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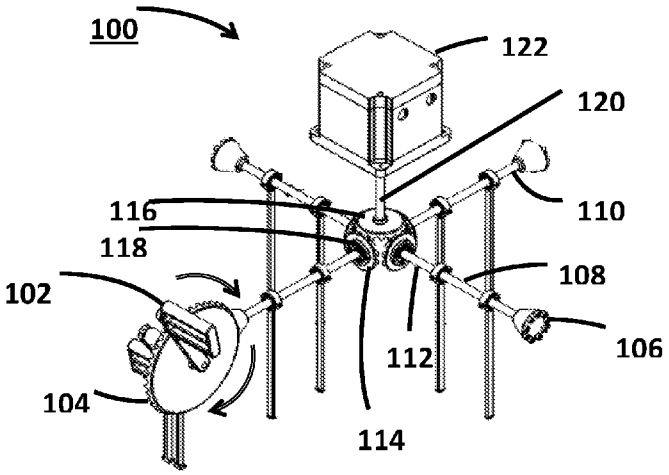

FIG. 1

(57) Abstract: An energy transfer system is disclosed. The system (100) includes plurality of rotatable input shafts (108), each having a first end (110) and a second end (112). The first end (110) is coupled to a plurality of drive sources (102). A plurality of rotatable output shafts (120) are operatively coupled to a pinion (116). A plurality of rolling friction gears (114) are coupled to the second end (112) of the plurality of the rotatable input shafts (108). The plurality of rolling friction gears (114) have circular gear teeth that mesh with circular gear teeth of the pinion (116) for transferring rotating movements of the plurality of the rotatable input shafts into rotating movements of the plurality of the rotatable output shafts (120). Each of the plurality of the rolling friction gears (114) houses a freewheeling clutch (118) acting upon the pinion (116).

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— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
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AN ENERGY TRANSFER SYSTEM

FIELD OF DISCLOSURE

[0001] The present disclosure relates to an energy transfer system, and specifically relates to the energy transfer system for transferring rotating movements of multiple rotary inputs into rotating movements of multiple rotary outputs.

BACKGROUND

[0002] Energy is generated using conventional sources like oil, gas, and coal, or using non-conventional sources like wind, solar, tides, and biomass. The generated energy is always required to be transferred from one end to other. Energy transfer systems are capable of transferring one or more forms of energy for driving one or more outputs, such as an alternator, a wheel, or a turbine.

[0003] The energy transfer systems employ gearboxes and transmission elements to transfer energy from the input to the output. Sliding friction gears are popular and majorly used in the energy transfer systems. However, loss of energy in such gears is higher as the sliding of the gears creates friction that translates into the heat. This ultimately reduces energy transmission efficiency of the overall system.

[0004] The existing gear mechanisms employed in the energy transfer systems can transfer energy from maximum two inputs to maximum two outputs at different rates, i.e., a differential. However, when the energy transfer systems have energy inputs more than two, the system becomes complicated as well as inefficient just by increasing the number of differentials used in the system.

[0005] Further, the existing non-conventional energy generating systems have a problem of meeting peak energy generation when the energy demand is at peak. This results in imbalance between peak demand and energy production, the phenomena, which is generally referred as ‘duck curve’.

[0006] The present disclosure is directed to alleviate one or more limitations stated above or any other limitations associated with the conventional systems.

SUMMARY

[0007] This summary is provided to introduce aspects related to an energy transfer system and the aspects are further described below in the detailed description. This summary is not intended to identify essential features of the claimed subject matter nor is it intended for use in determining or limiting the scope of the claimed subject matter.

[0008] In one non-limiting embodiment of the present disclosure, an energy transfer system is disclosed. The system includes a plurality of rotatable input shafts that have a first end and a second end. Each of the first end is operatively coupled to a plurality of drive sources. The system also includes a plurality of rotatable output shafts that are operatively coupled to a pinion. The system includes a plurality of rolling friction gears that are coupled to the second end of the plurality of the rotatable input shafts. The plurality of rolling friction gears have circular gear teeth that mesh with circular gear teeth of the pinion. This meshing causes transfer of rotating movements of the plurality of the rotatable input shafts into rotating movements of the plurality of the rotatable output shafts. Each of the plurality of the rolling friction gears houses a freewheeling clutch acting upon the pinion.

