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Eccentric gear mechanism and method of transferring turning force thereby

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(56) Related Art
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ECCENTRIC GEAR MECHANISM AND METHOD OF TRANSFERING
TURNING FORCE THEREBY

Abstract

An eccentric gear mechanism has an input drive (2) having a centric portion (3) rotated about an axis (A) and an eccentric portion (4), a moveable inner ring gear (1) having outer circumferential gear teeth, so that the centric portion (3) and the eccentric portion (4) of the input drive (2) turn in one direction against the movable inner ring gear (7), the inner ring gear (7) being configured in such a way that it allows an eccentric movement by the inner ring gear (7) and transfers a given turning force derived by the inner ring gear (7) in an opposite direction to the one direction; an outer ring gear (8) having inner circumferential gear teeth partially engaged with the outer circumferential gear teeth of the inner ring gear (7), so that when said given turning force is derived by the inner ring gear (7) in the opposite direction the outer ring gear (8) rotates around the axis (A), and the outer ring gear (8) transfers the given turning force in the one direction outwardly along the axis (A).

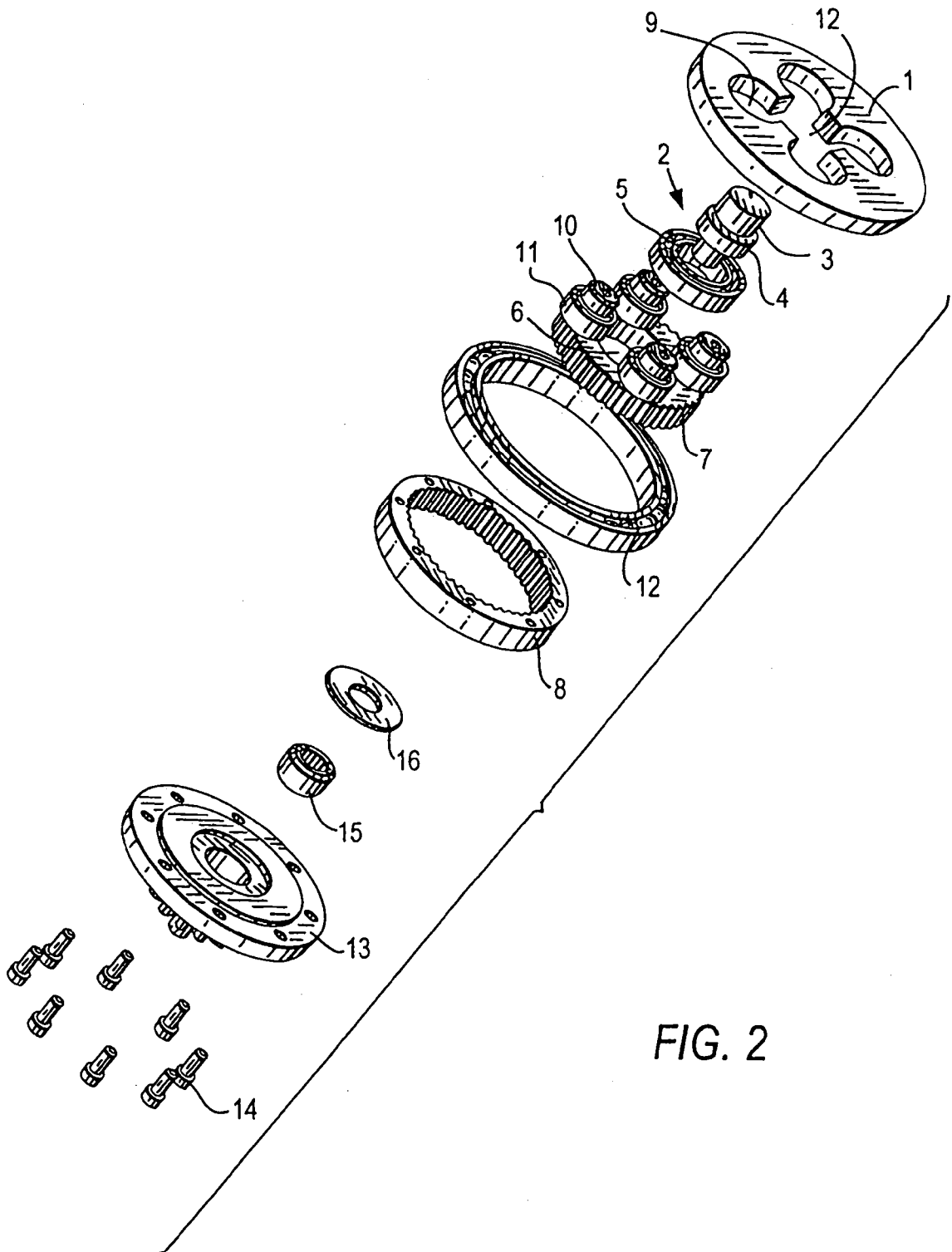


FIG. 2

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Patent and Trade Mark Attorneys

