



- (51) International Patent Classification:
F04B 9/04 (2006.01) *F04B 35/04* (2006.01)
F04B 35/01 (2006.01) *B29C 73/16* (2006.01)
- (21) International Application Number: PCT/US2016/012776
- (22) International Filing Date: 10 January 2016 (10.01.2016)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
10 2015 102 625.2
24 February 2015 (24.02.2015) DE
- (71) Applicant: ILLINOIS TOOL WORKS INC. [US/US];
155 Harlem Avenue, Glenview, Illinois 60025 (US).
- (72) Inventor: SPINDLER, Martin Patrick; Huegelhof 83,
88634 Herdwangen (DE).
- (74) Agent: HAUPTMAN, Benjamin J.; HAUPTMAN HAM,
LLP, 2318 Mill Road, Suite 1400, Alexandria, Virginia
22314 (US).
- (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, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, 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, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, 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,

[Continued on next page]

(54) Title: COMPRESSOR FOR DISCHARGING A MEDIUM

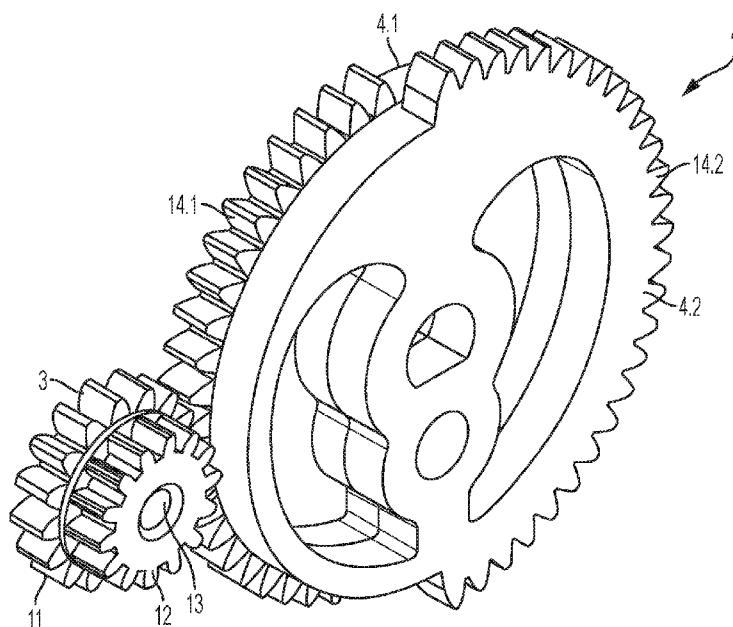


FIG. 4

(57) Abstract: In a compressor for discharging a medium, in particular tire sealant that is to be discharged from a container into a tire, wherein a motor (1) of the compressor (P) drives a step-up transmission wheel (3, 3.1) for moving at least one piston (6 - 6.6) in a compression chamber (7), the step-up transmission wheel (3, 3.1) is intended to be provided only partially on its circumference with a toothing (20) and/or to consist of two toothed wheels (11, 12) lying on each other.



SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, **Published:**
GW, KM, ML, MR, NE, SN, TD, TG).

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

COMPRESSOR FOR DISCHARGING A MEDIUM

The invention relates to a compressor for discharging a medium, in particular
tire sealant that is to be discharged from a container into a tire, wherein a motor
5 of the compressor drives a step-up transmission wheel for moving at least one
piston in a compression chamber.

Prior art

10 DE 10 2004 042 911 A1 discloses a device for conveying a gas from a pressure
chamber, in particular for discharging a sealant from this container into a tire of
a vehicle and for inflating the tire. A compressor can be attached to the sealant
container disclosed in said document. This compressor can also be configured
as a diaphragm compressor which compresses air present in the sealant
15 container in order to force sealant out of the sealant container.

Moreover, WO 2010/066448 discloses a device for conveying a gas from a
pressure chamber, in particular for discharging a sealant from this container into
a tire of a vehicle and/or for inflating the tire, wherein a piston is arranged to be
20 oscillatingly movable in the pressure chamber. A gear element is also assigned
to the piston and converts a rotational movement of the input shaft of a drive
into an oscillating movement.

