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(54) **LOCK ASSEMBLY FOR LOCKING A DOOR WITH RESPECT TO A DOOR FRAME**

(57) The invention relates to a lock assembly comprising a biasing element for biasing the latch with a biasing force in an extension direction from a retracted position towards an extended position and a retaining element to retain the latch in the retracted position with a retaining force, wherein the lock assembly further comprises a first magnet with a first magnetic field that extends out of the housing at the front plate, wherein the first magnet is movable from a first position to a second position when the first magnet is attracted to a magnetic material in a door frame, wherein the first magnet is coupled to the latch to convert the movement of the first magnet into a displacement of the latch into a release position in which the biasing force exceeds the retaining force.

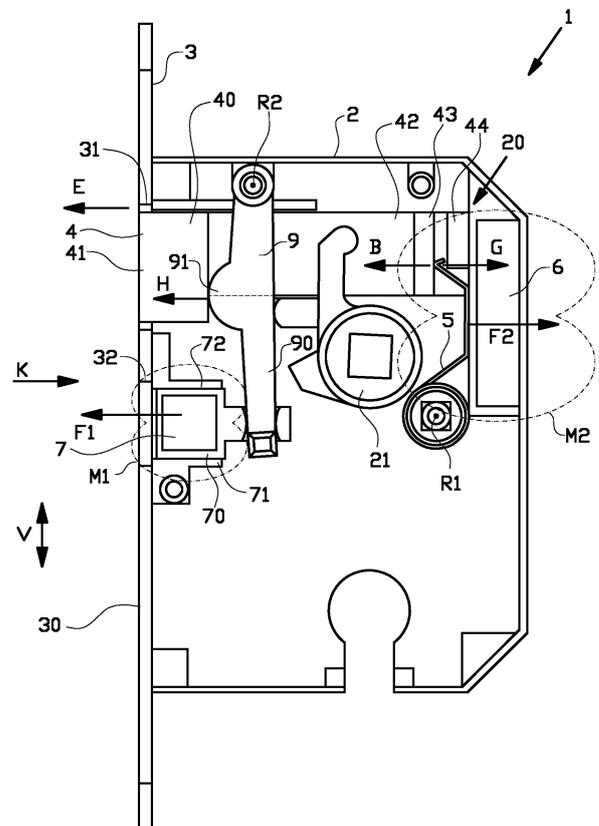


FIG. 1

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Description

BACKGROUND

[0001] The invention relates to a lock assembly for locking a door with respect to a door frame.

[0002] NL 7309838 A discloses a lock that is arranged to be mounted in a door, wherein the lock is provided with a latch that fits into a strike plate that is arranged to be mounted in a door frame. The strike plate is made of a non-magnetic material and includes a magnet that attracts the free end of the latch, which is made of a magnetic material. The magnet is arranged to pull the latch out of the lock into the strike plate.

[0003] WO 2012/100107 A2 discloses another lock with an magnetic latch that is drawn into a latch receptacle in the door frame because of the magnetic attraction between said magnetic latch and said latch receptacle. The magnetic latch is also retractable into the housing by magnetic attraction of said housing.

[0004] A disadvantage of these known locks is that both the lock and the strike plate or receptacle have to be made of a suitable material that facilitates the aforementioned magnetic attraction between the latch and the strike plate or receptacle. However, regular strike plates and latch receptacles are made of a magnetic material and typically do not comprise a magnet. Also, latches are typically made from a hard metal, such as brass, to optimize the resistance against breaking and entering. Brass is non-magnetic. Thus, in order for the known locks to work, the consumer not only has to buy a new lock with an alternative and possibly less secure latch, but he also may need to buy a suitable strike plate.

[0005] Furthermore, the magnets of the known locks are relatively small and as a consequence do not have a very strong magnetic field. The magnets are therefore not as effective as conventional springs in keeping the latch in the extended position. The relatively small magnetic force between the latch and the strike plate or the latch receptacle can be easily overcome by manipulating the lock with a larger, stronger magnet.

[0006] It is an object of the present invention to provide an alternative lock assembly for locking a door with respect to a door frame, preferably without affecting the security characteristics of the latch and/or without requiring a special strike plate.

SUMMARY OF THE INVENTION

[0007] According to a first aspect, the invention provides a lock assembly for locking a door with respect to a door frame, wherein the lock assembly comprises a housing and a front plate with a latch opening at the side of the housing that is arranged to face the door frame when the door is locked, wherein the lock assembly comprises a latch that is movable between an extended position in which the latch extends at least partially outside the housing through the latch opening in an extension

direction and a retracted position in which the latch is retracted within the housing in a retraction direction opposite to the extension direction, wherein the lock assembly is provided with a biasing element that is operationally coupled to the latch for biasing the latch with a biasing force in the extension direction from the retracted position towards the extended position and a retaining element that is arranged to retain the latch in the retracted position with a retaining force, wherein the lock assembly further comprises an actuator element with a first magnet, wherein the first magnet has a first magnetic field that extends out of the housing at the side of the front plate, wherein the first magnet is movable from a first position to a second position when the first magnet is attracted to a magnetic material in the door frame opposite to the front plate within the first magnetic field, wherein the actuator element is operationally coupled to the latch to convert the movement of the first magnet from the first position to the second position into a displacement of the latch in the extension direction from the retracted position into a release position between the retracted position and the extended position in which the biasing force exceeds the retaining force.

[0008] Once the latch is displaced into the release position, the latch can be moved from the release position into the extended position under the influence of the biasing force, which can be supplied by a regular biasing element, such as a spring. The biasing element can provide a strong biasing force that can not easily be manipulated. Furthermore, the material choice for the part of the latch that extends out of the housing in the extended position is not necessarily restricted to magnetic materials. In addition, the latch receptacle can be a regular latch receptacle of a magnetic material. The lock assembly can thus also be operated with a conventional or previously mounted latch receptacle, provided that the latch receptacle comprises a magnetic material at a location opposite to the first magnet.

[0009] In an embodiment the first magnet is spaced apart from the latch. The first magnet can thus be considered as a separate part of the lock assembly, not being part of the latch.

[0010] In an embodiment the first magnet is closer to the front plate in the second position than in the first position. Hence, the first magnet can move towards the front plate when attracted by the magnetic material in the door frame.

[0011] In an embodiment the front plate is provided with an auxiliary opening at a distance from the latch opening, wherein the first magnet in the second position extends at least partially through the auxiliary opening and/or lies flush with the externally facing side of the front plate at the auxiliary opening. The first magnet can thus interact with the door frame at a spaced apart location with respect to the latch, and can therefore interact with the door frame independently from the latch. Furthermore, by allowing the first magnet to approach the door frame as close as possible, the attraction of the first mag-

net to the magnetic material in the door frame can be maximized.

[0012] In an embodiment the actuator element is operationally coupled to the latch by a transmission mechanism. The transmission mechanism can convert the movement of the first magnet from the first position to the second position into the displacement of the latch into the release position.

[0013] In a preferred embodiment thereof, the transmission mechanism is arranged for converting the movement of the first magnet from the first position to the second position into a release force that is exerted on the latch in the extension direction, wherein the magnitude of the release force is equal to or exceeds the difference between the retaining force and the biasing force in the retracted position of the latch. The difference between the retaining force and the biasing force only has to be very small to tip the balance in favor of the retaining force and to effectively retain the latch in the retracted position. Hence, the release force that tips the balance back towards the biasing force can be very small as well. Therefore, the lock assembly according to the invention can be operated with a very small magnetic force at the first magnet. The first magnet can thus be very compact.

