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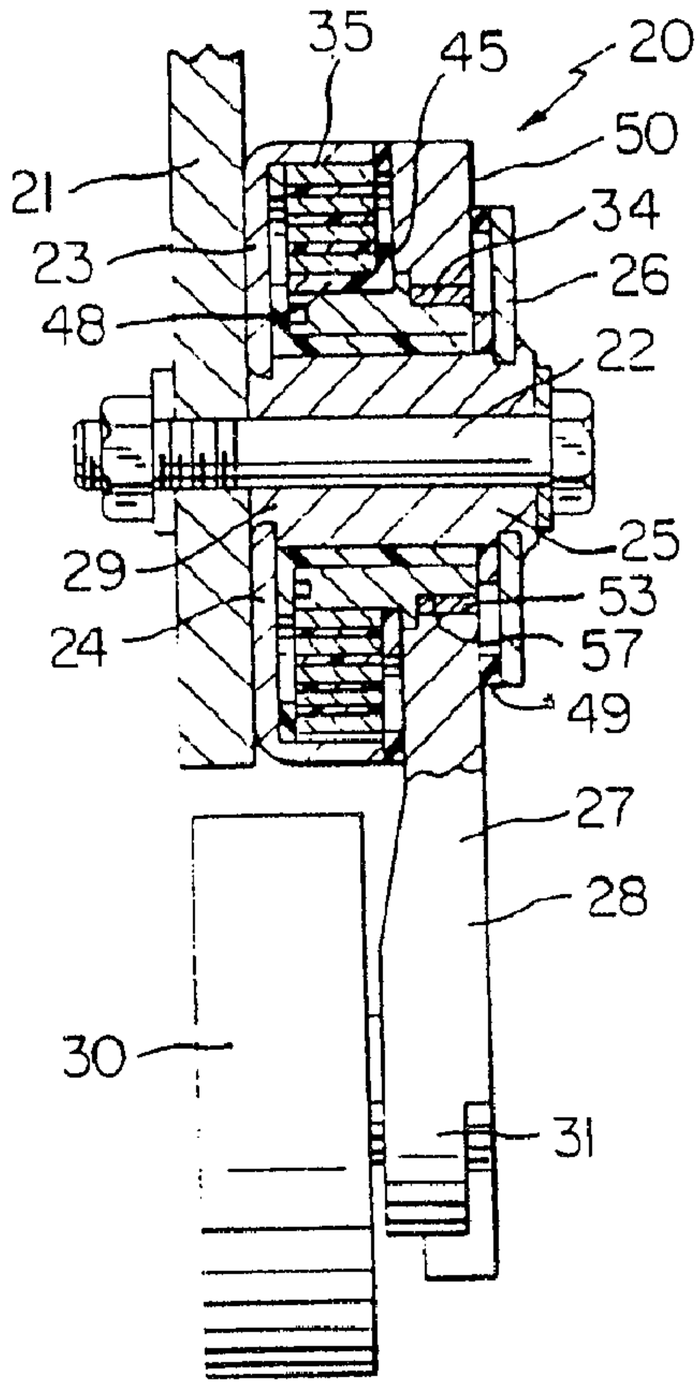
(54) Titre : TENDEUR POUR COURROIE DE TRANSMISSION D'ENERGIE ET METHODE DE FABRICATION
(54) Title: TENSIONER FOR A POWER TRANSMISSION BELT AND METHOD OF MAKING THE SAME



(57) Abrégé/Abstract:
An improved tensioner is provided for a power transmission belt for operation in an endless path. The tensioner includes a support means for being fixed relative to the belt. A belt-engaging means is carried by the support means and is movable

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(57) Abrégé(suite)/Abstract(continued):
relative thereto. A coiled torsion spring has a first end which is operatively-interconnected to the support means and a second end which is operatively-interconnected to the belt-engaging means for urging the belt-engaging means relative to the support means and against the belt with a force to tension the belt. The spring has a certain torque when the belt-engaging means is disposed at a certain position relative to the support means. The improved tensioner has changeable structure holding one of the ends of the spring in an adjusted position relative to its respective operatively-interconnected means so as to provide for the certain torque of the spring when the belt-engaging means is disposed at the certain position relative to the support means; and/or the changeable structure includes a spacer which is carried by one of the support means and the belt-engaging means, where one of the ends of the spring is disposed against the spacer so as to be interconnected to one of the support means and the belt-engaging means; and/or the tensioner has the changeable structure holding one of the ends of the spring in an adjusted position before the support means and the belt-engaging means had been assembled together; and/or a coiled torsion spring is provided having a first end which is operatively-interconnected to the support means and a second end which is operatively-interconnected to the belt-engaging means for urging the belt-engaging means relative to the support means and against the belt with a force to tension the support means and against the belt with a force to tension the belt, the spring having a certain torque when the belt-engaging means is disposed at a certain position relative to the support means. Novel methods for making such improved tensioners are also taught.

ABSTRACT

An improved tensioner is provided for a power transmission belt for operation in an endless path. The tensioner includes a support means for being fixed relative to the belt. A belt-engaging means is carried by the support means and is movable relative thereto. A coiled torsion spring has a first end which is operatively-interconnected to the support means and a second end which is operatively-interconnected to the belt-engaging means for urging the belt-engaging means relative to the support means and against the belt with a force to tension the belt. The spring has a certain torque when the belt-engaging means is disposed at a certain position relative to the support means. The improved tensioner has changeable structure holding one of the ends of the spring in an adjusted position relative to its respective operatively-interconnected means so as to provide for the certain torque of the spring when the belt-engaging means is disposed at the certain position relative to the support means; and/or the changeable structure includes a spacer which is carried by one of the support means and the belt-engaging means, where one of the ends of the spring is disposed against the spacer so as to be interconnected to one of the support means and the belt-engaging means; and/or the tensioner has the changeable structure holding one of the ends of the spring in an adjusted position before the support means and the belt-engaging means had been assembled together; and/or a coiled torsion spring is provided having a first end which is operatively-interconnected to the support means and a second end which is operatively-interconnected to the belt-engaging means for urging the belt-engaging means relative to the support means and against the belt with a force to tension the support means and against the belt with a force to tension the belt, the spring having a certain torque when the belt-engaging means is disposed at a certain position relative to the support means. Novel methods for making such improved tensioners are also taught.

(a) TITLE OF THE INVENTION

TENSIONER FOR A POWER TRANSMISSION BELT AND METHOD OF MAKING THE SAME.

(b) TECHNICAL FIELD TO WHICH THE INVENTION BELONGS

This invention relates to new tensioners for power transmission belts for operation in an endless path, and to new methods of making such tensioners.

(c) BACKGROUND ART

It is known to provide a tensioner for a power transmission belt for operation in an endless path. Such prior art tensioner includes a support means for being fixed relative to the belt, and a belt-engaging means which is carried by the support means and which is movable relative thereto. A coiled torsion spring has a first end which is operatively-interconnected to the support means and has a second end which is operatively-interconnected to the belt-engaging means for urging the belt-engaging means relative to the support means and against the belt with a force to tension the belt. The spring has a certain torque when the belt-engaging means is disposed at a certain position relative to the support means. For example, see U.S. Patent No. 4,596,538 to Henderson.

(d) DESCRIPTION OF THE INVENTION

An object of one aspect of the present invention is to provide a belt tensioner that has unique means for adjusting the torque of the torsion spring thereof to a desired torque when the belt-engaging means thereof is disposed at a certain position relative to the support means thereof.

An object of another aspect of this invention is to provide new methods for making tensioners for power transmission belts for operation in an endless path.

By a first one aspect of this invention, a tensioner is provided for a power transmission belt for operation in an endless path, the tensioner comprising a support means for being fixed relative to the belt, a belt-engaging means which is carried by the support means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to the support means and a second end which is operatively-interconnected to the belt-engaging means for urging the belt-

engaging means relative to the support means and against the belt with a force to tension the belt, the spring having a certain torque when the belt-engaging means is disposed at a certain position relative to the support means, the improvement wherein: the tensioner has changeable structure holding one of the ends in an adjusted position relative to its respective operatively-interconnected means so as to provide for the certain torque of the spring when the belt engaging-means is disposed at the certain position relative to the support means.

By a second aspect of this invention, a tensioner is provided for a power transmission belt for operation in an endless path, the tensioner comprising a support means for being fixed relative to the belt, a belt-engaging means which is carried by the support means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to the support means and a second end which is operatively-interconnected to the belt-engaging means for urging the belt-engaging means relative to the support means and against the belt with a force to tension the belt, the spring having a certain torque when the belt-engaging means is disposed at a certain position relative to the support means, the improvement wherein: the tensioner has changeable structure holding one of the ends in an adjusted position relative to its respective operatively-interconnected means so as to provide for the certain torque of the spring when the belt engaging-means is disposed at the certain position relative to the support means, the changeable structure comprising a spacer which is carried by one of the support means and the belt-engaging means, the one of the ends of the spring being disposed against the spacer so as to be interconnected to the one of the support means and the belt-engaging means.

By a third aspect of this invention, a tensioner is provided for a power transmission belt for operation in an endless path, the tensioner comprising a support means for being fixed relative to the belt, a belt-engaging means which is carried by the support means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to the support means and a second end which is operatively-interconnected to the belt-engaging means for urging the belt-engaging means relative to the support means and against the belt with a force to tension

the belt, the spring having a certain torque when the belt-engaging means is disposed at a certain position relative to the support means, the improvement wherein: the tensioner has changeable structure holding one of the ends in an adjusted position relative to its respective operatively-interconnected means so as to provide for the certain torque of the spring when the belt engaging-means is disposed at the certain position relative to the support means, the tensioner having the changeable structure holding the one of the ends of the spring in the adjusted position before the support means and the belt-engaging means had been assembled together.

By a fourth aspect of this invention, a tensioner is provided for a power transmission belt for operation in an endless path, the tensioner comprising a support means for being fixed relative to the belt, a belt-engaging means and having a shaft means, a belt-engaging means which is carried by the support means and which has an arbor means which is rotatably disposed on the shaft means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to the support means and a second end which is operatively-interconnected to the belt-engaging means for urging the belt-engaging means relative to the support means and against the belt with a force to tension the support means and against the belt with a force to tension the belt, the spring having a certain torque when the belt-engaging means is disposed at a certain position relative to the support means, the improvement wherein: the tensioner has changeable structure holding one of the ends in an adjusted position relative to its respective operatively-interconnected means so as to provide for the certain torque of the spring when the belt engaging-means is disposed at the certain position relative to the support means.

By a fifth aspect of this invention, a method is provided for making a tensioner for a power transmission belt for operation in an endless path, the tensioner comprising a support means for being fixed relative to the belt, a belt-engaging means which is carried by the support means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to the support means and a second end which is operatively-interconnected to the belt-engaging means for urging the belt-engaging means relative to the support means and against the belt with a force

to tension the belt, the spring having a certain torque when the belt-engaging means is disposed at a certain position relative to the support means, the improvement comprising the step of: forming the tensioner to have changeable structure holding one of the ends in an adjusted position relative to its respective operatively-interconnected means so as to provide for the certain torque of the spring when the belt-engaging means is disposed at the certain position relative to the support means.

By a sixth aspect of this invention, a method is provided for making a tensioner for a power transmission belt for operation in an endless path, the tensioner comprising a support means for being fixed relative to the belt, a belt-engaging means which is carried by the support means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to the support means and a second end which is operatively-interconnected to the belt-engaging means for urging the belt-engaging means relative to the support means and against the belt with a force to tension the belt, the spring having a certain torque when the belt-engaging means is disposed at a certain position relative to the support means, the improvement comprising the steps of: forming the tensioner to have changeable structure holding one of the ends in an adjusted position relative to its respective operatively-interconnected means so as to provide for the certain torque of the spring when the belt-engaging means is disposed at the certain position relative to the support means; forming the changeable structure to comprise a spacer which is carried by one of the support means and the belt-engaging means; and disposing the one of the ends of the spring against the spacer so as to be interconnected to the one of the support means and the belt-engaging means.

By a seventh aspect of this invention, a method is provided for making a tensioner for a power transmission belt for operation in an endless path, the tensioner comprising a support means for being fixed relative to the belt, a belt-engaging means which is carried by the support means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to the support means and a second end which is operatively-interconnected to the belt-engaging means for urging the belt-engaging means relative to the support means and against the belt with a force to tension the belt, the spring having a certain torque when the belt-engaging means is

disposed at a certain position relative to the support means, the improvement comprising the step of: forming the tensioner to have changeable structure holding one of the ends in an adjusted position relative to its respective operatively-interconnected means so as to provide for the certain torque of the spring when the belt-engaging means is disposed at the certain position relative to the support means, the step of forming the tensioner to have the changeable structure holding the one of the ends in an adjusted position taking place before the support means and the belt-engaging means are assembled together.

By an eighth aspect of this invention, a method is provided for making a tensioner for a power transmission belt for operation in an endless path, the tensioner comprising a support means for being fixed relative to the belt and having shaft means, a belt-engaging means which is carried by the support means and which has an arbor means which is rotatably disposed on the shaft means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to the support means and a second end which is operatively-interconnected to the belt-engaging means for urging the belt-engaging means relative to the support means and against the belt with a force to tension the belt, the spring having a certain torque when the belt-engaging means is disposed at a certain position relative to the support means, the improvement comprising the step of: forming the tensioner to have changeable structure holding the second end of the spring in an adjusted position relative to the belt-engaging means so as to provide for the certain torque of the spring when the belt-engaging means is disposed at the certain position relative to the support means.

By variants of the first, second and third aspects of the invention, in the tensioner the changeable structure comprises a rotatable member which is carried by one of the support means and the belt-engaging means, and which is interconnected to the one of the ends of the spring.

By another variant of these first, second and third aspects of the invention, and/or the above variant thereof, one of the ends of the spring is tang-like, the rotatable member having a slot therein that receives the tang-like end of the spring therein so as to be interconnected to the one end of the spring.