Problem

25 The problem addressed by the present invention is that of simplifying and
improving known compressors for conveying a gas from a pressure chamber
and for transporting a medium.

30

Solution to the problem

The problem is solved by the fact that the step-up transmission wheel is provided only partially on its circumference with a tothing and/or consists of
5 two toothed wheels lying on each other.

In one illustrative embodiment of the present invention, the compressor has a motor which is connected eccentrically to a piston rod via an output wheel, which piston rod moves a piston in the compression chamber. According to the
10 invention, provision is made that the step-up transmission wheel is arranged upstream from the output wheel. The step-up transmission wheel and output wheel are adapted to each other such that a different transmission of force can take place depending on which toothings are in engagement. For this purpose, provision is made that the output wheel consists of two wheel halves that lie on
15 each other. Each wheel half has a tothing, but the latter does not extend over the entire circumference, and instead only over a predetermined arc distance. In the preferred illustrative embodiment, this arc distance is in each case 180°.

By contrast, the step-up transmission wheel consists of two toothed wheels
20 which lie on each other and which interact alternately with one or other wheel half of the output wheel. One toothed wheel has a greater diameter than the other toothed wheel. The toothed wheel with the smaller diameter can apply a greater force to the output wheel than can the toothed wheel with the greater diameter. Therefore, the toothed wheel with the smaller diameter engages in
25 the corresponding tothing of the output wheel when air is to be compressed into the compression chamber. By contrast, if air is only to be sucked in, the toothed wheel with the greater diameter engages in the tothing of the output wheel half assigned to it.

30 In a further illustrative embodiment of the invention, the step-up transmission wheel is provided only partially on its circumference with a tothing. This tothing alternately engages in at least two toothings of a fork element on which

at least one piston is provided. The function is such that, with the direction of rotation remaining constant, the step-up transmission wheel engages alternately in the different toothings and thus causes a different movement of the piston.

5 In a preferred illustrative embodiment, the piston is connected to a fork element which forms an elongate opening into which the step-up transmission wheel engages. Two opposite side flanks of this fork element enclose this elongate opening more or less elliptically, wherein the side flanks on the inside of the elongate opening are provided with the toothings lying opposite each other. By
10 contrast, the step-up transmission wheel is provided with a tothing over only about half of its circumference. If this step-up transmission wheel now rotates about its axis, the arrangement is configured such that the tothing of the step-up transmission wheel initially runs along an inner tothing of the fork element and, at the end of this tothing, engages with at least one tooth in the opposite
15 tothing. This brings about a movement of the fork element in the opposite direction, as a result of which the piston is moved to and fro in the compression chamber.

In a preferred illustrative embodiment, however, the fork element is connected
20 to in each case one piston at both ends. It is also conceivable here that the fork element is also connected to several pistons via a corresponding joint and corresponding piston rods, which pistons move in corresponding compression chambers. This allows a corresponding compressor according to the invention to be arranged in a wheel rim, specifically in a five-hole wheel rim, since the
25 corresponding pistons are then able to move between the holes.

In these arrangements, a transmission of force and a distribution of the pressure forces to different compression chambers are greatly improved.

30

Description of the figures

Further advantages, features and details of the invention will become clear from the following description of preferred illustrative embodiments and from the drawing, in which

Figure 1 shows a perspective view of a compressor according to the invention;

Figure 2 shows a plan view of the compressor according to Figure 1;

Figure 3 shows a partial view of the compressor according to Figure 2 seen in direction X;

Figure 4 shows a perspective view of the interaction between a step-up transmission wheel and an output wheel;

Figures 5-8 show schematic plan views of a further illustrative embodiment of part of a compressor according to the invention in different positions of use;

Figures 9 and 10 show schematic plan views of two further illustrative embodiments of parts of a compressor according to the invention.

According to Figure 1, a compressor P according to the invention has a motor 1, which is cooled by a fan 2. A step-up transmission wheel 3, which sits on a motor shaft (not shown), interacts with an output wheel 4.

