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(71) Applicant *(for all designated States except US)*: **EXODUS R & D PTY LTD** [AU/AU]; 10 Goodall Parade, Mawson Lakes, South Australia 5095 (AU).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **FLENCHE, George** [AU/AU]; 5 Dyer Street, Elizabeth Downs, South Australia 5113 (AU).

(74) Agent: **LESICAR PERRIN**; 58 Rundle Street, Kent Town, South Australia 5067 (AU).

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(54) Title: AN ARRANGEMENT FOR CONVERTING THE OUTPUT OF A MOTOR TO VARIABLE OSCILLATABLE DRIVE OF A SHAFT FOR A PUMP AND/OR COMPRESSOR AND/OR OTHER DEVICES ETC

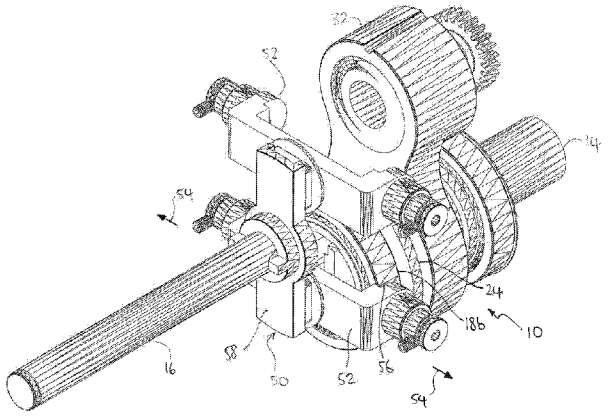

Figure 5

(57) Abstract: The present invention relates to an improved means of being able to translate the uni- directional constant speed motor into an oscillating motion in order to rotate an output shaft back and forth along a stable axis.

AN ARRANGEMENT FOR CONVERTING THE OUTPUT OF A MOTOR TO VARIABLE OSCILLATABLE DRIVE OF A SHAFT FOR A PUMP AND/OR COMPRESSOR AND/OR OTHER DEVICES ETC.

FIELD OF THE INVENTION

This invention relates to a motion converting system and, more particularly, to a drive shaft driven at fairly constant uni-directional rotatable velocity and a driven shaft oscillatably rotatable in response to the rotation of the drive shaft and a coupling mechanism to vary the rotational oscillation between the drive and the driven shafts to generate a means and a technique which provides high torque and allows the torque to be traded if required for the speed of the motor at a given power level, and/or is able to provide continuous output torque from the motor when the oscillatable drive shaft is driving a pump and/or compressor and other devices.

BACKGROUND OF THE INVENTION

Conventionally oscillation motors are useful in a variety of applications that involve limited rotation response to an electric current such applications could be used in pumps, compressors, washing machines and even on more intricate electronic and electrical applications such as facsimile machines, optical scanners, DVD players and so forth.

For the most part, as the person skilled in the art would be aware, the oscillation rotor is driven by torque produced by interaction between an electric drive current and a magnetic field. The rotors of such motors conventionally have either a rigid radial support system such as is provided with bearings or a torsion shaft support system in which one or both ends of the rotor are secured to an axially extending torsion shaft or shafts.

One of the main disadvantages of using an electric motor with oscillating rotation at a fixed rotational speed is that continuous output torque will not be provided for if changes in the variable ratio coupling between the output shaft and the input motor are required.

Hence it is not possible at present to effectively convert the output of a constant speed motor to a variable oscillating drivable output shaft without the loss of torque.

Therefore there remains a need to be able to provide continuously variable oscillating transmission to an output drivable shaft from a motor wherein some type of coupling

arrangement between the motor and the output shaft will be able to provide a high efficiency mechanism free of electrical and electronic control and still be able to continuously sustain output torque even during alternating oscillation requirements thereby, if required, allowing a technique wherein the high torque benefits of such an arrangement can therefore allow the torque to be traded for speed at a given power level and so forth.

It is therefore an object of the present invention to overcome at least some of the aforementioned problems or to provide the public with a useful alternative.

SUMMARY OF THE INVENTION

Therefore in one form of the invention there is proposed A drive arrangement characterised by:
a drive shaft driven at constant uni-directional rotatable velocity;
an output shaft that is configured to be oscillatably rotatable; and
a mechanical means of converting said uni-directional rotatable motion of the drive shaft into oscillatable rotatation of said output shaft.

Preferably the arrangement further includes a mechanical means of altering the angle of oscillation of said output shaft.

In preference said mechanical means of converting motion includes a bearing unit journalled around said drive shaft and rotatable therewith, and a first cam means that is rotatable with said drive shaft and moveable along the drive shaft axis.

Preferably said bearing unit is moveable to an eccentric position relative to said drive shaft by way of movement of said first cam means along the drive shaft axis.

Preferably said first cam means is in the form of at least one cam plate including a slot with which said bearing unit is engaged such that movement of said cam plate along said drive shaft causes the bearing unit to move radially outwardly from said shaft and hence become eccentric.

In preference said mechanical means of converting the linear motion of the eccentric bearing unit into oscillatory motion of the output shaft includes a body associated with the eccentric bearing unit, said body made to move in a linear back and forth motion.

Preferably said body includes a pivotable extension to which said output shaft is fixed such that the output shaft extends along a stable axis that is spaced apart from the pivot axis of the

extension, the linear motion of the body thus providing for the oscillatory motion of the output shaft.

Preferably said mechanical means of converting motion includes a second cam means adapted to counterbalance the effect of the eccentric bearing unit.

In preference said second cam means is in the form of at least one second cam plate adapted to also rotate and journal around said drive shaft and be engageable with said first cam slots such that the second cam plate is moveable to an eccentric position in an opposite direction to said bearing unit.

Advantageously said mechanical means of converting motion further includes a rotatable worm arrangement disposed in a substantially parallel relationship with said drive shaft and whereby said first cam means is moveable in opposite directions along the drive shaft axis by way of clockwise or anticlockwise rotation of a rotatable worm associated therewith.

