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(54) Door arrangement with drive and magnetic lock

(57) The invention discloses a door arrangement comprising a door leaf operating device (1) comprising a driving device utilizing a shaft (5) for performing movement of the door leaf (9) during operation of the door arrangement, said driving device comprising a transmission (7), said shaft (5) is provided with a first magnetic locking device (2) arranged to follow the shaft (5) during

operation and for locking engagement during stand still with a second magnetic device (3). Which second magnetic device (3) is fixed to a structure of the door arrangement, the magnetic locking devices (2,3) are further operatively connected to the door leaf operating device via a transmission (7) of the driving device.

Furthermore, a method for locking a door arrangement in a desired condition is disclosed.

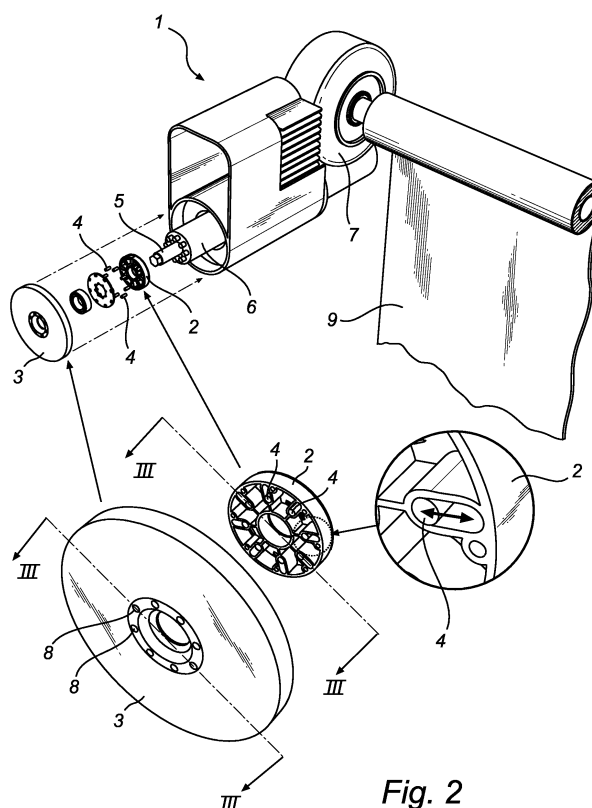


Fig. 2

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Description

Field of the invention

[0001] The invention relates to a door arrangement of the kind disclosed in the preamble of claim 1, which door arrangement comprises a door leaf connected to a driving device utilizing a shaft for performing movement of the door leaf during operation of the door arrangement, said driving device comprises a transmission. Furthermore the invention relates to a method of locking the door leaf in a desired position.

Technical background

[0002] Door arrangements include a number of different types of designs such as overhead doors, vertical lifting doors, folding doors, roller doors etc. An example of a door arrangement of the kind disclosed usually comprises a motor device connected via a transmission for operation of the door in order to achieve an opening or a closing movement of the door.

[0003] In prior art solutions there is sometimes problems, particularly in vibrating environments, with door leaf of building doors slowly unintentionally travelling in direction of the balancing position (position of equilibrium), this phenomenon does particularly occur in vertically vibrating environments, for example at stamping industries.

[0004] There are prior art solutions for preventing a door leaf from accidentally falling down, for example if the spring holding the door leaf in a balanced position breaks, that functions as a kind of emergency brake. These kind of emergency brakes do take care of quick and accelerating processes and not a slowly travelling door leaf.

[0005] Hence, there is a need for an improved door arrangement preventing the door leaf from unintentionally travelling.

Summary of the invention

[0006] One general object of the invention is to improve safety of a door arrangement comprising a motor. A further object of the invention is to provide a door arrangement for a building door that, in relation to prior art door arrangements, provides a device and method for preventing unintentional travelling of the door leaf from a stand still position of the door leaf.

[0007] The above-mentioned object is achieved by a door arrangement comprising a door arrangement comprising a door leaf operating device comprising a driving device utilizing a shaft for performing movement of the door leaf during operation of the door arrangement, said driving device comprising a transmission. Said shaft is provided with a first magnetic locking device arranged to follow said shaft during operation and for locking engagement during stand still with a second magnetic device

being fixed to a structure of the door arrangement. The magnetic locking devices are further operatively connected to said door leaf operating device via the transmission of said driving device.

