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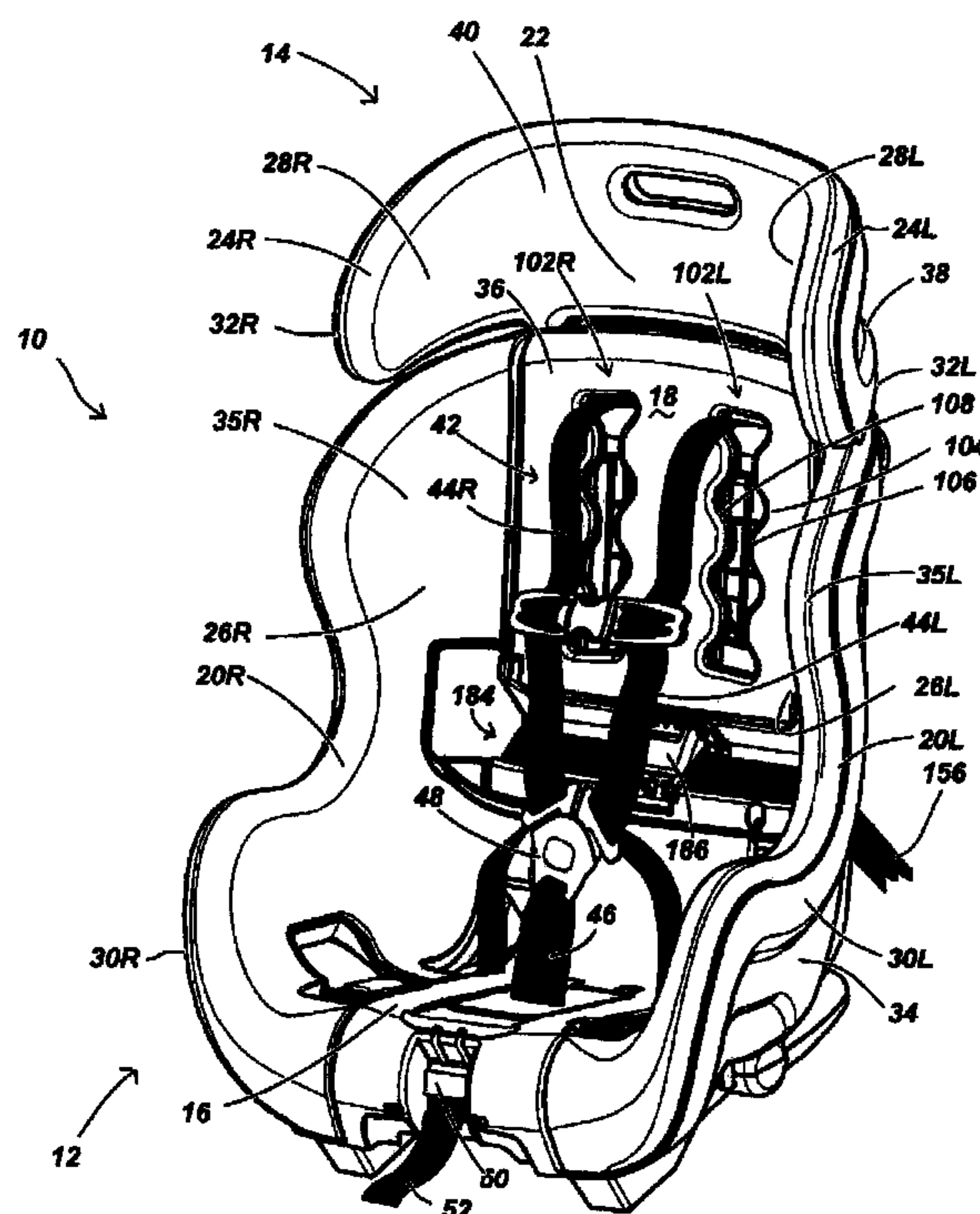
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(54) Title: JUVENILE CONVERTIBLE CAR SEAT



(57) Abrégé/Abstract:

A car seat for transporting a child in an automobile is described which is convertible from a rear-facing infant carrier into a forward-facing toddler carrier by the inclusion or removal of a separable headrest. The car seat features a belt adjustment system as well as a crotch belt adjustment system in addition to front and rear restraint attachment components.



Abstract

A car seat for transporting a child in an automobile is described which is convertible from a rear-facing infant carrier into a forward-facing toddler carrier by the inclusion or removal of a separable headrest. The car seat features a belt adjustment system as well as a crotch belt adjustment system in addition to front and rear restraint attachment components.

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JUVENILE CONVERTIBLE CAR SEAT

Technical Field

This invention relates generally to a juvenile convertible car seat with a restraining harness and moveable headrest. More specifically, the invention includes adjustability of an internal harness to fit various sized and growing children in such a manner that the harness never requires disassembly and corresponding reassembly in a new position, thereby reducing the potential to misuse the product, as well as the ability to use the product over a wider age span through the ability to selectively include or remove a headrest depending on the size of the occupant.

Background of the Invention

Juvenile convertible car seats are designed for use with growing children. These car seats are designed to convert the car seat from a rear facing and reclined position for infants (from birth up to 20, 22 or even 30 lbs.) to an upright and forward facing position for toddlers (up to 40 or even 65 lbs. or more). Convertible car seats are secured on an automobile seat with the automobile seat belt(s) threaded through specific forward or rear facing belt paths, relative to a forward or rear facing installation. Construction of a convertible car seat typically comprises of a molded plastic seat shell that is essentially a bucket seat shell with a seat and back support surface, forward extending side supports, a molded-in frame, and other details for the attachment of pads, belt systems, and other components. The belt system, or internal harness, restrains the child occupant and is generally a 5-point system with a crotch strap, two lap belts, and two shoulder belts. The belt system also includes some sort of adjuster to loosen or tighten the belts, and it is typically located at or under the front of the seat for easy access. A sewn fabric seat pad provides comfort.

The child population is increasing in weight and size relative to age and safety advocate groups are urging parents to keep children in child restraints (especially those with an internal harness) as long as possible. Therefore, convertible car seats are typically large and are getting larger to contain older and heavier children.

When used rear facing for an infant, the convertible car seat must be reclined to properly support the developing child. This creates a challenge, especially for a large convertible seat. Juvenile car seats are typically used in the back seat of an automobile and the seat back of the reclined and rear facing juvenile car seat often interferes with the seat back of the front automobile seat. This incompatibility prevents the juvenile car seat from properly reclining or even prevents its use entirely.

1 Harness system adjustment, specifically that of the two shoulder belts, has
2 always been an area of misunderstanding and misuse by the consumer. Typically,
3 juvenile car seat backs have multiple sets of slots at different heights to correspond to a
4 growing child's shoulders. To adjust the shoulder belts from one slot to another, the
5 consumer has to un-secure the harness and unthread the shoulder belts from the
6 current slots and rethread them through the desired slots and then re-secure. Crotch
7 straps on some car seats have multiple use positions also and some must be
8 unthreaded, moved and rethreaded similar to shoulder belts. This disassembly and
9 reassembly introduces risks to the use of the car seat as the correct and crucial
10 reassembly relies entirely on the consumer, who may not be mechanically inclined.

11 Some juvenile convertible car seats have a means to slide the shoulder belts up
12 or down to a new height without disassembly and rethreading. This is accomplished
13 with a sliding carriage behind and/or in front of the seat back that the shoulder belts
14 pass over or through. The shoulder belts pass through the seat back of the molded
15 shell via a single pair of large, vertically elongated slots that correspond to the range of
16 motion of the adjustable carriage. The carriage position is adjusted by a mechanism
17 that is located behind the seat back and often hidden from the user and is thus non-
18 obvious and/or difficult to use. Even fewer convertible car seats have the ability to
19 adjust the crotch strap without disassembly, and current adjustment means are, again,
20 non-obvious and difficult.

21 LATCH stands for Lower Anchorages and Tethers for Children and is an industry
22 standard of child restraint attachment. It typically includes a length of belt with a clip at
23 each end and an adjuster in between to adjust the length of the belt. The belt can be
24 threaded through either the rear facing or forward facing belt paths of the convertible car
25 seat and the clips attach to metal loops on either side of the seating area behind the
26 seat cushion of the auto seat. The metal loops are attached to the frame of the car.
27 With the clips attached to the loops, the LATCH belt can be adjusted tightly and the car
28 seat is secured. The use of LATCH is optional but car seats are required to be so
29 equipped as an alternate method of attachment to the standard auto seat belts.

30 Side impact performance is a growing concern with juvenile car seats, and while
31 high sides on a seat, along with the internal harness do contain the child occupant, the
32 juvenile car seat itself can still slide side-to-side even when properly installed. This
33 movement is caused by the juvenile car seat sliding laterally relative to the auto belts or
34 LATCH belt. A solution is integral belt clamps that reside within or adjacent to the rear

1 and/or forward facing belt paths of the juvenile car seat. These clamps hold the auto or
2 LATCH belts tight to the juvenile car seat and prevent or minimize side-to-side sliding
3 relative to these belts.

4 Most convertible car seats have a recline feature that manages the seat recline
5 position for comfort and/or proper positioning in forward or rear facing installations.
6 Rear facing installation always requires more recline to properly support a developing
7 infant.

8 It has become common for nearly all children's car seats to include at least one
9 cup or drink holder. These take many forms and are either removable or retractable by
10 some means.

11 The purpose of this invention is to solve these problems with current car seats in
12 a practical, reliable, convenient, and cost effective manner. It will make transportation of
13 a growing child safer and more convenient.

14 ***Summary of the Invention***

15 This invention is a juvenile convertible car seat which can be used rear facing for
16 infants and forward facing for toddlers, in an automobile. The focus of this invention is
17 on a reasonable fit of a large convertible car seat in an automobile (specifically rear
18 facing) and adjustability of an internal harness to fit various sized and growing children
19 in such a manner that the harness never requires disassembly and corresponding
20 reassembly in a new position, which introduces potential misuse.

21 This convertible car seat includes a seating surface, a seat back surface, raised
22 sides, and structural frame rails on either side behind the seat and back surfaces
23 running nearly the length of the entire seat. The basic structure is molded in one plastic
24 part. The sides and backrest are lined with energy absorbing foam. It also includes a 5-
25 point internal harness as described above which is adjustable to fit various sizes of
26 children without disassembling and rethreading the harness. The car seat also includes
27 a recline stand, auto belt clamps, forward and rear facing belt paths, and a removable
28 upper back section.

29 The removable upper back section, when removed, reduces the seat back height
30 and minimizes interference with the front automobile seats when the car seat is
31 installed rear-facing in a rear automobile seat. This allows a proper recline angle for an
32 infant. The remaining non-removable back area is sufficiently large to support an infant
33 and maintain seat structure. The removable back section of this invention incorporates
34 portions of the forward extending sides of the car seat.

1 Attachment of the removable upper back section can be achieved any number of
2 ways but in this case it is accomplished with a generally "U" shaped metal component
3 that is fastened to the removable upper back with the legs of the "U" pointing downward.
4 The legs of the "U" slide into the structural frame rails behind the seat back surface of
5 the molded plastic seat shell. At least one slot is formed in at least one of the downward
6 pointing "U" legs and is engaged by at least one spring biased tooth that resides in the
7 corresponding structural frame rail(s) of the shell. Engagement of the tooth to the slot
8 on the "U" leg is automatic once the legs are inserted far enough into the rails. Removal
9 of the upper back is accomplished by applying pressure to a tooth removal lever to
10 overcome the spring bias, disengaging the slot on the "U" leg, and sliding the upper
11 back and its legs out of the frame rails. The removable upper back must be installed on
12 the juvenile seat once the child is about 20 or 22 pounds to provide the additional
13 support height necessary for the larger child.

14 Another advantage of the removable back is that the seat can be packaged with
15 the removable back disassembled. This allows for a smaller box which saves
16 warehousing and shipping costs—especially important when shipping from overseas.

17 The two shoulder belts of the 5-point harness system of this invention are
18 adjusted vertically by means of a movable carriage or transverse beam located behind
19 the seat back. The shoulder belts pass through this carriage and through two large
20 vertical slots in the seat back, that correspond generally to the vertical range of motion
21 of the carriage. The carriage slides generally vertically or parallel to the molded seat
22 back between the two main structural rails located behind the seat back.

23 This carriage comprises of two parts that trap a pair of inwardly spring-biased
24 plungers that extend laterally from either side of the carriage. These plungers penetrate
25 vertical slots molded through each of the two structural frame rails. These slots allow a
26 range of motion of the carriage and the penetrating plungers and include apertures that
27 correspond to teeth on the plungers. The apertures and corresponding plunger teeth
28 define the various height positions of the carriage, and ultimately, the shoulder belts
29 passing through the carriage. The teeth are urged into the apertures via the spring bias.
30 Each plunger includes a finger grip area that the user may utilize to pull the plunger
31 outward, overcoming the spring and disengaging the tooth from the particular aperture.
32 Both plungers must be pulled outward simultaneously to disengage the teeth on both
33 structural frame rails and then moved, along with the carriage, to a desired height and
34 new set of apertures. Releasing the plungers allows the springs to urge the teeth

1 inward into the new set of apertures, latching the carriage into the new position.

2 Because the vertical slots and apertures are located on the outside of the structural
3 frame rails, the user can make the desired shoulder belt height adjustment without
4 uninstalling the car seat and can visually confirm what position the carriage is in and that
5 the teeth on the plungers are fully engaged.

6 The two vertical shoulder belt slots in the seat back surface are unique from the
7 equivalent slots of other car seats in that their shape is such that no cover plate is
8 required in the occupant area. Each of the two vertical slots is actually a series of
9 generally horizontal belt slots located at corresponding positions to where the shoulder
10 belts pass through the carriage as positioned by the latching apertures on the main shell
11 rails. The number of the horizontal belt slots is the same number of latching apertures.
12 The series of slots is connected by a narrow central slot of approximately 1" in width and
13 the edges are angled at approximately 45° to transition smoothly into the horizontal belt
14 slots. All corners are rounded such that the connecting slots assume a wave-like shape
15 on each side. The wave-like sides of the connecting slots allow the shoulder belts to
16 slide easily from position to position (by means of the carriage) eliminating or greatly
17 reducing the chance that the belt will "hang" as the position is changed. The central
18 connecting slot is narrow to preserve as much of the back seating surface as possible
19 and therefore eliminating the need for any kind of cover plate in front of the slots.

20 The crotch strap is also adjustable away from or closer to the back surface
21 without any disassembly. This is accomplished with a large hole molded in the seat
22 surface of the shell with a series of teeth under the seating surface on either side of the
23 hole. A sliding cover plate on the inside of the seat covers the large hole. A crotch
24 strap receiver part with a raised center section with a slot to receive the crotch strap is
25 slideably attached to the bottom of the cover plate up through the hole in the shell such
26 that the raised center section penetrates a smaller hole in the cover plate. The cover
27 plate and crotch strap receiver are biased toward each other via two springs secured to
28 the cover plate. The crotch strap receiver has teeth that correspond and engage teeth
29 on the shell via the spring bias. To adjust, the user grips the bottom of the crotch strap
30 on the raised center section of the crotch strap receiver, pushes down to disengage the
31 teeth and slides the crotch strap, crotch strap receiver, and cover plate to the desired
32 position. The spring bias urges the teeth of the crotch strap receiver and the shell to
33 engage at whatever position the crotch strap receiver is moved. The top cover plate
34 simply slides along the seating surface and provides cover for the large hole. The large

1 hole in the shell defines the overall range of motion of the crotch strap receiver and
2 ultimately, the crotch strap.

3 The recline of this convertible car seat is achieved by means of a pivoting U-
4 shaped arm with a horizontal beam and two legs terminating in hubs located under the
5 shell. The arm pivots via a lug on each hub of the arm that penetrates a corresponding
6 hole molded on the outside of each structural shell rail. The recline arm pivots rearward
7 or forward to either recline or make the seat upright. The arm is retained in either
8 reclined or upright position via an outwardly spring biased plunger located at the end of
9 each hub. The shell in this area is shaped such that the outwardly biased plungers
10 create an interference with the shell, holding the recline arm in place in either position.
11 The spring bias is only strong enough to hold the recline arm in place and is easy to
12 overcome by the user who only has to rotate the arm out of one position, which
13 compresses the springs and moves the plungers out of the way, and allows the arm to
14 swing to the next position where the biased plungers again retain arm position.

15 The forward facing auto and LATCH belt path is located about a third of the way
16 up the seat back surface and is situated in front of the two main structural rails of the
17 seat. It is defined by a trough and an opening at either end to allow threading of the
18 auto or LATCH belts. This trough is open to the front. To further strengthen the belt
19 path, a filler component is attached to the front of the trough and closes it, making a
20 double-walled structural box. The filler also covers structural shell ribs as well as
21 smoothing and further defining the belt path. A belt clamp at the center of the belt path
22 filler compresses on the auto or LATCH belts and prevents unwanted side to side
23 motion of the car seat relative to the auto seat and belts. This clamp consists of two
24 parts, a lock arm and a cam that interacts with the filler component. The lock arm is
25 pivotally attached to the belt path filler part just below where the auto belt(s) lie. The
26 cam component is pivotally attached to the opposite end of the lock arm. With the auto
27 or LATCH belts in place, the user pivots the lock arm down over the belt(s) and rotates
28 the cam down which engages two lugs on the cam part with two ledges molded onto the
29 filler part. The interaction of the cam lugs with the ledges keeps the lock arm closed,
30 and maintains pressure on the auto or LATCH belts.

31 The rear facing auto and LATCH belt path is located at the front of the convertible
32 car seat, just forward of the crotch strap attachment and on the seating surface. It is
33 defined by openings in the vertical walls on either side of the seating surface that direct
34 the auto or LATCH belts laterally over the seating surface and through each opening.

1 Adjacent to each of these openings is a recess. Inside each recess is a belt clamp
2 assembly that encompasses the width of the recess which closes the opening and
3 strengthens the path in this area. Pivotaly attached at the front of the clamp assembly
4 base is a lock arm. Pivotaly attached to the rear of the clamp assembly base is a cam.
5 The pivot axis of this cam is perpendicular to that of the lock arm axis. The auto or
6 LATCH belts are threaded through the belt path, and over the clamp assembly base. To
7 clamp the auto or LATCH belts, the user pivots the lock arm component down over the
8 belts and rotates the cam part over the end of the lock arm opposite its attachment to
9 the clamp base. The cam interaction with the lock arm relative to the clamp base keeps
10 the lock arm closed and maintains pressure on the auto or LATCH belts. The other end
11 of the belt path, on the opposite side of the seat is a mirror image of this clamp
12 base/lock arm/cam assembly. Both forward facing and rear facing belt clamps minimize
13 unwanted side to side motion of the juvenile car seat relative to the auto seat when
14 clamped onto the auto or LATCH belts.

