



(86) Date de dépôt PCT/PCT Filing Date: 2001/10/19

(87) Date publication PCT/PCT Publication Date: 2002/04/25

(85) Entrée phase nationale/National Entry: 2003/04/07

(86) N° demande PCT/PCT Application No.: US 2001/045324

(87) N° publication PCT/PCT Publication No.: 2002/032481

(30) Priorité/Priority: 2000/10/19 (60/241,665) US

(51) Cl.Int.⁷/Int.Cl.⁷ A61B 17/34

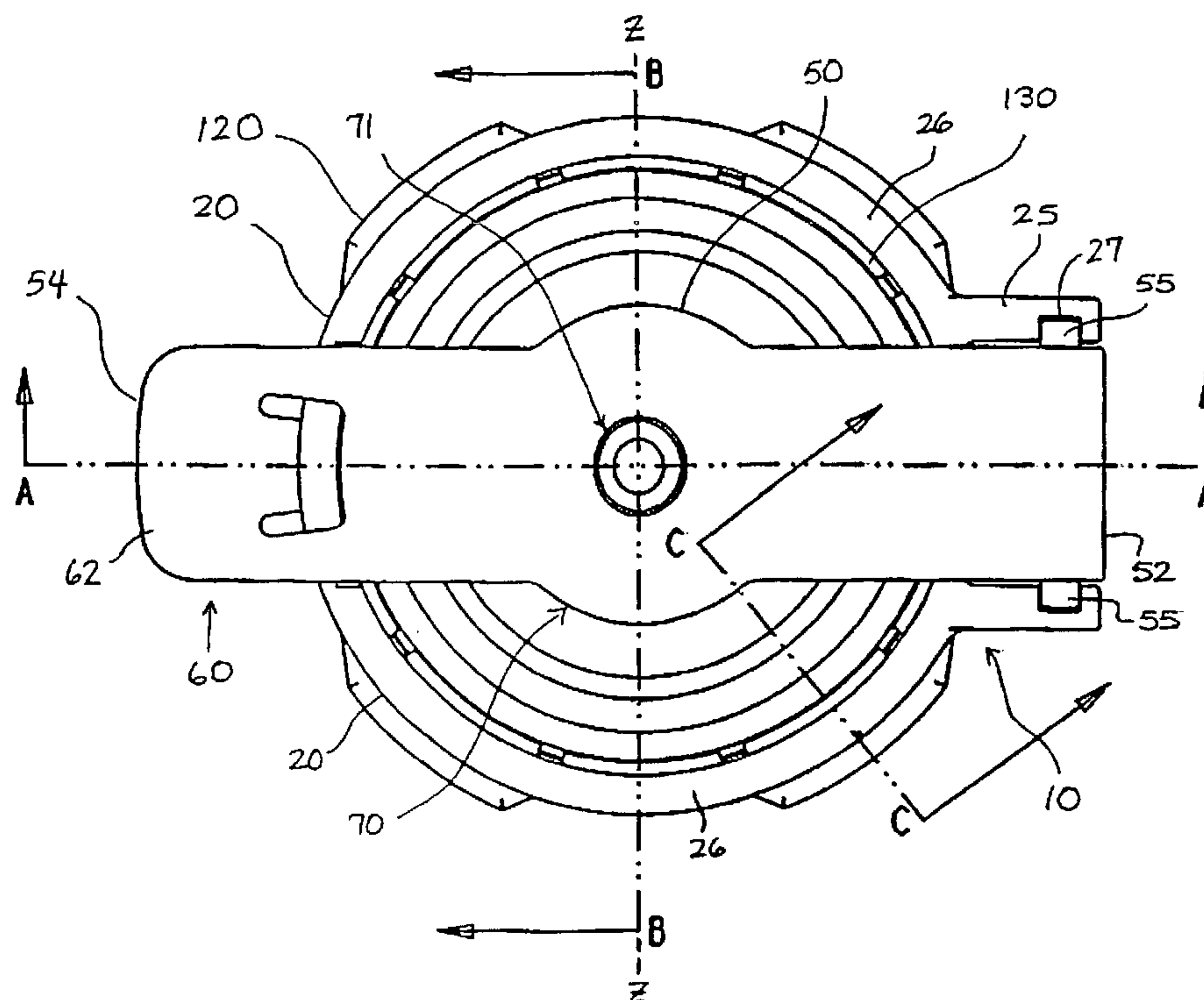
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(54) Titre : JOINT POUR TROCART FIXE

(54) Title: ADAPTOR CAP TROCAR ASSEMBLY



(57) Abrégé/Abstract:

A diameter reduction mechanism for a fixed seal trocar employing a movable reduction member pivotally connected with a housing (20). The housing (20) is adapted to be mounted on a proximal end of a valve assembly (120) of the trocar (100). The reduction member (50) defines a hole (71) aligned with a passageway (150) defined by the trocar (100). The hole (71) defines an operable area less than an operable area defined by the passageway (150). The diameter reduction mechanism is configured for the ease of selectively employing the reduction member (50) between a first position reducing the operable area of the passageway (150) and a second position wherein the reduction member (50) is clear of the passageway (150). The first position is configured to limit excessive off-axis and angular movements of small diameter surgical instruments and the second position is configured to accommodate an unrestricted use of large diameter surgical instruments in the passageway.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

CORRECTED VERSION

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
25 April 2002 (25.04.2002)

PCT

(10) International Publication Number
WO 02/032481 A3

(51) International Patent Classification⁷: **A61B 17/34**

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(21) International Application Number: PCT/US01/45324

(22) International Filing Date: 19 October 2001 (19.10.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/241,665 19 October 2000 (19.10.2000) US

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(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

