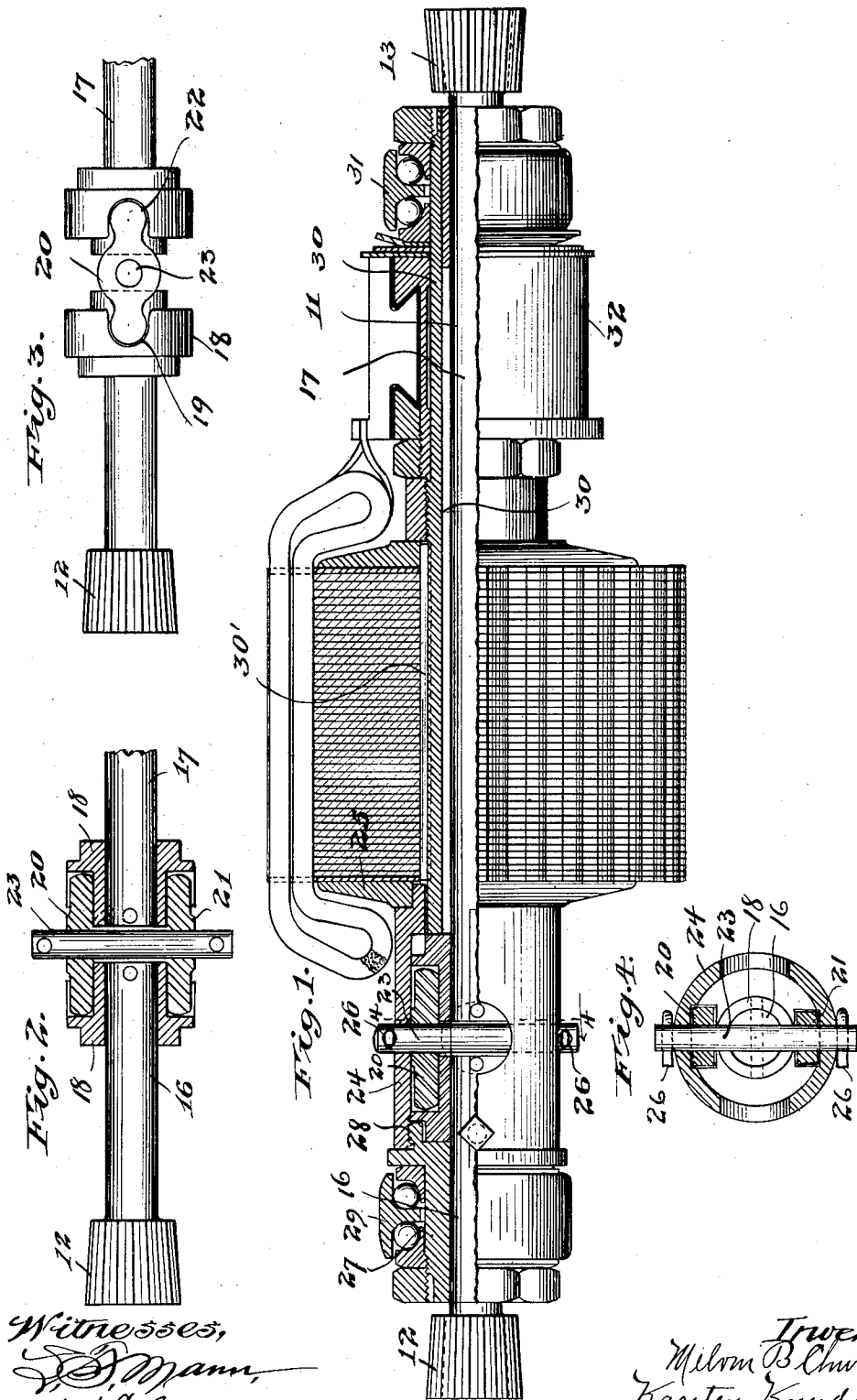


M. B. CHURCH & K. KNUDSEN,
DRIVING MECHANISM.

APPLICATION FILED FEB. 23, 1904. RENEWED OCT. 3, 1906.

