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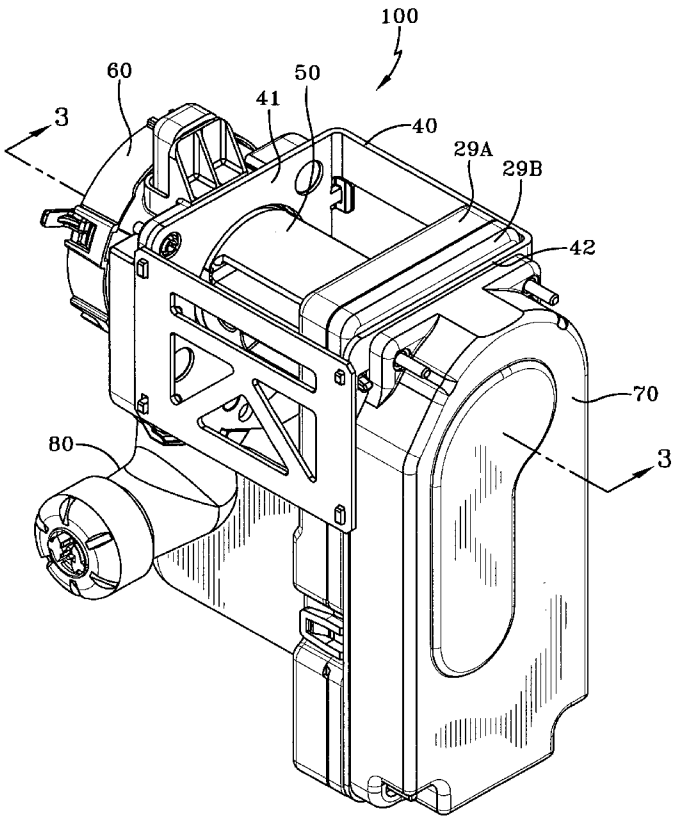


FIG-1

(57) Abstract: An electromechanical seat belt retractor (100) has a spool (50) that rotates about an axis of rotation (R) for winding and unwinding a seat belt. An electric motor (30) selectively rotates the spool (50). A clutch mechanism (10) including an over-clutch (14) is driven by the electric motor (30) through one or more gears. The clutch mechanism (10) is coaxially aligned with the axis of rotation (R) of the spool (50) and is linearly spaced from the spool. Upon a forward actuation of the electric motor (30) a clutch plate (12) of the clutch mechanism (10) moves linearly to engage the spool coupling to the spool (50) and rotates the spool about the axis of rotation (R) to initiate a winding of the seat belt. After the clutch plate (12) engages the spool (50) a reversal of the electric motor (30) linearly moves the clutch plate (12) away from the spool disengaging from the spool (50). Preferably the clutch mechanism (10) is a Bendix type clutch mechanism. In a preferred embodiment, the clutch plate (12) first engages the over-clutch (14) that is locked to the spool (50).

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ELECTROMECHANICAL SEAT BELT RETRACTOR

This invention relates to electro-mechanical seat belt retractors using an electric motor to wind up the seat belt.

A conventional seat belt system in a motor vehicle has a seat belt retractor for winding up a seat belt, a tongue slidably attached to the seat belt, and a buckle to which the tongue can be latched. In a crash where a large deceleration is exerted on the vehicle while a vehicle occupant wears the seat belt, the seat belt restrains and protects the vehicle occupant.

A seat belt retractor has a spiral spring that always biases a spool, on which the seat belt is wound, in the belt-wind up direction. When not in use the seat belt is fully wound on the spool by the biasing force of the spiral spring. A locking mechanism is activated in a crash to stop the rotation of the spool in an unwinding direction, thereby preventing the seat belt from being withdrawn.

A seat belt retractor having an electric motor to drive the spool is commonly referred to as an electro mechanical retractor. When it is determined that a crash is imminent as well as in other operating situations, the tension on a seat belt is increased by increasing the driving force of an electric motor, thereby increasing the restraint of the vehicle occupant. When a vehicle crash is actually detected, a pyrotechnic seat belt pretensioner mechanism can be actuated.

A variety of electro mechanical seat belt retractors are commercially available, but in the event no crash occurs the predetermined or otherwise tightening of the seat belt must either be reversed or otherwise disengaged.

Seat belt retractors should be sophisticated in performance and yet simple and reliable in design. The coupling of an electric motor to a seat belt retractor provides opportunities to improve the performance of the seat belt system to better secure the vehicle occupant prior to a crash but it has also created additional cost and complexity issues that need to be solved.

The present invention is an electromechanical seat belt retractor that gives a high quality performance while improving reliability and reducing cost. This invention provides a novel way to engage and disengage the various electro

mechanical elements so that the belt wind up forces are safely and efficiently transmitted from the electric motor more directly to the spool while bypassing the more fragile components of the seat belt retractor. The electric motor is disengaged from the mechanism such that the seat belt retractor can function independent of the electric motor during normal driving conditions.

FIG. 1 is a perspective view of the electromechanical seat belt retractor according to the present invention.

FIGs. 2A and 2B are exploded views of the electromechanical seat belt retractor of FIG. 1.

FIG. 3 is a cross sectional view showing the linearly moveable clutch mechanism in a pre-engagement location.

FIG. 4A is a cross sectional view showing the linearly moveable clutch mechanism prior to engaging an over-clutch.

FIG. 4B is a cross sectional view of the linearly moveable clutch plate engaged to the over-clutch wherein the clutch plate is pushed into contact with an end of the spool containing a locking means comprising a plurality of spring loaded balls adapted to lock into recesses in an end of the over-clutch.

FIG. 5A is an exploded view of the spool and clutch mechanism.

FIG. 5B is a second exploded view of the spool and clutch mechanism from a different direction.

FIG. 6 is a perspective view of the clutch mechanism with the one cover removed.

FIG. 7A shows the rotation to engage the over-clutch and spool.

FIG. 7B shows the opposite rotation causing a disengagement of the clutch mechanism from the over-clutch and spool.

FIG. 8 is a perspective view of the electromechanical seat belt retractor with a pretensioner mechanism attached to a side of the frame.

FIG. 9A is a cross sectional view of the electromechanical seat belt retractor taken along line 9A - 9A of FIG. 8.

FIG. 9B is the cross sectional view of FIG. 9A after the pretensioner mechanism has been activated.

With reference to FIGs. 1, 2A and 2B, an electromechanical seat belt retractor 100 according to the present invention has a frame 40 that holds a spool 50 between two opposing sides 41, 42 of the frame 40. Attached to one side of the seat belt retractor 100 is a biasing spring assembly 60 having a spirally wound pretensioned spring 62 that provides a bias to the seat belt retractor 100 so that the seat belt (not shown) is always biased in the wound up direction. As a vehicle occupant pulls on the seat belt, the spool 50 rotates and the seat belt is pulled outwardly increasing the tension on the biasing spring 62. Interposed between the biasing spring assembly 60 and shown also on the lower left hand side 41 of the frame 40 is a pretensioner mechanism 80, which in an crash situation can be actuated to cause a rapid rotation of the spool 50 to rewind part of the seat belt to onto the spool to restrain the vehicle occupant.

On another side 42 of the frame 40 of the seat belt retractor 100 an outer dust cover 70 covers a spool locking mechanism of known construction that includes an inertial sensor and web sensor. The spool locking mechanism includes a lockcup 74 that is rotationally supported on an axle such as a portion of the torsion bar. The lockcup 74 supports a housing 71 that in turn supports a moveable weight sensor or mass 72. The spool locking mechanism includes a locking pawl 73 rotationally mated with a frame side 42 and a lock wheel as well as other known components that will lock the spool 50 from further rotation in a seat belt protraction direction during periods of high vehicle deceleration and/or periods of rapid protraction of the seat belt from the spool. Interposed between the dust cover 70 and the frame 40 is a two-piece clutch housing 92 that contains a clutch mechanism 10 that can be activated by an electric motor 30 as shown in FIG. 2B.

FIGs. 2A and 2B are exploded views of the entire seat belt retractor 100 showing the components that are used to make the entire assembly. With reference to the upper portion of FIG. 2A, the biasing spring assembly 60 as illustrated. A spirally wound biasing spring 62 is pre-wound using a clip 61 and is attached to the spring cover 66 which is connected to the housing 63 such that a biasing force is always applied to the spool 50 after the clip 61 is removed.

The biasing spring 62 is connected to one end 76A of a torsion bar 76 by a spring arbor 65. The biasing spring assembly 60 is then attached to the frame 40. In between the spring biasing assembly 60 and the frame 40 is a clutch bracket 90 that holds a clutch housing 92, a locking pawl 94 an o-ring 96 and a retainer washer 98. The pretensioner mechanism 80 includes a cap 81, a shorting clip 82, a gas-generating device 83 and a manifold 84. The manifold 84 houses a rack 85, an o-ring 86 and a push retainer 87 that are connected to the frame 40 of the seat belt retractor 100 in such a way that during a crash, the gas-generating device 83 can be activated and the rack 85 will engage the clutch housing 92 that drives an end 76A of the torsion bar 76 causing a rapid rotation of the spool 50 to pretension the seat belt.