By another variant of these first, second and third aspects of the invention, and/or the above variant and/or variants thereof, the rotatable member has locking means locking the member in a certain rotational position relative to the one of the support means and the belt-engaging means to provide for the certain torque. By one variation thereof, the locking means comprises knurling means.

By yet another variant of these first, second and third aspects of the invention, and/or the above variant and/or variants thereof, the changeable means comprises a pair of spacers which is carried in spaced-apart relation by one of the support means and the belt-engaging means so as to define a slot therebetween, one of the ends of the spring being disposed in the slot so as to be interconnected to one of the support means and the belt-engaging means. By one variation thereof, one of the support means and the belt-engaging means has a notch therein that defines two spaced-apart edge means, the pair of spacers being respectively disposed against the two spaced-apart edge means so as to be carried in the notch.

By still another variant of these first, second and third aspects of the invention, and/or the above variant and/or variants thereof, the second end of the spring comprises an inner end thereof, and one of the support means and the belt-engaging means comprises the belt-engaging means. By one variation thereof, the changeable structure comprises a ring member which is rotatably carried by the belt-engaging means. By a second variation thereof, the changeable structure comprises removable spacer means which are carried by the belt-engaging means.

By yet a further variant of these first, second and third aspects of the invention, and/or the above variant and/or variants thereof, the changeable means comprises a pair of spacers which is carried in spaced-apart relation by one of the support means and the belt-engaging means so as to define a slot therebetween, the one of the ends of the spring being disposed in the slot so as to be interconnected to the one of the support means and the belt-engaging means.

By a further variant of these first, second and third aspects of the invention, and/or the above variant and/or variants thereof, the second end of the spring comprises an inner end thereof, one of the support means and the belt-engaging means comprises

the belt-engaging means, and the changeable structure comprises a rotatable member which is carried by one of the support means and the belt-engaging means, and which is interconnected to the one of the ends of the spring.

By one variant of the fourth aspect of the invention, the changeable structure comprises a rotatable member which is carried by the belt-engaging means, and comprising the arbor means thereof.

By another variant of the fourth aspect of the invention, and/or the above variant thereof, one of the second end of the spring is tang-like, the rotatable member having a slot therein that receives the tang-like end of the spring therein so as to be interconnected to the second end of the spring.

By yet another variant of the fourth aspect of the invention, and/or the above variant and/or variants thereof, the rotatable member has locking means locking the member in a certain rotational position relative to one of the support means and the belt-engaging means to provide for the certain torque. By a variation thereof, the locking means comprises knurling means.

By still another variant of the fourth aspect of the invention, and/or the above variant and/or variants thereof, the changeable means comprises a pair of spacers which is carried in spaced-apart relation by the arbor means and the belt-engaging means so as to define a slot therebetween, the second end of the spring being disposed in the slot so as to be interconnected to the belt-engaging means.

By yet still another variant of the fourth aspect of the invention, and/or the above variant and/or variants thereof, the arbor means and the belt-engaging means has a notch therein that defines two spaced-apart edge means, the changeable structure comprising a spacer which is disposed against one of the two spaced-apart edge means so as to be carried in the notch.

By still a further variant of the fourth aspect of the invention, and/or the above variant and/or variants thereof, the second end of the spring comprises an inner end thereof.

By still a further variant of the fourth aspect of the invention, and/or the above variant and/or variants thereof, the changeable structure comprises a removable spacer means which is disposed between the arbor means of the belt-engaging means and the second end of the spring.

By a still further variant of the fourth aspect of the invention, and/or the above variant and/or variants thereof, the changeable structure comprises removable spacer means which are carried by the belt-engaging means.

By one variant of the fifth, sixth and seventh aspects of this invention, the method includes the step of forming the changeable structure to comprise a rotatable member which is carried by one of the support means and the belt-engaging means and which is interconnected to the one of the ends of the spring.

By another variant of the fifth, sixth and seventh aspects of this invention, and/or the above variant thereof, the method includes the steps of forming the one of the ends of the spring to be tang-like, and forming the rotatable member to have a slot therein that receives the tang-like end of the spring therein so as to be interconnected to the one end of the spring.

By yet another variant of the fifth, sixth and seventh aspects of this invention, and/or the above variant and/or variants thereof, the method includes the step of forming the rotatable member to have locking means locking the member in a certain rotational position relative to the one of the support means and the belt-engaging means to provide for the certain torque.

By yet still another variant of the fifth, sixth and seventh aspects of this invention, and/or the above variant and/or variants thereof, the method includes the step of forming the locking means to comprise knurling means.

By yet still another variant of the fifth, sixth and seventh aspects of this invention, and/or the above variant and/or variants thereof, the method includes the steps of forming the changeable means to comprise a pair of spacers which is carried in spaced-apart relation by one of the support means and the belt-engaging means so as to define a slot therebetween, and disposing the one of the ends of the spring in the slot so as to be interconnected to the one of the support means and the belt-engaging means.

By a still further variant of the fifth, sixth and seventh aspects of this invention, and/or the above variant and/or variants thereof, the method includes the steps of forming one of the support means and the belt-engaging means to have a notch therein that defines two-spaced-apart edge means, and disposing the pair of spacers respectively against the two spaced-apart edge means so as to be carried in the notch.

By yet still a further variant of the fifth, sixth and seventh aspects of this invention, and/or the above variant and/or variants thereof, the method includes the step of forming the second end of the spring to comprise an inner end thereof, the one of the support means and the belt-engaging means comprising the belt-engaging means.

By a still further variant of the fifth, sixth and seventh aspects of this invention, and/or the above variant and/or variants thereof, the method includes the step of forming the changeable structure to comprise a ring member which is rotatably carried by the belt-engaging means.

By another variant of the fifth, sixth and seventh aspects of this invention, and/or the above variant and/or variants thereof, the method includes the step of forming the changeable structure to comprise removable spacer means which are carried by the belt-engaging means.

By yet still another variant of the fifth, sixth and seventh aspects of this invention, and/or the above variant and/or variants thereof, the method includes the steps of forming the changeable means to comprise a pair of spacers which is carried in spaced-apart relation by one of the support means and the belt-engaging means so as to define a slot therebetween, and disposing the one of the ends of the spring in the slot so as to be interconnected to the one of the support means and the belt-engaging means.

By yet another variant of the fifth, sixth and seventh aspects of this invention, and/or the above variant and/or variants thereof, the method includes the steps of forming the one of the support means and the belt-engaging means to have a notch therein that defines two spaced-apart edge means, and disposing the spacer against one of the two spaced-apart edge means so as to be carried in the notch.

By a still further variant of the fifth, sixth and seventh aspects of this invention, and/or the above variant and/or variants thereof, the method includes the step of forming the second end of the spring to comprise an inner end thereof, the one of the support means and the belt-engaging means comprising the belt-engaging means.

By one variant of the eighth aspect of this invention, the method includes the step of forming the changeable structure to comprise a rotatable member which is carried by the belt-engaging means and comprising the arbor means thereof.

By another variant of the eighth aspect of this invention, and/or the above variant thereof, the method includes, the steps of forming the second end of the spring to be tang-like, and forming the rotatable member to have a slot therein that receives the tang-like end of the spring therein so as to be interconnected to the second end of the spring.

By still another variant of the eighth aspect of this invention, and/or the above variant and/or variants thereof, the method includes the step of forming the rotatable member to have locking means locking the member in a certain rotational position relative to the belt-engaging means to provide for the certain torque. By one variation thereof, the method includes the step of forming the locking means to comprise knurling means.

By yet still another variant of the eighth aspect of this invention, and/or the above variant and/or variants thereof, the method includes, the steps of forming the changeable means to comprise a pair of spacers which is carried in spaced-apart relation by the arbor means of the belt-engaging means so as to define a slot therebetween, and disposing the second end of the spring in the slot so as to be interconnected to the belt-engaging means.

By yet a further variant of the eighth aspect of this invention, and/or the above variant and/or variants thereof, the method includes the steps of forming the arbor means of the belt-engaging means to have a notch therein that defines two-spaced-apart edge means, forming the changeable structure to comprise a spacer, and disposing the spacer against one of the two spaced-apart edge means and the second end of the spring so as to be carried in the notch.

By yet still a further variant of the eighth aspect of this invention, and/or the above variant and/or variants thereof, the method includes the step of forming the second end of the spring to comprise an inner end thereof.

By yet another variant of the eighth aspect of this invention, and/or the above variant and/or variants thereof, the method includes the step of forming the changeable structure to comprise removable spacer means which are disposed between the arbor means of the belt-engaging means and the second end of the spring.

By yet still another variant of the eighth aspect of this invention, and/or variant and/or variants thereof, the method includes the step of forming the changeable structure to comprise removable spacer means which are carried by the belt-engaging means.

(e) DESCRIPTION OF THE FIGURES

In the accompanying drawings,

Figure 1 is a fragmentary front view of the belt tensioner of an embodiment of one aspect of this invention mounted to a support bracket and illustrating in full lines one position thereof and in phantom lines other positions thereof;

Figure 2 is a fragmentary cross-sectional view taken on line 2-2 of Figure 1;

Figure 3 is an exploded perspective view of the various parts of the tensioner of Figures 1 and 2;

Figure 4 is an exploded perspective view illustrating various parts for setting the torque of the spring of the tensioner of an embodiment of an aspect of this invention during the method of making the tensioner according to the method of this invention;

Figure 5 is a view similar to Figure 4 illustrating certain parts in their assembled relation;

Figure 6 is a side view of the parts illustrated in Figure 5 with part of the structure being taken on line 6-6 of Figure 5;

Figure 7 is a view similar to Figure 6 and illustrates the method of another aspect of this invention for locking the tensioner in the adjusted position thereof;

Figure 8 is an exploded perspective view illustrating another embodiment of the tensioner of an aspect of this invention;

Figure 9 is a side view of the parts of Figure 8 in a certain assembled relation thereof;

Figure 10 is a view similar to Figure 9 and illustrates the parts in their locked position;

Figure 11 is a view similar to Figure 1 and illustrates another tensioner of another embodiment of an aspect of this invention;

Figure 12 is a fragmentary cross-sectional view taken on line 12-12 of Figure 11;

Figure 13 is an exploded perspective view of the various parts that form the tensioner of Figures 11 and 12;

Figure 14 is an exploded perspective view of certain of the parts of the tensioner of Figures 11 and 12 and illustrates one of the steps of the method of another aspect of this invention for making the tensioner of Figures 11 and 12;

Figure 15 is a perspective view of the parts of Figure 14 in the assembled relation thereof;

Figure 16 is an enlarged fragmentary view of part of the assembled structure illustrated in Figure 15;

Figure 17 is a view similar to Figure 16 and illustrates the one end of the spring being disposed in an adjusted position thereof and illustrating the locking spacers therefor in an exploded manner; and

Figure 18 is a view similar to Figure 17 and illustrates the spacers of Figure 17 in their inserted and final locking positions.

(f) AT LEAST ONE MODE FOR CARRYING OUT THE INVENTION

While the various features of this invention are hereinafter illustrated and described as being particularly adapted to provide a tensioner for a certain type of power transmission belt, it is to be understood that the various features of various embodiments of aspects of this invention can be utilized singly or in various combinations thereof to provide a tensioner for other types of belts as desired.

Therefore, broad aspects of this invention are not to be limited only to the embodiments illustrated in the drawings because the drawings are merely utilized to illustrate one of a wide variety of uses of various aspects of this invention.

Referring now to the Figures 1 and 2, the new belt tensioner of one embodiment of an aspect of this invention is generally indicated by the reference numeral 20. It is illustrated as being interconnected to a support bracket 21 of an internal combustion engine (not shown) by a single bolt means 22 in a manner fully set forth in the aforementioned U.S. Patent No. 4,661,087, to Henderson. Of course, other mounting means can be used.

The tensioner 20 comprises a support means 23 that comprises a cup-shaped casing 24, a shaft means 25 and a plate means 26 all interconnected together so that, when the support means 23 is interconnected to the support bracket 21, the support means 23 remains stationary with the support bracket 21 as is well known in the art.

The tensioner 20 also comprises a belt-engaging means 27 that comprises a belt-engaging arm 28 that is provided with a tubular arbor 29 that is rotatably disposed on the shaft means 25 so as pivotally to mount the belt-engaging arm 28 to the shaft means 25. The belt-engaging means 27 further comprises a pulley means 30 that is rotatably mounted to an end 31 of the belt-engaging arm 28 so that an outer peripheral surface 32 of the pulley 30 can engage against a power transmission belt for operation in an endless path relative to the support bracket 21. Such a belt construction 33 is illustrated in phantom lines in Figure 1.

The tubular arbor 29 of the belt-engaging means 27 of this embodiment of an aspect of this invention is a part that is initially separate from the belt-engaging arm 28, but is subsequently secured thereto by a locking ring 34 in a manner hereinafter set forth so that the arbor 29 and the belt-engaging arm 28 will rotate in unison. On the other hand, the arbor of the belt-tensioner set forth in the aforementioned U.S. Patent No. 4,661,087, to Henderson, is integral and one-piece with the belt-engaging arm.

The tensioner 20 also comprises a coiled torsion spring 35 which is formed from a flat metallic ribbon coiled upon itself so as to have an inner end 36 and an outer end 37. An antifriction ribbon 38 is also interleaved between the coils of the spring 35 to reduce friction of such coils during the winding and unwinding thereof in a manner well-known in the art. The spring 35 is disposed in the cup-shaped casing 24 with the outer end 37 of the spring 35 extending through a slot 39 in the cup-shaped casing 24 and

hooking against a surface 40 thereof so as to interconnect the end 37 of the spring 35 to the support means 23. The inner end 36 of the spring 35 is tang-like and is received in a slot 41, (see Figure 4), of the arbor 29 of the belt-engaging means 27 so as to interconnect the spring 35 to the belt-engaging means 27.