2 SHEETS—SHEET 1.



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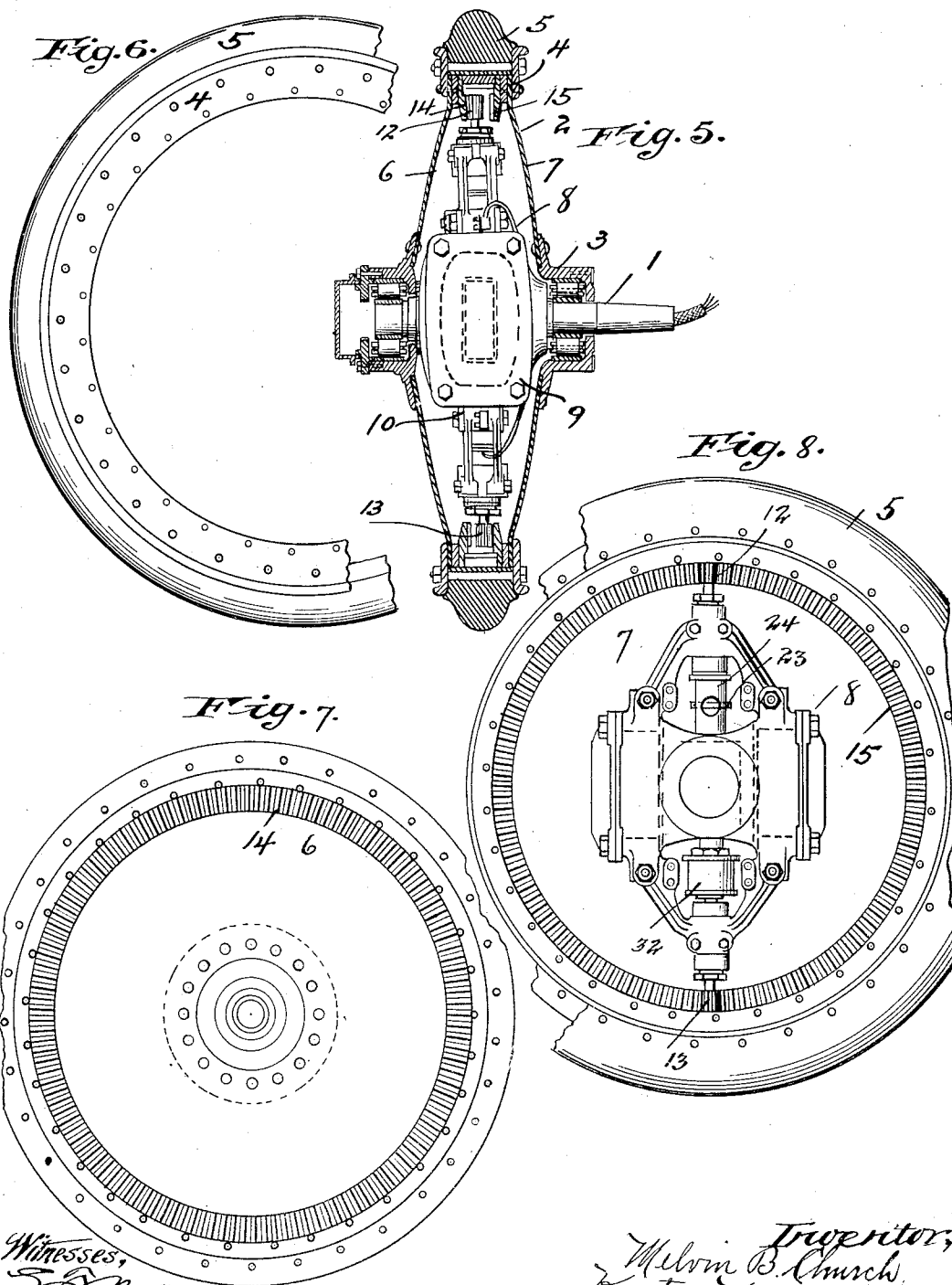
No. 856,943.