The output wheel 4 is connected eccentrically to a piston rod 5, which moves a piston 6 (Figure 3) in a compression chamber 7. A valve piece 8, which has a line 9 to a tire, for example, and has a connection 10 to a container for tire sealant, for example, is attached to this compression chamber 7.

This compressor functions as follows:

The step-up transmission wheel 3 is moved in rotation via the motor 1 and transmits its rotational movement to the output wheel 4. The latter in turn moves the piston rod 5 in the compression chamber 7. In this way, air is forced out of the compression chamber 7 into the valve piece 8 and into the line 9. A medium, in particular tire sealant, is then either sucked in from a container (not shown) via the connection 10 or is additionally forced into the line 9 and thus introduced, for example, into a tire that is to be sealed.

The present invention relates in part to an improvement of the force transmission of the force of the motor 1 to the piston rod 5 or the piston 6. It is known that more force is needed when compressing the air in the compression chamber 7 than when sucking new air into the compression chamber. To take account of this force relationship, both the step-up transmission wheel 3 and also the output wheel 4 are preferably formed in two parts. According to Figure 4, the step-up transmission wheel 3 consists of two toothed wheels 11 and 12 which lie on each other and which have a congruent opening 13 for receiving a motor shaft. Moreover, the toothed wheel 11 also has a greater diameter than the toothed wheel 12.

The output wheel 4 consists of two halves 4.1 and 4.2. Each half is provided with a toothing 14.1 and 14.2, respectively. Each toothing 14.1 and 14.2 extends over only a half circumference of the respective output wheel half 4.1, 4.2, while the other half is free of toothing. Here too, provision is made that the output wheel half 4.2 with the toothing 14.2 has a greater diameter than the output wheel half 4.1 with the toothing 14.1. The toothed wheel 12 with the smaller diameter interacts with the output wheel half 4.2 with the greater diameter, while the toothed wheel 11 with the greater diameter interacts with the output wheel half 4.1 with the smaller diameter. As soon as the toothed wheel 12 with the smaller diameter comes into engagement with the toothing 14.2 of the output wheel half 4.2, a greater force can thus be applied by the step-up

transmission ratio, such that this state of engagement is preferred when a greater force is intended to act on the piston 6 during the compression. When the piston 6 retreats in order for new air to be sucked into the compression chamber 7, the toothed wheel 11 with the greater diameter is then in engagement with the toothing 14.1 of the output wheel 4.1 with the smaller diameter.

Figures 5 to 8 show a further illustrative embodiment of a possible actuation of two pistons 6.1 and 6.2 in two compression chambers (not shown). The two pistons 6.1 and 6.2 are connected to each other via a fork element 15. For this purpose, the fork element 15 has two curved side flanks 16.1 and 16.2 which connect two connector stubs 17.1 and 17.2 on the pistons 6.1 and 6.2 to each other. The side flanks 16.1 and 16.2 enclose an elongate opening 18, and, within the interior of this elongate opening 18, parts of the side flanks 16.1 and 16.2 extending approximately parallel to each other are provided with a toothing 19.1 and 19.2, respectively.

A step-up transmission wheel 3.1, approximately half of which is provided with a further toothing 20, engages in this elongate opening 18.

20

This illustrative embodiment of a gear according to the invention, in particular for compressors, functions as follows:

The step-up transmission wheel 3.1, which sits on a shaft of a drive, rotates about its axis A. In doing so, the toothing 20 of the step-up transmission wheel 3.1 runs along the inner toothing 19.1 of the side flank 16.1, such that the fork element 15 moves downward according to the arrow 21 when the step-up transmission wheel 3.1 is fixed in position. During this, the piston 6.2 moves deeper into its compression chamber and forces the fluid or gas contained therein out of this compression chamber. At the same time, the piston 6.2 moves out from its associated compression chamber and sucks in fluid or gas.

Figure 6 shows the step-up transmission wheel 3.1 running along the toothing 19.1, the step-up transmission wheel 3.1 here being located approximately at the middle of the elongate opening 18.