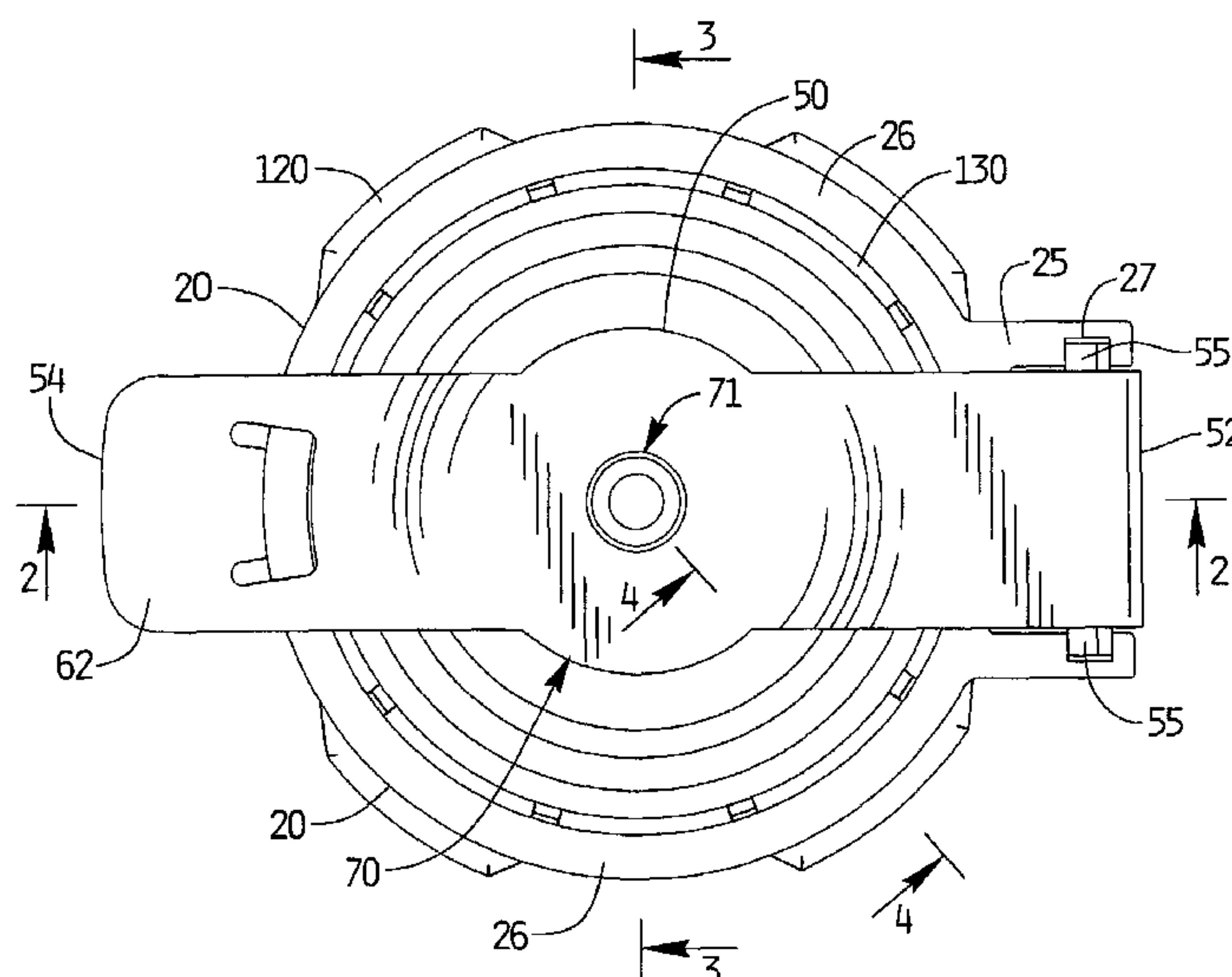
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

[Continued on next page]

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WO 02/032481 A3

WO 02/032481 A3



(88) Date of publication of the international search report:
15 August 2002

(15) Information about Correction:
see PCT Gazette No. 16/2003 of 17 April 2003, Section II

(48) Date of publication of this corrected version:
17 April 2003

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

ADAPTOR CAP TROCAR ASSEMBLY

CROSS REFERENCE TO RELATED APPLICATIONS

This case claims priority to Applicant's U.S. Provisional Application 60/241,665, filed October 19, 2000, the entire contents of which are hereby incorporated by reference.

BACKGROUND

1. Technical Field

The present disclosure relates to a mechanism for controlling the operable area of a passageway defined in a valve assembly of a trocar. More particularly, the present disclosure relates to a diameter reduction mechanism that is removably positionable over the passageway of the trocar to restrict the movement of small diameter surgical instruments to a reduced operable area of the passageway without sealing with the trocar and pivot clear of the passageway to accommodate large diameter surgical instruments.

2. Background of Related Art

Trocar valve assemblies are configured to provide a fluid tight sealing system before, during, and after a surgical instrument is entered through the trocar during minimally invasive surgical procedures. Sealing systems, such as a valve assembly for a passageway defined by a trocar connected with a cannula include an outer seal which can be fixed or floating, in combination with additional inner seals. Fixed outer seals are

limited by their ability to sustain a seal when smaller surgical instruments are moved off-axis, away from and generally parallel to the central longitudinal axis, towards the inside circumference of the cannula. Fixed seals are also limited by their ability to sustain their integrity when small diameter surgical tool angulation is employed. These extreme ranges of motion of smaller diameter surgical instruments within the cannula can create a “cat eye” or crescent shaped gap in the fixed seal that can result in a loss of seal integrity. Additional problems include the ability of a sealing system to be sufficiently flexible to maintain its integrity when both small diameter and large diameter surgical instruments are used.

Devices to restrict the diameter of a passageway in a trocar housing generally require a complex additional mechanism to be positioned on the proximal end of the trocar housing that restricts the range of motion of small surgical instruments and include additional seals or replace seals of the valve assembly with seals configured for small surgical instruments. These diameter reducing devices, however, typically require the disassembly and assembly of the proximal end of the trocar to adjust for the varying sizes of diameter reduction devices.

A continuing need exists for a diameter reducing structure that can limit parallel off-axis as well as angular movements of small diameter surgical instruments and accommodate larger diameter surgical instruments without disassembling the proximal end of the trocar.

SUMMARY

A diameter reduction mechanism is provided for assisting the valve assembly of a trocar in maintaining a seal. The diameter reduction mechanism includes a housing and a movable limiter. The limiter is diametrically positionable over the passageway to control the parallel off-axis and angular movements of smaller diameter surgical instruments. The limiter includes a locking mechanism and a pivot. The locking mechanism is adapted for use by a surgeon to readily lock the limiter in position over the passageway and to unlock and move the limiter clear of the passageway. Once the limiter is clear of the passageway, larger diameter surgical instruments are freely positionable within the passageway without any further adjustments by the operator.