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UNITED STATES PATENT OFFICE.

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DRIVING MECHANISM.

No. 856,943.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that we, MELVIN B. CHURCH and KARSTEN KNUDSEN, both citizens of the United States, residing, respectively, at Grand Rapids, in the county of Kent and State of Michigan, and Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Driving Mechanisms, of which the following is a specification.

This invention relates to improvements in driving mechanisms, and refers more specifically to an improved mechanism whereby two shaft members are yieldably connected with each other and driven in such manner as to impart the driving power to other elements operatively connected with the respective shaft sections, the arrangement being such that inequalities of driving engagement are compensated for or equalized.

The salient object of the invention is to provide a mechanism of the character referred to, in which power derived from a single source will be transmitted to two different elements or two different parts of the same element, uniformly and equally, independently of inaccurate connections and independently of the movement of one driven member relatively to the other driven member, within reasonable limits.

Other objects are to provide a construction whereby two toothed gears may be driven from the same source of power through the medium of an interrupted or sectional shaft provided with fixed pinions engaging the respective gears and imparting to the latter equal driving power; to provide a construction of the character last referred to in which the two pinions are enabled to accurately and fully engage the respective gears regardless of whether the driven gears are arranged with their teeth in exact meshing register with the respective pinions, or, in other words, to avoid the inequality of engagement which would ensue if both gears were driven from a single shaft provided with two fixed pinions; to provide in a construction of this character a simple, compact and durable arrangement of the parts, and one particularly adapted for use with a mechanism in which the driving power is transmitted to the intermediate portion of the drive shaft; to provide a construction which may be readily assembled and taken apart,

for the purposes of inspection or repair; and, in general, to provide a simple and improved mechanism of the character referred to.

To the above ends, the invention consists in the matters hereinbefore described, and more particularly pointed out in the appended claims.

The invention will be readily understood from the following description, reference being had to the accompanying drawings, in which,—

Figure 1 is a view of the driving shaft and parts mounted thereon, one half of the mechanism being shown in axial sectional view and the other half in side elevation; Fig. 2 is a view, partly in section and partly in elevation, of the equalizing connections, whereby the interrupted shaft sections are connected, the view being taken in the same plane as that shown in Fig. 1; Fig. 3 is a plan view of the parts shown in Fig. 2; Fig. 4 is a transverse sectional view taken on line 4—4 of Fig. 1; Fig. 5 is a sectional view of a vehicle wheel and shaft equipped with one embodiment of my invention, the wheel proper being shown in axial section and the principal parts of the mechanism therein in side elevation, with parts broken away; Fig. 6 is a fragmentary view of the wheel rim, with the side or face plates removed; Figs. 7 and 8 are inside face views of the two side plates of the wheel.

In the application of our invention herein shown and described, the drive shaft forms part of an electric motor mechanism which is arranged within the hub of a vehicle wheel; but it is to be understood that the invention is not limited to this particular application, although it is of peculiar importance in this connection.

Describing first the general arrangement of parts, and referring to Fig. 5, 1 designates the end portion of a vehicle axle, and 2 designates, as a whole, a wheel journaled thereon. Said wheel comprises a hub portion 3 fitting upon the journal of the axle, a rim 4 provided with a suitable tire 5, two internally-concave and outwardly-convex side-plates 6 and 7, and a motor mechanism arranged within the hollow wheel thus formed, and designated as a whole 8. The motor mechanism is fixedly supported upon the end of the wheel axle 1; the two field members 9 and 10, respectively, together constituting a hollow rigid shell

within which is journaled the armature or rotating member of the motor. The specific construction and arrangement of the field members of the motor form no part of the present invention, and need not therefore be specifically described; but it may be remarked that the general construction and arrangement correspond to that described in patent to A. B. Holson, No. 701,341, dated June 3, 1902, to which patent reference is made for a more specific description.

