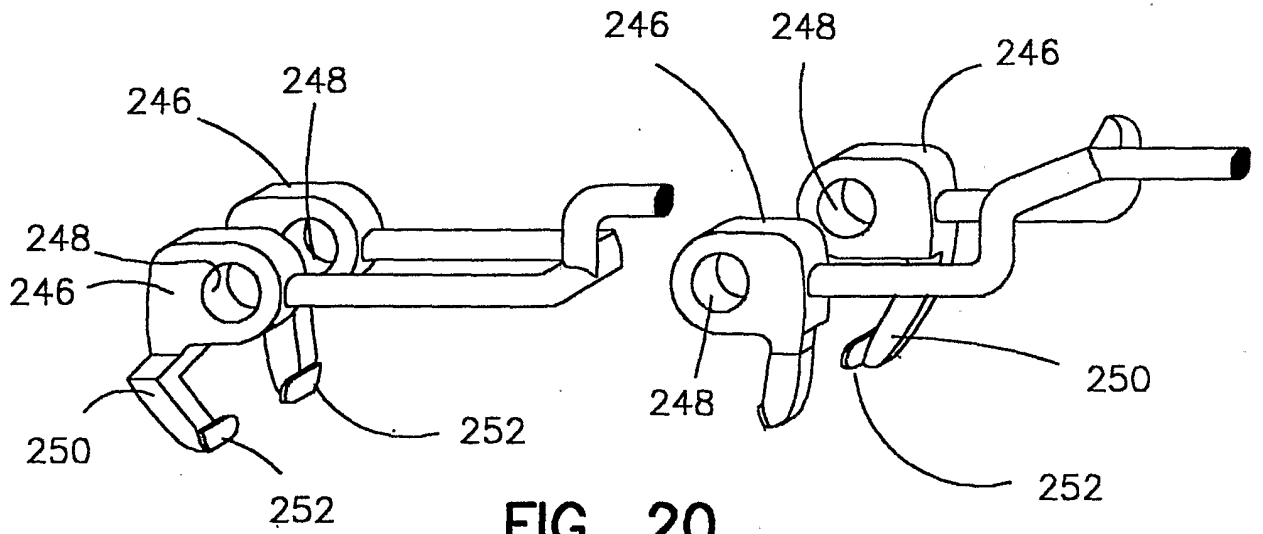


FIG. 20

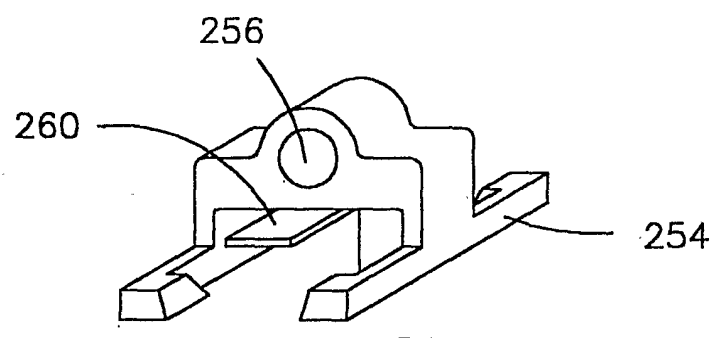