[0014] In an embodiment the transmission mechanism comprises a lever that is coupled to the first magnet and is arranged to displace the latch from the retracted position into the release position through abutment of the lever with the latch in the extension direction when the first magnet is moved from the first position to the second position. The lever can thus effectively transmit the movement of the first magnet onto the latch.

[0015] In an embodiment the lever is rotatable about a lever axis, wherein the first magnet is arranged to be attracted to the magnetic material in the door frame by a first magnetic force, wherein the first magnet is coupled to the lever at a first distance to the lever axis, wherein the lever is arranged to abut the latch at the same side of the lever axis as the first magnet at a second distance to the lever axis that is smaller than the first distance. The ratio between the first distance and the second distance can result in a proportional increase of the release force with respect to the first magnetic force.

[0016] In an alternative embodiment the latch is provided with a drive cam, wherein the transmission mechanism comprises a cam plate with a cam slot for receiving the drive cam, wherein the actuator element is operationally coupled to the cam plate for moving the cam plate with respect to the latch such that the movement of the first magnet from the first position to the second position is converted via the interaction between the cam slot and the drive cam, into the displacement of the latch from the retracted position into the release position. This alternative transmission mechanism can provide the same displacement of the latch into the release position.

[0017] In an embodiment the retaining element comprises a second magnet with a second magnetic field that is arranged to retain the latch in the retracted position

with a retaining force that is proportional to the strength of the second magnetic field. In this manner, both the retaining and the actuating of the latch can be performed magnetically.

5 **[0018]** In an embodiment thereof the second magnet is placed in a fixed position in the housing, wherein the latch is movable with respect to the second magnet, wherein the second magnet is arranged for exerting a second magnetic force on the latch when the latch is within the second magnetic field, wherein the second magnetic force is the retaining force. The second magnet can therefore be a separate part of the lock assembly, not being part of the latch.

10 **[0019]** In a further embodiment thereof the second magnet is placed opposite to the latch in the retraction direction. Thus, the second magnetic force can act on the latch in line with the retraction direction.

15 **[0020]** In an embodiment the second magnet is placed at or near the retracted position of the latch. Preferably, the latch is arranged to abut the second magnet in the retracted position. In this manner, the magnitude of the second magnetic force can be maximized near the retracted position.

20 **[0021]** In an embodiment the latch comprises a latch head facing in the extension direction and a latch tail facing in the retraction direction, wherein the latch tail comprises magnetic material, wherein the second magnet is arranged for exerting the retaining force on the magnetic material in the latch tail when the latch tail is within the second magnetic field. The latch can for example have a latch head made from a hard, non-magnetic material, such as brass, and a latch tail made from a magnetic material.

25 **[0022]** In a further alternative embodiment of the invention the retaining element comprises a blocking element that is arranged to engage the latch and/or to mechanically exert the retaining force on the latch. The blocking element can be used as a mechanical alternative to the second magnet.

30 **[0023]** Preferably, the blocking element is a blocking pin, wherein the latch is provided with a groove for receiving the blocking pin. The engagement of the blocking pin in the groove can securely retain the latch in the retracted position.

35 **[0024]** In an embodiment thereof, the blocking element is biased to move to a blocking position in which blocking element engages the latch. The biasing force can be counteracted by the release force that is exerted on the latch in the extension direction.

40 **[0025]** In a further alternative embodiment the lock assembly comprises a retracting element for retracting the latch into the retracted position, wherein the second magnet is placed in a fixed position in the housing, wherein the retracting element is movable with respect to the second magnet, wherein the second magnet is arranged for exerting a second magnetic force on the retracting element when the retracting element is within the second magnetic field, wherein the retracting element is opera-

tionally coupled to the latch to convert the second magnetic force into the retaining force that retains the latch. Thus, in contrast to the previously described embodiment, it is not the latch that is attracted by the second magnet, but the retracting element, which can indirectly pull the latch into the retracted position. Hence, the material of the latch can be freely chosen without being restricted to magnetic materials. The latch can for example be entirely made of a hard metal, such as brass.

[0026] In a preferred embodiment the retracting element is rotatable about a retracting axis, wherein the second magnet is arranged for exerting the second magnetic force on the retracting element at a third distance from the retracting axis, wherein the retracting element exerts the retaining force on the latch at a fourth distance from the retracting axis that is greater than the third distance.

[0027] In an embodiment the latch is provided with a retaining cam, wherein the retracting element is arranged to engage the latch in the retraction direction at the retaining cam. The latch can thus be moved by the retracting element in the retraction direction into the retracted position.

[0028] In an embodiment the retracting element is the biasing element, wherein the biasing element is arranged to engage the latch in both the extension direction and the retraction direction. The biasing element can thus serve as both the biasing element and the retracting element.

[0029] In an embodiment the biasing element comprises magnetic material. The biasing element can therefore be attracted by the second magnet.

[0030] In an embodiment the biasing element is a spring. The spring can be used to strongly bias the latch in the extension direction. A strong biasing force can prevent unauthorized manipulation of the latch from the extended position back into the retracted position.

[0031] In an alternative embodiment the housing comprises magnetic material and wherein the second magnet is provided on or in the latch in a position in which the magnetic material of the housing is within the second magnetic field when the latch is in the retracted position. In this particular embodiment, the latch itself contains the magnet to retain the latch in the retracted position.

[0032] In an embodiment the latch comprises a latch head facing in the extension direction and a latch tail facing in the retraction direction, wherein the second magnet is provided on or in the latch tail. Thus, the latch head can be made of a different material than the latch tail, for example of a hard metal such as brass.

[0033] In an embodiment the lock assembly further comprises a follower that is arranged to retract the latch towards and/or into the retracted position. The follower can be manually operated to unlock the lock assembly with respect to the door frame and to open the door, e. g. by operation of a door handle that is coupled to the follower.

[0034] In an embodiment, the aforementioned lock assembly is arranged for use with a latch receptacle or a

latch receptacle consisting of or comprising a magnetic material. Such latch receptacles are widely available or already installed in the door frame. The consumer can therefore buy a regular latch receptacle or replace the lock assembly only if such a regular latch is already mounted.

[0035] According to a second aspect, the invention provides a set comprising the aforementioned lock assembly and a latch receptacle that is arranged to be mounted in the door frame opposite to the lock assembly, wherein the latch receptacle consists of or comprises a magnetic material towards which the first magnet, in use, is attracted to move from the first position to the second position. Such a set does not require a special latch receptacle.

[0036] The various aspects and features described and shown in the specification can be applied, individually, wherever possible. These individual aspects, in particular the aspects and features described in the attached dependent claims, can be made subject of divisional patent applications.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037] The invention will be elucidated on the basis of an exemplary embodiment shown in the attached schematic drawings, in which:

figure 1 shows a side view of a lock assembly according to a first embodiment of the invention in an open state;

figure 2 shows a side view of the lock assembly according to figure 1 after being moved into a release state;

figure 3 shows a side view of the lock assembly according to figure 2 after being moved into a closed state;

figure 4 shows a side view of the lock assembly according to figure 3 after being returned to the open state;

figure 5 shows a side view of an alternative lock assembly according to a second embodiment of the invention in an open state;

figure 6 shows a side view of a further alternative lock assembly according to a third embodiment of the invention in an open state;

figure 7 shows a side view of the alternative lock assembly according to figure 6 in a release state;

figure 8 shows a side view of the alternative lock assembly according to figure 6 in a closed state; and

figure 9 shows a side view of a further alternative lock assembly according to a fourth embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0038] Figures 1-4 show a lock assembly 1 according to a first embodiment of the invention, for locking and unlocking a door with respect to a door frame (not shown).