Describing now more particularly the present invention, 11 designates, as a whole, a drive shaft constituting the armature shaft of the motor, and provided at each end with a driving pinion, as 12, 13, respectively. Upon the inner faces of the side plates 6 and 7 of the wheel, concentrically with the axis of the latter and in opposite relation to each other, are mounted two annular racks 14 and 15, with which the pinions 12 and 13 respectively engage.

Referring now to Fig. 1, the drive shaft 11 consists of two sections 16 and 17 arranged in alinement with each other, and the proximate ends of which are connected by means of an equalizing or evener mechanism, which permits a movement of one shaft section relatively to the other. To this end, each shaft section is provided with a collar 18 pinned or otherwise rigidly secured thereto; each collar being provided in its periphery, at diametrically opposite points, with sockets or bearing recesses 19 (see Fig. 3). The recesses 19 of the respective collars face each other and are adapted to receive the ends of a pair of eveners 20, 21, the engaging ends 22 of which are curved to mesh, gear-tooth fashion, with the recesses 19. The two eveners, 20, 21, are mounted upon a cross pin 23, which extends through the centers of the eveners and between the proximate ends of the main shaft in alinement with the axis of the latter. The cross pin 23 constitutes the connection by means of which the torque of the armature is transmitted to the eveners, and from the latter to the two shaft sections. In the present instance, the torque of the motor is transmitted to the cross pin through the medium of a sleeve 24 surrounding the entire evener mechanism, as shown clearly in Fig. 1, and connected at its inner end rigidly with the armature of the motor, designated as a whole 25; the ends of the cross pin being extended through and beyond the exterior of the sleeve 24 and secured therein by through pins 26.

From the foregoing description it will be understood that one shaft section may rotate relatively to the other a limited distance, such rotation being permitted by the rocking of the eveners on the cross pin 23. Accordingly the pinions 12 and 13 may be placed in mesh with their respective racks regardless of the angular relation of the rack teeth of

one rack relatively to those of the other; and it will be further obvious that if the teeth of the rack are inaccurately formed or spaced apart, the necessary movement of one shaft section relatively to the other may occur without varying the driving force imparted to the respective racks through the evener mechanism and shaft sections. In other words, the shaft sections will oscillate back and forth relatively to each other to compensate for inequalities in the gear construction, but the pinions will nevertheless at all times impart the full driving torque of the armature to the gear racks.

In the present construction, a bearing sleeve 27 is mounted upon that end of the armature shaft having the sleeve 24, and has screw-threaded engagement with the latter, as indicated at 28. The sleeve 27 carries a roller-bearing mechanism designated as a whole 29, and through the medium of which the armature structure is supported within the field members.

The shaft section 17 extends loosely through the armature, as indicated in Fig. 1. 30 designates a second sleeve, which extends entirely through the armature and is provided at its outer end with a second roller-bearing mechanism 31, and between said roller-bearing mechanism and the armature with a commutator mechanism designated as a whole 32. The armature is keyed to the sleeve 30, as indicated at 30'. The outer bearing rings of the roller-bearing mechanisms 29 and 31 are clamped immovably between the opposite halves of the shell constituting the field of the motor and hereinbefore referred to, as clearly shown in Fig. 5.

The operation of the mechanism has been fully indicated in connection with the description of the construction, and need not therefore be repeated. It will be obvious that the construction can be modified without departing from the invention; and we do not therefore limit ourselves to the details of construction shown herein, except to the extent that such details are made the subject of specific claims.

Besides relieving thrust on the main bearing, another advantage of my invention is that the intermeshing teeth are relieved from friction and wear.