In a further form of the invention there is proposed a drive arrangement adapted to oscillatory rotate a drivable shaft for an application such as a pump and/or compressor, said arrangement including:

a main housing block containing;

a motor driven shaft;

a motion transferring coupling unit adapted to engage the motor driven shaft and an output oscillating drive shaft;

said coupling unit including a threaded bore and a threaded worm, said threaded worm adapted to vertically displace up or down said threaded bore in conjunction with the coupling unit along a length of said motor driven shaft;

said coupling unit further including a coupling bearing unit of radial dimensions comparable to rest upon said motor driven shaft and having opposing coupling bearing unit plate along an inner rim or shoulder of said coupling bearing unit;

motor driven shaft cam plate positioned about said motor driven shaft adapted to be moveable along a length of said motor driven shaft by coupling unit plates that are located on the inner rim or shoulder of said bearing unit contained within the coupling unit;

wherein said motor driven shaft cam plates include angled slots that engage an orthogonal moving guide plate and a balance cam plate;

a bearing unit arrangement that consists of two bearing units that are positioned on either side of

the coupling unit and are adapted to provide bearing load support and rotatability to the motor driven shaft;

wherein one of the bearing units of the bearing arrangement resting upon the motor driven shaft is in relative movement with the balanced cam plate such that any vertical movement of the bearing unit along the length of the motor driven shaft will be in vertical opposite linear direction to the balance cam plate in order to maintain equal mass and balance for the drive arrangement; such that when the threaded worm is rotated in a clockwise or anti- clockwise direction it is able to extend or reduce the degree of oscillation of the motion transfer between the motor driven shafts and the output oscillatable drive shaft such that when the worm thread rotates this enables the bearing within the coupling unit which has the coupling bearing unit plates engaged then to move the motor driven shaft cam plates along the axis of the motor driven shaft such that the motor driven shaft cam plates due to their angled slots which engage with the lateral moving guide plates and the balanced cam plate results in one of the bearing units of the bearing arrangement positioned about the coupling unit on the motor driven shaft which provides the bearing unit to become eccentric to the main axis of the motor driven shaft wherein once the bearing unit becomes eccentric, the eccentric arrangement is then able to provide for linear movement of a body member wherein said body member is adapted to engage a hinging point upon the drivable oscillatable output shaft.

An advantage of such an arrangement is that for the first time it is now possible to provide a novel and improved means of being able to translate the uni-directional constant speed motor into an oscillating motion in order to rotate an output shaft back and forth along a stable axis.

Advantageously the establishment of the eccentric configuration in this drive arrangement through the unique use of the coupling unit which is able to vertically move up and down by virtue of the threaded bore and worm thread wherein the vertical alignment then interacts with a series of plates and cams which is able to slightly offset the bearing unit establishing the eccentric configuration, means that this eccentric movement can then control the degree of oscillation, back and forth movement once engaged with an output driveable shaft.

Given that this technique provides high torque that is constant/consistent regardless of the degree and level of oscillation, advantageously the size of the motor, the speed and the power supply can all be traded because of the ability to maintain output torque regardless of the degree of oscillation required during the application in environments in the use of devices such as pumps and compressors and other devices etc.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate several implementations of the invention and, together with the description, serve to explain the advantages and principles of the invention. In the drawings:

Figure 1 is a schematic representation, or interpretable as an exploded view to some degree of the parts that make up the componentry associated and connected to those features that are driveable by an input source such as but not confined to an electric motor;

Figure 2 is a schematic or interpretable to some degree as an exploded representation showing the features and parts that make up the coupling unit which engages those parts referred to in Figure 1 of which will be described in greater detail hereafter;

Figure 3 shows the combination of Figures 1 and 2 together in their operable configuration.

Figures 4a, 4b, and 4c show a series of sketches of the componentry making up a preferred embodiment of the drive arrangement of this invention showing the various states of the system providing for neutral or no transfer of motion from the motor driven shaft to the oscillatable output drive shaft, the configuration of the drive arrangement when forward movement is provided for and then finally in Figure 4c when reverse operation is presented.

Figure 5 is a perspective view of how one preferred embodiment of this drive arrangement may look and one is attached to an oscillatable driveable output shaft.

Figure 6 is a perspective view of the body member engaging the output drivable shaft.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following detailed description of the invention refers to the accompanying drawings. Although the description includes exemplary embodiments, other embodiments are possible, and changes may be made to the embodiments described without departing from the spirit and scope of the invention. Wherever possible, the same reference numbers will be used throughout the embodiments and the following description to refer to the same and like parts.

The present invention relates to a drive arrangement 10 adapted to rotate a drivable shaft in an oscillatory motion for an application such as a pump and/or compressor (not shown).

Referring to the drawings now in greater detail wherein provided in Figure 1 is an exploded view of parts 12 associated with a motor driven shaft shown generally as 14.

As a person skilled in the art will appreciate the motor driven shaft 14 most likely would extend from an electric motor (not shown), and for the most part the purpose of the electric motor would be to have its constant speed rotation to be able to be translated into oscillatable rotatable movement of an output shaft 16 shown in later drawings. Conversion of the output 14 of the constant speed motor to the variable oscillatable drive of the output shaft 16, say for example to a pump and/or compressor, is achieved through the use of a highly efficient mechanism as will be explained in greater detail hereafter that will see continuous uninterrupted output torque despite the fact that the output shaft 16 is oscillating and can be adjusted to alternate over varying degrees.

As part of this arrangement 12 there is also a motor drive shaft bearing unit arrangement which includes bearing units 18a and 18b, two motor driven cam plates shown generally as 20, rod 22 and as follows balance cam plates 24, as well as guide cam plates 26. Circlips 28a and 28b function to hold the relevant componentry as shown in Figure 1 in their respective fastened and secured alignment about the motor driven shaft 14.

The bearing unit 18b associated with the main drive shaft 14 is engaged by the motor driven shaft cam plates 20 which are positioned on opposing sides of shaft 14a to rest up against part of the inner rim or shoulder of the bearing unit 18b.

The guide cam plates 26 like the motor driven shaft cam plates 20 can rest either side of 14b and when configured as shown in Figure 3 will rest up against the inner shoulder or rim of bearing unit 18b.

Figure 2 represents the componentry 30 that makes up for the most part the coupling unit which includes its main housing block, both generally referred to as 32, having a threaded bore hole 34 which works in communication with a threaded worm 36. The housing block further includes a second bore hole 38 for receiving another bearing unit 40 associated with the motor driven shaft 14 as will become apparent.

It is envisaged that once the coupling unit 32 is engaged with the motor driven shaft and the various other components described in Figure 1 that they will all be contained within a much larger secure housing block (not shown) and it will in fact be movement of the threaded worm 36

that will see vertical upward or downward displacement of the coupling unit 32, that is, movement of the coupling unit 32 in a direction parallel to the axis of the drive shaft 14.

Hence the threaded worm 36 will not simply thread its way through the threaded bore 34 of the coupling unit 32 but will in fact provide the means in which the coupling unit 32 can vertically move up and down to which as discussed shortly hereafter this ability to move vertically up and down and interaction with the componentry discussed in Figure 1 will see corresponding movement of the driven shaft cam plates 20 and slight radial offsetting of bearing unit 18b. The bearing unit 18b is thus caused to move in an eccentric pattern about the main drive shaft 14 and provides a means in which the linear movement against the eccentric rotation can then be translated onto an output shaft 16 to see that output shaft driven in a backward and forward oscillation. The way in which this is achieved is described in more detail below. Use of the balance cam 24 in combination with the bearing unit 18b provides an eccentric configuration to which vibration is avoided as is also described in more detail below.

As also shown in Figure 2 there is a circlip 42 along with a coupling unit bearing 44 which is also engaged by a coupling unit bearing cam plate 46. It is these components which interact with some of the main drive shaft components 12.