The invention, together with attendant advantages, will be best understood by reference to the following detailed description of the invention when used in conjunction with the figures below.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the presently disclosed diameter reduction structure fixed trocar seal are described herein with reference to the drawings, wherein:

FIG. 1 is a top view of one preferred embodiment of a diameter reduction mechanism for a fixed trocar seal constructed in accordance with the present disclosure;

FIG. 2 is a cross-sectional side view of the diameter reduction mechanism for the fixed trocar seal of FIG. 1 along lines A-A;

FIG. 3 is a cross-sectional side view of the diameter reduction mechanism for the fixed trocar seal of FIG. 1 along lines B-B;

FIG. 4 is a close-up of a partial cross-sectional side view of the diameter reduction mechanism for the fixed trocar seal of FIG. 1 along lines C-C;

FIG. 5 is a close-up of detail D of a pivot assembly of the diameter reduction mechanism for the fixed trocar seal of FIG. 2;

FIG. 6 is a close-up of detail E of the interface between the valve assembly and the diameter reduction mechanism for the fixed trocar seal of FIG. 2; and

FIG. 7 is a perspective view of the top of the diameter reduction mechanism for the fixed trocar seal of FIG. 1.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The present disclosure contemplates the introduction into a body of a patient a trocar adapted for receiving all types of surgical instruments including clip appliers, graspers, dissectors, retractors, staplers, laser fibers, endoscopes, as well as electrosurgical cutting, coagulating, and ablation devices, and the like. All such objects are referred to herein as “instruments”.

Referring now in specific detail to the drawings in which like referenced numerals identify similar or identical elements throughout the several views, and initially to FIGS.

1-3, a novel diameter reduction mechanism for a fixed trocar seal 10 is shown constructed in accordance with the present disclosure and intended to be configured as an integral portion or an attachment to a conventional trocar assembly 100. Trocar assembly 100 includes valve assembly 120, end cap 130, and cannula (not shown). Trocar assembly 100 defines a passageway 150 aligned with a central longitudinal axis-X. Passageway 150 defines a first operable area. Valve assembly 120 is configured to provide a seal between a cavity formed in the patient and the outside atmosphere during and subsequent to insertion of an instrument through the cannula.

Diameter reduction mechanism for fixed trocar seal 10 includes a housing 20 and a limiter 50. Housing 20, in one preferred embodiment is an integral and proximal portion of valve assembly 120 of trocar 100. In another preferred embodiment, housing 20 is a tubular shaped ring adapted for being removably connected to a proximal end of valve assembly 120. Housing 20 includes a tubular wall 26 having a distal end portion 22 and a proximal end portion 24 aligned with the longitudinal axis-X.

Referring now to FIGS. 2-4 and 6, distal end portion 22 of tubular wall 26 includes an inwardly and radially extending protuberance 23 configured to engagingly mate and lock with an annular lip 133 positioned on end cap 130 of valve assembly 120.

As shown in FIGS. 1, 2 and 5, proximal end portion 24 includes a receptacle 25 having a pair of opposed notches 27 configured for the pivoting of limiter 50 and a

diametrically opposed lip 28 positioned on wall 26. Lip 28 has an arcuate shaped portion extending outwardly and radially from wall 26 with a distal facing generally flat portion.

Referring now to FIGS. 1-3 and 5-6, in one preferred embodiment, diameter reduction mechanism 10 in a first position includes housing 20 lockingly engaged with valve assembly 120 and limiter or reduction member 50 extending diametrically over passageway 150 and valve assembly 120. Limiter 50 includes a first end 52 being pivotally connected to a receptacle 25 of housing 20 and a second end 54 being engaged and locked with lip 28. An axis-Z is defined perpendicular to limiter 50 and axis-Y that intersects axis-X.

Limiter 50 has an elongate planar beam shape having a thickness in the direction of axis-X and a width in the direction of axis-Z. The width of limiter 50 can vary, but is approximately less than or equal to the diameter of passageway 150. A hole or opening 71 is centrally positioned on limiter 50 and aligned with the longitudinal axis-X. Limiter 50 also includes an annular recess 59 positioning hole 71 distal to first end 52 and second end 54 such that a proximal side of a rim 72 of hole 71 is positioned approximately equal to or below the proximal edge of valve assembly 120.

In FIGS. 1-3 and 5, first end 52 can include interfaces such as a hinge, a threaded connection, or a slide, such that the limiter 50 can pivot about notch 27 of receptacle 25. In one preferred embodiment first end 54 includes a pair pins 55 perpendicular to axis-Y positionable within notches 27. Pins 55 have a controlled tolerance to fit tightly within

notches 27 for a pure rotational hinge type movement or notches 27 can include a predetermined amount of play or bias such that limiter 50 can translate a controlled distance along axis-Y, for example, or pivot angularly within a plane Z-Y formed by the intersection of axes Z and Y.

Referring now to FIGS. 1, 2 and 7, second end 54 includes a locking mechanism 60 having a first cantilevered element 62 extending along axis-Y with a second cantilevered element 64 and a third cantilevered element or locking element 66 extending distally therefrom and generally parallel to longitudinal axis-X. A distal end of element 66 includes a radially inwardly extending protuberance 67 configured for engagingly interfacing with lip 28 to lock limiter 50 in the first position. A fillet 63 extends between an edge 61 of element 62 and a distal end edge 65 of element 64. Fillet 63 is ergonomically configured for the positioning of a limb or portion of a limb of a surgeon for the proximal movement or flexing of second end 54 to disengage protuberance 67 from lip 28.

Limiter 50 includes an interior portion 70 having a proximal first rim 72 and a distal second rim 74 defining hole 71 as well as an annular portion 78. Rim 72 has a conical shape with a distally decreasing inside diameter and rim 74 has a conical shape with a distally increasing diameter. The conical shapes of rims 72 and 74 are advantageously configured to support a limited degree of small surgical instrument angulation. Hole 71 is aligned with the longitudinal axis-X in the first position and less

than the inside diameter of passageway 150 by a predetermined amount, depending upon the desired application. Thus, hole 71 reduces the first operable area to a second operable area less than the first operable area. It is envisioned that diameter reduction mechanism for fixed trocar seal 10 can be provided in a variety of reducing diameters in a kit configuration having multiple limiters 50 and/or mechanisms 10 and be readily removed and replaced as an assembly without interrupting the integrity of the valve assembly.

As shown in FIGS. 1-3 and 7, interior portion 70 includes an annular channel 76 extending proximally from the distal side of limiter 50. Channel 76 is in apposition with rim 74 and defines rim 74 as a distally extending cantilevered element that provides a controlled degree of flexing or bias by rim 74 to urge instruments towards the central longitudinal axis. Annular portion 78 extends distally from interior portion 70. Annular portion 78 has a distal end 79 configured for seating on a rim 139 of a proximal end of end cap 130. Rim 139 defines a proximal portion of passageway 150 in conjunction with annular portion 78 in the first position. Annular portion 78 defines an inside diameter approximately equivalent to the proximal portion of passageway 150 defined by end cap 130. Thus, limiter 50 in the first position is configured as a cross beam supported on ends 54 and 52 by housing 20 and by the positioning of annular portion 78 in direct contact with rim 139 of end cap 130. Annular portion 78 provides structural support for limiter 50 and it precludes the misalignment of instruments while providing a non-sealing interface with passageway 150.