As shown in the lower portion of FIG. 2A, on the left hand side of the frame 40 is a mechanical bushing 78 and a toothed pilot wheel 77. The torsion bar 76 extends on one side through a pilot wheel and extends on another side to the lockcup 74. A thrust washer 75 is received on the torsion bar. An inertia disk 79 which is part of the weight sensor 72, a calibration spring 210, a return spring 204, a cam 206 and an activation disk 105 vehicle sensor pawl 73, a housing 101 connected by a pivot pin 106 are also illustrated. A pin 202, lockbar 201 and wire 200 are shown along with a web sensor pawl 203, a calibration spring 210 and return spring 204, an activation disk 205, cam 206 and other miscellaneous elements 207, 208, 209 are shown, some of which are optional accessories not required in using the present invention per se, but are illustrated to show the entire seat belt retractor 100. These mechanisms are commonly used in mechanical seat belt retractors and provide a way of locking the spool 50 during a rapid seat belt protraction and rapid vehicle deceleration that would cause the web sensor to activate or the sensor weight 72 to tip causing the sensor pawl 73 to pivot which initiates the locking of the spool 50 which is not free to rotate relative to the torsion bar 76 and any applied force on the torsion bar 76 could be absorbed thereby.

As shown in FIGs. 2B and 3, a feature of the present invention is an electric motor 30 attached to a clutch mechanism 10. The electric motor 30 is

attached to the lower portion of the seat belt retractor 100 and is encased in a motor sleeve 31. The electric motor is also attached to the clutch mechanism 10 that is entirely encased within a first clutch cover portion 29A and a mating second clutch cover portion 29B. The rotor 32 of the electric motor 30 is attached to a pinion gear 33 that drives cluster and idle gears 35, 36, 37. The cluster gear 36 and idle gears 35, 37 are mounted and attached through the cover portions 29A to the frame side 42 using cluster and idler pins 38 as illustrated. The pins 38 are engage with threads using screws 39. The idle gears 33, 35, 36, 37 connected to the electric motor 30 are connected to a ring gear 34 of the clutch mechanism 10 which is coaxially aligned with the axis of rotation R of the spool 50. In FIG. 2B, 5A and 5B, the ring gear 34 has a plurality of recesses 110 on an inner diameter into which protrusions 111 on a tubular shaped cylindrical ring 20 is pressed. The cylindrical ring 20 has an outside diameter with a helical thread 21 on its outer surface. Attached to the cylindrical ring 20 is a clutch plate 12 having an inside circumferential surface with a complementary helical thread 11 that mates to the cylindrical ring 20 in such a fashion that as the ring gear 34 is turned by the motion of the electric motor 30. The clutch plate 12 can move along and be moved by the helical thread 21. This is made possible by a drag wire 8 wrapped around the outer circumference of the clutch plate 12, as shown in FIG. 6. The drag wire 8 is a spring type device that provides frictional drag on the clutch plate 12. When assembled into the clutch cover portions 29A, 29B as shown in FIG. 4A, the drag wire 8 is not free to rotate as the ring gear 34 and cylindrical ring 20 rotate. Accordingly, the clutch plate 12 will be driven inwardly absent any rotational motion until it approaches the end of the helical threaded portion 21 of the cylindrical ring 20. It will then initiate an increased torsional force that overcomes the drag friction on the drag wire 8 and enables the clutch plate 12 to rotate freely inside the drag wire 8. As a portion of the drag wire 8 is being moved linearly inward and by the forward motion of the electric 30 an over-clutch 14 is engaged, as shown in FIG. 4B. The over-clutch 14 has a plurality of recesses 16 shown in FIG. 5A on a first side 14A of the over-clutch 14. As the clutch plate 12 approaches the over-clutch, the

teeth 13 on the clutch plate 12 engage the recesses 16 in the over-clutch such that the clutch plate 12 continues to move towards the spool 50 until the teeth 13 of the clutch plate 12 are fully engaged within the arcuately elongated recesses 15 of the over-clutch 14, as the over-clutch 14 is then rotated along with the spool 50 by the clutch plate 12. In FIGs. 3 and 5B the spool 50 has an end 51 with a plurality of holes 52 therein adapted to accept a coil spring 53 in each hole 52 and one of a plurality of balls 54, preferably ball bearings 54 is positioned between a coil spring 53 and the over-clutch 14. On one side of the over-clutch 14 there are a plurality of recesses 15 correspondingly aligned with the holes 52 in the end of the spool 50. Upon assembly to the spool 50 the over-clutch 14 has these recesses 15 come into alignment with the holes 52 wherein the coil spring loaded ball bearings 54 are moved into the recesses 15 on the over-clutch 14 creating a locking engagement between the over-clutch 14, and the spool 50. The over-clutch 14 is held against the spool 50 by a retainer clip (not shown). As illustrated in FIGs. 4B and 7A, when the spool 50 is rotated by the movement of the electric motor 30 in a direction to affect seat belt retraction, which is accomplished by rotation of the idle gears 33, 35, 36, 37 being connected to the ring gear 34 causes the clutch plate 12 to move linearly inward and engage the over-clutch 14 which in turn being fixed to the spool 50 creates the motion necessary to initiate rotation of the spool 50 to tighten the seat belt. The activation of the electric motor 30 can occur in many non-crash situations to tighten a seat belt about a vehicle occupant or when a sensor indicates that a crash appears imminent. In such a condition the seat belt will be tightened to ensure that the vehicle occupant is properly restrained prior to a crash. Should a crash be sensed by another sensor, the pretensioner mechanism 80 will activate to cause a significant increase in pretension forces to occur further driving the spool 50. In many occurrences the use of an electric motor 30 is provided in the event that a rapid deceleration of the vehicle is sensed wherein the pretensioning of the seat belt and the vehicle occupant is desirable.

A unique feature of the new seat belt retractor 100 is that engagement of the spool 50 occurs through a linear movement that is coaxial with the axis of

rotation of the spool 50. The clutch plate 12 can engage the spool 50 through the over-clutch 14 in such a fashion that it creates a secure locking system that is independent of the other mechanism throughout the retractor 100. This is important in that loads and overloads of the fragile plastic components used throughout the mechanism can be avoided in that a direct linkage is created between the spool 50 and the clutch mechanism 10 and gearing of the electric motor 30 are independent of the other mechanism. This ensures that the seat belt may be pretensioned by the pretensioner mechanism 80 without unduly loading any of the other components of the seat belt retractor 100. Secondarily by reversing the electric motor 30 as shown in FIG. 7B, the seat belt can be unwound onto the spool and the clutch mechanism 10 will be moved along the helical thread 21 of the ring 20, such that as the clutch plate 12 moves away from the spool 50 and the pre-attached over-clutch 14 which enables the entire electric motor-clutch mechanism to disengage from the spool 50. Once this occurs, the clutch mechanism 10 is totally isolated from the normal operation of the seat belt retractor in such a fashion that the electromechanical seat belt retractor can operate as a conventional seat belt retractor without any drag or resistance created by the electric motor or clutch mechanism 10. This is quite useful in ensuring that none of the mechanical systems that are normally used within a seat belt retractor need to be modified for the incorporation of the motorized clutch mechanism 10. This ensures that there is no additional drag caused by the clutch mechanism 10 that is provided without interfering with the normal operation of the seat belt retractor. What is unique about the electric motor initiated, linear movement of the clutch mechanism 10 is that the entire clutch mechanism can be positioned in a very nominal amount of space. The entire clutch mechanism 10 is located inside the side 42 of the frame 40 and the mechanical weight sensing mechanisms are located inside the dust cover 70 that are normally attached to such a seat belt retractor. The entire clutch mechanism 10 is provided in a very compact and efficient assembly occupying a small amount of space that is extremely important when providing seat belt retractors with this level of performance capability or complexity.

In FIG. 8, the pretensioner mechanism 80 is shown attached to the frame 40 of the seat belt retractor 100. The pretensioner mechanism 80 has a cap 81 attached by threads. The cap 81 has an opening exposing a shorting clip 82 to which a wiring harness (not shown) can be attached. The shorting clip 82 is attached to a pyrotechnic gas generator 83 that includes a propellant charge and an igniter as shown in FIG. 9A. The gas generator 83 is shown stored in a transverse chamber portion 84B of the manifold housing 84. In a longitudinal chamber portion 84A is housed a piston 85. The piston 85 has an enlarged flanged end portion 85C with an O-ring type seal 131 engaging the walls of the longitudinal chamber portion 84A. A rack 85A extends outwardly from the flanged end portion 85C. On one side of the rack 85A are gear teeth 85B that engage the gear teeth 92B of a pinion gear 92A when the pretensioner mechanism is activated to move the piston 85 in the longitudinal chamber 84A causing the pinion gear 92A to rotate the spool 50 to take up slack in the seat belt. The end of the torsion bar 76 is shown in the opening through the pinion gear 92A.

In FIG. 9A a first large longitudinal extending passageway 85D extends partially through the lower portions of the piston 85 and extends a substantial distance into the rack 85A to a closed end 85F. The length of the passageway 85D is at least 20 mm and the cross sectional area A_L is generally uniform along the length L and is preferably at least 12.6 mm^2. The cross section is circular having a diameter D_L of at least 4 mm.

A second passageway 85E intercepts the first longitudinal passageway 85D. The location of the passageway 85E may vary relative to the length of first longitudinal passageway 85D. The intersection point is approximately halfway up the length of the first longitudinal passageway 85D. The passageway 85E is an exhaust passageway open on at least one end to the chamber 84A such that gasses produced by the pyrotechnic element can pass to reduce the pressure in chamber 84B. The transverse vent 85E can pass through one or both sides of the rack 85A and the passageway 85E is very small in comparison to the cross-sectional area of the first passageway 85D. The total area A_T of one or two of

the second passageway is less than 7% of the area A_L of the first passageway 85D. The cross-sectional area A_T is 0.8 mm^2 and is of a circular cross section having a diameter D_T of about 1 mm when only one exhaust vent is used. The diameter D_T is less than 1 mm when two such passageways 85E are employed.

