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(54) **Lock arrangement**

(57) A multi-point lock comprising a locking unit (12b) arranged to be mounted in a door and a lock rail (24) arranged to be mounted to a frame for said door, where with the lock rail is linearly movable between a first and a second end position. A spring (28) exerts a force (F1) on the lock rail in a direction towards an open end position. Through the means of a force means (26a, 32a), such as magnets, that exert a force (F2) on the lock rail in a direction towards a locked end position there is achieved a balance of the spring force, which minimizes tearing on the locking unit and provides a better user friendliness.

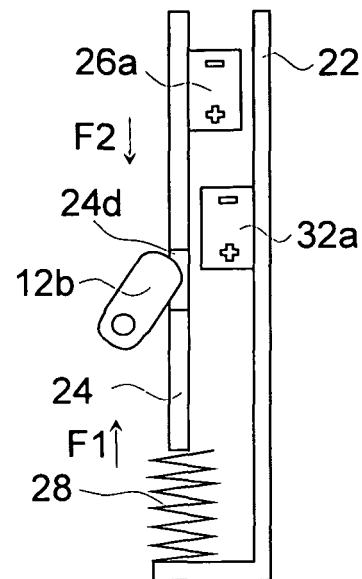


Fig. 7a

Description

TECHNICAL FIELD

[0001] The present invention relates generally to a lock arrangement and then in particular to a multipoint lock with an enhanced performance.

BACKGROUND

[0002] The demands on the lock arrangements of today are generally getting higher and higher in regard to for example user-friendliness and durability.

[0003] A so-called multipoint lock is a lock with which there are more than one lock point, i.e. a connection point between the door and doorframe. Such locks are comprised with a number of arrangements, such as three interconnection arrangements that are simultaneously controlled by a lock unit or a handle. This can for example be achieved by means of a lock rail, which is movable in a vertical direction under the control of a locking device and which during movement acts one or more coupling arrangements.

[0004] At this type of multipoint lock it is preferable that the displacement of the lock rail can be achieved with as little force as possible for increasing the user friendliness and reduce the wear of the lock arrangement by which the lock rail is manoeuvred. It is at the same time important that the lock rail is returned to an open end position when the lock arrangement is unlocked by means of, for example, a spring force. When this desire is achieved, for example, by means of a spring, there is however a risk that a key by which the lock arrangement is manoeuvred can not be taken out without exerting a rotational force on said key.

SUMMARY OF THE INVENTION

[0005] One object of the present invention is to provide a lock arrangement of the kind described in the introduction, which exhibits great user friendliness and durability.

[0006] The invention is based on the insight that one can arrange a power exerting means in the form of at least one magnet that non-linearly counteracts the spring force, that strives to move the lock rail to an unlocked end position.

[0007] According to the invention there is provided a lock arrangement that includes a locking unit arranged to be mounted in a door, wherein said locking unit comprises a bolt that is rotatable between an open position and a locked position, a lock rail arranged to be mounted to a frame of said door, wherein the lock rail is linearly movable between a first and a second end position, and a spring which exerts a force on the lock rail in a direction towards the first end position, wherewith the lock rail comprises a groove in which the bolt engages when said bolt is in the locked position, when the lock rail is in the second end position. The lock arrangement is characterized by

at least one magnet which exerts a force on the lock rail in a direction towards the second end position, wherein the net force that is being exerted on the lock rail by the spring and the magnet is in a direction towards the first end position when the lock rail is in a position between the first end portion and a neutral position, and in a direction towards the second end portion when the lock rail is in a position between said neutral position and the second end position.

10 [0008] There is also provided a cabinet that is defined in the accompanying claim 10.

[0009] In this manner there is achieved a lock arrangement at which the need of a rotational force exerted on the key, when it is taken out of the lock, is avoided. The lock arrangement according to thus comprises at least one magnet that is arranged to exert a force on the lock rail, in a direction towards the second end position. Due to the fact that a magnet is being used for achieving a force in a opposite direction to the spring force, there is achieved a number of special advantages. The use of a magnet achieves directly, without other adaptations, that the counteracting force is non-linear. The magnet gives under contact with a cooperating means such as another magnet or a member of magnetic material, a sufficiently large retentive force when the bolt and the lock rail are in their locked positions. As soon as the bolt is rotated in the opening direction so that the contact between the magnet and the other means is broken, the inhibit ability of the magnet causes the force to decline rapidly, almost instantly, wherewith the spring force directly exceeds the magnetic force and moves the lock rail and the bolt to their open positions. Hereby there is achieved a very easily manoeuvred and ergonomically advantageous lock arrangement wherein the small manoeuvring force contributes to reduce the wear of the key and where no force is required to be exerted to the key when it is taken out.

[0010] In an exemplifying embodiment of the lock arrangement the force that is exerted by the magnet varies non-linearly in regard to the position of the lock rail in order to achieve a total non-linear force on the lock rail.