Limiter 50 is movably positioned on housing 20 such that when the surgeon desires to use instruments larger than the diameter of hole 71, the limiter 50 can be readily pivoted out of the first position over passageway 150 by using the limb or the portion of the limb of the surgeon to pull proximally against fillet 63 or edge 61. When limiter 50 is pivoted clear of passageway 150, diameter reduction mechanism for fixed trocar seal 10 is in a second position. Limiter 50 in the second position, is preferably extending distally and parallel to the longitudinal axis-X, but it may include stops or be biased to a range of positions from extending proximally and generally parallel to the longitudinal axis-X to being parallel to axis-Y, for example.

It is also envisioned that limiter 50 can be suitably configured for translation or angular movement with the X-Y plane such that limiter 50 can include a variable circumference configured to be aligned with axis-X that can be integral to or removably attached to limiter 50 to accommodate varying sized instruments without removing limiter 50 or diameter reduction mechanism for fixed trocar seal 10 from the trocar.

Referring now to FIG. 7, in operation, diameter reduction mechanism for fixed trocar seal 10 is positioned over a proximal end of valve assembly 120 of trocar 100 and forwarded distally to engage and lock housing 20 with valve assembly 120. Moving limiter 50 accommodates the selective changing of the operable area of passageway 150. Limiter 50 in the first position is configured to limit the off axis movements as well as the angulation of small diameter surgical instruments less than or equal to the diameter of

hole 71. Limiter 50 is adapted to readily accommodate, with a single movement of edge 61 or fillet 63, the movement of limiter 50 from the first position to the second position for the positioning of larger diameter surgical instruments. Limiter 50 is adapted for being readily replaced to the first position by the limb of the surgeon positioning second end 54 to suitably engage locking mechanism 60 to retain limiter 50 in the first position.

Although the illustrative embodiments of the present disclosure have been described herein with reference to the accompanying drawings, it is to be understood that the disclosure is not limited to those precise embodiments, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope or spirit of the disclosure. All such changes and modifications are intended to be included within the scope of the disclosure.

WHAT IS CLAIMED IS

1. A trocar seal for use with a trocar assembly, which comprises:

a housing adapted for mounting to a trocar assembly, the housing including an outer wall defining a longitudinal axis, and proximal and distal ends, the housing having an inner transverse wall;

an inner seal disposed within the housing in general alignment with the longitudinal axis, the inner seal having an aperture for sealed reception of an elongated object introduced therein; and

a reduction member mounted to the housing and movable relative to the housing between first and second positions, the reduction member having an interior portion defining an opening therethrough, the opening being in general alignment with the aperture of the inner seal when the reduction member is in the first position thereof, the interior portion being dimensioned to minimize offset lateral movement of the elongated object during manipulation of the elongated object, the reduction member further including an annular portion disposed distal of the interior portion, the annular portion dimensioned to engage the transverse wall of the housing to support the reduction member when in the first position thereof.

2. The trocar seal of claim 1 including an outer seal peripherally disposed with respect to the inner seal and being dimensioned to define a sealing interface to substantially minimize passage of insufflation gases through the housing.

3. The trocar seal of claim 1, wherein the reduction member includes a rim, the rim defining the opening, the rim including a proximal first portion and a distal second portion, the proximal first portion defining a conical shape and a distally decreasing inside diameter, the distal second portion defining a conical shape and a distally increasing inside diameter.

4. The trocar seal of claim 3, wherein at least a portion of the rim defining the opening is a cantilevered structure, the cantilevered structure including a bias, the bias configured to urge instruments towards the central longitudinal axis.

5. The trocar seal of claim 1, wherein the housing includes a proximal end portion, the proximal end portion defining a rim, the annular portion of the reduction member being adapted for mounting on the rim of the proximal end portion of the housing, the annular portion providing an unsealed connection between the rim of the valve assembly and the hole in the reduction member.

6. The trocar seal of claim 1, wherein a locking mechanism is positioned on the reduction member, the locking mechanism including a distally extending cantilevered element having a distal end portion with a protuberance, the protuberance extending inwardly and radially and having a generally flat proximally facing surface adapted for engaging with a lip of the housing, the lip having a distally facing generally flat surface.

7. A diameter reduction mechanism adapted for selective use with a fixed trocar seal comprising:

a housing including a tubular wall adapted for mounting on a proximal end of a trocar valve assembly, the valve assembly having at least one fixed seal and defining a longitudinal passageway, the longitudinal passageway defining a first operable area;

a reduction member having a first end, an opposing second end, and an interior portion, the first end being pivotally connected to the housing, the second end having a locking mechanism for engaging with the housing, the reduction member having a first position wherein the reduction member is positioned over the first operable area of the passageway with the second end locked with the housing, the pivotal connection permitting movement and a second position wherein the reduction member is positioned clear of the first operable area of the passageway, the reduction member and housing providing an unsealed interface with the valve assembly;

a rim positioned on the interior portion of the reduction member, the rim defining a hole aligned with the passageway, the hole defining a second operable area less than the first operable area of the passageway.

8. The diameter reduction mechanism of claim 7, wherein the housing includes a receptacle having a pair of notches and the first end of the reduction member includes a pair of opposing linearly aligned pins, the pins being configured and dimensioned for positioning in the notches of the receptacle and permitting movement of the reduction member.

9. The diameter reduction mechanism of claim 8, wherein the receptacle and the pins are configured to support the translation of the reduction member in a plane aligned with the pins and perpendicular to the longitudinal axis.

10. The diameter reduction mechanism of claim 8, wherein the receptacle and the pins are configured to support the angular movement of the reduction member in a plane aligned with the pins and perpendicular to the longitudinal axis.

11. The diameter reduction mechanism of claim 8, wherein the connection between receptacle and the pins includes a bias, the bias configured to urge the reduction member to a first position wherein the hole is aligned with the passageway.

12. The diameter reduction mechanism of claim 7, wherein the rim defining the hole in the interior portion has a proximal first portion and a distal second portion, the proximal first portion defining a conical shape and a distally decreasing inside diameter, the distal second portion defining a conical shape and a distally increasing inside diameter.

