(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 August 2012 (23.08.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/109699 A1

(51) International Patent Classification:
F16D 13/38 (2006.01) *F16H 1/28* (2006.01)
F16D 13/70 (2006.01) *F16D 13/46* (2006.01)
F16H 3/56 (2006.01) *F16H 1/32* (2006.01)
E21B 3/00 (2006.01)

(21) International Application Number:
PCT/AU2012/000129

(22) International Filing Date:
10 February 2012 (10.02.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2011900517 16 February 2011 (16.02.2011) AU

(71) Applicant *(for all designated States except US)*: **RAMBOR PTY LIMITED** [AU/AU]; 108 Albatross Road, Nowra, NSW 2541 (AU).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **MASTALIR, Peter** [AU/AU]; 1 The Glen, Mount Pleasant, NSW 2519 (AU).

(74) Agent: **SPRUSON & FERGUSON**; GPO BOX 3898, Sydney, New South Wales 2001 (AU).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,

[Continued on next page]

WO 2012/109699 A1

(54) Title: A GEAR AND CLUTCH ASSEMBLY

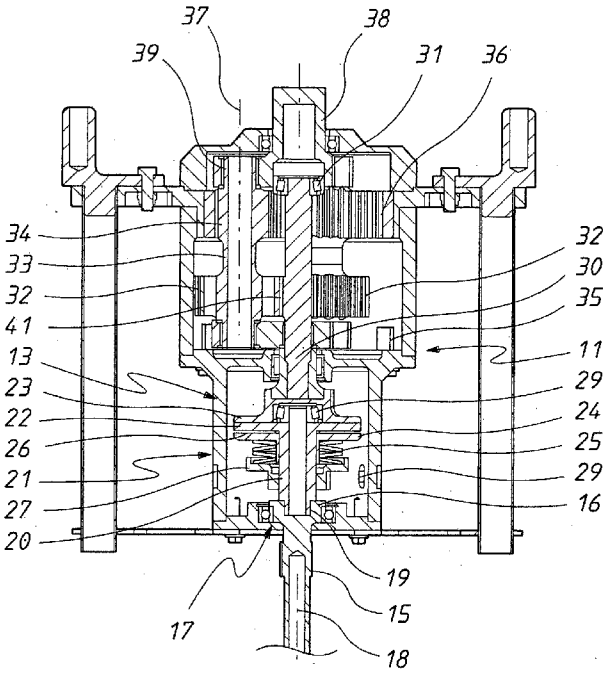

FIG.3

(57) Abstract: A gear and clutch assembly (10) to be used in a mining drill rig, the assembly including a gear housing (12) and a clutch housing (13). Fixed to the housing (1 1) are mountings (14) via which assembly can be fixed to the remainder of the drill rig. The assembly (10) is adapted to limit the torque transmitted to a predetermined torque.

UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

A GEAR AND CLUTCH ASSEMBLY

Technical Field

The present invention relates to gear and clutch assemblies, and more particularly but not exclusively to gear and clutch assemblies employable in apparatus that drill holes and insert bolts in rock layers surrounding a mine tunnel.

Background of the Invention

Drill rigs are used to drill holes and insert bolts in rock layers surrounding a mine tunnel. These drill rigs have gear assemblies that increase the torque to be applied to the drill or bolt.

A disadvantage of these previously known drive trains is that to provide the desired torque, the size of the rigs becomes excessive. Still further previous apparatus is not adapted to limit the torque applied to the drill or roof bolt.

Object of the Invention

It is the object of the present invention to overcome or substantially ameliorate at least one of the above disadvantages.

Summary of the Invention

There is disclosed herein a gear and clutch assembly including:

an input shaft to be rotatably driven by a motor;

a clutch having an input and an output, the clutch input being driven by the input shaft to drive the clutch output so that the clutch input and output angularly rotate in unison until a predetermined torque is applied to the clutch input, with said clutch input then being able to rotate at a greater angled velocity than the clutch output when said predetermined torque is exceeded;

a sun gear;

a first set of planetary gears meshingly engaged with the first sun gear so as to be driven thereby;

a ring gear;

a second set of planetary gears, the second set of gears being meshingly engaged with the ring gear, with the second set of planetary gears being driven by the first set of planetary gears;

a carrier supporting the second set of gears so as to be rotatably driven thereby;

an output shaft, the output shaft being driven by the carrier; and wherein

the input shaft and the output shaft are operatively associated so that axial forces applied to the input shaft are transmitted to the output shaft.

