Solenoid Operated Electric Strike

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Abstract

An electric strike with a pivotally mounted catch which is locked by a pivotally mounted detent engageable with a pivotally mounted detent arm controlled by the catch, movement of the detent being controlled by an electrically energizable solenoid and moveable core assembly which has a portion of the core extending outwardly of the solenoid, the core being pivotally interconnected with the detent and said portion of the core moving inwardly of the solenoid upon energization of the latter. The detent arm may be omitted and the detent may, in such case, engage a pin carried by the catch.

16 Claims, 9 Drawing Figures
SOLENOID OPERATED ELECTRIC STRIKE

This application is a continuation-in-part of our co-pending application Ser. No. 227,895 entitled SOLENOID OPERATED ELECTRIC STRIKE and filed Feb. 20, 1972, now abandoned.

This invention relates to electrically operable door strikes used either to unlock or lock a door, gate, or other barrier or to stop or release certain types of moveable devices, upon electrical energization thereof.

Electrically operable door strikes, also known in the art as electric strikes, electric releases or electric door openers, are well known and are used primarily to control the opening of a door providing access to a space where it is desired to restrict the persons entering such space. For example, it may be used in conjunction with an apartment house door, so that a person or persons can leave the building by withdrawing the door latch internally and without electrically energizing the strike, but so that persons may not open the door from the exterior without either a proper key or electrical energization of the strike by various means, e.g. by the operation of the push button by a person from internally of the building, by an authorized solenoid and moveable arm of the building. Such a push button can be replaced by devices such as a card-key control device, an air control switch, etc.

In some applications, such as in institutions, it is desirable to lock a door or doors by energization of the strike so that in the event of power failure and an emergency, such as a fire, the doors will be unlocked automatically. One embodiment of the invention is of the type which locks upon energization of the strike and is applicable to door interlock systems; fire control doors; institutional fail-safe doors; door control of emergency alarm systems and control of stop-motion devices.

The strike is located in the door frame where there is very little space. Therefore, it is very important that the strike and its operating mechanism occupy as little space as possible. Also, to be reliable, it is important that the electric coil be able to exert a substantial force on the catch holding or releasing mechanism even though it is small, particularly if the door is being pushed while the coil is energized. It has been found that as a practical matter a solenoid and moveable core or plunger type of mechanism can, for a given size, provide a greater force than an electromagnet with an armature and yet be simple in construction.

However, when a solenoid is energized it normally pulls the core or plunger inwardly of the coil which, while simply connected to release a catch upon energization of the coil, creates complications when it is desired to lock the catch upon energization of the coil. For example, to lock the catch the detent lever or plate usually moves toward the catch and the catch detent arm, but if the portion of the solenoid plunger which extends out of the core faces the catch, the plunger movement is away from the catch which either requires a reversing mechanism or a more complicated detent lever and detent arm and additional space.

Also, the plunger of the solenoid usually is confined to movement in a straight line whereas the detent is pivotally mounted which means that the point of connection thereon moves in an arc so that the plunger cannot be connected directly thereto if binding of the plunger is to be avoided.

In accordance with the preferred embodiment of the invention, the detent for the catch of a strike moves toward the catch, but the exposed portion of the solenoid plunger faces away from the catch and is pivotally joined to the detent so that energization of the coil of the solenoid causes the detent to move away from the coil. With such a construction, the mechanism used to control the catch may be as simple as that previously used and yet the space requirements are kept to a minimum. Although such construction is particularly advantageous for a strike in which the catch is locked upon energization of the solenoid, it is also useful for releasing a catch upon energization without causing complexity in the catch control mechanism.

In another embodiment of the invention the detent, strike and solenoid and plunger construction are the same as in the first embodiment, but the exposed portion of the plunger faces toward the catch and the detent and is connected to the detent in the same manner as it is connected thereto in the first embodiment so as to avoid binding of the plunger.

One object of the invention is to provide a solenoid and core operated electric strike which is simple in construction, small in size, reliable in operation and which can be energized by alternating or direct current at any desired voltage.

Other objects and advantages of the invention will be apparent from the following detailed description of presently preferred embodiments thereof, which description should be considered in conjunction with the accompanying drawings in which:

FIGS. 1 and 2 are perspective views of the preferred embodiment of the invention respectively showing the catch in the locked position and in the released position;

FIG. 3 is a fragmentary, perspective view of a modified form of the embodiment shown in FIGS. 1 and 2, in which the catch is released upon energization of the solenoid;

FIGS. 4 and 5 are perspective views of a modified form of the embodiment shown in FIGS. 1 and 2 in which the solenoid is located in a different position with respect to the catch; and

FIGS. 6-9 are perspective views of modified forms of the embodiment shown in FIGS. 1 and 2 in which the catch is released upon energization of the solenoid.