Patents Act 1990

JOHN KURT JUNKERS

**COMPLETE SPECIFICATION
STANDARD PATENT**

Invention Title:

*Eccentric gear mechanism and method of transferring turning force
thereby*

The following statement is a full description of this invention including the best method of performing it known to us:-

BACKGROUND OF THE INVENTION

The present invention relates to eccentric gear mechanisms, and methods of transferring turning forces thereby.

Eccentric gear mechanisms are known in the art. An eccentric gear mechanism is known which includes an inner ring gear with outer gear teeth provided on its outer circumference, an outer ring gear with inner gear teeth provided on its inner circumference and engaging with the outer gear teeth of the inner ring gear, and means for generating an eccentric movement between the gears.

The known eccentric gear mechanisms usually have some disadvantages. In particular, they create unwanted vibrations at high speed.

The known eccentric gear mechanism turns an inner ring gear, which moves against the outer, centrally located ring gear, so that the outer ring gear turns in the same direction as the eccentric sun drive and the inner ring gear in the opposite direction unlike planet gears. This means that action and reaction are reversed. While this is not a problem with a tool having just a single eccentric gear mechanism as the direction of the input drive can be switched, it is a problem when two or more eccentric gear mechanisms are placed on top of each other or one eccentric gear mechanism is placed on top of planetary gear stages to obtain a high ratio, because unlike the planetary

5 gear mechanism, the eccentric gear mechanism can not use in its outer,
centrally located ring gear as the reaction absorbing part, because it would
decrease the total ratio of the eccentric gear mechanism. It is known that
sliding motion is roughly ten times higher than turning friction, and if anything
moving eccentric needs to transmit a central force until now the sliding motion
10 was required in the existing eccentric gear mechanisms.

It is therefore believed that the existing gear mechanisms can be further
improved.

15 Any discussion of documents, acts, materials, devices, articles or the like
which has been included in the present specification is solely for the purpose of
providing a context for the present invention. It is not to be taken as an
admission that any or all of these matters form part of the prior art base or were
common general knowledge in the field relevant to the present invention as it
20 existed before the priority date of each claim of this application.

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SUMMARY OF THE INVENTION

It is an object of the present invention, at least in its preferred form(s), to provide a new, eccentric gear mechanism which has a very high gear ratio in a relatively small space.

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Throughout this specification the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

15

In a first aspect, the present invention provides an eccentric gear mechanism, comprising an input drive having an axis, a centric portion rotated about said axis and an eccentric portion; a movable inner ring gear arranged circumferentially surrounding and rotatably on said eccentric portion to allow an eccentric movement and to allow a transfer of a turning force along said axis and having outer circumferential gear teeth and a plurality of pins; an outer single-piece ring gear which extends only in an axial direction and as a whole is arranged only circumferentially surrounding said inner ring gear and having inner circumferential teeth partially engaged with said outer circumferential gear teeth of said inner ring gear, so that when said centric portion and said eccentric portion of said input drive turn in one direction against said inner ring gear to apply a turning force to said inner ring gear in an opposite direction, said inner ring gear turns against said outer ring gear and applies a turning force to said outer ring gear in said one direction and transfers said turning force applied on said outer ring gear outwardly along said axis; a housing having one opening for receiving said input drive and a plurality of further openings spaced from said one opening and receiving said pins in a way that allows said eccentric movement of said inner ring gear without allowing said inner ring gear to turn around said axis, while allowing said pins to move in said further openings; and bearing means including a first bearing provided between said eccentric portion of said input drive and said inner ring gear, a plurality of further bearings provided between said pins of said inner ring gear and said further openings of said housing, an additional bearing provided on said outer

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5 ring gear, and a still further bearing provided on an opposite end of said input drive.