[0011] The lock arrangement preferably comprises one pair or multiple pairs of cooperating magnets which are cheap and easy to mount and which also does not take up a lot of space.

45 [0012] Some of the magnets are preferably mounted on a sliding block that is situated on the lock rail, wherein one can utilize existing parts for the mounting.

[0013] The lock arrangement preferably comprises an outer rail, in which the lock rail is slidably arranged which gives a compact solution, especially if some of the magnets are mounted to the outer rail.

[0014] Other preferable embodiments of the invention are defined in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The invention will hereby be described by the way of example, with reference to the accompanying

drawings, wherein:

Fig. 1 is an overview of a cabinet door and a cabinet wall that shows a lock arrangement according to the invention,

Fig. 2 is an exploded view of a lock arrangement according to the invention,

Fig. 3a is an overview of the lock arrangement in fig. 1 in an unlocked position,

Fig. 3b is a detailed view of an upper door hinge at the lock arrangement in fig. 3a,

Fig. 3c is a detailed view of a locking bolt at the lock arrangement in fig. 3a,

Fig. 4a-c corresponds to fig. 3a-c but during a locking operation,

Fig. 5a and 5c corresponds to fig. 3a and 3c but with the lock arrangement in a locked position,

Fig. 5b is a detailed view of a lower door hinge at the lock arrangement in fig. 3a in a locked position,

Fig. 6a-c corresponds to fig. 5a-c but during an unlocking operation,

Fig. 7a-c are schematic sketches showing the principle of a lock arrangement according to the invention and

Fig. 8 is a curve diagram illustrating vertical forces on a lock rail at a lock arrangement according to the invention as a function of vertical position.

EMBODIMENTS

[0016] In the following text a preferred embodiment of a lock arrangement according to the invention will be described in detail, foremost in reference to fig. 1. Even if reference is made in this description in regard to different directions, such as upper and lower, vertically and horizontally etc., it shall be understood that the references depict what is being shown in the different figures and shall therefore not be seen as limited beyond this.

[0017] In fig. 1 there is shown a part of a cabinet 1 with a cabinet door 2 and a side member 3. A lock arrangement 10 according to the invention comprises a lock unit in the form of a lock 12 that is mounted in the cabinet door 2. The lock is of a conventional kind and includes a housing 12a with a rotatably mounted core therein, which when rotated causes a lock bolt 12b to be moved between a vertical and a horizontal position. Furthermore, there are two door hinges 14 attached to the inside of the cabinet door.

[0018] Furthermore the lock arrangement 10 comprises a rail construction 20 that is attached to the door frame on the inside of the side member 3.

[0019] The parts comprised in the rail construction 20 are shown in fig. 2, wherein the two main parts are an outer rail 22 and a lock rail 24.

[0020] The outer rail 22 is made of a square tube made of, for example, aluminium that exhibits a number of through holes 22a for fixing screws. A notch 22b is arranged for an injection moulded magnet holder 32, which is fastened to the outer rail. The magnet holder functions in holding a number of force members in the form of magnets, preferably two magnets 32a, in place. These magnets that can be made of neodym are, in a preferred embodiment, cylinder magnets with a diameter in the order of 5mm and a height of around 5mm.

[0021] Furthermore the outer rail presents two recessed and non-through notches 22c for a respective door fastener 14.

[0022] Furthermore there are two different notches 22d, 22e for lock bolts of different kinds. This gives the lock arrangement flexibility in regard to the lock design due to the fact that numerous notches for lock bolts enable the use of the rail construction together with many different types and designs of lock bolts. The outer rail also exhibits a notch for a bottom plate 30, whose function is to hold in place a biasing arrangement in the form of a spring 28. Laminated plugs 34 are inserted into the end portions of the outer rail in order to protect against moisture and dirt as well as sabotage.

[0023] The lock rail 24 that is manufactured of a material of high durability, such as anticorrosion-tempered steel, exhibits a number of elongated holes 24a through which the fixing screws will extend. These holes also define the length of stroke for the locking, i.e. the maximal vertical movement of the lock rail between an upper end position, corresponding to an open position, and a lower end position, corresponding to a locked position. Furthermore there exist a number of holes for snap arrangements on a number of sliding blocks 26, that are mounted to the lock rail for guiding of its sliding movement. The topmost sliding block, shown furthest to the right in the figure, is arranged for the receiving of two force members in the form of magnets 26a of the same kind as the aforementioned magnets 32a. The two magnets 32a in the magnet holder 32 are arranged to cooperate with the two magnets 26a in the sliding block, such as described below.

[0024] Two L-shaped notches 24c are arranged in the lock rail 24 with openings for the receiving of a respective door fastener 14. It is at these notches that two of the lock points are situated. Lastly the lock rail exhibits the notches 24d, 24e for a bolt and which correspond to the notches 22d, 22e in the outer rail.