When the tensioner 20 is assembled in a manner hereinafter set forth, the torsion spring 35 has been so wound that it tends to move the belt-engaging arm 28 in a clockwise direction in Figure 1 from the phantom line position indicated by the reference numeral 42 in Figure 1 to the phantom line position represented by the reference numeral 43 in Figure 1. In this manner, the pulley 30 will engage against the belt 33 at the position indicated by the solid line to impose a tensioning force on the belt 33 in a manner well-known in the art.

In the past, each spring 35 was so constructed and arranged that when it was assembled in a tensioner, the spring was to provide a certain torque on the belt-engaging means when the belt-engaging arm 28 was disposed at a certain position relative to the support means. Therefore, it would provide for proper tensioning of a belt during the use thereof. However, it was found, according to the teachings of broad aspects of this invention, that inconsistent spring torque made keeping tensioner torque output within the required tolerances for each different type of engine use very difficult. Spring sorting by torque output and selective assembly of the tensioners were costly and produced high spring scrap rates.

Therefore, it was found, according to the teachings of broad aspects of this invention, that the tensioner 20 can be provided with changeable structure that holds one of the ends of the spring in an adjusted position relative to its respective operatively-interconnected means. This provides for a certain torque of the spring when the belt-engaging means is disposed at a certain position thereof relative to the support means. In the embodiment of the tensioner 20 of an aspect of this invention illustrated in Figures 1 to 7, such changeable structure is provided by the arbor 29 of the belt-engaging means 27 initially being separate from the belt-engaging arm 28 in a manner hereinafter set forth.

In order to provide antifriction material on each side of the torsion spring 35 when the spring is disposed in the cup-shaped casing 24 in the assembled relation therewith, a pair of disc-like members 44 and 45 is provided. These members 44,45 are disposed on opposite sides of the spring 35. The disc-like member 44 has a tubular bearing structure 46 that is disposed between the shaft means 25 and the inner peripheral surface 47 of the arbor 29 of the belt-engaging means 27 so as to provide friction material between the shaft means 25 and the pivoting movement of the belt-engaging arm 28, in a manner well-known in the art. The disc-like member 45 has a partial tubular structure 48 that is disposed adjacent to the inner coil 49 of the spring 35 for the reasons fully set forth in the aforementioned U.S. Patent No. 4,596,538, to Henderson. Hence, a further discussion of the disc-like members 44 and 45 is deemed unnecessary as the details of the members 44 and 45 are fully disclosed in such patent.

Additionally, a disc-like member 49 of polymeric material is disposed between the end plate 26 and the side 50 of the belt-engaging arm 28 to reduce friction between the pivoting movement of the belt-engaging arm 28 and the stationary end plate 26.

Thus, since the details of the structure and the operation of the belt tensioner 20 are similar to the belt-tensioner fully disclosed in the aforementioned U.S. Patent No. 4,661,087, to Henderson, a further discussion of the structure and operation of the belt tensioner 20 of an aspect of this invention is deemed unnecessary.

The aforementioned feature of embodiments of aspects of this invention for adjusting the torque of the spring 35 during the assembly of the tensioner 20 will now be described in detail.

The belt-engaging arm 28 of the tensioner 20 is formed of metallic material and has a stepped opening 51 passing therethrough. This defines a first cylindrical surface 52 and a second cylindrical surface 53 respectively adjacent to the opposed sides 54 and 50 of the belt-engaging arm 28, and also defines a flat internal annular shoulder 55 therebetween, as illustrated in Figure 3.

The arbor 29 is formed of metallic material and has a stepped external peripheral surface which is defined by a first external cylindrical surface 56 and a second external cylindrical surface 57 that has a smaller diameter than the surface 56 and is separated

therefrom by an outwardly-directed annular rib means 58. Rib means 58 is adapted to have its outer peripheral surface 59 substantially mate with the cylindrical surface 52 of the belt-engaging arm 28 when that surface 52 is disposed therein. It is also adapted to have a flat annular shoulder 60 engage against the annular shoulder 55 of the belt-engaging arm 28 in the manner illustrated in Figure 2. In this way, the peripheral surface 57 of the arbor 29 is disposed spaced radially-inwardly from the internal peripheral surface 53 of the belt-engaging arm 28.

When the arbor 29 is first assembled in the opening 51 of the belt-engaging arm 28 in the above manner, the arbor 29 can be rotated relative to the belt-engaging arm 28 and can be subsequently locked in a desired rotational position thereof by having the knurled metallic ring 34, which has knurls 61 on the outer peripheral surface thereof and knurls 62 on the inner peripheral surface thereof. The metallic ring 34 is inserted between the surfaces 53 and 57 of the belt-engaging arm 28 and the arbor 29 so that the knurls 61 and 62 thereof grip in a manner well-known in the pressfit art. The respective surfaces 53 and 57 lock the arbor 29 to the belt-engaging arm 28 in such rotational position thereof, so that, thereafter, the belt-engaging arm 28 and the arbor 29 rotate in unison in that selected rotational position of the arbor 29 relative to the belt-engaging arm 28.

The arbor 29 has an end surface 63 which is provided with a plurality of openings 64 which are disposed therein to cooperate with a plurality of projections 65 on a rotatable tool 66 of an apparatus of another embodiment of an aspect of this invention that is generally indicated by the reference numeral 67 in the drawings.

The apparatus 67 includes a support structure that is generally indicated by the reference numeral 68 in Figure 6 and is represented by dashed lines, the support structure 68 having an opening 69 passing therethrough.

The belt-engaging arm 28 of a tensioner 20 is adapted to be disposed on the support structure 68 in the manner illustrated in Figure 6 so that the opening 51 thereof is aligned with the opening 69. The belt-engaging arm 28 is adapted to be held on such structure 68 in a fixed manner by any suitable holding structure (not shown) so that the

end 70 of the belt-engaging arm 28 will be located in a fixed position on the support structure 68 for a purpose hereinafter set forth.

Thereafter, the arbor 29 is inserted into the opening 51 so that the shoulder 60 thereof abuts against the annular shoulder 55 of the belt-engaging arm 28. Thereafter, the disc member 45 is assembled over the arbor 29 and then the spring 35 is disposed over the arbor 29 and against the disc 45, with the inner end 36 of the spring 35 being received in the notch 41 of the arbor 29.

The end 37 of the spring 35 is then moved to a set position that is represented by the reference numeral 71 in Figure 5 by a holding pin 72 of the apparatus 67. In this manner, the end 37 of the spring 35 is in the fixed position 71 relative to the fixed position 73 for the end 70 of the belt-engaging arm 28 in the manner illustrated in Figure 5.

With the end 37 of the spring 35 held at the position 71 and with the end 70 of the belt-engaging arm 28 held at the position 73 as illustrated in Figure 5, the tool 66 is lowered against the arbor 29 so that the projections 65 are received in the openings 64. In this manner, the tool 66 can rotate the arbor 29 in the direction indicated by the arrow 74 in Figure 5 in the manner illustrated in Figure 6 to create a windup force of the spring 35. Thus, a desired output torque for the spring 35 will eventually be reached for the settings 71 and 73, at which time the rotation of the tool 66 is terminated. While the tool 66, and thus the arbor 29, is being held in that position, a ram 75 of the apparatus 67 is moved upwardly as represented by the arrow 76 in Figure 6 to insert the locking ring 34 through the opening 69 of the support means 68 and into the space between the surfaces 53 and 57 of the belt-engaging arm 28 and the arbor 29 to lock the arbor 29 in the set rotational position as being held by the tool 66 as illustrated in Figure 7.

Thereafter, the assembled belt-engaging arm 28, spring 35 and arbor 29 can be removed from the apparatus 67 as a completed subassembly by backing off the tool 66 and the ram 75. Such subassembly can then be assembled with the other parts of the tensioner 20 to complete the tensioner in the manner fully set forth in the aforementioned U.S. Patent No. 4,596,538, to Henderson. The torque of the spring 35 will be at an adjusted setting thereof that will assure that, when the belt-engaging arm 28 is disposed

in a certain position relative to the support means 23, the spring 35 will provide a desired torque for tensioning a belt when the tensioner 20 is utilized in the manner illustrated in Figure 1.

In this manner, it can be seen that the springs 35 for the tensioners 20 of this embodiment of this aspect of this invention need not be substantially-identical to each other when forming the tensioners 20 of this embodiment of this aspect of this invention. The apparatus 67 will assure that, when each spring 35 is in the assembled relation illustrated in Figure 4 wherein the end 37 of the spring 35 is at the position 71 and the end 70 of the belt-engaging arm 28 is held at the position 73, the tool 66 can adjust the inner end 36 of the spring 35 to a certain position that will provide a desired specified torque, at which time the arbor 29 is then locked in place in such rotational position provided by the tool 66.

While the locking ring 34 is utilized to lock the arbor 29 in the desired rotational position in the opening 51 of the belt-engaging arm 28 in the manner previously set forth, it is to be understood that other locking arrangements can be utilized.

For example, the surface 57 of the arbor 29 could itself be knurled so that when the arbor is fully inserted into the belt-engaging arm 28, such knurls will lock with the surface 53 in the belt-engaging arm 28.

In particular, another tensioner of another embodiment of an aspect of this invention is generally indicated by the reference numeral 20A in Figures 8 to 10. Parts thereof which are similar to the tensioner 20 previously-described are indicated by like reference numerals followed by the reference letter "A".

As illustrated in Figures 8 to 10, the belt-engaging arm 28A is identical to the belt-engaging arm 28 previously described. The arbor 29A has the surface 57A thereof provided with knurls 77 which will dig into the surface 53A of the belt-engaging arm 28A when the arbor 29A is fully inserted down into the opening 51A of the belt-engaging arm 28A in the manner illustrated in Figure 10 to lock the arbor 29A in its rotational position relative to the belt-engaging arm 28A.

Thus, the apparatus 67A of this embodiment of an aspect of this invention can be so constructed and arranged that, initially, the belt-engaging arm 28A will be held on the

supporting structure 68A with the end 70A thereof held in a certain position. The arbor 29A will be held adjacent to the belt-engaging arm 28A by another supporting structure 78 of the apparatus 67A. The tool 66A could rotate the arbor 29A to a desired rotational position thereof that will provide the torque output of the spring 35A when the outer end 37A of the spring 35A is being held in a certain position relative to the end 70A of the belt-engaging arm 28A in the manner previously set forth. A ram 79 of the apparatus 67A can then cooperate with the tool 66A to force the belt-engaging arm 28A and the arbor 29A together in the manner illustrated in Figure 10 after the removal of the supporting structure 78. The knurls 77 on the surface 57A of the arbor 29A will dig into the surface 53A of the belt-engaging arm 28A and thereby lock the arbor and the belt-engaging arm together in the rotational position that will cause the torque output of the spring 35A to be at the desired torque output in the same manner as provided by the apparatus 67 when utilizing the locking ring 34 previously set forth.

In order to ensure that the arbor 29A will lock in place, it may be found that the arbor 29A should be made out of a harder material than that of the arbor 29 so as to form stronger knurls 77 for the previously-described locking function.

While the tensioners 20 and 20A previously-described utilize arbors 29 and 29A that are initially separate from their respective belt-engaging arm 28 and belt-engaging arm 28A, it is to be understood that the other changeable structure can be utilized for changing the position of the inner end of the spring in its interconnection to the arbor of the belt-engaging arm so as to adjust the torque output of the spring for the reasons previously set forth.

In particular, another tensioner of another embodiment of another aspect of this invention is generally indicated by the reference numeral 20B in Figures 11 to 18. Parts thereof which are similar to the tensioners 20 and 20A previously-described are indicated by like reference numerals followed by the reference letter "B".

It can be seen from Figures 11 to 18 that the tensioner 20B is generally identical to the tensioner 20 previously-described except that the arbor 29B is integral and one-piece with the belt-engaging arm 28B so that the arbor 29B cannot initially rotate relative to the belt-engaging arm 28B.

However, instead of the fixed arbor 29B having the narrow slot 41 previously-described for the arbor 29, the arbor 29B is provided with a relatively wide notch 80 in an outer peripheral surface 81 thereof that defines facing shoulders 82 and 83 as illustrated.

The apparatus 67B for assembling the spring 35B to the belt-engaging arm 28B is so arranged that the end 70B of the belt-engaging arm 28B is held at the position 73B as illustrated in Figure 15 while the end 37B of the spring 35B is held at the position 71B by the rod 72B of the apparatus 67B. The inner end 36B of the spring 35B will be located in the notch 80 of the arbor 29B. Thereafter, the end 36B of the spring 35B is moved to a desired position within the notch 80 which will produce a certain torque output. Such movement of the end 36B is by a tool which is similar to the tool 66 of the apparatus 67 except that the tool would only grasp the end 36B of the spring 35B and move such end to its desired torque-output-producing position which would be as illustrated in Figure 17. Thus, at least one properly-sized arcuate spacer 84 and/or 85 can then be disposed respectively into the notch 80 on opposite sides of the end 36B of the spring 35B. Such spacer 84 and/or 85 respectively engage against the edges 82 and 83 of the notch 80 and the end 36B of the spring 35B to hold the end 36B of the spring 35B in the properly-selected position thereof to provide the desired output torque of the spring 35B. The end 37B of the spring 35B is at the position 71B and the end 70B of the belt-engaging arm 28B is at the position 73B.

Of course, for each different spring 35B, the end 36B thereof will be at a different position and different sizes of the spacers 84 and/or 85 will be utilized to hold that end 36B at the desired position thereof.

In that manner, the operator of the apparatus 67B will be provided with a plurality of different spacers 84 and/or 85. The sizes of spacers 84 and/or 85 will be such that such spacers will hold the end 36B of a spring 35B at a certain position within the notch 80 of the arbor 29B of a belt-engaging arm 28B.