[0008] The gear ratio of the transmission is used by the magnetic locking device to help avoiding the door leaf from travelling downwards in an vibrating environment. Since the transmission, and gear ratio, decrease the force/torque from the door leaf acting on the magnetic locking device there is only need of a relatively small force for braking the shaft by a locking device.

[0009] Advantageously, the magnetic parts of the first magnetic device are movable, during operation of said shaft, by a centrifugal force, to an inactive position radially away from said shaft for effecting a release of said locking engagement. The magnetic locking device is automatically engaged, for braking of the shaft, at lower rotational speed or stand still. Thus, the principle of locking said shaft enable use of light weight magnetic devices.

[0010] More specifically, the magnetic devices of the door arrangement are provided on a driven side of the transmission of said driving device. The door leaf is operatively connected to the door operating device via a gear transmission, which is driven, at a driven side, by a motor. The magnetic locking device connected to the motor shaft i.e. at the driven side of the transmission.

[0011] Even with a theoretically irreversible transmission there could be problems with an unintentionally travelling door leaf, this is generally when the transmission is designed close to the limit for irreversible gear ratio.

[0012] Preferably, said first magnetic device of the door arrangement has magnetic parts provided in pockets and radially movable in relation to said shaft. The movement of the magnetic parts in the oblong pockets enable the magnetic parts to take an active or inactive position in relation to the second magnetic device.

[0013] Advantageously, the magnetic parts of the first magnetic device are movable, during operation of said shaft, by a centrifugal force, to an inactive position radially away from said shaft for effecting a release of said locking engagement. During operation from stand still the motor overcomes the magnetic force between the first and second magnetic device, the shaft starts to rotate and the magnetic parts of the first magnetic device are pushed, by the centrifugal force, to a position radially out from the shaft. Hence, the distance is increased between the magnets of the first and second magnetic devices during operation and the magnetic locking effect cease automatically during operation.

[0014] Suitably, the magnetic parts of the first magnetic locking device are attractable to an active position radially towards said shaft by the second magnetic device for effecting locking engagement between the first and second magnetic devices.

[0015] A system for operation of the magnetic locking device is not necessary since the activation/inactivation is automatic. Consequently, the risk for failure of the magnetic locking device is minimized.

[0016] Advantageously, the weight of said magnetic parts of the first magnetic locking device are adapted for balancing a magnetic force, between said first and second magnetic device, to a centrifugal force acting on the magnetic parts during operation of said door. This balancing between the magnetic force and the weight of the magnetic parts provides a certain energy/torque for breaking the magnetic lock during start of the driving device. When the centrifugal force in combination with the driving torque, from the motor, the magnetic force between the first and second magnetic device is overcome and the magnetic parts are thrown to the radially outer position by the centrifugal force. The magnetic force between the first and second magnetic devices could also be achieved by electro-magnetic devices or other equipment.

[0017] Suitably, said magnetic parts of the first magnetic locking device are evenly distributed around said shaft. The interaction between the magnetic parts of the first and second magnetic devices is improved by an even distribution of a plurality of magnetic parts, since there is in this case many magnetic parts to interact during stand still. During stand still all of the magnetic parts of the first magnetic device are attracted to the radially inner position by the magnetic force from the second magnetic device.

[0018] The above-mentioned object of the invention is achieved by a method for locking a door arrangement in any condition according to the preamble of claim 8 comprising a door leaf operating device comprising a driving device utilizing a shaft for performing movement of the door leaf during operation of the door arrangement, said driving device comprising a transmission. A first magnetic locking device, provided on said shaft, is following said shaft during operation, and said method comprising the steps of lockingly engage said first magnetic locking device and a second magnetic device during a stand still, which second magnetic device is fixed to a structure of the door arrangement, and operatively connecting said magnetic locking devices to said door leaf operating device via the transmission of said driving device.

[0019] Preferably, the step of operatively connecting said magnetic locking devices includes connecting said magnetic devices of the door arrangement on a driven side of the transmission.