[0009] In an embodiment of the disclosure, the plurality of drive sources includes at least one of a pedal, a solar panel, regenerative braking, wind, and fluid.

[0010] In an embodiment of the disclosure, the rotatable input shafts are coupled to the plurality of drive sources through at least one of a turbine, a wheel, a sprocket, and a motor.

[0011] In an embodiment of the disclosure, the plurality of rotatable output shafts is coupled to at least one of a continuous variable transmission and a planetary gear.

[0012] In an embodiment of the disclosure, the plurality of rolling friction gears are at least one of rolling friction spur gears, rolling friction helical gears, rolling friction bevel gears, and rolling friction rack and pinion gears.

[0013] In an embodiment of the disclosure, the meshing of the circular gear teeth of the rolling friction gears with the circular gear teeth of a pinion form a single point of friction contact, thereby transmitting rotating movements of the rotatable input shafts to the rotatable output shafts.

[0014] In an embodiment of the disclosure, the energy transfer system includes a flywheel that is coupled to the rotatable output shafts. The flywheel stores energy generated by the plurality of the drive sources.

[0015] In an embodiment of the disclosure, the freewheeling clutch selectively engages and disengages the rotatable input shafts and the pinion.

[0016] In an embodiment of the disclosure, the freewheeling clutch is operatively interposed between the rotatable input shafts and the pinion to effect driving engagement therebetween. The freewheeling clutch disengages the rotatable input shafts and the pinion for freewheeling operation when the pinion overruns the rotatable input shafts.

[0017] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description.

OBJECTS OF THE DISCLOSURE

[0018] Some of the objects of the system of the present disclosure are aimed to ameliorate one or more problems of the prior art or to at least provide a useful alternative and are listed herein below.

[0019] An object of the present disclosure is to provide an energy transfer system that transfers rotational movements of the multiple inputs into rotational movements of the multiple outputs.

[0020] Another object of the present disclosure is to provide an energy transfer system that reduces the transmission losses and improves energy transmission efficiency of the overall system.

[0021] Yet another object of the present disclosure is to provide an energy transfer system that meets peak energy generation when the energy demand is at peak.

[0022] Yet another object of the present disclosure is to provide an energy transfer system that is efficient, uncomplicated, and cost-effective.

[0023] Other objects and advantages of the present disclosure will be more apparent from the following description when read in conjunction with the accompanying figures, which are not intended to limit the scope of the present disclosure.

BRIEF DESCRIPTION OF ACCOMPANYING DRAWINGS

[0024] The novel features and characteristic of the disclosure are set forth in the appended claims. The disclosure itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying figures. One or more embodiments are now described, by way of example only, with reference to the accompanying figures wherein like reference numerals represent like elements and in which:

[0025] FIG. 1 illustrates a perspective view of an input side of an energy transfer system, in accordance with an embodiment of the present disclosure.

[0026] FIG. 2 illustrates a perspective view of an output side of an energy transfer system, in accordance with an embodiment of the present disclosure.

[0027] FIG. 3 illustrates a view of a sub assembly, wherein a rolling friction gear is coupled to a rotatable shaft, in accordance with an embodiment of the present disclosure.

[0028] FIG. 4 illustrates a view of a sub assembly, wherein a plurality rolling friction gears are meshed with a pinion, in accordance with an embodiment of the present disclosure.

[0029] The figures depict embodiments of the disclosure for purposes of illustration only. One skilled in the art will readily recognize from the following description that alternative embodiments of the structures and methods illustrated herein may be employed without departing from the principles of the disclosure described herein.

DETAILED DESCRIPTION

[0030] An energy transfer system will now be described with reference to the accompanying drawings, which do not restrict the scope and ambit of the present disclosure. The description is provided purely by the way of illustration.

[0031] The embodiments herein and the various features and advantageous details thereof are explained with reference to the non-limiting embodiments in the following description. Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

[0032] Embodiments of the present disclosure disclose an energy transfer system. The system allows transfer of energy from multiple rotatable inputs to multiple rotatable outputs. The rotatable inputs may comprise inputs from drive sources, such as a pedal of a cycle, regenerative braking, a solar panel, a wind, or a fluid. The rotatable outputs may comprise a continuous variable transmission or a planetary gear.

[0033] The system comprises rolling friction gears that are coupled to the rotatable inputs through drive inputs shafts. The rolling friction gears are configured to accumulate energy from the multiple rotary inputs.