Referring now to the arrangement 10 of the present invention shown in Figure 3 where in summary it can be best described that items 28a, 18a, 18b, 20, 22, 24 and 26 rotate via an input source such as but not confined to an electric motor. The threaded worm 36 is what is best described as really a controlling thread. It is considered a controlling thread because of its ability to mechanically rotate the control thread 34 in a clockwise or anti-clockwise direction and thereby shift the coupling unit 32 in a direction parallel with the main shaft axis. This means that you are essentially altering the vertical movement of the coupling unit 32 which in turn moves items 44, 46 and hence motor driven cam plates 20 and allows items 44 and 46 to be paused at a particular location along the shaft 14. It will become apparent that this movement is what allows the oscillation angle of shaft 16 to be altered.

The motor driven shaft cam plates 20 include angled slots 48 which slide with the guide cam plates 26 in opposing vertical direction of the bearing unit 18b of the motor driven shaft arrangement and also work under a counterbalance with balance cam plate 24.

As can be envisaged from Figure 3 and also with the assistance of Figures 4a, 4b and 4c the bearing unit 18b and balance cam plate 24 are fixed in position and can only move vertically up

and down in the direction of arrows shown. Bearing unit 18b and balance cam plate 24 move vertically in opposite directions providing equal mass and balance and thereby removing any vibration possibilities that can result from the fact that eccentric rotation has been established by the offsetting of bearing 18b by the movement of the threaded worm 36. Extension or retraction of the coupling unit 32 depends on whether the movement of the threaded worm 36 was clockwise or anti-clockwise in control.

One should thus now realize that in moving the coupling unit 32 in one direction causes the motor driven cam plates 20 to move in the same direction and, by way of slideable engagement between the angled slots 48 of the cam plates 20 and each of the fixed balance cam plate 24 and fixed bearing unit 18b, the cam plate 24 and bearing unit 18b are made to move in a direction radially out from the drive shaft 14 in opposite directions to one another. It is this linear motion of the bearing unit 18b which can then be translated to oscillatory motion of the driven shaft 16 as will be described.

Figure 4b shows the balance cam plate 24 moving opposite to the bearing unit 18b providing a counter-balance effect wherein the motor driven shaft cam plates 20 each positioned on one side of 14a are moved by the coupling unit along the axis, and this moves the balance cam plate 24 to move in the opposite direction to the bearing unit 18b.

Figure 4c simply shows the configuration provided for in Figure 4b but this time in reverse rather than with the forward orientation.

It is to be understood that the sliding interaction between the angled slots and the respective balance cam plates 24 and bearing unit 18b can be achieved by any known suitable means. The present invention is not intended to be limited to any one type of bearing, any one method of joining the components together or any one method of allowing for the components to interact and move relative to each other.

Figure 5 is simply a perspective view showing an image looking down into the arrangement 10 shown with coupling unit 32 and its relationship to the motor driven shaft 14 and also the output shaft 16 to which the coupling unit allows motion transfer of the continuous uni-directional rotation of electric motor to an oscillating back and forth rotation of the output shaft 16.

There is shown the addition of a body member 50 to the arrangement 10 which has associated therewith the output shaft 16. The body member 50 includes a first portion 52 that is fixed but

linearly moveable in the direction of arrows 54. This portion includes shoulders 56 between which extends the bearing unit 18b. Once bearing unit 18b moves, this causes it to be eccentric to the main shaft 14 and by way of abutment with shoulders 56 causes the first portion 52 to also move linearly back and forth in the direction of arrows 54.

The body member 50, which is shown individually in Figure 6, further includes a second portion 58 pivotably connected to the first portion, the second portion 58 including the driven shaft 16 disposed and fixed a spaced distance away from the pivot axis of the second portion 58. The skilled addressee would realize that if the driven shaft 16 is fixed along a stable axis, linear movement of the first portion will result in rotational oscillatory motion of shaft 16. The output shaft 16 is thus able to rotatably oscillate back and forth to the degree in which the first portion 52 of the body member 50 moves in its linear direction. The output shaft 16 could thus be adapted to form part of a pump or compressor or any other device or arrangement that requires such movement.

Also shown in Figure 5 is an additional linearly moveable portion disposed above the output shaft 16 which in the embodiment shown would move linearly back and forth as per the lower portion but in the opposite direction. Whilst not required in causing the output shaft 16 to oscillate, it acts as a stabiliser. It is to be understood that the first and second portions of the body member 50, whilst being pivotably moveable with respect to one another, may also be made moveable such that the distance between the axis of rotation of shaft 16 and the pivot axis of the second portion is adjustable.

The benefits of the present invention should now be apparent in that it provides a novel and improved means of being able to translate the uni-directional constant speed motor into an oscillating motion in order to rotate an output shaft back and forth along a stable axis.

The arrangement provides coupling between an oscillatable output shaft and an input motor through the use of a mechanical threaded worm which is able to adjust the degree of oscillation required of the output oscillatable drive shaft, thereby providing a highly efficient mechanism with continuous output torque provided even by altering the level of required oscillation of the output shaft when it is deflected back and forth into its required operation.

While in the past motors have used a rigid bearing support system that require an electronic control for motion transferring between the constant unidirectional rotation and oscillation, these arrangements are fraught with disadvantages not the least on cost of construction and their

limited life, as they are particularly subject to failure when used in corrosive environments and they also tend to exhibit significant hysteresis characteristics due to metal to metal contact.

Further advantages and improvements may very well be made to the present invention without deviating from its scope. Although the invention has been shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope and spirit of the invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices and apparatus.

In any claims that follow and in the summary of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprising" is used in the sense of "including", i.e. the features specified may be associated with further features in various embodiments of the invention.

CLAIMS

1. A drive arrangement characterised by:
   a drive shaft driven at constant uni-directional rotatable velocity;
   an output shaft that is configured to be oscillatably rotatable; and
   a mechanical means of converting said uni-directional rotatable motion of the drive shaft into oscillatable rotatation of said output shaft.

2. A drive arrangement as characterised in claim 1 further including a mechanical means of altering the angle of oscillation of said output shaft.

3. A drive arrangement as characterised in claim 1 or claim 2 wherein said mechanical means of converting motion includes a bearing unit journalled around said drive shaft and rotatable therewith, and a first cam means that is rotatable with said drive shaft and moveable along the drive shaft axis.

4. A drive arrangement as characterised in claim 3 wherein said bearing unit is moveable to an eccentric position relative to said drive shaft by way of movement of said first cam means along the drive shaft axis.

5. A drive arrangement as characterised in claim 4 wherein said first cam means is in the form of at least one cam plate including a slot with which said bearing unit is engaged such that movement of said cam plate along said drive shaft causes the bearing unit to move radially outwardly from said shaft and hence become eccentric.

6. A drive arrangement as characterised in claim 4 or claim 5 wherein said mechanical means of converting the linear motion of the eccentric bearing unit into oscillatory motion of the output shaft includes a body associated with the eccentric bearing unit, said body made to move in a linear back and forth motion.