Therefore, it can be seen that the tensioner 20B of this embodiment of this aspect of this invention has changeable structure holding one of the ends of the springs in an adjusted position relative to its respective operatively-interconnected means so as to

provide for a certain torque of the spring when the belt-engaging means is disposed at a certain position relative to the support means.

While the various embodiments of the tensioner of various aspects of this invention each have the inner end of the torsion spring adjusted by changeable structure, it is to be understood that the other end of the spring could be changed by changeable structure during its interconnection with the support means, if desired. Additionally both ends of the spring could be provided with changeable structure, if desired.

Therefore, it can be seen that various aspects of this invention provide new tensioners for a power transmission belt for operation in an endless path and provides new methods of making such tensioners.

CLAIMS

1. In a tensioner for a power transmission belt for operation in an endless path, said tensioner comprising a support means for being fixed relative to said belt, a belt-engaging means which is carried by said support means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to said support means and a second end which is operatively-interconnected to said belt-engaging means for urging said belt-engaging means relative to said support means and against said belt with a force to tension said belt, said spring having a certain torque when said belt-engaging means is disposed at a certain position relative to said support means, the improvement wherein: said tensioner has changeable structure holding one of said ends in an adjusted position relative to its respective operatively-interconnected means so as to provide for said certain torque of said spring when said belt-engaging means is disposed at said certain position relative to said support means.

2. A tensioner as set forth in claim 1, wherein said changeable structure comprises a rotatable member which is carried by one of said support means and said belt-engaging means, and which is interconnected to said one of said ends of said spring.

3. A tensioner as set forth in claim 2, wherein said one of said ends of said spring is tang-like, said rotatable member having a slot therein that receives said tang-like end of said spring therein so as to be interconnected to said one end of said spring.

4. A tensioner as set forth in claim 2 or claim 3, wherein said rotatable member has locking means locking said member in a certain rotational position relative to said one of said support means and said belt-engaging means to provide for said certain torque.

5. A tensioner as set forth in claim 4, wherein said locking means comprises knurling means.

6. A tensioner as set forth in claims 1 to 5, wherein said changeable means comprises a pair of spacers which is carried in spaced-apart relation by one of said support means and said belt-engaging means so as to define a slot therebetween, said one of said ends of said spring being disposed in said slot so as to be interconnected to said one of said support means and said belt-engaging means.

7. A tensioner as set forth in claim 6, wherein said one of said support means and said belt-engaging means has a notch therein that defines two spaced-apart edge means, said pair of spacers being respectively disposed against said two spaced-apart edge means so as to be carried in said notch.

8. A tensioner as set forth in claims 1 to 7, wherein said second end of said spring comprises an inner end thereof, and wherein said one of said support means and said belt-engaging means comprises said belt-engaging means.

9. A tensioner as set forth in claim 8, wherein said changeable structure comprises a ring member which is rotatably carried by said belt-engaging means.

10. A tensioner as set forth in claim 8, wherein said changeable structure comprises removable spacer means which are carried by said belt-engaging means.

11. In a method of making a tensioner for a power transmission belt for operation in an endless path, said tensioner comprising a support means for being fixed relative to said belt, a belt-engaging means which is carried by said support means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to said support means and a second end which is operatively-interconnected to said belt-engaging means for urging said belt-engaging means relative to said support means and against said belt with a force to tension said belt, said spring having a certain torque when said belt-engaging means is disposed at a certain position relative to said support means, the improvement comprising the step of: forming said tensioner to have changeable structure holding one of said ends in an adjusted position relative to its respective operatively-interconnected means so as to provide for said certain torque of said spring when said belt-engaging means is disposed at said certain position relative to said support means.

12. A method of making a tensioner as set forth in claim 11, and including the step of: forming said changeable structure to comprise a rotatable member which is carried by one of said support means and said belt-engaging means and which is interconnected to said one of said ends of said spring.

13. A method of making a tensioner as set forth in claim 12, and including the steps of: forming said one of said ends of said spring to be tang-like; and forming said rotatable member to have a slot therein that receives said tang-like end of said spring therein so as to be interconnected to said one end of said spring.

14. A method of making a tensioner as set forth in claim 12, and including the step of: forming said rotatable member to have locking means locking said member in a certain rotational position relative to said one of said support means and said belt-engaging means to provide for said certain torque.

15. A method of making a tensioner as set forth in claim 14, and including the step of: forming said locking means to comprise knurling means.

16. A method of making a tensioner as set forth in claims 11 to 15, and including the steps of: forming said changeable means to comprise a pair of spacers which is carried in spaced-apart relation by one of said support means and said belt-engaging means so as to define a slot therebetween; and disposing said one of said ends of said spring in said slot so as to be interconnected to said one of said support means and said belt-engaging means.

17. A method of making a tensioner as set forth in claim 16, and including the steps of: forming said one of said support means and said belt-engaging means to have a notch therein that defines two-spaced-apart edge means; and disposing said pair of spacers respectively against said two spaced-apart edge means so as to be carried in said notch.

18. A method of making a tensioner as set forth in claims 11 to 17, and including the step of: forming said second end of said spring to comprise an inner end thereof, said one of said support means and said belt-engaging means comprising said belt-engaging means.

19. A method of making a tensioner as set forth in claim 18, and including the step of: forming said changeable structure to comprise a ring member which is rotatably carried by said belt-engaging means.

20. A method of making a tensioner as set forth in claim 18, and including the step of: forming said changeable structure to comprise removable spacer means which are carried by said belt-engaging means.

21. In a tensioner for a power transmission belt for operation in an endless path, said tensioner comprising a support means for being fixed relative to said belt, a belt-engaging means which is carried by said support means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to said support means and a second end which is operatively-interconnected to said belt-engaging means for urging said belt-engaging means relative to said support means and against said belt with a force to tension said belt, said spring having a certain torque when said belt-engaging means is disposed at a certain position relative to said support means, the improvement wherein: said tensioner has changeable structure holding one of said ends in an adjusted position relative to its respective operatively-interconnected means so as to provide for said certain torque of said spring when said belt-engaging means is disposed at said certain position relative to said support means, said changeable structure comprising a spacer which is carried by one of said support means and said belt-engaging means, said one of said ends of said spring being disposed against said spacer so as to be interconnected to said one of said support means and said belt-engaging means.

22. A tensioner as set forth in claim 21, wherein said changeable means comprises a pair of spacers which is carried in spaced-apart relation by one of said support means and said belt-engaging means so as to define a slot therebetween, said one of said ends of said spring being disposed in said slot so as to be interconnected to said one of said support means and said belt-engaging means.

23. A tension as set forth in claim 21 or 22, wherein said one of said support means and said belt-engaging means has a notch therein that defines two spaced-apart edge means, said spacer being disposed against one of said spaced-apart two edge means so as to be carried in said notch.

24. A tensioner as set forth in claim 21, claim 22 or claim 23, wherein said second end of said spring comprises an inner end thereof; and wherein said one of said support means and said belt-engaging means comprises said belt-engaging means.

25. In a method of making a tensioner for a power transmission belt for operation in an endless path, said tensioner comprising a support means for being fixed relative to said belt, a belt-engaging means which is carried by said support means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to said support means and a second end which is operatively-interconnected to said belt-engaging means for urging said belt-engaging means relative to said support means and against said belt with a force to tension said belt, said spring having a certain torque when said belt-engaging means is disposed at a certain position relative to said support means, the improvement comprising the steps of: forming said tensioner to have changeable structure holding one of said ends in an adjusted position relative to its respective operatively-interconnected means so as to provide for said certain torque of said spring when said belt-engaging means is disposed at said certain position relative to said support means; forming said changeable structure to comprise a spacer which is carried by one of said support means and said belt-engaging means; and disposing said one of said ends of said spring against said spacer so as to be interconnected to said one of said support means and said belt-engaging means.

26. A method of making a tensioner as set forth in claim 25, and including the steps of: forming said changeable means to comprise a pair of spacers which is carried in spaced-apart relation by one of said support means and said belt-engaging means so as to define a slot therebetween; and disposing said one of said ends of said spring in said slot so as to be interconnected to said one of said support means and said belt-engaging means.

27. A method of making a tensioner as set forth in claim 25 or claim 26, and including the steps of: forming said one of said support means and said belt-engaging means to have a notch therein that defines two spaced-apart edge means; and disposing said spacer against one of said two spaced-apart edge means so as to be carried in said notch.

28. A method of making a tensioner as set forth in claim 25, claim 26 or claim 27, and including the step of: forming said second end of said spring to comprise an inner end thereof, said one of said support means and said belt-engaging means comprising said belt-engaging means.

29. In a tensioner for a power transmission belt for operation in an endless path, said tensioner comprising a support means for being fixed relative to said belt, a belt-engaging means which is carried by said support means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to said support means and a second end which is operatively-interconnected to said belt-engaging means for urging said belt-engaging means relative to said support means and against said belt with a force to tension said belt, said spring having a certain torque when said belt-engaging means is disposed at a certain position relative to said support means, the improvement wherein: said tensioner has changeable structure holding one of said ends in an adjusted position relative to its respective operatively-interconnected means so as to provide for said certain torque of said spring when said belt engaging-means is disposed at said certain position relative to said support means, said tensioner having said changeable structure holding said one of said ends of said spring in said adjusted position before said support means and said belt-engaging means had been assembled together.

30. A tensioner as set forth in claim 29, wherein said changeable structure comprises a rotatable member which is carried by one of said support means and said belt-engaging means, and which is interconnected to said one of said ends of said spring.

31. A tensioner as set forth in claim 30, wherein said one of said ends of said spring is tang-like, said rotatable member having a slot therein that receives said tang-like end of said spring therein so as to be interconnected to said one end of said spring.

32. A tensioner as set forth in claim 30 or claim 31, wherein said rotatable member has locking means locking said member in a certain rotational position relative to said one of said support means and said belt-engaging means to provide for said certain torque.

33. A tensioner as set forth in claim 32, wherein said locking means comprises knurling means.

34. A tensioner as set forth in claims 29 to 33, wherein said changeable means comprises a pair of spacers which is carried in spaced-apart relation by one of said support means and said belt-engaging means so as to define a slot therebetween, said one of said ends of said spring being disposed in said slot so as to be interconnected to said one of said support means and said belt-engaging means.

35. A tensioner as set forth in claim 34, wherein said one of said support means and said belt-engaging means has a notch therein that defines two spaced-apart edge means, said pair of spacers being respectively disposed against said two spaced-apart edge means so as to be carried in said notch.

36. A tensioner as set forth in claims 29 to 35, wherein said second end of said spring comprises an inner end thereof; and wherein said one of said support means and said belt-engaging means comprises said belt-engaging means.

37. A tensioner as set forth in claims 29 to 36, wherein said changeable structure comprises a ring member which is rotatably carried by said belt-engaging means.

38. A tensioner as set forth in claims 29 to 36, wherein said changeable structure comprises removable spacer means which are carried by said belt-engaging means.

39. In a method of making a tensioner for a power transmission belt for operation in an endless path, said tensioner comprising a support means for being fixed relative to said belt, a belt-engaging means which is carried by said support means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to said support means and a second end which is operatively-interconnected to said belt-engaging means for urging said belt-engaging means relative to said support means and against said belt with a force to tension said belt, said spring having a certain torque when said belt-engaging means is disposed at a certain position relative to said support means, the improvement comprising the step of: forming said tensioner to have changeable structure holding one of said ends in an adjusted position relative to its respective operatively-interconnected means so as to provide for said certain torque of said spring when said belt-engaging means is disposed at said certain

position relative to said support means, said step of forming said tensioner to have said changeable structure holding said one of said ends in an adjusted position taking place before said support means and said belt-engaging means are assembled together.

40. A method of making a tensioner as set forth in claim 39, and including the step of: forming said changeable structure to comprise a rotatable member which is carried by one of said support means and said belt-engaging means and which is interconnected to said one of said ends of said spring.

41. A method of making a tensioner as set forth in claim 39 or claim 40, and including the steps of: forming said one of said ends of said spring to be tang-like; and forming said rotatable member to have a slot therein that receives said tang-like end of said spring therein so as to be interconnected to said one end of said spring.

42. A method of making a tensioner as set forth in claim 40 or claim 41, and including the step of: forming said rotatable member to have locking means locking said member in a certain rotational position relative to said one of said support means and said belt-engaging means to provide for said certain torque.

43. A method of making a tensioner as set forth in claim 42, and including the step of: forming said locking means to comprise knurling means.

44. A method of making a tensioner as set forth in claims 39 to 43, and including the steps of: forming said changeable means to comprise a pair of spacers which is carried in spaced-apart relation by one of said support means and said belt-engaging means so as to define a slot therebetween; and disposing said one of said ends of said spring in said slot so as to be interconnected to said one of said support means and said belt-engaging means.

45. A method of making a tensioner as set forth in claim 44, and including the steps of: forming said one of said support means and said belt-engaging means to have a notch therein that defines two-spaced-apart edge means; and disposing said pair of spacers respectively against said two spaced-apart edge means so as to be carried in said notch.

46. A method of making a tensioner as set forth in claims 39 to 45, and including the step of: forming said second end of said spring to comprise an inner end thereof, said one of said support means and said belt-engaging means comprising said belt-engaging means.

47. A method of making a tensioner as set forth in claim 39 and claims 41 to 46, and including the step of: forming said changeable structure to comprise a ring member which is rotatably carried by said belt-engaging means.

48. A method of making a tensioner as set forth in claim 39 and claims 41 to 46, and including the step of: forming said changeable structure to comprise removable spacer means which are carried by said belt-engaging means.

49. In a tensioner for a power transmission belt for operation in an endless path, said tensioner comprising a support means for being fixed relative to said belt, a belt-engaging means and having a shaft means, a belt-engaging means which is carried by said support means and which has an arbor means which is rotatably disposed on said shaft means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to said support means and a second end which is operatively-interconnected to said belt-engaging means for urging said belt-engaging means relative to said support means and against said belt with a force to tension said support means and against said belt with a force to tension said belt, said spring having a certain torque when said belt-engaging means is disposed at a certain position relative to said support means, the improvement wherein: said tensioner has changeable structure holding one of said ends in an adjusted position relative to its respective operatively-interconnected means so as to provide for said certain torque of said spring when said belt engaging-means is disposed at said certain position relative to said support means.