[0039] The lock assembly 1 comprises a housing 2 that is arranged to be received in a pocket in the door and a front plate 3 at the side of the housing 2 that faces the door frame when the door is closed or locked with respect to the door frame. The housing 2 houses a locking mechanism 20. The lock assembly 1 further comprises a bolt, latch bolt or latch 4 that is operationally coupled to the locking mechanism 20 and that is arranged to engage the door frame, or a strike member or a latch receptacle (not shown) at the door frame, when the door is closed or locked with respect to the door frame. The front plate 3 is provided a plate-like body 30 and a latch opening 31 in the plate-like body 30. The latch 4 is movable through the latch opening 31 in a retraction direction K and an extension direction E between a retracted position within the housing 2, as shown in figures 1 and 4, and an extended position at least partially outside the housing 2, as shown in figure 3, respectively.

[0040] The latch 4 comprises a latch body 40 with a latch head 41 facing in the extension direction E and a latch tail 42 facing in the retraction direction K. Preferably, the part of the latch head 41 that extends out of the housing 2 in the extended position, is made of a hard metal, such as brass, to resist breaking and entering. Brass is non-magnetic. In this exemplary embodiment, the latch tail 42 is provided with an extension cam 43 and a retaining cam 44 for interacting with the locking mechanism in a manner that will be described hereafter.

[0041] As shown in figure 3, the locking mechanism 20 is provided with a biasing element 5, in this example in the form of a spring or torsion spring, for spring-loading or biasing the latch 4 with a biasing force B in the extension direction E towards the extended position. The biasing element 5 is mounted to the housing 2 and is arranged to engage the latch 4 in the extension direction E, preferably by rotation about a retracting axis R1. In particular, the biasing element 5 is arranged to forcefully abut the extension cam 43 in the extension direction E. The lock mechanism 20 is further provided with a follower 21 that is arranged to engage the latch 4 in the retraction direction K and to retract the latch 4 in the retraction direction K against the biasing force B into the retracted position as shown in figure 4. The follower 21 can be operationally coupled to a door handle (not shown) to allow for manual retraction of the latch 4 into the retracted position.

[0042] As shown in figures 1-4, the lock mechanism 20 further comprises an actuator element in the form of a first magnet 7 that is arranged to actuate the release of the latch 4 from the retracted position into the extended position and a retaining element in the form of a second magnet 6 that is arranged to retain the latch 4 with a retaining force G in the retracted position.

[0043] The second magnet 6 is placed in or mounted to the housing 2 in a fixed position. In this example, the second magnet 6 is placed opposite to the biasing element 5 in the retraction direction K, preferably at or near the retracted position of the latch 4. The latch 4 is movable

with respect to the second magnet 6 between the extended position and the retracted position. The second magnet 6 provides or generates a second magnetic field M2 that extends in the extension direction E towards the biasing element 5. When the latch 4 is retracted towards the retracted position in the retraction direction K, e.g. by operation of the follower 21, the biasing element 5 is forced backwards into the retraction direction K as well through its abutment with the extension cam 43 at the latch tail 42. Once the biasing element 5 is close enough to the second magnet 6, the magnitude of its second magnetic field M2 becomes so strong that the second magnetic force F2 exceeds the biasing force B. The biasing element 5 is thus attracted by and moves towards the second magnet 6. The biasing element 5 now engages the latch 4 in the retraction direction K at the retaining cam 44 opposite to the extension cam 43 and moves the latch 4 in the retraction direction K towards and into the retracted position.

[0044] The biasing element 5 thus acts as a retracting element for indirectly retaining the latch 4 with respect to the second magnet 6. The retaining force G exerted by the biasing element 5 on the latch 4 is proportional to the second magnetic force F2 exerted by the second magnet 6 on the biasing element 5. In particular, the second magnet 6 is arranged for exerting the second magnetic force F2 on the biasing element 5 at a first distance from the retracting axis R1, wherein the biasing element 5 exerts the retaining force G on the latch 4 at a second distance from the retracting axis R1 that is greater than the first distance, wherein the ratio between the first distance and the second distance corresponds to the proportionality between the second magnetic force F2 and the retaining force G.

[0045] The advantage of latch 4 according to the aforementioned first embodiment of the invention is that the latch 4 can be made from a single material, which does not necessarily have to be magnetic. Thus, a material with optimal hardness and/or other desired characteristics can be chosen, to optimize the security of the lock assembly 1 according to the second embodiment of the invention.

[0046] Figure 5 shows an alternative lock assembly 101 according to a second embodiment of the invention, that only differs from the first embodiment in that the latch 104 is adapted for directly retaining the latch 104 in the retracted position with respect to the second magnet 6. In this second embodiment, the latch tail 142, instead of the biasing element 105, is made of or comprises the magnetic material, which is arranged to be attracted by the second magnet 6 when the latch tail 142 is within range of the second magnetic field M2 of the second magnet 6. In particular, the second magnet 6 exerts a retaining force G on the magnetic material in the latch tail 142 that is equal to the second magnetic force F2. The second magnetic force F2, and thus the retaining force G, is proportional to the distance of the magnetic material to the second magnet 6. In this second embod-

iment of the invention, the biasing element 105 does not necessarily have to comprise a magnetic material. Also, the biasing element 105 solely biases the latch 104 in the extension direction E, but does not engage the latch 104 in the retraction direction K. Hence, the retaining cam 44 of the first embodiment is superfluous and therefore absent.

[0047] In either of the two aforementioned embodiments, the latch 4, 104 is retained in the retracted position by a retaining force G acting against the biasing force B of the biasing element 5. The retaining force G only needs to be slightly or marginally larger than or exceed the biasing force B to bring and retain the latch 4, 104 into the retracted position. When the latch 4, 104 is moved away from the retracted position in the extension direction E, the magnitude of the retaining force G rapidly decreases, and tips the balance in favor again of the biasing force B. When the biasing force B is greater than or exceeds the retaining force G, for example in a release position as shown for the latch 4 of the first embodiment in figure 2, the latch 4 automatically continues to move in the extension direction E towards the extended position, solely under the influence of the biasing force B from the biasing element 5.

[0048] The following is a description of the features that cause the initial displacement of the latch 4, 104 from the retracted position into the release position. The features are only described in relation to the lock assembly 1 of the first embodiment of the invention, but are equally applicable to the alternative lock assembly 101 according to the second embodiment of the invention.

[0049] To bring or displace the latch 4 from the retracted position into the release position as shown in figure 2, the lock mechanism 20 comprises the first magnet 7. The first magnet 7 is spaced apart from the latch 4 and does not form a part of said latch 4. In this example, the first magnet 7 is placed at a distance below the latch opening 30 in the front plate 3. The first magnet 7 is movable from a first position, as shown in figure 1, to a second position, as shown in figure 2. The second position is closer to the front plate 3 than the first position. Preferably, the front plate 3 is provided with an auxiliary opening 32 for allowing the first magnet 7 to lie flush with or at least partially extend from the externally facing side of the front plate 3. To guide the movement of the first magnet 7 between the first position and the second position, the first magnet 7 is mounted in a magnet holder 70. In this exemplary embodiment, the magnet holder 70 is guided between two guides 71, 72 that are fixed to the housing 2 and that extend parallel to the path travelled by the first magnet 7 between the first position and the second position. Preferably, the movement of the first magnet 7 between the first position and the second position is linear or substantially linear.

[0050] The first magnet 7 generates or provides a first magnetic field M1 that extends at least partially out of the housing 2 at the side of the front plate 3 in both the first position and the second position of the first magnet 7.

The first magnet 7 moves from the first position to the second position when the first magnet 7 is attracted to a magnetic material in the door frame, e.g. a latch receptacle, a strike member, a strike box or a strike plate of a magnetic material opposite to the lock assembly 1, by a first magnetic force F1. In the perception of the user, the first magnet 7 'detects' the presence of the magnetic material in the door frame, which is an indication that the door is closed with respect to said door frame, and subsequently causes or actuates the displacement of the latch 4 from the retracted position, as shown in figure 1, into the release position, as shown in figure 2.