13. The diameter reduction mechanism of claim 7, wherein at least a portion of the rim defining the opening is a cantilevered structure, the cantilevered structure including a bias, the bias configured to urge instruments towards the central longitudinal axis.

14. The diameter reduction mechanism of claim 7, wherein the annular portion has a distal end and the valve assembly includes a proximal rim, the distal end of the

annular portion being adapted for mounting on the proximal rim of the valve assembly, the proximal rim defining a portion of the passageway, the annular portion providing an unsealed proximal extension of the passageway between the rim of the valve assembly and the hole in the reduction member.

15. A method for selectively changing the operable diameter of a fixed seal trocar comprising the steps of:

providing a diameter reduction mechanism and a trocar, the trocar having a valve assembly, the valve assembly including a proximal end portion and a fixed seal, the trocar defining a longitudinal axis and a passageway aligned with the longitudinal axis, the passageway defining a first operable area, the diameter reduction mechanism having a housing and a reduction member configured for selectively reducing the operable area of the passageway of the trocar, the diameter reduction mechanism being adapted to mount on the valve assembly without providing a sealing interface to the trocar;

positioning the diameter reduction mechanism on the proximal end of the valve assembly; and

moving the reduction member to select between a first position of the diameter reduction mechanism and a second position of the diameter reduction mechanism, the first position and the second position being unsealed positions with the trocar, the reduction member in the first position being positioned over the passageway

and the reduction member defining a second operable area less than the first operable area and the reduction member in the second position being positioned to provide an unrestricted access to the first operable area of the passageway.

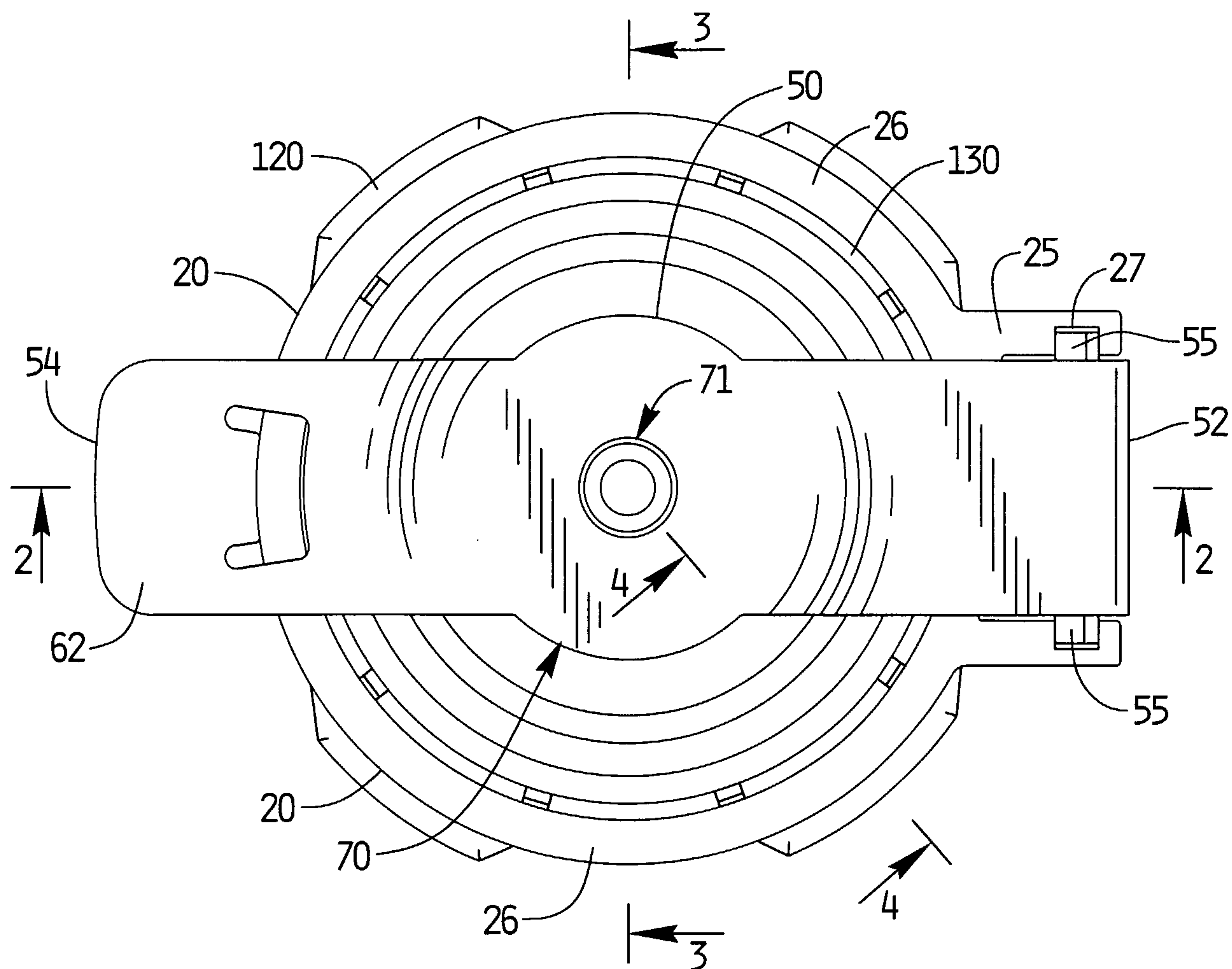
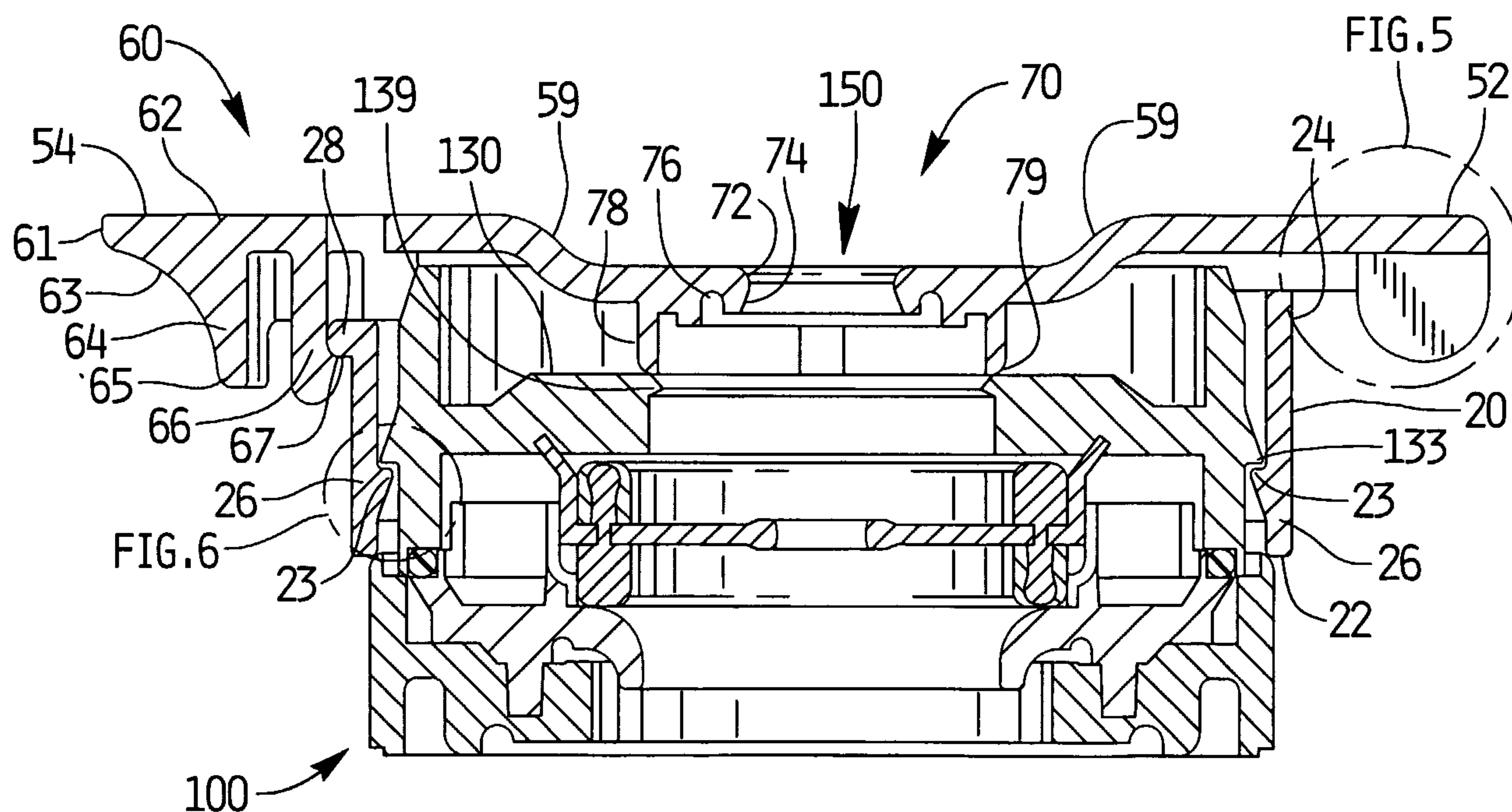
16. The method for selectively changing the operable diameter of a valve assembly of claim 15, wherein the step of positioning includes engaging the housing on the proximal end of the valve assembly and further including the step of forwarding the housing to a locked position by distally forwarding the housing along the longitudinal axis over the proximal end of the valve assembly to lock the housing with the valve assembly.