With reference to FIG. 9B when the pyrotechnic gas generator 83 is ignited the gas 300 pushes the piston 85 thrusting it upward into the chamber 84A causing the pinion gear 92A to rotate the spool 50 removing the web slack. Upon ignition of the propellant in addition to gas 300 from the propellant, the small amount of solid debris 301 is created. This solid debris enters the first longitudinal passage 85D moving past the transverse passage 85E and impacting in the end 85F of the first passageway 85D creating turbulence. This debris 301 is lodged in the end 85F of the first passageway 85D at least during the time that gas is being generated by the pyrotechnic element 83 and as such the debris 301 tend not to block or impede the gas venting through the second transverse passageway 85E. The increase of gas pressure creates a blocking action holding the debris 301 against the end 85F as the gas 300 vents through the side or transverse passageway 85E. By providing a sufficiently large holding space in the volume of 85D beyond the transverse passageway 85E, all the debris 301 is entrapped by the flow of gas 300 trying to leave through the second transverse passageway 85E. In FIG. 9A, the gas venting second passageway 85E is located a distance X of at least 10 mm from the closed end 85F. The diameter of the first passageway 85D is at least four times greater than the diameter of the second transverse passageway 85E. The area A_L is preferably about ten times greater than the total area A_T.

CLAIMS

1. An electromechanical seat belt retractor (100) comprising:

a spool (50) that rotates about an axis of rotation (R) for winding and unwinding a seat belt;

an electric motor (30) for selectively rotating the spool (50);

a clutch mechanism (10) driven by the electric motor (30) through gears (33, 34, 35, 36, 37), the clutch mechanism (10) being coaxially aligned with the axis of rotation (R) of the spool (50) and spaced from the spool (50); and

actuation of the electric motor (30) in a first direction causes a clutch plate (12) of the clutch mechanism (10) to move and to engage the spool (50), or to engage an over-clutch (14) pre-attached to the spool, and thereafter rotating the spool (50) about the axis of rotation (R) to initiate winding of the seat belt.

2. An electromechanical seat belt retractor (100) according to claim 1 wherein after the clutch plate (12), or the clutch plate and over-clutch (14) in combination, engages the spool (50), a reversal of the electric motor (30) into a second direction moves the clutch plate (12) away from the spool thereby disengaging the spool (50).

3. An electromechanical seat belt retractor (100) according to claim 1 having a frame (40) for holding the spool (50) and clutch housing (92) attached to an end of the frame (40), the clutch cover portions having an opening to allow an end of the spool (50) to be engaged by the clutch mechanism (10).

4. An electromechanical seat belt retractor (100) according to claim 3 wherein the clutch housing (92) have an internal surface; and the clutch (10) has a friction drag spring partially encircling an outer surface of the clutch plate (12) and in contact with the internal surface of the clutch housing (92) to prevent rotational movement of the clutch plate (12) until a predetermined force or torque level is exceeded as the spool (50) is engaged.

5. An electromechanical seat belt retractor (100) according to claim 3 wherein the cutch (10) has

a ring gear (34) coaxially aligned with the axis of rotation (R) of the spool (50);

a cylindrical ring (20) attached to the ring gear (34), the cylindrical ring having an outer diametrical surface with a helical thread (21); and wherein

the clutch plate (12) has a complementary helical thread (11) on an inner diametrical surface, the clutch plate (12) being mounted onto the cylindrical ring (20) and linearly moved by a rotation of the ring gear (34).

6. An electromechanical seat belt retractor (100) according to claim 5 wherein the clutch mechanism (10) has: an over-clutch (14), the over-clutch being attached to an end of the spool (50) and positioned between the end of the spool and the clutch plate (12), the over-clutch (14) has recesses (16) on a first side facing the clutch plate (12); and the clutch plate has a plurality of pivotable teeth (13) on a side of the clutch plate (12) facing the over-clutch (14) for engaging the recesses (16) in an interlocking manner.

7. An electromechanical seat belt retractor (100) according to claim 6 wherein the over-clutch (14) has a second side spaced from and facing an end of the spool (50), the second side has a plurality of recesses (15) therein; and the end of the spool (50) has a plurality of holes (52) therein, each hole (52) in the end of the spool being oriented to align with one of the recesses (15) in the over-clutch (14), each hole (52) in the end of the spool holding a coil spring (53) and a ball (54) that extends into a recess (15) in the over-clutch to align the over-clutch with the end of the spool (50) by compressing the coil springs (53), and upon further rotational movement of the ring gear (34) the clutch plate (12) overcomes the drag spring force and rotates causing the over-clutch (14) to rotate due to the engagement of the teeth (13) and recesses and the balls (54)

being seated into the recesses (15) of the over-clutch causing the spool (50) to rotate.

8. An electromechanical seat belt retractor (100) according to claim 7 wherein a reversal of the electric motor (30) causes the clutch plate (12) to move linearly away from the spool (50) and the over-clutch (14) and disengages the spool from the clutch mechanism (10).

9. An electromechanical seat belt retractor (100) according to claim 1 having a spring assembly (60) for biasing the seat belt in the normally wound position, the spring assembly being connected to the spool (50) to cause rotational movement of the spool.

10. An electromechanical seat belt retractor (100) according to claim 1 having a pretensioner mechanism (80) connected to the electromechanical seat belt retractor to drive the spool (50) during a crash.

11. An electromechanical seat belt retractor (100) according to claim 1 having a mechanical spool rotation locking device including a torsion bar (76), an inertial sensor and means for locking the spool (50) from an unwinding rotation.