50. A tensioner as set forth in claim 49, wherein said changeable structure comprises a rotatable member which is carried by said belt-engaging means, and comprising said arbor means thereof.

51. A tensioner as set forth in claim 49 or claim 50, wherein said one of said second end of said spring is tang-like, said rotatable member having a slot therein that receives said tang-like end of said spring therein so as to be interconnected to said second end of said spring.

52. A tensioner as set forth in claim 2 or claim 3, wherein said rotatable member has locking means locking said member in a certain rotational position relative to said one of said support means and said belt-engaging means to provide for said certain torque.

53. A tensioner as set forth in claim 52, wherein said locking means comprises knurling means.

54. A tensioner as set forth in claims 49 to 53, wherein said changeable means comprises a pair of spacers which is carried in spaced-apart relation by said arbor means and said belt-engaging means so as to define a slot therebetween, said second end of said spring being disposed in said slot so as to be interconnected to said belt-engaging means.

55. A tensioner as set forth in claims 49 to 54, wherein said arbor means and said belt-engaging means has a notch therein that defines two spaced-apart edge means, said changeable structure comprising a spacer which is disposed against one of said two spaced-apart edge means so as to be carried in said notch.

56. A tensioner as set forth in claims 49 to 55, wherein said second end of said spring comprises an inner end thereof.

57. A tensioner as set forth in claims 49 to 56, wherein said changeable structure comprises a removable spacer means which are disposed between said arbor means of said belt-engaging means and said second end of said spring.

58. A tensioner as set forth in claims 49 to 56, wherein said changeable structure comprises removable spacer means which are carried by said belt-engaging means.

59. In a method of making a tensioner for a power transmission belt for operation in an endless path, said tensioner comprising a support means for being fixed relative to said belt and having shaft means, a belt-engaging means which is carried by said support means and which has an arbor means which is rotatably disposed on said shaft means and which is movable relative thereto, a coiled torsion spring having a first end which is operatively-interconnected to said support means and a second end which is operatively-interconnected to said belt-engaging means for urging said belt-engaging means relative to said support means and against said belt with a force to tension said

belt, said spring having a certain torque when said belt-engaging means is disposed at a certain position relative to said support means, the improvement comprising the step of: forming said tensioner to have changeable structure holding said second end of said spring in an adjusted position relative to said belt-engaging means so as to provide for said certain torque of said spring when said belt-engaging means is disposed at said certain position relative to said support means.

60. A method of making a tensioner as set forth in claim 59, and including the step of: forming said changeable structure to comprise a rotatable member which is carried by said belt-engaging means and comprising said arbor means thereof.

61. A method of making a tensioner as set forth in claim 59 or claim 60, and including the steps of: forming said second end of said spring to be tang-like; and forming said rotatable member to have a slot therein that receives said tang-like end of said spring therein so as to be interconnected to said second end of said spring.

62. A method of making a tensioner as set forth in claim 60 or claim 61, and including the step of: forming said rotatable member to have locking means locking said member in a certain rotational position relative to said belt-engaging means to provide for said certain torque.

63. A method of making a tensioner as set forth in claim 62, and including the step of: forming said locking means to comprise knurling means.

64. A method of making a tensioner as set forth in claims 59 to 63, and including the steps of: forming said changeable means to comprise a pair of spacers which is carried in spaced-apart relation by said arbor means of said belt-engaging means so as to define a slot therebetween; and disposing said second end of said spring in said slot so as to be interconnected to said belt-engaging means.

65. A method of making a tensioner as set forth in claims 59 to 64, and including the steps of: forming said arbor means of said belt-engaging means to have a notch therein that defines two-spaced-apart edge means; forming said changeable structure to comprise a spacer; and disposing said spacer against one of said two spaced-apart edge means and said second end of said spring so as to be carried in said notch.

66. A method of making a tensioner as set forth in claims 59 to 65, and including the step of: forming said second end of said spring to comprise an inner end thereof.

67. A method of making a tensioner as set forth in claims 59 to 66, and including the step of: forming said changeable structure to comprise removable spacer means which are disposed between said arbor means of said belt-engaging means and said second end of said spring.

68. A method of making a tensioner as set forth in claims 59 to 67, and including the step of: forming said changeable structure to comprise removable spacer means which are carried by said belt-engaging means.

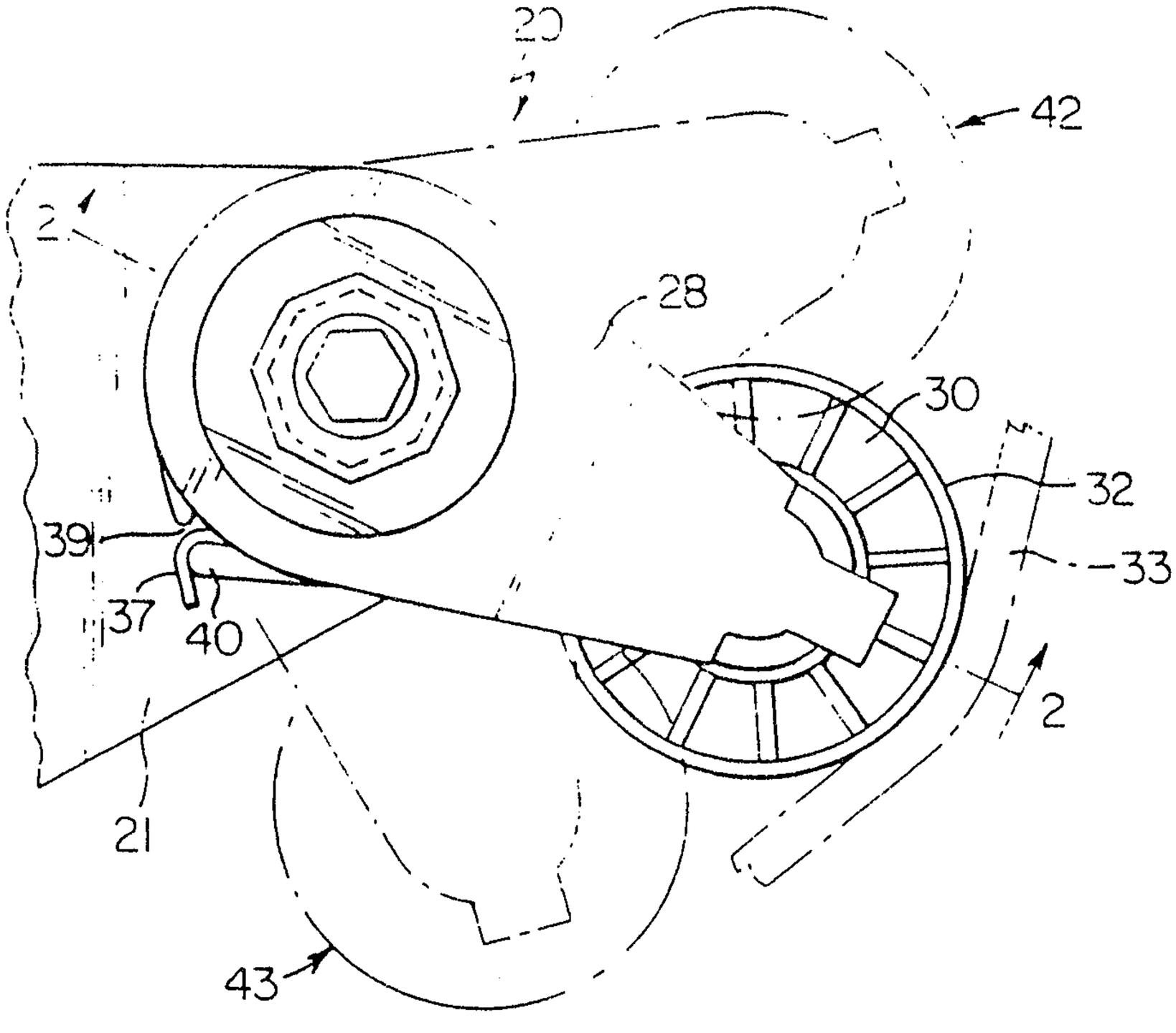
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FIG. 1

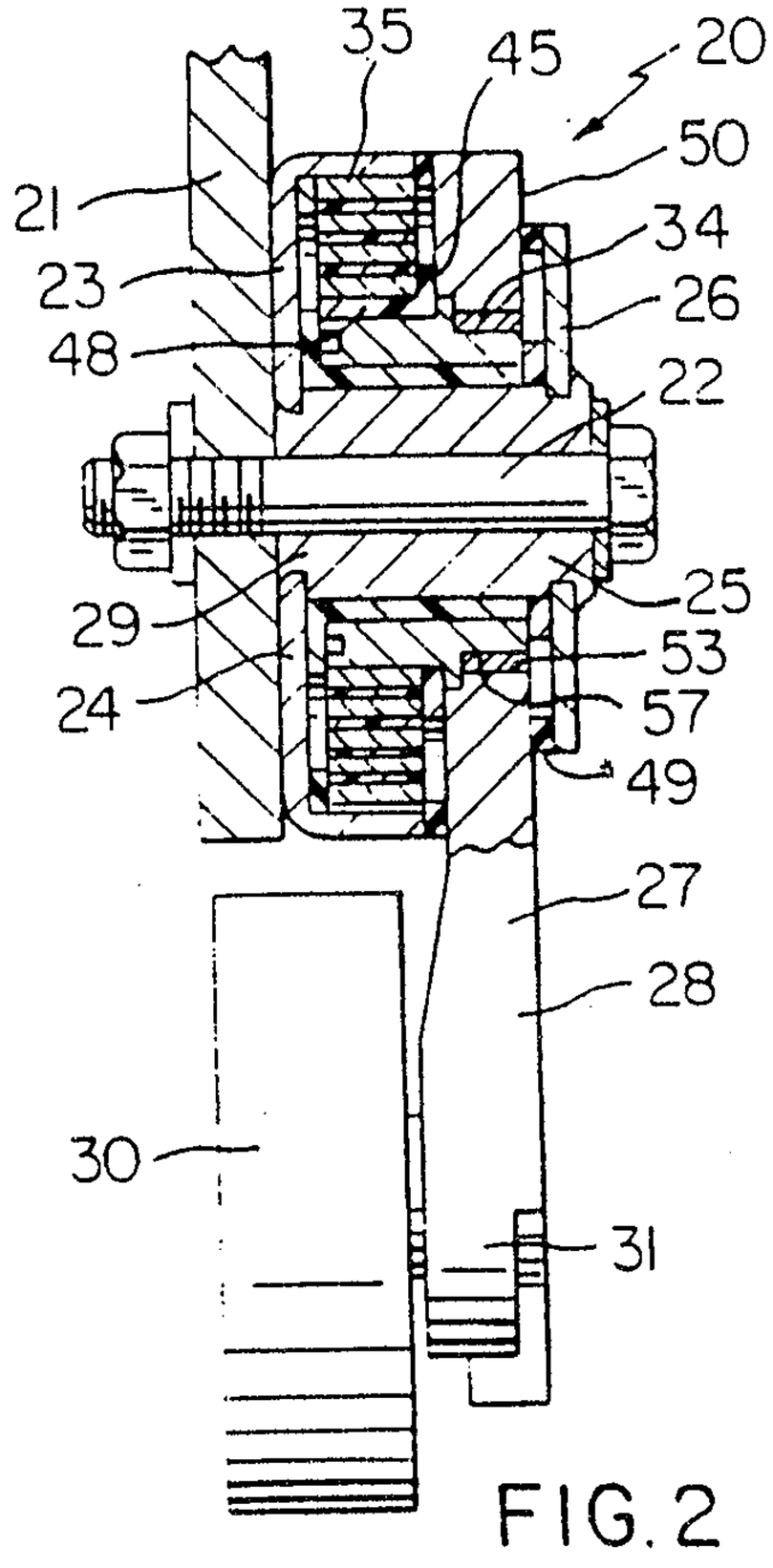
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FIG. 2