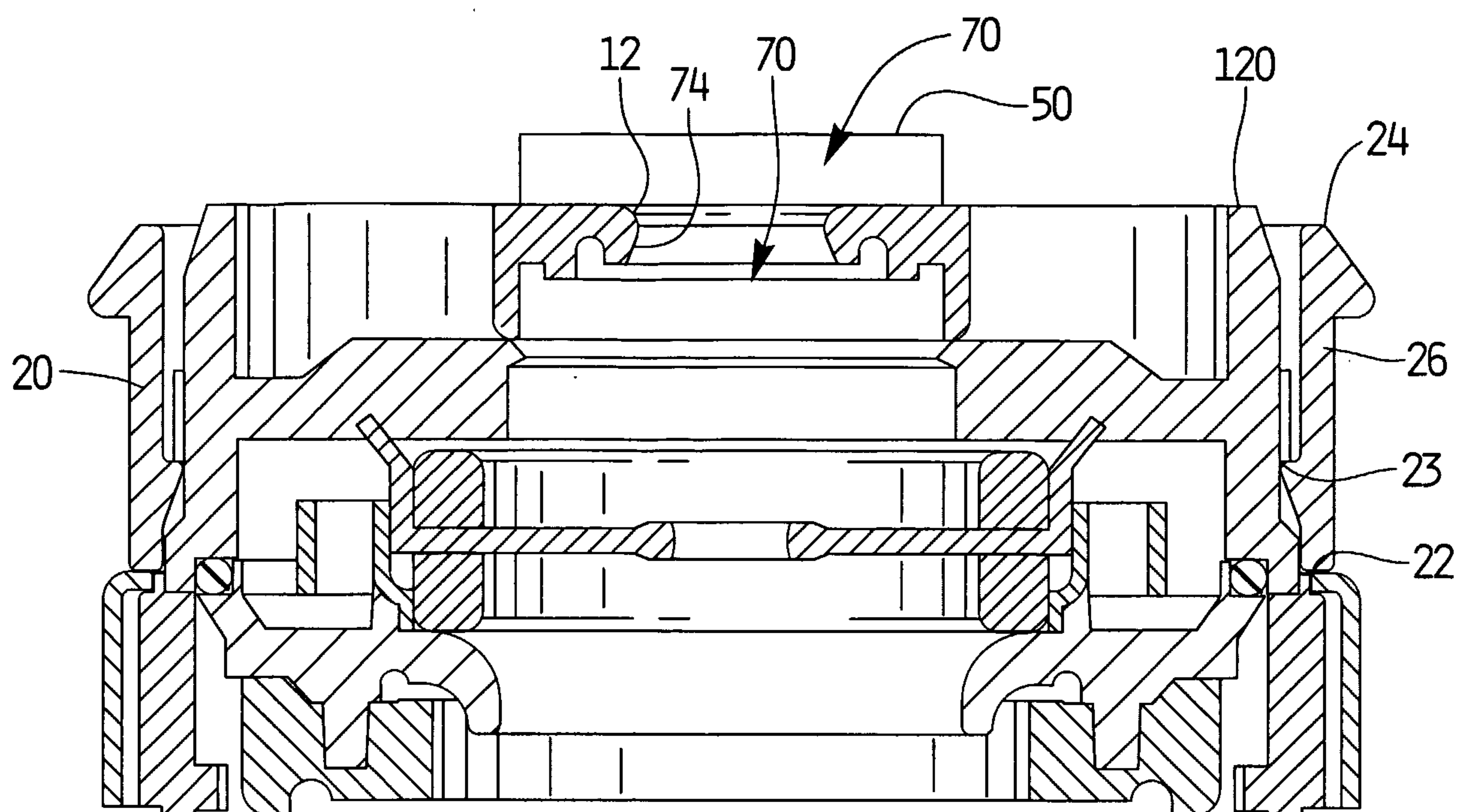
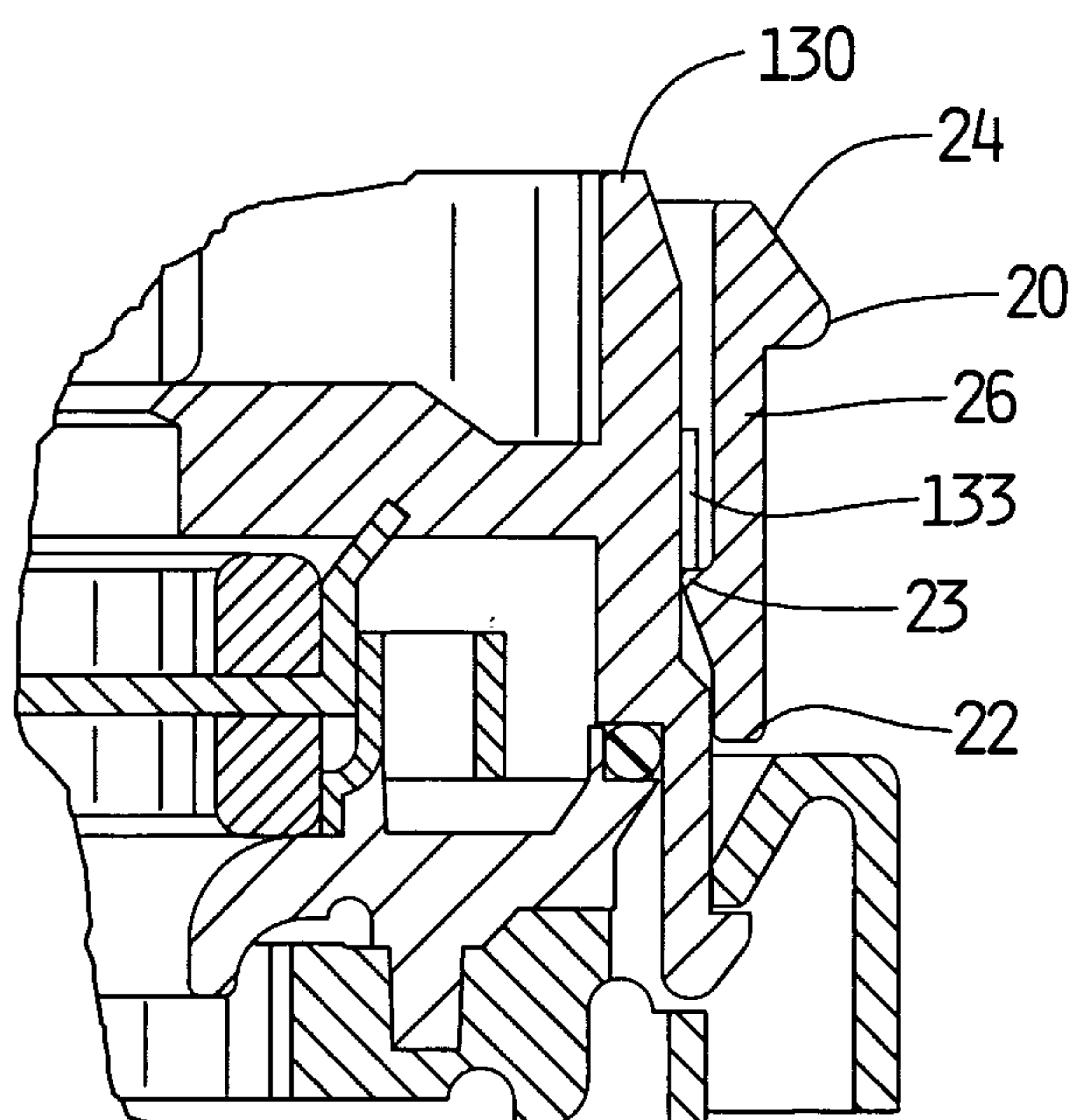
17. The method for selectively changing the operable diameter of a valve assembly of claim 15, wherein the step of moving includes locking the reduction member in the first position by distally moving the reduction member to lock with the housing.