[0020] Advantageously, the method, further comprising the step of providing magnetic parts in pockets of said first magnetic device, which magnetic parts are radially movable in relation to said shaft.

[0021] Suitably, the method, further comprising the step of releasing said locking engagement between the first and second magnetic devices by operation of said shaft effecting the magnetic parts of the first magnetic device to move, by a centrifugal force, to an inactive position radially away from said shaft.

[0022] Advantageously, the method, further comprising the step of attracting the magnetic parts of the first magnetic locking device to an active position radially to-

wards said shaft by the second magnetic device for effecting locking engagement with the second magnetic device. The word lock/locking in the meaning of this application is interpreted as involving at least a distinct holding condition to said lockingly engaged parts.

Brief description of drawings

[0023] By way of example, embodiments of the present invention will now be described with reference to the accompanying figures of drawings in which:

Fig 1a is a perspective view of a vertical lifting building door arrangement.

Fig 1b is a perspective view of an over head building door arrangement.

Fig 1c is a perspective view of a roll up building door arrangement.

Fig 2 is an exploded view of a door leaf operating device according to the invention.

Fig 3a is a section view along the line III-III from fig 2 of the magnetic devices.

Fig 3b is a section view along the line III-III from fig 2 of the magnetic devices, showing the movement of the magnetic parts.

Description of Preferred Embodiments

[0024] One embodiment of the door arrangement, according to the invention, will now be described in relation to Figs. 1 to 3.

[0025] Fig. 1a, 1b, 1c depicts different kind of building door arrangements, where the present invention is suitably.

[0026] Fig. 2 shows a door leaf operating device 1 with a motor 6 driving a transmission 7 connected to the door leaf for operation of the door. The motor is, in this preferred embodiment, an electric motor and the transmission is a worm gear. Other suitable kinds of motor and transmission can also be used. The magnetic lock, comprising the first 2 and second 3 magnetic devices, is provided on the motor shaft 5. The first magnetic device 2 rotates with the motor shaft 5 and the second magnetic device 3 is fixed connected to the motor housing.

[0027] Static magnets 8 in the second magnetic device 3 will attract the magnets 4 in the rotational disc 2, and when the axis, and first magnetic device 2, slows down and stop the magnetic force pulls the magnets 4 in the oval holes of the rotational disc 2 towards the centre axis of the motor. This is since the magnets 4 of the first magnetic device 2 can move radially, in the oval holes, between a position closer to the centre axis and a position radially away from the first position. The corresponding stationary magnets 8 of the second magnetic device 3 are positioned at a radius from the centre axis corresponding to the position closer to the centre axis of the movable magnets 4. When the motor 6 stops rotation of the shaft 5 the magnetic force acting between the static

magnets 8 and the magnets 4 in the rotational disc the movable magnets 4 are attracted to the radially innermost position and the magnetic force helps to prevent the shaft 5 from starting to rotate unintentionally. In this stand still condition the gravity is overcome by the magnetic force and even magnetic parts 4 in the lower part of the first magnetic device 2 are attracted upwards towards the shaft 5. The locking torque from the first and second magnetic devices is approximately 0,5-1 Nm, this is enough, in combination with the gear ratio from the transmission, to prevent the door blade from unintentional travelling in for example vibrating environment. This kind of vertically vibrating environment is present at industries, but vibrations at the door arrangement could also result from wind or other conditions. The progress of doors is in the direction of faster opening/closing of doors, therefore the gear ratio of the transmission 7 is increasing. During the latest development the gear ratio of the transmission has been increased from 1:67 to 1:41 and consequently the limit for irreversibility of the transmission is coming closer. Even with an irreversible transmission there could be problems with slowly unintentional travelling of the door blade in a vibrating environment. But the magnet lock according to the present invention applied at the motor side of a transmission 7 driving a door leaf 9, in combination with the gear ratio of the transmission 7 can prevent this problem.