15 The LATCH belt assembly can be stored inside the convertible car seat when not
16 in use inside two wells located to the rear and at either side of the seating surface. A
17 small tether belt attaches the LATCH belt assembly permanently to the interior of the car
18 seat shell. This tether is long enough to allow the LATCH belt assembly to reach both
19 the rear facing and forward facing belt paths, where it can be used to secure the
20 convertible car seat.

21 These and other objects of the present invention will become more readily
22 apparent from a reading of the following detailed description in conjunction with the
23 accompanying drawings, wherein like reference numerals indicate similar parts, and
24 with further reference to the appended claims.

25 ***Brief Description of the Drawings***

26 The invention may take physical form in certain parts and arrangements of parts,
27 a preferred embodiment of which will be described in detail in the specification and
28 illustrated in the accompanying drawings which form a part hereof, and wherein:

29 *FIG. 1* is a front perspective of the convertible car seat in upright, forward facing
30 configuration with upper back attached;

31 *FIG. 2* is a rear perspective of the convertible car seat in upright, forward facing
32 configuration with upper back attached;

33 *FIG. 3* is a top view of the convertible car seat in upright, forward facing
34 configuration;

1 *FIG. 4* is a bottom view of the convertible car seat in upright, forward facing
2 configuration;

3 *FIG. 5* is a left side view of the convertible car seat installed in upright, forward
4 facing configuration on an automobile seat;

5 *FIG. 6* is a left side view of the convertible car seat in reclined, rear facing
6 configuration on an automobile seat, with upper back removed;

7 *FIG. 7* is a close up view of *FIG. 5* showing a cut-away section of the metal legs
8 of the removable back inserted into the shell rail;

9 *FIG. 8A* is a close up of *FIG. 7* showing detail of removable upper back retention
10 spring and tooth engaging metal leg of the upper back;

11 *FIG. 8B* is the same view as *FIG. 8A* but with metal leg of removable upper back
12 partially disengaged from the tooth;

13 *FIG. 8C* is the same view as *FIG. 8A* but with metal leg of removable upper back
14 disengaged and showing no contact with the tooth;

15 *FIG. 9* is a close up view of *FIG. 2* with the rear cover removed to expose
16 moveable shoulder belt carriage with carriage cover also removed to expose spring-
17 biased plunger mechanism at rest;

18 *FIG. 10A* is a cut-away section through the spring-biased plunger mechanism of
19 the shoulder belt carriage showing penetration and engagement of the left plunger into
20 the left shell rail;

21 *FIG. 10B* is a cut-away section through the spring-biased plunger mechanism of
22 the shoulder belt carriage showing disengagement of the left plunger from the left shell
23 rail with spring compressed;

24 *FIG. 11A* is a cut-away section through the crotch belt receiver teeth and
25 corresponding shell teeth showing engagement in the rearmost position;

26 *FIG. 11B* is a cut-away section through the crotch belt receiver teeth and
27 corresponding shell teeth showing disengagement and a phantom of an alternate
28 position;

29 *FIG. 12A* is a cut-away section through the crotch belt showing retention within
30 the crotch belt receiver that is spring biased up towards the cover plate;

31 *FIG. 12B* is a cut-away section through the crotch belt showing the crotch belt
32 receiver depressed, with springs compressed, and receiver teeth disengaged from shell
33 teeth;

1 *FIG. 13A* is a close-up view of *FIG. 5* showing the recline leg in upright, forward
2 facing position with plunger and corresponding spring exposed;

3 *FIG. 13B* is a close-up left side view with recline leg in between reclined and
4 upright position with plunger and corresponding compressed spring exposed;

5 *FIG. 14A* is a cut-away view showing the forward facing belt path and belt clamp
6 in the open position;

7 *FIG. 14B* is a cut-away view showing the forward facing belt path and belt clamp
8 in the closed position with cam unlocked;

9 *FIG. 14C* is a cut-away view showing the forward facing belt path and belt clamp
10 in the closed position with cam locked;

11 *FIG. 15A* is a cut-away view showing the left rear facing belt clamp in open
12 position with cam unlocked;

13 *FIG. 15B* is a cut-away view showing the left rear facing belt clamp in closed
14 position with cam unlocked;

15 *FIG. 16A* is a cut-away section view through and normal to the left rear facing belt
16 clamp showing it closed with the cam in unlocked position; and

17 *FIG. 16B* is a cut-away section view through and normal to the left rear facing belt
18 clamp showing it closed with the cam in locked position.

19 ***Detailed Description of the Invention***

20 Referring now to the drawings wherein the showings are for purposes of
21 illustrating the preferred embodiment of the invention only and not for purposes of
22 limiting the same. The figures show a convertible car seat with a detachable upper back
23 to allow a proper rear facing installation in an auto as well as for the benefit of a smaller
24 package size and with an adjustable shoulder harness mechanism that never requires
25 rethreading of the harness and which can be adjusted from the front of the car seat
26 when installed on an automobile seat, as well as other inventions.

27 As illustrated in *FIG. 1*, convertible car seat **10** has two major components, seat
28 shell assembly **12** and removable upper back assembly **14**. Seat shell assembly **12**
29 incorporates a seating surface **16**, a back surface **18** which are generally perpendicular
30 to one another, and adjacent raised right side **20R** and raised left side **20L**. Raised
31 sides **20R** and **20L** incorporate inner surfaces **26R** and **26L** respectively, and outer
32 surfaces **30R** and **30L** respectively. Inner surfaces **26R** and **26L** form the main inside
33 contours of respective energy absorbing foam components **35R** and **35L** that span the
34 entire inner side surfaces of seat shell assembly **12**. Back surface **18** defines the main

1 outer contour of energy absorbing foam component **36** that covers the upper interior
2 back surface of seat assembly **12**.

3 Removable upper back assembly **14** incorporates a back surface **22** and
4 adjacent raised right side **24R** and raised left side **24L**. Raised sides **24R** and **24L**
5 incorporate inner surfaces **28R** and **28L** respectively, and outer surfaces **32R** and **32L**
6 respectively. Inner surfaces **28R** and **28L** and back surface **22** form the inner contour of
7 energy absorbing foam liner **40** which spans the entire interior of upper back assembly
8 **14**

9 Removable upper back surface **22** is essentially an extension of seat shell
10 assembly back surface **18**. Removable back inner surfaces **28R** and **28L** of raised
11 sides **24R** and **24L** are essentially extensions of seat shell assembly **12** inner surfaces
12 **26R** and **26L** of raised sides **20R** and **20L**.

13 Internal harness **42** includes shoulder/lap belts **44R** and **44L**, crotch belt **46** and
14 buckle/latch assembly **48**. Harness adjuster **50** is located in front and directly below
15 seating surface **16** where it is easily accessed. Tightening internal harness **42** is
16 achieved by pulling adjuster belt **52** through the adjuster **50**, which is connected to and
17 pulls on the shoulder/lap belts **44R** and **44L** better illustrated in *FIG. 2*. Loosening the
18 harness is done by lifting a lever on the adjuster **50** and pulling on the shoulder belts
19 which pulls adjuster belt **52** back into the adjuster **50**.

20 A sewn pad covers the majority of the car seat, but it is not shown for clarity.

21 Removable upper back outer surfaces **32R** and **32L** are essentially extensions of
22 seat shell assembly outer surfaces **30R** and **30L**, respectively, as shown in *FIG. 2*.
23 Upper back outer surfaces **32R** and **32L** are joined together by the central rear surface
24 **54**. These three surfaces define the essential shape of the plastic upper back
25 component **38** of the upper back assembly **14**. Both rear surface **54** of the plastic upper
26 back **38** and back surface **22** of the removable upper back **14** foam liner **40** are
27 penetrated by hand grip **56**.

28 Seat shell assembly **12** outer surfaces **30R** and **30L** are intersected by main rails
29 **58R** and **58L** located behind back surface **18** and below seating surface **16**. Main rails
30 **58R** and **58L** share rear contoured surface **60**, bottom contoured surface **62** (also
31 shown in *FIG. 4*), and also include inner surfaces **66R** and **66L** and outer surfaces **64R**
32 and **64L**, respectively. Inner surfaces **66R** and **66L** extend upward under the seat and
33 are bridged by seating surface **16**. This combination of surfaces defines the essential
34 form of the main molded plastic seat shell **34**.

1 Rear rail cover **68** connects main rails **58R** and **58L** and shares rear surface **60**
2 with them. Rear cover **68** includes instruction storage recess **70**. Apertures **72** are
3 located near the top of main rails **58R** and **58L** and accept angled metal component **74**
4 of removable upper back assembly **14**. *FIG 7* illustrates metal component **74** inserted
5 through aperture **72** and down inside main rail **58R/58L**. *FIG 8A* more clearly shows
6 spring **80** biasing tooth **82** into slot or notch **78** on metal component **74**. When metal
7 component **74** is inserted into main rails **58R** and **58L** (better illustrated in *FIG 8C*),
8 angled tip **76** acts on tooth **82**, moving it out of the way and overcoming the bias of
9 spring **80** (see *FIG 8B*) to allow metal component **74** to pass far enough for alignment
10 and consequential biased engagement of tooth **82** with slot **78**. Tooth removal lever **84**
11 may be pulled to disengage tooth **82** from slot **78**, compressing spring **80**, for removal of
12 metal component **74** from main rails **58R** and **58L**, also shown in *FIGS 8B* and *8C*.

13 Movable shoulder belt carriage assembly **88** (synonymously moveable transverse
14 adjustment beam) shown in *FIG. 9*, manages the height of shoulder belts **44R** and **44L**.
15 Shoulder belts **44R** and **44L** pass through slots **100R** and **100L** in moveable carriage
16 body **90** that lies between main rails **58R** and **58L**. Plungers **92R** and **92L** extend
17 laterally from either end of carriage body **90** and penetrate substantially vertical slots
18 **86R** and **86L** in main rails **58R** and **58L**. Springs **96** bias plungers **92R** and **92L** inward
19 relative to carriage body **90** and drive tooth **94** located on each plunger **92R** and **92L**
20 (*FIG. 10A, 10B*) into recesses **98** located adjacent to vertical slots **86R** and **86L** in main
21 rails **58R** and **58L**. A series of generally evenly spaced recesses **98** adjacent to vertical
22 slots **86R** and **86L** (see *FIGS. 5 – 6*) define the alternative vertical positions of carriage
23 assembly **88**, and ultimately the vertical positions of shoulder belts **44R** and **44L** within
24 the global range of adjustability permitted by vertical slots **86R** and **86L**. *FIG. 5*
25 illustrates the highest position **110** while *FIG. 6* illustrates the lowest position **112**.
26 Adjusting the height of the shoulder belt carriage assembly **88** requires that both
27 plungers **92R** and **92L** be pulled outward simultaneously, overcoming biasing springs **96**
28 and disengaging tooth **94** located on each plunger **92R** and **92L** from current position
29 recesses **98** as shown in *FIG. 10B*. The shoulder belt carriage assembly **88** can then be
30 raised or lowered to the desired position where tooth **94** from each plunger **92R** and **92L**
31 can align and engage with another position of recess **98** via the bias of spring **96** as
32 shown in *FIG. 10A*.

33 *FIG. 1* shows right and left shoulder belt slots **102R** and **102L**. Each generally
34 vertical slot **102R** and **102L** includes multiple generally horizontal shoulder belt slots

1 **104**, a narrow and generally vertical connecting slot **106**, and transition ramps **108**
2 forming an hourglass arrangement. The number and vertical position of horizontal slots
3 **104** corresponds directly to the number and vertical position of recesses **98** adjacent to
4 vertical slots **86R** and **86L** in main rails **58R** and **58L**. Narrow connecting slot **106**
5 allows shoulder belts **44R** and **44L** to slide from one set of horizontal shoulder belt slots
6 **104** to the next set of slots **104**, by means of movable shoulder belt carriage assembly
7 **88**, without requiring that vertical slots **102R** and **102L** be as wide as horizontal slots
8 **104** along their entire length. The narrow areas of connecting slot **106** between the
9 horizontal slot **104** positions preserve and maximize back surface **18** to increase
10 occupant support and comfort and eliminate the need for any type of cover plate to
11 conceal what would be larger voids. Transition ramps **108** allow the shoulder belts to
12 slide easily through the narrow connecting slot **106**, as shoulder belt height is adjusted
13 from position to position, and reduces the chances of the shoulder belts "hanging up".

14 Crotch belt **46** is adjustable away from or closer to back surface **18** of seat shell
15 assembly **12** and best illustrated in *FIGS. 11A* and *11B*, and *FIGS. 12A* and *12B*.
16 Crotch belt **46** is attached to belt receiver **114** through crotch slot **116**. Belt receiver **114**
17 attaches below seating surface **16** and extends up through large opening **124** (also
18 shown in *FIG. 4*) in seating surface **16** of seat shell assembly **12** and through smaller
19 opening **122** in cover plate **120** (also shown in *FIG. 3*). Belt receiver **114** is coupled to
20 and biased by springs **128**, upward, toward cover plate **120**, essentially sandwiching this
21 area of seat shell **34**. Belt receiver **114** incorporates teeth **118** on each side that are
22 sized and spaced to correspond with teeth **126** located underneath seating surface **16**
23 that flank either side of large opening **124**. The bias of springs **128** on belt receiver **114**
24 up toward cover plate **120** also biases crotch belt receiver teeth **118** up and into seat
25 shell teeth **126**. This biased engagement maintains position of belt receiver **114** and
26 ultimately, crotch belt **46**. Adjustment of crotch strap **46** position is accomplished by
27 gripping the base of strap **46** where it enters belt receiver **114** at crotch slot **116**, and
28 pushing down on receiver **114** to overcome the bias of springs **128** with cover plate **120**
29 and disengaging the teeth **118** of receiver **114** from seat shell teeth **126** (*FIGS. 11B*,
30 *12B*). With teeth disengaged, the belt receiver **118** and crotch belt **46** can be moved to
31 a new position where teeth **118** of receiver **114** can align with and engage different shell
32 teeth **126** by means of springs **128** as illustrated in *FIG. 11B*.

33 Recline leg **130** manages the forward facing position **132** (*FIG. 5*) and rear facing
34 position **134** (*FIG. 6*) of convertible car seat **10**. Recline leg **130** is rotatably attached to

1 main rails **58R** and **58L** at pivot axis **140**. Adjacent to the attachment and pivot axis **140**
 2 of recline leg **130** is a recess defined by contoured surface **142** in both main rails **58R**
 3 and **58L**. Surface **142** is formed such that it limits the range of motion for recline leg **130**
 4 and defines upright position **132** where recline leg **130** supports the rear of convertible
 5 car seat **10** as illustrated in *FIG. 5* and reclined position **134** where recline leg **130**
 6 supports the front of convertible car seat **10** as illustrated in *FIG. 6*. Each side of recline
 7 leg **130** contains a sliding plunger **136** that is biased by springs **138** beyond the
 8 envelope of recline leg **130**. The bias of springs **138** forces plungers **136** to interfere
 9 with contoured surface **142**, maintaining recline leg **130** in either upright position **132**
 10 (also shown in *FIG. 13A*) or reclined position **134**, and preventing it from flopping freely
 11 between the two positions. The bias of springs **138** is only enough to support the weight
 12 of recline leg **130** itself, and is easily overcome by a consumer grasping and rotating
 13 recline leg **130** to change position. *FIG. 13B* illustrates recline leg **130** in between
 14 positions **132** and **134** with plunger **136** forced inside recline leg **130**, with spring **138**
 15 compressed and sliding along surface **142** until recline leg **130** is rotated to either
 16 position **132** or **134**.

17 *FIG. 5* illustrates automobile seat **180** and the interaction with convertible car seat
 18 **10** in forward facing position **132**. *FIG. 6* illustrates automobile seat **180** and the
 19 interaction with convertible car seat **10** in rear facing position **134** and front automobile
 20 seat back **182** in close proximity to the top of convertible car seat **10**. If removable
 21 upper back assembly **14** were installed on car seat **10**, it would likely interfere with front
 22 automobile seat back **182** and prevent car seat **10** from installing properly on automobile
 23 seat **180** in rear facing position **134**.

24 Forward facing belt path **184** incorporates an auto belt clamp **186** at its
 25 approximate center as shown in *FIG. 1*. *FIG. 14A* shows a side view of belt path **184**
 26 and belt clamp **186** with auto belt **156** threaded through belt path **184**. Lock arm **144** is
 27 pivotally attached to the lower part of belt path **184** at axis **152** and is shown in an open
 28 position. Cam **146** is pivotally attached to lock arm **144** at axis **154** and includes locking
 29 lugs **148**. Belt path **184** also includes locking ledges **150**. *FIG. 14B* shows lock arm **144**
 30 closed against auto belt **156** with cam **146** in an unsecured position. *FIG. 14C* shows
 31 cam **146** closed against lock arm **144** with locking lugs **148** of cam **146** engaged under
 32 locking ledges **150** of belt path **140**. Engagement of locking lugs **148** and ledges **150**
 33 prevent lock arm **144** from opening and maintains constant pressure on auto belt **156**.
 34 To release lock arm **144**, the user must rotate cam **146** upward, disengaging locking

1 lugs **148** from locking ledges **150** so lock arm **144** can be rotated open, releasing
2 pressure on auto belt **156**, which can then be unthreaded from belt path **184**.

3 Openings **160R** and **160L** as shown in *FIG. 3*, establish a rear facing auto belt
4 path for convertible car seat **10** with rear facing belt clamps **162R** and **162L** adjacent to
5 openings **160R** and **160L** and generally flush with seating surface **16**. *FIG. 15A* shows
6 a side view of belt clamp **162L**, that comprises a clamp base **164**, lock arm **166** pivotally
7 connected to the forward end of clamp base **164** at axis **168**, cam **172** pivotally
8 connected to the rear edge of clamp base **164**, at axis **174** which is perpendicular to
9 axis **168**, and auto belt **178**. Lock arm **166** is open and away from clamp base **164** and
10 incorporates collar **170** on the end opposite axis **168**. *FIG. 15B* shows lock arm **166**
11 closed and against clamp base **164** and auto belt **178**. *FIG. 16A* shows cam **172** in the
12 unlocked position (as in *FIG. 15B*), with sleeve **176** of cam **172** in unsecured
13 relationship to collar **170** on lock arm **166**. Rotating cam **172** down as shown in *FIG.*
14 *16B* moves sleeve **176** over collar **170** of lock arm **166**, securing lock arm **166** and
15 maintaining constant pressure on auto belt **178**.

16 In the foregoing description, certain terms have been used for brevity, clearness
17 and understanding; but no unnecessary limitations are to be implied therefrom beyond
18 the requirements of the prior art, because such terms are used for descriptive purposes
19 and are intended to be broadly construed. Moreover, the description and illustration of
20 the invention is by way of example, and the scope of the invention is not limited to the
21 exact details shown or described. This invention has been described in detail with
22 reference to specific embodiments thereof, including the respective best modes for
23 carrying out each embodiment. It shall be understood that these illustrations are by way
24 of example and not by way of limitation.