[0051] As further shown in figure 2, the lock mechanism 20 is provided with a transmission mechanism 9 for transferring or converting the movement of the first magnet 7 from the first position to the second position into the required displacement of the latch 4 from the retracted position into the release position. In particular, the transmission mechanism 9 converts the movement of the first magnet 7 from the first position to the second position into a release force H acting on the latch 4 in the extension direction E. The transmission mechanism 9 is configured such that the release force H is greater than the difference between the retaining force G and the biasing force B. As the retaining force G is only marginally larger than the biasing force B, the person skilled in the art will understand that the latch 4 can be moved into the release position with only a small or minimal magnitude of the release force H. The lock assembly 1 can thus be operated with very small forces.

[0052] The transmission mechanism 9 comprises a lever 90 that extends between the first magnet 7 and the latch 4 and that operationally converts the movement of the first magnet 7 into a movement of the latch 4 in the extension direction E. The lever 90 is coupled to the first magnet 7 via the magnet holder 70 and interacts with the latch 4 via abutment in the extension direction E. The lever 90 according to this exemplary embodiment is rotatable about a lever axis R2, wherein the first magnet 7 and the latch 4 are both on the same side of said lever axis R2. Preferably, the lever 90 interacts with the latch 4 at a third distance from the lever axis R2, while the first magnet 7 acts on the lever 90 at a fourth distance that is greater than the third distance, resulting in a higher release force H being exerted on the latch 4. The lever 90 comprises a main body 91 that extends in the longitudinal direction of the lever 90 and an abutment member 91 that protrudes from the main body 91 towards the latch 4 at or near the latch head 41. In this example, the abutment member 91 is arranged directly behind the latch head 41 in the retraction direction K, for abutting the latch head 41 in the extension direction E.

[0053] The method of operating the lock assemblies 1, 101 according to the invention during a locking cycle will be elucidated below with reference to the lock assembly according to the first embodiment in figures 1-4. The steps of the method are also applicable to the lock assembly 101 as shown in figure 5.

[0054] Figure 1 shows the situation in which the door is not closed, e.g. not nearby the door frame. Thus, the front plate 3 is not opposite to the door frame or any magnetic material in the door frame. The first magnet 7 is in the first position. The latch 4 is retracted in the retraction direction K into the housing 2, for example by manual operation of a door handle (not shown), which turns the follower 21. In figure 1, the follower 21 is returned to its initial position. The magnet material in the biasing element 5 (or the magnetic material in the latch 104 of figure 5) is within range of the second magnetic field M2 and is attracted by the second magnet 6 with the second magnetic force F2. The second magnetic force F2 results in a retaining force G that is being exerted on the latch 4, which retaining force G is greater than or exceeds the biasing force B. The retaining force G thus retains the latch 4 in the retracted position.

[0055] Figure 2 shows the situation in which the door is closed or nearly closed. The front plate 3 is now opposite to the door frame and the magnetic material in the door frame, e.g. a latch receptacle, a strike plate or strike box, is within range of the first magnetic field M1. The first magnet 7 is attracted to the magnetic material in the door frame by the first magnetic force F1. The first magnet 7 moves from the first position into the second position, which movement is transferred by the transmission mechanism 9 into a release force H that is being exerted on the latch 4 in the extension direction E. The release force H is greater than the difference between the retaining force G and the biasing force B and thus causes the latch 4 to move from the retracted position into the release position.

[0056] Figure 3 shows the situation in which the door is closed and the lock assembly 1 has locked the door with respect to the door frame. In particular, the latch 4 has moved from the release position into the extended position under the influence of the biasing force B which, in the release position of the latch 4, is greater than the retaining force G exerted on the latch 4 in the opposite direction. The latch 4 is now engaged with the door frame, preferably at the latch receptacle, the strike plate or box strike.

[0057] Figure 4 shows the situation in which the lock assembly 1 is unlocked and the door is opened with respect to the door frame. The latch 4 is retracted into the retraction direction K by the (manual) operation of the follower 21. When the latch 4 passes the release position in the retraction direction K, the latch head 41 comes into abutment with the abutment member 91 of the transmission mechanism 9, which causes the first magnet 7 to be returned from the second position into the first position.

[0058] In the method above, the first magnet 7 can be considered to act as an auxiliary latch for actuating the release of the main latch 4.

[0059] Figures 6, 7 and 8 show a further alternative lock assembly 201 according to a third embodiment of the invention, which differs from the aforementioned embodiments in that its latch 204 is provided with a retaining

element 206, rather than the housing 202. In this embodiment, the retaining element 206 again is a second magnet 206 with a second magnetic field M2 and a second magnetic force F2. Hence, the second magnet 206 according to the third embodiment is movable between the extended position and the retracted position and is arranged to be attracted to a magnetic material in or at the housing 202 by a second magnetic force F2 (the retaining force G). In this exemplary embodiment, the second magnet 206 is provided in or at the latch tail 242, and preferably protrudes from the latch tail 242 towards the housing 202. It will be apparent to one skilled in the art that such an alternative configuration may also be applied to the previously described embodiment, by providing a magnet like the second magnet 206 in the latch tail 42 and by providing a magnetic material in or at the housing 2.

[0060] The further alternative lock assembly 201 further differs from the aforementioned embodiments in that its transmission mechanism 209 converts the movement of the actuator element in the form of the first magnet 207 from the first position to the second position differently into the release force H at the latch 204. In particular, the alternative transmission mechanism 209 comprises a cam plate 290 with a cam slot 291 extending diagonally with respect to the extension direction E and the vertical direction V. The latch 204 is provided with a drive cam 245 that is received in the cam slot 291 of the transmission mechanism 209. Preferably, the drive cam 245 is arranged at or near the latch head 241. The cam slot 291 is orientated diagonally such that a downward movement of the cam plate 290 in the vertical direction V causes or is converted into a displacement of the drive cam 245 in the extension direction E, while a retraction of the drive cam 245 together with the latch 204 in the retraction direction K causes or is converted into an upwards displacement of the cam plate 290. This type of transmission mechanism 209 can be used to convert the movement of the first magnet 207 from the first position, as shown in figure 6, towards the second position, as shown in figure 7, into a displacement of the latch 204 from the retracted position, as shown in figure 6, into the release position, as shown in figure 7. To pull the cam plate 290 downwards, the first magnet 207 or its holder (not shown) is provided with a first slide surface 273 extending in the same diagonal direction as the cam slot 291. The cam plate 290 extends to below the first magnet 207 in the vertical direction V and is provided with a second slide surface 292 that is parallel to and face the first slide surface 273.

[0061] When the first magnet 207 moves from the first position, as shown in figure 6, into the second position, as shown in figure 7, the first slide surface 273 is brought into forceful abutment with the second slide surface 292 and displaces said second slide surface 292 downwards, thereby causing the cam plate 290 as a whole to move downwards. The downward movement of the cam plate 290 is converted by the interaction between the cam slot 291 and the drive cam 245 into a release force H acting

on the latch 204 in the extension direction E. This causes the latch 204 to move from the retracted position, as shown in figure 6, into the release position, as shown in figure 7. From this point forward, the alternative lock assembly 201 functions in the same manner as the previously described embodiments, in the sense that a first biasing force B1 exerted by the biasing element 205 onto the latch 204 in the extension direction E is greater than or exceeds the retaining force G. The latch 204 automatically moves further in the extension direction E into the extended position as shown in figure 8.