[0034] The system may also comprise a flywheel as an intermediate energy storage device. The flywheel may be configured to be accommodated between the multiple rotatable inputs and the multiple rotatable outputs. The flywheel is accelerated by the mechanical energy obtained from the multiple rotatable inputs.

[0035] The terms “comprises”, “comprising”, or any other variations thereof used in the specification, are intended to cover a non-exclusive inclusion, such that an assembly that comprises a list of components or steps does not include only those components or steps but may include other components or steps not expressly listed or inherent to such setup or method. In other words, one or more elements in an assembly proceeded by “comprises... a” does not,

without more constraints, preclude the existence of other elements or additional elements in the assembly.

[0036] Henceforth, the present disclosure is explained with the help of one or more figures of exemplary embodiments. However, such exemplary embodiments should not be construed as limitation of the present disclosure. In the figures, assembly of the energy transfer system on to a vehicle is not depicted for the purpose of simplicity. One skilled in the art would appreciate that the energy transfer system of the present disclosure may be employed in any vehicle including but not limiting to a two wheeled vehicle, a three wheeled vehicle, a four wheeled vehicle, and the like.

[0037] The following paragraphs describe the present disclosure with reference to FIGS. 1-4. In the figures, the same element or elements which have similar functions are indicated by the same reference signs.

[0038] In an embodiment of the present disclosure, an input side of an energy transfer system **100** is disclosed in FIG. 1. The system **100** comprises a plurality of drive sources **102**. FIG. 1 depicts a drive source in a form of pedal. However, it is to be understood that any number of drive sources may be employed in the system **100** of the present disclosure. The drive sources **102** may include at least one of the pedal, a solar panel, regenerative braking, wind, fluid, or the like.

[0039] A plurality of drive members **104** may be coupled to the each of the plurality of the drive sources **102**. In an embodiment of the present disclosure, the pedals may be used as the drive sources **102**. The pedals may rotate the drive members **104**. In an example, a crank may be used as the drive member **104**. The drive member **104** may have a plurality of teeth formed on a perimeter. These teeth may mesh with teeth of a gear **106** to rotate the gear **106** at speed equal to the speed of rotation of the drive member **104**.

[0040] The system **100** may comprise a plurality of drive input shafts **108** rotatable about their axis. A drive receiving end **110** of each of the rotatable drive input shafts **108** may be connected to the gear **106**. This connection, in turn, couples the each of the rotatable drive input shafts **108** to each of the drive members **104**, respectively. Thus, torque is delivered from the drive members **104** to the rotatable drive input shafts **108**. This, in turn, causes the rotatable drive input shafts **108** to rotate about their axis in either one direction or the other. A second end **112**

of each of the rotatable drive input shafts **108** may be connected to each of a plurality of a rolling friction gears **114**.

[0041] The rolling friction gears **114** may be employed as at least one of spur gears, helical gears, bevel gears, a rack and pinion gears, or a combination thereof. The rolling friction gears **114** may have teeth formed on a perimeter. The teeth of the rolling friction gears **114** mesh with teeth of a pinion **116**. The meshing establishes a single point of friction contact that allows transfer of energy from the rolling friction gears **114** to the pinion **116**. In comparison with sliding friction gears, use of the rolling friction gears reduces the transmission losses and improves energy transmission efficiency. This is majorly due to the number of frictional contacts made with the pinion while rotating the gears. In sliding friction gears, the gears establish eight points of frictional contacts with the pinion. Consequently, the transmission losses are higher in the sliding friction gears.

[0042] Each of the plurality of the rolling friction gears **114** may house a freewheeling clutch **118**. The freewheeling clutch **118** is operatively interposed between the rotatable drive input shafts **108** and the pinion **116** to effect driving engagement therebetween. The freewheeling clutch **118** disengages these members for freewheeling operation when the pinion **116** overruns the rotatable drive input shaft **108**. The disengagement and engagement of the freewheeling clutch **118** may require a separate timing sensor (not shown) in order to time the disengagement and engagement. The timing sensor ensures that the teeth of the rolling friction gears **114** do not crack or break due to torque present in the rolling friction gears **114**.

[0043] The freewheeling clutch **118** ensures that the pinion **116** turns at speed higher than the rotating speed of the rolling friction gears **114** or the rotatable drive input shafts **108**. The combination of the rolling friction gear **114** with the freewheeling clutch **118** allows accumulation of energy from all the rotatable drive input shafts **108**, even when the rotational speed of one of one input shaft is lesser than the rotational speed of the other input shafts.