- 5 According to Figure 7, an uppermost tooth 22 of the toothing 20 of the step-up transmission wheel 3.1 has now reached an uppermost tooth 23 of the toothing 19.1. At the same time, an opposite tooth 24 engages under an uppermost tooth 25 of the opposite toothing 19.2. Upon further rotation of the step-up transmission wheel 3.1, the toothing 20 engaging in the toothing 19.2 carries
10 the fork element 15.1 in the opposite direction, as is shown by the arrow 26. Figure 8 shows the corresponding central position of the step-up transmission wheel 3.1 in the elongate opening 18.

- Finally, the tooth 24 of the toothing 20 of the step-up transmission wheel 3.1
15 reaches a lower tooth 27 of the toothing 19.1 and the position of use shown in Figure 5, wherein the opposite tooth 22 again unlatches from the toothing 19.2. The tooth 24 now comes into engagement with the toothing 19.1, as is shown in Figure 5.

- 20 Figure 9 shows that the fork element 15 according to the invention can also interact with three pistons. For this purpose, instead of the piston 6.2, two piston rods 5.1 and 5.2 are connected to the fork element 15 via a joint 28. A piston 6.3, 6.4 is provided at the other end of the piston rods 5.1, 5.2, respectively.

- 25 In Figure 10, the fork element 15 actuates two mutually opposite pairs of pistons 6.3, 6.4 and 6.5, 6.6, wherein the pair 6.5, 6.6 replaces the piston 6.1 and is connected to the fork element 15 via corresponding piston rods 5.3 and 5.4, respectively, and via a joint 28.1.

- 30 However, the process of movement of the arrangement according to Figure 9 and Figure 10 corresponds to the details concerning the function of the illustrative embodiment according to Figures 5 to 8.

List of reference signs

1	motor	34		67	
2	fan	35		68	
3	step-up transmission wheel	36		69	
4	output wheel	37		70	
5	piston rod	38		71	
6	piston	39		72	
7	compression chamber	40		73	
8	valve piece	41		74	
9	line	42		75	
10	connection	43		76	
11	toothed wheel	44		77	
12	toothed wheel	45		78	
13	opening	46		79	
14	toothing	47			
15	fork element	48		A	axis of 3.1
16	side flank	49			
17	connector stub	50			
18	elongate opening	51			
19	toothing	52			
20	toothing of 3.1	53			
21	arrow	54			
22	uppermost tooth of 20	55			
23	uppermost tooth of 19.1	56			
24	tooth of 20	57			
25	uppermost tooth of 19.2	58			
26	arrow	59			
27	lower tooth of 19.1	60		P	compressor
28	joint	61			
29		62			
30		63			
31		64			
32		65			
33		66			

Claims

1. A compressor for discharging a medium, in particular tire sealant that is to be discharged from a container into a tire, wherein a motor (1) of the compressor (P) drives a step-up transmission wheel (3, 3.1) for moving at least one piston (6 – 6.6) in a compression chamber (7),
5 characterized in that
10 the step-up transmission wheel (3, 3.1) is provided only partially on its circumference with a toothing (20) and/or consists of two toothed wheels (11, 12) lying on each other.
2. The compressor as claimed in claim 1, characterized in that the step-up transmission wheel (3) is connected eccentrically to an output wheel (4) and, by way of the latter, to a piston rod (5), which moves a piston (6) in a compression chamber (7).
15
3. The compressor as claimed in claim 2, characterized in that the output wheel (4) consists of two wheel halves (4.1, 4.2), each with a toothing (14.1, 14.2), wherein the toothing (14.1) of one wheel half (4.1) extends about one arc distance and the toothing (14.2) of the other wheel half (4.2) extends about another arc distance.
20
4. The compressor as claimed in claim 3, characterized in that the arc distance is in each case 180°.
25
5. The compressor as claimed in at least one of claims 1 through 4, characterized in that the two toothed wheels (11, 12) lying on each other interact alternately with one or other wheel half (4.1, 4.2) of the output wheel (4).
30

6. The compressor as claimed in claim 5, characterized in that one toothed wheel (11) has a greater diameter than the other toothed wheel (12).
- 5 7. The compressor as claimed in claim 1, characterized in that the step-up transmission wheel (3.1) interacts with two mutually opposite toothings (19.1, 19.2) of a fork element (15).
- 10 8. The compressor as claimed in claim 7, characterized in that the fork element (15) forms, by means of two side flanks (16.1, 16.2), an elongate opening (18) into which the step-up transmission wheel (3.1) engages and in which the toothings (19.1, 19.2) are also arranged.
9. The compressor as claimed in claim 7 or 8, characterized in that pistons (6.1-6.6) are arranged on both sides of the fork element (15).