[0062] Similarly, if the follower 221 is operated to retract the latch 204 from the extended position, as shown in figure 8, into the retracted position, as shown in figure 6, the inward movement of the latch 204 in the retraction direction K is converted by the interaction between the drive cam 245 and the cam slot 291 into an upward movement of the cam plate 290. This brings the second slide surface 292 into forceful abutment with the first slide surface 273, causing a returning force B2 that is exerted on the first magnet 207 in a direction from the second position towards the first position, that effectively moves the first magnet 207 back into the first position. The alternative lock assembly 201 is now ready for another locking cycle.

[0063] Figure 9 shows a further alternative lock assembly 301 according to a fourth embodiment of the invention, which differs from the aforementioned third embodiment in that its latch 304 is not provided with a magnet. In fact, the latch 304 is not retained in the retracted position by a magnet or a magnetic force at all. Instead, the further alternative lock assembly 301 is provided with an alternative retaining element 306 in the form of a mechanical blocking assembly. The mechanical blocking assembly comprises a blocking element 361, in this example in the form of a blocking pin, that is arranged to mechanically engage the latch 304 and a third biasing element 362 for biasing the blocking element 361 to a blocking position with a third biasing force B3, as shown in figure 9. In the blocking position, the blocking element 361 engages with a groove 346 in the latch 304 in a direction transverse or perpendicular to the extension direction E. The blocking element 361 is provided with a blocking surface 363 that faces under an oblique angle in the retraction direction K. The groove 346 is provided with an oblique slide surface 347 facing in the extension direction E opposite to the blocking surface 363.

[0064] The blocking surface 363 and the slide surface 347 are arranged to slide over each other when the latch 304 is moved in the extension direction E. The third biasing force B3 and the angle of the blocking surface 363 and the slide surface 347 determine the amount of retaining force G that is mechanically exerted by the blocking element 361 on the latch 304 in the retraction direction K. When the actuating element in the form of the first magnet 307 moves from the first position into the second position under the influence of the first magnetic force F1, and said movement is converted by the transmission

mechanism 309 into a release force H exerted onto the latch 304 in the extension direction E, the release force H is greater than the retaining force G exerted by the mechanical blocking assembly on the latch 304 in the opposite direction. Therefore, the latch 304 moves in the extension direction E into the release position and the blocking element 361 is forced upwards by the slide surface 347 of the groove 346 that passes or shifts underneath the blocking element 361. Once the blocking element 361 no longer engages with the groove 346, the mechanical blocking assembly no longer exerts a retaining force G onto the latch 304 in the retraction direction K, and the latch 304 can be fully extended under the action of the first biasing force B1 of the first biasing element 305.

[0065] Similar to the previous embodiments, the latch 304 can simply be returned into the retracted position by the action of the follower 321. Once the latch 304 is in the retracted position again, the blocking element 361 engages the groove 346 in the latch 304 again.

[0066] Alternatively the aforementioned blocking element 361, or another mechanical blocking means, can also be used to mechanically retain the biasing element 5 of the first embodiment, so that its second magnet 6 becomes redundant.

[0067] It is to be understood that the above description is included to illustrate the operation of the preferred embodiments and is not meant to limit the scope of the invention. From the above discussion, many variations will be apparent to one skilled in the art that would yet be encompassed by the scope of the present invention. For example, the magnets can be arranged in different suitable positions, orientations or numbers, provided that the forces required for the functional operation of the lock assemblies 1, 101, 201, 301 are maintained. Furthermore, the mechanical blocking assembly of the fourth embodiment can be embodied by various mechanical components that are able to exert a retaining force G on the latch 304. A non-limitative list of exemplary mechanical components are leaf springs, deformable or flexible protrusions and/or clipping or snapping elements. The mechanical blocking assembly may also be applied to the first embodiment or the second embodiment, by leaving out the second magnet 6 and by providing the latch 4, 104 with a groove similar to the groove 346 of the fourth embodiment.

[0068] In summary, the invention relates to a lock assembly 1, 101, 201, 301 comprising a biasing element 5, 105, 205, 305 for biasing the latch 4, 104, 204, 304 with a biasing force B, B1 in an extension direction E from a retracted position towards an extended position and a retaining element 5, 105, 205, 305 to retain the latch 4, 104, 204, 305 in the retracted position with a retaining force G, wherein the lock assembly 1, 101, 201, 301 further comprises a first magnet 7, 207, 307 with a first magnetic field M1 that extends out of the housing 2, 202 at the front plate 3, wherein the first magnet 7, 207, 307 is movable from a first position to a second position when

the first magnet 7, 207, 307 is attracted to a magnetic material in a door frame, wherein the first magnet 7, 207, 307 is coupled to the latch 4, 104, 204, 304 to convert the movement of the first magnet 7, 207, 307 into a displacement of the latch 4, 104, 204, 304 into a release position in which the biasing force B exceeds the retaining force G.

Claims

1. Lock assembly for locking a door with respect to a door frame, wherein the lock assembly comprises a housing and a front plate with a latch opening at the side of the housing that is arranged to face the door frame when the door is locked, wherein the lock assembly comprises a latch that is movable between an extended position in which the latch extends at least partially outside the housing through the latch opening in an extension direction and a retracted position in which the latch is retracted within the housing in a retraction direction opposite to the extension direction, wherein the lock assembly is provided with a biasing element that is operationally coupled to the latch for biasing the latch with a biasing force in the extension direction from the retracted position towards the extended position and a retaining element that is arranged to retain the latch in the retracted position with a retaining force, wherein the lock assembly further comprises an actuator element with a first magnet, wherein the first magnet has a first magnetic field that extends out of the housing at the side of the front plate, wherein the first magnet is movable from a first position to a second position when the first magnet is attracted to a magnetic material in the door frame opposite to the front plate within the first magnetic field, wherein the actuator element is operationally coupled to the latch to convert the movement of the first magnet from the first position to the second position into a displacement of the latch in the extension direction from the retracted position into a release position between the retracted position and the extended position in which the biasing force exceeds the retaining force.
2. Lock assembly according to claim 1, wherein the first magnet is spaced apart from the latch.
3. Lock assembly according to claim 1 or 2, wherein the first magnet is closer to the front plate in the second position than in the first position, preferably wherein the front plate is provided with an auxiliary opening at a distance from the latch opening and wherein the first magnet in the second position extends at least partially through the auxiliary opening and/or lies flush with the externally facing side of the front plate at the auxiliary opening.
4. Lock assembly according to any one of the preceding claims, wherein the actuator element is operationally coupled to the latch by a transmission mechanism, preferably wherein the transmission mechanism is arranged for converting the movement of the first magnet from the first position to the second position into a release force that is exerted on the latch in the extension direction and wherein the magnitude of the release force is equal to or exceeds the difference between the retaining force and the biasing force in the retracted position of the latch.
5. Lock assembly according to claim 4, wherein the transmission mechanism comprises a lever that is coupled to the first magnet and is arranged to displace the latch from the retracted position into the release position through abutment of the lever with the latch in the extension direction when the first magnet is moved from the first position to the second position, preferably wherein the first magnet is arranged to be attracted to the magnetic material in the door frame by a first magnetic force, wherein the lever is rotatable about a lever axis, wherein the first magnet is coupled to the lever at a first distance to the lever axis, wherein the lever is arranged to abut the latch at the same side of the lever axis as the first magnet at a second distance to the lever axis that is smaller than the first distance.
6. Lock assembly according to claim 4, wherein the latch is provided with a drive cam, wherein the transmission mechanism comprises a cam plate with a cam slot for receiving the drive cam, wherein the actuator element is operationally coupled to the cam plate for moving the cam plate with respect to the latch such that the movement of the first magnet from the first position to the second position is converted via the interaction between the cam slot and the drive cam, into the displacement of the latch from the retracted position into the release position.
7. Lock assembly according to any one of the preceding claims, wherein the retaining element comprises a second magnet with a second magnetic field that is arranged to retain the latch in the retracted position with a retaining force that is proportional to the strength of the second magnetic field.
8. Lock assembly according to claim 7, wherein the second magnet is placed in a fixed position in the housing, wherein the latch is movable with respect to the second magnet, wherein the second magnet is arranged for exerting a second magnetic force on the latch when the latch is within the second magnetic field, wherein the second magnetic force is the retaining force.
9. Lock assembly according to claim 8, wherein the

second magnet is placed opposite to the latch in the retraction direction, preferably wherein the second magnet is placed at or near the retracted position of the latch, preferably wherein the latch is arranged to about the second magnet in the retracted position, preferably wherein the latch comprises a latch head facing in the extension direction and a latch tail facing in the retraction direction, wherein the latch tail comprises magnetic material, wherein the second magnet is arranged for exerting the retaining force on the magnetic material in the latch tail when the latch tail is within the second magnetic field.