Preferably, the input shaft and the output shaft have a common rotational axis.

Preferably, said first set of gears consists of three gears.

Preferably, said second set of gears consists of three gears.

Preferably, said assembly includes a housing, with said ring gear fixed to said housing so as to be stationary.

Preferably, said clutch includes a first plate, the first plate being driven by the first input shaft;

a second plate, the second plate being drivingly connected to the first sun gear and having a plurality of detents, a plurality of rotatable elements, each element being located in a respective one of the detents, and a spring urging the elements into the detents that the first plate drives the second plate.

Preferably, the elements are located in apertures of the first plates, with the elements leaving the detents when said predetermined torque is exceeded so that the first plate can rotate at a greater angular velocity than the second plate.

Preferably, said clutch includes a collar, the collar being mounted on the clutch input shaft so as to be movable axially therealong, a pressure plate, the pressure plate being located so that the first plate is located between the second plate and pressure plate, with the pressure plate engaged with the elements, and wherein said spring located ~~between the collar and pressure plate to urge the pressure plate against the elements to aid~~ in retaining the elements in the detents.

Brief Description of the Drawings

A preferred form of the present invention will now be described by way of example with reference to the accompanying drawings wherein:

Figure 1 is a schematic isometric view of a gear and clutch assembly;

Figure 2 is a schematic side elevation of the assembly of Figure 1; and

Figure 3 is a schematic sectioned side elevation of the gear and clutch assembly of Figures 1 and 2.

Detailed Description of the Preferred Embodiments

In the accompany drawings there is schematically depicted a gear and clutch assembly 10 to be used in a drill rig used for the purposes of forming bolt passages within which an anchor bolt may be inserted to engage a rock layer surrounding a mine tunnel. The assembly 10 may also be employed in the rig to tension the anchor bolt.

The assembly 10 includes a housing 11 including a gear housing 12 and a clutch housing 13. Fixed to the housing 11 are mountings 14 via which the assembly may be fixed to the remainder of the drill rig.

The assembly 10 includes an input shaft 15 that is driven by a motor, typically a hydraulic motor. The shaft 15 enters the housing 13 and has at its end extremity a flange 16. The flange 16 is engaged and supported by a bearing 17 that aids supporting the shaft 15 for rotation about the central rotational axis 18.

The flange 16 has a splined circular passage 19 that drives a clutch input shaft 20. The shaft 20 is part of a clutch assembly 21 that includes a drive flange (plate) 22 and a driven flange (plate) 23, and a pressure plate 24.

A spring or set of springs 25 is compressed against the plate 24 so as to urge the plate 24 toward to flange 23. The plate 24 is slidably mounted on the clutch input shaft 20 so as to be movable axially along the shaft 20.

The flange 23 has a plurality of apertures, within each aperture there is located a spherical element 26. Each element 26 is also located in a detent in the flange 23. Until a predetermined torque is exceeded, the flanges 22 and 23 rotate in unison so as to rotate at the same angular velocity. However when a predetermined torque is exceeded, the spherical elements 26 will leave the detents in the flange 23 so that the flange 22 can rotate at a greater angular velocity than the flange 23.

The abovementioned predetermined torque is determined by the compression forces applied to a spring 25.

A compression collar 27 is threadably mounted on the clutch input shaft 20, so that upon any relative angular movement between the collar 27 and the shaft 20, the collar

27 will move axially along the shaft 20 to increase or decrease the compression applied to the spring 25. Typically a bolt would engage the collar 27 to fix the collar 27 at the desired position on the shaft 20. The bolt and the collar 27 are accessible by means of apertures 29 in the housing 13. The shaft 28 is fixed to the flange 22 so as to drive the flange 22.

The spring 25 urges the pressure plate 24 against the spherical elements 26 to retain the spherical elements in the detents of the flange 23. Upon a predetermined torque being exceeded, the elements 26 will move out of their respective detents as the plate 24 is slidably mounted on the shaft 20.

A thrust bearing 29 transfers any axial load applied to the shaft 15 to the flange 23.