10 In a second aspect, the present invention provides a method of transferring a turning force by an eccentric gear mechanism, comprising the steps of providing an input drive having an axis, a centric portion with said axis and an eccentric portion; rotating said centric portion about said axis; providing a moveable inner ring gear arranged circumferentially rotatably on said eccentric portion to allow an eccentric movement and to allow a transfer of a turning force along said axis and having outer circumferential gear teeth and a plurality of pins, and an outer single-piece ring gear which extends only in an axial direction and as a whole only circumferentially surrounding said inner ring gear and having inner circumferential teeth; partially engaging said inner circumferential teeth of the outer ring gear with said outer circumferential gear teeth of said inner ring gear, so that when said centric portion and said eccentric portion of said input drive turn in one direction against said moveable inner ring gear to apply a turning force to said moveable inner ring gear in an opposite direction, said inner ring gear moves against said outer ring gear and applies a turning force to said outer ring gear in said one direction and transfers said turning force applied on said outer ring gear outwardly along said axis; a housing having one opening for receiving said input drive and a plurality of further openings spaced from said one opening and receiving said pins in a way that allows said eccentric movement of said inner ring gear without allowing said inner ring gear to turn around said axis, while allowing said pins to move in said further openings; and bearing means including a first bearing provided between said eccentric portion of said input drive and said inner ring gear, a plurality of further bearings provided between said pins of said inner ring gear and said further openings of said housing, an additional bearing provided on said outer ring gear, and a still further bearing provided on an opposite end of said input drive.

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Embodiments of the eccentric gear mechanism have from the outside-in, the centrally located outer ring gear with the gear teeth on its inner circumference, the inner ring gear with its gear teeth on its outer circumference moveable relative to the gear teeth on the inner circumference of the outer ring gear when pushed against the ring gear by the centrally located eccentric drive.

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Therefore, when the centrally located eccentric drive turns clockwise, the inner ring gear receives a counterclockwise turning force when turning in the gear teeth of the centrally located outer ring gear, while the outer ring gear receives a clockwise turning force. This in turn means that if the direction of the turning of the centrally located eccentric drive is to be upheld when more than one stage is applied, the outer ring gear becomes the drive gear and the inner ring gear becomes the reaction gear. This in turn means that the eccentric motion of the inner ring gear needs to be transferred from a sliding motion into a rotating motion to increase its efficiency as its has otherwise no major advantage.

This can be achieved by providing a housing part, which can be formed for example as a lid. For this purpose, embodiments of the eccentric gear mechanism have connecting means for connecting said inner ring gear with said housing and including one opening provided for receiving said input drive, and another opening which is spaced from said one opening and receives a pin with a bearing in a way that allows said eccentric movement of said inner ring gear without allowing said inner ring gear to turn while allowing said bearing to rotate in said another opening.

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BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention will be described hereinafter, by way of example only, with reference to the accompanying drawings, in which:

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Figure 1 is an axial end view of a preferred embodiment of an eccentric gear mechanism in accordance with the present invention, in different positions of its parts during the operation of the mechanism;

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Figure 2 is an exploded view of the eccentric gear mechanism, showing its individual parts;

Figures 3 and 4 show two opposite perspective views of the eccentric gear mechanism; and

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Figure 5 schematically shows the motions of the parts of the eccentric gear mechanism.

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DESCRIPTION OF THE PREFERRED EMBODIMENTS

10 A preferred embodiment of an eccentric gear mechanism in accordance with the present invention has an immovable, non-rotatable housing 1 which can be formed for example as a lid, or as a housing to which the stationary lid is immovably non-rotatably connected.

15 The eccentric gear mechanism further has an input drive which is identified as a whole with reference numeral 2. The input drive has a centric portion which forms an input shaft 3 and is rotated from outside around an axis A. The input drive 2 has an eccentric portion, formed for example as an eccentric cam 4.

20 The eccentric cam 4 is provided with a bearing 5. It is insertable with the bearing 5 into an inner opening 6 of an inner ring gear 7. The inner ring gear 7 has outer gear teeth provided on its outer circumference.

25 The eccentric gear mechanism further has an outer ring gear 8 provided with inner gear teeth on its inner circumference. The outer gear teeth of the inner ring gear 7 engage partially with the inner gear teeth of the outer ring gear 8.

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Means are provided for connecting the inner ring gear 7 to the housing part 1 formed for example as a lid. The connecting means include for example at least one opening 9 provided in the housing part 1 and at least one pin 10 provided on the inner ring gear 7 and having a bearing 11
5 inserted into the opening 9 with a gap between an outer diameter of the bearing 11 and a diameter of the opening 9. As can be seen from the drawings, several openings 9 can be provided in the housing part 1, and several bearings 11 with the pins 10 can be inserted in them. The housing part 1 is also provided with an opening 12 in which the input shaft 3 is
10 rotatably inserted.