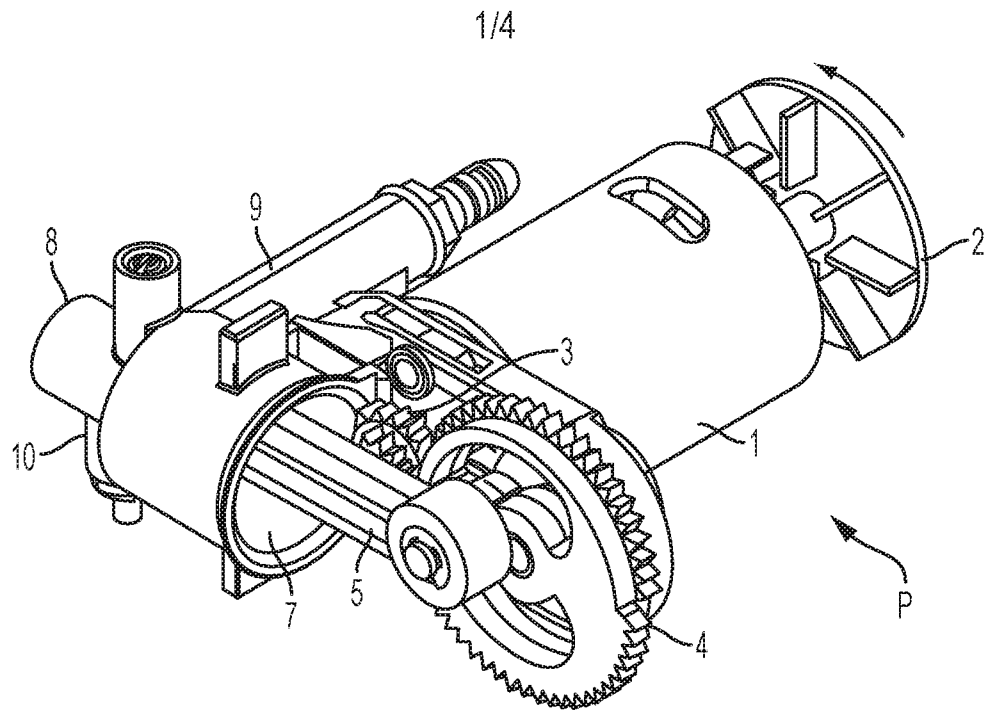


FIG. 1

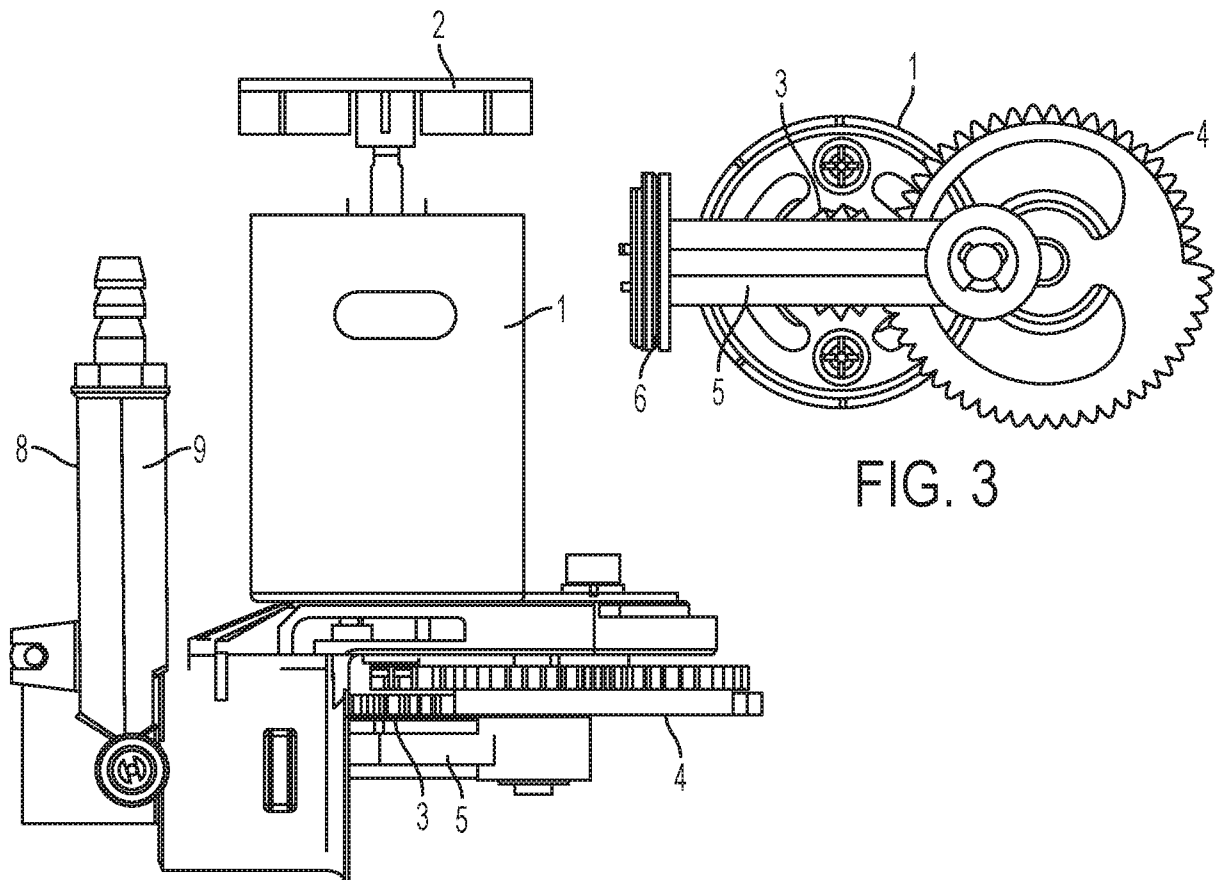


FIG. 3

FIG. 2

2/4

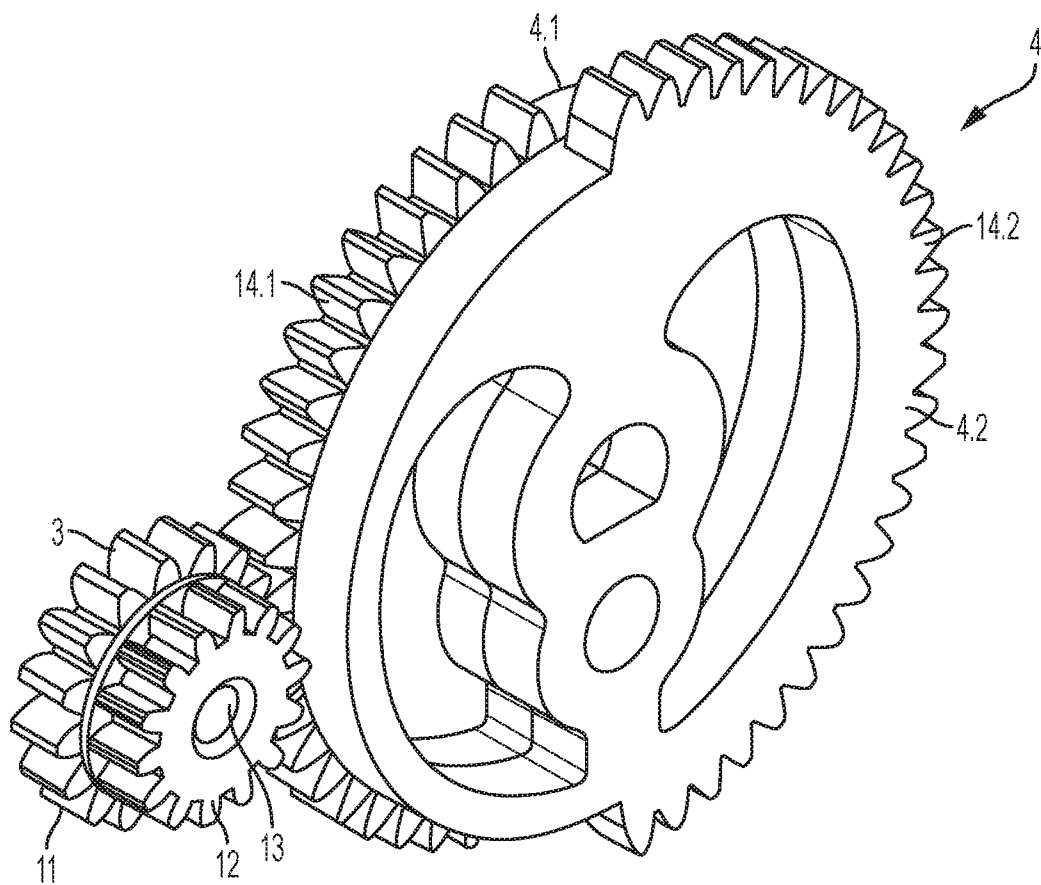


FIG. 4

3/4

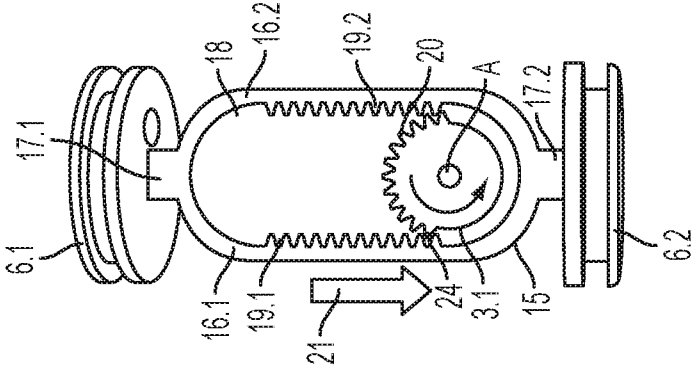


FIG. 5

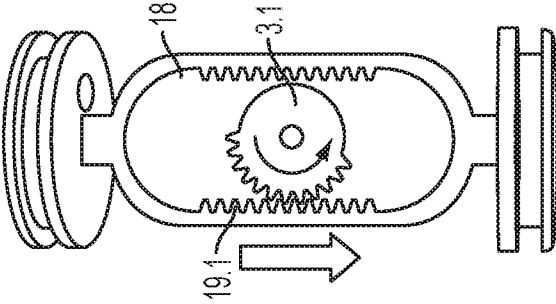


FIG. 6

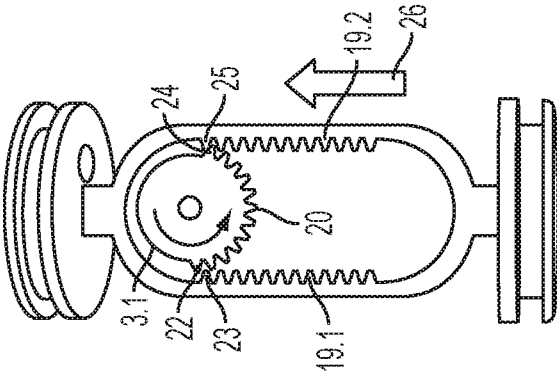


FIG. 7

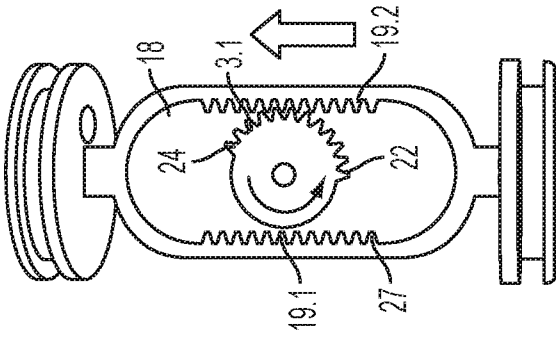


FIG. 8

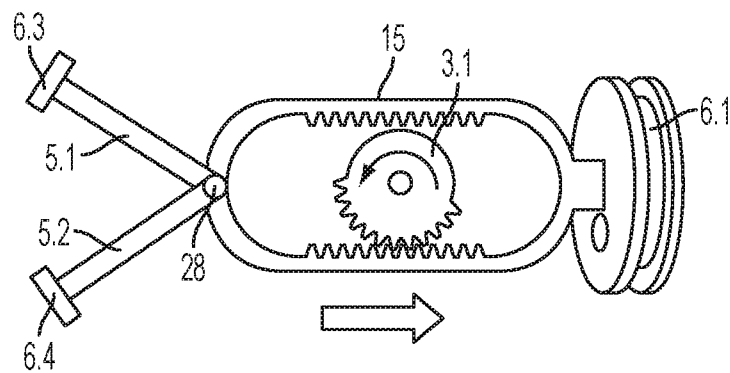


FIG. 9

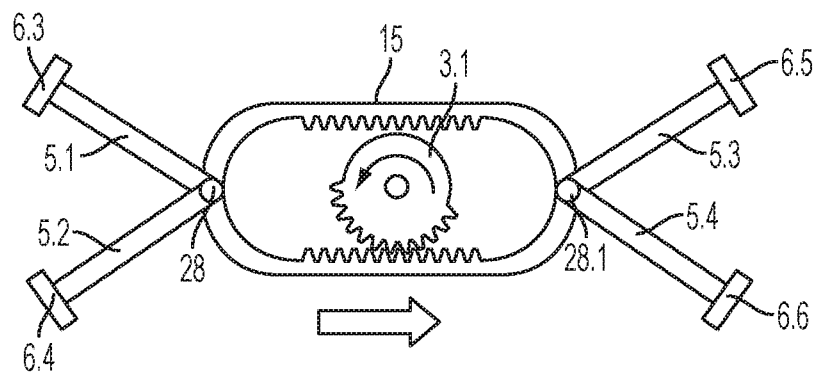


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/012776

A. CLASSIFICATION OF SUBJECT MATTER