With reference to FIG. 1, a catch 10 is pivotally mounted on a shaft 11 which is surrounded by spring 12, which urges the catch face outwardly of the strike housing which comprises a relatively long and narrow base 13 with upstanding walls 14, 15, 16, 17 and 18. The housing may comprise additional walls and the mounting plate for the strike has been omitted for ease in illustration. The face of the catch 10 engages a latch 19 which normally is carried by a door and which is moveable in the direction of the arrow 20 to disengage it from the catch 10. When the latch 19 is disengaged from the catch 10, the latch 19, and the portion of the door on which it is mounted, is moveable in the direction of the arrow 20.

The cooperation of the catch 10 with the latch 19 is well known in the art, and when the catch 10 is locked, the door carrying the latch 19 cannot be opened until the latch is moved in the direction of the arrow 20. However, when the catch 10 is released, the door can be opened without withdrawing the latch 19, because the catch 10 is permitted to move.
around the shaft 11 into the position thereof shown in FIG. 2.

The ends of the shaft 11 are supported by the walls 15 and 16, and the wall 16 has a curved slot 21 therein through which a pin 22, mounted on the catch 10, extends. Outward movement of the catch is limited by engagement with the pin 22 and the end wall of the slot 21, and inward movement of the catch 10 is limited by engagement of the pin 22 with the opposite end wall of the slot 21.

An arm 23 is pivotally mounted at 24 on the wall 16 and has an upstanding projection 25, which is engageable with a detent 26 when it is in the position shown in FIG. 1. The detent 26 is pivotally mounted at 27 on the wall 17, and is similarly pivotally mounted on the opposite end on the wall 18. Thus, the detent 26 can move, at its end spaced from the axis 27, toward and away from the catch 10, and preferably movement of the detent 26 toward the catch 10 is limited by a fixed pin 28 extending upwardly from the base 13.

The base 13 carries a solenoid and core assembly 29 which comprises a solenoid 30 which can be continuously or discontinuously energized, a frame 31, and a moveable core 32 extending axially of the solenoid 30. A yoke 33 is mounted on the end of the core 32, and a washer 34 is mounted between the yoke 33 and the core 32. The core 32 is surrounded by a spring 35 which urges the core outwardly of the interior of the solenoid 30.

The yoke 33 is connected to a portion of the detent 26 by a lever in the form of a U-shaped rod 36, which is pivotally connected to the yoke 33 at one end and is pivotally connected to the detent 26 at the opposite end and at a portion of the detent 26 spaced from its pivot axis, the intermediate portion of the rod 36 extending alongside the solenoid 30. The rod 36 may be retained in place by the wall 17 or in any other manner, such as by flattening one end thereof as shown in FIGS. 4 and 5.

In FIG. 1 the parts of the strike are shown in the positions which they assume when the solenoid 30 is energized and in FIG. 2 they are shown in the positions they assume when the solenoid is de-energized. Thus, as shown in FIG. 1, with the solenoid 30 energized, the detent 26 is against the pin 28 and in a position in which it engages the projection 25 on the arm 23 when an attempt is made to rotate the catch 10 around the shaft 11, the pin 22 engaging the arm 23. Accordingly, the catch 10 is prevented from rotating around the shaft 11 and is locked.

However, when the solenoid 30 is de-energized, the spring 35 moves the core 32, the rod 36 and the detent 26 to the positions shown in FIG. 2, so that if pressure is applied to the catch 10 to cause it to rotate around the shaft 11, the projection on the arm 23 is free to move past the detent 26 so that the catch 10 may be withdrawn to the position shown in FIG. 2. Accordingly, the embodiment shown in FIGS. 1 and 2 is one in which the catch 10 is locked when the solenoid 30 is energized and is released when the solenoid 30 is not energized.

When it is desired to employ the parts shown in FIGS. 1 and 2 to cause the catch 10 to be locked when the solenoid is de-energized and to be released when the solenoid is energized, the arm 23 may be modified as shown in FIG. 3. In FIG. 3, the arm 23 is replaced by an arm 37 which has an L-shaped projection 38 extending therefrom. One portion 39 of the projection 38 is engageable with the detent 26 when the solenoid 30 is de-energized, and the parts are in the position shown in FIG. 3. However, the spacing between he portion 39 and the main body of the arm 37 is sufficient to permit the end of the detent 26 to pass therebetween when the detent 26 is moved by the solenoid core to the position shown in FIG. 1 which permits the arm 37 to rotate about its axis 24, and therefore, permits the catch 10 to rotate about its pivot axis to the position shown in FIG. 2. It will be noted from FIG. 3 that to provide the necessary clearance for the projection 38, the rod 36 is mounted on the opposite side of the solenoid 30 from that shown in FIGS. 1 and 2 and the detent 26a is cut away at 26b, it being necessary for the projection 38 to move substantially to the base 13 to permit adequate movement of the catch 10.