It is to be understood that the connecting means can be designed differently. For example, the openings 9 can be provided in the inner ring gear 7, while the pins 10 can be provided in the housing part 1.
15 Also, other variants are possible as well.

The outer ring gear 8 of the eccentric gear mechanism has more teeth than the inner ring gear 7. For example, the outer ring gear 8 can have two more teeth than the inner ring gear 6.

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The outer ring gear 8 is arranged in a bearing 12 and connected to a sun gear 13, or can be made as of one piece with the latter. The connection can be carried out by screws 14. The opposite end of the

input shaft 3 can be supported for example in a needle bearing 15. A washer 16 can be arranged on the sun gear 13.

When the input shaft 3 is rotated from outside around the axis
5 A, the inner ring gear 7 can not rotate and instead the inner ring gear performs a gyration motion. The gyration of the inner ring gear 7 causes a rotation of the outer ring gear 8 around the axis A in the same direction as the input shaft 3, and the outer ring gear 8 transfers the turning force along the axis A outwardly.

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The thusly designed eccentric gear mechanism has a very high gear ratio to provide a much bigger speed reduction and a torque multiplication, and it is much more compact.

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It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

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While the invention has been illustrated and described as embodied in an eccentric gear mechanism, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

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Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

5 THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. An eccentric gear mechanism, comprising an input drive having an axis, a centric portion rotated about said axis and an eccentric portion; a movable inner ring gear arranged circumferentially surrounding and rotatably
10 on said eccentric portion to allow an eccentric movement and to allow a transfer of a turning force along said axis and having outer circumferential gear teeth and a plurality of pins; an outer single-piece ring gear which extends only in an axial direction and as a whole is arranged only circumferentially surrounding said inner ring gear and having inner circumferential teeth partially
15 engaged with said outer circumferential gear teeth of said inner ring gear, so that when said centric portion and said eccentric portion of said input drive turn in one direction against said inner ring gear to apply a turning force to said inner ring gear in an opposite direction, said inner ring gear turns against said outer ring gear and applies a turning force to said outer ring gear in said one
20 direction and transfers said turning force applied on said outer ring gear outwardly along said axis; a housing having one opening for receiving said input drive and a plurality of further openings spaced from said one opening and receiving said pins in a way that allows said eccentric movement of said inner ring gear without allowing said inner ring gear to turn around said axis,
25 while allowing said pins to move in said further openings; and bearing means including a first bearing provided between said eccentric portion of said input drive and said inner ring gear, a plurality of further bearings provided between said pins of said inner ring gear and said further openings of said housing, an additional bearing provided on said outer ring gear, and a still further bearing
30 provided on an opposite end of said input drive.

2. An eccentric gear mechanism as defined in claim 1, wherein said housing has a housing part formed as a lid.

35 3. An eccentric gear mechanism as defined in claim 1 or claim 2, wherein said eccentric portion of said input drive is weight-balanced.

4. A method of transferring a turning force by an eccentric gear mechanism, comprising the steps of providing an input drive having an axis, a
40 centric portion with said axis and an eccentric portion; rotating said centric

5 portion about said axis; providing a moveable inner ring gear arranged circumferentially rotatably on said eccentric portion to allow an eccentric movement and to allow a transfer of a turning force along said axis and having outer circumferential gear teeth and a plurality of pins, and an outer single-piece ring gear which extends only in an axial direction and as a whole only
10 circumferentially surrounding said inner ring gear and having inner circumferential teeth; partially engaging said inner circumferential teeth of the outer ring gear with said outer circumferential gear teeth of said inner ring gear, so that when said centric portion and said eccentric portion of said input drive turn in one direction against said moveable inner ring gear to apply a turning
15 force to said moveable inner ring gear in an opposite direction, said inner ring gear moves against said outer ring gear and applies a turning force to said outer ring gear in said one direction and transfers said turning force applied on said outer ring gear outwardly along said axis; a housing having one opening for receiving said input drive and a plurality of further openings spaced from
20 said one opening and receiving said pins in a way that allows said eccentric movement of said inner ring gear without allowing said inner ring gear to turn around said axis, while allowing said pins to move in said further openings; and bearing means including a first bearing provided between said eccentric portion of said input drive and said inner ring gear, a plurality of further bearings
25 provided between said pins of said inner ring gear and said further openings of said housing, an additional bearing provided on said outer ring gear, and a still further bearing provided on an opposite end of said input drive.

30 5. An eccentric gear mechanism substantially as hereinbefore described with reference to the accompanying drawings.