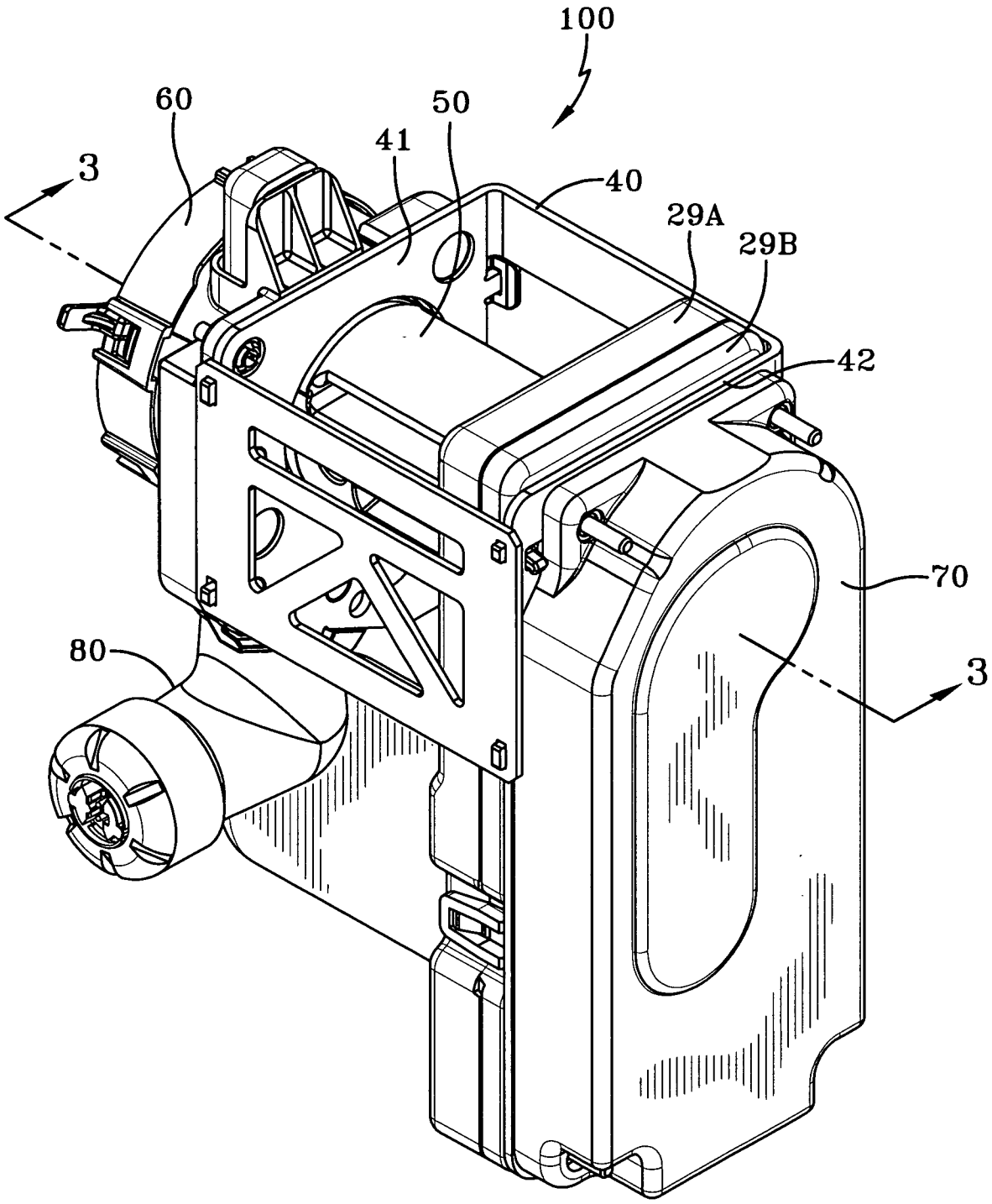


FIG-1

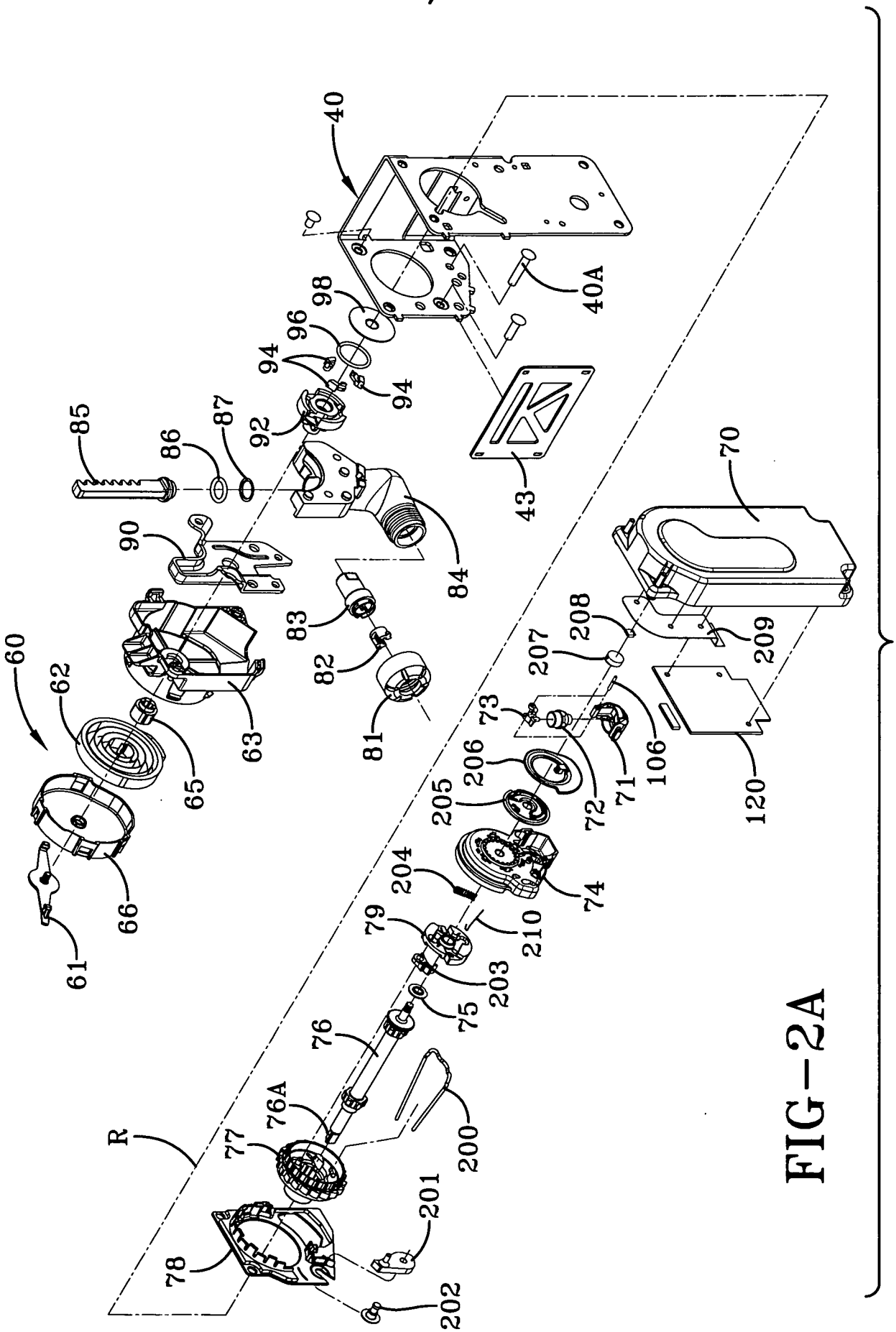

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FIG-2A

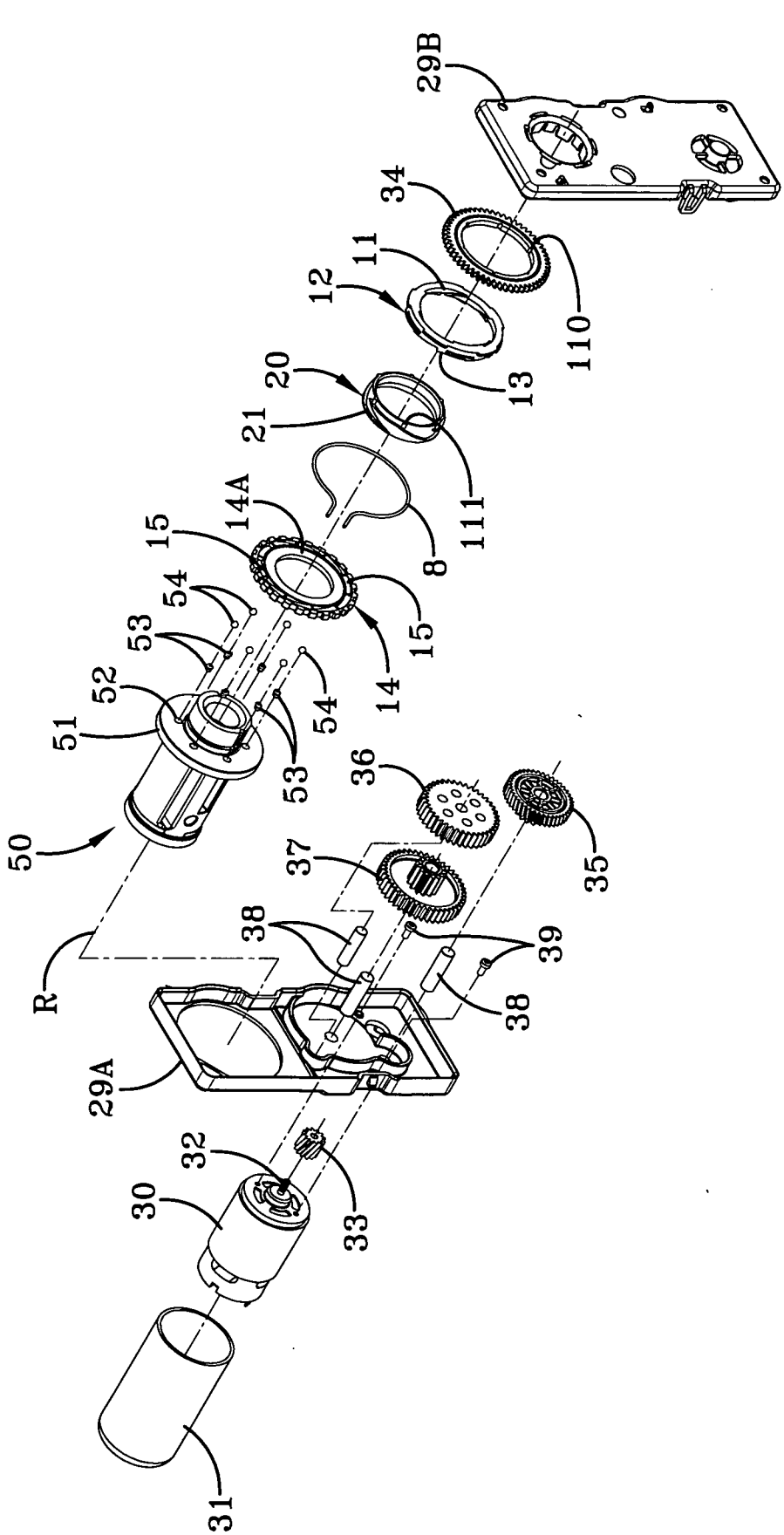

29B
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FIG-2B

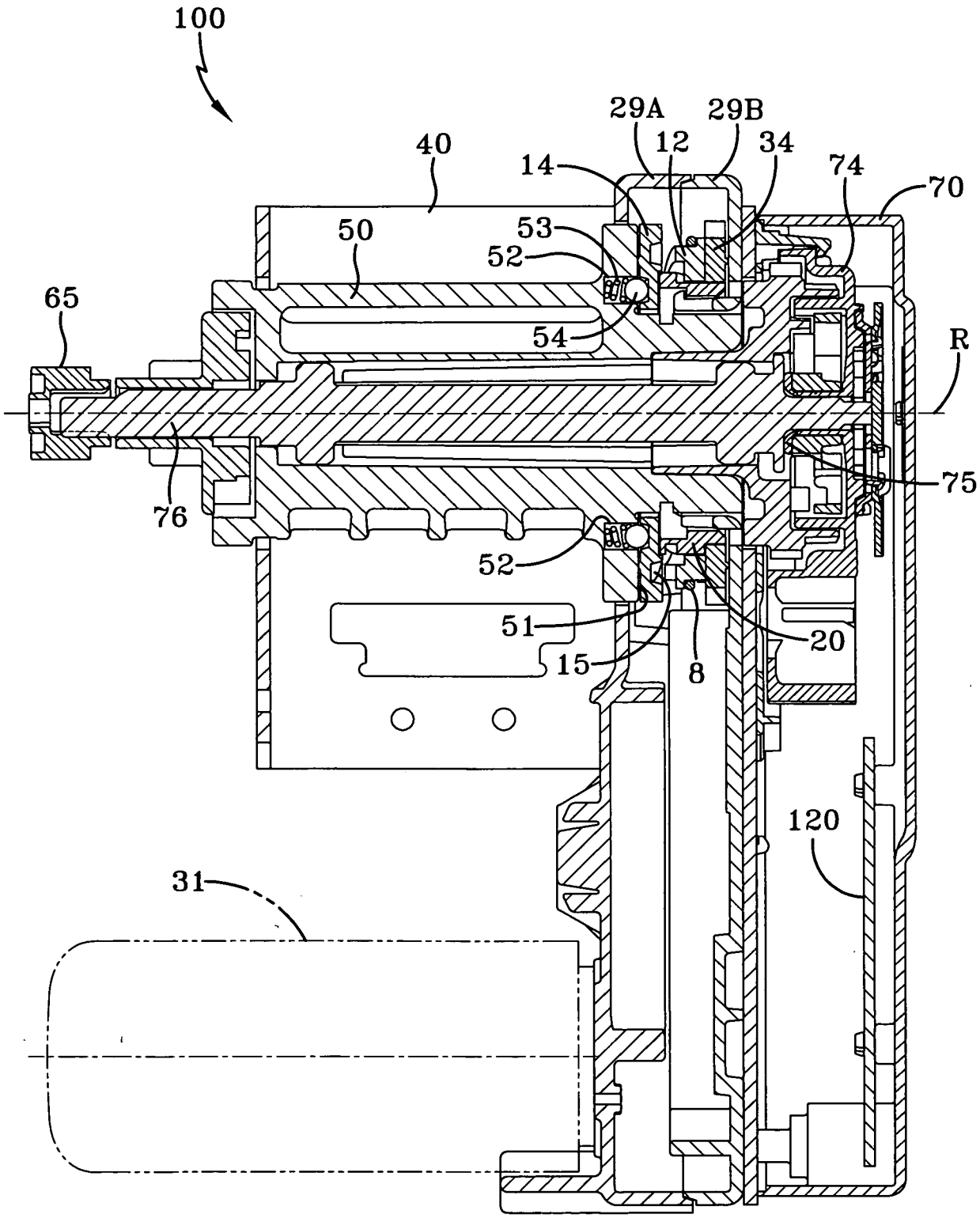

100
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FIG-3

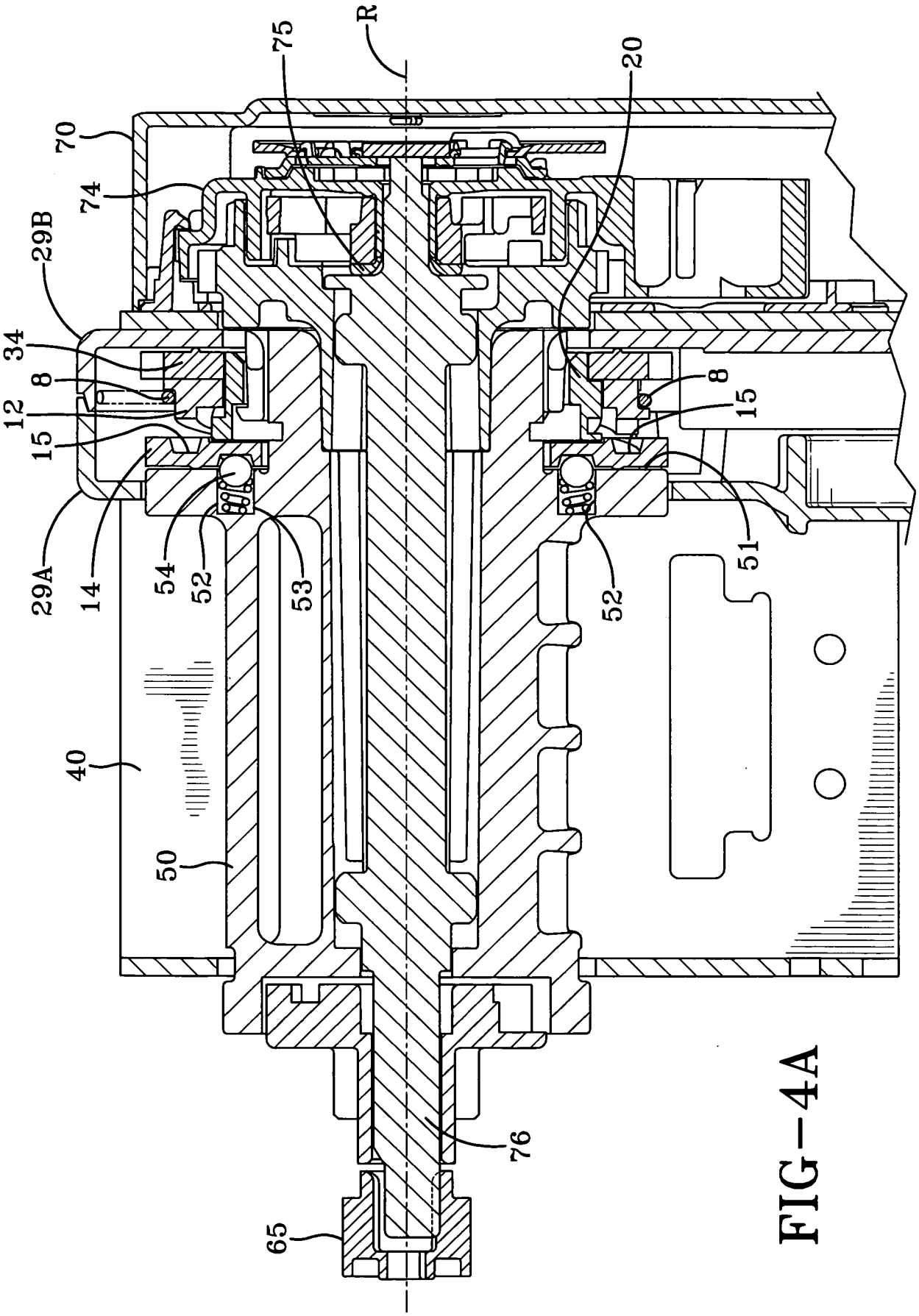


FIG-4A