The embodiments shown in the preceding figures are particularly suitable for installation where the depth of the door frame is relatively small. However, in some applications, the door frame depth is sufficient to permit reorientation of the solenoid and core assembly 29 to the positions shown in FIGS. 4 and 5. In the embodiments shown in FIGS. 4 and 5 the shaft 11, and hence the pivot axis of the catch 10, is disposed transversely to the length of the base 40 of the strike housing, and the detent arm 41 is pivotally mounted at 42 on the wall 42a. Preferably, the embodiment shown in FIGS. 4 and 5 is provided with a second detent arm 43 similar to the arm 41 and similarly mounted on the wall 45. Outward movement of the catch 10 may be limited in any well known manner, such as by an ear 44 on the side wall 45 of the housing and engageable with the arm 43, each of the arms 41 and 43 having a slot 46 (FIG. 5) for receiving the pin 22.

The solenoid and moveable core assembly 29 in FIGS. 4 and 5 is identical with the solenoid and core assembly 29 shown in the preceding Figures, and the detent 26 is mounted and operates similarly to the detent 26 shown in the preceding Figures. The core 32 is connected to the detent 26 by the U-shaped rod 36 and may be retained in the yoke 33 by a flat 49 at one end. The arms 41 and 43 have projections 47 and 48 which are engageable with the detent 26 when the solenoid 30 is energized and which pass by the detent 26 when the solenoid 30 is de-energized. Thus, when the solenoid is energized, the detent 26 is in the position shown in FIG. 4 and engages the projections 47 and 48 preventing movement of the catch 10 around the shaft 11 by reason of the arms 41 and 43 and the pins 22. However, when the solenoid 30 is de-energized, the detent 26 assumes the position shown in FIG. 5 so that the arms 41 and 43 are free to move with the catch 10 permitting the catch 10 to move to the released position shown in FIG. 5. The catch 10 is returned to the outwardly extending position shown in FIG. 4 by means of the spring 12.

As described hereinbefore, the embodiment of FIG. 3 is similar to the embodiment shown in FIGS. 1 and 2 in that the exposed portion of the core 32 faces away from the detent 26a. However, it differs therefrom in that the catch 10 is locked when the solenoid 30 is de-energized. A further embodiment in which the catch 10 is locked when the solenoid 30 is de-energized but in which the solenoid and core assembly 29 is reversed, is illustrated in FIGS. 6 and 7. Except for the reversal of the assembly 29 and the replacement of the rod 36 by
a shorter rod 50, the structure shown in FIGS. 6 and 7 is the same as that shown in FIGS. 1 and 2.

In the embodiment shown in FIGS. 6 and 7, the solenoid and core assembly 29 is mounted on the base 13 with the exposed portion of the core or plunger 32 facing the detent 26, and the yoke 33 on the end of the core or plunger 32 is connected to the detent 26 by means of a U-shaped rod 50, similar to the U-shaped rod 36 shown in FIGS. 1–3. The action of the detent 26, the catch 10, the arm 23 and the pin 22 is the same as that described in connection with FIGS. 1 and 2. Thus, with the solenoid and core assembly 29 de-energized, the detent 26 assumes the position shown in FIG. 6 and locks the catch 10. When the solenoid and core assembly 29 is energized, the detent 26 is moved by the core 32 and the rod 50 to the position shown in FIG. 7, thereby permitting the arm 23, and hence the catch 10, to rotate.

If desired, the detent arm 23 may be omitted and the detent may directly engage the pin 22 on and controlled by the catch 10. FIGS. 8 and 9 illustrate an embodiment similar to the embodiment shown in FIGS. 6 and 7, but differing therefrom primarily in that the detent arm 23 has been omitted and the pin 22 on the catch 10 is directly engaged by the detent 51.

In FIGS. 8 and 9 the solenoid core assembly is mounted on a relatively long and narrow base 53 having upwardly extending walls 54, 55, 56, 57 and 58, such base and walls forming a housing for the various parts. The housing may comprise additional walls which have been omitted in the drawings for ease of illustration. A portion of the mounting plate 59 for the strike is shown in FIGS. 8 and 9.