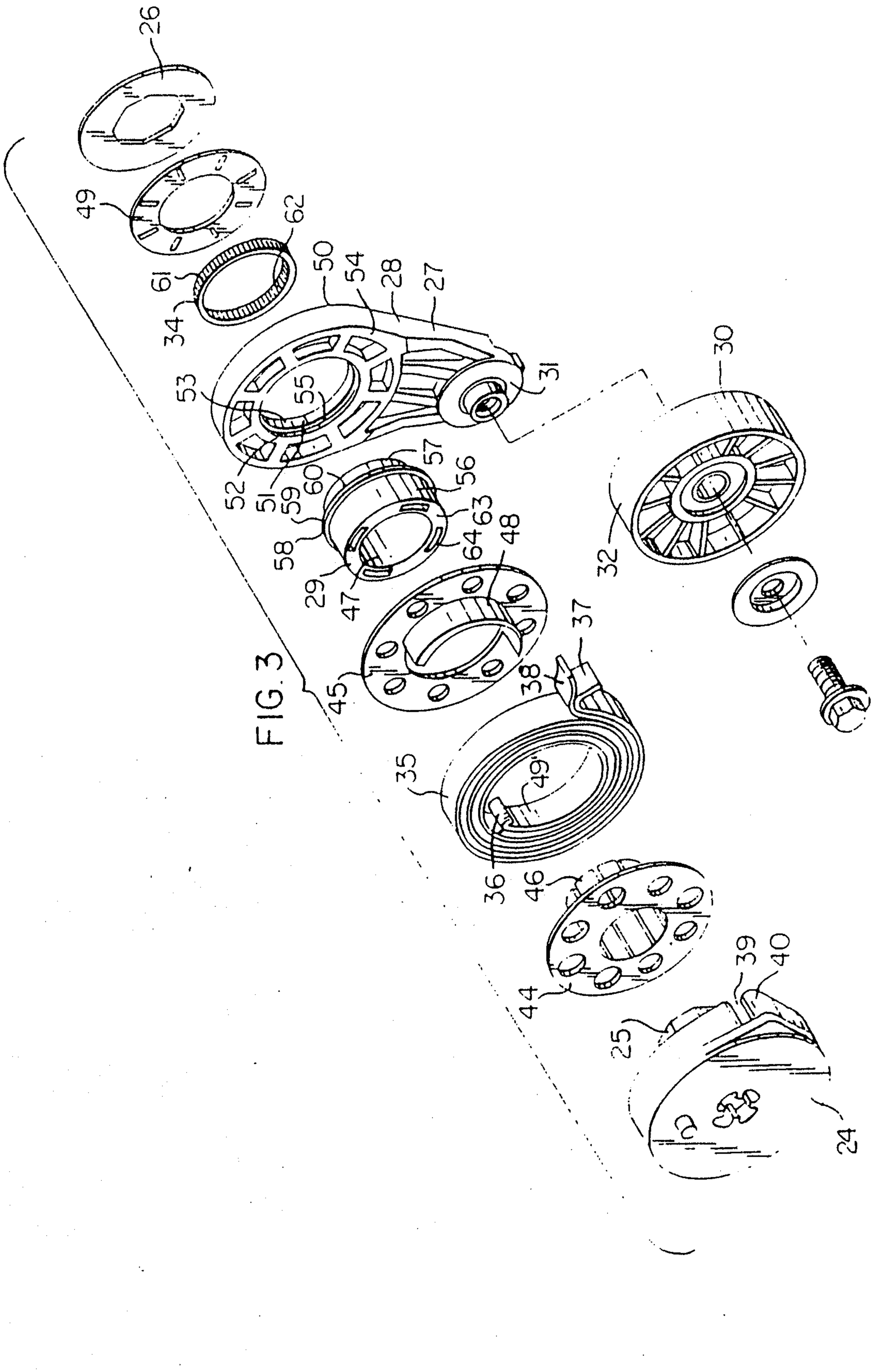
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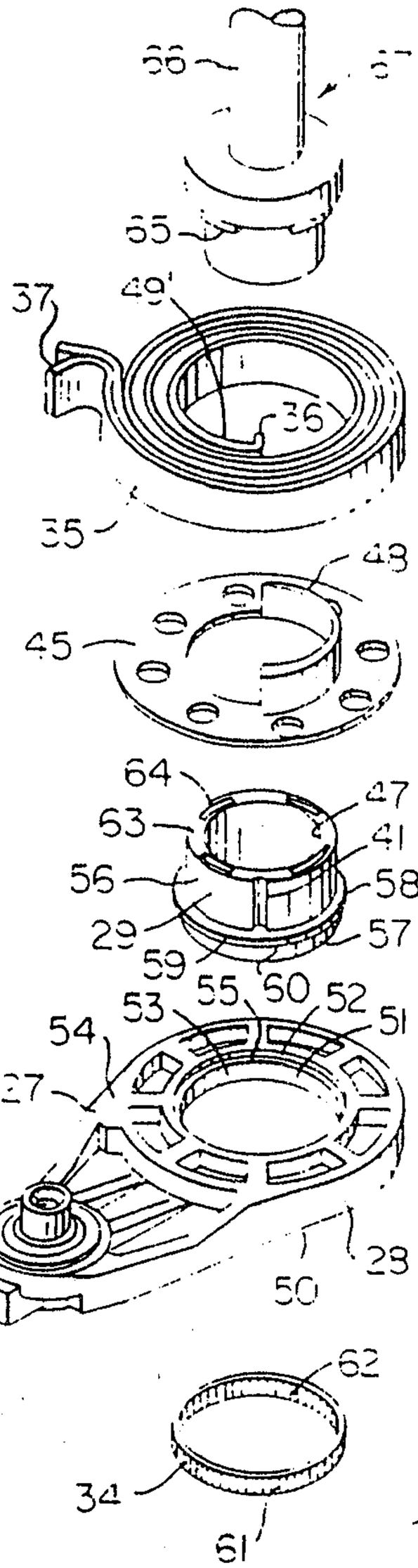
FIG. 3