FIG. 21

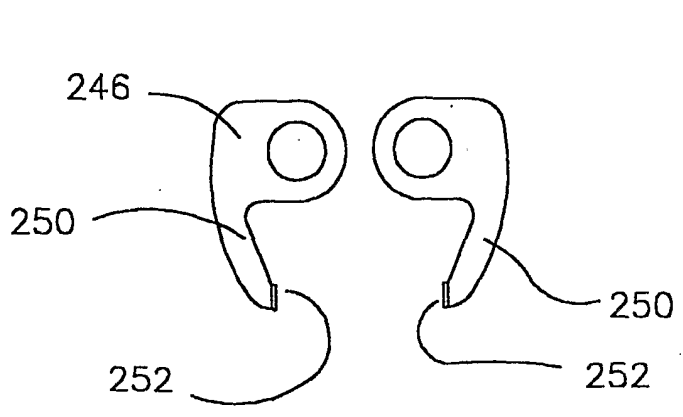


FIG. 22

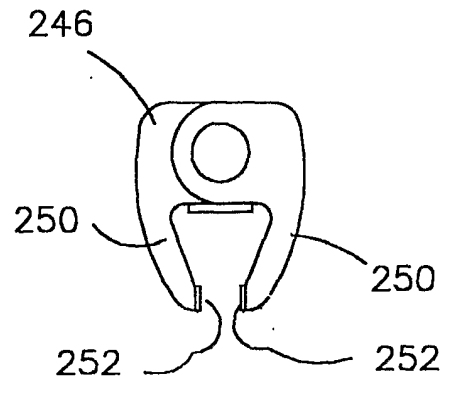