10. Lock assembly according to any one of claims 1-8, wherein the lock assembly comprises a retracting element for retracting the latch into the retracted position, wherein the second magnet is placed in a fixed position in the housing, wherein the retracting element is movable with respect to the second magnet, wherein the second magnet is arranged for exerting a second magnetic force on the retracting element when the retracting element is within the second magnetic field, wherein the retracting element is operationally coupled to the latch to convert the second magnetic force into the retaining force that retains the latch, preferably wherein the retracting element is rotatable about a retracting axis, wherein the second magnet is arranged for exerting the second magnetic force on the retracting element at a third distance from the retracting axis, wherein the retracting element exerts the retaining force on the latch at a fourth distance from the retracting axis that is greater than the third distance, preferably wherein the latch is provided with a retaining cam, wherein the retracting element is arranged to engage the latch in the retraction direction at the retaining cam, preferably wherein the retracting element is the biasing element, wherein the biasing element is arranged to engage the latch in both the extension direction and the retraction direction.
11. Lock assembly according to any of claims 7-10, wherein the biasing element comprises magnetic material.
12. Lock assembly according to any one of the preceding claims, wherein the biasing element is a spring.
13. Lock assembly according to claim 7, wherein the housing comprises magnetic material and wherein the second magnet is provided on or in the latch in a position in which the magnetic material of the housing is within the second magnetic field when the latch is in the retracted position, preferably wherein the latch comprises a latch head facing in the extension direction and a latch tail facing in the retraction direction, wherein the second magnet is provided on or in the latch tail.
14. Lock assembly according to any one of claim 1-6, wherein the retaining element comprises a blocking element that is arranged to engage the latch and/or to mechanically exert the retaining force on the latch, preferably wherein the blocking element is a blocking pin, wherein the latch is provided with a groove for receiving the blocking pin, preferably wherein the blocking element is biased to move to a blocking position in which blocking element engages the latch.
15. Lock assembly according to any one of the preceding claims, wherein the lock assembly further comprises a follower that is arranged to retract the latch towards and/or into the retracted position.
16. Lock assembly according to any one of the preceding claims, for use with a latch receptacle or a latch receptacle consisting of or comprising a magnetic material.
17. Set comprising the lock assembly according to any one of the preceding claims and a latch receptacle that is arranged to be mounted in the door frame opposite to the lock assembly, wherein the latch receptacle consists of or comprises a magnetic material towards which the first magnet, in use, is attracted to move from the first position to the second position.