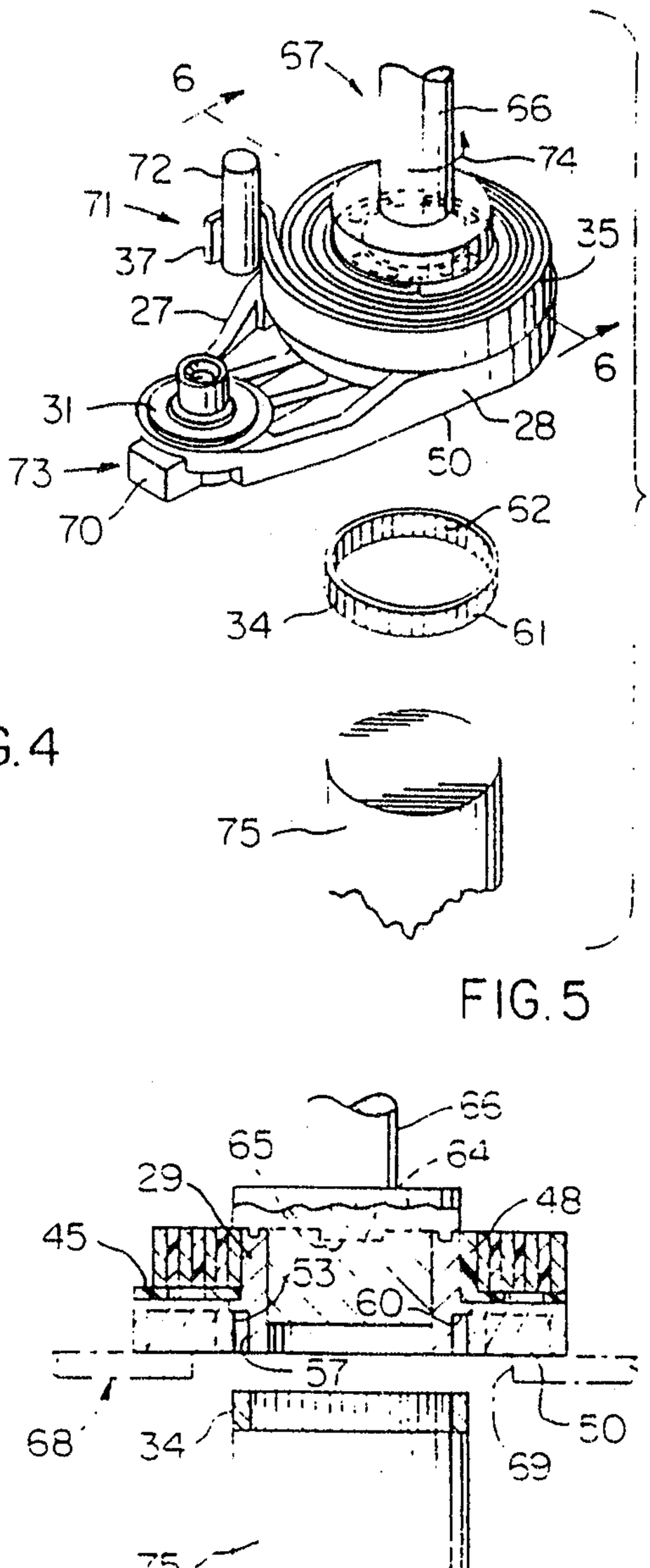


FIG.4

FIG.5

FIG.6

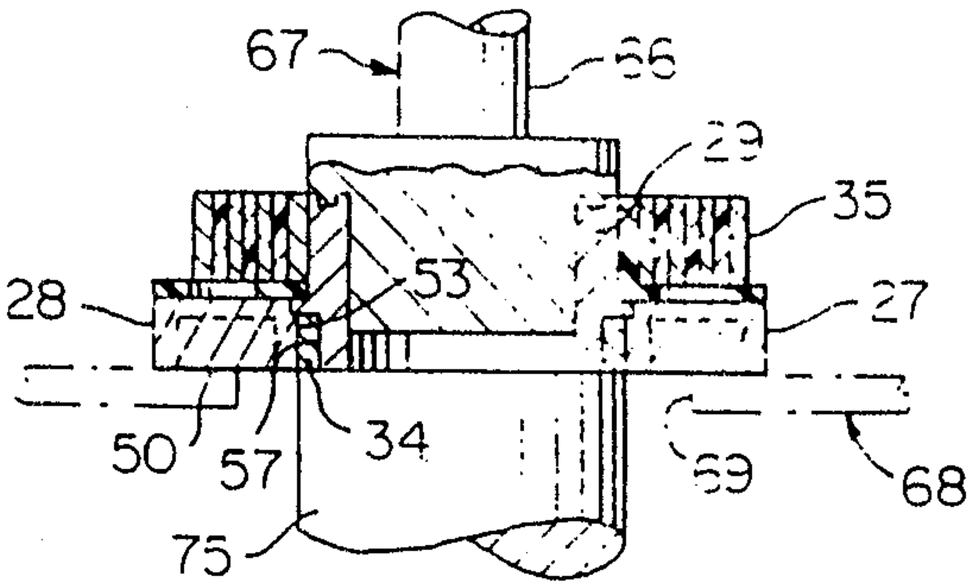


FIG. 7

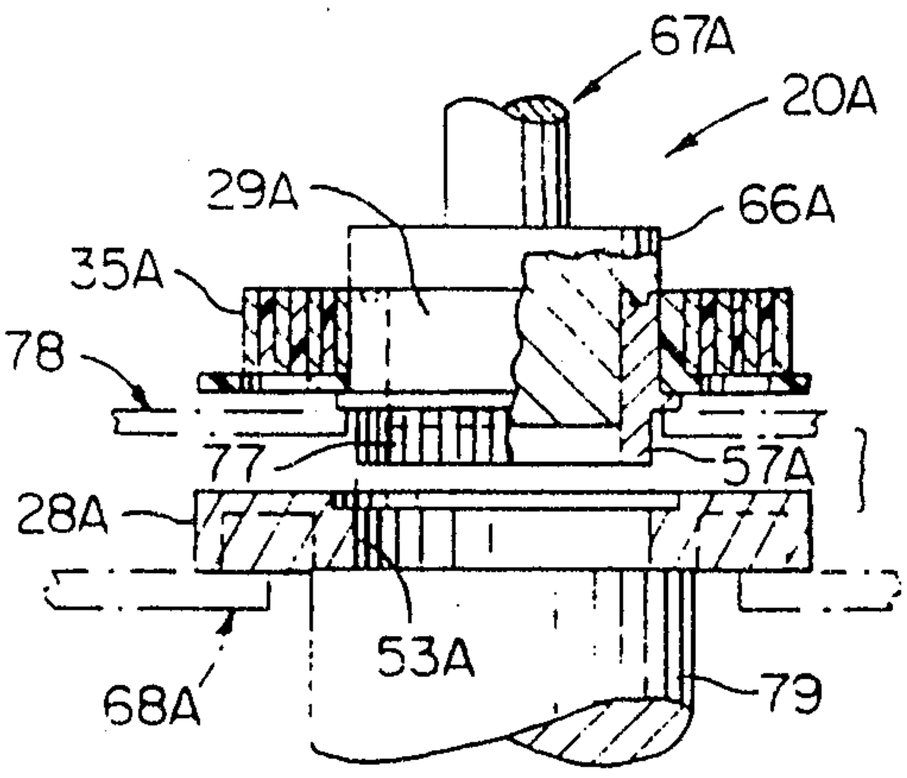


FIG. 9

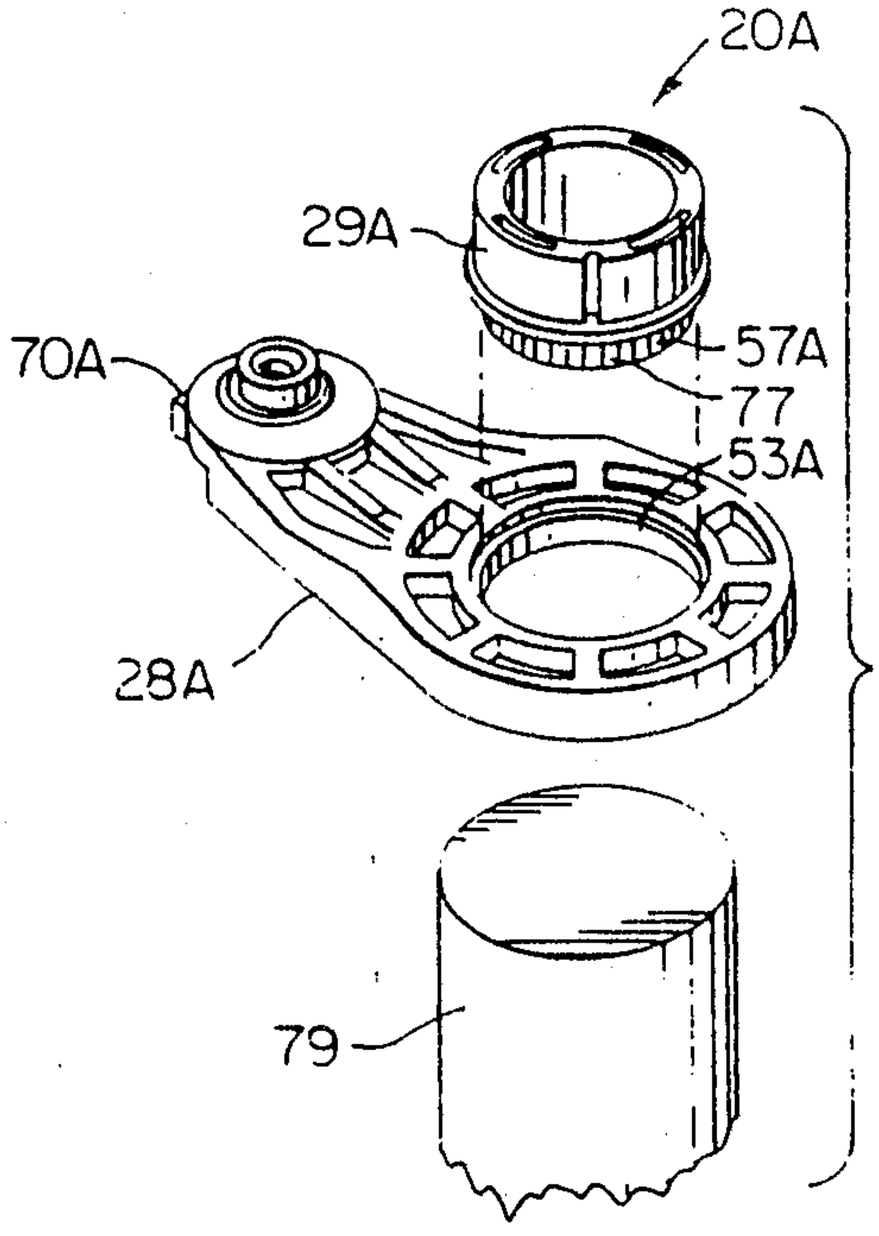


FIG. 8

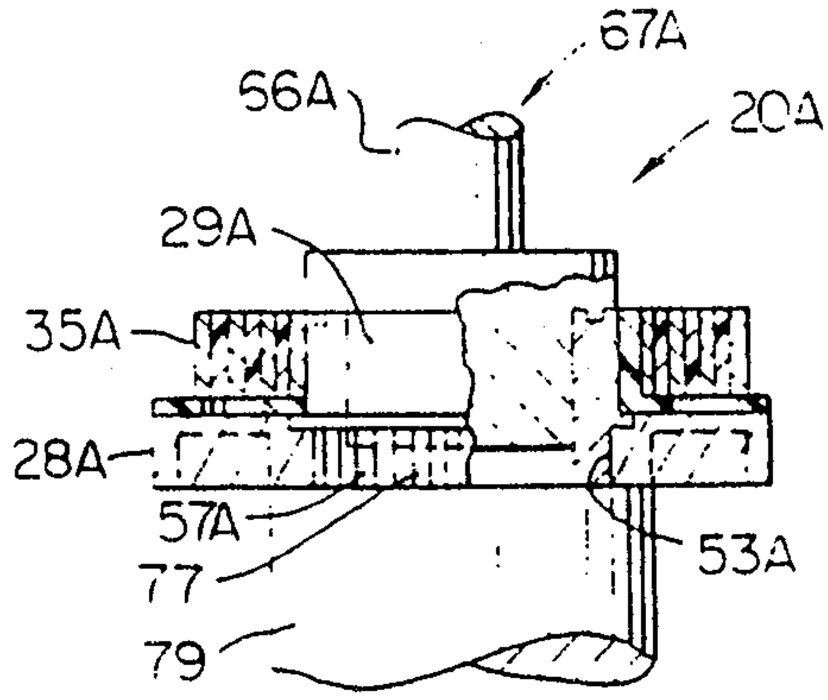


FIG. 10

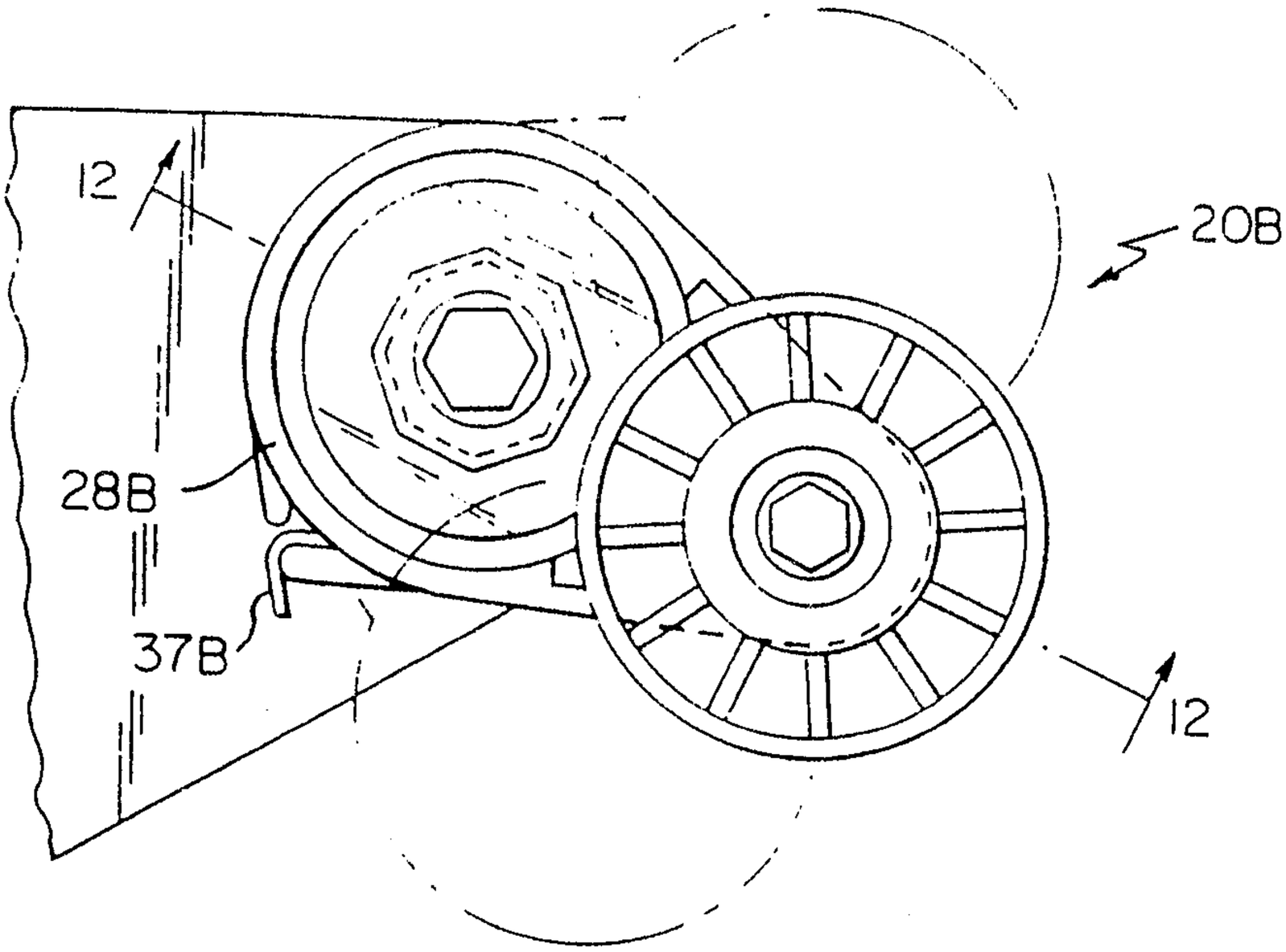


FIG. 11

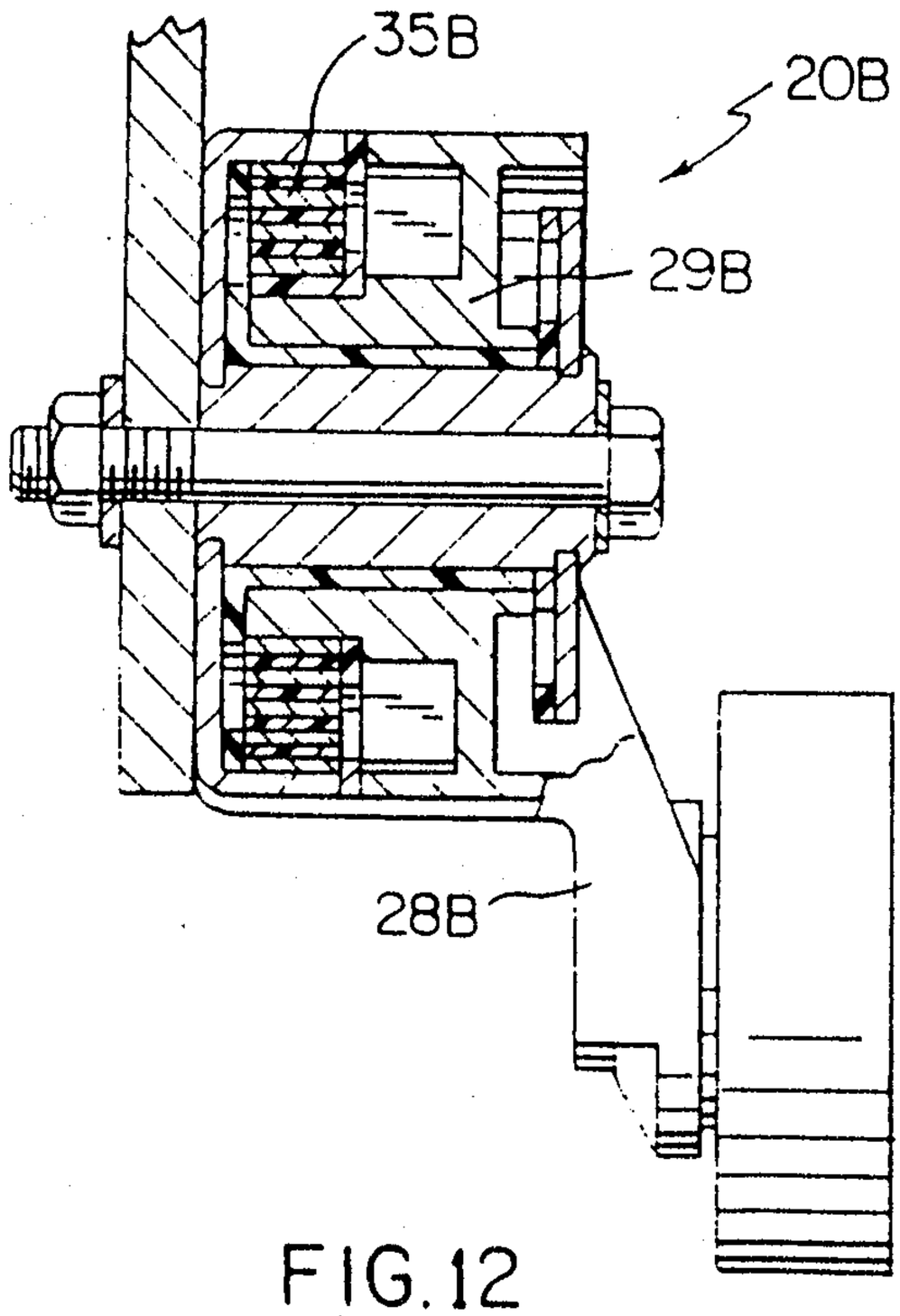