What is Claimed is:

1. A car seat for transporting a child in an automobile comprising:
 - a car seat belt harness, said harness comprising:
 - a pair of shoulder belts; and
 - an adjuster belt connected to said shoulder belts;
 - a car seat shell, said shell having a seat portion and a back portion, said back portion having a pair of spaced apart car seat back portion longitudinal slots for threading of said shoulder belts of said harness therethrough;
 - a pair of rails positioned on a rear side of said back portion, said rails having a headrest aperture in a top portion of said rails and a rail longitudinal slot extending along at least a portion of a side of said rails;
 - a moveable transverse adjustment beam between said rails, said beam controlling a height of said shoulder belts;
 - a moveable beam securing means;
 - a positionable crotch strap adjustment means in said seat portion; and
 - a removable headrest having a pair of downwardly-extending projections, said projections positionable into said headrest apertures of said rails and secured into said rails by at least one rail securing means.
2. The car seat of claim 1 wherein
 - said slots for threading of said shoulder belts have at least one hourglass shape.
3. The car seat of claim 1 wherein
 - said removable headrest projections have at least one notch for securing engagement with a spring-biased tooth.
4. The car seat of claim 3 wherein
 - said removable headrest projections have at least two notches for securing engagement with said spring-biased tooth.

5. The car seat of claim 1 wherein

said beam securing means further comprises at least two recesses adjacent said rail longitudinal slots for mating engagement with a spring-biased tooth on a plunger handle at opposed ends of said moveable transverse beam.

6. The car seat of claim 5 wherein

said beam securing means further comprises at least three recesses adjacent said rail longitudinal slots.

7. The car seat of claim 1 which further comprises:

a rear securing means for securing a vehicle seat belt when said car seat is facing forward; and

a front pair of securing means for securing said vehicle seat belt when said car seat is facing rearward.

8. The car seat of claim 1 which further comprises:

a repositionable recline leg for adjusting an angle of inclination of said car seat depending on whether it is facing in a rear or a forward direction by movement from a first to a second position, said recline leg pivotally attached to a bottom portion of said rails.

9. The car seat of claim 8 wherein said repositionable recline leg further comprises:

an outwardly-biased sliding plunger which interfaces with an undersurface of said car seat shell and retains said plunger either in said first or second position and is movable therebetween by manual force to overcome said outward biasing of said plunger.

10. The car seat of claim 7 wherein said rear securing means comprises:

a rear pivotal lock arm with a rear cam and locking lugs pivotally attached to said locking arm;

said car seat shell having a plurality of rear locking ledges in underlying axial relationship to said rear pivotal lock arm;

wherein pivotal movement of said rear lock arm in conjunction with pivotal movement of said rear cam and rear locking lugs from an open to a closed position engages said rear locking lugs and said rear locking ledges in physical pressured contact with said vehicle belt thereby preventing lateral movement of said vehicle belt when said rear lock arm and rear cam and rear locking lugs are in said closed position.

11. The car seat of claim 7 wherein said front pair of securing means comprises:

a front clamp base;

a front lock arm pivotally connected to a first end of said clamp base and having a collar at an opposed second end;

a front cam pivotally connected to said second end of said clamp base, said pivotal movement directionally transverse to said pivotal movement of said front lock arm;

said car seat shell having a plurality of front locking ledges in underlying axial relationship to said front pivotal lock arm;

wherein pivotal movement of said front lock arm in conjunction with subsequent pivotal movement of said front cam from an open to a closed position engages said collar of said front lock arm with a sleeve within said front cam whereby said front locking ledges are in physical pressured contact with said vehicle belt thereby preventing lateral movement of said vehicle belt when said front lock arm and front cam are in said closed position.

12. The car seat of claim 1 wherein said moveable transverse adjustment beam has a pair of beam slots to receive said shoulder belts,

said beam slots in axial alignment with said spaced apart longitudinal slots in said back portion of said car seat shell, to receive said shoulder belts,

said beam secured into said rails by a pair of beam securing means.

13. The car seat of claim 1 wherein said positionable crotch strap adjustment means comprises:

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a moveable plate essentially under said seating area, said plate moveable within an opening in said seating area, said crotch strap secured to said moveable plate;

said moveable plate spring biased against a bottom surface of said seating area;

wherein said spring bias causes protrusions on said moveable plate to engage recesses on said bottom surface of said seat controlling said moveable plate location; and

wherein pushing downward on said moveable plate causes said protrusions to disengage said recesses allowing said moveable plate to move from a first to at least one second position, and wherein releasing said moveable plate allows said protrusions to engage alternate recesses on bottom of said seat.

14. The car seat of claim 13 wherein said positionable crotch strap adjustment means further comprises

a cover plate above said moveable plate.

15. A shoulder belt adjustment system for use in a car seat comprising:

at least a pair of shoulder belts;

a car seat shell, said shell having a seat portion and a back portion, said back portion having a pair of spaced apart car seat back portion longitudinal slots for threading of said shoulder belts of said harness therethrough;

a pair of rails positioned on a rear side of said back portion, said rails having a rail longitudinal slot extending along at least a portion of a side of said rails;

a moveable transverse adjustment beam between said rails and extending through said rail longitudinal slots, said beam controlling a height of said shoulder belts; and

a beam securing means to maintain said beam at a desired location.

16. The shoulder belt adjustment system of claim 15 wherein
said slots for threading of said shoulder belts have at least one hourglass shape.
17. The shoulder belt adjustment system of claim 16 wherein
said beam securing means further comprises at least two recesses adjacent said rail longitudinal slots for mating engagement with a spring-biased tooth on a plunger handle at opposed ends of said moveable transverse beam.
18. The shoulder belt adjustment system of claim 17 wherein
said beam securing means further comprises at least three recesses adjacent said rail longitudinal slots.
19. The shoulder belt adjustment system of claim 17 wherein said moveable transverse adjustment beam has a pair of beam slots to receive said shoulder belts,
said beam slots in axial alignment with said spaced apart longitudinal slots in said back portion of said car seat shell, to receive said shoulder belts.
20. A rear lock for a child car seat used with a vehicle seat belt when said car seat is facing forward comprising:
a pivotal lock arm with a cam and locking lugs pivotally attached to said locking arm;
a vehicle belt locking means for interfacing with said pivotal locking means;
and
wherein pivotal movement of said lock arm in conjunction with pivotal movement of said cam with locking lugs from an open to a closed position engages said locking lugs and said vehicle belt locking means in physical pressured contact with said vehicle belt thereby preventing lateral movement of said vehicle belt when said lock arm and cam with locking lugs are in said closed position.
21. The rear lock of claim 20 wherein said vehicle belt locking means comprises:

a plurality of locking ledges in underlying axial relationship to said pivotal lock arm.

22. A front lock for a child car seat used with a vehicle seat belt when said car seat is facing rearward comprising:

a clamp base;

a lock arm pivotally connected to a first end of said clamp base and having a collar at an opposed second end;

a cam pivotally connected to said second end of said clamp base, said pivotal movement directionally transverse to said pivotal movement of said lock arm;

said clamp base having a vehicle belt locking means for interfacing with said pivotal lock arm; and

wherein pivotal movement of said lock arm in conjunction with subsequent pivotal movement of said cam from an open to a closed position engages said collar of said lock arm with a sleeve within said cam whereby said lock arm in physical pressured contact with said vehicle belt through said belt locking means prevents lateral movement of said vehicle belt when said front lock arm and front cam are in said closed position.

23. The front lock of claim 22 wherein said vehicle belt locking means comprises:

a plurality of front locking ledges in underlying axial relationship to said pivotal lock arm.

24. A car seat shoulder harness adjustment system comprising:

a seating area and a back area having two spaced apart shoulder belt longitudinal slots;

a pair of left and right rails behind said back area and at least a portion of said seating area, each of said rails having a longitudinal slot disposed therein;

a transverse adjustment beam behind said back wherein,

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said beam is adjustable through at least two vertical distances,

said beam penetrating said slots in said left and right side rails,

said beam having two knobs at opposed ends of said beam and exterior of said slots, and wherein

said knobs comprise inwardly-biased extensions of said beam which engage at least two different recesses adjacent said longitudinal slots in said rails, a shoulder belt passing through each of said shoulder belt slots, and wherein a height of said beam controls a height of said shoulder belts; and

wherein outward force sufficient to overcome said inwardly-biased extensions allows movement of said beam between said at least two vertical distances.

25. An adjustable crotch strap in a car seat for transporting a child comprising:

a seating area and a back area;

said crotch strap secured to a movable plate essentially under said seating area, said plate movable within an opening in said seating area;

said moveable plate spring biased against a bottom surface of said seating area;

wherein said spring bias causes protrusions on said moveable plate to engage recesses on said bottom surface of said seat controlling said moveable plate location; and

wherein pushing downward on said moveable plate causes said protrusions to disengage said recesses allowing said moveable plate to move from a first to at least one second position, and wherein releasing said moveable plate allows said protrusions to engage alternate recesses on bottom of said seat.

26. The adjustable crotch strap of claim 25 which further comprises:

a cover plate above said seat portion.

27. A convertible car seat for use as both an infant rear-facing car seat as well as for a toddler forward-facing car seat comprising:

a seat with a front and a back with contiguous left and right vertically extending sidewalls wherein said back and vertically extending sidewalls comprise a lower section;

said seat having a separable upper section secured to said seat by a securing means;

said seat having a recline stand which adjusts the angle of said back from a generally upright position for forward-facing use to an angled position for rearward-facing use; and wherein

said upper section may be removed for rearward facing use causing a reduction in a distance measured from said front of seat to a top of said seat.

28. A car seat for transporting a child in an automobile comprising:

a car seat belt harness, said harness comprising:

a pair of shoulder belts; and

an adjuster belt connected to said shoulder belts;

a car seat shell, said shell having a seat portion and a back portion, said back portion having a pair of spaced apart car seat back portion longitudinal slots for threading of said shoulder belts of said harness therethrough;

a pair of rails positioned on a rear side of said back portion, said rails having a headrest aperture in a top portion of said rails and a rail longitudinal slot extending along at least a portion of a side of said rails;

a moveable transverse adjustment beam between said rails and extending through said rail longitudinal slot, said beam controlling a height of said shoulder belts;

a transverse adjustment beam securing means;

a positionable crotch strap adjustment means in said seat portion;

a removable headrest having a pair of downwardly-extending projections, said projections positionable into said headrest apertures of said rails and secured into said rails by at least one rail securing means;

a single rear securing means for securing a vehicle seat belt when said car seat is facing forward; and

a front pair of securing means for securing said vehicle seat belt when said car seat is facing rearward.

29. The car seat of claim 28 wherein

said slots for threading of said shoulder belts have at least one hourglass shape.

30. The car seat of claim 28 wherein

said removable headrest projections have at least one notch for securing engagement with a spring-biased tooth.

31. The car seat of claim 30 wherein

said removable headrest projections have at least two notches for securing engagement with said spring-biased tooth.

32. The car seat of claim 28 wherein

said beam securing means further comprises at least two recesses adjacent said rail longitudinal slots for mating engagement with a spring-biased tooth on a plunger handle at opposed ends of said moveable transverse beam.

33. The car seat of claim 32 wherein

said beam securing means further comprises at least three recesses adjacent said rail longitudinal slots.

34. The car seat of claim 28 which further comprises:

a repositionable recline leg for adjusting an angle of inclination of said car seat depending on whether it is facing in a rear or a forward direction by movement from a first to a second position, said recline leg pivotally attached to a bottom portion of said rails.

35. The car seat of claim 34 wherein said repositionable recline leg further comprises:

an outwardly-biased sliding plunger which interfaces with an undersurface of said car seat shell and retains said plunger either in said first or second position and is movable therebetween by manual force to overcome said outward biasing of said plunger.

36. The car seat of claim 28 wherein said rear securing means comprises:

a rear pivotal lock arm with a rear cam and locking lugs pivotally attached to said locking arm;

said car seat shell having a plurality of rear locking ledges in underlying axial relationship to said rear pivotal lock arm;

wherein pivotal movement of said rear lock arm in conjunction with pivotal movement of said rear cam and rear locking lugs from an open to a closed position engages said rear locking lugs and said rear locking ledges in physical pressured contact with said vehicle belt thereby preventing lateral movement of said vehicle belt when said rear lock arm and rear cam and rear locking lugs are in said closed position.

37. The car seat of claim 28 wherein said front pair of securing means comprises:

a front clamp base;

a front lock arm pivotally connected to a first end of said clamp base and having a collar at an opposed second end;

a front cam pivotally connected to said second end of said clamp base, said pivotal movement directionally transverse to said pivotal movement of said front lock arm;

said car seat shell having a plurality of front locking ledges in underlying axial relationship to said front pivotal lock arm;

wherein pivotal movement of said front lock arm in conjunction with subsequent pivotal movement of said front cam from an open to a closed position engages said collar of said front lock arm with a sleeve within said front cam whereby said front locking ledges are in physical

-25-

pressured contact with said vehicle belt thereby preventing lateral movement of said vehicle belt when said front lock arm and front cam are in said closed position.

38. The car seat of claim 28 wherein said moveable transverse adjustment beam has a pair of beam slots to receive said shoulder belts,

said beam slots in axial alignment with said spaced apart longitudinal slots in said back portion of said car seat shell, to receive said shoulder belts,

said beam secured into said rails by a pair of beam securing means.

39. The car seat of claim 28 wherein said positionable crotch strap adjustment means comprises:

a moveable plate essentially under said seating area, said plate moveable within an opening in said seating area, said crotch strap secured to said moveable plate;

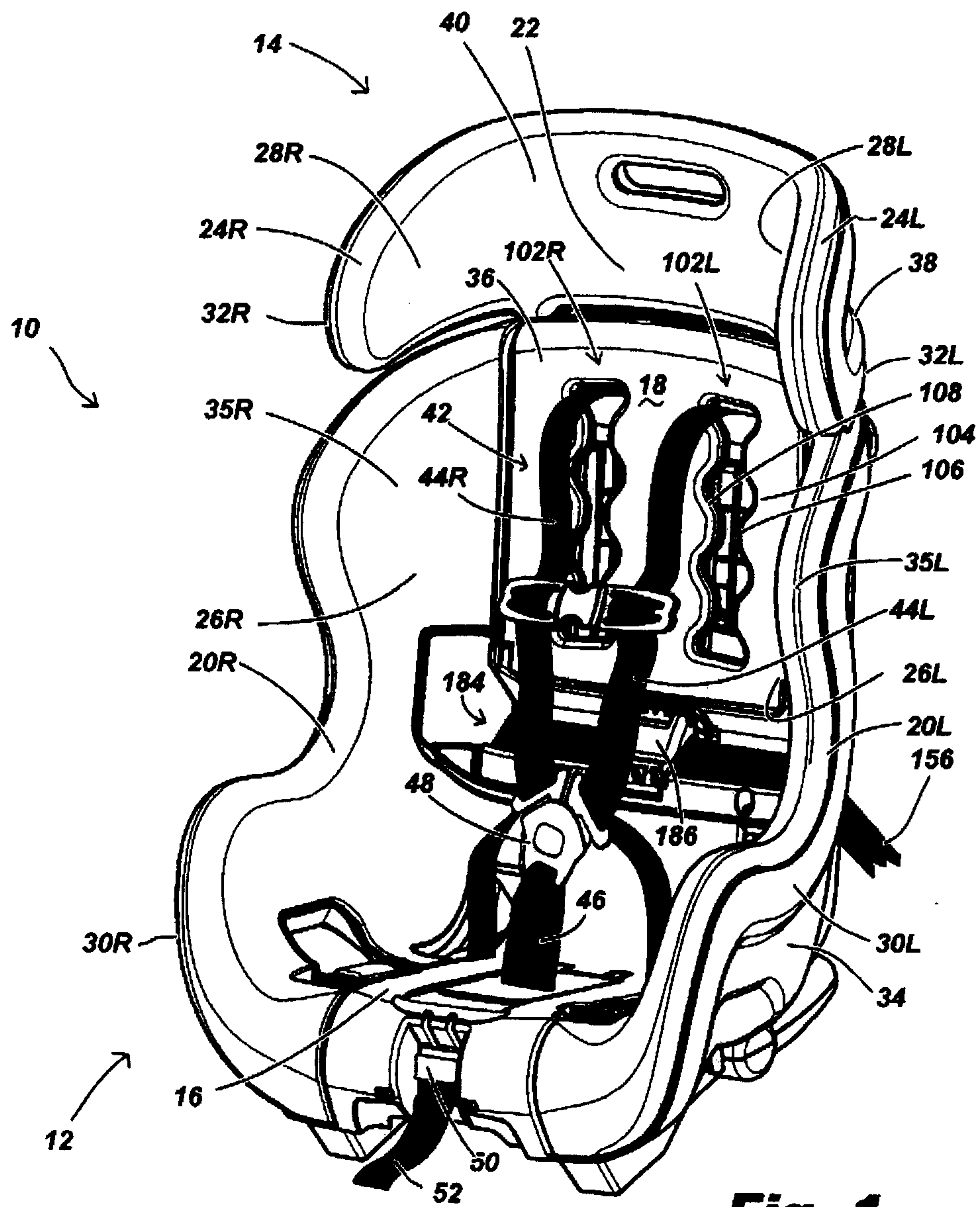
said moveable plate spring biased against a bottom surface of said seating area;

wherein said spring bias causes protrusions on said moveable plate to engage recesses on said bottom surface of said seat controlling said moveable plate location; and

wherein pushing downward on said moveable plate causes said protrusions to disengage said recesses allowing said moveable plate to move from a first to at least one second position, and wherein releasing said moveable plate allows said protrusions to engage alternate recesses on bottom of said seat.

40. The car seat of claim 39 wherein said positionable crotch strap adjustment means further comprises

a cover plate above said moveable plate.