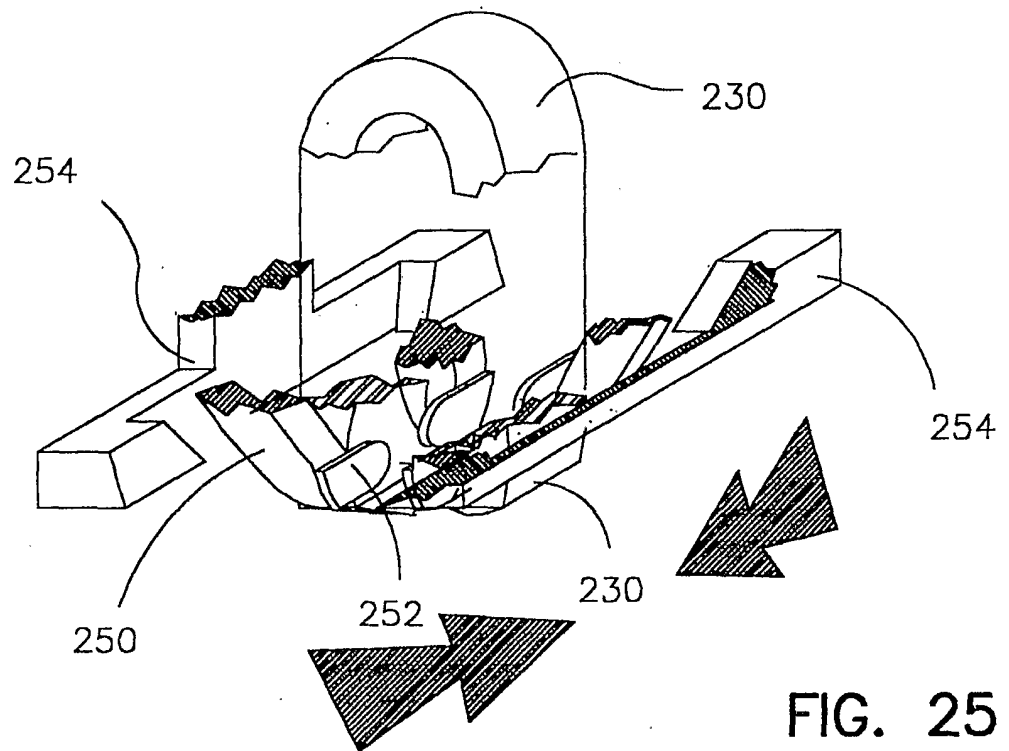
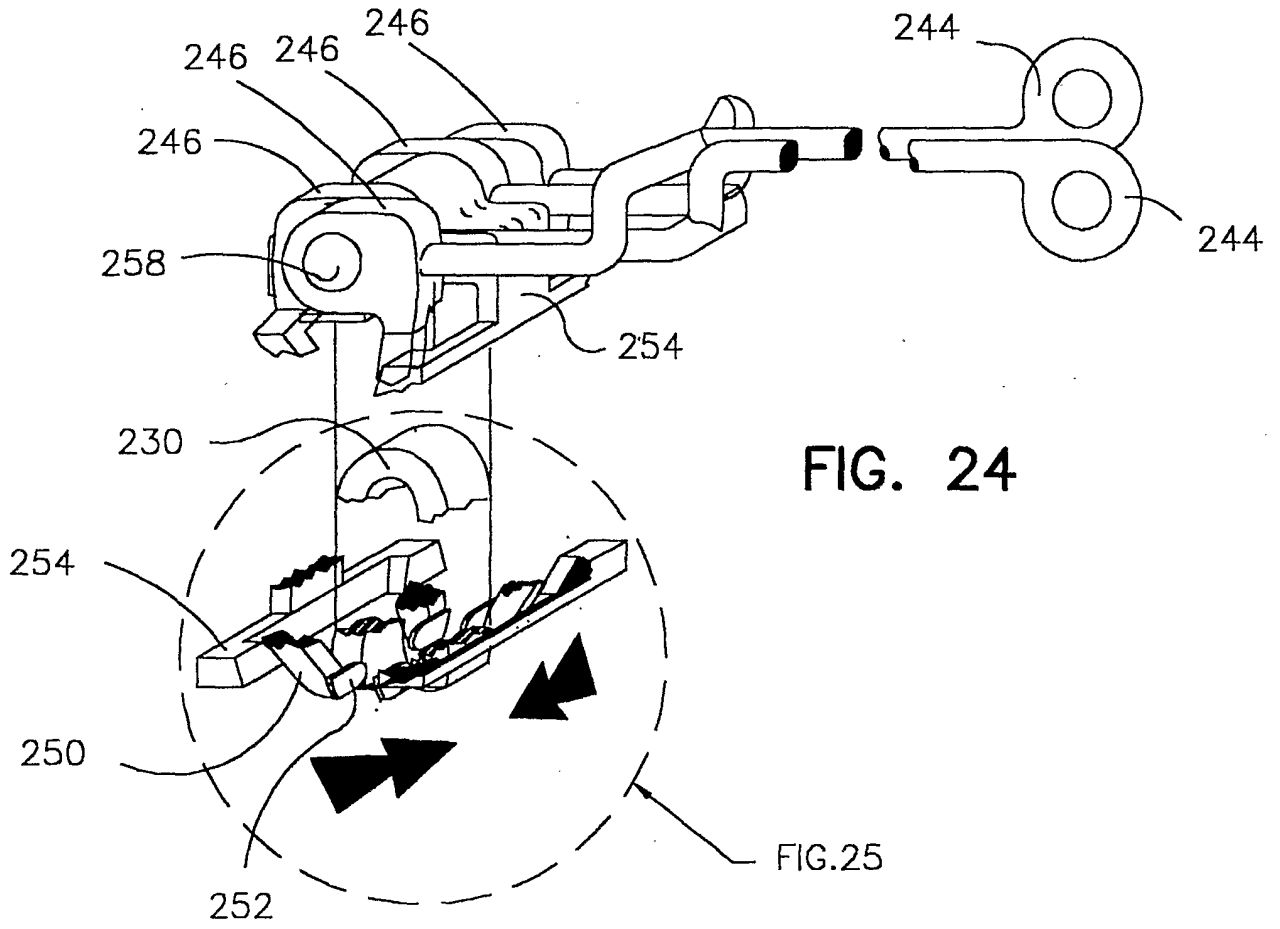