FIG. 12

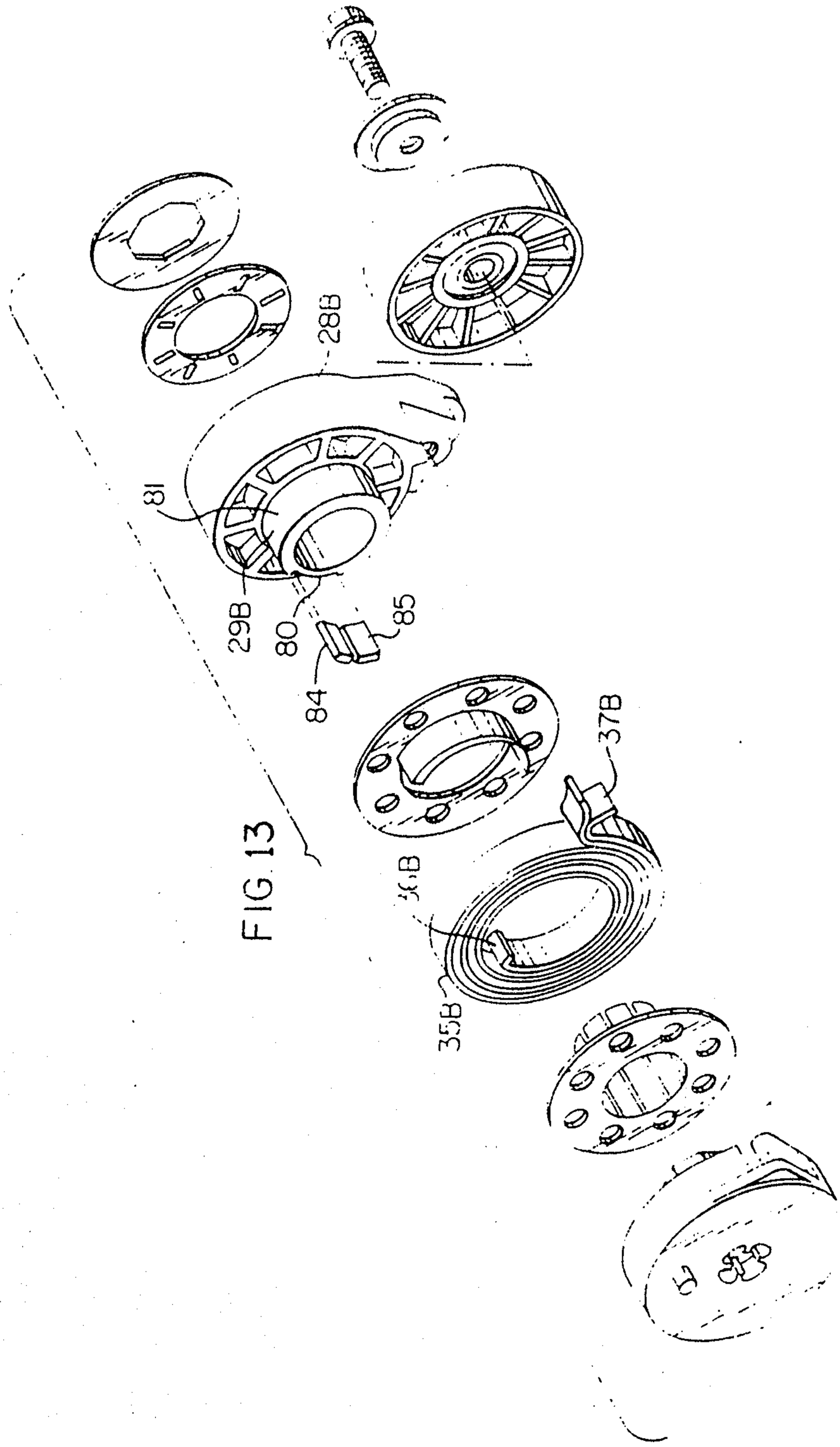


FIG 13

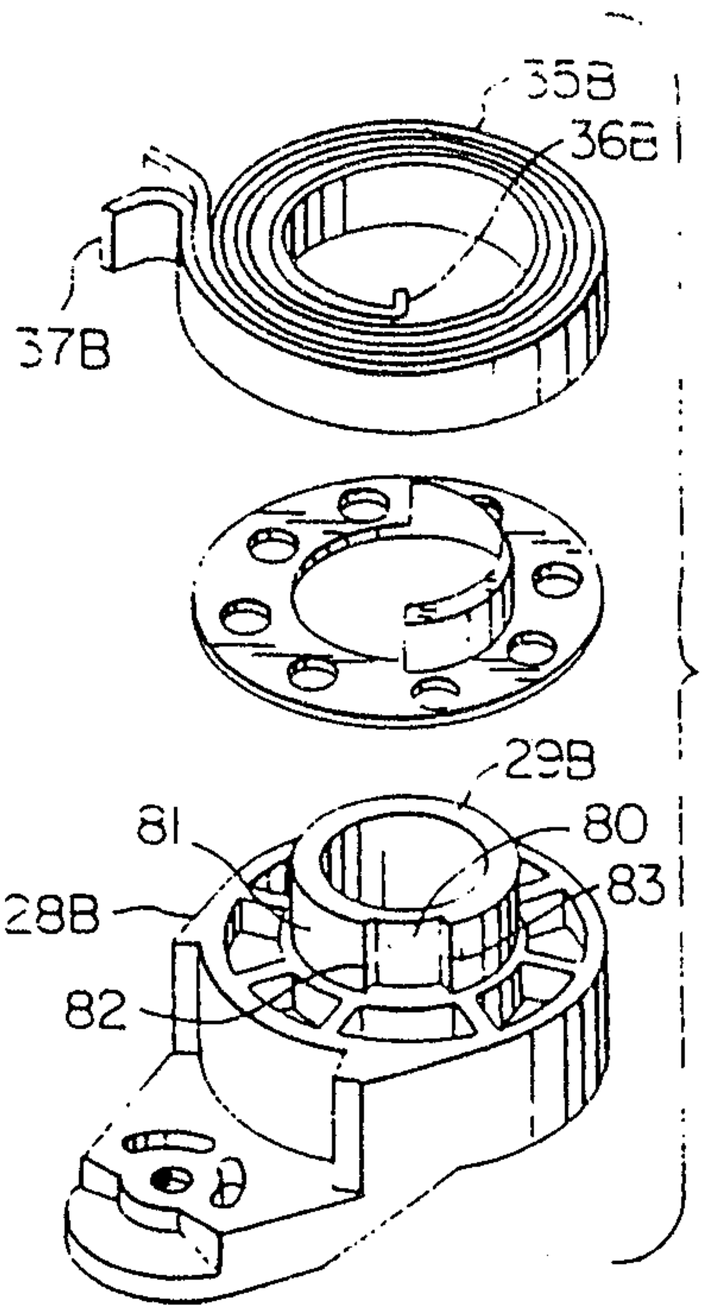


FIG. 14

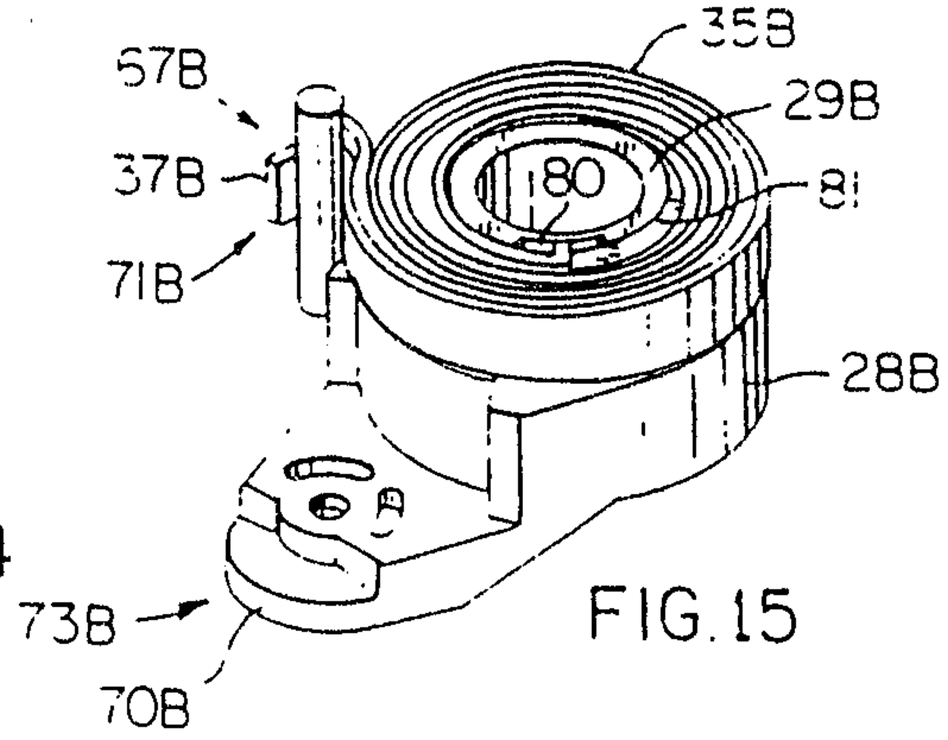


FIG. 15

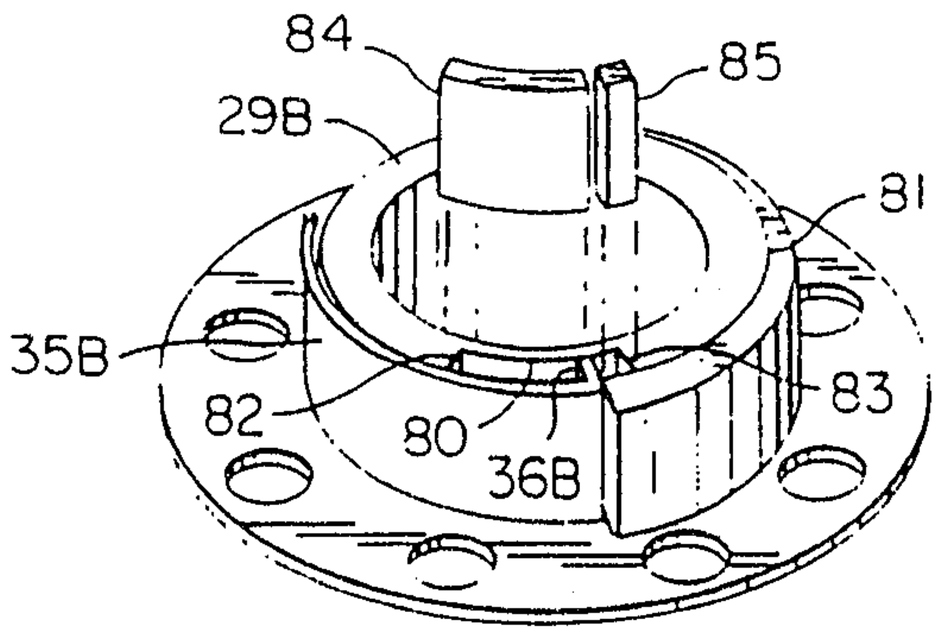


FIG. 17

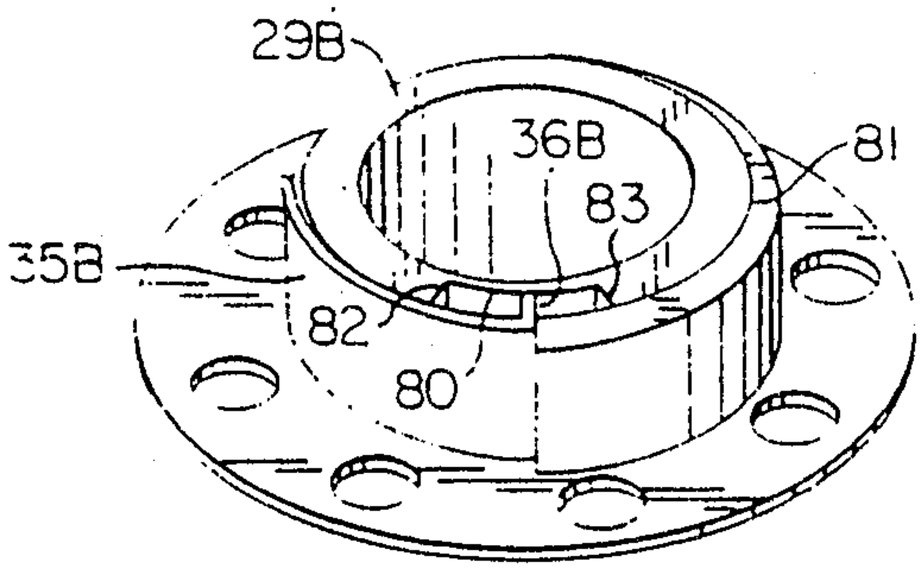
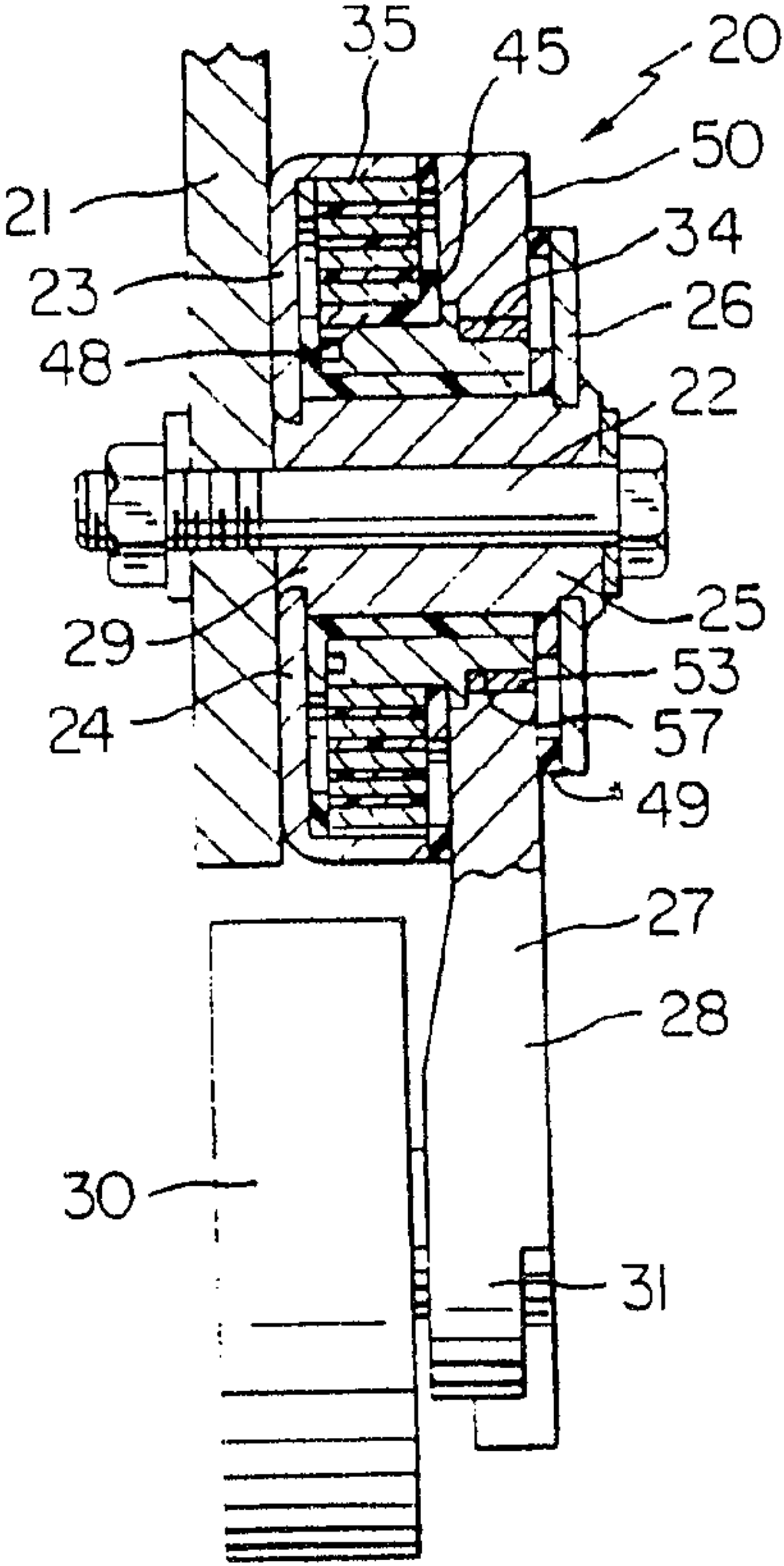


FIG. 16

FIG. 18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