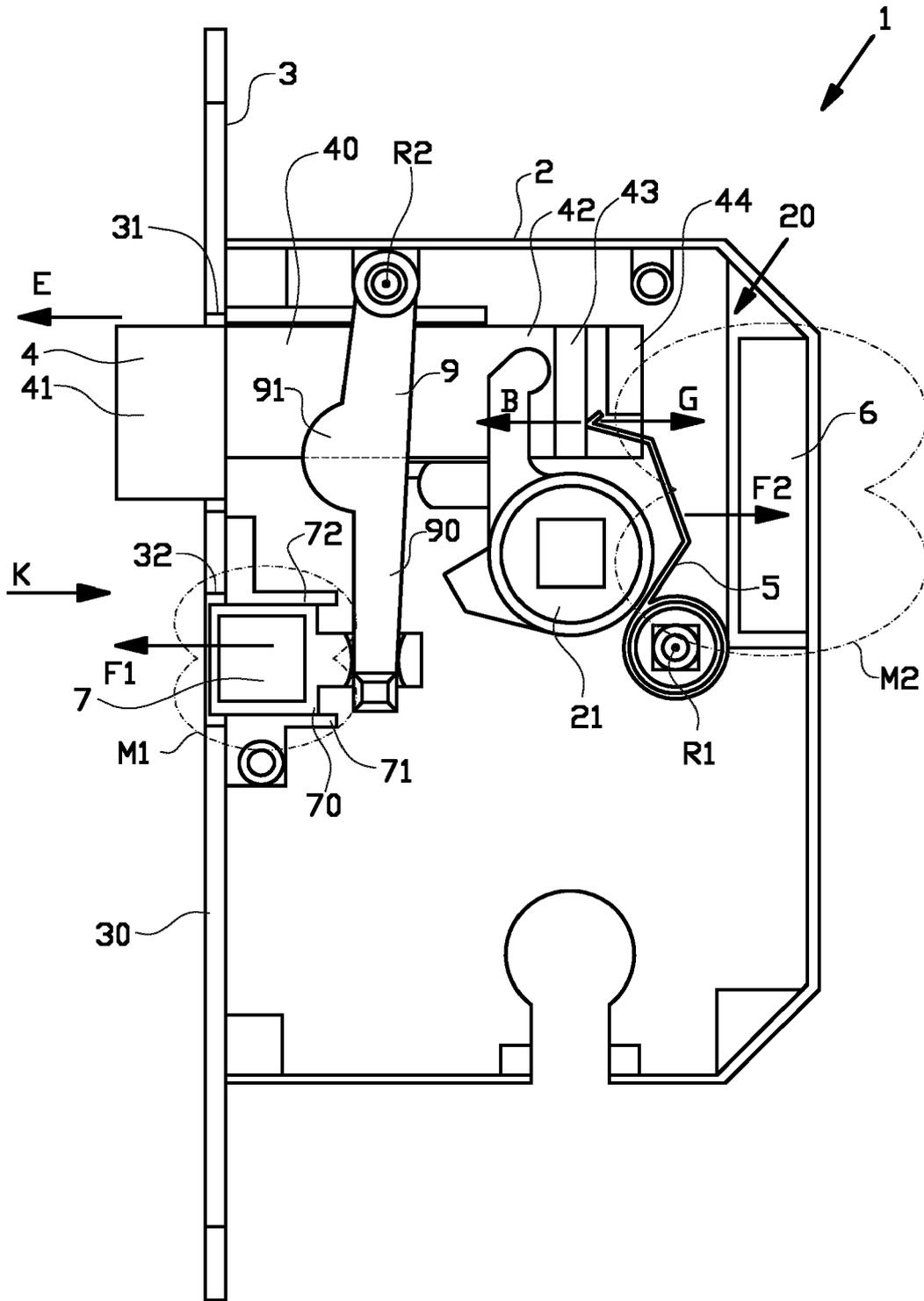


FIG. 3

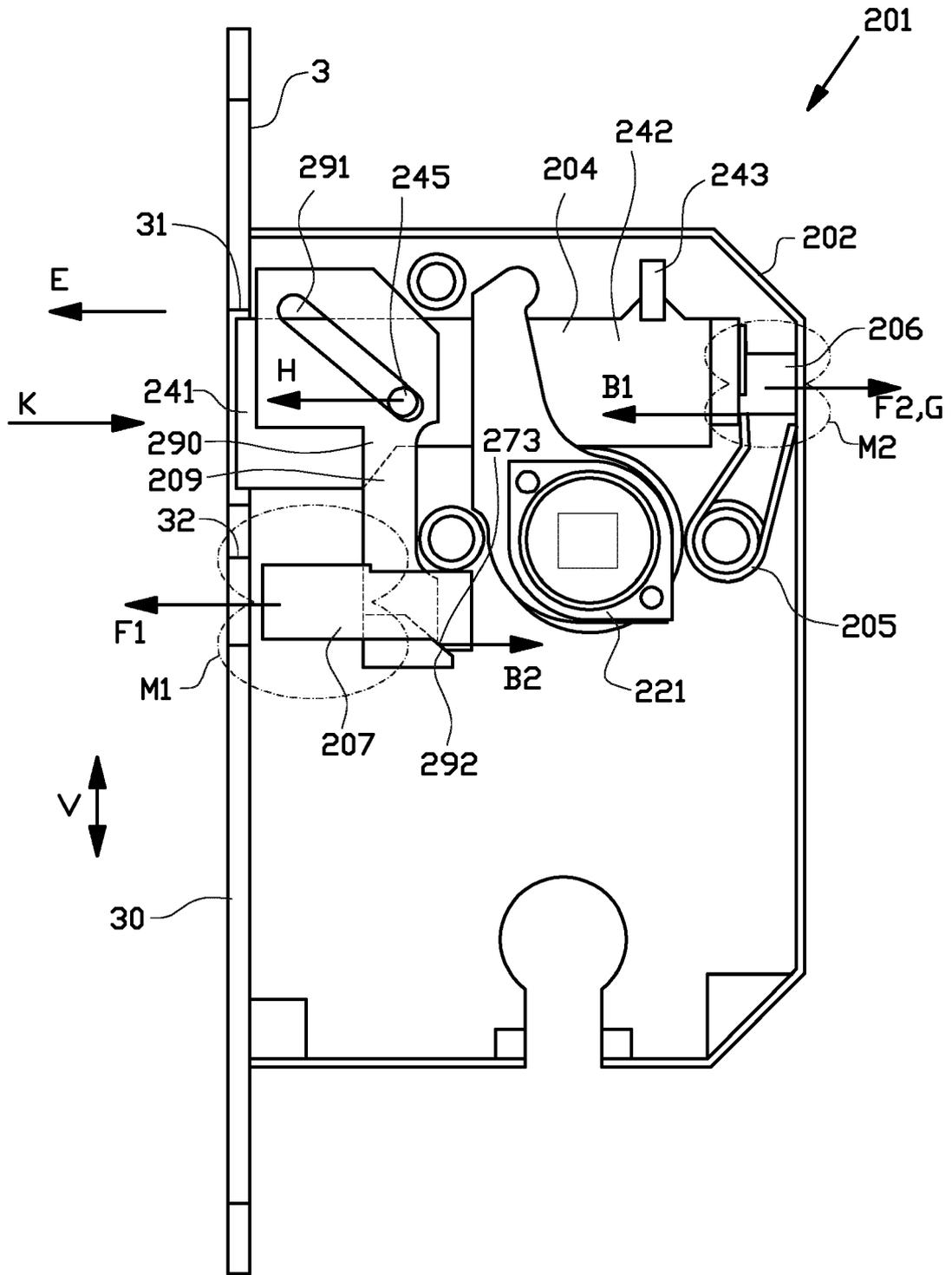


FIG. 6

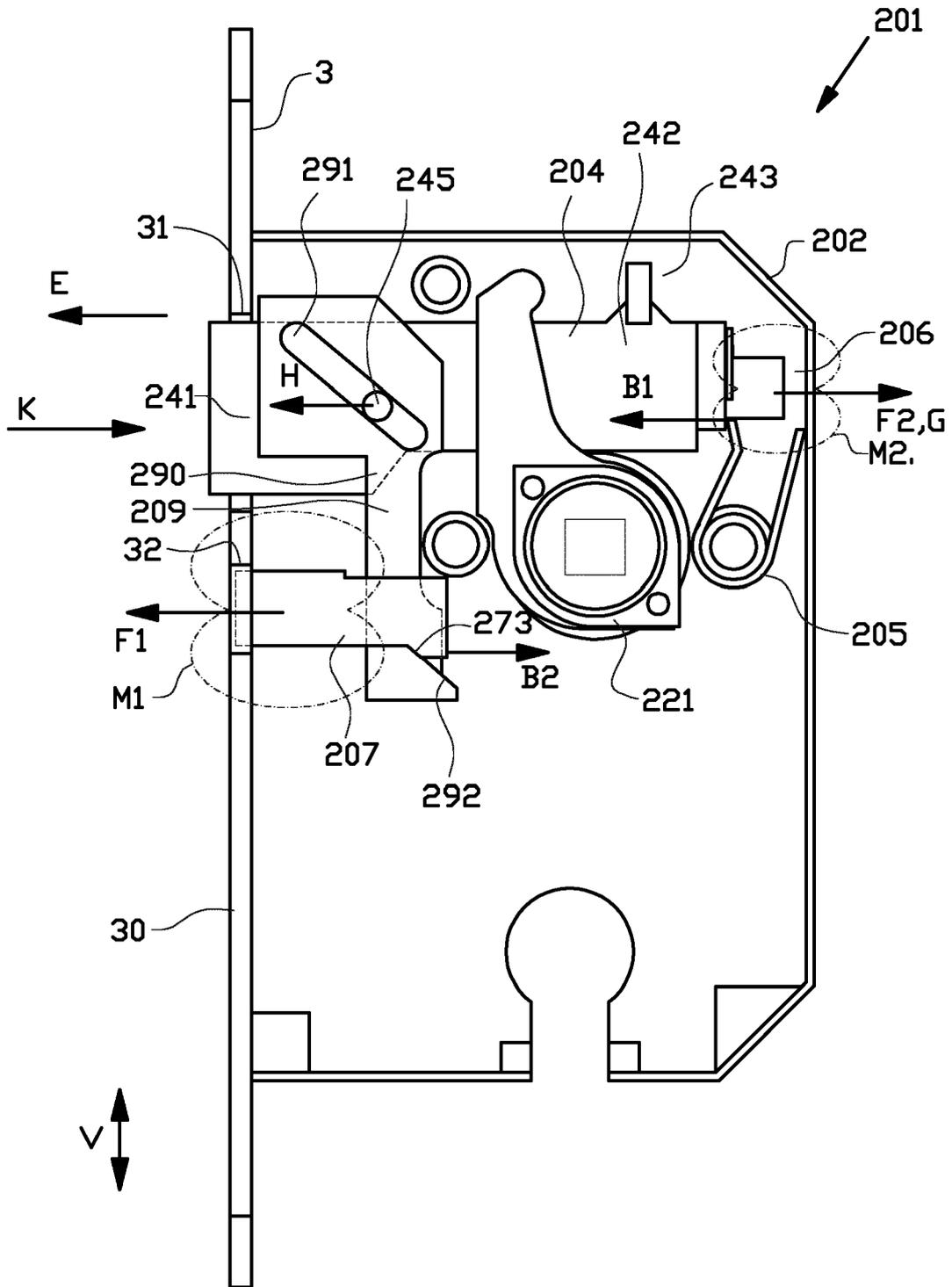


FIG. 7

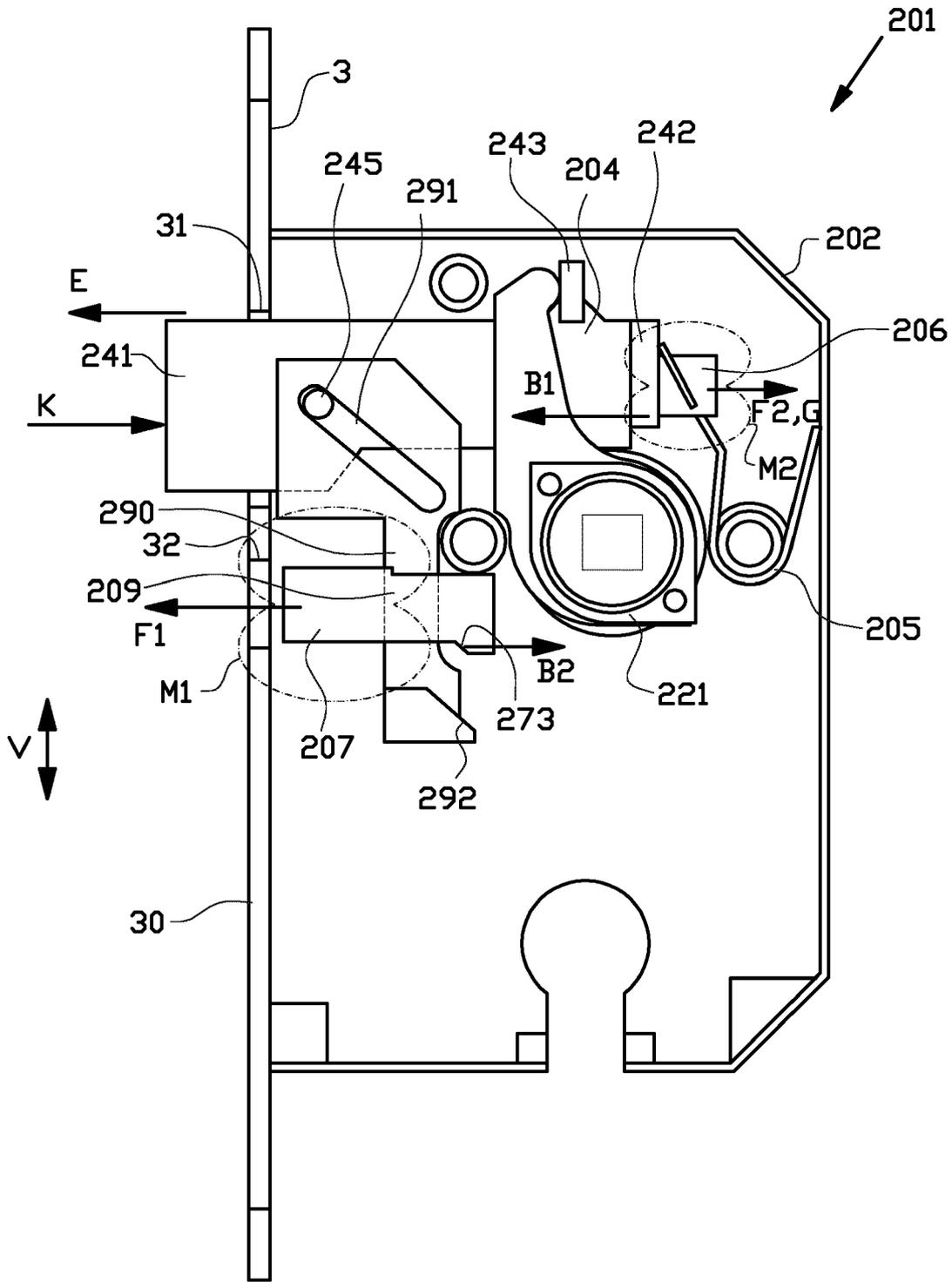