[0028] Fig 3 depicts a section of the first 2 and second 3 magnetic device. When the motor starts to rotate the shaft 5, the torque from the motor overcomes the magnetic locking force (periphery direction). The magnetic force between the static magnets 8 and the magnets 4 in the rotational disc 2 is also affected and overcome by the centrifugal force (radial direction) and the magnets 4 in the rotational disc 2 are pushed outwards (in the elongated slot in the rotational disc) by the centrifugal force. During further operation, opening or closing, of the door the magnetic parts 4 remain in the radially outer position and hence there is no braking magnetic force acting between the first 2 and second 3 magnetic device during operation, this is as long as the first magnetic device 2 is rotating.

[0029] The magnetic parts 4 are positioned in elongated radially directed pockets in the rotational disc 2, which is made of plastic. A lid is attached at the rotational disc 2 over the magnetic parts 4 and the elongated pockets for protection and holding the magnetic parts in place. The lid can be attached by for example welding or gluing or other suitable method.

[0030] The magnetic parts 4 of the first magnetic locking device 2 and the magnetic components 8 of the second magnetic device are positioned just opposite each other at stand still as shown in fig 3a. When the first magnetic device 2 is rotating with the shaft 5 the magnetic parts 4 are moving in a radially direction as shown in fig 3b, this gives a radial distance between the magnetic parts 4 and 8 and the magnetic attraction between the magnetic parts 4 and 8 cease.

[0031] In this preferred embodiment, the magnetic parts 4 and 8 are evenly distributed around the centre axis.

[0032] In an alternative embodiment the magnetic parts 4 and 8 could be electro-magnets to be activated/operated.

[0033] The magnetic locking device brakes/locks the motor shaft 5 during stand still, the motor shaft 5 is connected to the transmission 7 for driving an outgoing shaft for operation of the door leaf. By using a transmission with high gear ratio or even an irreversible transmission the braking/locking force at the motor shaft 5 can be at a low level but still manage to avoid unintentional rotation of the outgoing shaft.

Claims

1. Door arrangement comprising a door leaf operating device (1) comprising a driving device utilizing a shaft (5) for performing movement of the door leaf (9) during operation of the door arrangement, said driving device comprising a transmission (7).

characterized in that said shaft (5) is provided with a first magnetic locking device (2) arranged to follow said shaft during operation and for locking engagement during stand still with a second magnetic device (3) being fixed to a structure of the door arrangement, said magnetic locking devices (2,3) is further operatively connected to said door leaf operating device via said transmission (7) of said driving device.

2. Door arrangement (1) according to claim 1, wherein said magnetic devices (2,3) is provided on a driven side of the transmission (7) of said driving device.
3. Door arrangement (1) according to any one of claims 1 to 2, wherein said first magnetic device (2) has magnetic parts (4) provided in pockets and radially movable in relation to said shaft (5).
4. Door arrangement (1) according to any one of claims 1-3, wherein magnetic parts (4) of said first magnetic device (2) are movable, during operation of said shaft (5), by a centrifugal force, to an inactive position radially away from said shaft for effecting a release of said locking engagement.
5. Door arrangement (1) according to any one of claims 1-4, wherein magnetic parts (4) of the first magnetic locking device (2) are attractable to an active position radially towards said shaft (5) by the second magnetic device for effecting locking engagement between the first and second magnetic devices.
6. Door arrangement (1) according to any one of claims 1-4, wherein the weight of magnetic parts (4) of the first magnetic locking device (2) are adapted for bal-

ancing a magnetic force, between said first (2) and second magnetic device (3), to a centrifugal force acting on the magnetic parts (4) during operation of said door.

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7. Door arrangement (1) according to any one of claims 1-6, wherein magnetic parts (4) of the first magnetic locking device (2) are evenly distributed around said shaft (5).