[0044] The accumulated energy at each of the rolling friction gears **114** is transferred to a rotatable drive output shaft **120** that is operatively coupled to the pinion **116**. The rotatable drive output shaft **120** may be coupled to a plurality of driven sources. The driven sources may comprise of continuous variable transmission **122** and a planetary gear assembly. Alternatively, the rotatable drive output shaft **120** may be coupled to a flywheel (not shown) to store the

energy generated by the plurality of drive sources. The energy stored in the flywheel may be used at the later stage to fulfill peak demand of the energy.

[0045] FIG. 2 illustrates a perspective view of an output side of an energy transfer system **100**, in accordance with an embodiment of the present disclosure. The system **100** depicts that a rotatable output shaft **202** of the continuous variable transmission **122** may be coupled to a plurality of rotatable input shafts **204**. The input shafts **204** may further drive a plurality of output applications, such as a wheel, a turbine, an alternator, or the like.

[0046] FIG. 3 illustrates a view of a sub assembly **300**, wherein the rolling friction gear **114** is coupled to the rotatable drive input shaft **108**, in accordance with an embodiment of the present disclosure. As shown, the freewheeling clutch **118** may be connected at the second end **112** of the rotatable drive input shaft **108** and may be housed within an inner periphery **302** of the rolling friction gear **114**. When used at the input side of the system **100**, the freewheeling clutch **118** may be mounted in a way that an outer race is the overrunning member or freewheeling member. When used in the output side of the system **100**, the freewheeling clutch **118** may be mounted in a way that an inner race is the overrunning member or freewheeling member. In an exemplary embodiment of the present disclosure, four rolling friction gears are meshed with the pinion, wherein each of the rolling friction gears is spaced at a right angle with respect to each other. It may be understood that the diameter of the pinion can be increased so as to mesh n-number of the rolling friction gears spaced apart equally at a predetermined angle.

[0047] FIG. 4 illustrates a view of a sub assembly **400**, wherein the plurality of rolling friction gears **114** are meshed with the pinion **116**, in accordance with an embodiment of the present disclosure. In an exemplary embodiment of the present disclosure, teeth of four rolling friction gears **114** are meshed with the teeth of the pinion **116**. The pinion **116** may include a plurality of roller bearings **402** attached on the periphery with an angle perpendicular to an axis of the rotation of the pinion **116**. It may be understood that any number of rolling friction gears may be meshed with the pinion, based upon the size of the pinion. Also, an angle between each of the rolling friction gears depend upon the size of the pinion and the number of rolling friction gears meshed with the pinion.

Equivalents

[0048] With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

[0049] It will be understood by those within the art that, in general, terms used herein, are generally intended as "open" terms (e.g., the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to," etc.). It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the absence of such recitation no such intent is present. For example, as an aid to understanding the description may contain usage of the introductory phrases "at least one" and "one or more" to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a claim recitation by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim recitation to inventions containing only one such recitation, even when the same claim includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an" (e.g., "a" and/or "an" should typically be interpreted to mean "at least one" or "one or more"); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation *is* explicitly recited, those skilled in the art will recognize that such recitation should typically be interpreted to mean *at least* the recited number (e.g., the bare recitation of "two recitations," without other modifiers, typically means *at least* two recitations, or *two or more* recitations). Furthermore, in those instances where a convention analogous to "at least one of A, B, and C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, and C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). In those instances where a convention analogous to "at least one of A, B, or C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, or C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more

alternative terms, whether in the description, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase "A or B" will be understood to include the possibilities of "A" or "B" or "A and B".

[0050] While various aspects and embodiments have been disclosed herein, other aspects and embodiments will be apparent to those skilled in the art. The various aspects and embodiments disclosed herein are for purposes of illustration and are not intended to be limiting, with the true scope being indicated in the description.

TECHNICAL ADVANCEMENTS AND ECONOMIC SIGNIFICANCE

[0051] The present system offers solution to the existing problems by transferring energy from the multiple inputs to the multiple outputs. The system also reduces the transmission losses and improves energy transmission efficiency of the overall system. Furthermore, the system meets peak energy generation when the energy demand is at peak. This solves the problem of "duck curve". The energy transfer system is efficient, uncomplicated, and cost-effective.