The flange 23, via a splined connection, drives the shaft 30. The shaft 30 has its lower end supported in the flange 23, and is supported at its upper end by a thrust bearing 31.

The shaft 30 drives a sun gear 41 that is meshed with three planetary gears 32 arranged at equal angles about the axis 18, and therefore the shaft 30. Each of the gears 32 is integrally formed with a shaft 33 and a further gear 34. Accordingly there are three gears 44.

Each of the shafts 33 is rotatably supported in a lower carriage 35 and an upper carriage 39 that are free to rotate about the axis 18 while permitting rotation of the gears 32 and 34.

The gears 34 are meshingly engaged with a ring gear 36 that is fixed to the housing 12 so as to be stationary. Accordingly rotation of the gears 32 will cause rotation of the gears 34 about their respective rotational axis 37 (also the axes of the shaft 33 and gears 32), and therefore rotation of the carriages 35 and 39 about the axis 18.

~~The upper carriage 35 is integrally formed with or provided with output shaft 38~~ that drives the associated drill bit.

The thrust bearing 31 is mounted in the upper carriage 35 so that any axial thrust applied to the shaft 15 will ultimately be applied to the output shaft 38.

In operation of the above described preferred embodiment, the shaft 15 will drive the shaft 38 at an increased torque, but at a reduced angular velocity. This will occur until

the torque applied to the shaft 15 exceeds a predetermined torque determined by the clutch 21. In that respect it should be appreciated the predetermined torque is adjustable by operation of the collar 27, that is the compressive force applied to the spring 25.

The flange 22 drives the flange 23, with the flange 23 then driving the shaft 30. The first set of planetary gears 32 are meshingly engaged with the sun gear 41 so as to be driven thereby. The first set of gears 32 drive the second set of planetary gears 34, with the gears 34 being meshingly engaged with the ring gear 36. Rotation of the gears 34 causes rotation of the carriages 35 and 39, with the upper carriage 39 being connected to the output shaft 38 so as to drive the shaft 38. Via the thrust bearings 29 and 31, axial forces applied to the shaft 15 are transferred to the shaft 38 so that the forces may be applied to a drill bit.

CLAIMS:

1. A gear and clutch assembly including:

an input shaft to be rotatably driven by a motor;

a clutch having an input and an output, the clutch input being driven by the input shaft to drive the clutch output so that the clutch input and output angularly rotate in unison until a predetermined torque is applied to the clutch input, with said clutch input then being able to rotate at a greater angled velocity than the clutch output when said predetermined torque is exceeded;

a sun gear;

a first set of planetary gears meshingly engaged with the first sun gear so as to be driven thereby;

a ring gear;

a second set of planetary gears, the second set of gears being meshingly engaged with the ring gear, with the second set of planetary gears being driven by the first set of planetary gears;

a carrier supporting the second set of gears so as to be rotatably driven thereby;

an output shaft, the output shaft being driven by the carrier; and wherein

the input shaft and the output shaft are operatively associated so that axial forces applied to the input shaft are transmitted to the output shaft.

2. The assembly of claim 1, wherein the input shaft and the output shaft have a common rotational axis.

3. The assembly of claim 1 or 2, wherein said first set of gears consists of three gears.

4. The assembly of claim 1, 2 or 3, wherein said second set of gears consists of three gears.

5. The assembly of any one of claims 1 to 4, wherein said assembly includes a housing, with said ring gear fixed to said housing so as to be stationary.

6. The assembly of any one of claims 1 to 5, wherein said clutch includes a first plate, the first plate being driven by the first input shaft;

a second plate, the second plate being drivingly connected to the first sun gear and having a plurality of detents, a plurality of rotatable elements, each element being located in a respective one of the detents, and a spring urging the elements into the detents that the first plate drives the second plate.

7. The assembly of claim 6, wherein the elements are located in apertures of the first plates, with the elements leaving the detents when said predetermined torque is exceeded so that the first plate can rotate at a greater angular velocity than the second plate.

8. The assembly of any one of claims 1 to 7, wherein the clutch includes a collar, the collar being mounted on the clutch input shaft so as to be movable axially therealong, a pressure plate, the pressure plate being located so that the first plate is located between the second plate and pressure plate, with the pressure plate engaged with the elements, and wherein said spring located between the collar and pressure plate to urge the pressure plate against the elements to aid in retaining the elements in the detents.