7. A drive arrangement as characterised in claim 6 wherein said body includes a pivotable extension to which said output shaft is fixed such that the output shaft extends along a stable axis that is spaced apart from the pivot axis of the extension, the linear motion of the body thus providing for the oscillatory motion of the output shaft.

8. A drive arrangement as characterised in any one of claims 5-7 wherein said mechanical means of converting motion includes a second cam means adapted to counterbalance the effect of the eccentric bearing unit.

9. A drive arrangement as characterised in claim 8 wherein said second cam means is in the form of at least one second cam plate adapted to also rotate and journal around said drive shaft and be engageable with said first cam slots such that the second cam plate is moveable to an eccentric position in an opposite direction to said bearing unit.

10. A drive arrangement as characterised in claim 8 or claim 9 wherein said mechanical means of converting motion further includes a rotatable worm arrangement disposed in a substantially parallel relationship with said drive shaft and whereby said first cam means is moveable in opposite directions along the drive shaft axis by way of clockwise or anticlockwise rotation of a rotatable worm associated therewith.

11. A drive arrangement adapted to oscillatory rotate a drivable shaft for an application such as a pump and/or compressor, said arrangement including:
a main housing block containing;
a motor driven shaft;
a motion transferring coupling unit adapted to engage the motor driven shaft and an output oscillating drive shaft;
said coupling unit including a threaded bore and a threaded worm, said threaded worm adapted to vertically displace up or down said threaded bore in conjunction with the coupling unit along a length of said motor driven shaft;
said coupling unit further including a coupling bearing unit of radial dimensions comparable to rest upon said motor driven shaft and having opposing coupling bearing unit plate along an inner rim or shoulder of said coupling bearing unit;
motor driven shaft cam plate positioned about said motor driven shaft adapted to be moveable along a length of said motor driven shaft by coupling unit plates that are located on the inner rim or shoulder of said bearing unit contained within the coupling unit;
wherein said motor driven shaft cam plates include angled slots that engage an orthogonal moving guide plate and a balance cam plate;
a bearing unit arrangement that consists of two bearing units that are positioned on either side of the coupling unit and are adapted to provide bearing load support and rotatability

to the motor driven shaft;

wherein one of the bearing units of the bearing arrangement resting upon the motor driven shaft is in relative movement with the balanced cam plate such that any vertical movement of the bearing unit along the length of the motor driven shaft will be in vertical opposite linear direction to the balance cam plate in order to maintain equal mass and balance for the drive arrangement;

such that when the threaded worm is rotated in a clockwise or anti- clockwise direction it is able to extend or reduce the degree of oscillation of the motion transfer between the motor driven shafts and the output oscillatable drive shaft such that when the worm thread rotates this enables the bearing within the coupling unit which has the coupling bearing unit plates engaged then to move the motor driven shaft cam plates along the axis of the motor driven shaft such that the motor driven shaft cam plates due to their angled slots which engage with the lateral moving guide plates and the balanced cam plate results in one of the bearing units of the bearing arrangement positioned about the coupling unit on the motor driven shaft which provides the bearing unit to become eccentric to the main axis of the motor driven shaft wherein once the bearing unit becomes eccentric, the eccentric arrangement is then able to provide for linear movement of a body member wherein said body member is adapted to engage a hinging point upon the drivable oscillatable output shaft.