FIG. 23

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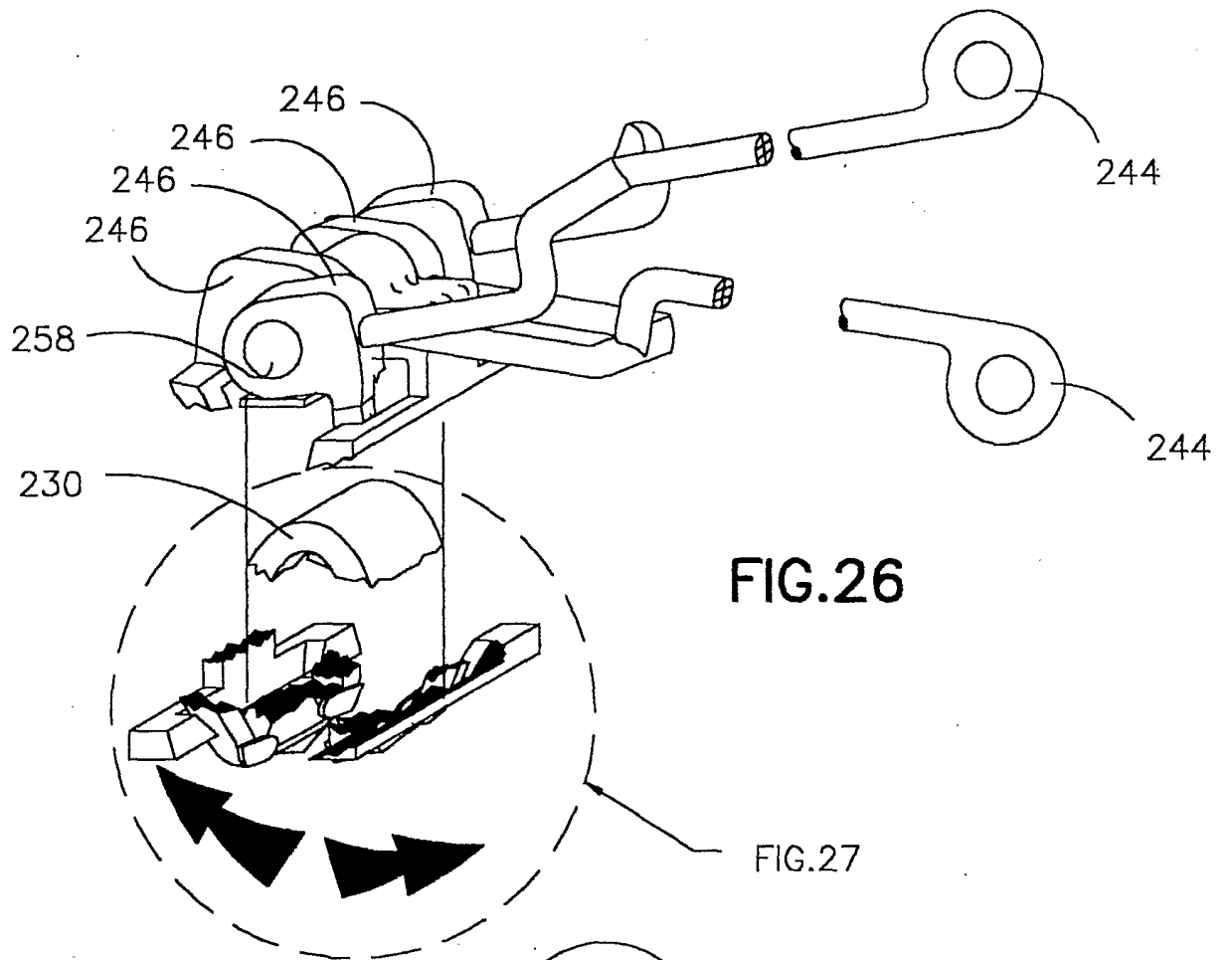