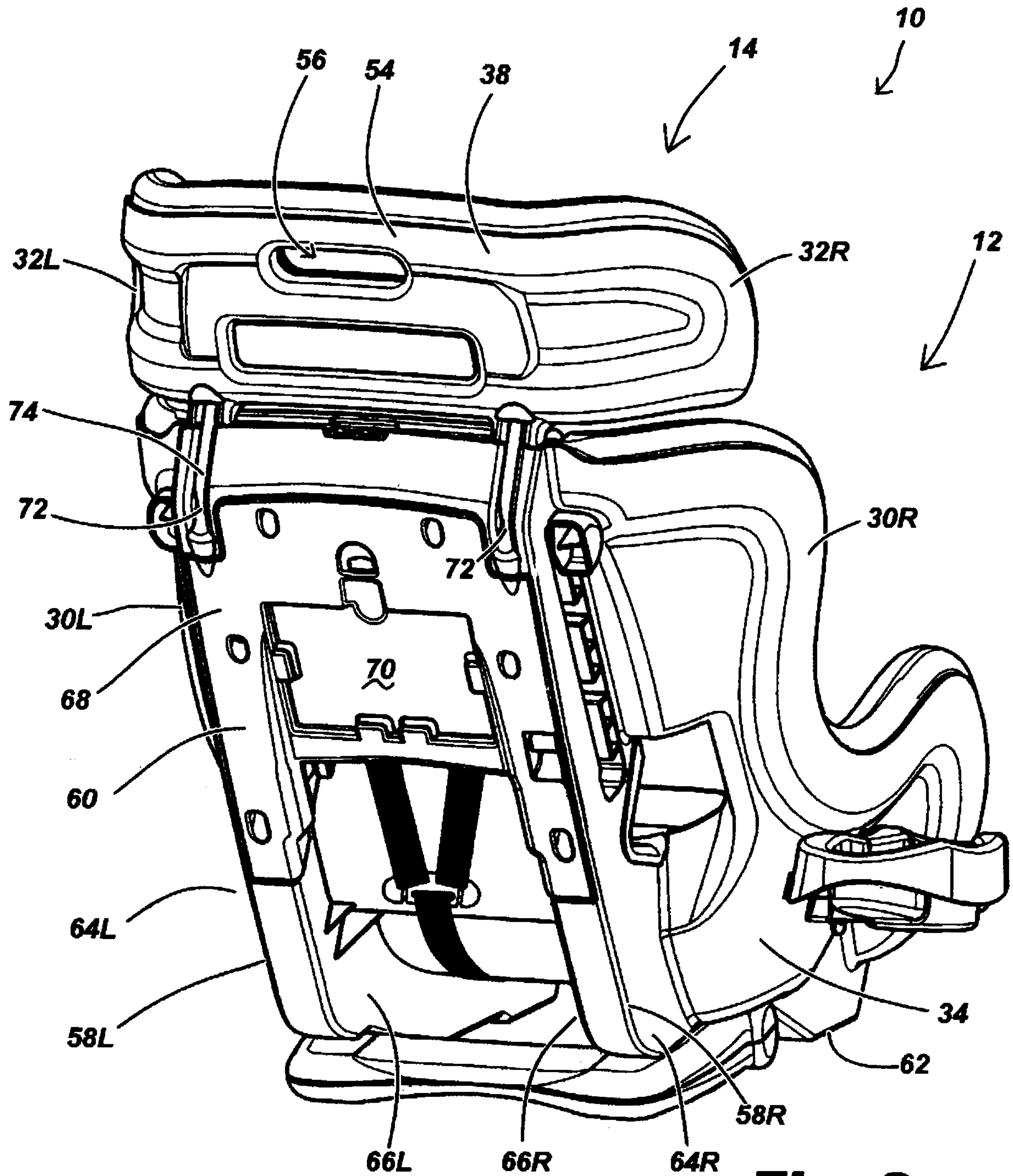


Fig. 2

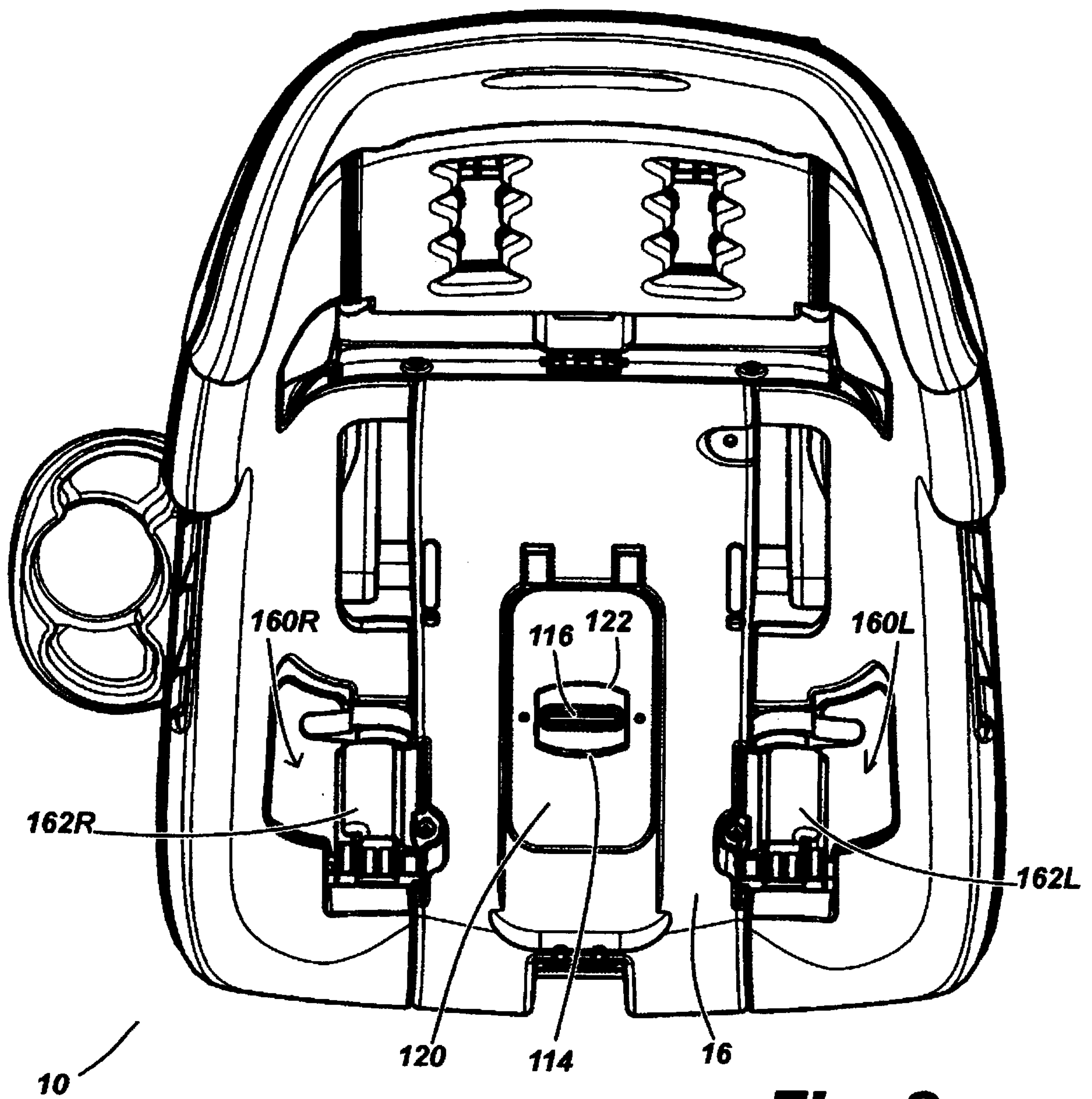


Fig. 3

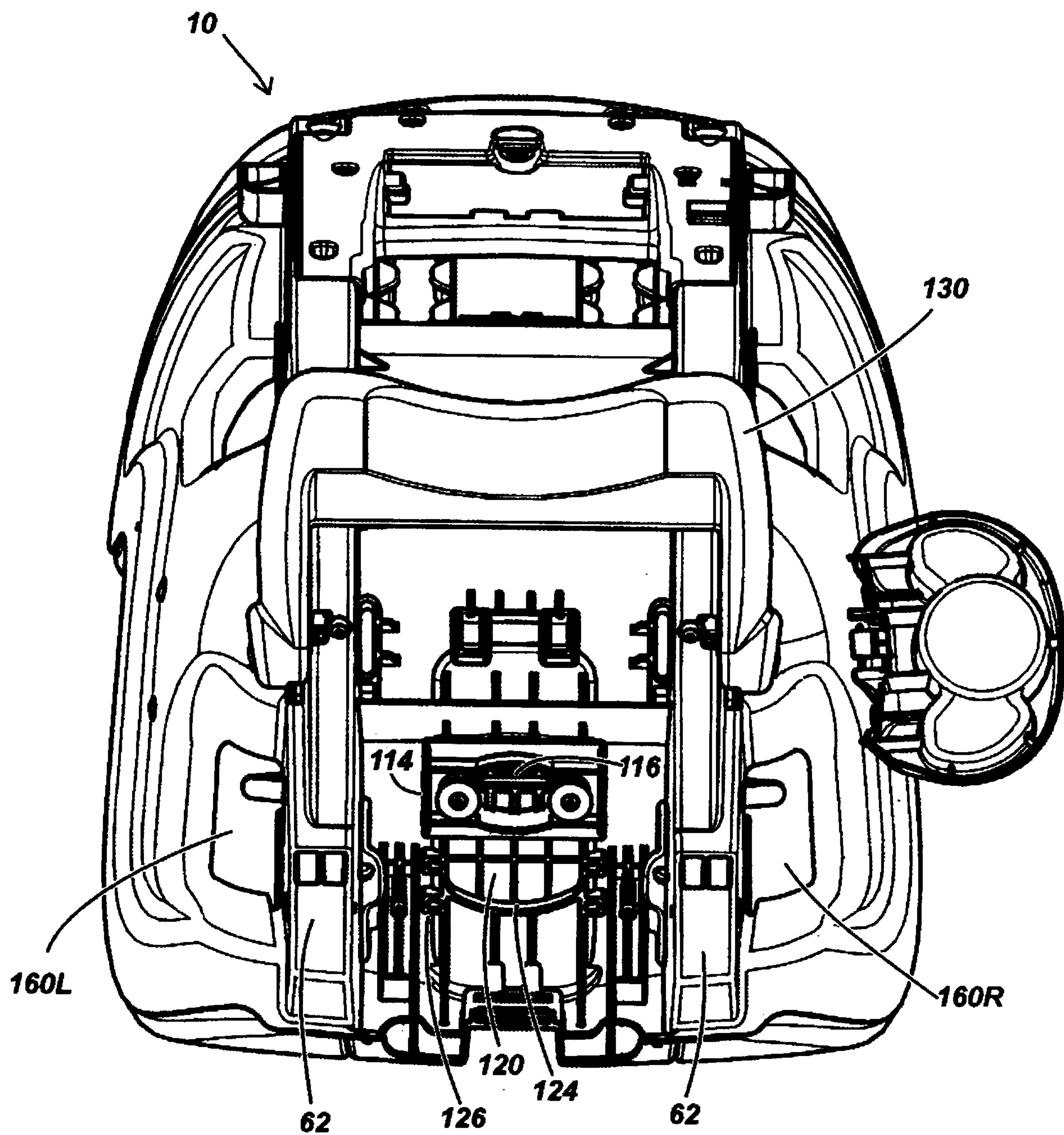
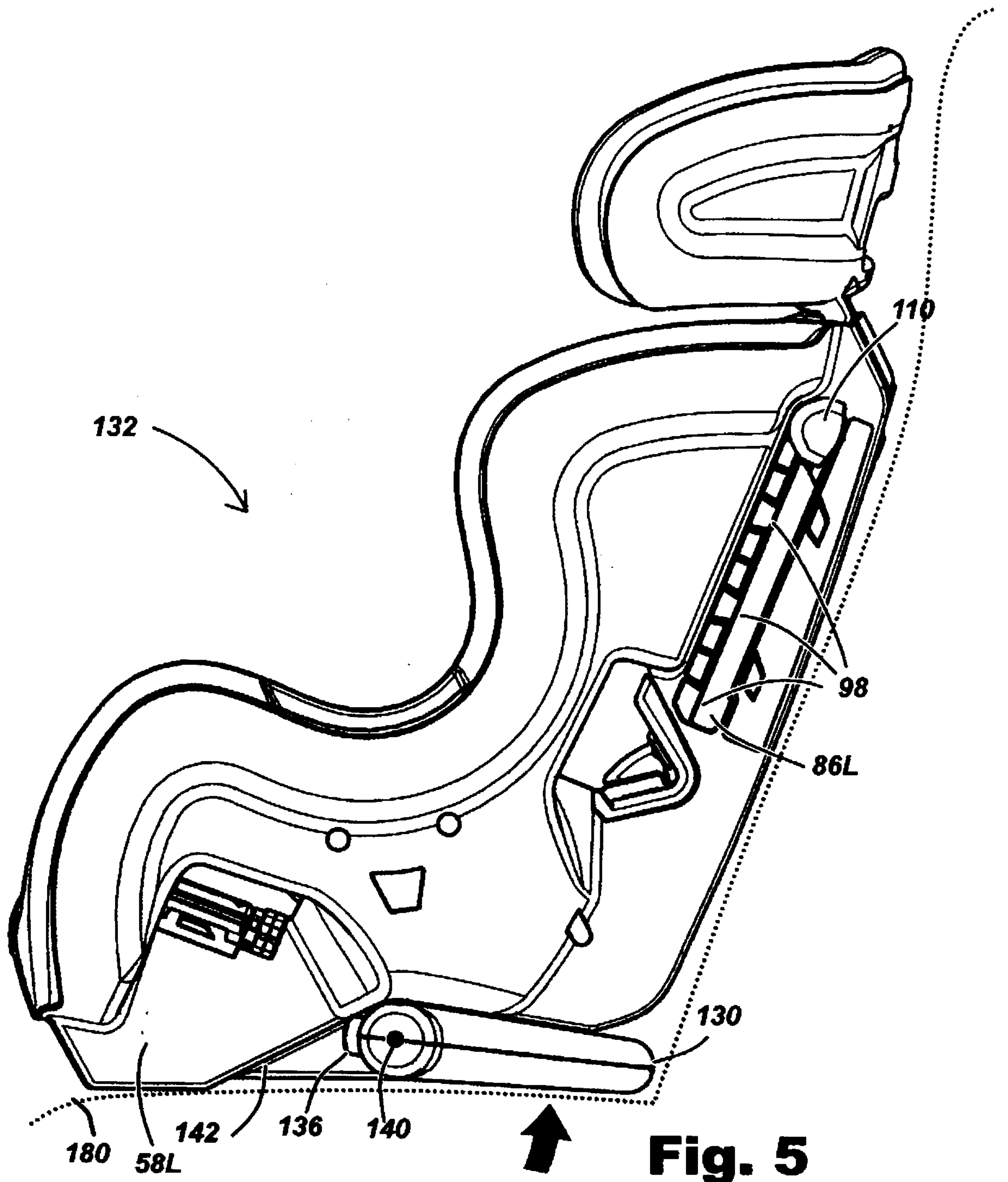