[0025] The general function of the lock arrangement 1 is the following. In an unlocked position, see fig. 3a-c, the lock bolt 12b is in a vertical position and therefore does not interfere with the rail construction 20. The lock

rail 24 is freely movable relative to the door fasteners 14 due to the fact that the openings of the notches 24c are leveled with the respective door fastener. Therefore the cabinet door may freely be opened and closed with the lock arrangement in a position as shown in fig. 3a-c.

[0026] In fig. 4a-c the lock arrangement is shown when a locking operation has commenced due to the lock bolt 12b having been given a movement to the position shown in fig. 4a and 4c. It will be seen in fig. 4c that the lock bolt in this movement engages with the bolt notch 24d in the lock rail 24 and that during continuous rotation pushes this down against the force of the spring 29, as is illustrated by the downwardly directed arrow in the figure. As illustrated in fig. 4b this downwardly directed movement of the lock rail leads to the openings of the notches 24c for the door fasteners 14 to be moved, such that the door fasteners end up in the inner portion of the notches. Thereby, the door fasteners are locked in place and two further lock points have been achieved in addition to the one located where the bolt 12b engages with the lock rail.

[0027] The movement of the lock bolt 12b to a horizontal position, i.e. a locked position for the lock arrangement, has been completed in fig. 5a-c. It will be seen that the spring 28 has been compressed to its maximal potential.

[0028] In fig. 6a-c it is shown that the movement of the lock bolt 12b from a horizontal to a vertical position gives the lock rail the reversed movement, i.e. an upward movement.

[0029] Again with reference to fig. 5a-c, there will be seen that the upwardly directed force that the spring 28 exerts on the lock rail 24 during locking causes the lock rail in turn to exert an upwardly directed force on the lock bolt 12b. This force on said lock bolt must be resisted by a user through via a rotational force on the key that is inserted into the lock housing 12a. Such a rotational force eventually leads to tearing at the key and lock tong.

[0030] The aforementioned unwanted rotational force is avoided with the aid of a magnetic force that counteracts the force exerted by the spring 28, in such a way as will be described under the reference of fig. 7a-c and fig. 8. The spring 28 exerts an upwardly directed force F1 on the lock rail 24 with a strength that varies in proportion to the vertical position of said lock rail.

[0031] This is shown in fig. 8 where the "Open position" corresponds to fig. 7a, "Neutral position" corresponds to fig. 7b and "Locked position" corresponds to fig. 7c. The upwardly directed force from the spring on the lock rail thus varies in a linear fashion from essentially zero in the open position to a value of "+x" in the locked position. The value of x is decided from the application in question.

[0032] The magnets 26a that are mounted to the lock rail 24 and the magnets 32a that are mounted to the outer rail 22 exert a force of attraction on each other. This force results in a downwardly directed force F2 on the lock rail that also varies depending on the vertical position of the lock rail, as is apparent in fig. 8, to a maximum negative value that is lower than "-x". Contrary to the upwardly

directed force F1 the downwardly directed force F2 varies in a non-linear fashion in regard to the vertical position of the lock rail. The net force, i.e. $F1-F2$ is also shown in this figure. The spring 28 and the magnets are dimensioned and placed so that the net force is negative, i.e. directed downwardly between the locked position and the neutral position and positive, i.e. directed upwardly between the neutral position and the open position. This results in the following effect.

[0033] When a user rotates the lock bolt with the aid of a key from the open position in fig. 7a to the neutral position in fig. 7b, this is done against a positive, i.e. an upwardly directed net force. When the neutral position in fig. 7b has been passed and the rotation continues to the locked position in fig. 7c the rotation is carried out with a negative, i.e. a downwardly directed net force that, in practice, aids the rotational movement. In the locked position the lock rail 22 takes a stable lower end position where the downwardly directed magnet force is greater than the upwardly directed spring force. This means that a user that takes out the key from the lock can do this without a rotational force on the cylinder core must be counteracted, which in turn leads to less tearing on the key and cylinder core.

[0034] At the dimensioning of the spring 28 and the magnets 26a, 32a it is important that the spring is dimensioned so that it is able to return the lock rail to its upper end position with a good margin as well as not exerting a greater force than the force of attraction of the magnetic joint in the locked position. It is also important that the net force $F1-F2$ has a maximum value - positive or negative - that is not so great as to put up an uncomfortable resistance when the lock bolt 12b is being moved between a locked position and an open position.

[0035] A preferred embodiment of a lock arrangement according to the invention has been described. A man skilled in this particular field will realize that this can be varied within the scope of the accompanying claims. Thus, the lock rail 24 may be comprised of numerous parts that are assembled together by for example sliding blocks, which from a manufacturing view may be preferred.