6. A method of transferring a turning force by an eccentric gear mechanism, said method substantially as hereinbefore described with
35 reference to the accompanying drawings.

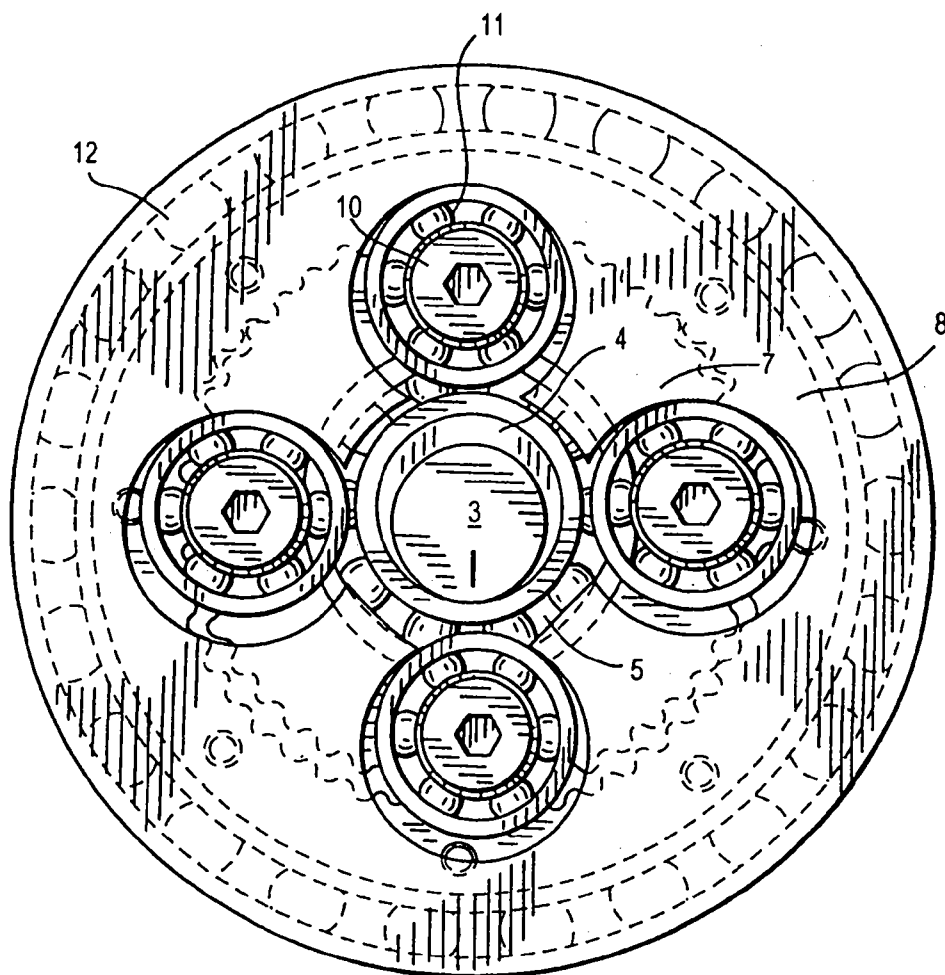