FIG. 26

FIG. 27

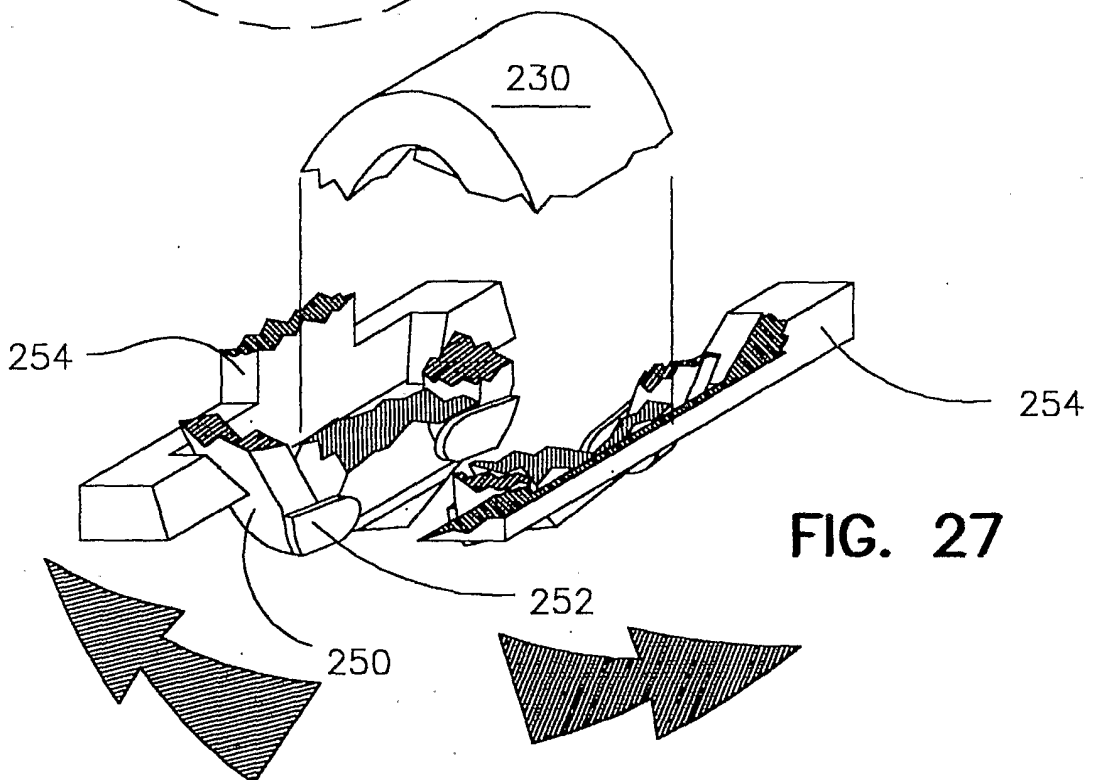


FIG. 27

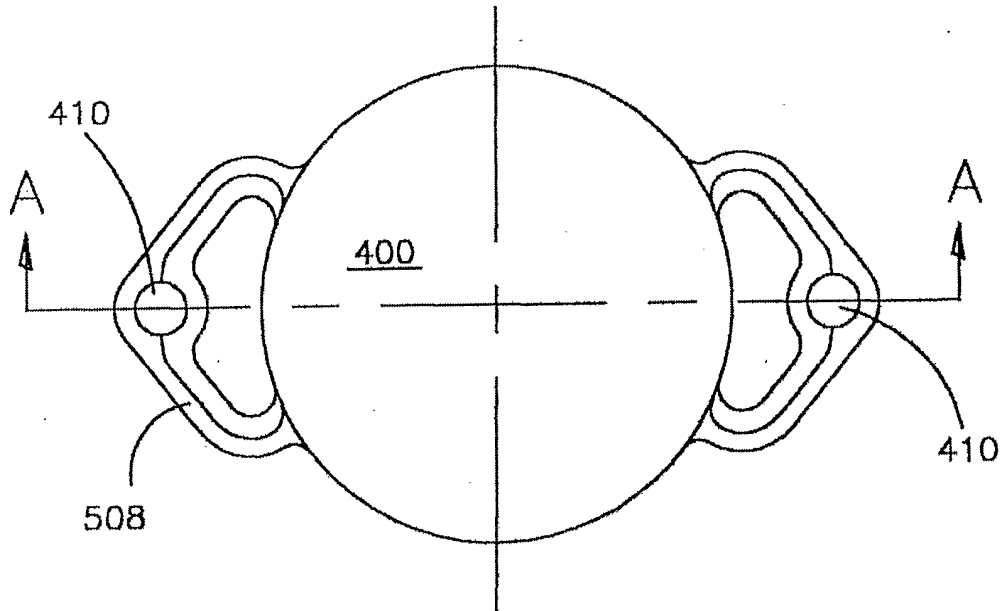


FIG. 28

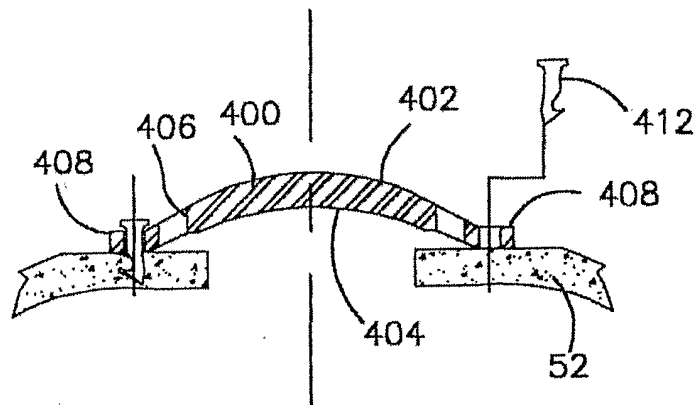


FIG. 29