REFERRAL NUMERALS

Description	Reference Number
energy transfer system	100
drive sources	102
drive members	104
Gear	106
Rotatable drive input shafts	108
drive receiving end of rotatable drive input shaft	110
second end of rotatable drive input shaft	112
rolling friction gears	114
Pinion	116
freewheeling clutch	118
rotatable drive output shaft	120
energy storage medium	122

rotatable output shaft	202
rotatable input shafts	204
sub assembly	300, 400
inner periphery of the rolling friction gear	302
roller bearings	402

Claims

1. An energy transfer system (100) consisting:

a plurality of rotatable drive input shafts (108) of an input side, each having a drive receiving end (110) and a second end (112), the drive receiving end (110) being operatively coupled to a plurality of drive sources (102);

a rotatable drive output shaft (120) of the input side, operatively coupled to a pinion (116);

characterized in that

a plurality of rolling friction gears (114) coupled to the second end (112) of the plurality of the rotatable drive input shafts (108) of the input side, the plurality of rolling friction gears (114) having circular gear teeth that mesh with circular gear teeth of the pinion (116) for transferring rotating movements of the plurality of the rotatable drive input shafts (108) of the input side into rotating movement of the rotatable drive output shaft (120) of the input side, wherein each of the plurality of the rolling friction gears (114) houses a freewheeling clutch (118) acting upon the pinion (116); and

an energy storage medium (122) configured to store energy generated from the rotating movement of the rotatable drive output shaft (120) of the input side, wherein the energy storage medium (122) drives a plurality of driven sources operatively coupled through a rotatable output shaft (202) of an output side.

2. The energy transfer system (100) as claimed in claim 1, wherein the plurality of drive sources (102) includes one of a pedal, a solar panel, regenerative braking, wind, and fluid.

3. The energy transfer system (100) as claimed in claim 1, wherein the rotatable drive input shafts (108) of the input side are coupled to the plurality of drive sources (102) through one of a turbine, a wheel, a sprocket, and a motor.

4. The energy transfer system (100) as claimed in claim 1, wherein the rotatable drive output shaft (120) of the input side is coupled to one of a continuous variable transmission and a planetary gear.

5. The energy transfer system (100) as claimed in claim 1, wherein the plurality of rolling friction gears are one of rolling friction spur gears, rolling friction helical gears, rolling friction bevel gears, and rolling friction rack and pinion gears.

6. The energy transfer system (100) as claimed in claim 1, wherein meshing of the circular gear teeth of the rolling friction gears (114) with the circular gear teeth of a pinion form a single point of friction contact, thereby transmitting rotating movements of the rotatable drive input shafts (108) of the input side to the rotatable drive output shaft (120) of the input side.

7. The energy transfer system (100) as claimed in claim 1 consists a flywheel operatively coupled to the rotatable drive output shaft (120) of the input side to store energy generated by the plurality of the drive sources (102).

8. The energy transfer system (100) as claimed in claim 1, wherein the freewheeling clutch (118) selectively engages and disengages the rotatable drive input shafts (108) of the input side and the pinion (116).

9. The energy transfer system (100) as claimed in claim 1, wherein the freewheeling clutch (118) is operatively interposed between each of the plurality of the rotatable drive input shafts (108) of the input side and the pinion (116) to effect driving engagement therebetween and to disengage the plurality of the rotatable drive input shafts (108) of the input side and the pinion (116) for freewheeling operation when the pinion (116) overruns the plurality of the rotatable drive input shafts (108) of the input side.