FIG. 1

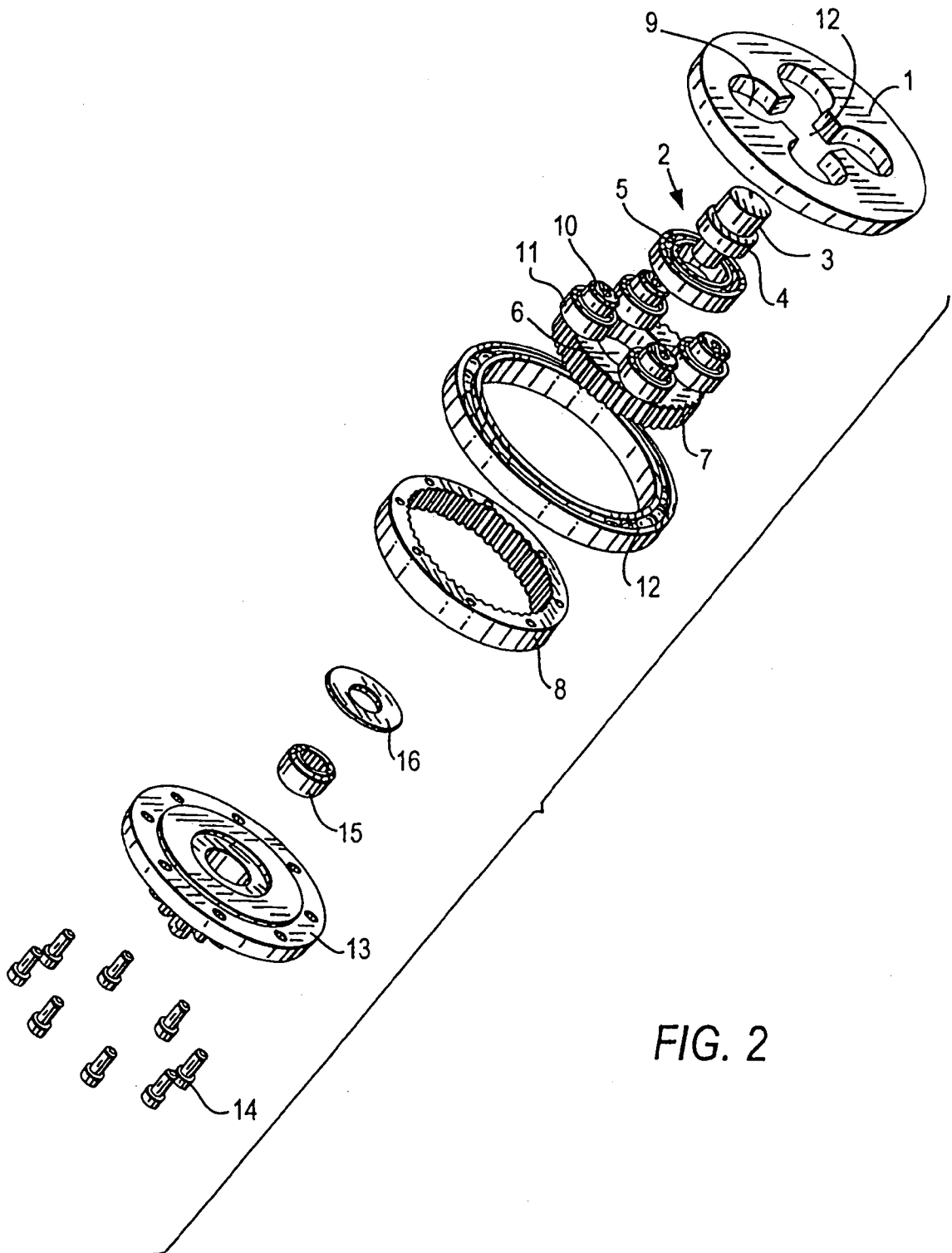


FIG. 2

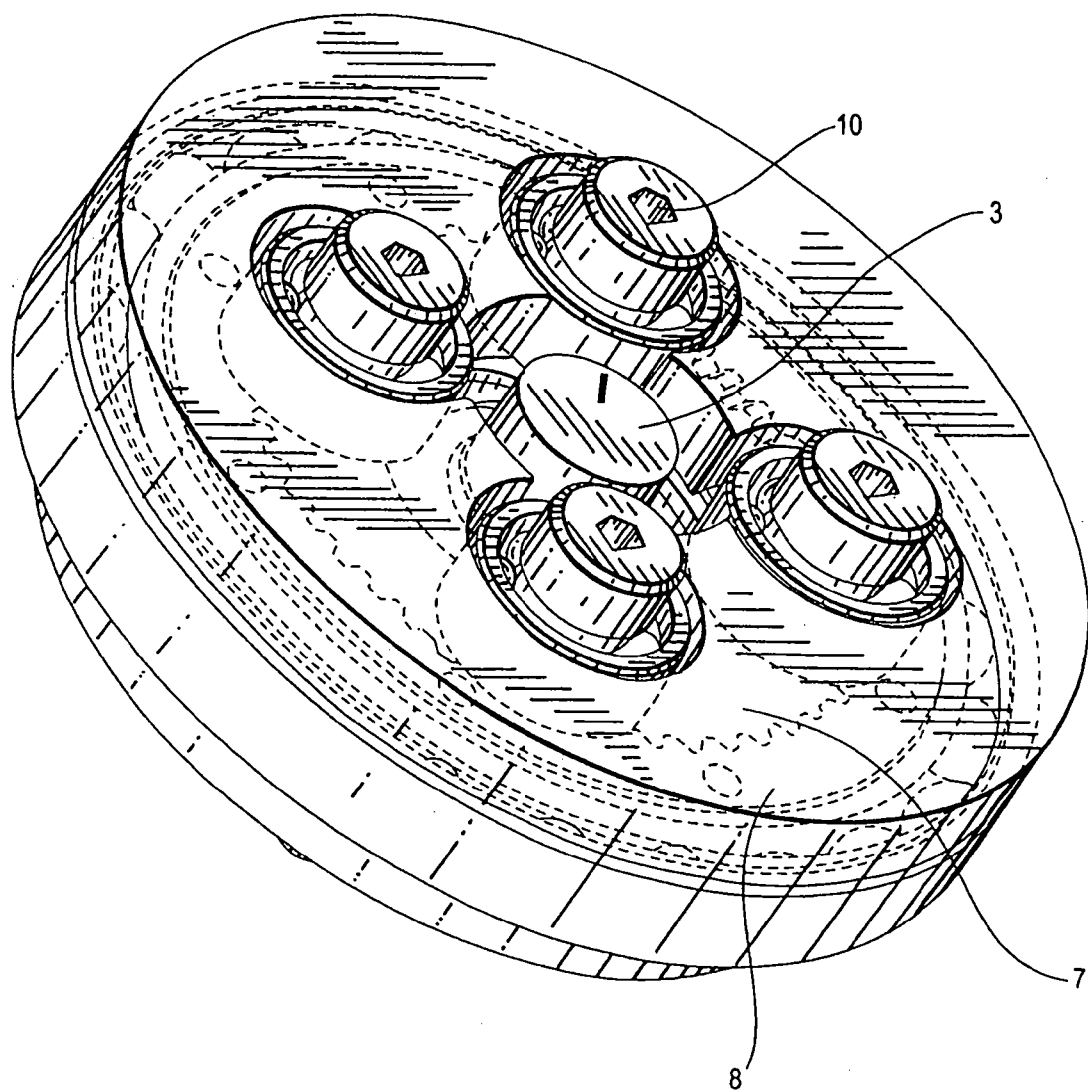