As is well known when a force acts against other forces work is always done against the force which offers the least resistance. In the present case this principle finds an important application as a result of the arrangement of the racks, pinions and evener in that the wear, usual in intermeshing gear teeth is practically eliminated, for as the driving power does its work at the point of least resistance, this work in the present invention will be performed at the points where the teeth are in such relative position as to have no sliding movement the one upon the other

and thus offer the least resistance in their intermeshing action, that is, between those teeth whose point of contact is at or nearest to the line of centers of the gear and pinion, or in other words between the teeth which are working on the pitch line; and when this effective working position is secured by one pinion in relation to its rack the driving force is transmitted through it and work is thus performed, whereas with the teeth of the other pinion and rack which are not in this effective relation, but which are in position to cause a sliding or grinding action of one tooth on the other, the driving energy is not transmitted to such an extent as to cause undue wear on the teeth, this effect being due to the balancing action of the evener. In this way although the forces acting on the two driving pinions are always maintained equal, the greater part of the energy is transmitted, first by one pinion and then by the other, according as each is in position to do the work with the minimum friction loss. It is to be understood however that what we have indicated above as an alternating action in the transmission of energy does not effect or modify the results flowing from the couple action of the pinions and the relieving of the thrust on the main bearing for whether the one or the other pinion is effectively transmitting the energy, both pinions maintain their connection with the opposite sides of the driven member and their control thereof to relieve the main bearing of side thrust.

Another result of the use of the arrangements above described is that the side thrust on the pinion shaft bearings is relieved. Ordinarily, geared members have a tendency to work away from each other owing to the sliding action of the intermeshing teeth in transmitting the power, but as in the present case the force is transmitted in great degree only through the teeth which are on the center line of the gear members, and consequently have no radial thrusting action, the thrust on the bearings will be relieved, and not only this, but in the form of this invention herein described in which each rack is engaged by a pinion at one side thereof, there will be practically no twisting strain or pressure on the rack tending to give a twisting thrust longitudinally of the main bearing of the driven member because the pinion has no tendency to thrust the rack away from it.

We claim as our invention:

1. In combination, a pair of compensating gears, an equalizer connecting them, a third gear member meshing with both compensating gears, and driving means, substantially as described.

2. In combination, a pair of compensating gears, an equalizer connecting them and a third gear meshing with both compensating gears, said equalizer acting as a power trans-

mission element, and means for driving the pair of gears, substantially as described.

3. In combination, a plurality of compensating gears, equalizer mechanism connecting said gears for compensating movement, and another gear element cooperating in common with said compensating gears at separated points, the portions of said gear cooperating with the compensating gears being rigid with each other.

4. In combination, a pair of compensating gears, an equalizer connecting them and a third gear meshing with both compensating gears, and means for driving the pair of gears through said equalizer, substantially as described.

5. A driving mechanism comprising a driving member, an encircling member to be driven, connections between the driving member and substantially opposite points of the encircling member to drive the same and equalizer means to control the transmission from the driving member to the encircling member at said opposite points whereby a perfect couple action in continuous rotary motion is effected, substantially as described.

6. A driving mechanism comprising a driving member, an encircling member to be driven, shaft sections and gearing connecting the driving member to substantially opposite sides of the encircling member and equalizing means to control the transmission between each shaft section and the encircling member, substantially as described.

7. A driving mechanism comprising a driving member, an encircling member to be driven, a pair of annular racks carried thereby, gearing intermediate the racks and the driving member to transmit the power to the encircling member at substantially opposite points thereof and equalizing means to control the transmission at each of said opposite points, substantially as described.

8. In combination, a pair of gears and a gear meshing therewith, means whereby said pair of gears have a compensating action in respect to each other, and means for driving the pair of gears, substantially as described.

9. In combination, a pair of gears, a third geared member meshing therewith, and equalizing means for the pair of gears, each gear of the pair alternating with its companion gear in transmitting the power with the greater efficiency according as the teeth of said gears respectively assume the more efficient power transmitting engagement with the teeth of the third geared member, substantially as described.