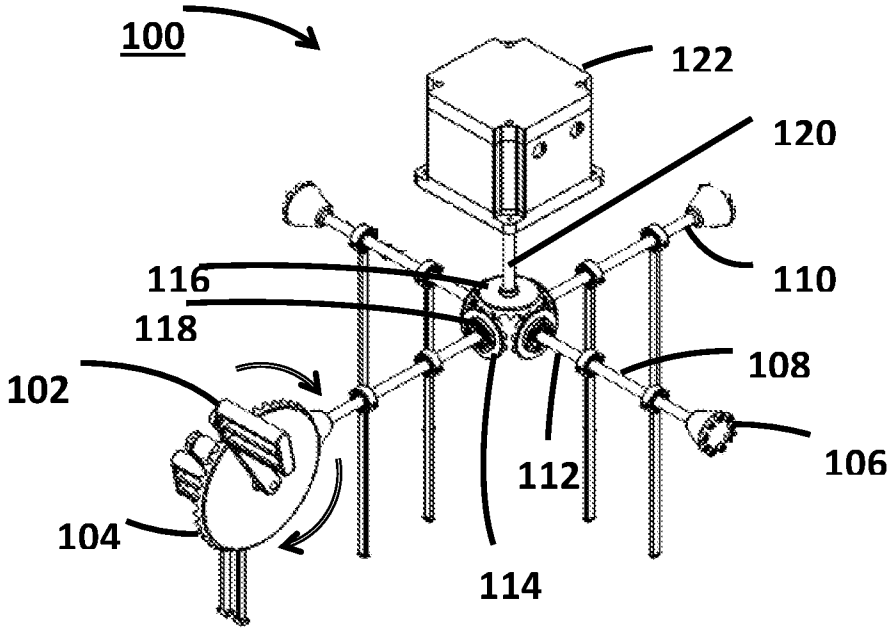

FIG. 1

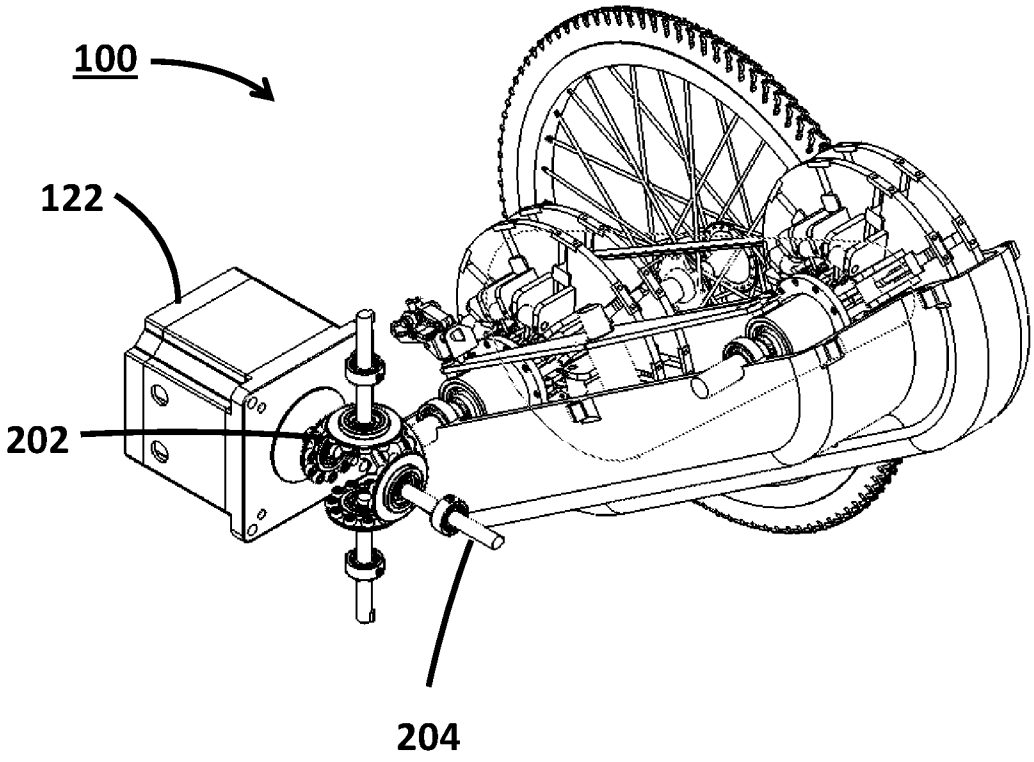

FIG. 2

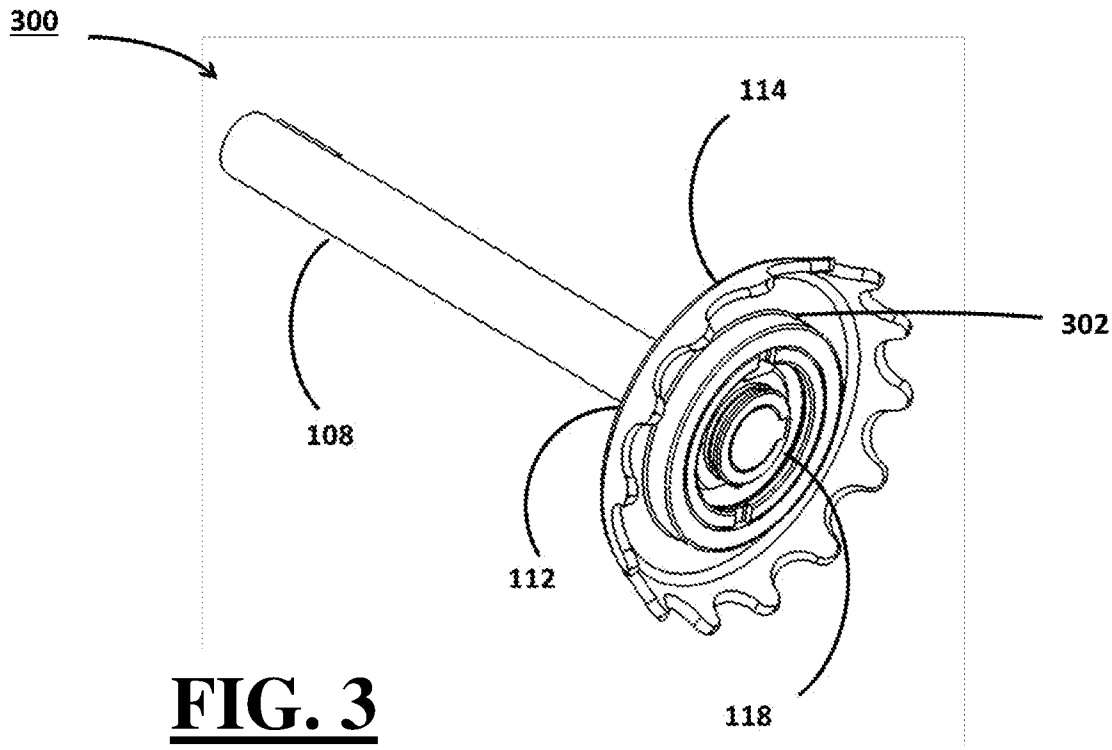

FIG. 3

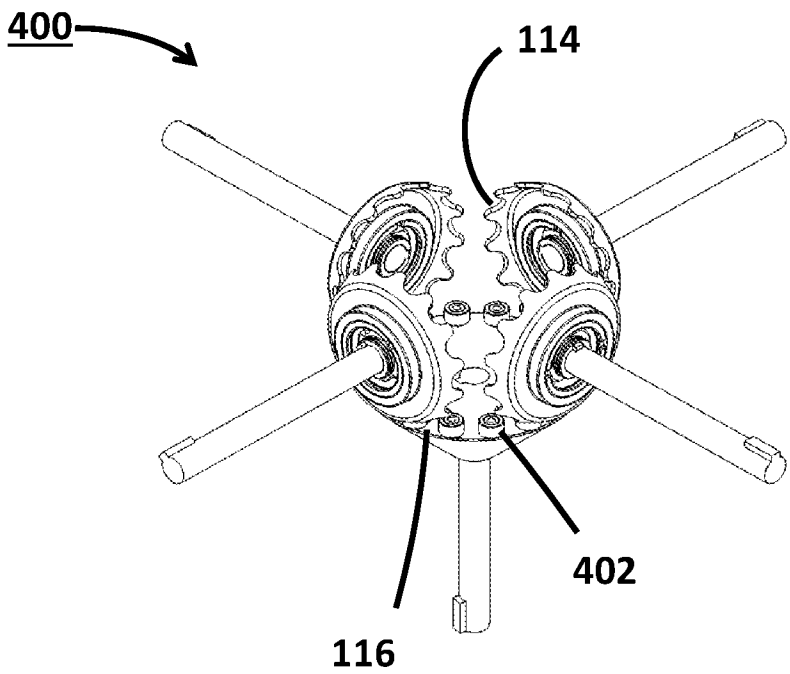

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2020/050085

A. CLASSIFICATION OF SUBJECT MATTER
F16H37/06 Version=2020.01

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F16H

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

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

TotalPatent One, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6612195 B2 (SIKORSKY AIRCRAFT CORP) 02 September 2003 col. 2, lines 20 to 65; fig. 1, 2	1-9
A	WO 1994001699 A1 (MASONI PIETRO) 20 January 1994 page 10, lines 14 to 25; fig. 4	1-9

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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