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8. Method for locking a door arrangement in a desired condition, said door arrangement (1) comprising a door leaf operating device comprising a driving device utilizing a shaft (5) for performing movement of the door leaf (9) during operation of the door arrangement and said driving device comprising a transmission (7)

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characterized in that a first magnetic locking device (2), provided on said shaft, is following said shaft during operation, and comprising the steps of

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lockingly engage said first magnetic locking (2) device and a second magnetic device (3) during stand still, which second magnetic device is fixed to a structure of the door arrangement,

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operatively connecting said magnetic locking devices (2,3) to said door leaf operating device via said transmission (7) of said driving device.
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9. Method according to claim 8 comprising the step of operatively connecting said magnetic locking devices includes connecting said magnetic devices of the door arrangement on a driven side of the transmission.
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10. Method according to anyone of claims 8 to 9, further comprising the step of

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providing magnetic parts (4) in pockets of said first magnetic device (2), which magnetic parts (4) are radially movable in relation to said shaft (5).
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11. Method according to anyone of claims 8-10, further comprising the step of releasing said locking engagement between the first (2) and second magnetic devices (3) by operation of said shaft (5) effecting the magnetic parts (4) of the first magnetic device (2) to move, by a centrifugal force, to an inactive position radially away from said shaft.

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12. Method according to anyone of claims 8 to 11, further comprising the step of

attracting the magnetic parts (4) of the first magnetic locking device (2) to an active position radially towards said shaft (5) by the second magnetic device (3) for effecting locking engagement with the second magnetic device (3).