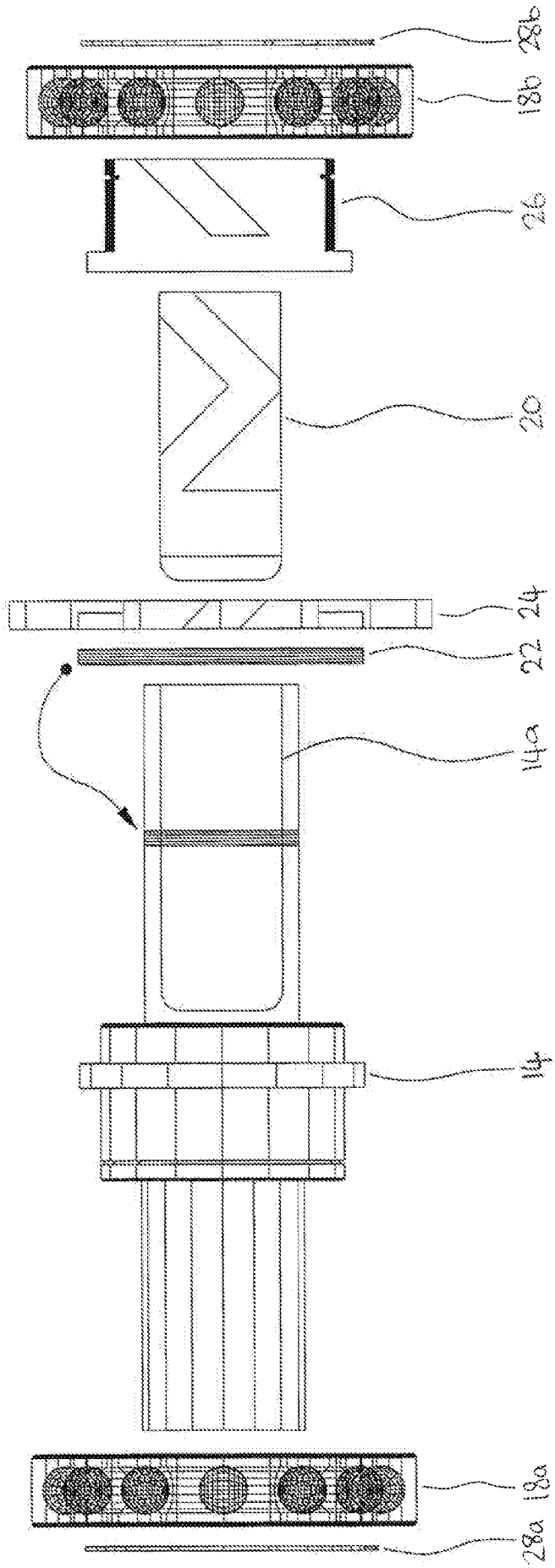

Figure 1

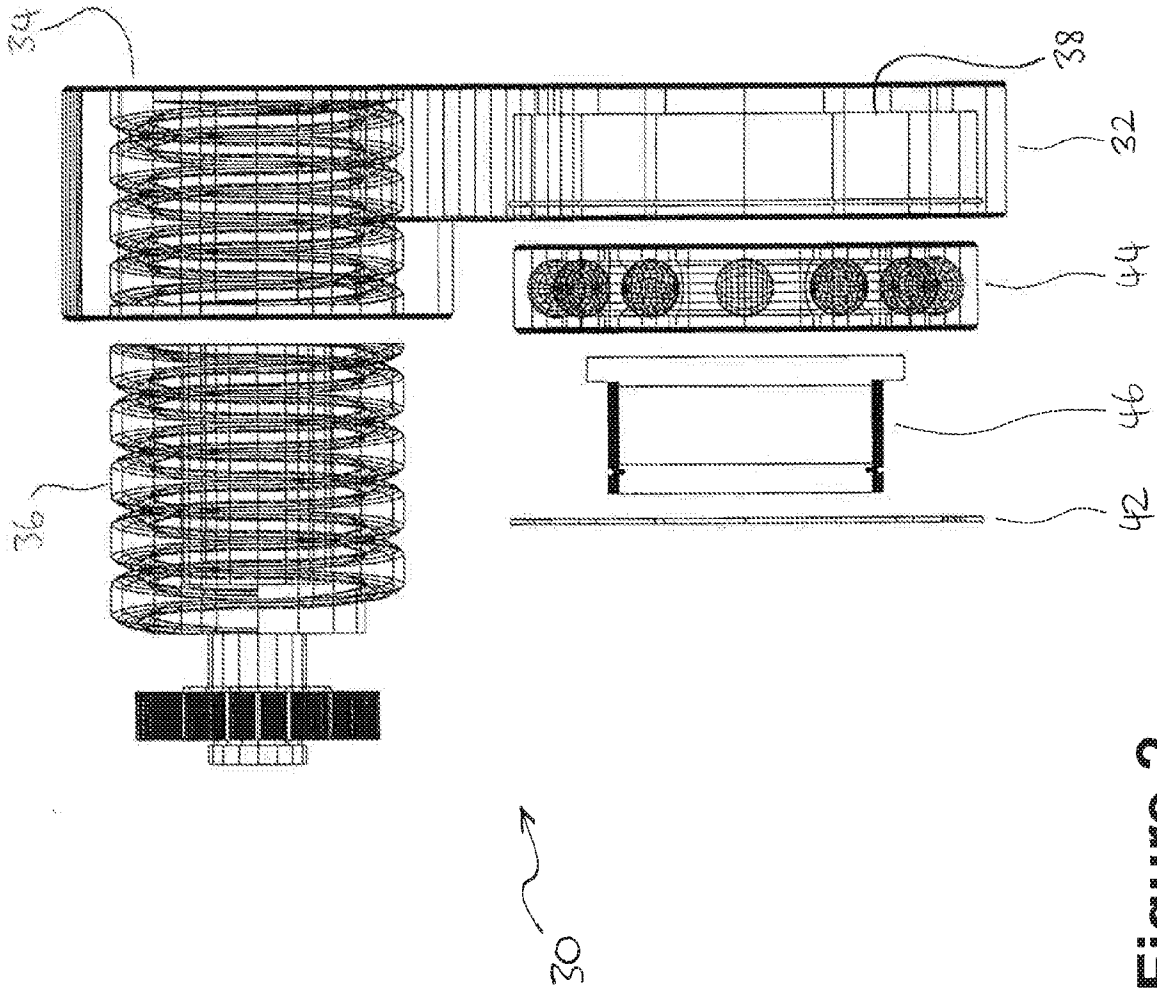

Figure 2

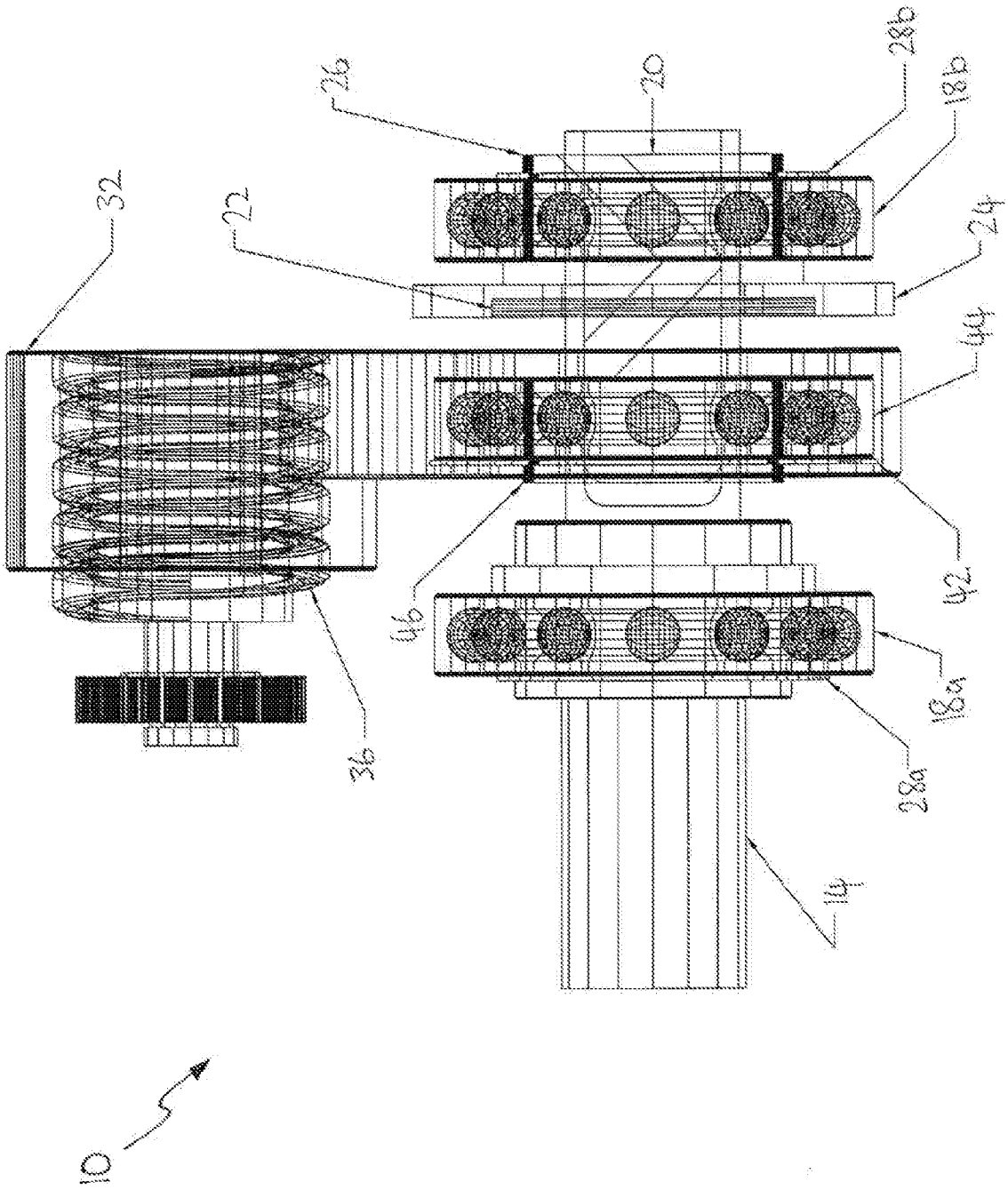
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Figure 3

