INTRA-OCULAR LENS

This invention relates to structures for making an improved lens implant, as a replacement for a cataract-clouded or otherwise diseased natural lens. The invention represents improvement over structures described in my copending application, Ser. No. 691,033, filed May 28, 1976, now U.S. Pat. No. 4,073,014 and it employs techniques of manufacture described in my co-pending application Ser. No. 780,682 filed on even date herewith and now U.S. Pat. No. 4,080,709. Reference is therefore made to said applications for greater background detail as to structures and as to manufacturing technique.

Regardless of the structure of an intra-ocular lens and its mount, relatively great surgical skill is required for installation at an iris opening, if post-operative trauma is to be avoided.

It is an object of the present invention to provide improved mounting structure for an intra-ocular lens.

Another object is to provide such structure lending itself to simplified iris-stabilized installation.

A specific object is to meet the above objects with a pre-assembled lens and mount which can be operatively manipulated and installed at the end of a hypodermic needle.

Another specific object is to provide an intra-ocular lens and mount with improved tool-manipulable resiliently compliant lens-positioning feet which will automatically spring into permanent engagement with the inner side of the iris, upon tool removal.

Still another specific object is to meet the above objects with coacting lens-mount and tool structure whereby eye-filling saline solution may be introduced as the tool structure is being inserted or removed.

It is a general object to meet the above objects with a pre-assembled lens and mount and manipulative tool so as to permit safe and reliable operative installation to an iris opening with substantially less requirement for operative skill and with inherently greater assurance of trauma-free post-operative results.

Other objects and various further features of novelty and invention will be pointed out or will occur to others skilled in the art from a reading of the following specification in conjunction with the accompanying drawings. In said drawings, which show, for illustrative purposes only, preferred forms of the invention:

FIG. 1 is an enlarged view in perspective of a preassembled intra-ocular lens and mount, the same being pre-assembled to a manipulative tool;

FIG. 2 is a plan view of an undeformed blank for the mounting adapter of the pre-assembled lens and mount of FIG. 1;

FIG. 3 is a view similar to FIG. 2, after deformation and assembly to the intra-ocular lens;

FIG. 4 is a sectional view taken at 4—4 in FIG. 3;

FIG. 5 is a view similar to FIG. 1, to illustrate a different mounting-adapter in pre-assembly to the intra-ocular lens;

FIG. 6 is a plan view of an undeformed blank for part of the mounting adapter of FIG. 5;

FIG. 7 is a view similar to FIG. 6, to show two blanks of FIG. 6 in assembly to each other and to the lens;

FIG. 8 is a sectional view of the parts of FIG. 7 in pre-assembled relation to the intra-ocular lens, the section being taken at 8—8 in FIG. 7;

FIG. 9 is a perspective view of a kit package for use in effecting surgical implantation of an intra-ocular lens;

FIG. 10 is a fragmentary view in perspective to show the lens-mount engaging underside portion of the manipulative tool of FIGS. 1 and 5; and

FIGS. 11 and 12 are similar fragmentary views of modifications of the blank of FIG. 6.

In FIG. 1, an intra-ocular lens 10, which may be of suitable injection-molded plastic but which is preferably of finish-ground optical glass, is assembled to a single-piece mounting adapter 11, and the latter is removably assembled to the elongate end 12 of manipulative-tool means 13. The tool means 13 will be recognized as essentially a hypodermic needle which may be disposable and which includes at its base end a fitting 14 for removable application to a syringe 15. The mounting adapter 11 may be formed from a thin sheet of resiliently compliant material by techniques described in said copending applications and as shown comprises a first and larger pair of radially outward iris-stabilizing lens-positioning feet 16–17 at first opposed quadrant locations, and a second and smaller pair of radially outward iris-stabilizing lens-positioning feet 18–19 at the remaining opposed quadrant locations. The smaller feet 18–19 are for insertion via an iris opening and are shown to be apertured and to have been resiliently bent to one axial side of the lens-and-mount assembly, being thus retained by passage of the needle end 12 through the then-diametrically aligned openings of feet 18. It will be understood that upon longitudinal retraction of needle 12 from its engagement with the apertures of feet 18–19, the latter will naturally spring back to their normally more flat or radially outward orientation.

Turning now more particularly to FIGS. 2 to 4, the mounting adapter 11 is seen to have been initially characterized by the blank outlines of FIG. 2, being thus cut-out from sheet material by one of the photo-etch or other techniques described in said applications, and being thereafter of the appearance shown in FIG. 3 when assembled to the lens element 10. The blank of FIG. 2 comprises a circumferentially continuous centrally open body characterized for substantial conformance with and generally registering adjacency to the periphery of lens element 10, the latter being circular as shown in FIG. 3. This body is essentially a series of four integrally connected angularly spaced quadrant tabs or segments 20–21–22–23, separated by cutaway regions or slots 24–25–26–27. All tabs or segments 20–21–22–23 extend radially inward of the peripheral diameter D of lens 10 for axial-end engagement therewith, and the cutaway regions or slots 24–25–26–27 extend radially outward to at least the diameter D and preferably slightly beyond said diameter, as shown in FIG. 3. The segment 23 may be of greater radial width than its diametrically opposite counterpart 21, to permit inscription of serial number and/or lens-identifying data thereon.

The pairs 16–17 and 18–19 of iris-stabilizing feet are integral with the adapter body at the respective quadrant regions of tabs 20 to 23. For the smaller feet 18–19, the provision of tool accommodating apertures 18'–19' limits these feet essentially to outwardly bowed strips which are integrally united to segments 21–23 at angularly spaced locations, near slots 24–25 in the case of foot 18, and near slots 26–27 in the case of foot 19; such a structural relation will be understood to characterize feet 18–19 with relatively great flexible compliance for the bending needed for the tool-engagement and im-