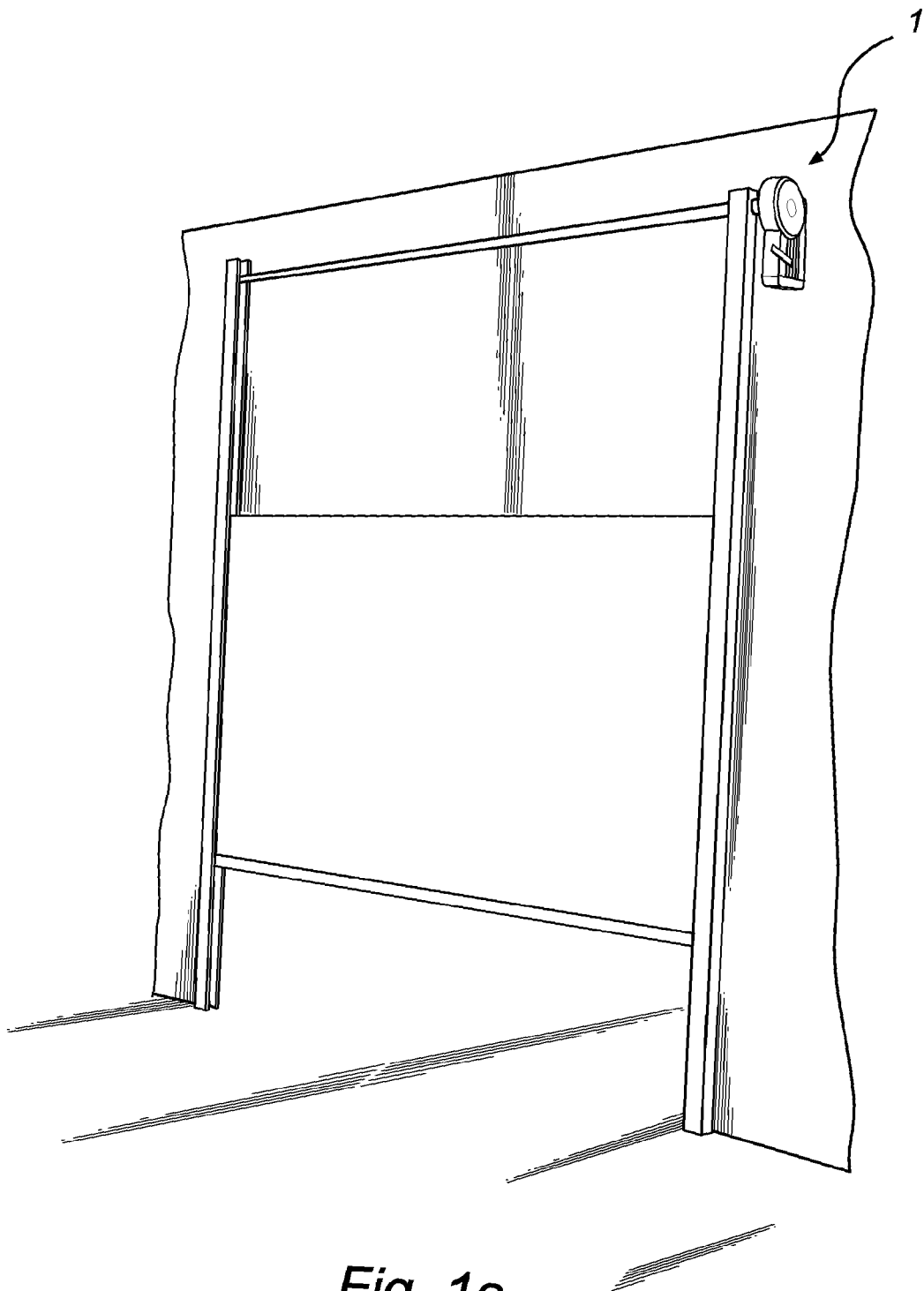


Fig. 1a

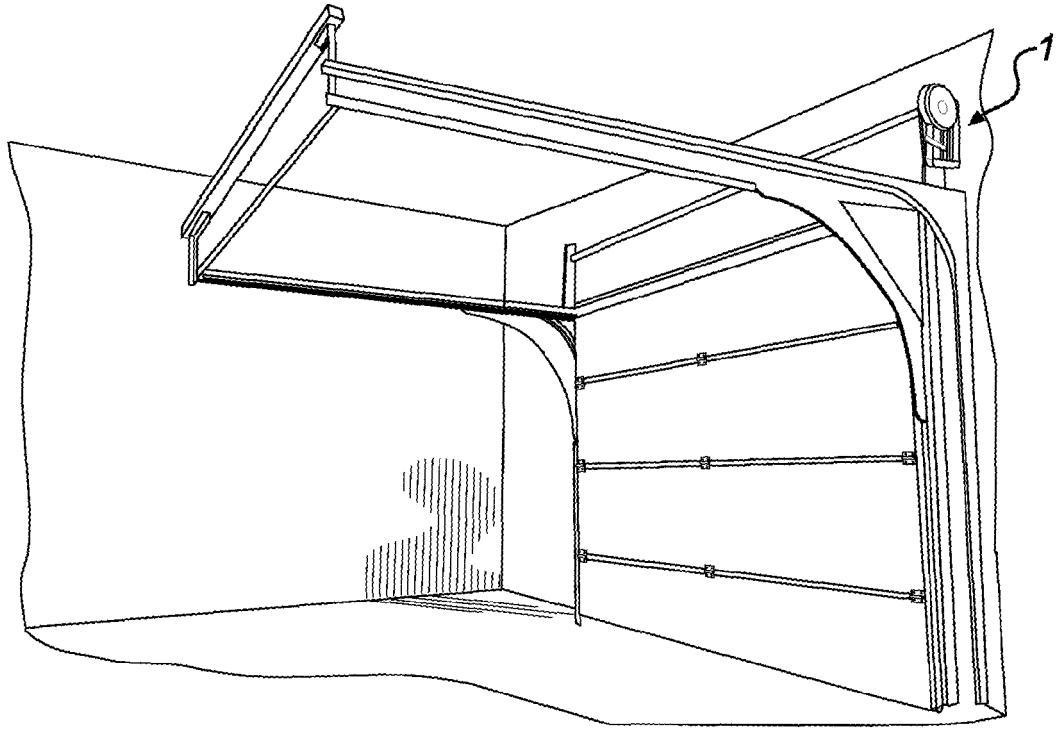


Fig. 1b

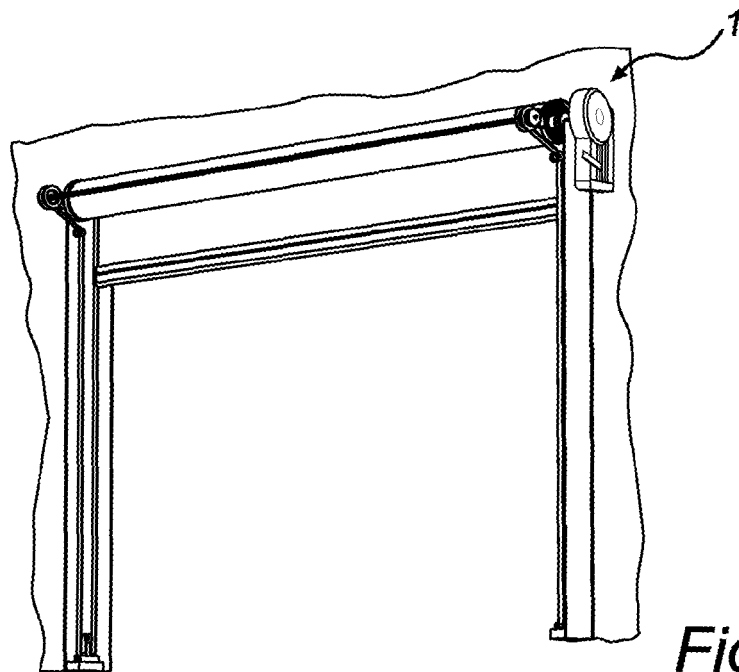


Fig. 1c

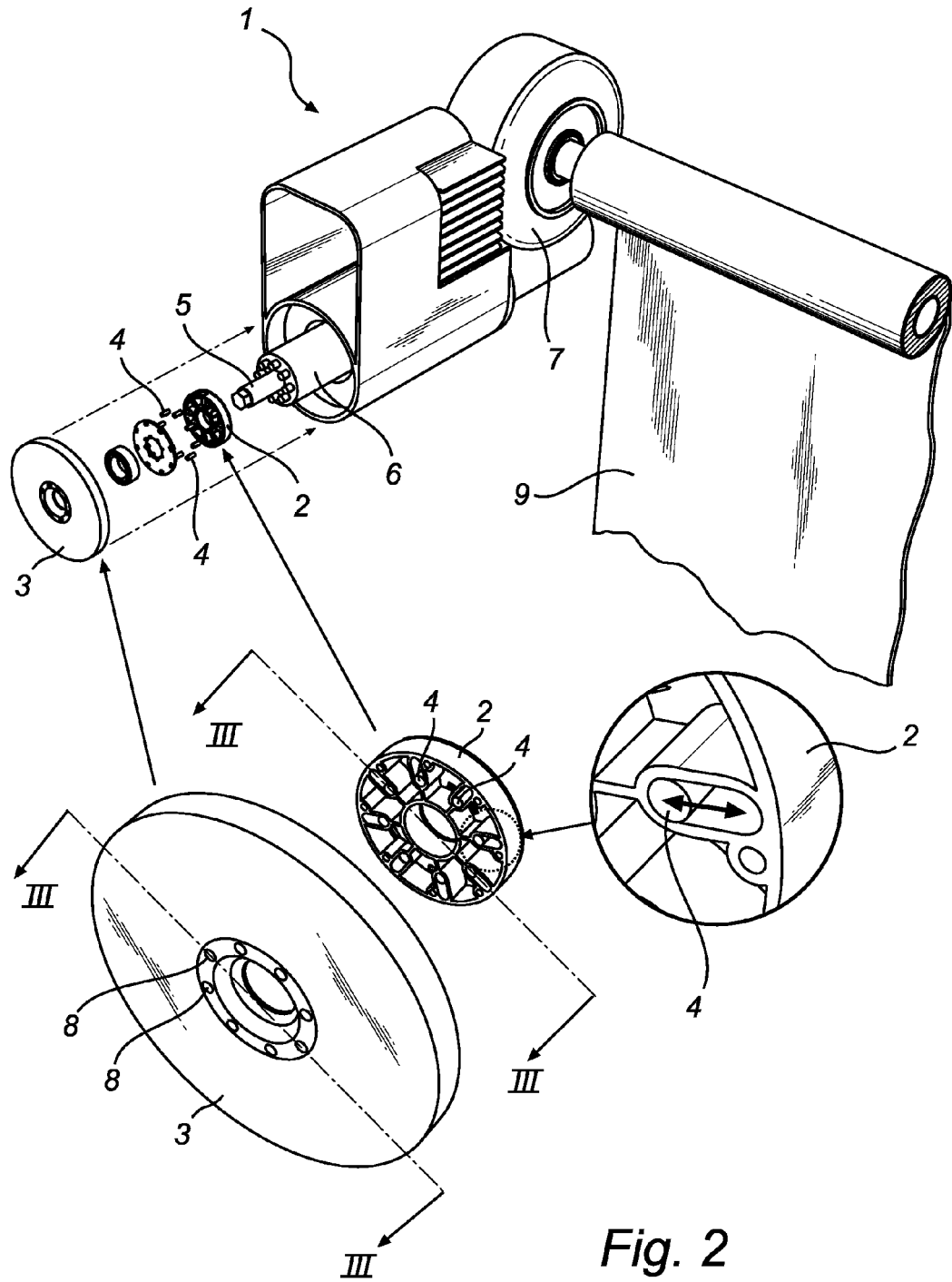


Fig. 2

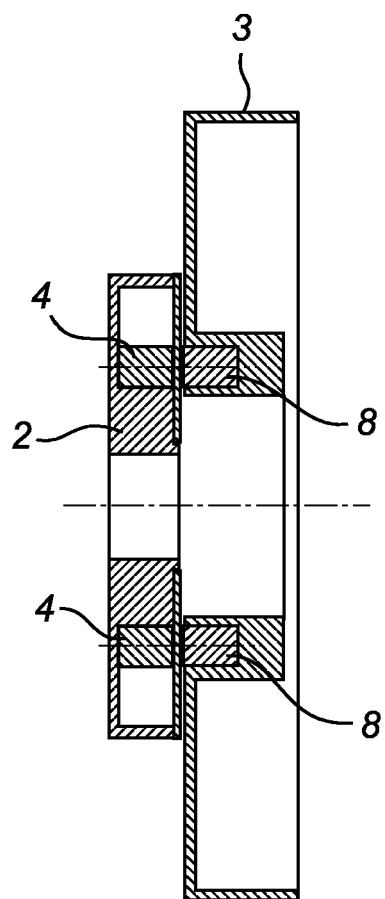


Fig. 3a

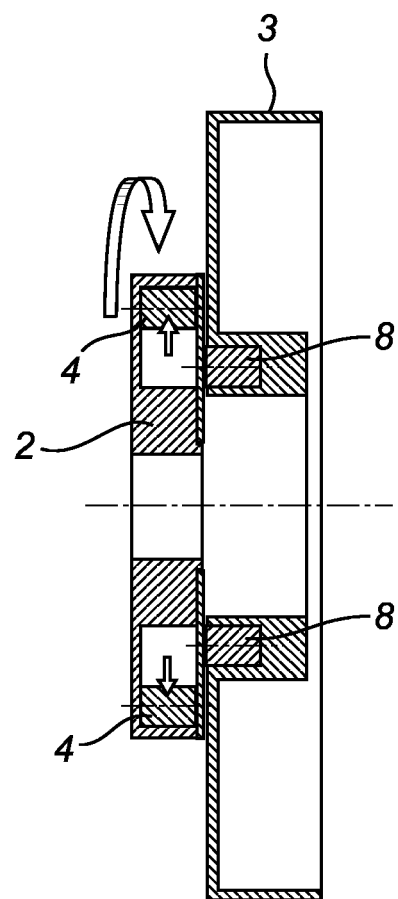


Fig. 3b



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 05 10 4039

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 6 794 778 B1 (WALKER WINSTON G ET AL) 21 September 2004 (2004-09-21)	1,2,7-9	E05F5/00 E05B65/00
Y	* column 4, lines 63-67 *	3,10	
A	* column 5, lines 18-62 *		
	* figures 1-3 *	4-6,11, 12	

X	EP 1 306 507 A (N. NORHOLM & K. LEMMING A/S) 2 May 2003 (2003-05-02)	1,7,8	
A	* paragraph [0024] *	2-6,9-12	
	* figures 1-3 *		

Y	US 4 681 279 A (NAKAMURA ET AL) 21 July 1987 (1987-07-21)	3,10	
	* column 4, lines 1-19 *		
	* column 4, line 59 - column 5, line 4 *		
	* figures 2,3,6,7 *		

The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7) E05D E05F E06B E05B
Place of search		Date of completion of the search	Examiner
The Hague		28 September 2005	Mund, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 05 10 4039

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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28-09-2005

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