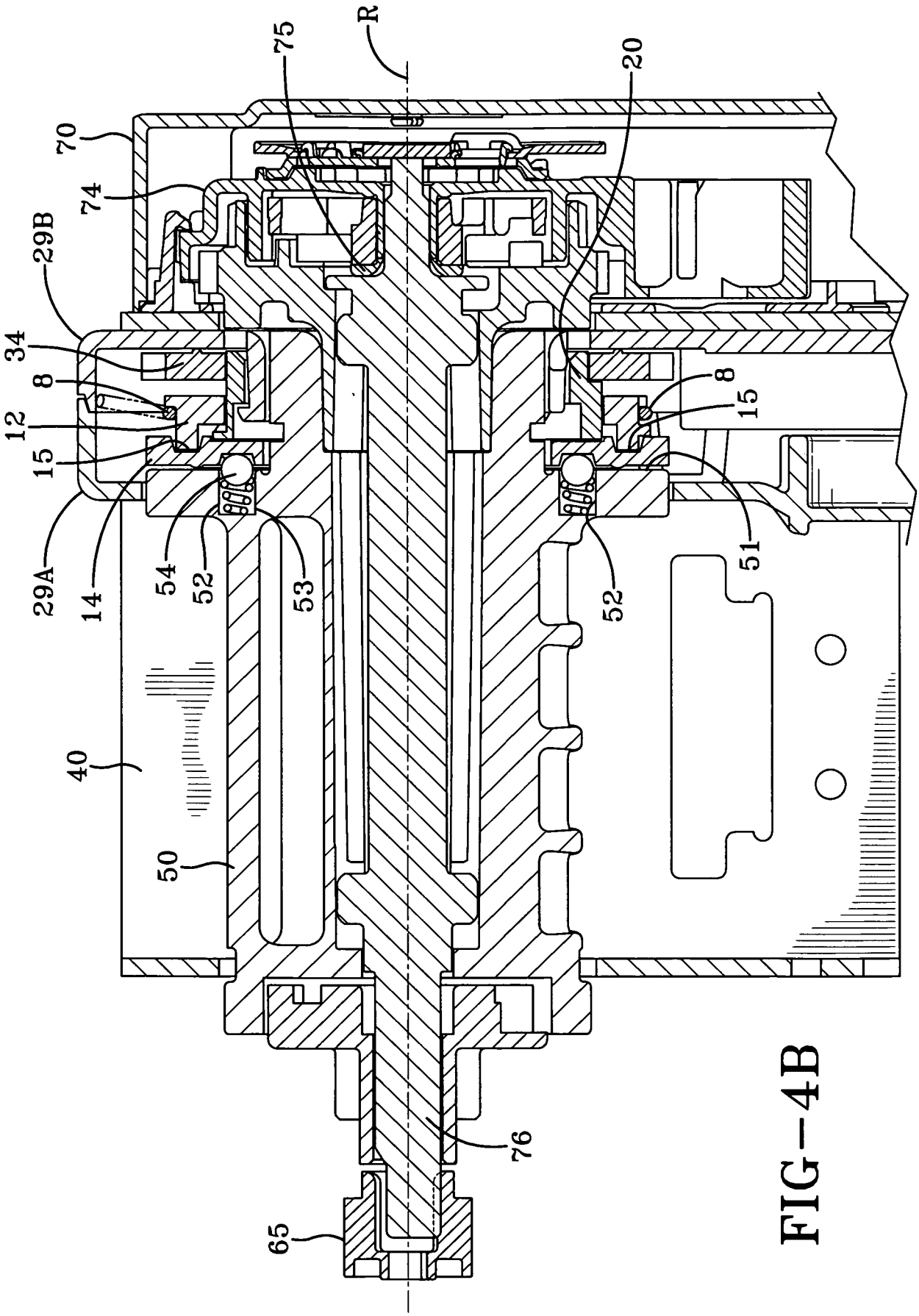


FIG-4B

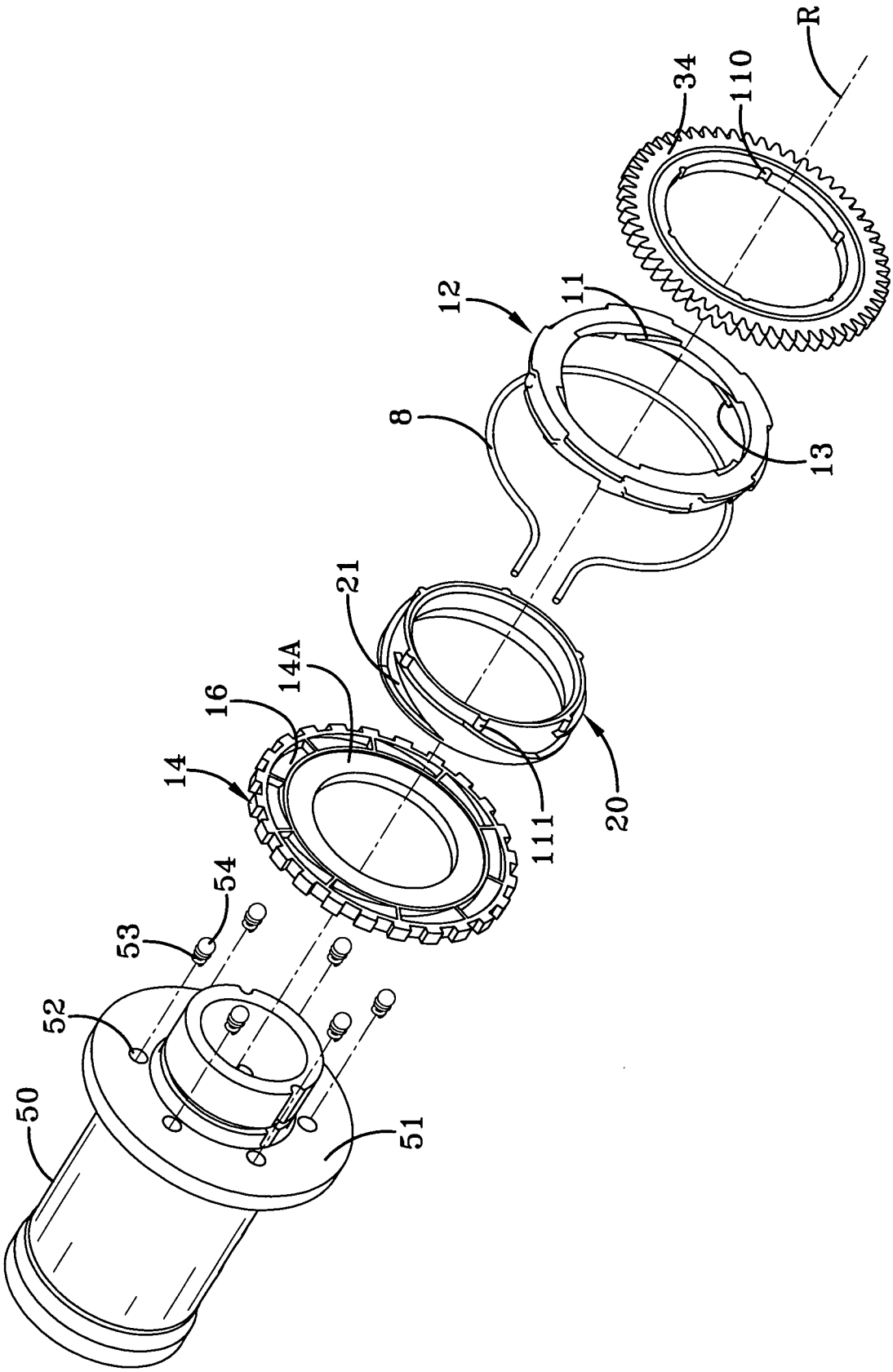


FIG-5A

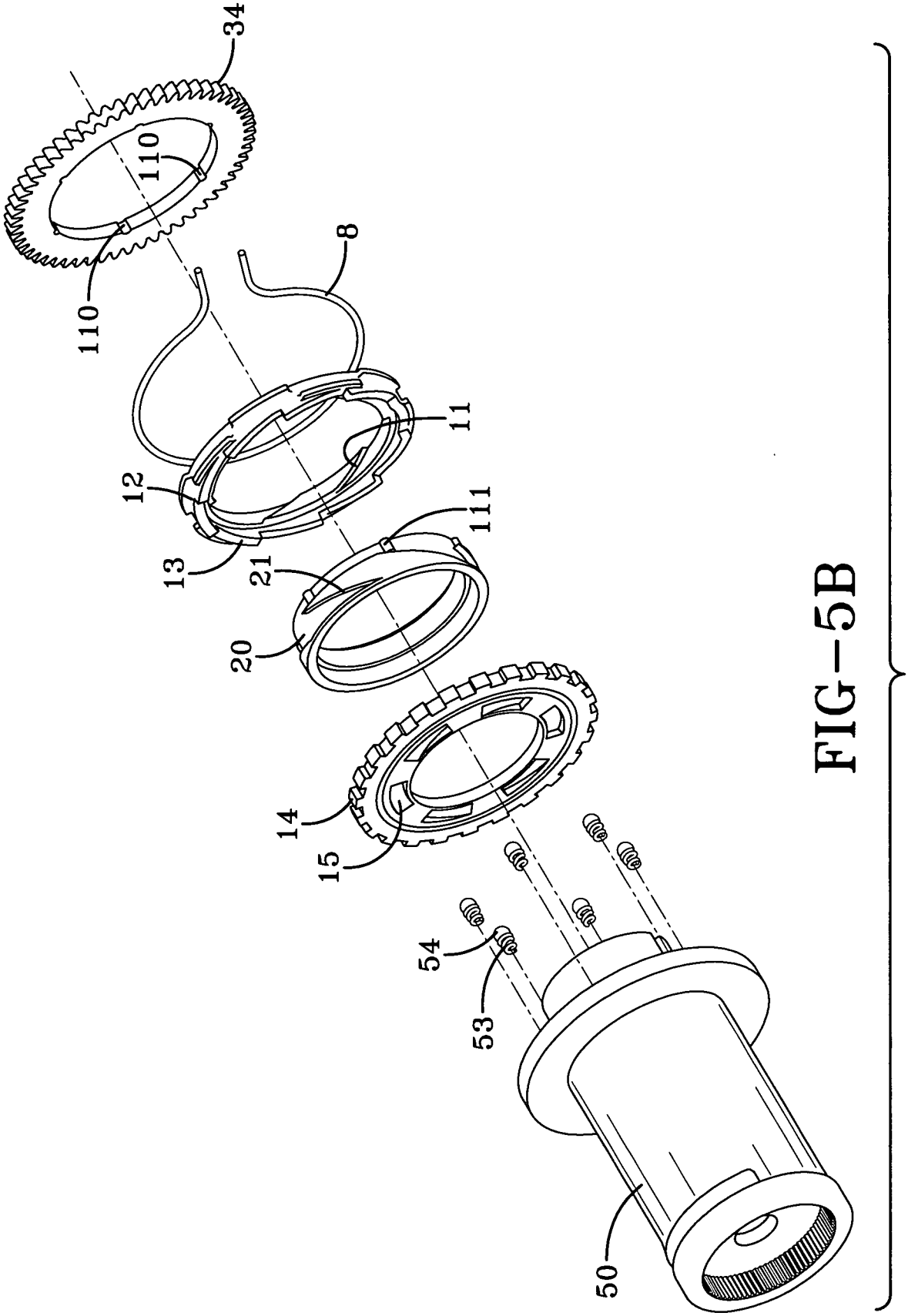


FIG-5B

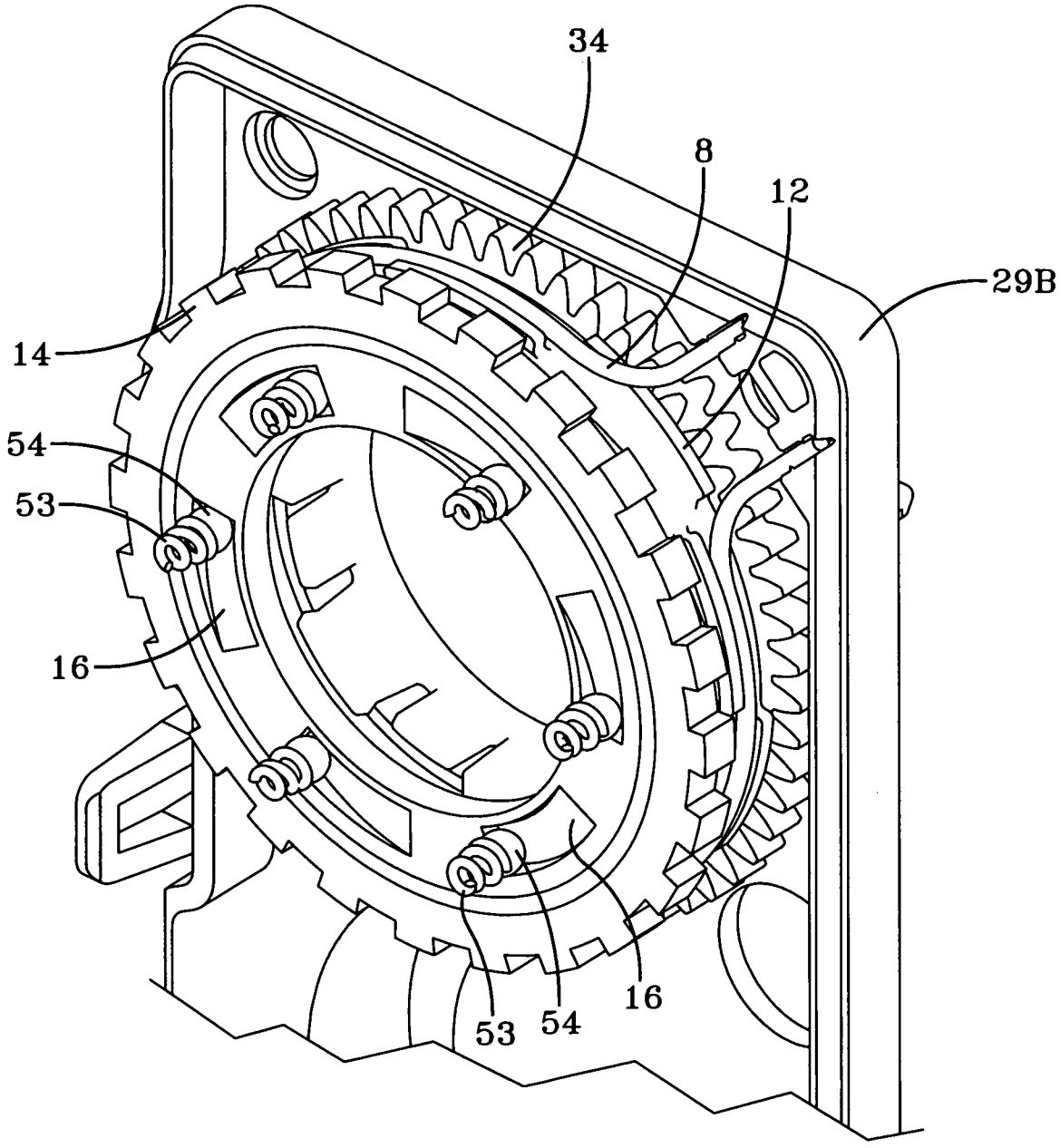


FIG-6

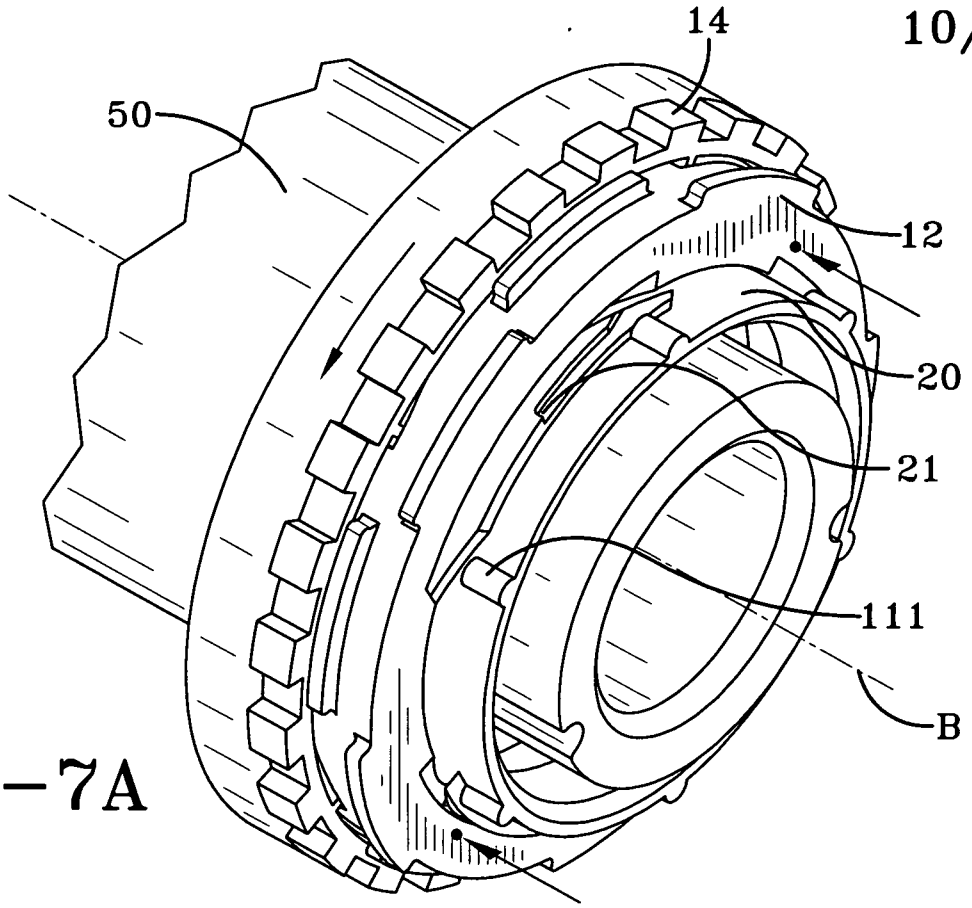


FIG-7A

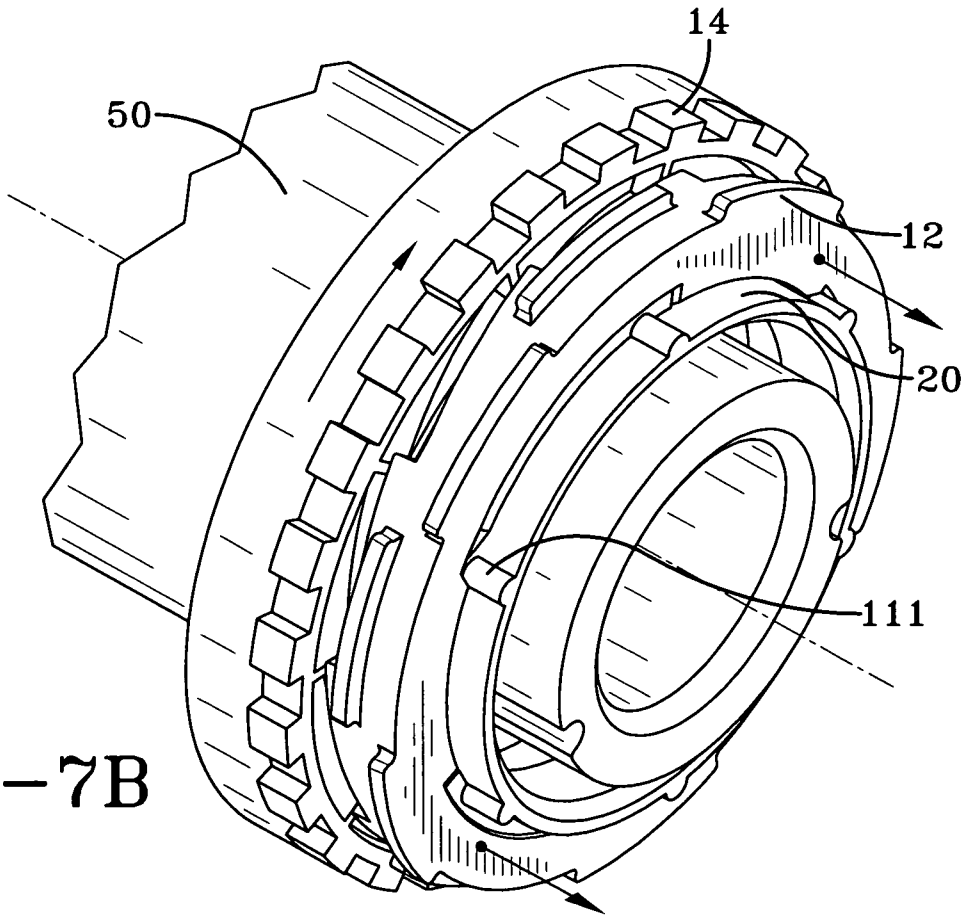


FIG-7B

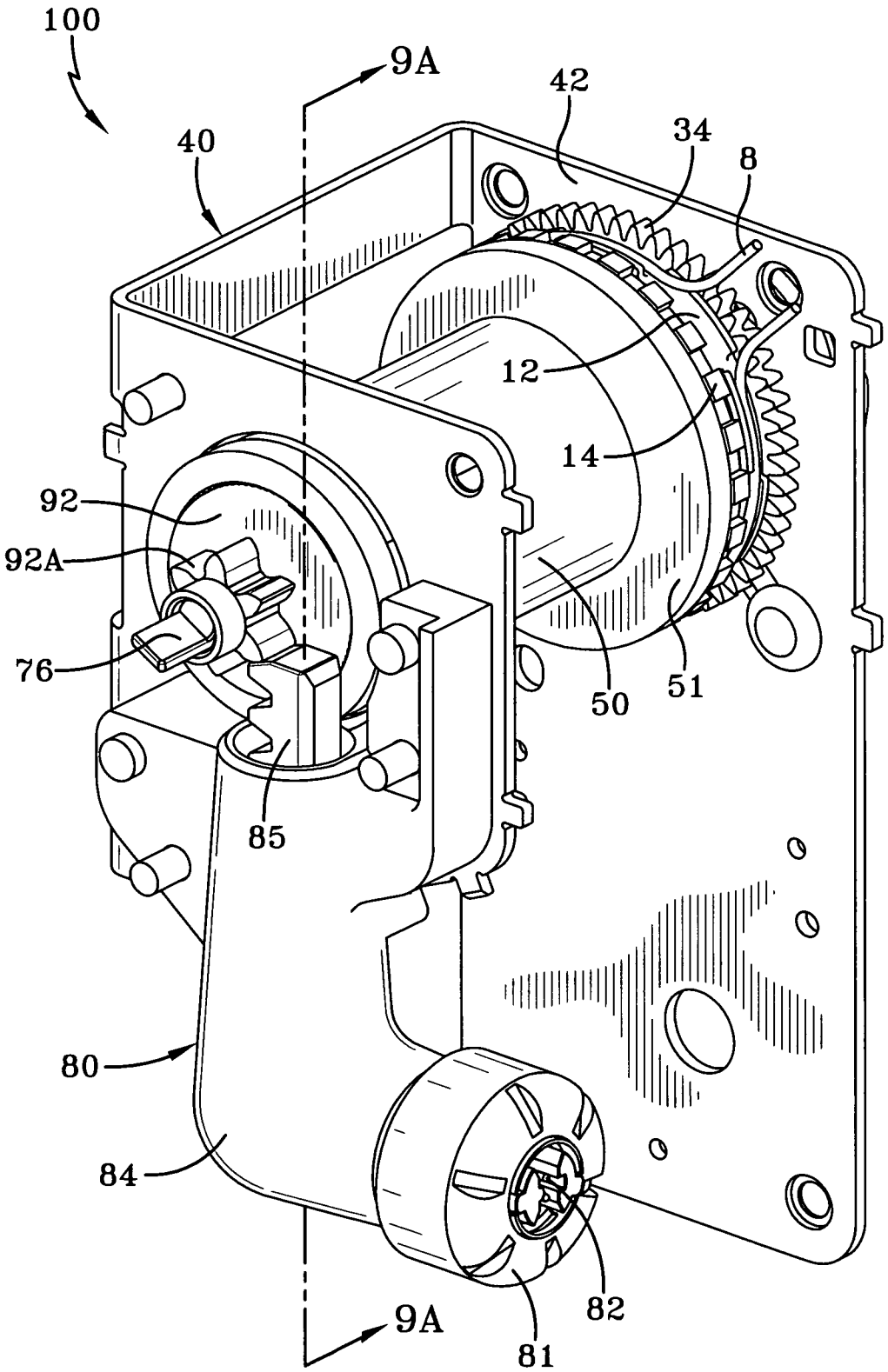


FIG-8

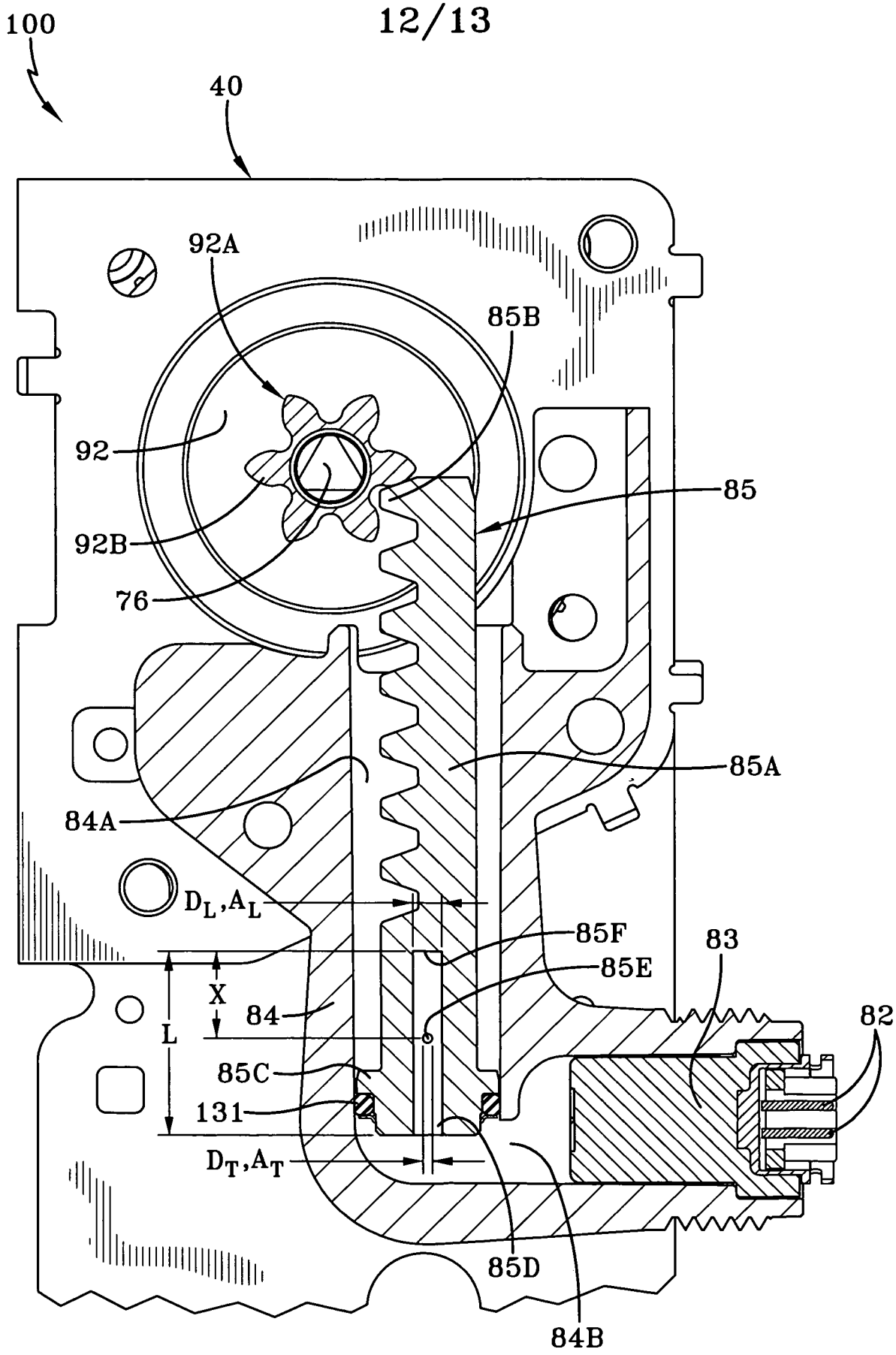

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85C