Fig. 4



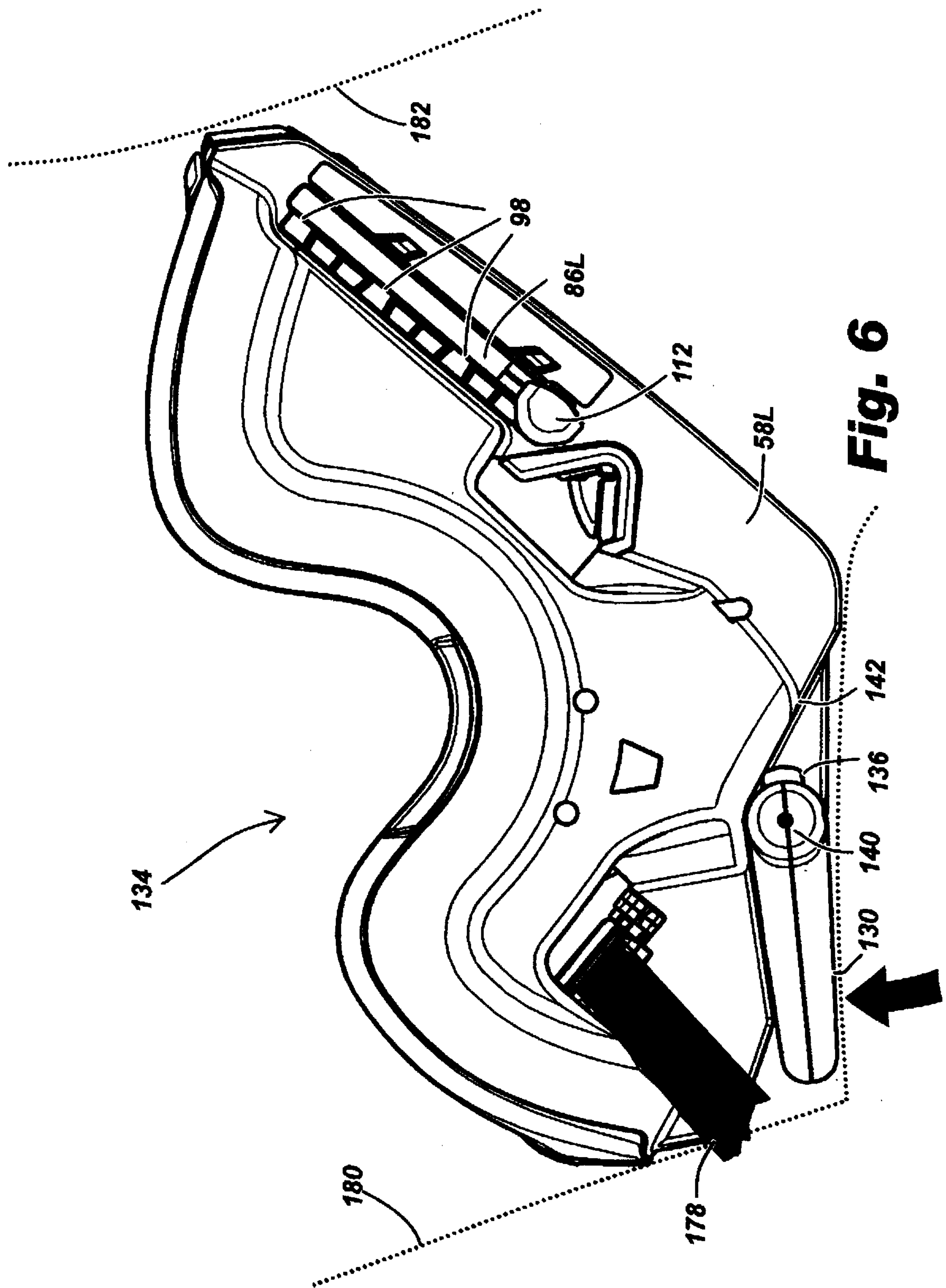


Fig. 6

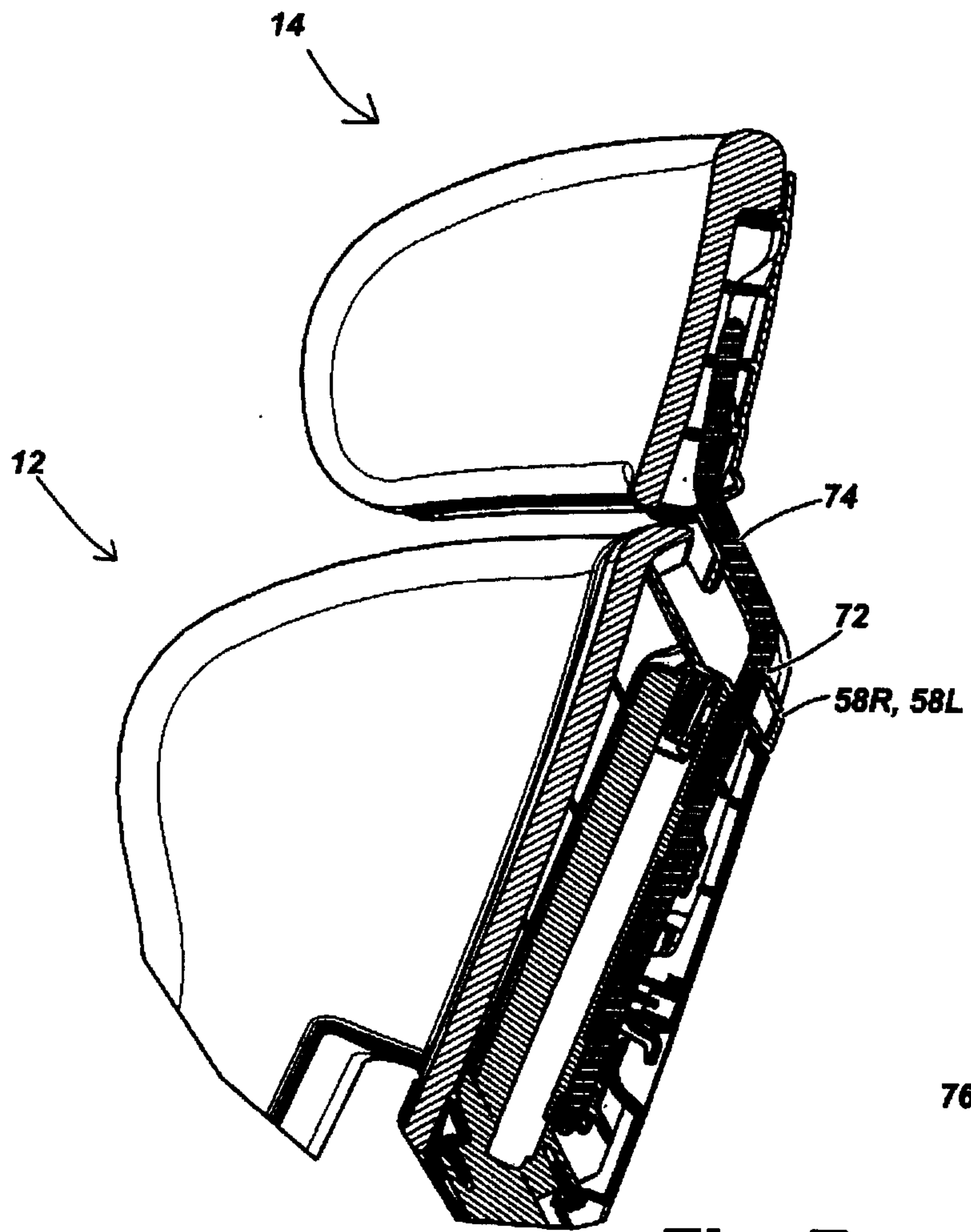


Fig. 7

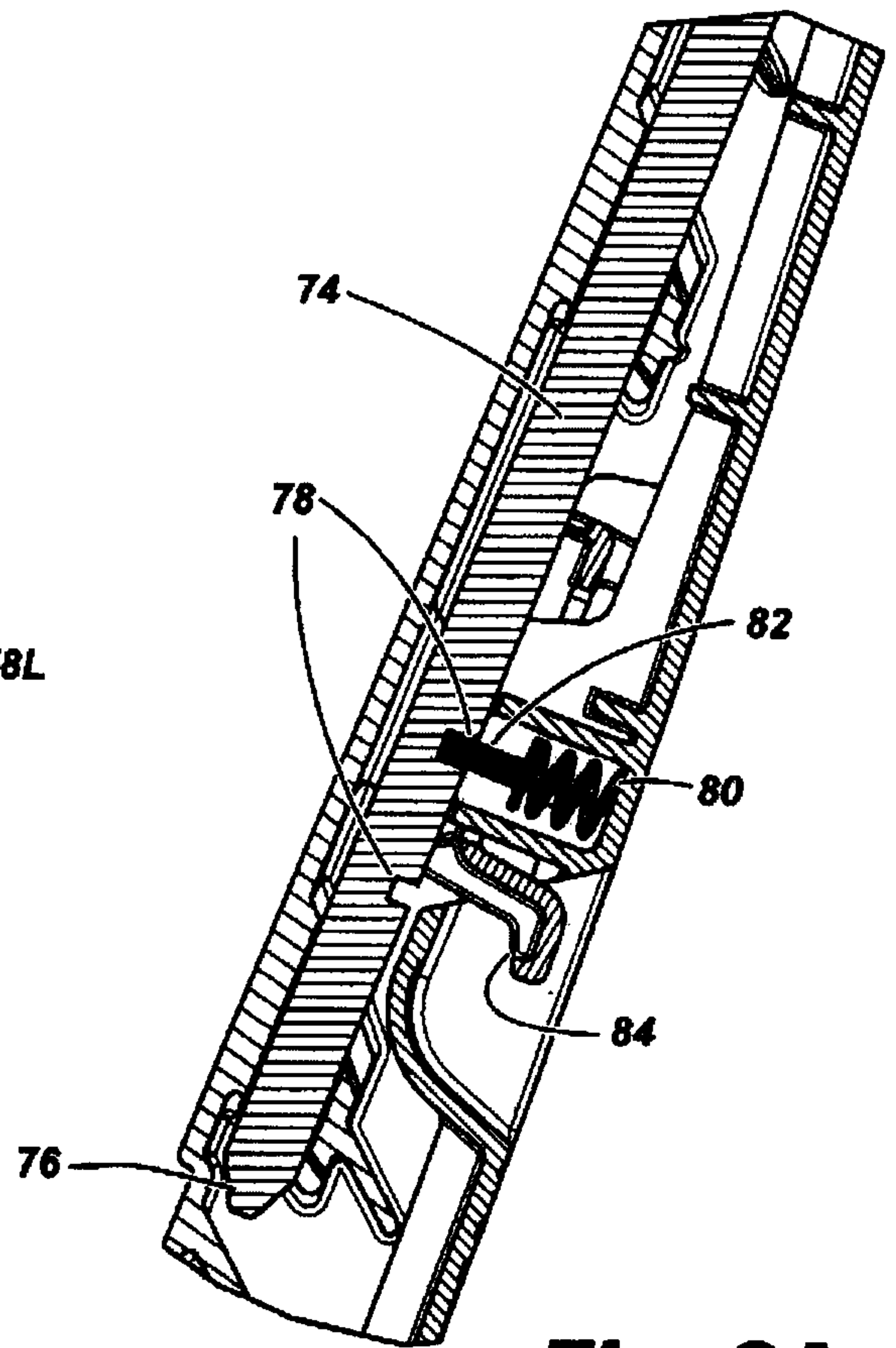


Fig. 8A

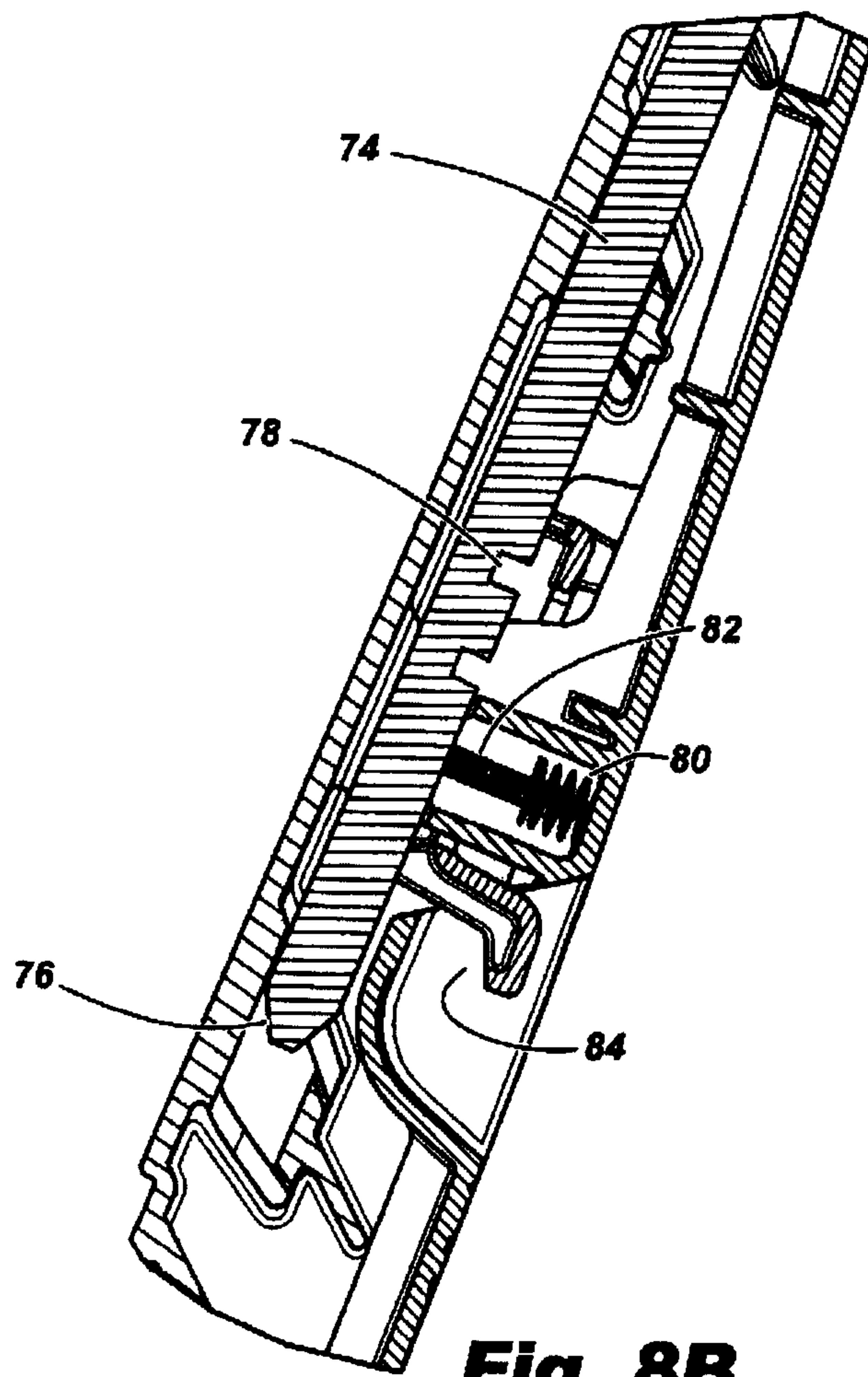


Fig. 8B

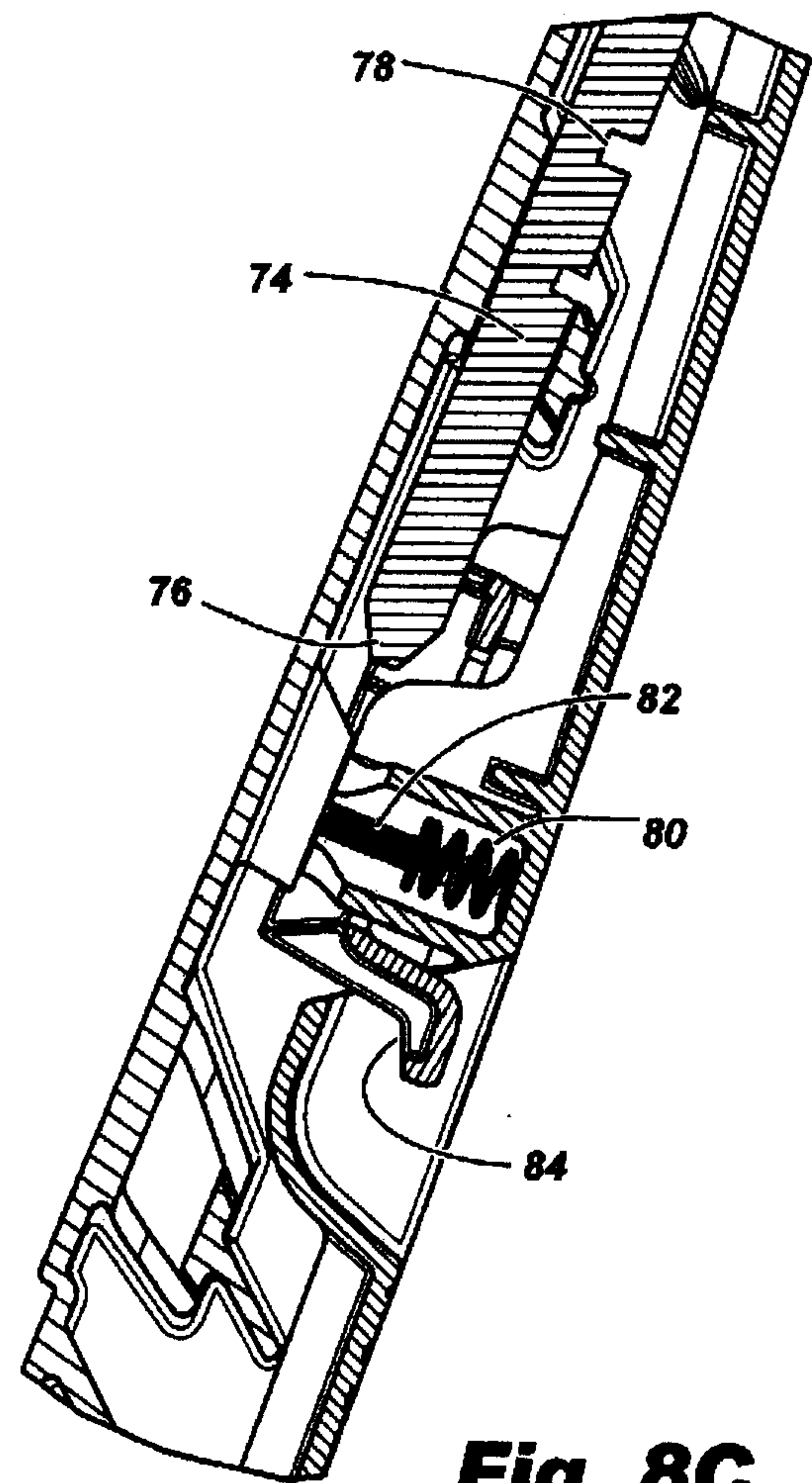


Fig. 8C

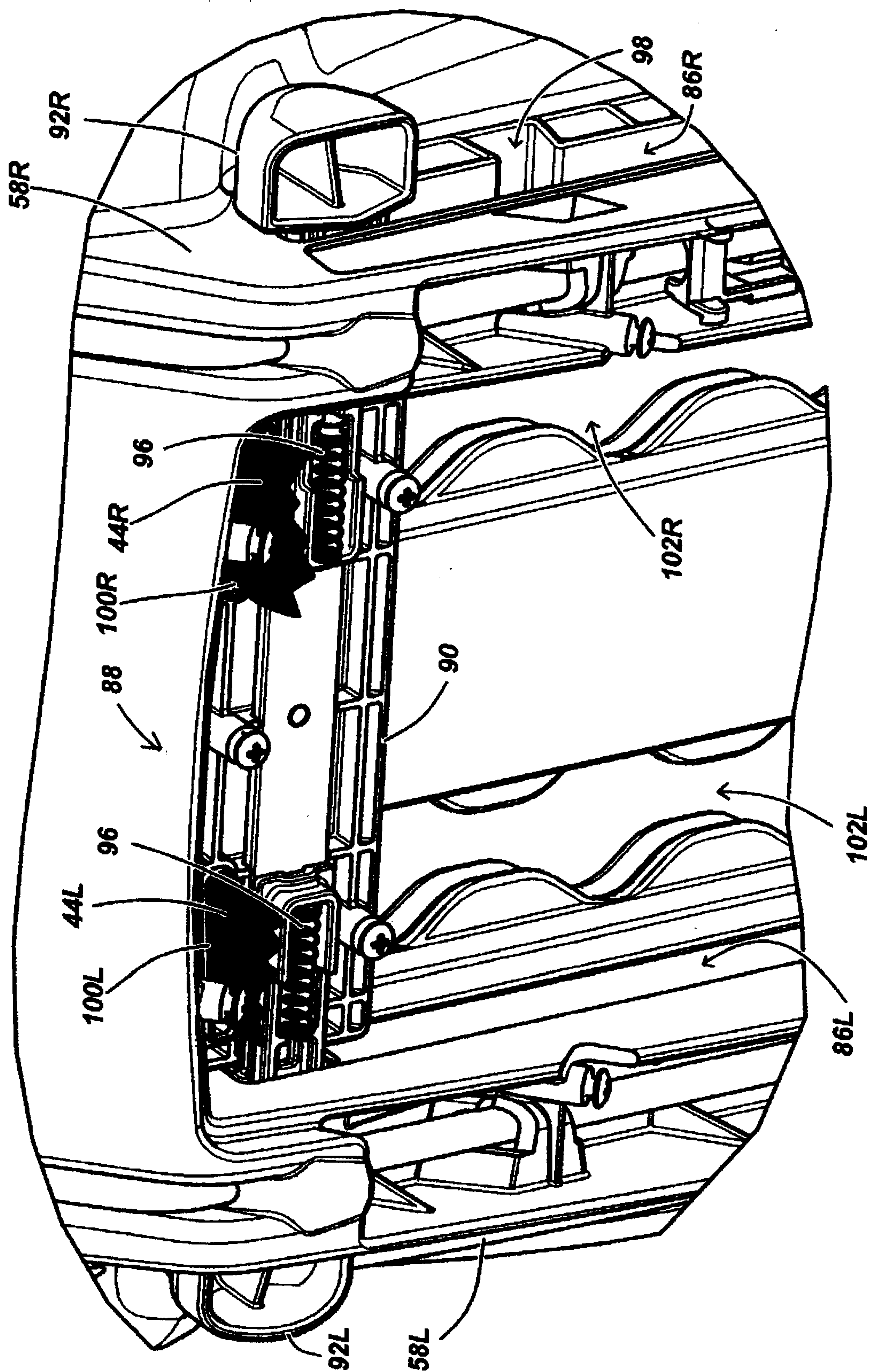
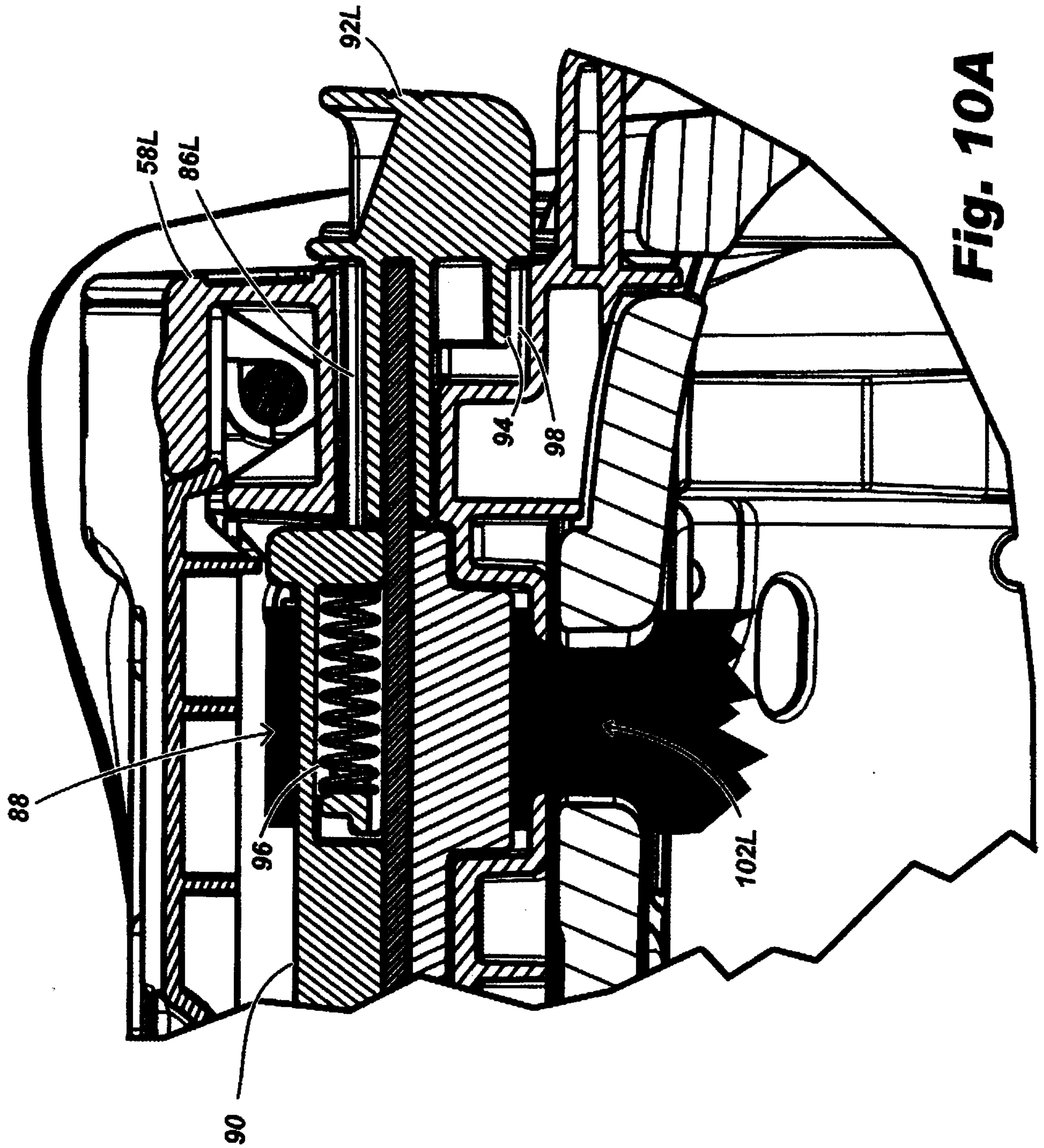