FIG. 8

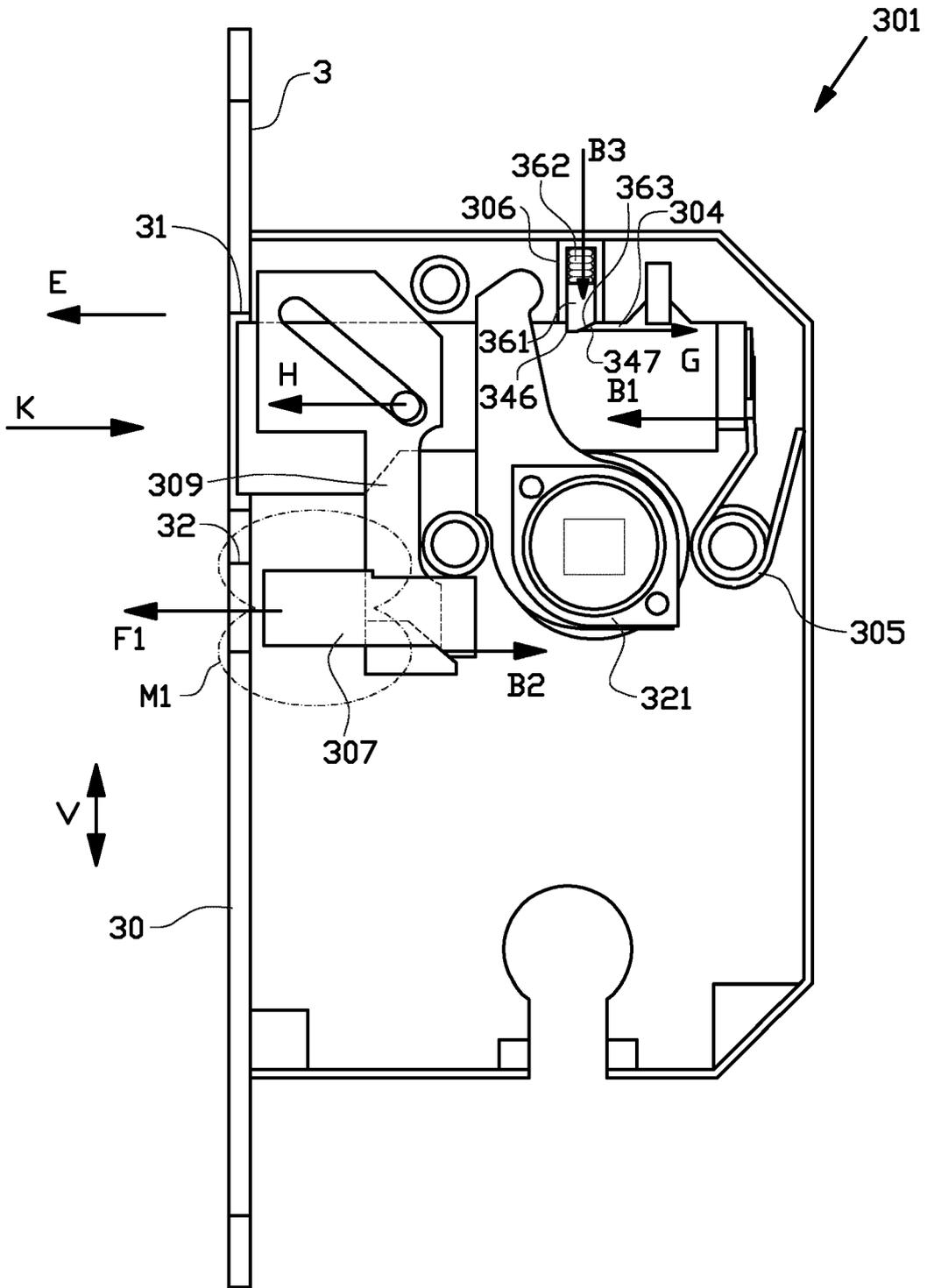


FIG. 9



EUROPEAN SEARCH REPORT

Application Number
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