FIG. 3

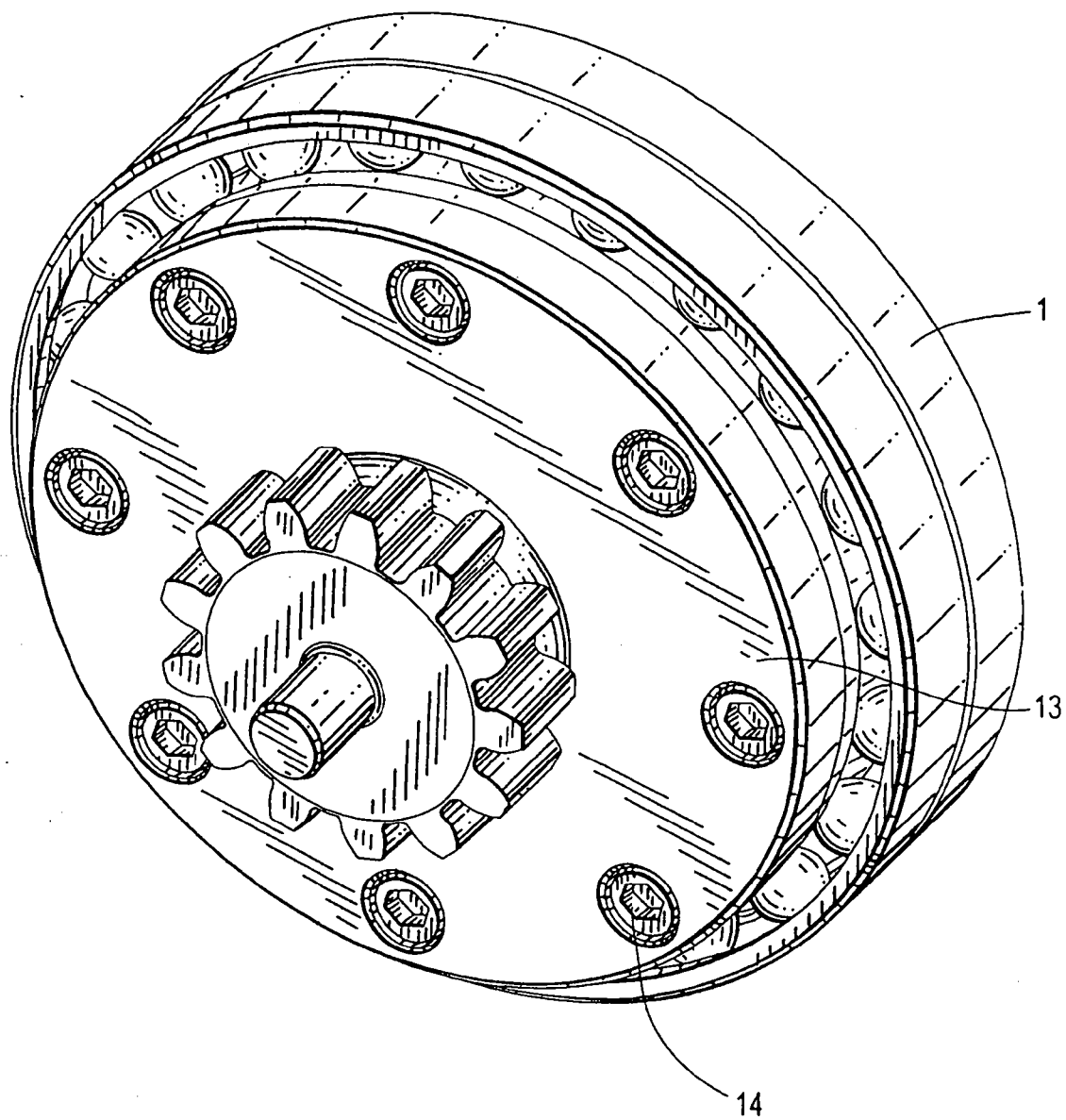


FIG. 4

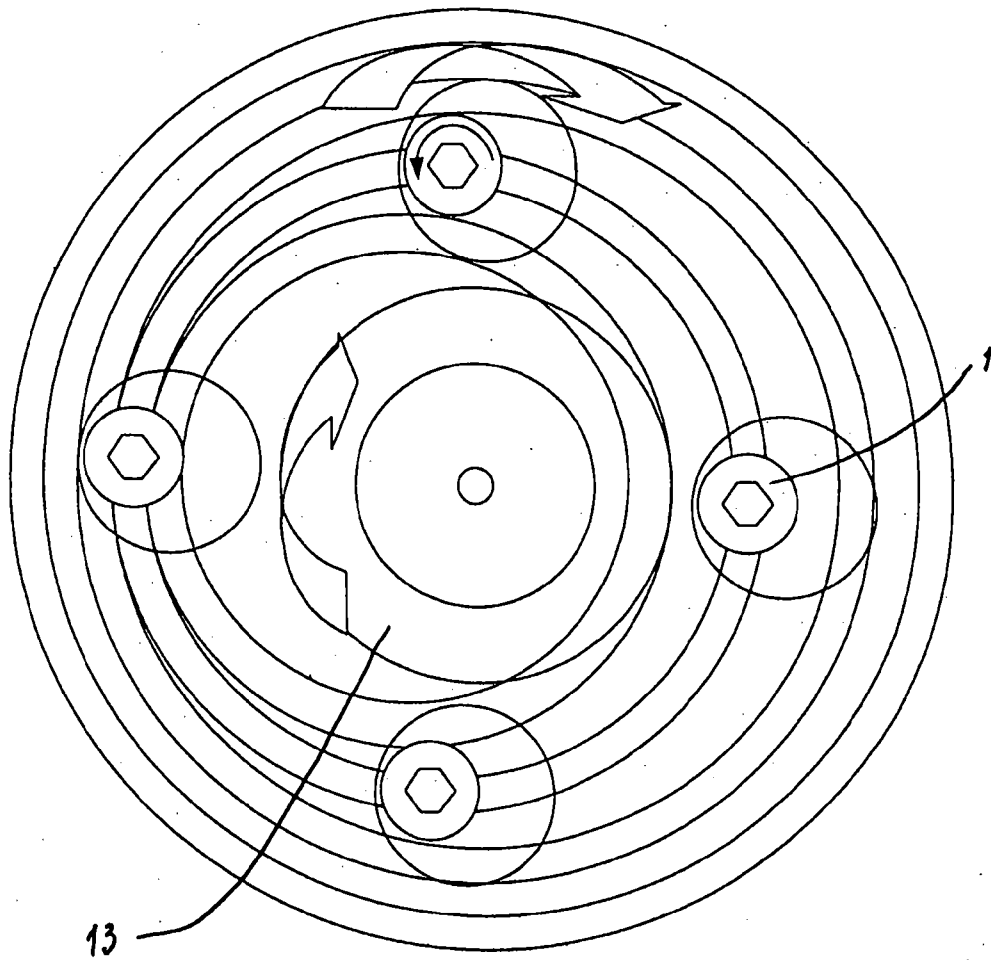


FIG. 5