Fig. 9



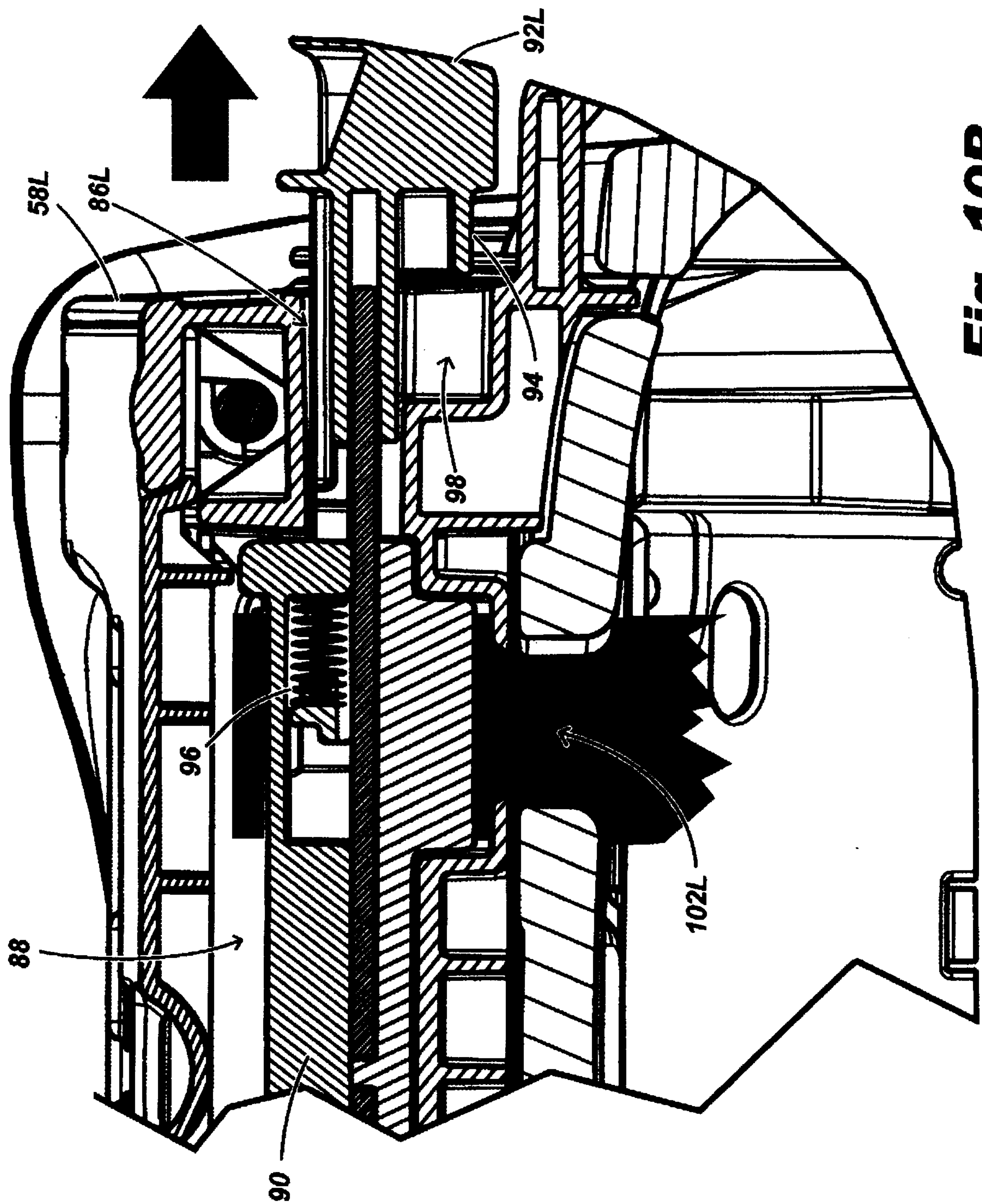


Fig. 10B

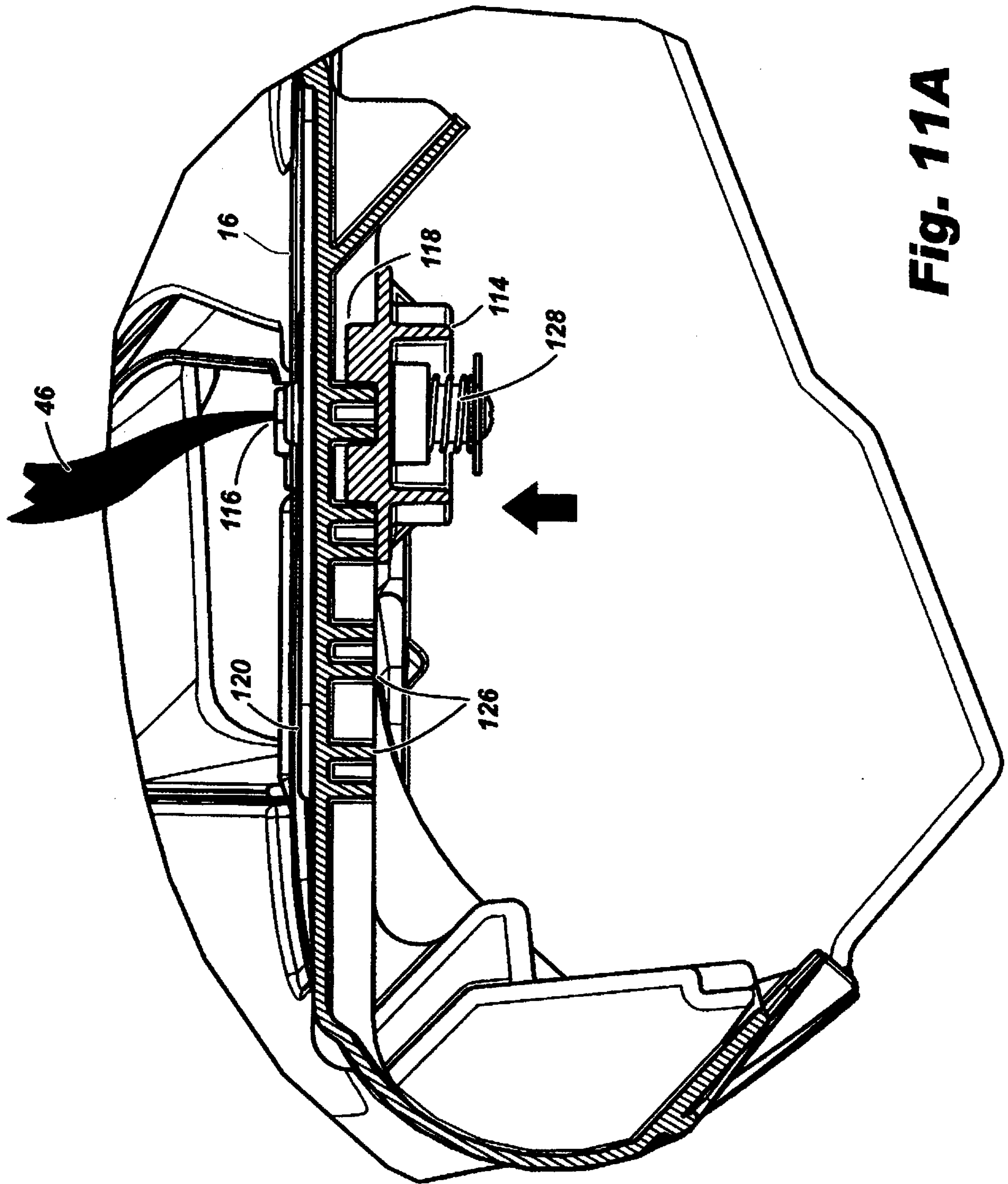


Fig. 11A

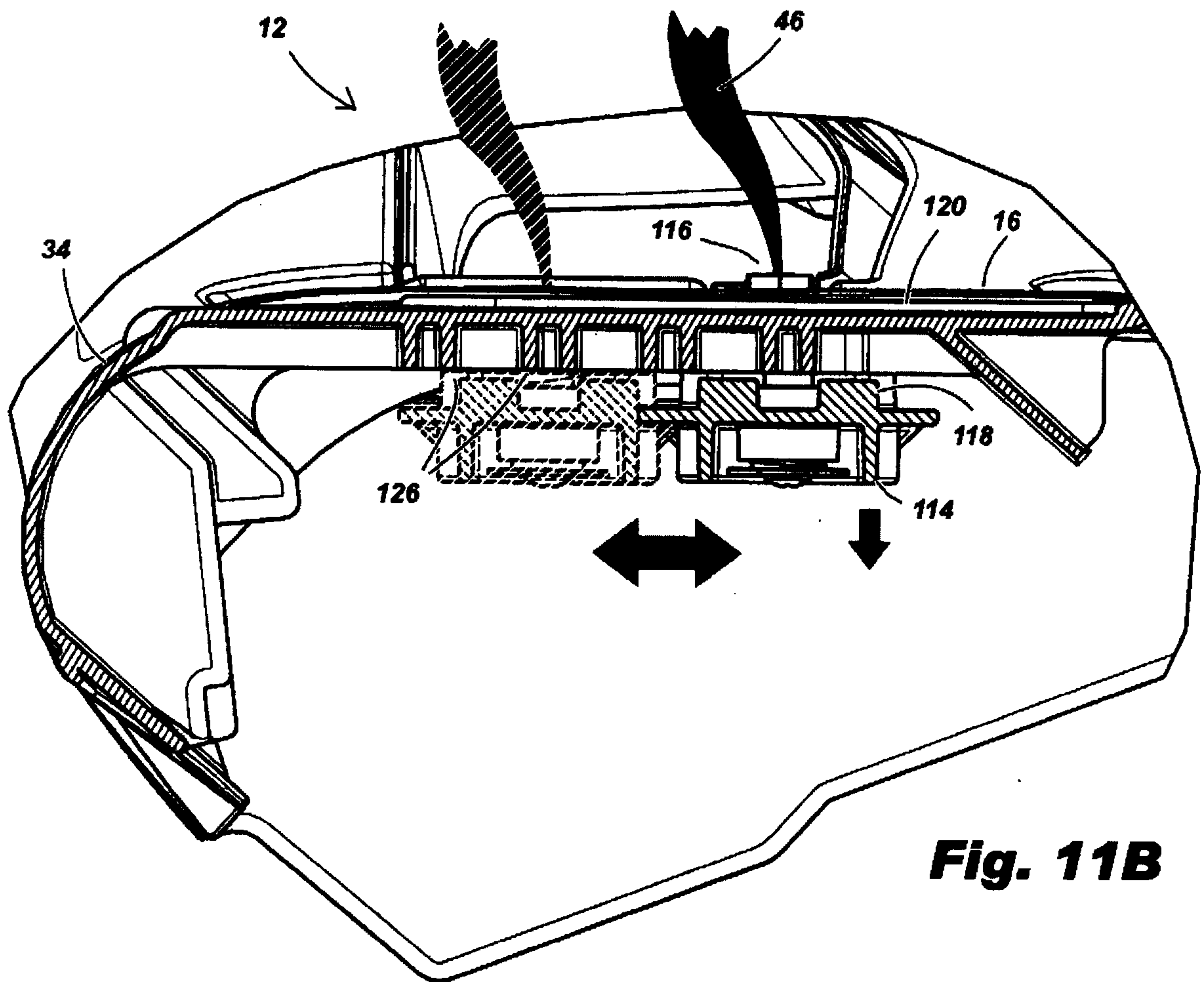


Fig. 11B

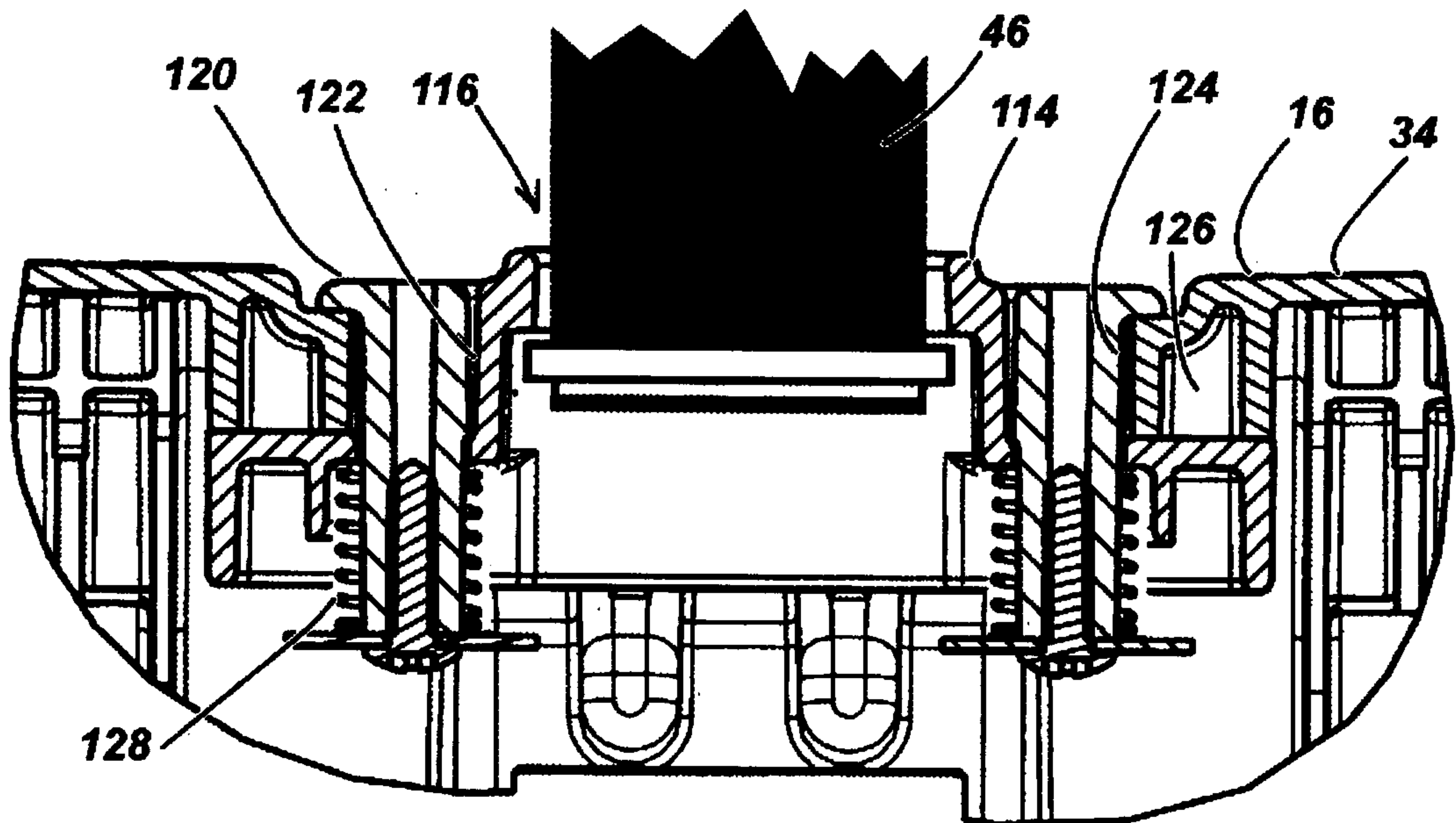