INV. F04B9/04 F04B35/01 F04B35/04 B29C73/16
ADD.

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)
F04B B29C

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1 285 899 A (CHEN, WAN-FU [JP]) 16 August 1972 (1972-08-16) figures 1a-d page 2, line 2 - line 69	1,7-9
X	US 5 259 256 A (BRACKETT, DOUGLAS [US]) 9 November 1993 (1993-11-09) figures 1-5 column 3, line 9 - column 5, line 33	1,7-9
X	US 6 439 104 B1 (NIDEC COPAL CORPORATION [JP]) 27 August 2002 (2002-08-27)	1,2,6
Y	figures 1-3	3
A	abstract	4,5
	----- -/--	



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

"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

"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

6 April 2016

Date of mailing of the international search report

15/04/2016

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Gnüchtel, Frank

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/012776

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 215 447 A (WEN, SAN-JOU [TW]) 1 June 1993 (1993-06-01) figures 1, 3 column 2, line 36 - line 48 -----	3
A	EP 2 353 848 A1 (JHOU, WEN-SAN [TW]) 10 August 2011 (2011-08-10) the whole document -----	1-9

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2016/012776

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 1285899	A	16-08-1972	BE 741779 A 04-05-1970
			CA 927699 A 05-06-1973
			DE 1957665 A1 18-06-1970
			FR 2023534 A1 21-08-1970
			GB 1285899 A 16-08-1972

US 5259256	A	09-11-1993	AU 4795793 A 03-03-1994
			EP 0651865 A1 10-05-1995
			US 5259256 A 09-11-1993
			US 5456159 A 10-10-1995
			US 5640881 A 24-06-1997
			WO 9403740 A1 17-02-1994

US 6439104	B1	27-08-2002	JP 2001041159 A 13-02-2001
			US 6439104 B1 27-08-2002

US 5215447	A	01-06-1993	NONE

EP 2353848	A1	10-08-2011	NONE