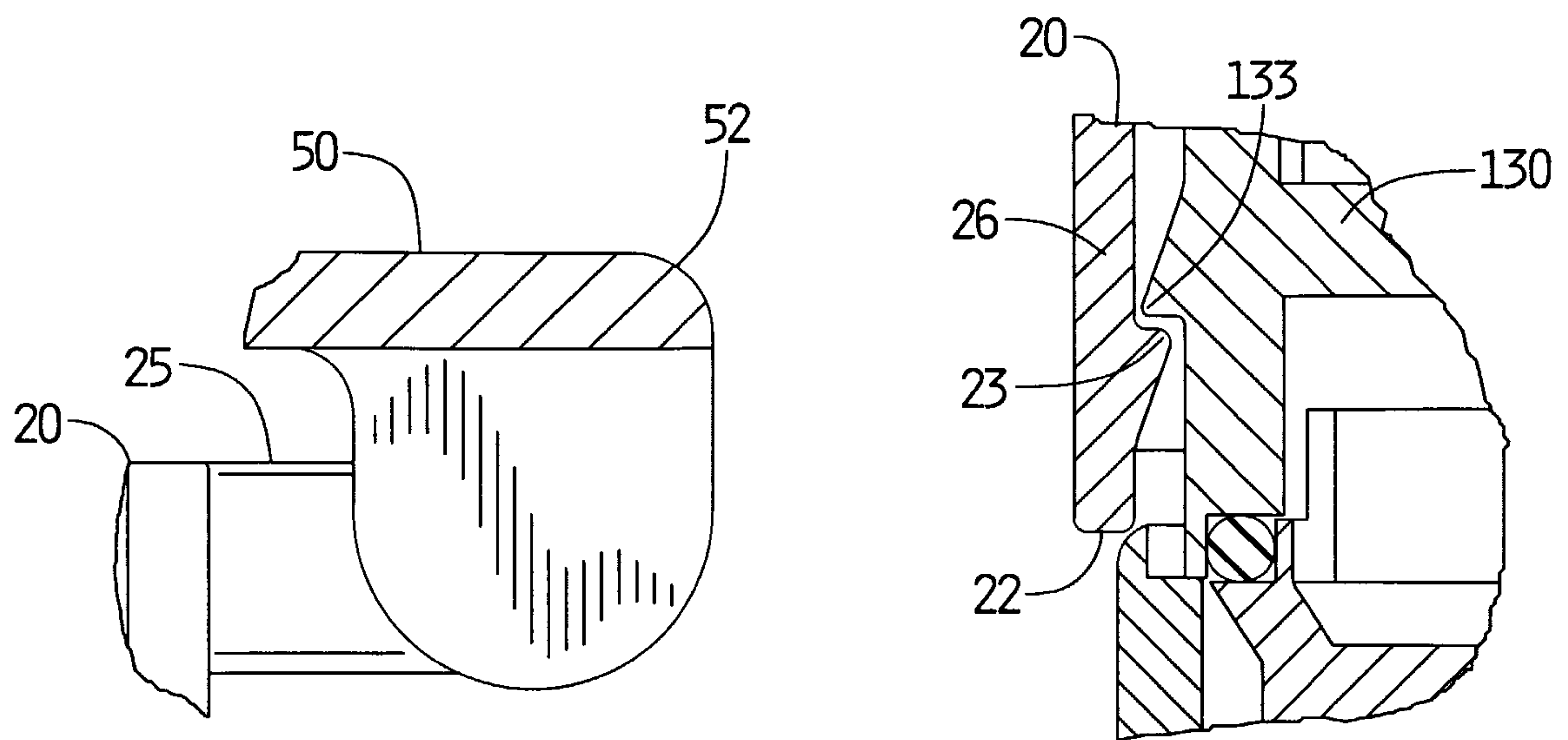
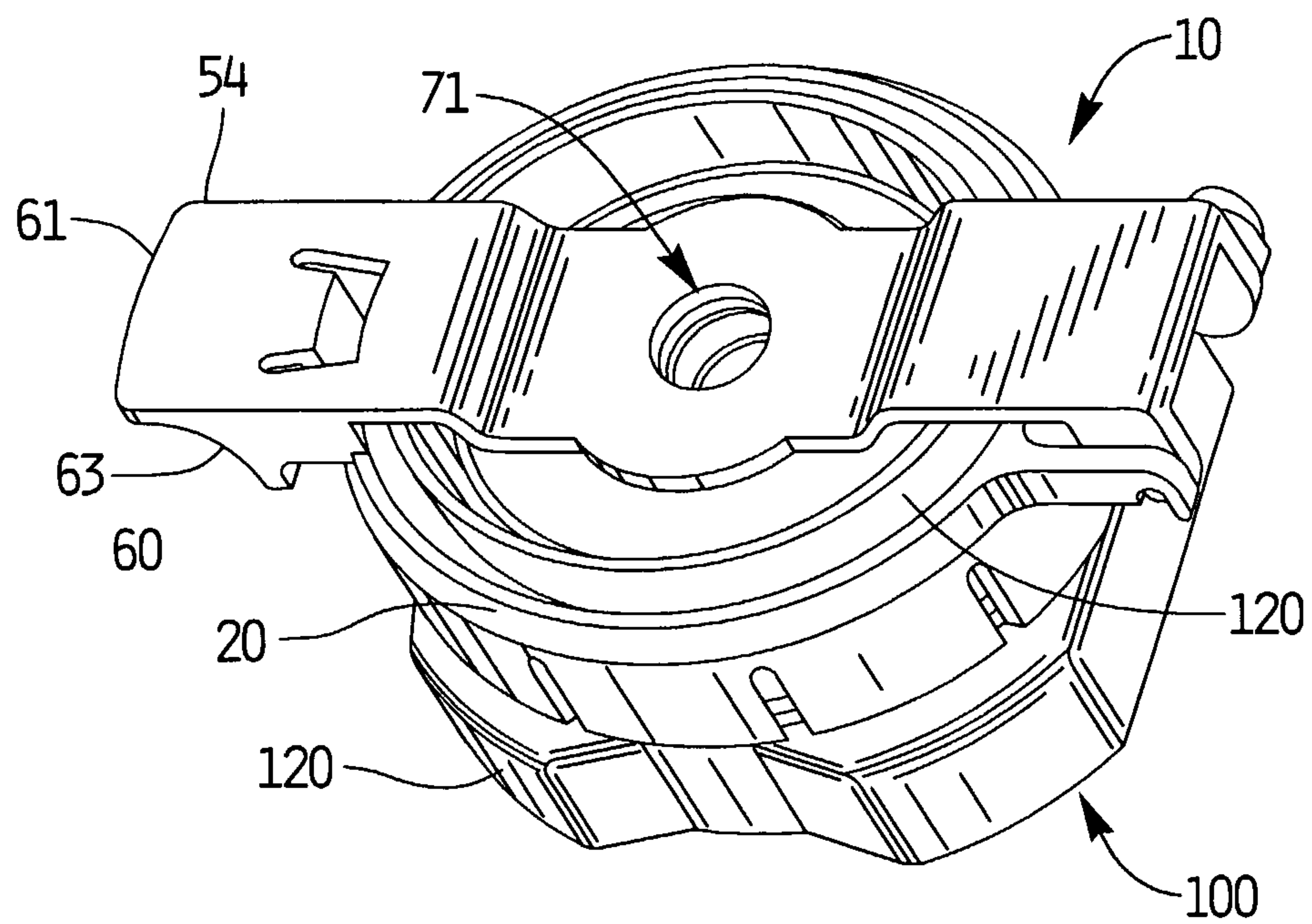
18. The method for selectively changing the operable diameter of a valve assembly of claim 17, wherein the step of moving includes unlocking the reduction member from the housing and further includes the step of moving the reduction member to extend distally at an angle approximately parallel to the longitudinal axis.

19. The method for selectively changing the operable diameter of a valve assembly of claim 17, wherein the step of moving includes locking the reduction member in the first position with the housing by the pivotal movement of the reduction member by a portion of a limb of a surgeon.

20. The method for selectively changing the operable diameter of a valve assembly of claim 15, wherein the step of providing includes providing a small diameter surgical instrument and the step of moving includes positioning the small diameter surgical instrument through the reduction member and trocar, the reduction member biasing the small diameter surgical instrument towards the longitudinal axis.

FIG. 1*FIG. 2*

*FIG. 3**FIG. 4*

*FIG. 5**FIG. 6**FIG. 7*