Fig 12A

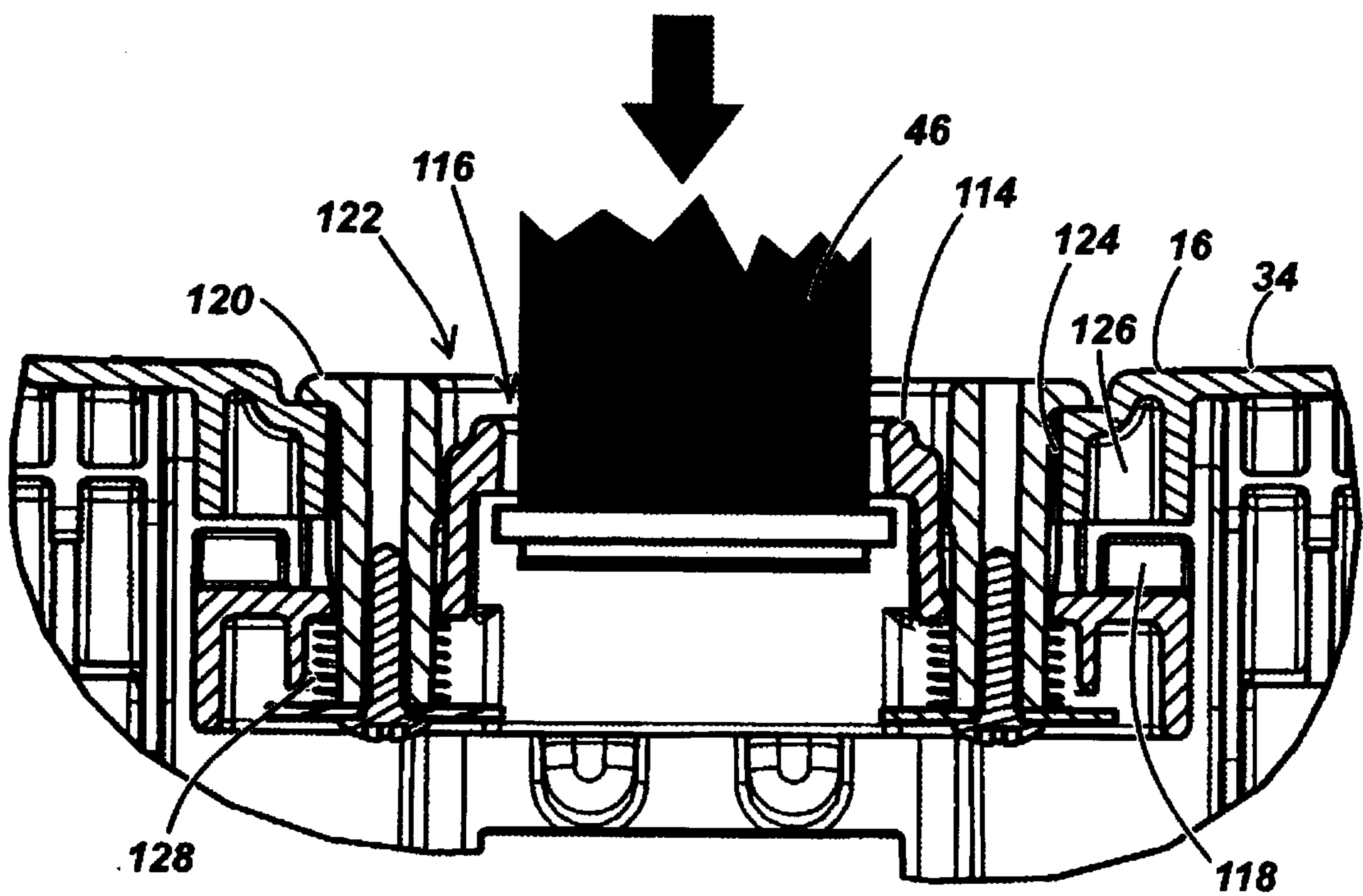


Fig 12B

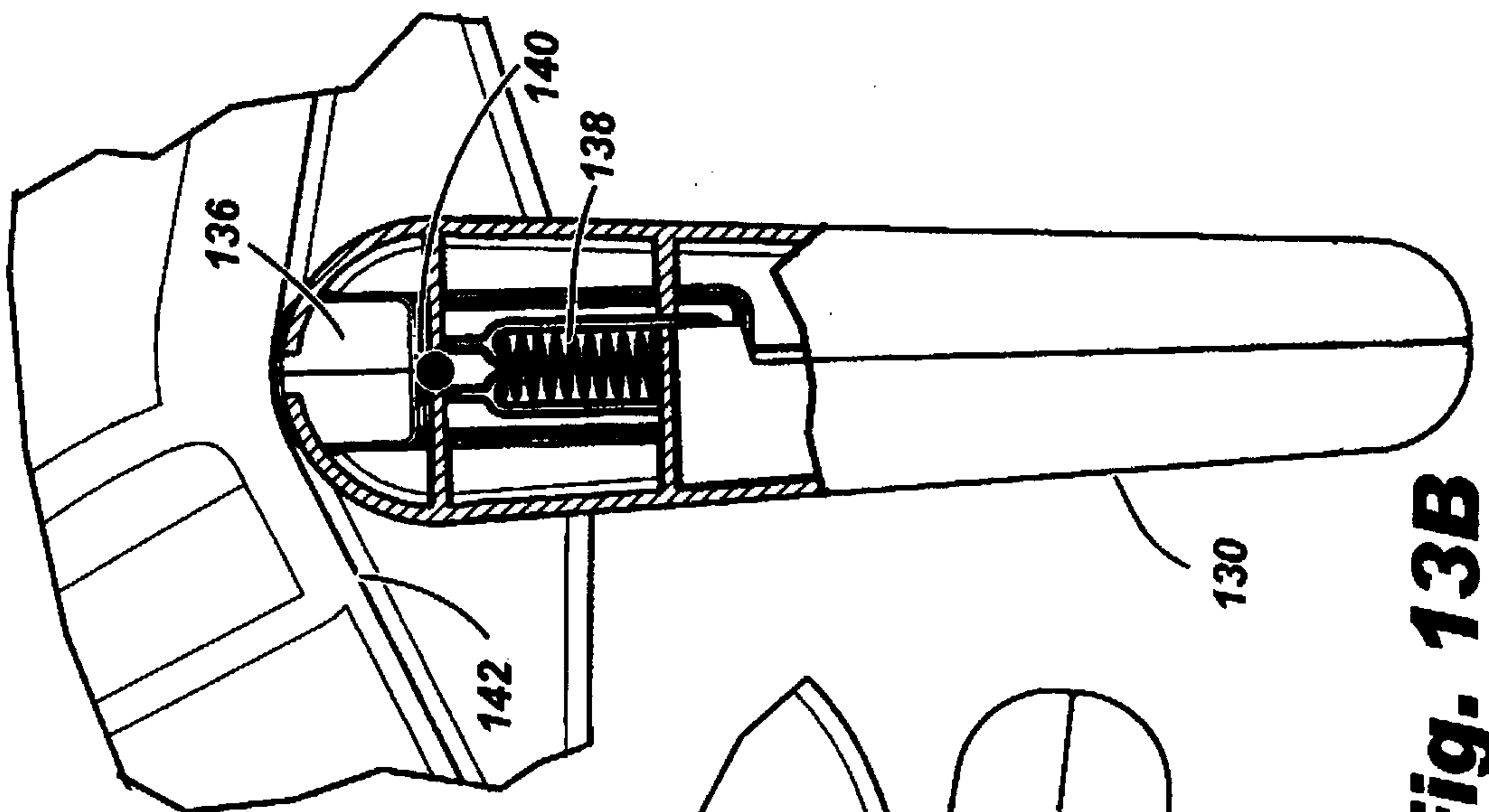


Fig. 13B

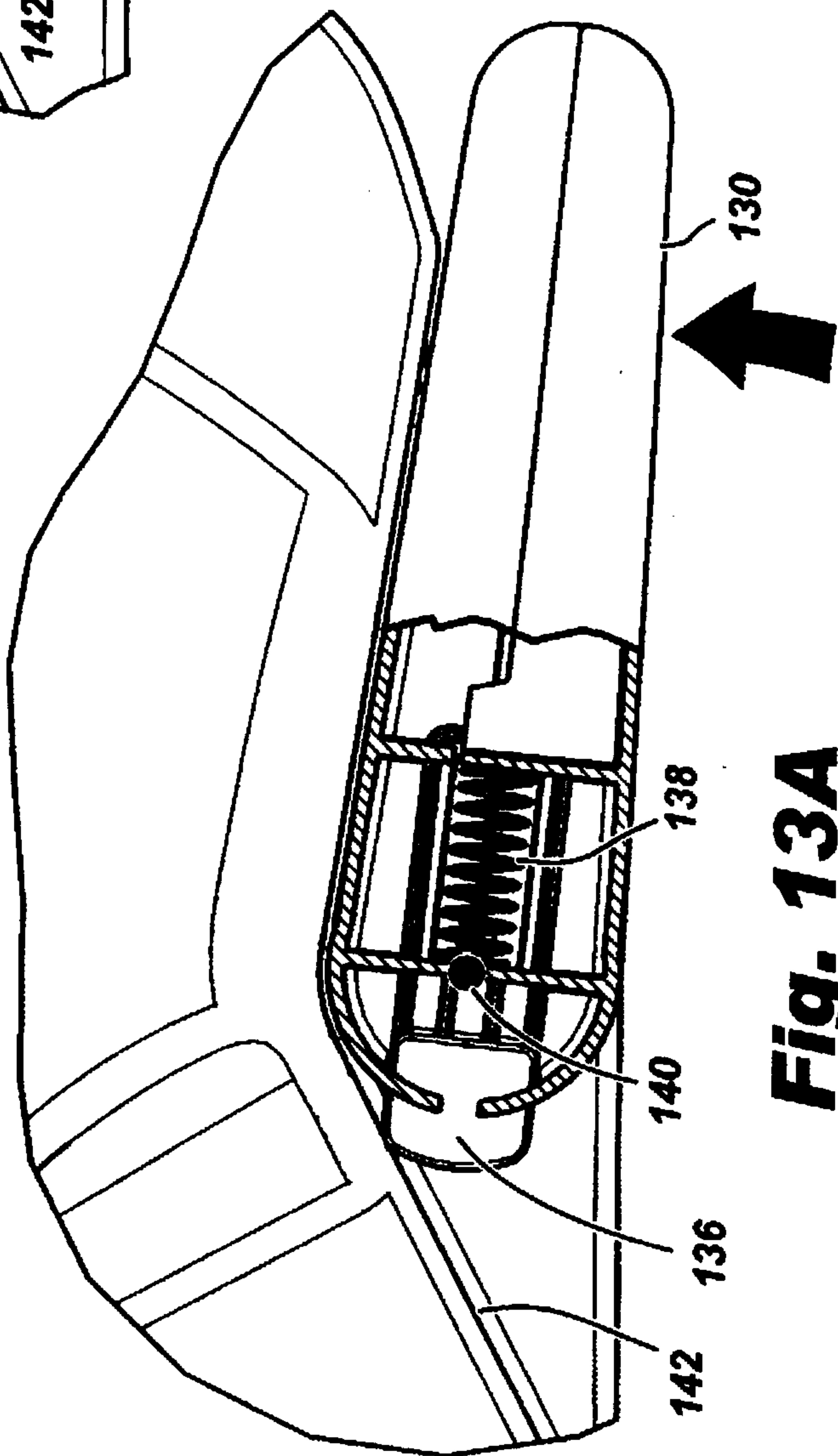
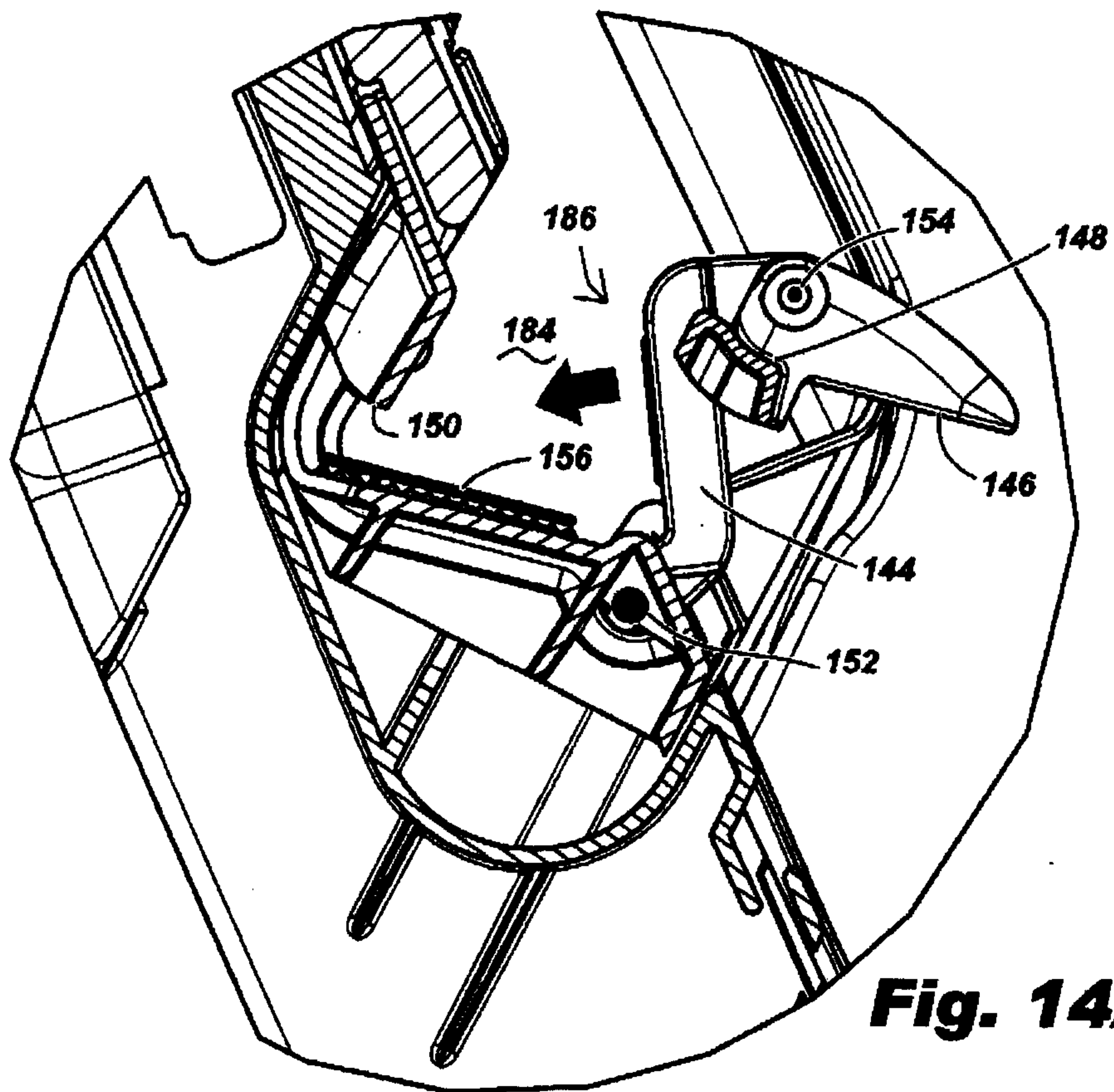