[0036] A lock tong 12 has been shown and described as a locking unit. In an alternative exemplifying embodiment this locking unit may be replaced by one of a different kind, such as a so-called coin lock, which is intended for receiving a coin in order to enable locking.

[0037] A three-point lock has been described. It will be evident that the idea of the invention is also applicable on locks with more or less lock points than three.

[0038] Even if a lock arrangement has been shown comprising a lock tong in a cabinet door and the rail construction is attached to a cabinet wall it shall be seen that the reverse is also possible. It will also be seen that the lock arrangement according to the present invention may be used for other purposes than a cabinet lock.

[0039] Even if magnets have been described as the members that exert a counteracting force to the spring

force there will be seen that other types of members are possible, such as springs with non-linear spring constant.

Claims

1. A lock arrangement, comprising:
 - a locking unit (12) arranged to be mounted in a door, wherein the locking unit comprises a bolt (12b) that is rotatable between an open position and a locked position, 10
 - a lock rail (24) arranged to be mounted to a frame of said door, wherein the lock rail is linearly movable between a first and a second end position, and 15
 - a spring (28) which exerts a force (F1) on the lock rail in a direction towards the first end position, 20
 - wherewith the lock rail comprises a notch in which the bolt engages when the bolt is in the locked position, when the lock rail is in the second end position, 25
- characterized by 25
 - at least one magnet (26a, 32a) that is arranged to exert a force (F2) on the lock rail in a direction towards the second end position, 30
 - wherewith the net force that is being exerted on the lock rail by the spring and the magnet is in a direction towards the end position for the lock rail when it is in a position between the first end position and a neutral position, and in a direction towards the second end position for the lock rail when it is positioned between the neutral position and the second end position. 35
2. A lock arrangement according to claim 1, wherein the force from the spring (28) on the lock rail varies linearly depending on the position of said lock rail. 40
3. A lock arrangement according to claim 2, wherein the force from the spring (28) on the lock rail (24) is essentially zero when said lock rail is in its first end position. 45
4. A lock arrangement according to any one of claims 1-3, wherein the force (F2) that is exerted by the magnet (26a, 32a) varies non-linearly depending on the position of the lock rail. 50
5. A lock arrangement according to claim 4, comprising a first array of magnets with at least one magnet (26a) arranged at the lock rail (24) and a second array of magnets with at least one magnet (32a) arranged at said door frame. 55

6. A lock arrangement according to claim 5, comprising a number of sliding blocks (26) that are mounted to the lock rail for guiding of its movement, wherein at least one of said sliding blocks is arranged for mounting of the first array of magnets (26a). 5
7. A lock arrangement according to claim 5 or 7, comprising an outer rail (22), in which the lock rail (24) extends, wherein the second array of magnets (32a) is mounted to the outer rail. 10
8. A lock arrangement according to claim 7, where with the outer rail (22) is a square tube, in which the lock rail is slidably arranged. 15
9. A cabinet (1) comprising a lock arrangement according to claim 1. 20