10. In combination, a pair of rotary power transmitting members, a third member in power transmitting engagement therewith, driving means and equalizing means for the pair of power transmitting members, substantially as described.

11. A drive shaft mechanism comprising a

shaft, a driving pinion on each end thereof, two rigidly united parallel gear racks with which the respective pinions are engaged, and means intermediate the ends of said shaft affording a yielding connection between said pinions, for the purpose described.

12. A drive shaft mechanism comprising a shaft, a driving pinion on each end thereof, two rigidly united parallel gear racks with which the respective pinions are engaged, and means intermediate the ends of said shaft affording a yielding connection between said pinions, comprising a pivot support carried by the shaft, an evenner carried by said pivot support, and operative connections between the respective pinions and the opposite ends of said evenner.

13. A drive shaft mechanism comprising two alined shaft sections, a pinion having rigid connection with each of said sections, two parallel rigidly united gear racks between which said shaft extends diagonally and with which the respective pinions are engaged, and means operatively connecting said shaft sections comprising a pivot support carried by the shaft, an oscillatory member mounted upon said pivot support, and intermeshing connections between the oscillatory member and respective shaft sections.

14. A drive shaft mechanism comprising two alined shaft sections, a rigid driving pinion for each, two rigidly united parallel annular racks between which said shaft is arranged to extend diagonally and diametrically and with which the respective pinions are engaged, and means for yieldably connecting and driving said shaft sections comprising a pivot support carried thereby and having its axis radial to the shaft axis, an oscillatory member mounted upon said pivot support, intermeshing connections between said oscillatory member and the respective shaft sections, and means for applying driving power to said oscillatory member at a point between the shaft sections.

15. In a power transmitting mechanism, a driven member, a pair of parallel coaxial connected racks carried thereby, a driving shaft extending diametrically and diagonally between said racks, pinions on the ends of said shaft engaging, one with one rack and one with the other rack, and an equalizing device forming a yielding connection between the driving and the driven members.

16. A drive-shaft mechanism comprising two alined shaft sections each provided with a rigid driving pinion, two rigidly united gear racks with which the respective pinions are engaged, a pair of diametrically opposite evenner bearings upon the meeting end of each shaft section, a pair of evenners one at each side of the shaft axis, having their ends engaged with said evenner bearings, a cross-support extending through the intermediate portions of the two evenners, and a driving

member operatively connected with said cross-support radially outside of the evenners.

17. In combination, a pair of rotary power transmitting members, a third member in power transmitting engagement therewith and equalizing means for the pair of power transmitting members, said equalizing means having movement relative to said pair of power transmitting means, substantially as described.

18. In combination in power transmission means, an encircling member, an inner member encircled thereby, connections between said inner member and substantially opposite points of the encircling member, driving means and equalizing means to secure a substantially uniform transmission of power at said opposite points, substantially as described.

19. In combination in power transmission means, an annular member, members at substantially opposite points in respect to the axial center of said annular member having power transmitting engagement therewith, connecting means between the opposite members, driving means and means whereby a compensating effect is secured at said opposite points, substantially as described.

20. In combination, annular power transmission members, a pair of members, one of which is in engagement with one annular member and the other member of the pair engaging the other annular member, the engaging points being substantially on opposite sides of the center of rotation of the annular members, connecting means between the members of the pair, and equalizing means, substantially as described.

21. In combination, annular power transmission members, a pair of members, one of which is in engagement with one annular member and the other member of the pair engaging the other annular member, the engaging points being substantially on opposite sides of the center of rotation of the annular members, connecting means between the members of the pair, inclined in relation to the axis of rotation, and equalizing means, substantially as described.

22. In combination, an annular geared member and a pair of gears meshing therewith at substantially opposite points, said gears having a compensating action in relation to the annular geared member, each gear of the pair alternating with its companion gear in transmitting the power with the greater efficiency according as the teeth of said gears respectively assume the more efficient power transmitting engagement with the teeth of the annular geared member, substantially as described.

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