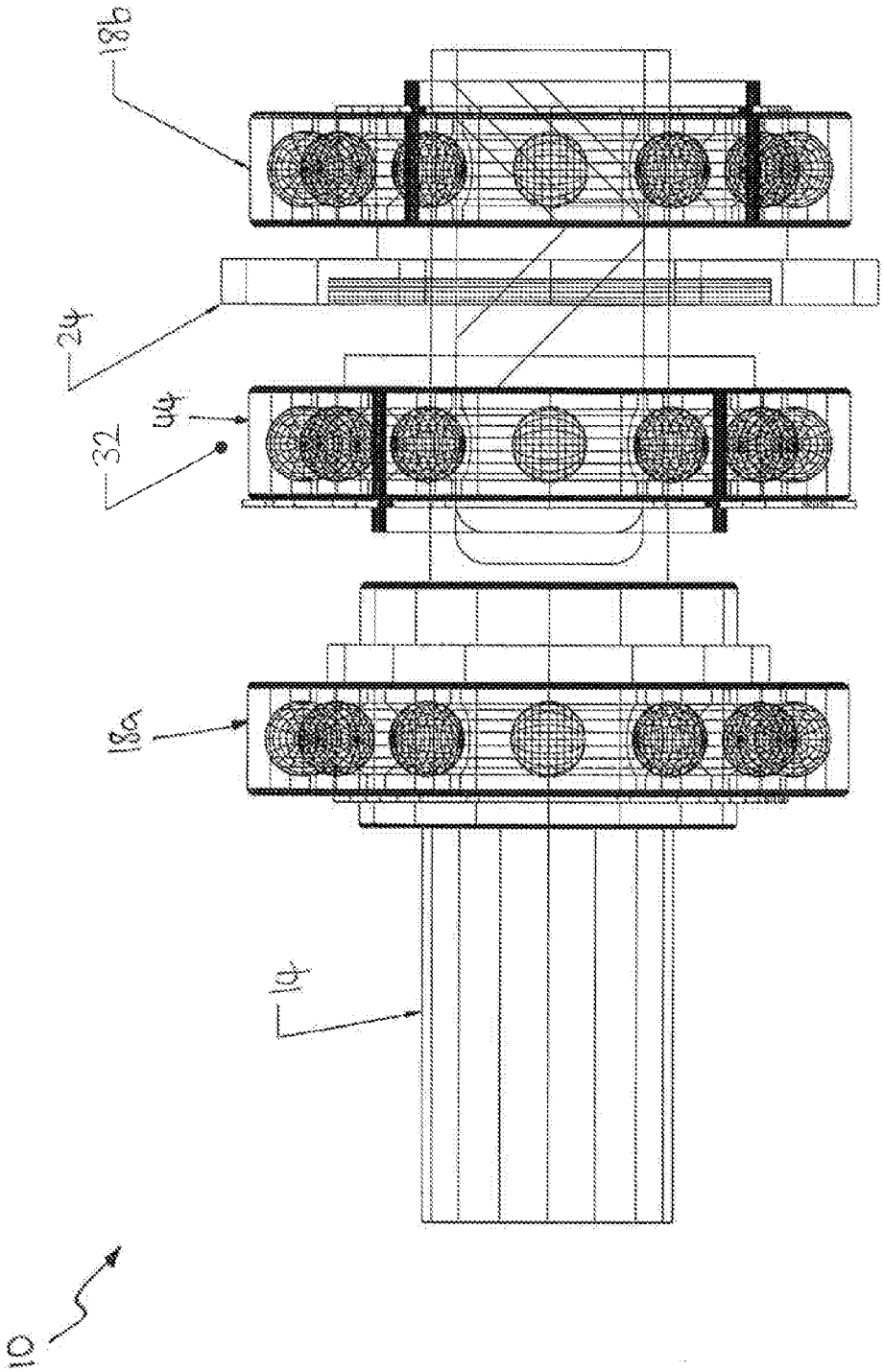

Figure 4a

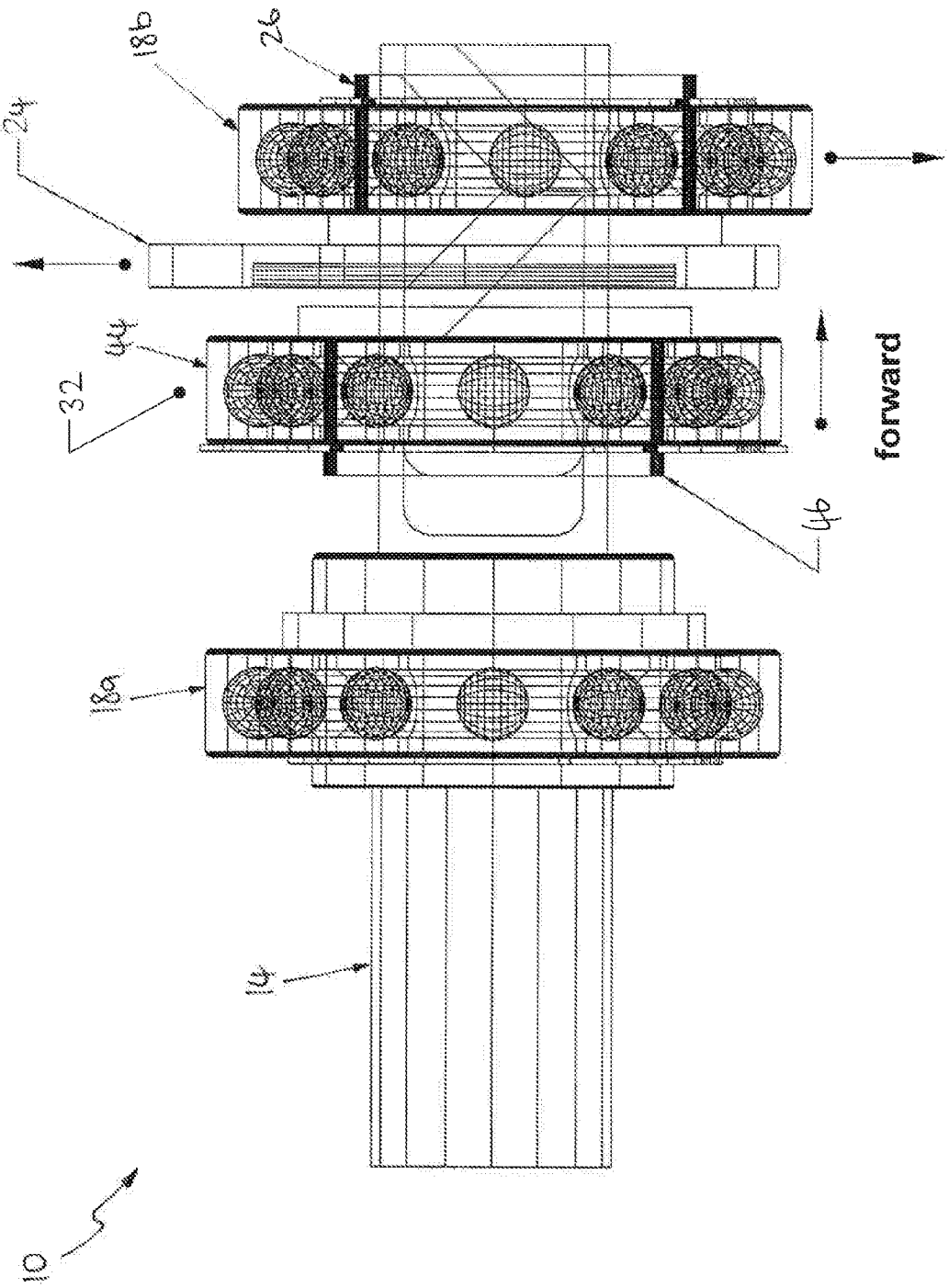

Figure 4b

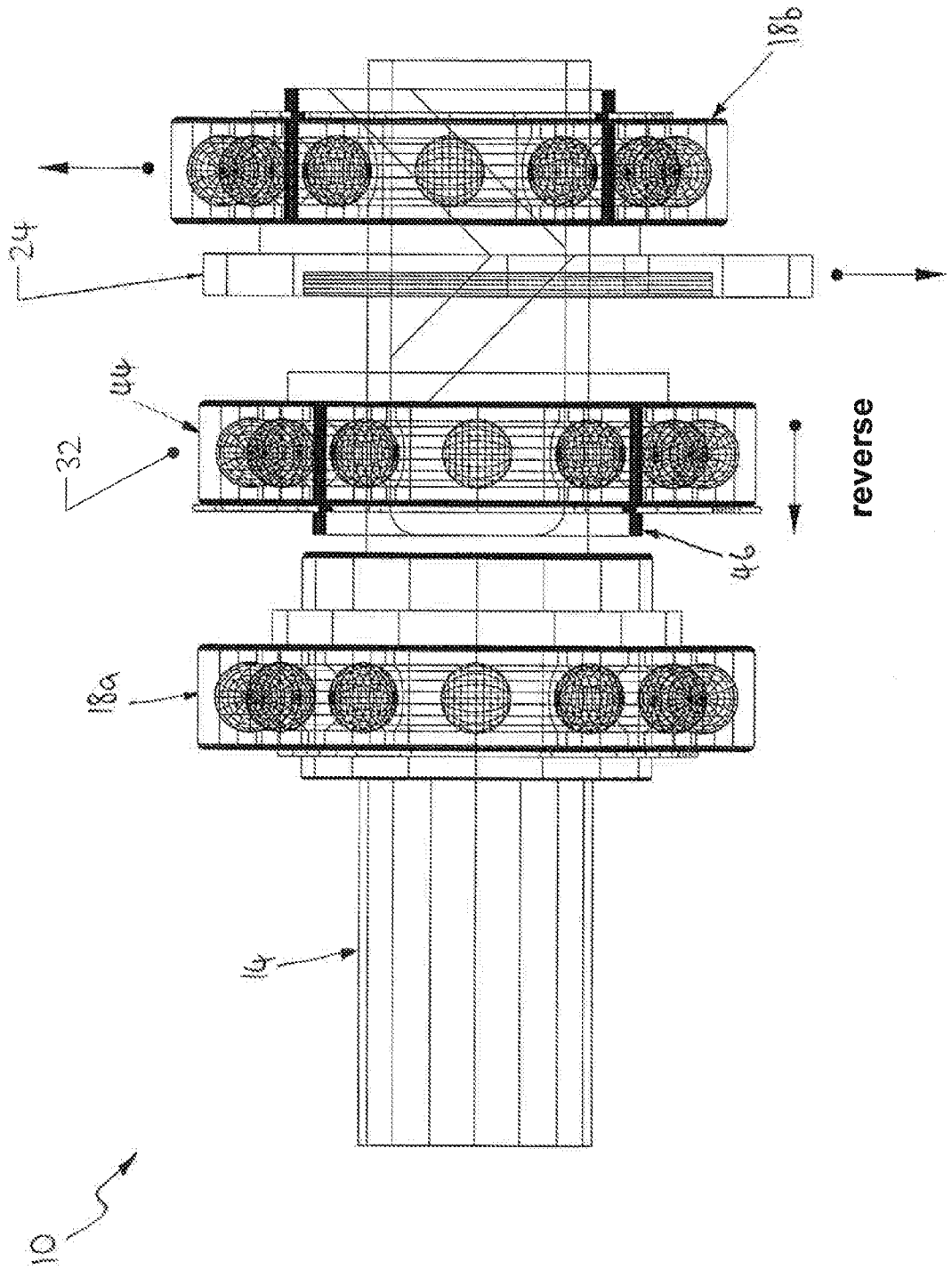

Figure 4c

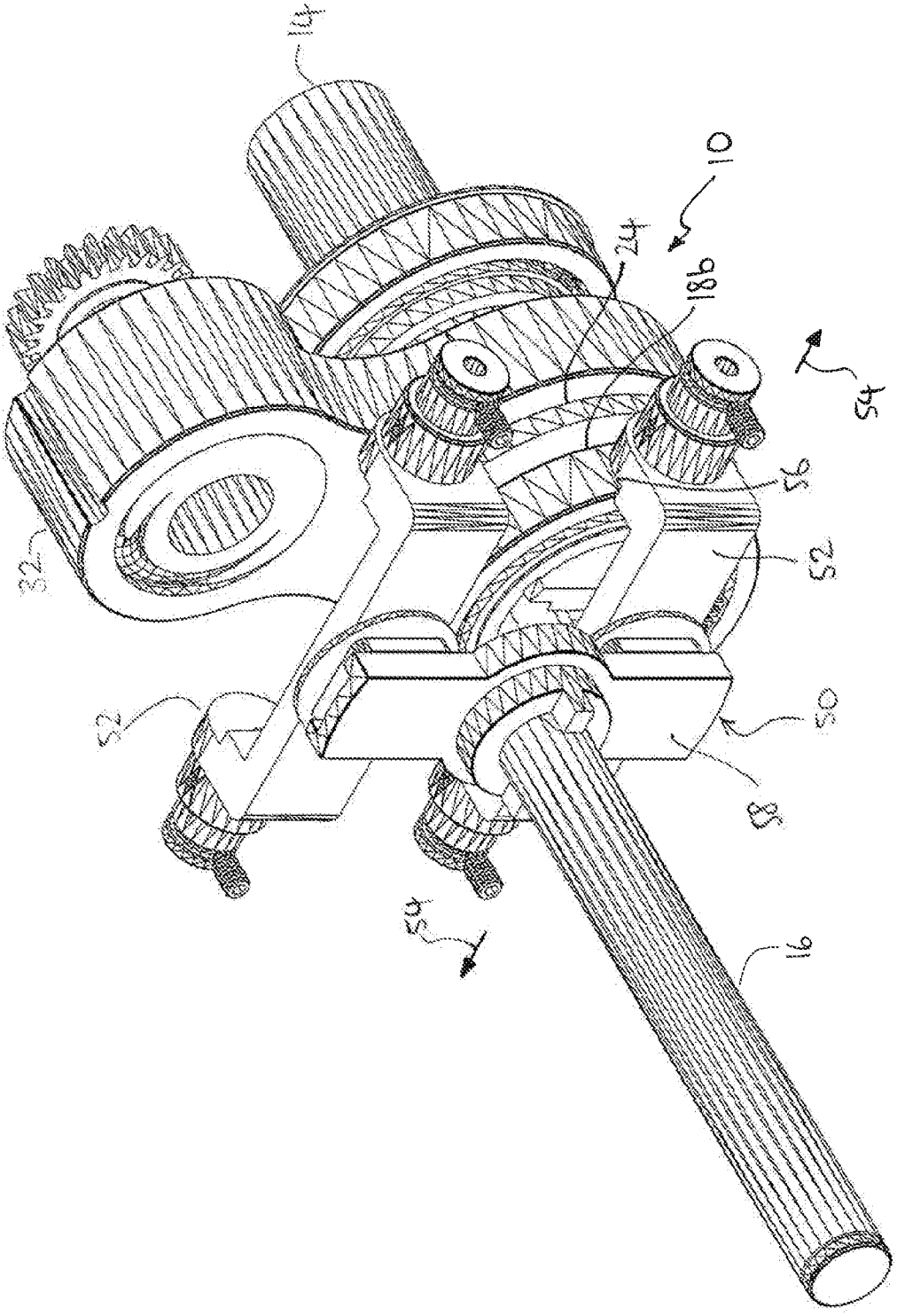

Figure 5

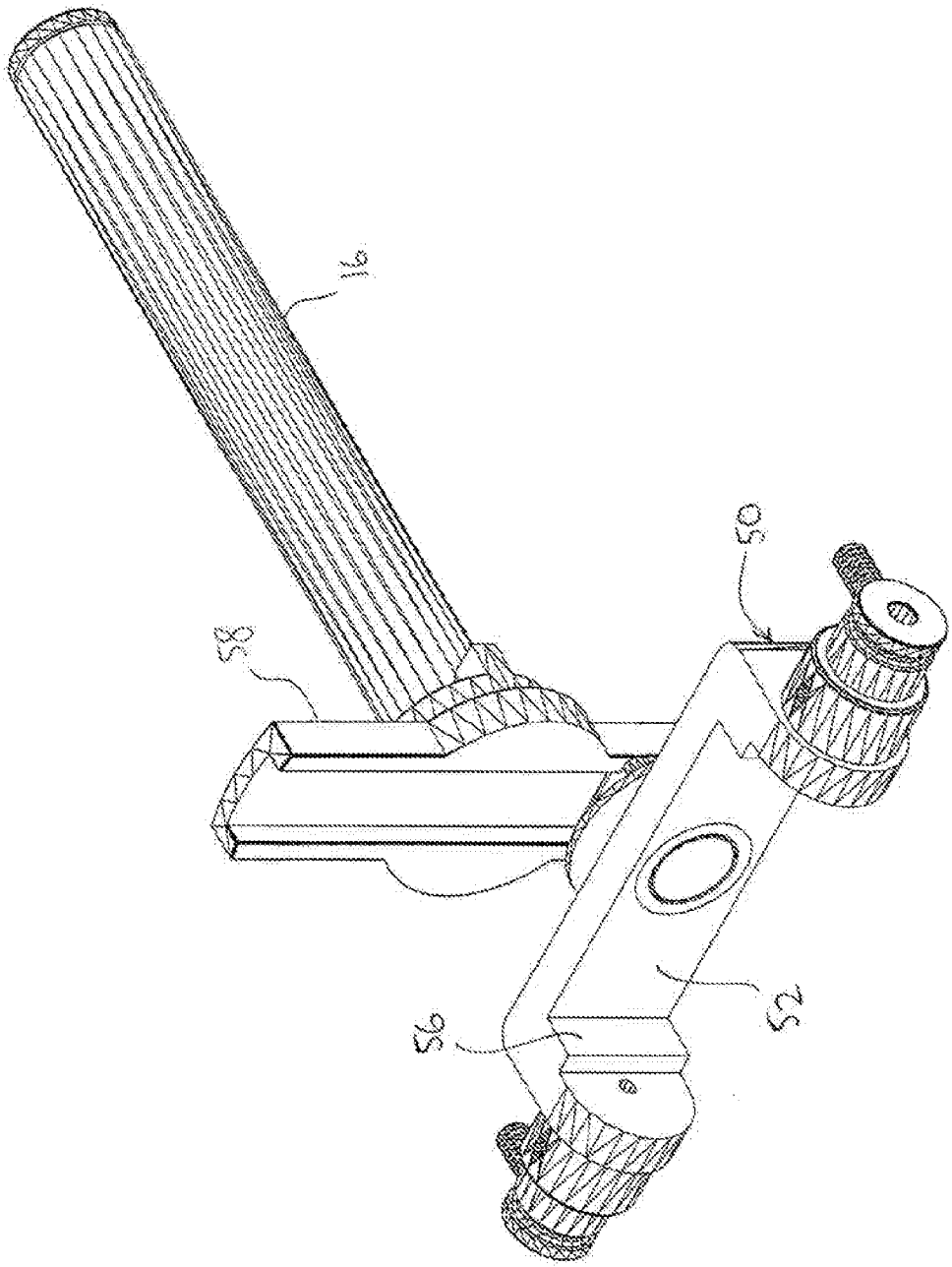

Figure 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2011/000193

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

F16H 25/16 (2006.01) ***F01C 9/00*** (2006.01) ***F04C 9/00*** (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)
WPI, EPODOC with IPC marks and keywords including drive shaft, input shaft, output shaft, unidirectional, rotary, oscillating, reciprocating, motion conversion, angle adjustment, eccentric, pump, compressor etc. Google Patents, Espace, Internet search with similar keywords.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages.	Relevant to claim No.
X	US 4013028 A (MURAKAMI) 22 March 1977 - See column 1 lines 5-7, column 1 line 57 to column 2 line 10	1, 2
X	WO 2007/047070 A2 (KIESTER) 26 April 2007 - See the abstract, figure 6a	1
X	Derwent Abstract Accession No. 2005-292933, RU 2250400 C1 (PYLAEV) 6 October 2003 - See the abstract	1

[X] Further documents are listed in the continuation of Box C [X] 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
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"O" document referring to an oral disclosure, use, exhibition or other means
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"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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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 May 2011	31 MAY 2011
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 **MLADEN MITIC** AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6283 3193

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2011/000193

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3516267 A (UHLIR) 23 June 1970 - See the abstract	1
X	GB 1141607 A (ASSOCIATED ELECTRICAL INDUSTRIES LTD.) 29 January 1969 - See the abstract, figures 1-3	1

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU2011/000193

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					
US	4013028	DE	2553336	GB	1477790	JP	51062253
WO	2007047070	US	2008234716				
RU	2250400	NONE					
US	3516267	DE	1902984	FR	2001077	GB	1254887
GB	1141607	NONE					

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

END OF ANNEX