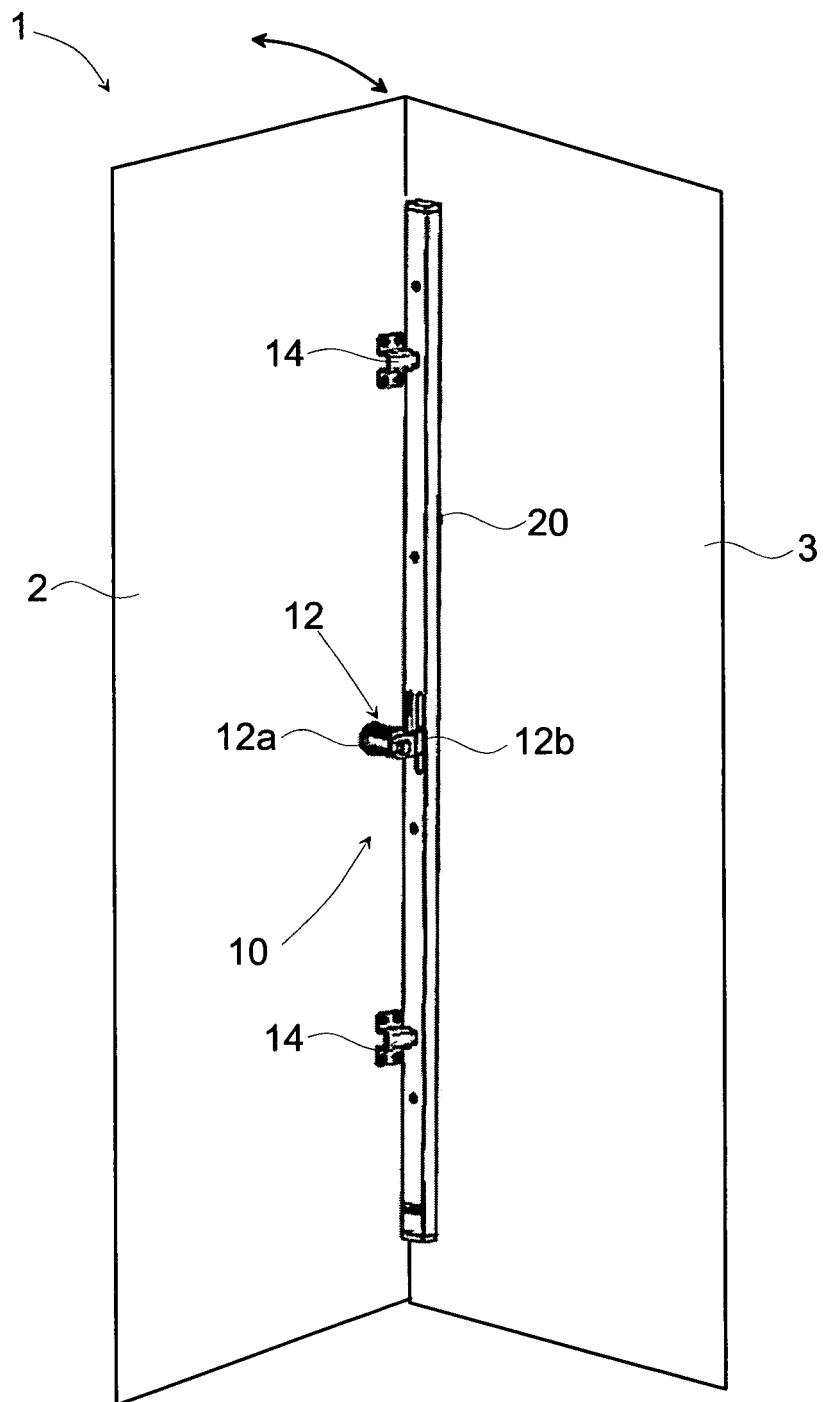


Fig. 1

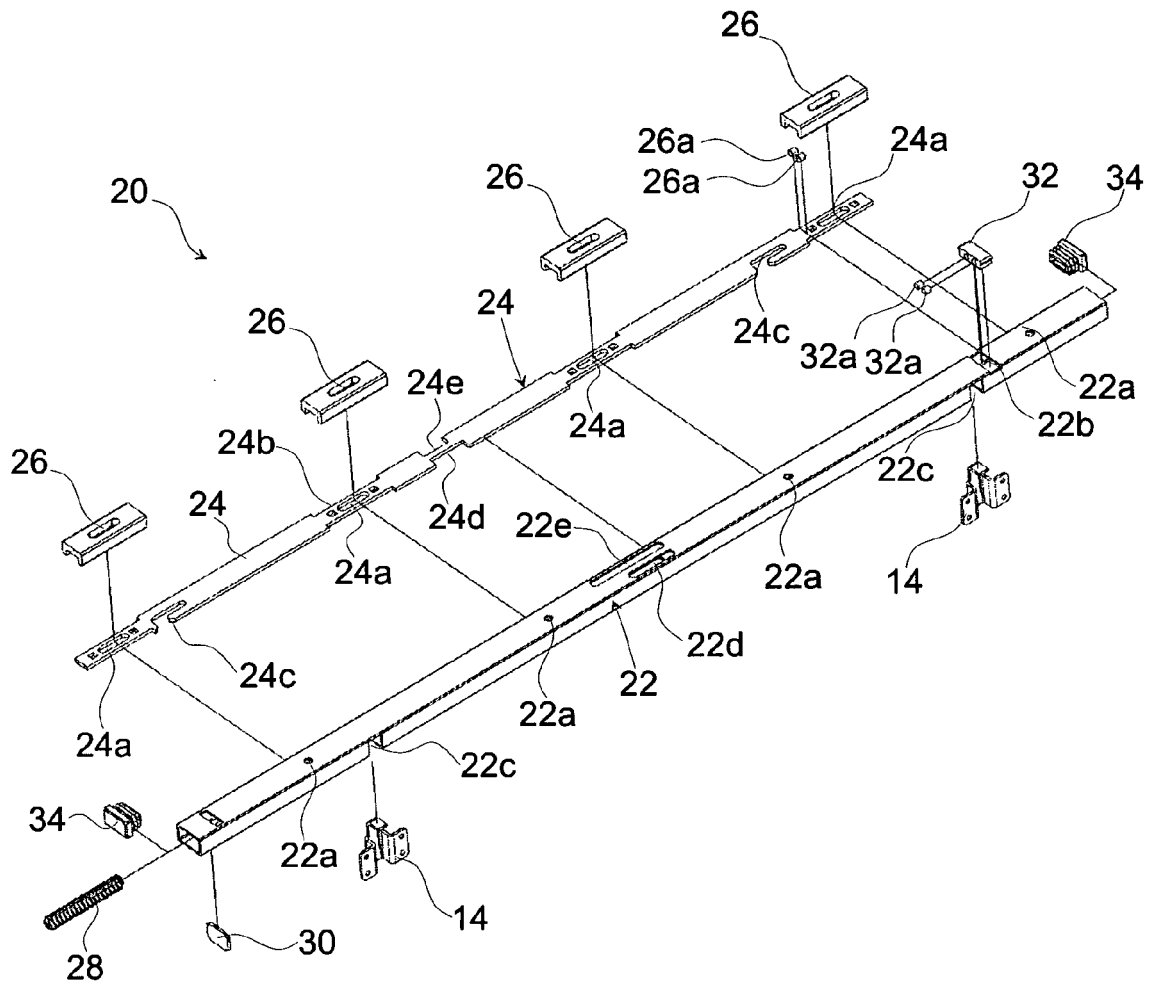


Fig. 2

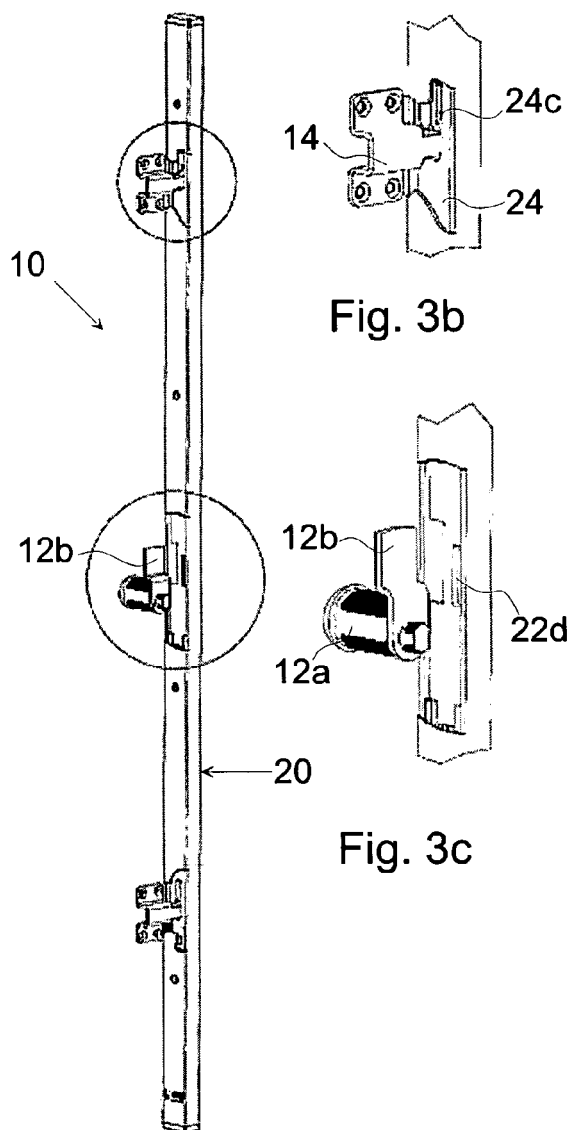


Fig. 3b

Fig. 3c

Fig. 3a

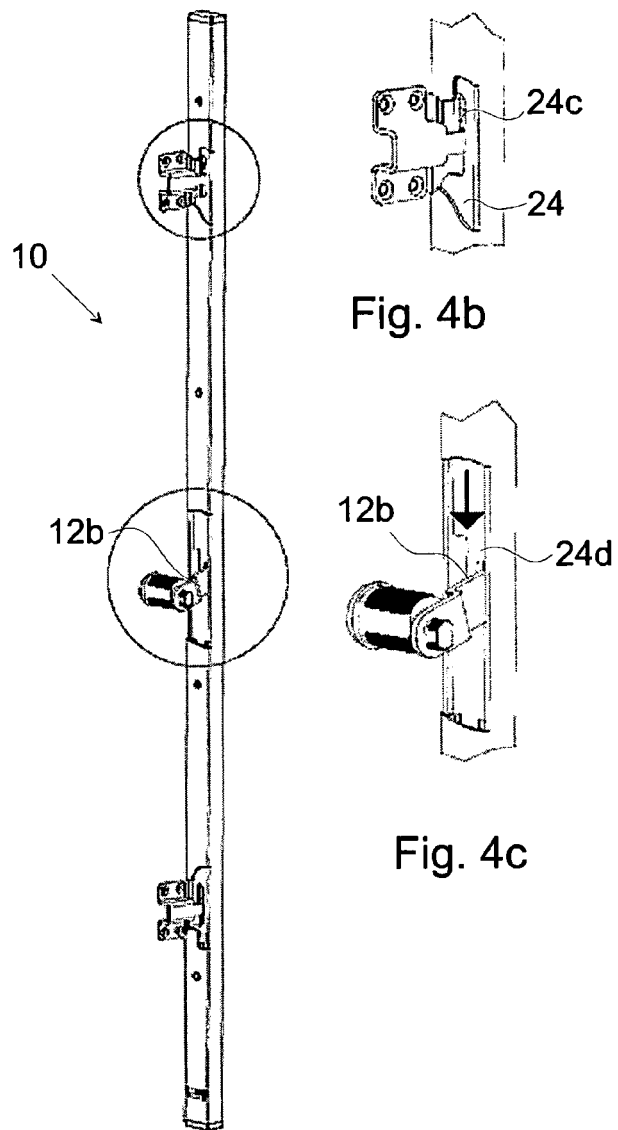


Fig. 4b

Fig. 4c

Fig. 4a