Fig. 13A



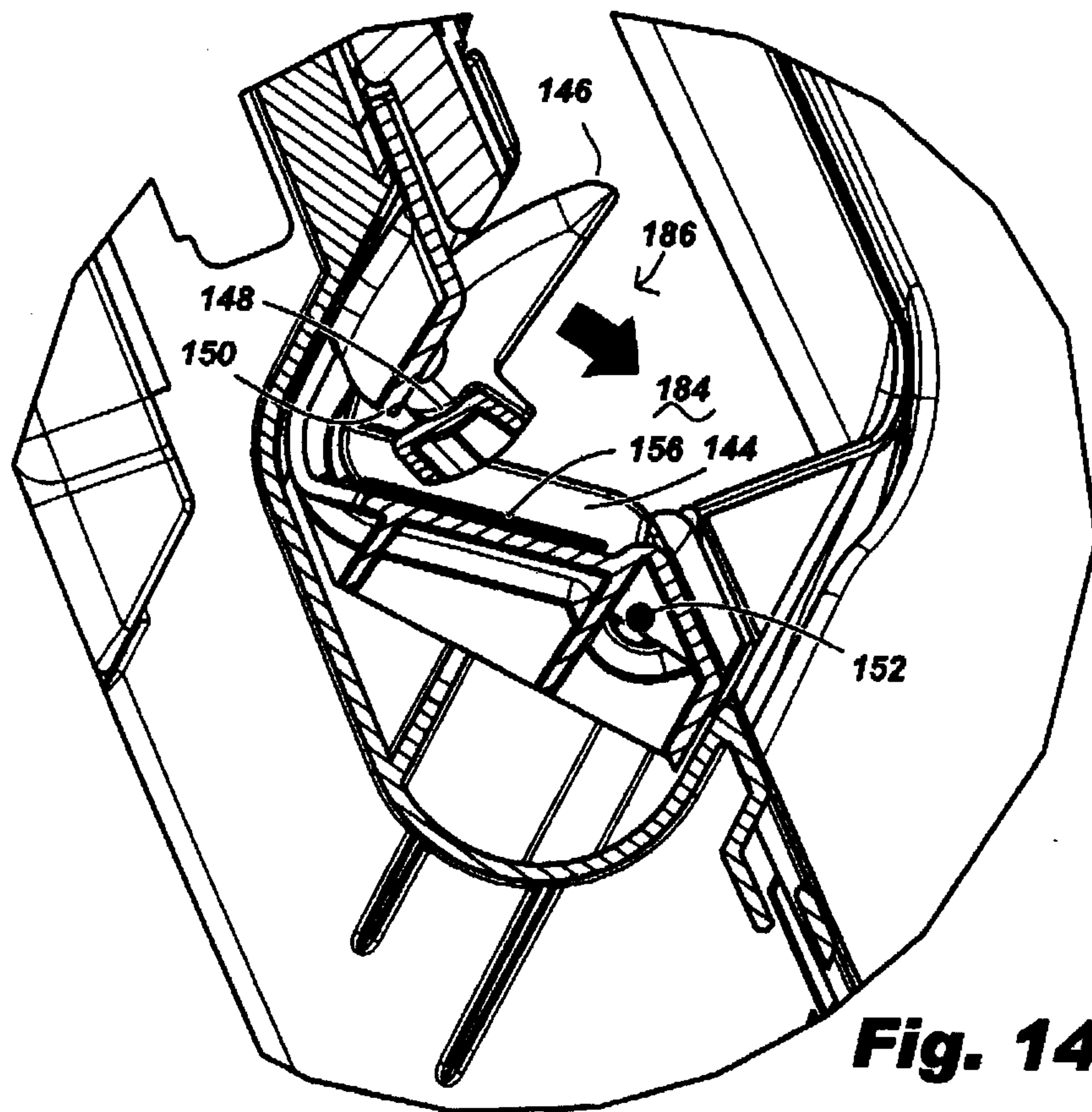


Fig. 14B

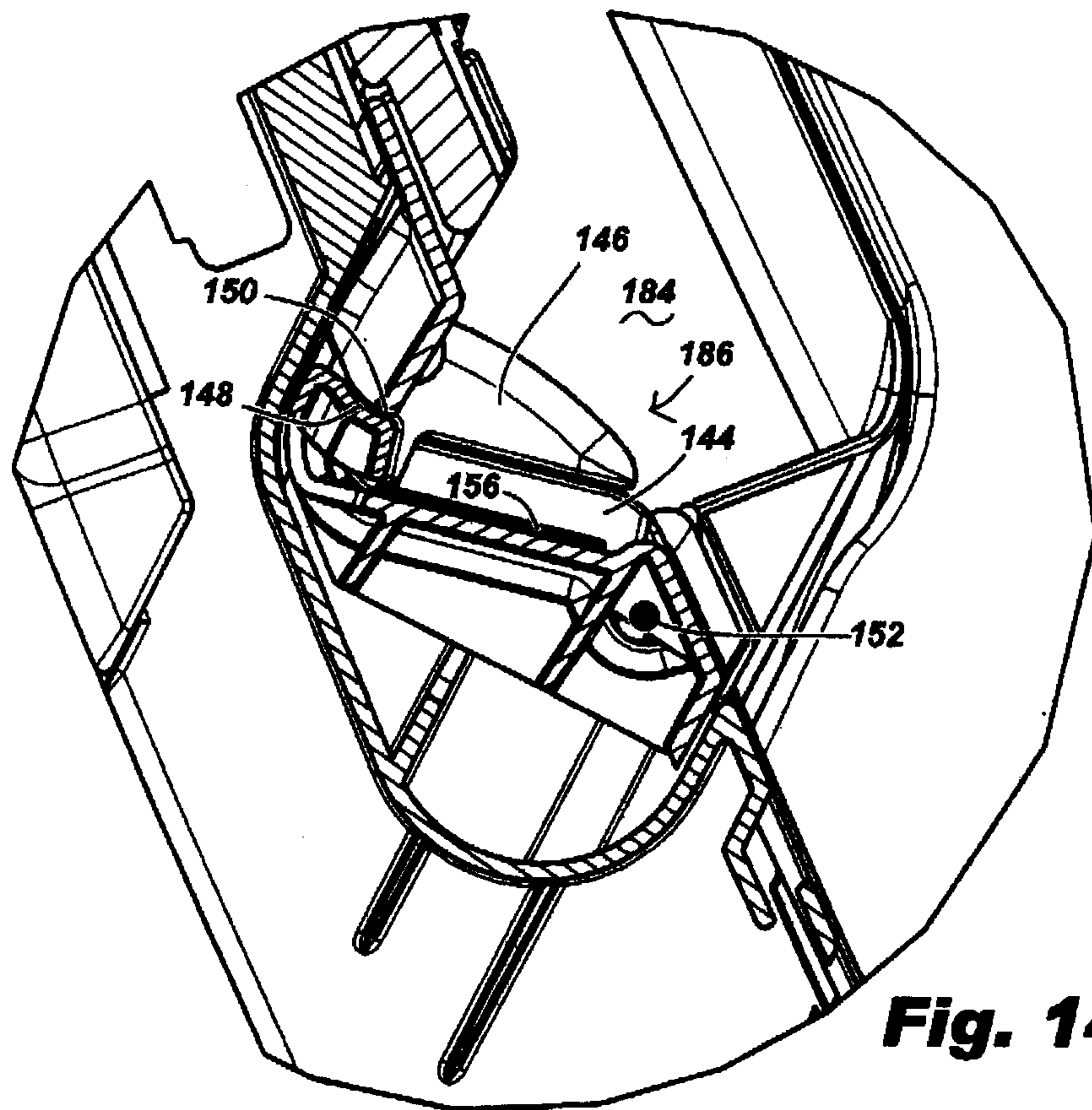


Fig. 14C

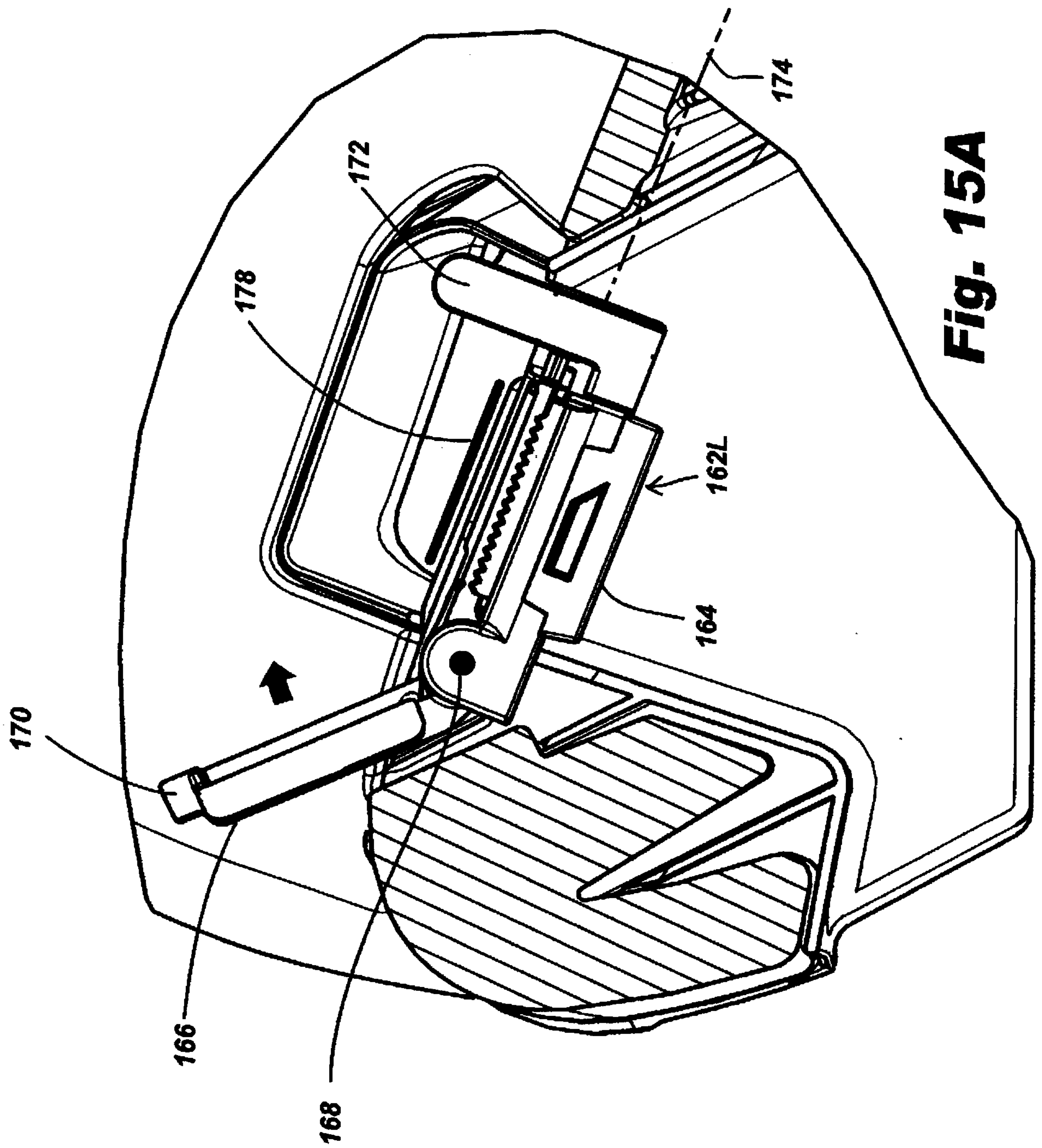


Fig. 15A

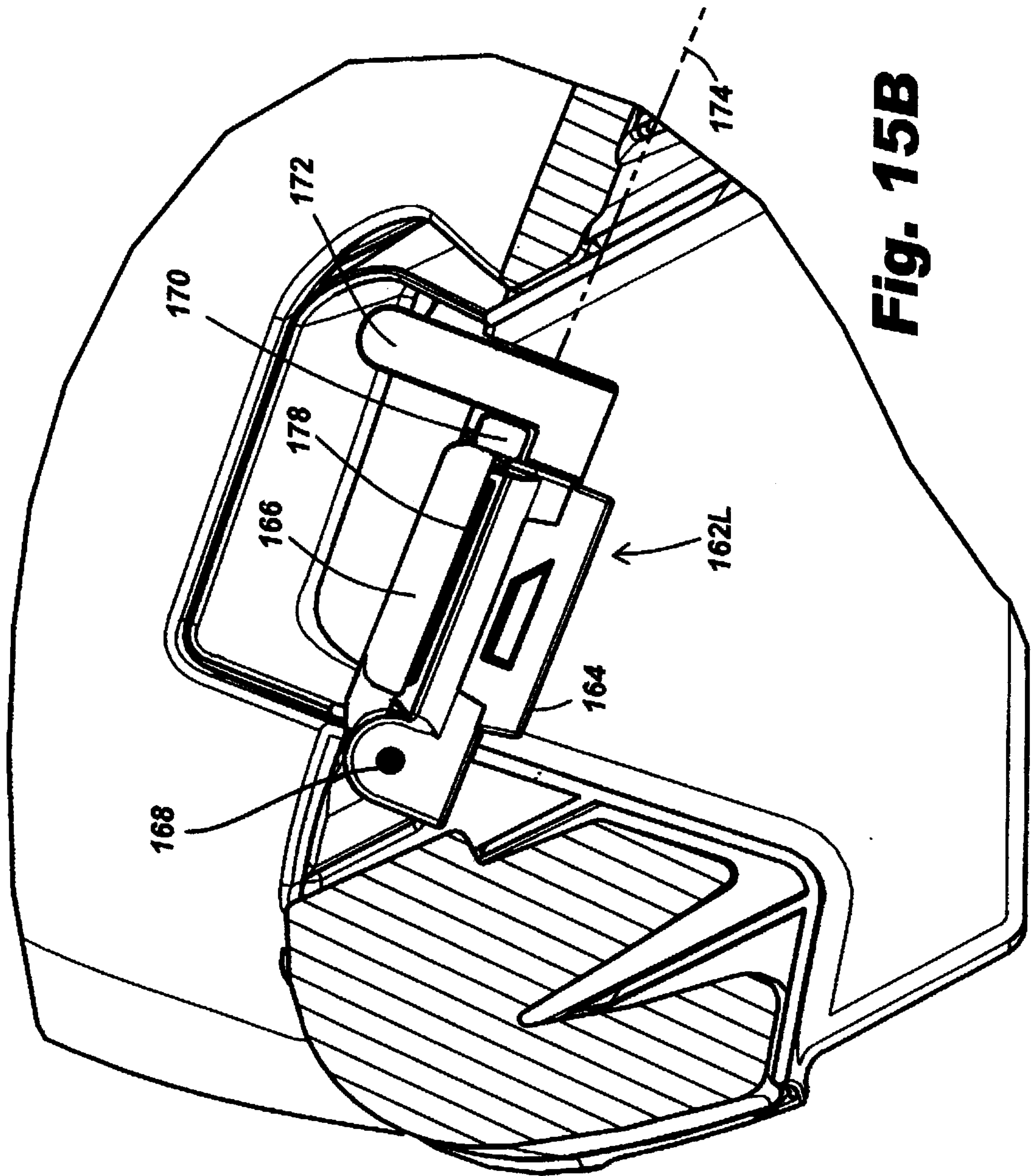


Fig. 15B

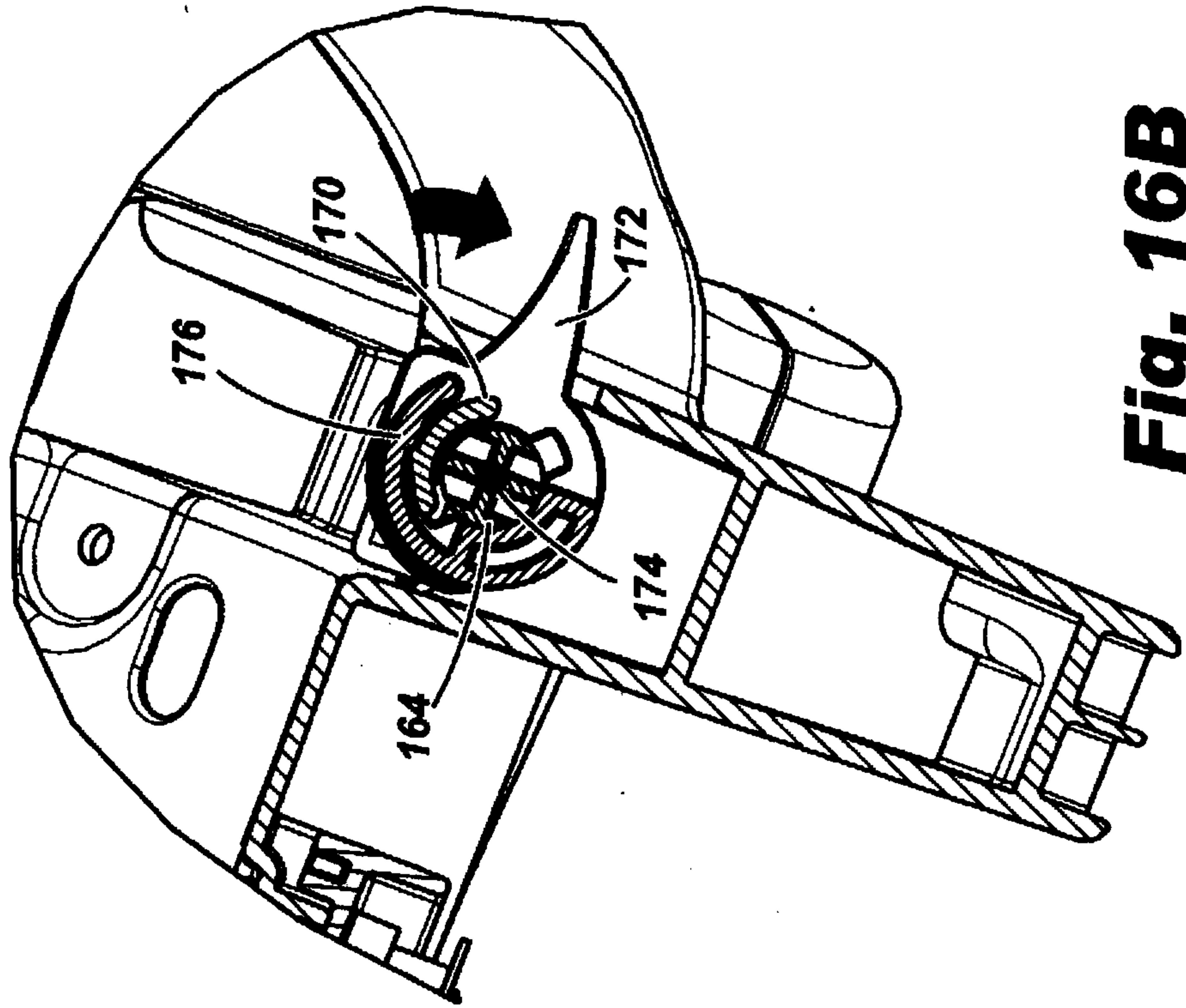


Fig. 16B

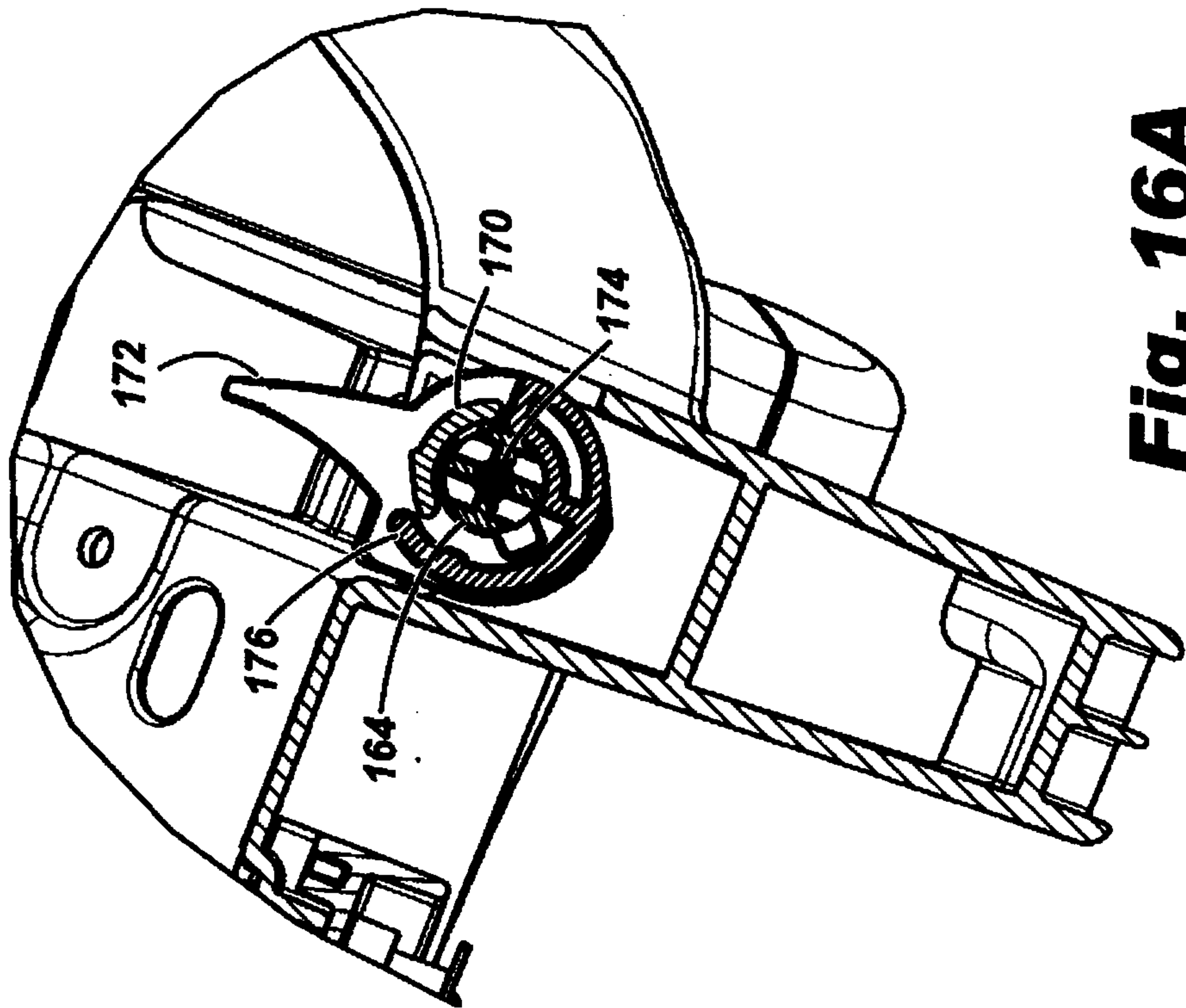


Fig. 16A