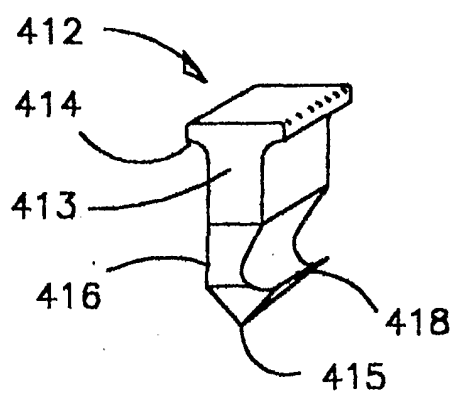


FIG. 30

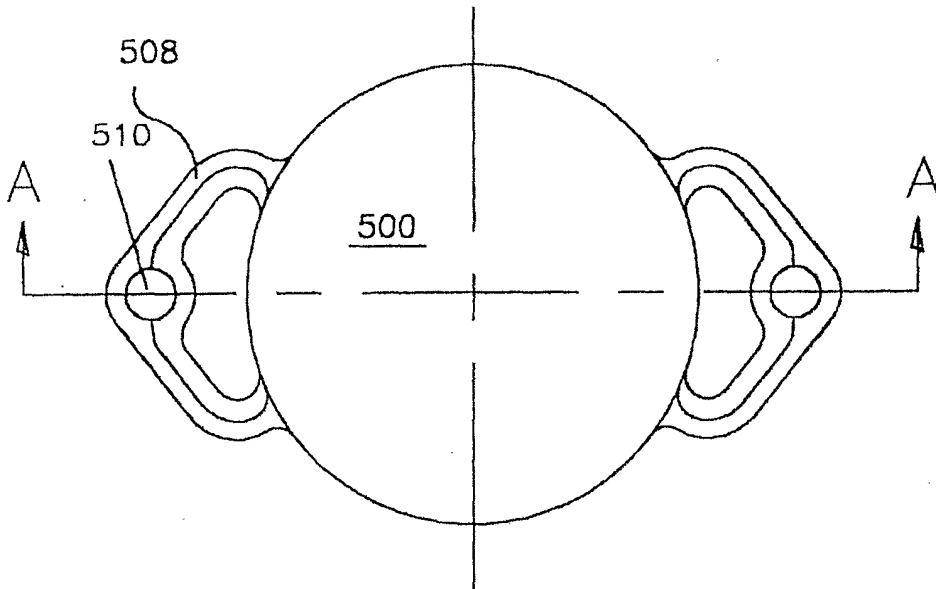


FIG. 31

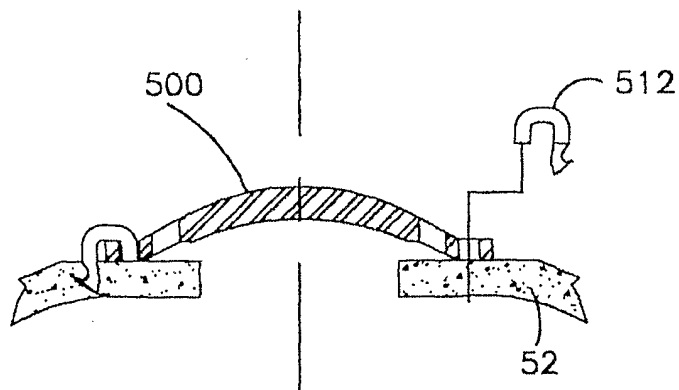


FIG. 32

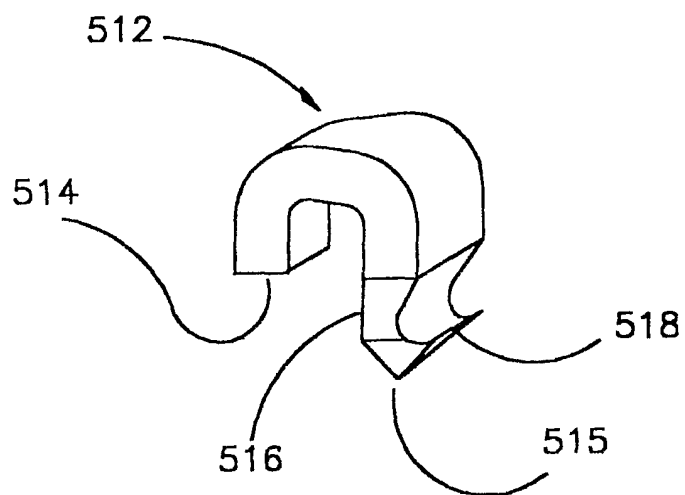


FIG. 33