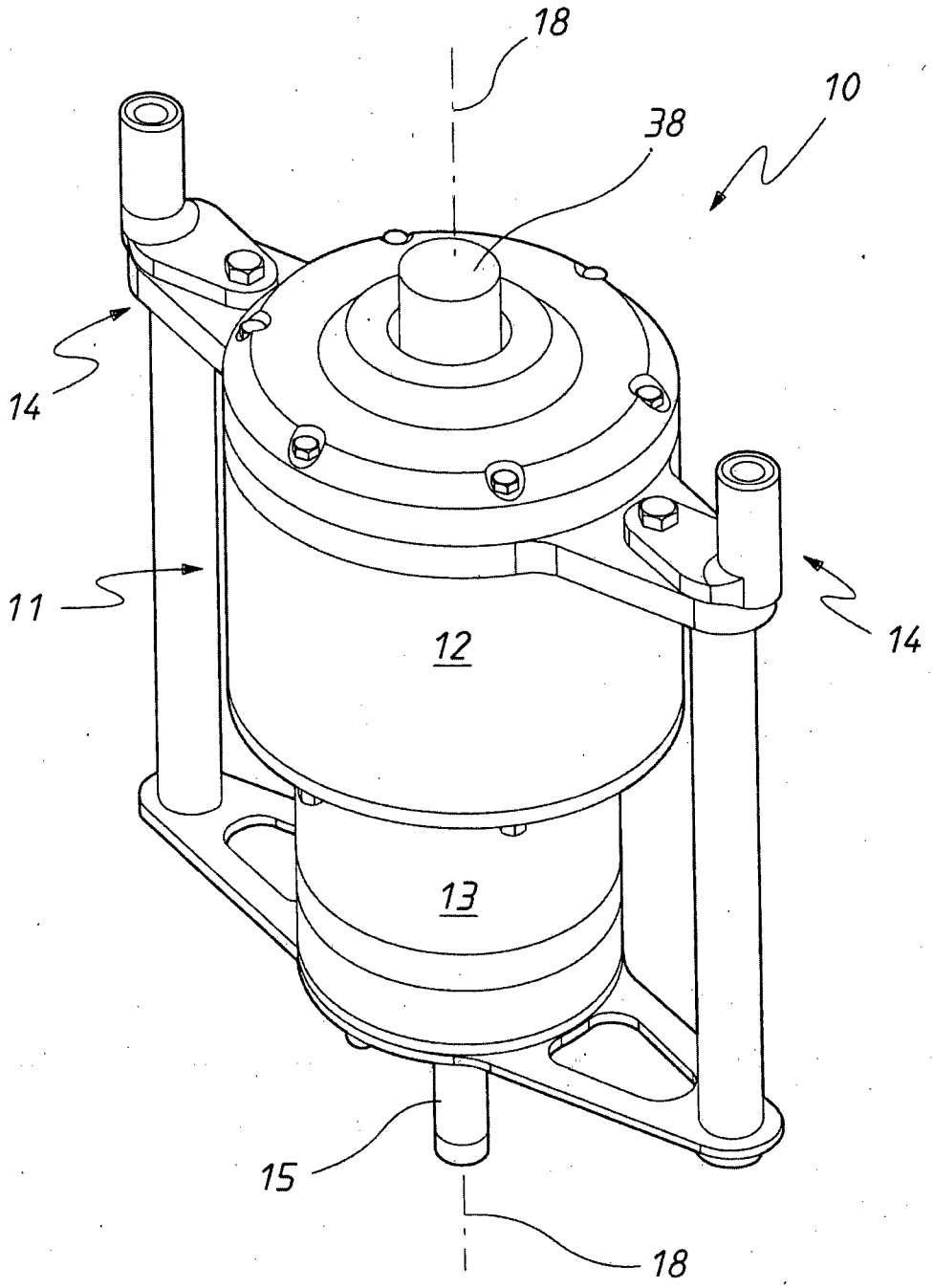

FIG. 1

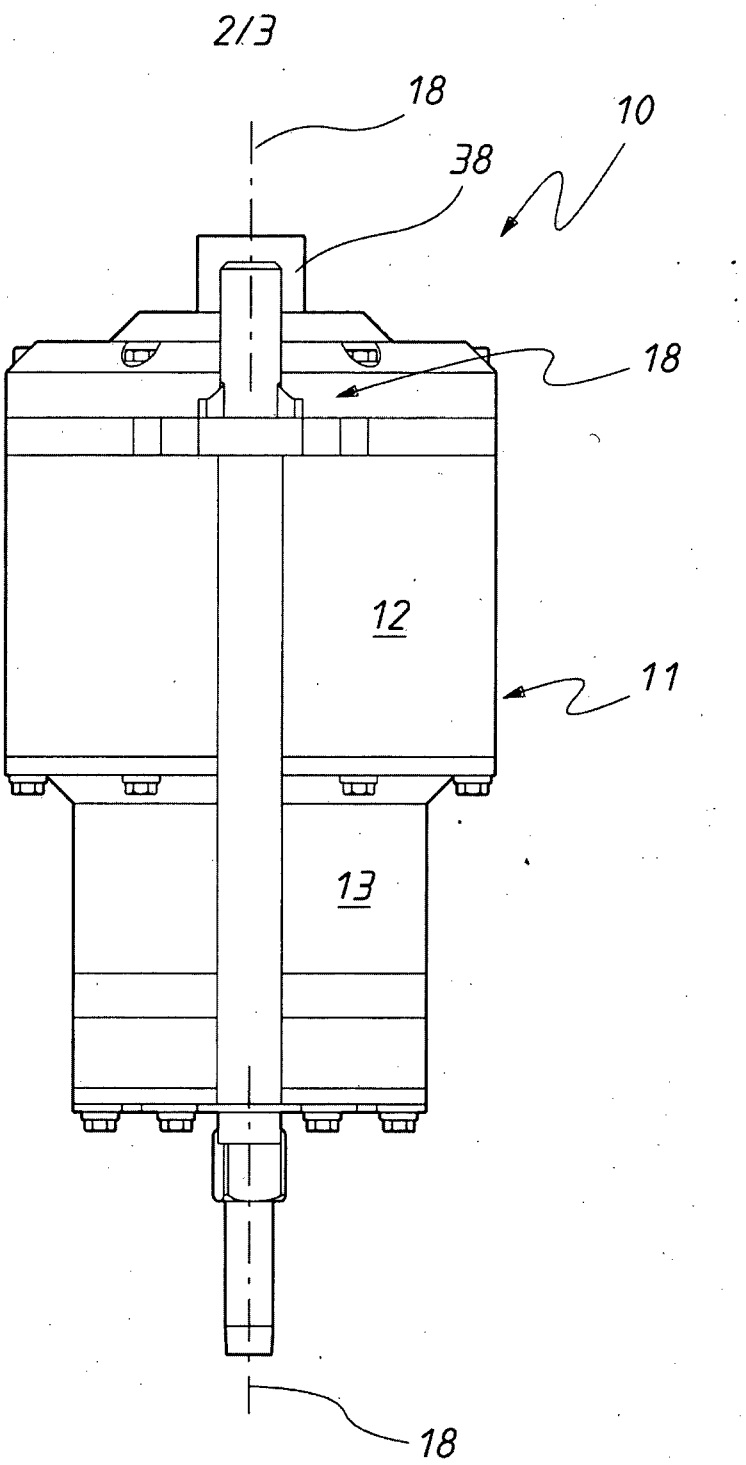

FIG.2

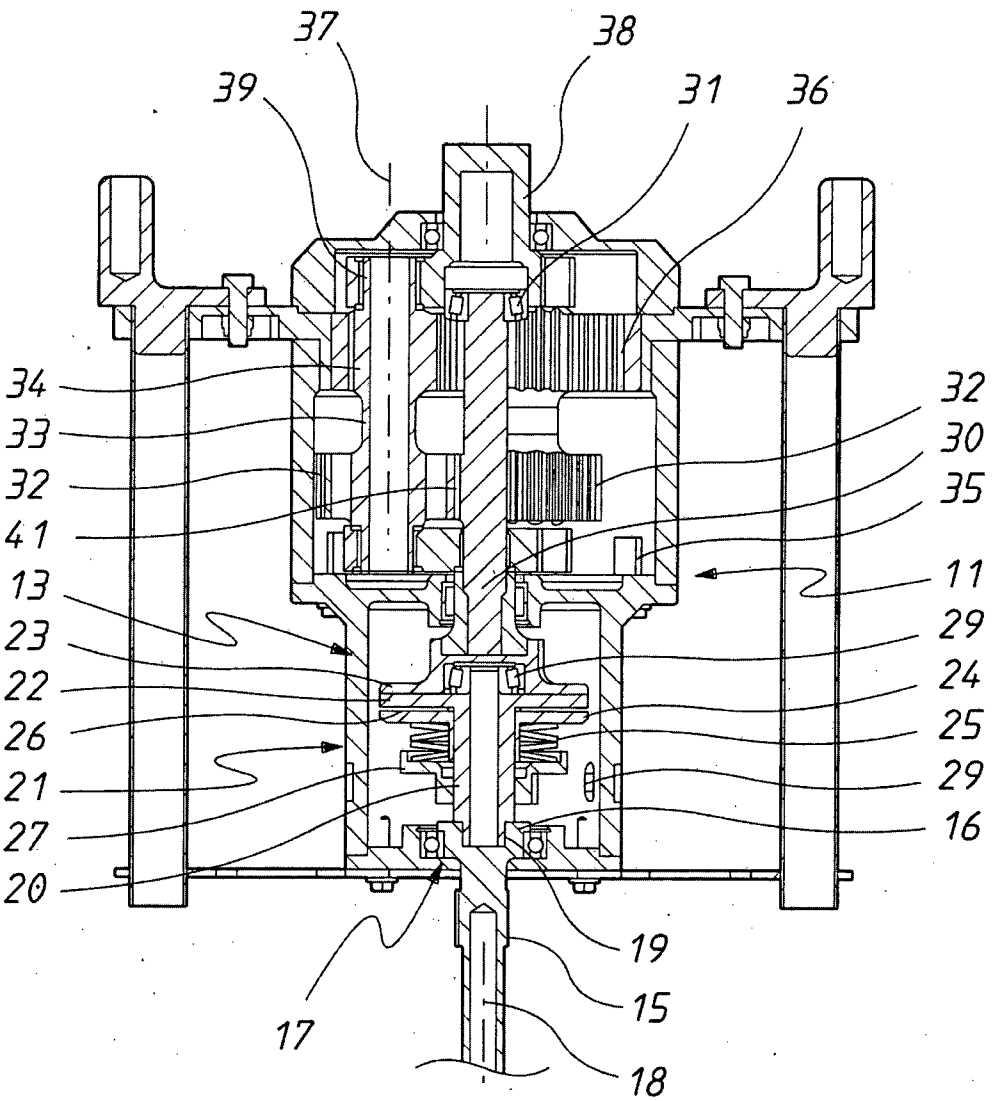
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FIG.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2012/000129

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

F16D 13/38 (2006.01) ***F16D 13/70*** (2006.01) ***F16H 3/56*** (2006.01) ***E21B 3/00*** (2006.01)
F16H 1/28 (2006.01) ***F16D 13/46*** (2006.01) ***F16H 1/32*** (2006.01)

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)

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)
EPODOC & WPI: IPC, ECLA: F16D 13/22, 13/38, 13/40, 13/42, 13/44, 13/46, 13/48, 13/50, 13/70, 23/08, E21B 3/-, 7/02, F16H 1/28, 1/32, 3/56; and keywords (gear, clutch, planetary gear, two, second, torque, increase, exceed) and similar terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	JP 2002-13598 A (OKAMURA MFG CO LTD) 18 January 2002. English abstract retrieved from EPODOC database.	
X	Abstract, figs. 1-3, Machine translation of the whole document	1-5
Y	Abstract, figs. 1-3, Machine translation of the whole document	6-8
	GB 2069073 A (HILTI AKTIENGESELLSCHAFT) 19 August 1981	
Y	Abstract, figs. 1-2, pages 1-2	6-8

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"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
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 April 2012	4 April 2012
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. +61 2 6283 7999	Authorized officer **Kumar KC** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6225 6156

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/AU2012/000129

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
JP	200213598	NONE					
GB	2069073	DE	3004991	ES	264745U	FR	2475658
		JP	56120828	NL	8006796	SE	8100461

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX