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(54) SPEED LIMITING DEVICE FOR A SLIDING DOOR

(57) A speed limiting device for a sliding door is described which comprises: a tightly closed casing, internally provided with at least one hydraulic circuit for the circulation of a hydraulic fluid and arranged to be made integral with a panel of the sliding door; a motion transmission means, located outside the casing and arranged to engage with a corresponding transmission element placed on the sliding door frame; a gear unit, located inside the casing and in fluid communication with the hydraulic circuit, connected to the motion transmission means through at least one transmission shaft and driven in rotation by the motion transmission means to move the hydraulic fluid inside the hydraulic circuit. The gear unit consists of a speed increasing gearbox comprising three or more toothed wheels with a different number of teeth. The speed increasing gearbox comprises in cascade, starting from the transmission shaft, a first toothed wheel with a first number of teeth, a second toothed wheel with a second number of teeth, a third toothed wheel with a third number of teeth, and a fourth toothed wheel with a fourth number of teeth, wherein the fourth number of teeth is smaller than the first number of teeth.

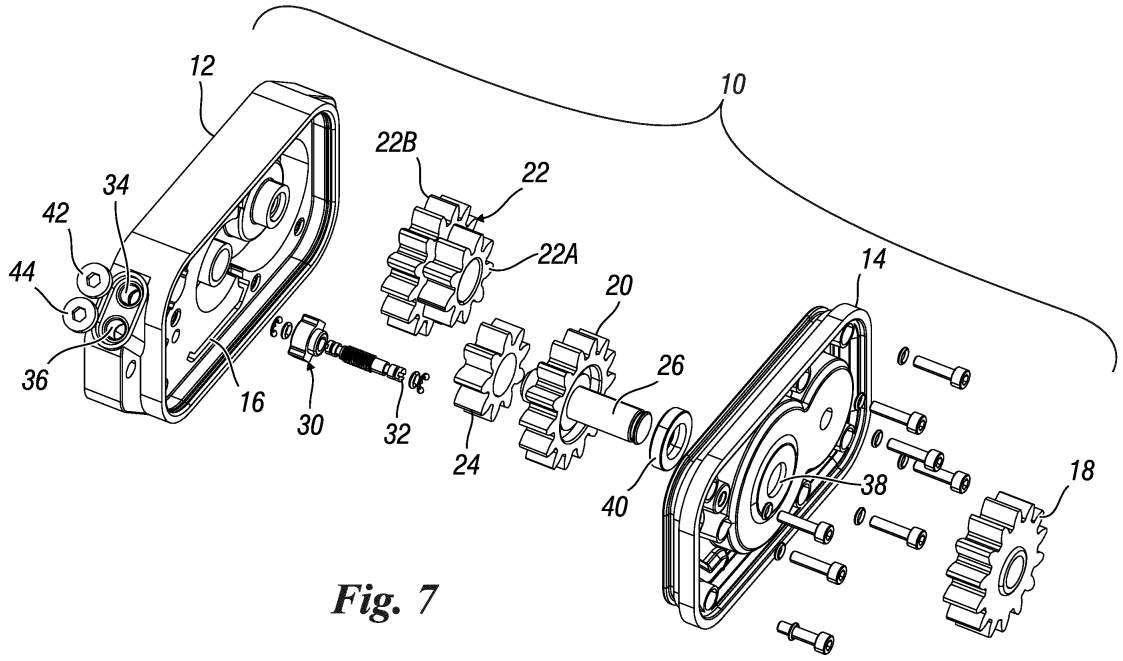

Fig. 7

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Description

[0001] The present invention generally relates to the technical field of sliding doors and, more specifically, a speed limiting device for a sliding fire door. Speed limiting devices of the prior art are described, for instance, in documents KR 200469772 Y1 and DE 202005006931 U1.

[0002] As is known, sliding fire doors, also referred to as firestop doors or gates, are safety protections which separate two contiguous rooms from flames so as to prevent that, should a fire ignite in a room, flames propagate to the contiguous room. In order for sliding fire doors to perform their technical functions, which essentially consist in providing a quick, without hesitation, locking and in being resistant to the very high temperatures normally present during a fire, they feature considerable mass and weight, very often greater than 1000 Kg.

[0003] In order to allow people and goods to normally and continuously pass through, the panel, or panels, of the sliding fire doors usually remain in their opening position. In the case of fire, panel closure is a priority and consequently it shall be provided by a self-locking system. However, locking systems which include a motor for this operation might not be efficient in case of fire, because in case of fire the motor could be itself vulnerable, inefficient, and ineffective.

[0004] In order to completely and unconditionally lock the door in case of fire, a widely used closure system imparts to the door itself accumulated energy in the form of a counterweight. This counterweight is usually provided with a restraining element, usually an electromagnetic device, which makes it possible to retain the sliding door during its opening without making the counterweight itself operate. In case of fire, the counterweight is released by its own restraining system to automatically draw the panel, or panels, towards their respective closure position.

[0005] Due to the high value of mass and weight of the sliding door, when the counterweight draws the panel, or panels, from the open door position to the closed door position, the panel or panels themselves can move at a speed which is higher and higher and uncontrolled. As a matter of fact, the counterweight (which is engineered ad hoc for every single sliding door), to overcome the mass or weight of the panel or panels, moves such leaves starting from an initial low speed, and subsequently imparts a continuous acceleration up to the complete closure of the leaves themselves. The above-mentioned sequence of events produces and is (without being noticed) a severe and impending hazardous situation, with the risk of squeezing with shearing effect.

[0006] Therefore, an object of the present invention is to provide a speed limiting device for a sliding door, preferably but not exclusively a sliding fire door, that is capable of solving the above-mentioned drawbacks of the prior art in an extremely simple, cost-effective, and particularly functional manner.

[0007] In details, an object of the present invention is to provide a speed limiting device for a sliding door which reduces the sliding speed of the panel or panels while the door itself is closing, thus allowing to maintain the sliding speed within safety values.

[0008] Another object of the present invention is to provide a speed limiting device for a sliding door which is adjustable, thus allowing to set the forward speed of the panel or panels up to a maximum allowed value, typically equal to 0.25 m/s.

[0009] A further object of the present invention is to provide a speed limiting device for a sliding door which, should the closing movement of the panel or panels be interrupted due to, for instance, an obstacle, makes it possible to resume the closing movement after the obstacle itself has been removed.

[0010] These objects and others according to the present invention are achieved by providing a speed limiting device for a sliding door as set forth in claim 1.

[0011] Further characteristics of the invention are highlighted in the dependent claims, which are an integral part of the present disclosure.

[0012] The characteristics and advantages of a speed limiting device for a sliding door according to the present invention will be more apparent from the following explanatory, but not limitative, description, which makes reference to the schematic drawing attached hereto, wherein:

figure 1 is a front view of a generic sliding door which can be equipped with a speed limiting device according to the present invention;
figure 2 is a detailed view of the speed limiting device applied to the sliding door shown in figure 1;
figure 3 is a front view of the speed limiting device according to the present invention, the enclosing panels being removed;
figure 4 is a side view of the speed limiting device of figure 3;
figures 5 and 6 show the two cover shells or half-shells respectively of the speed limiting device of figure 3; and
figure 7 is an exploded view showing the different part components of the speed limiting device of figure 3.

[0013] The figures show a preferred embodiment of the speed limiting device for a sliding door according to the present invention, identified as a whole by the reference numeral 10. The speed limiting device 10 comprises a tightly closed casing 12, 14, internally provided with at least one hydraulic circuit 16 for the circulation of a hydraulic fluid. Preferably, but not exclusively, the hydraulic fluid consists of glycol, which is a substantially thermostable fluid. Figures 1 and 2 show the casing 12, 14 of the speed limiting device 10 arranged to be made integral with a panel A of a generic sliding door which is provided, for instance, with a counterweight C which, in determined conditions of use, causes the door to close.

[0014] The speed limiting device 10 also comprises a motion transmission means 18, located outside the casing 12, 14 and arranged to engage with a corresponding transmission element B placed on the sliding door frame. For instance, as shown in the figures, the motion transmission means 18 of the speed limiting device 10 might consist of a toothed wheel, whereas the transmission element B placed on the sliding door frame might consist of a rack. However, both the motion transmission means 18 and the corresponding transmission element B could be formed of other elements such as, for instance, a belt and pulley transmission system.

[0015] The speed limiting device 10 also comprises a gear unit 20, 22, 24 located inside the casing 12, 14 and in fluid communication with the hydraulic circuit 16. The gear unit 20, 22, 24 is connected to the motion transmission means 18 through at least one transmission shaft 26 and is driven in rotation by the motion transmission means 18 to move the hydraulic fluid inside the hydraulic circuit 16.

[0016] In one preferred embodiment of the invention, the casing 12, 14 comprises at least one rear shell 12 and at least one front shell 14 tightly coupled with each other. The front shell 14 is provided with at least one through hole 38, with a respective sealing ring 40, for the transmission shaft 26.

[0017] According to the invention, the gear unit 20, 22, 24 is formed of a speed increasing gearbox comprising three or more toothed wheels 20, 22, 24 with a different number of teeth. In details, as shown in the figures, the speed increasing gearbox comprises in cascade, starting from the transmission shaft 26, a first toothed wheel 20 with a first number of teeth T1, a second toothed wheel 22A with a second number of teeth T2, a third toothed wheel 22B with a third number of teeth T3, and a fourth toothed wheel 24 with a fourth number of teeth T4. The presence of four toothed wheels 20, 22A, 22B, 24, arranged in cascade in the speed increasing gearbox, allows for considerably reducing the pressure losses in the hydraulic circuit 16. In order for the speed increasing gearbox to operate correctly, the fourth number of teeth T4 of the fourth toothed wheel 24 is obviously smaller than the first number of teeth T1 of the first toothed wheel 20. Namely:

$$T4 < T1.$$

[0018] Preferably, as shown for instance in figures 3 and 7, the first toothed wheel 20, the second toothed wheel 22A, the third toothed wheel 22B and the fourth toothed wheel 24 are straight-cut toothed wheels. Still preferably, the second toothed wheel 22A and the third toothed wheel 22B are integral and coaxial to each other. This particular arrangement of the toothed wheels, in particular of the second toothed wheel 22A and of the third toothed wheel 22B which are integral and coaxial to each other, i.e. manufactured in one piece, makes it possible to minimize the space taken up by the speed increasing gearbox, while reducing the overall dimensions of the speed limiting device 10.

[0019] According to a preferred, but not limitative, aspect of the present invention, due to productive economy needs and in order to obtain a particularly high multiplication ratio, while maintaining the dimensions of the speed limiting device 10 compact, the first number of teeth T1 of the first toothed wheel 20 is equal to the third number of teeth T3 of the third toothed wheel 22B, whereas the second number of teeth T2 of the second toothed wheel 22A is equal to the fourth number of teeth T4 of the fourth toothed wheel 24. Namely:

$$T1 = T3 \text{ and } T2 = T4.$$

[0020] Advantageously, the casing 12, 14 is internally provided with at least one compensation tank 28 for the hydraulic fluid, as shown in details in figure 3. The compensation tank 28 is in fluid communication with the hydraulic circuit 16 and operates as an expansion vessel for compensating for the thermal expansion of the hydraulic fluid induced by the thermal variation (temperature increment) taking place in case of thermal radiation. As a matter of fact, as is known, a considerable thermal variation induced on a hydraulic fluid, even if it features thermostable properties as glycol, produces a consequent volumetric variation which requires the presence of an expansion vessel should such hydraulic fluid circulate in a tightly closed hydraulic circuit.

[0021] Preferably, as shown in figure 3, the compensation tank 28 has a substantially cylindrical shape, with its axis inclined by about 45° with respect to the sliding direction of the panel A of the sliding door when the speed limiting device 10 is mounted in its operative condition. This technical feature, besides the fact that the compensation tank 28 also contains a determined amount of air in addition to the hydraulic fluid, makes it possible to convey in such compensation tank 28 the air bubbles usually contained in the hydraulic fluid (because they are injected into the compensation tank 28 together with the hydraulic fluid and/or because they were generated from the emulsion of two or more liquids which constitute the hydraulic fluid), so as to separate them from the hydraulic fluid itself therein. This air-fluid separation action might be obtained with the speed limiting device 10 located in any positions. In other words, thanks to the special arrangement of the compensation tank 28, the speed limiting device 10 can be rotated up to 360° around the axis of the transmission shaft 26, while maintaining the capacity to perform the separation of the air bubbles from the hydraulic fluid inside the compensation tank 28 itself.

[0022] According to a preferred aspect of the present invention, on the casing 12, 14 there are one or more inlet ports 34, 36 for the hydraulic fluid. In the embodiment

shown in the figures, a first inlet port 34 is in direct fluid communication with the hydraulic circuit 16, whereas a second inlet port 36 is in direct fluid communication with the compensation tank 28. In addition, at least one of the inlet ports 34, 36 can be arranged for being connected to at least one external tank for the hydraulic fluid. Every inlet port 34, 36 can also be provided with a respective closure plug 42, 44 (figure 7) in order to keep both the hydraulic circuit 16 and the compensation tank 28 tightly closed under normal operating conditions of the speed limiting device 10.

[0023] Conveniently, the hydraulic circuit 16 is provided with at least one flow control valve 30 for controlling the hydraulic fluid flow inside the hydraulic circuit 16 itself. As it is shown in particular in figures 3 and 7, the flow control valve 30 is, for instance, of the screw type 32.

[0024] The speed limiting device 10 according to the present invention operates as follows, based on the well-known and proven system of hydraulic gear pump. By generating a rotation of the transmission shaft 26, to which are integral the toothed wheels 20, 22A, 22B, 24 of the gear unit, the hydraulic fluid flow is moved all along a known path through the hydraulic circuit 16. The flow control valve 30 is able to reduce this flow in accordance with the needs by reducing the speed of rotation of the toothed wheels 20, 22A, 22B, 24 and, consequently, of the transmission shaft 26, which the motion transmission means 18 is connected to, which, in this specific case, consists of a further toothed wheel. Even if the flow control valve 30 is completely closed, the pressure losses in the hydraulic circuit 16 might provide a moderate passage of hydraulic fluid, so as to prevent the speed limiting device 10 from being undesirably arrested and consequently the panel A of the sliding door from being arrested too.

[0025] The transmission shaft 26 and the motion transmission means 18, which are coupled with the mechanism for opening/closing the sliding door, which in this specific case consists of a transmission element B of a rack type, determine the step-by-step control of the sliding speed of the panel A. Hence, when the speed limiting device 10 is in operation, the panel A of the sliding door is not hard to move, but is slow-moving in any case.

[0026] Even though traditional hydraulic gear pumps are universally deemed to be very effective and reliable, they have their own weak point when they rotate at a low speed. As discussed herein, the movement imparted to the sliding door is to be preferably maintained within a maximum value of approximately 0.25 m/s. Such maximum speed value at worst might be to cover the inherent pressure losses of the hydraulic system of the speed limiting device 10. However, the presence in the speed limiting device 10 according to the invention of a speed increasing gearbox with three or more (preferably four) toothed wheels 20, 22, 24 considerably reduces these pressure losses.

[0027] In the event of a closed-loop hydraulic gear pump, the variation of temperature of the hydraulic fluid inside the respective hydraulic circuit might adversely affect the pump itself, until blocking it or bringing it in cavitation. However, the presence in the speed limiting device 10 according to the invention of a compensation tank 28, as well as of an external tank, if any, exerting the same function, prevents said drawback, by compensating for the thermal expansions of the hydraulic fluid even in presence of sharp temperature variations (increments) which take place, for instance, in case of thermal radiation.

[0028] It has been demonstrated that the speed limiting device for a sliding door according to the present invention achieves the previously highlighted purposes.

[0029] The thus conceived speed limiting device for a sliding door according to the present invention is in any case susceptible of numerous modifications and variants, all falling within the same inventive concept; also, all details are replaceable by technically equivalent elements. In practice the materials used, as well as shapes and dimensions, can be materials, shapes and dimensions whatsoever, according to the technical requirements.

[0030] Therefore, the scope of protection of the invention is that set forth in the attached claims.

Claims

1. A speed limiting device (10) for a sliding door, the speed limiting device (10) comprising:

- a tightly closed casing (12, 14), internally provided with at least one hydraulic circuit (16) for the circulation of a hydraulic fluid, said casing (12, 14) being arranged to be made integral with a panel (A) of the sliding door, and said hydraulic circuit (16) being provided with at least one flow control valve (30) suitable for controlling the hydraulic fluid flow circulating internally to said hydraulic circuit (16);
- a motion transmission means (18), located outside the casing (12, 14) and arranged to engage with a corresponding transmission element (B) placed on the sliding door frame; and
- a gear unit (20, 22, 24), located inside the casing (12, 14) and in fluid communication with the hydraulic circuit (16), said gear unit (20, 22, 24) being connected to the motion transmission means (18) through at least one transmission shaft (26) and being driven in rotation by said motion transmission means (18) to move the hydraulic fluid inside the hydraulic circuit (16),

the speed limiting device (10) operating as a hydraulic gear pump in that, by generating the rotation of said transmission shaft (26) and said gear unit (20, 22, 24), the flow of said hydraulic fluid is moved all along a known path through said hydraulic circuit

(16), the speed limiting device (10) being **characterized in that** said gear unit (20, 22, 24) consists of a speed increasing gearbox comprising three or more toothed wheels (20, 22, 24) with a different number of teeth, said speed increasing gearbox comprising in cascade, starting from the transmission shaft (26), a first toothed wheel (20) with a first number of teeth (T1), a second toothed wheel (22A) with a second number of teeth (T2), a third toothed wheel (22B) with a third number of teeth (T3) and a fourth toothed wheel (24) with a fourth number of teeth (T4), wherein said fourth number of teeth (T4) is smaller than said first number of teeth (T1).

2. The speed limiting device (10) according to claim 1, **characterized in that** said first (20), second (22A), third (22B), and fourth (24) toothed wheels are straight-cut toothed wheels, and **in that** said second toothed wheel (22A) and said third toothed wheel (22B) are integral and coaxial to each other.

3. The speed limiting device (10) according to claim 1 or 2, **characterized in that** said first number of teeth (T1) of the first toothed wheel (20) is equal to said third number of teeth (T3) of the third toothed wheel (22B), and **in that** said second number of teeth (T2) of the second toothed wheel (22A) is equal to said number of teeth (T4) of the fourth toothed wheel (24).

4. The speed limiting device (10) according to any claims 1 to 3, **characterized in that** said casing (12, 14) is internally provided with at least one compensation tank (28) for the hydraulic fluid, said compensation tank (28) being in fluid communication with the hydraulic circuit (16) and containing a determined amount of air in addition to said hydraulic fluid.

5. The speed limiting device (10) according to claim 4, **characterized in that** said compensation tank (28) has a substantially cylindrical shape, with its axis inclined by about 45° with respect to the sliding direction of said panel (A) of the sliding door when the speed limiting device (10) is mounted in its operative condition.

6. The speed limiting device (10) according to claim 4 or 5, **characterized in that** on said casing (12, 14) one or more inlet ports (34, 36) for the hydraulic fluid are obtained, said one or more inlet ports (34, 36) being in fluid communication with the hydraulic circuit (16) and/or with the compensation tank (28), said one or more inlet ports (34, 36) being arranged for being connected to at least one external tank for the hydraulic fluid.

7. The speed limiting device (10) according to any claims 1 to 6, **characterized in that** said flow control valve (30) is of a screw type (32).

8. The speed limiting device (10) according to any claims 1 to 7, **characterized in that** said casing (12, 14) comprises at least one rear shell (12) and at least one front shell (14) tightly coupled with each other, wherein said front shell (14) is provided with at least one through hole (38), with a respective sealing ring (40), for said at least one transmission shaft (26).

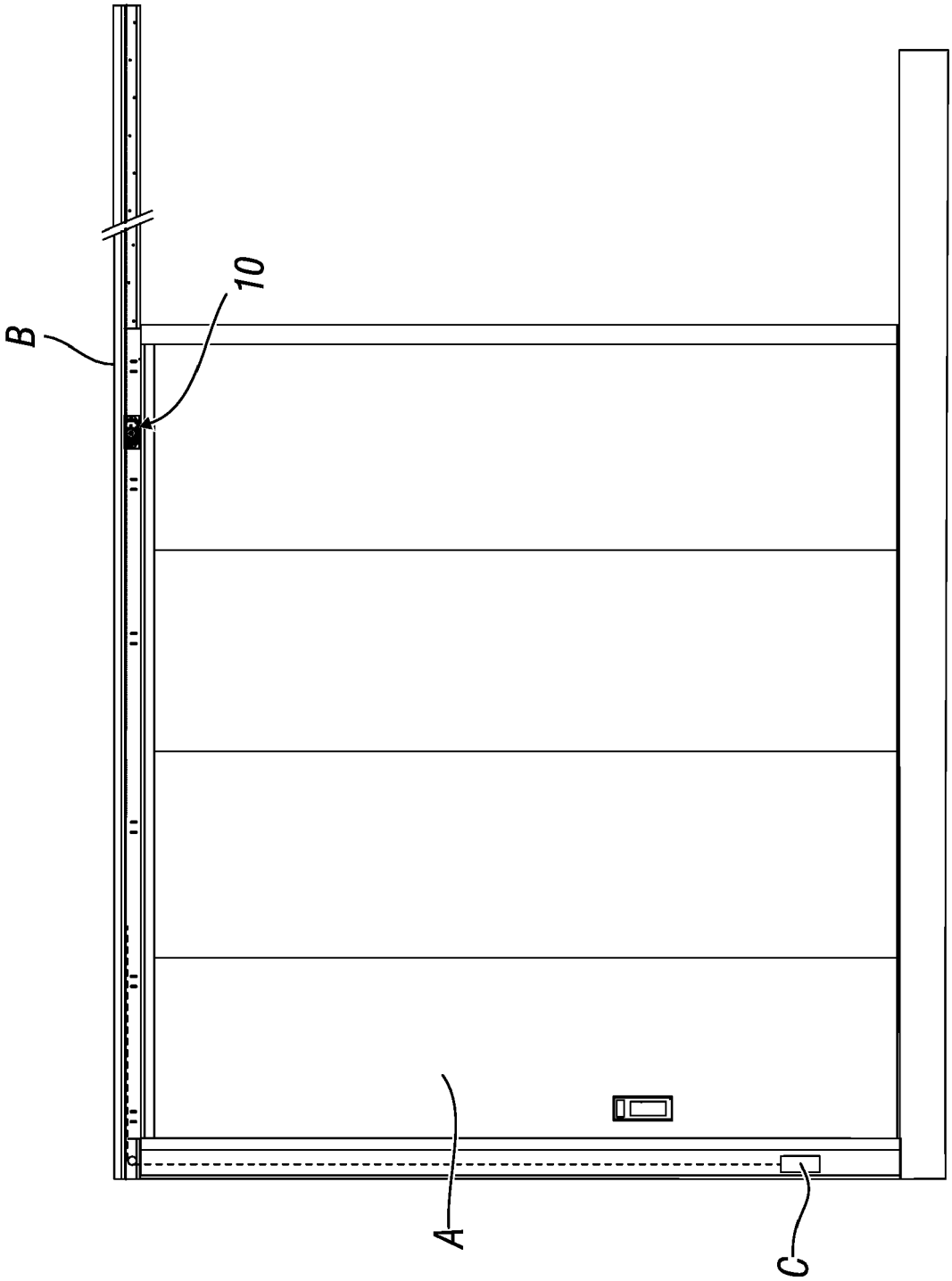

Fig. 1

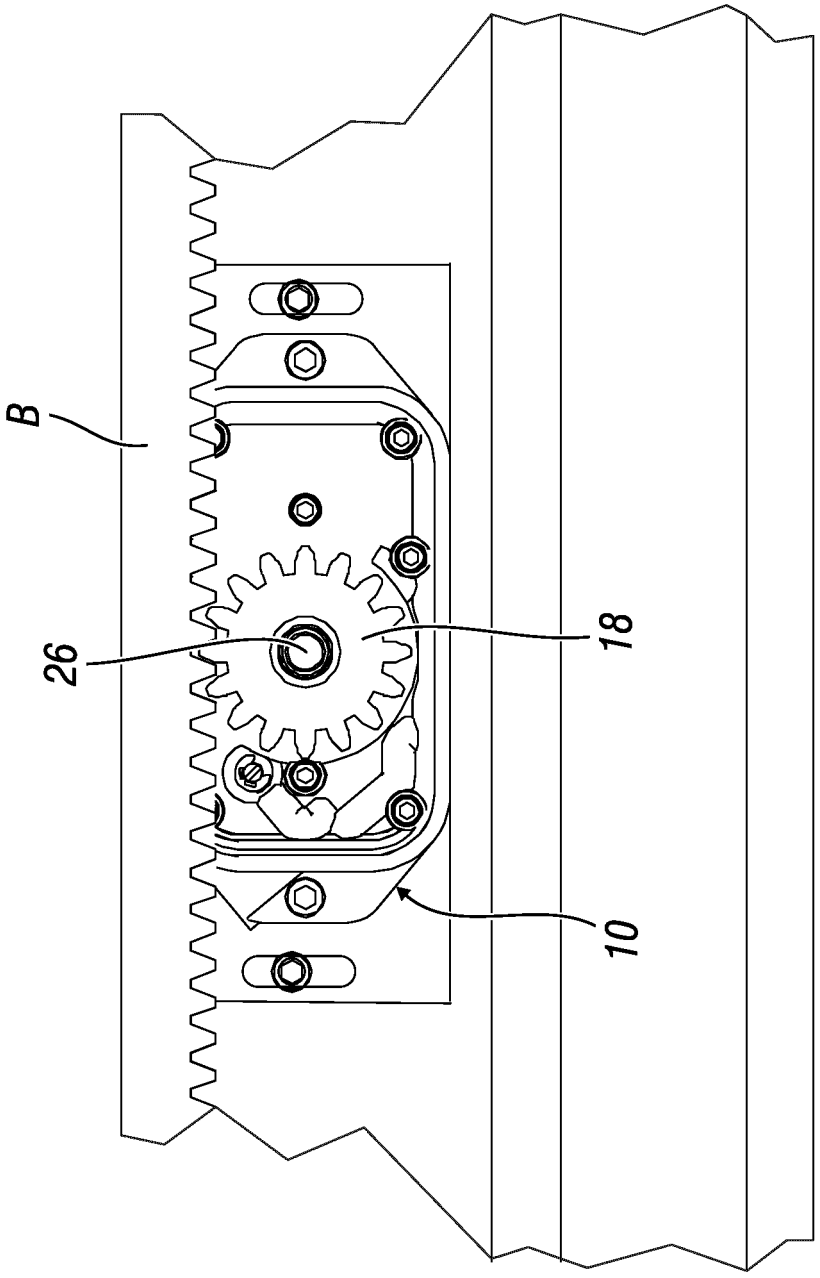

Fig. 2

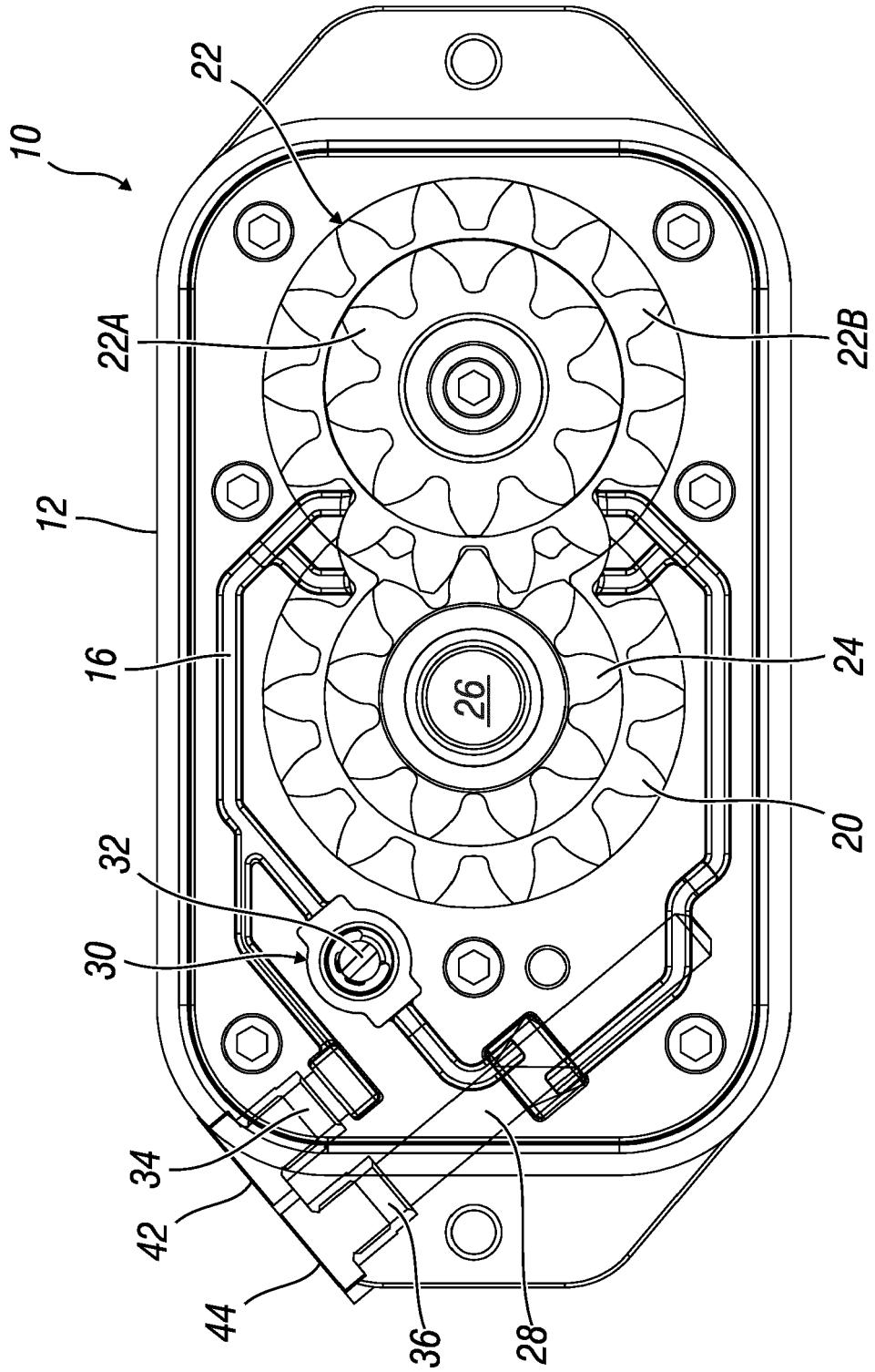

Fig. 3

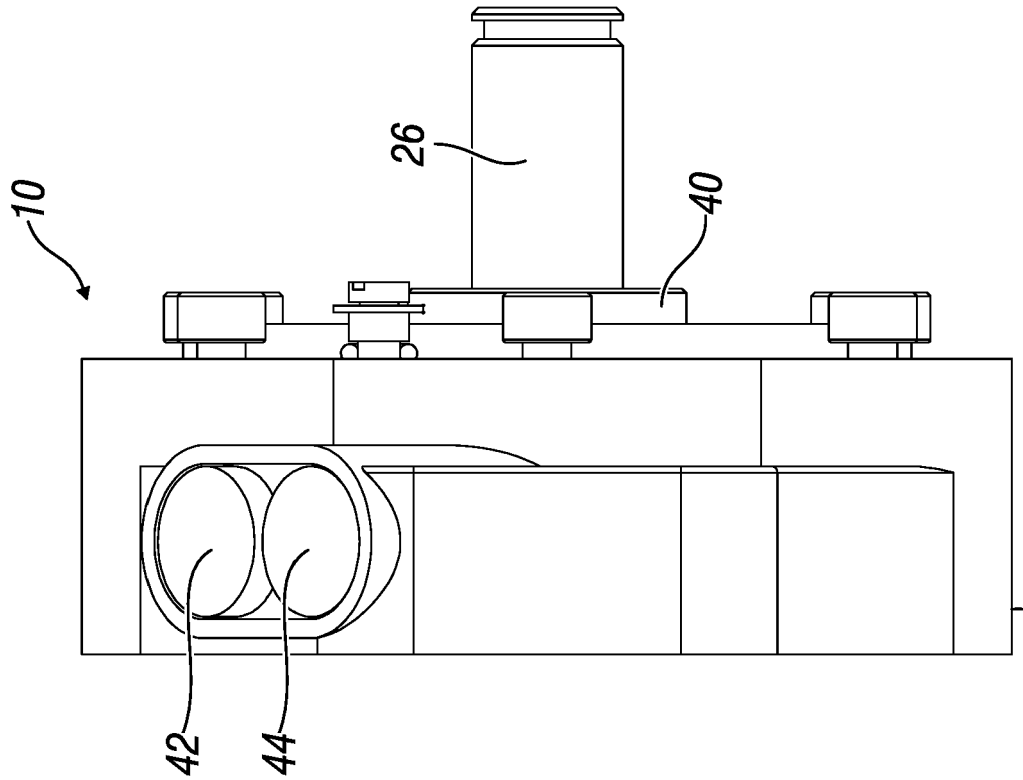

Fig. 4

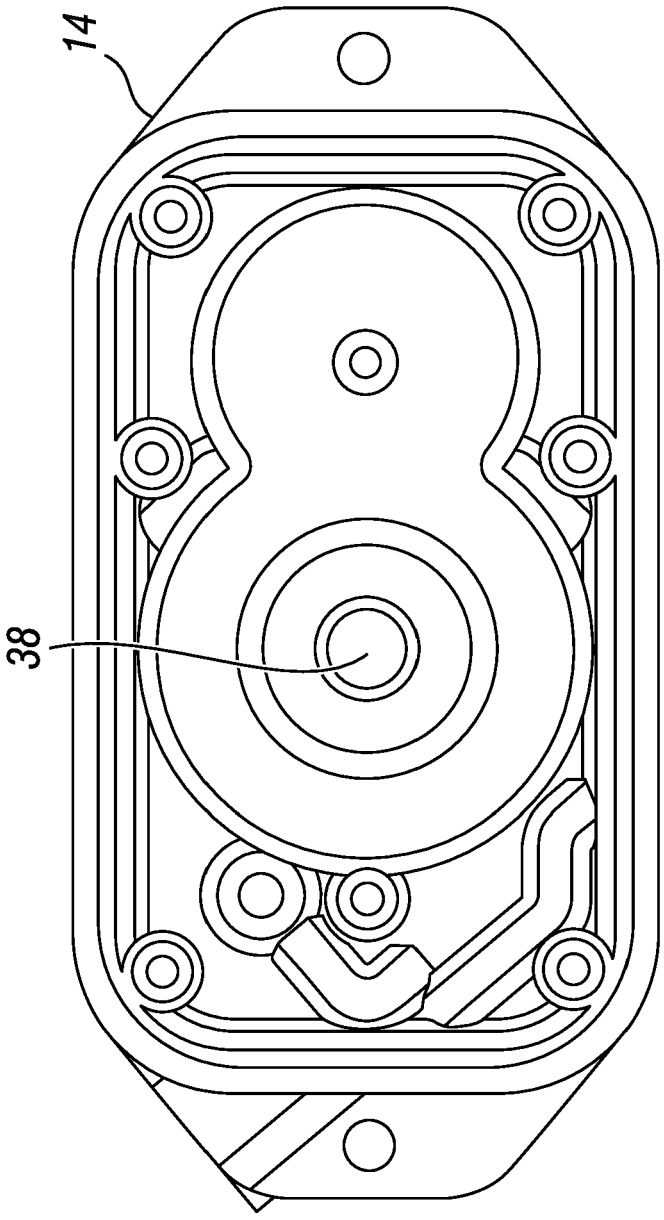

Fig. 5

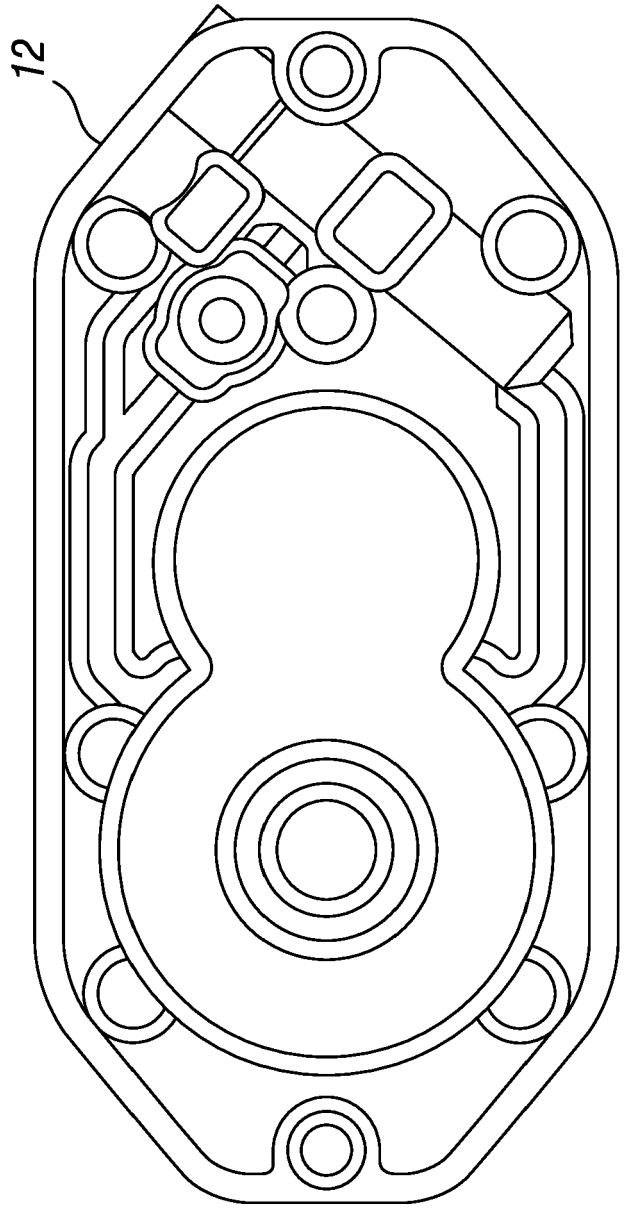

Fig. 6

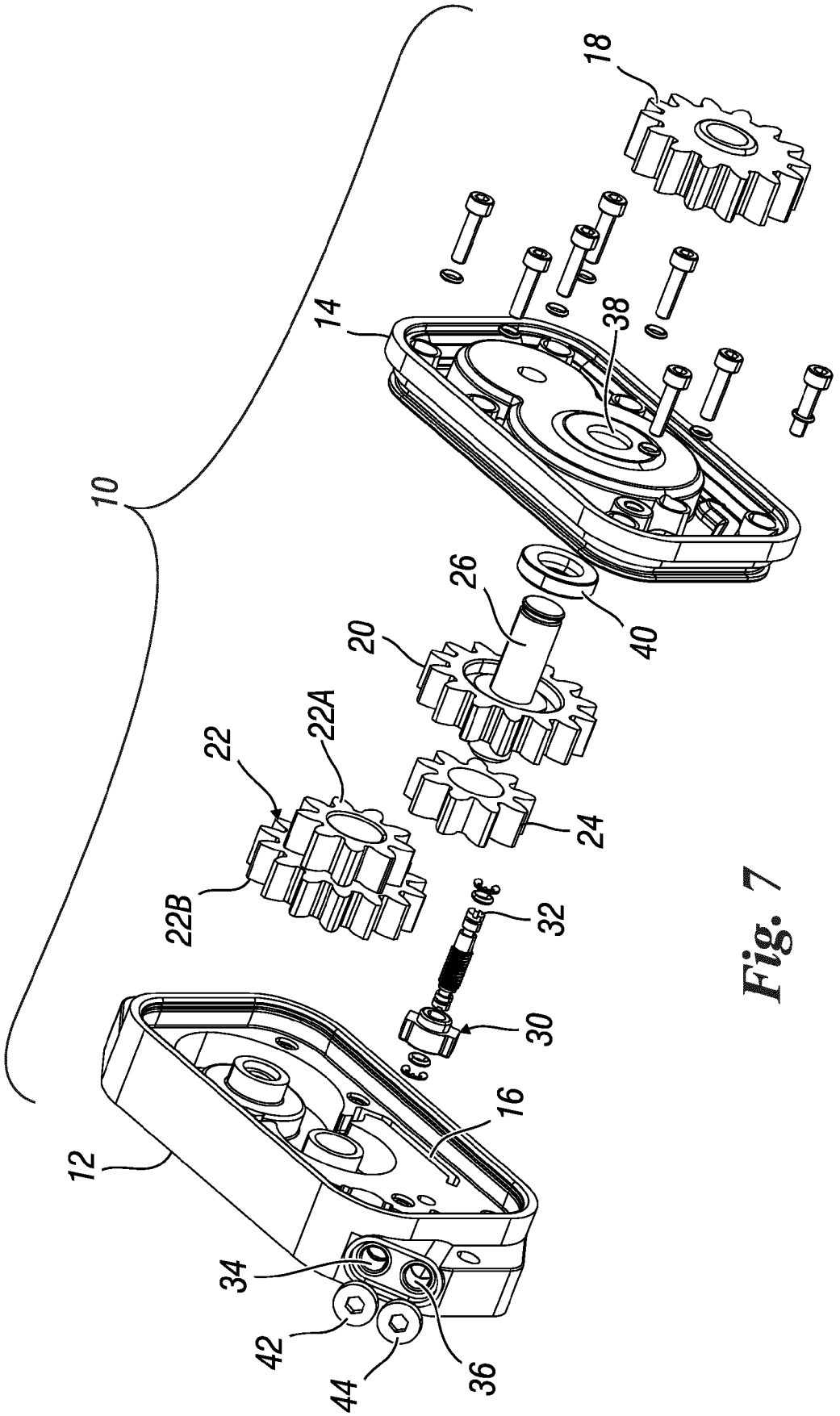

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 20 20 3604

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	KR 200 469 772 Y1 (JANG YOUNG KUN) 7 November 2013 (2013-11-07) * paragraph [0016] - paragraph [0024] * * figures 1-3 *	1-8	INV. E05F5/00
A	DE 20 2005 006931 U1 (HETTICH HEINZE GMBH & CO KG [DE]) 31 August 2006 (2006-08-31) * paragraph [0026] - paragraph [0027] * * figures 1-8 *	1-8	

TECHNICAL FIELDS SEARCHED (IPC)

E05F
F16D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 March 2021	Prieto, Daniel

CATEGORY OF CITED DOCUMENTS

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02-03-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 200469772 Y1	07-11-2013	NONE	
DE 202005006931 U1	31-08-2006	CN 101175425 A	07-05-2008
		DE 202005006931 U1	31-08-2006
		EP 1874159 A1	09-01-2008
		JP 4881945 B2	22-02-2012
		JP 2008538953 A	13-11-2008
		RU 2381732 C2	20-02-2010
		WO 2006114352 A1	02-11-2006

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Patent documents cited in the description

- KR 200469772 Y1 **[0001]**
- DE 202005006931 U1 **[0001]**