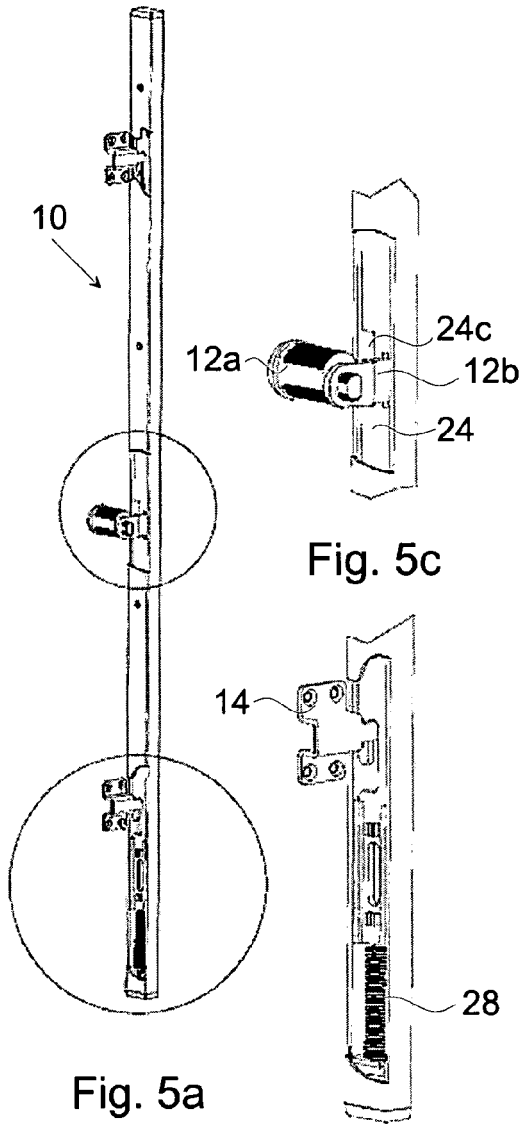


Fig. 5a

Fig. 5b

Fig. 5c

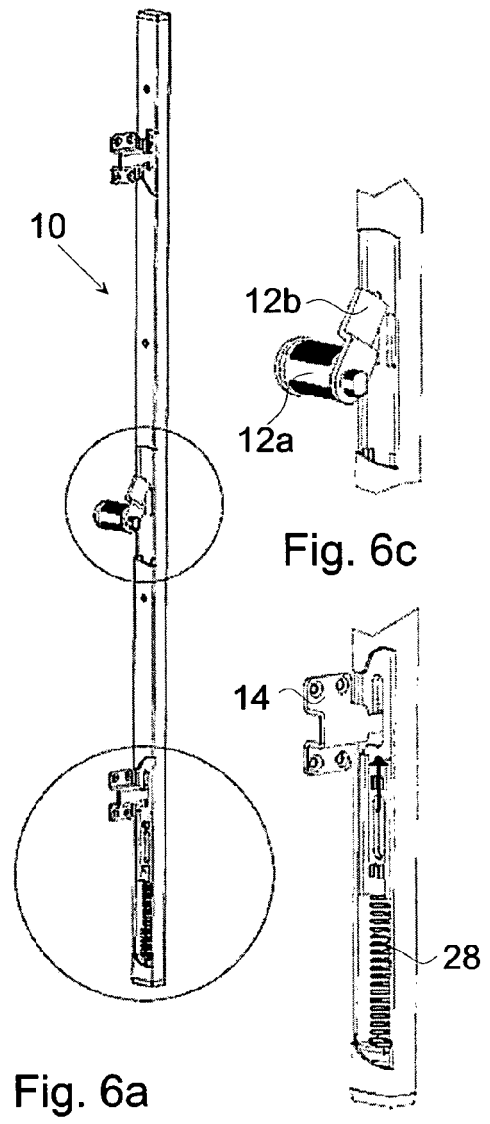


Fig. 6a

Fig. 6b

Fig. 6c

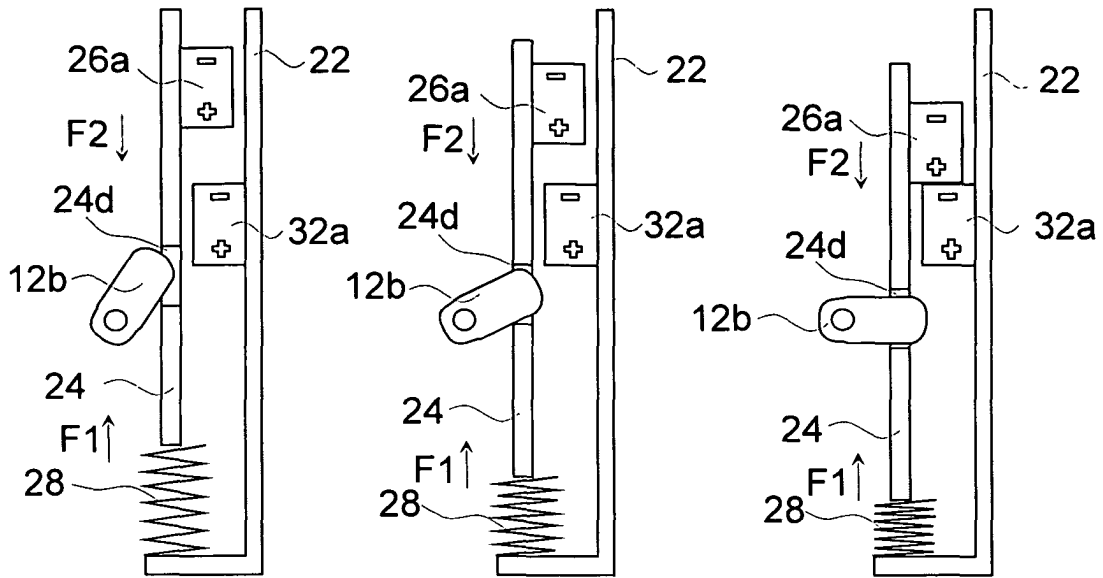


Fig. 7a

Fig. 7b

Fig. 7c

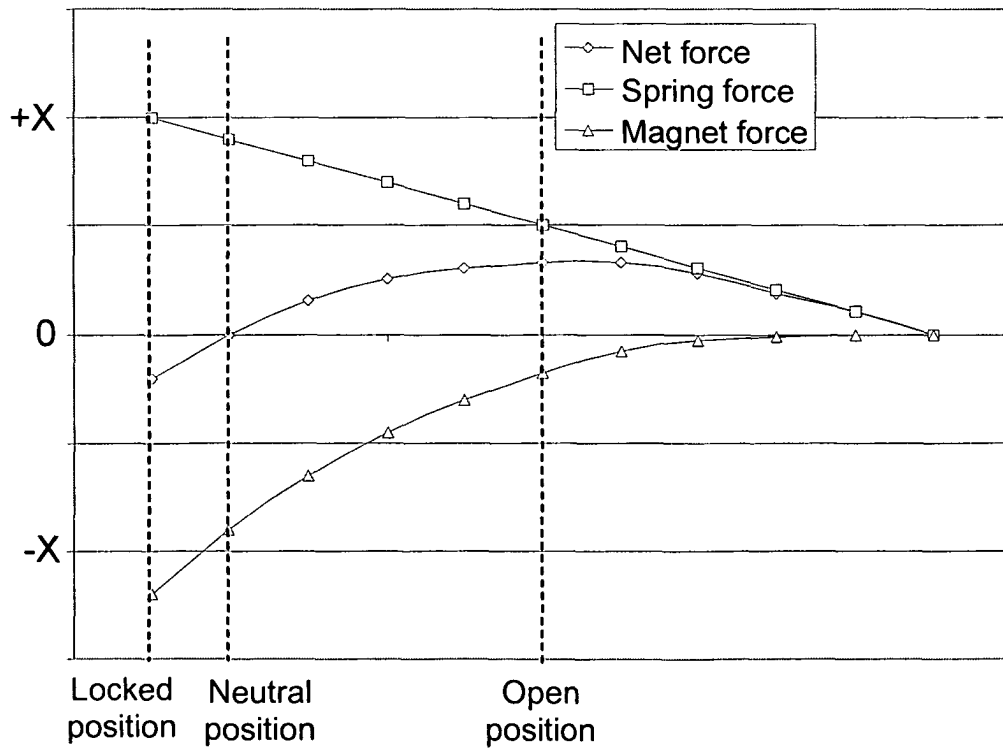


Fig. 8



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Office

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Application Number
EP 08 44 5011

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Place of search The Hague		Date of completion of the search 3 September 2008	Examiner Westin, Kenneth
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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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 08 44 5011

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