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D_T, A_T
85D
84B

FIG-9A

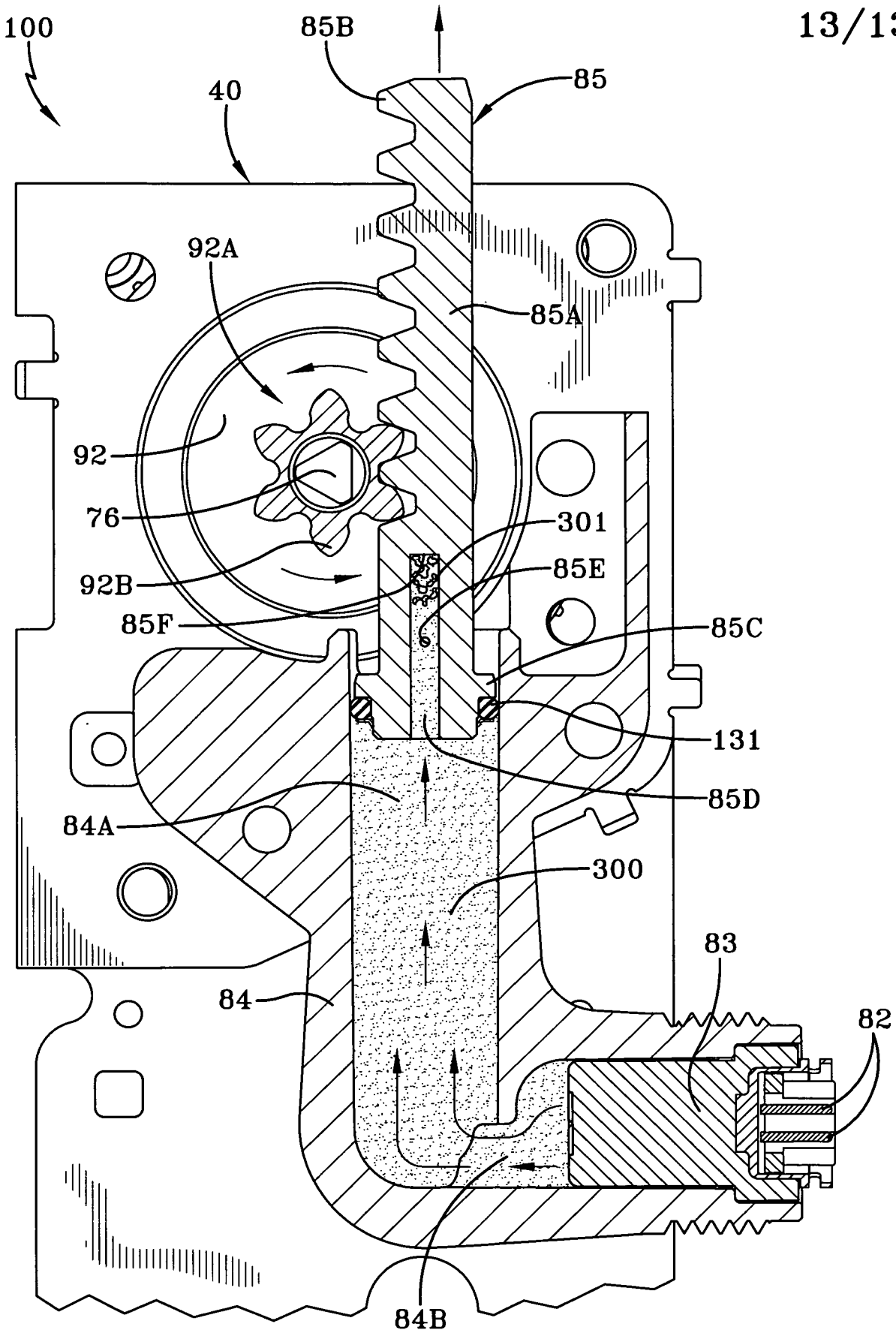

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85D
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84B

FIG-9B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2008/001038

A. CLASSIFICATION OF SUBJECT MATTER

B60R 22/34(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 B60R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models since 1975

Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

e-KIPASS (KIPO internal) : "SEAT BELT" & "RETRACTOR" & "MOTOR" & " CLUTCH PLATE"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,788,281 A (EIJI YANAGI et al.) 4 AUG. 1998 SEE THE ABSTRACT AND FIG 1.	1-11
A	US 5,244,231 A (BARNEY BAUER et al) 14 SEP. 1993 SEE THE ABSTRACT AND FIG 1.	1-11
A	US 6,390,403 B2 (MARTIN SPECHT) 21 MAY 2002 SEE THE ABSTRACT AND FIG1.	1-11
A	US 6,910,653 B2 (HIROMASA TANJI) 28 JUN. 2005 SEE THE ABSTRACT AND FIG 1.	1-11

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 JUNE 2008 (03.06.2008)	**03 JUNE 2008 (03.06.2008)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer HAM, Joung Hyun Telephone No. 82-42-481-5458

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2008/001038

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