The operation of the embodiment shown in FIGS. 8 and 9 is essentially the same as the embodiment shown in FIGS. 6 and 7. The detent 51 is normally urged into the position shown in FIG. 8 by reason of its connection to the yoke 33 through the U-shaped rod 50, and is limited in its movement away from the solenoid and core assembly 29 by reason of its engagement with the upwardly extending wall 56. In the position shown in FIG. 8, the nose portion 60 of the detent 51 is in the path of the pin 22 secured to the catch 10 so that inward movement of the catch 10 is prevented by the nose portion 60 of the detent 51.

With the solenoid 30 energized, the core 32 thereof moves inwardly of the solenoid 30, thereby moving the detent 51 into the position shown in FIG. 9. In such position, the nose 60 is out of the path of the pin 22 thereby permitting the catch 10 to be moved inwardly to the position shown in FIG. 9. Maximum inward movement of the catch 10 is limited by reason of the engagement of the pin 22 with a portion of the upwardly extending wall 56.

It will be apparent to those skilled in the art that various modifications may be made without departing from the principles of the invention. For example, although it is preferred because of simplicity to employ the bent rod 36 for interconnecting the solenoid core and the detent, nevertheless, another type of linkage may be interposed between the core and the detent.

What is claimed is:

1. An electric strike comprising a pivotally mounted catch, a detent pivotally mounted for movement of a portion thereof from a first position near said catch to a second position farther from said catch, means controlled by said catch and engageable with said portion of said detent in one of said positions for preventing rotation of said catch and movable with respect to said portion of said detent in the other position thereof to permit rotation of said catch, and electrically energizable solenoid with a movable core therein with a portion thereof extending from said solenoid, said solenoid, when energized, causing said portion of the core to move in a direction toward the interior of said solenoid and an interconnecting member extending from said core to said detent and pivotally connected at one end thereof to said core and pivotally connected at the other end thereof to said detent for moving said detent from said second position to said first position upon movement of said core in said direction.

2. An electric strike comprising a pivotally mounted catch, a detent pivotally mounted for movement of a portion thereof from a first position near said catch to a second position farther from said catch, means controlled by said catch and engageable with said portion of said detent in one of said positions for preventing rotation of said catch and movable with respect to said portion of said detent in the other position thereof to permit rotation of said catch, and an electrically energizable solenoid with a movable core therein with a portion thereof extending from said solenoid, said solenoid, when energized, causing said portion of the core to move in a direction toward the interior of said solenoid and a U-shaped rod pivotally connected at one end to said portion of said core and at its opposite end to said detent for moving said detent from said second position to said first position upon movement of said core in said direction, said rod having its intermediate portion extending alongside said solenoid.

3. A strike as set forth in claim 2, wherein said means engageable with said detent comprises a pivotally mounted arm having its pivot axis parallel to the pivot axis of said catch and having an engaging thereon upwardly extending therefrom in the direction of said pivot axis and engageable with said detent in said one position thereof, said catch having means thereon engageable with said arm for preventing rotation of said arm with respect to said catch in a predetermined direction but permitting rotation of said arm with respect to said catch in a direction opposite to said predetermined direction.

4. A strike as set forth in claim 3, wherein said projection on said arm is engageable with said detent in said first position of the latter.

5. A strike as set forth in claim 3, wherein said projection on said arm is engageable with said detent in said second position of the latter.

6. An electric strike as set forth in claim 2, wherein said means engageable with said detent comprises a projection on said catch spaced from the pivot axis of said catch and extending therefrom in the direction of said detent.

7. An electric strike comprising a relatively long and narrow base, a catch pivotally mounted from said base with its pivot axis extending in the direction of the length of said base, stop means on said base for limiting the movement of said catch in a first direction around the pivot axis thereof, spring means acting between said base and said catch and urging said catch in said first direction, an electrically energizable solenoid with an axially moveable core mounted on said base with the axis thereof extending substantially parallel to the pivot axis of said catch, with the solenoid spaced from said...
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catch in the direction of the length of said base and with a portion of said core extending from said solenoid on the side thereof opposite from said catch, said portion of said core moving in a direction toward the interior of said solenoid upon energization of the latter, a detent pivotally mounted from said base intermediate said solenoid and said catch and with the pivot axis thereof extending transversely to the pivot axis of said catch, a lever pivotally connected at one end to said portion of said core and extending to and being pivotally connected to a portion of said detent spaced from the pivot axis thereof, said lever moving said detent from a first position nearer said solenoid to a second position nearer said catch upon energization of said solenoid, spring means urging said detent and said portion of said core away from said catch and urging said detent into said first position thereof, an arm pivotally mounted from said base with its pivot axis spaced from the pivot axis of said catch and extending substantially parallel thereto, said arm having a projection thereon extending, at least in part, toward said detent and being free to move with respect to said detent when the latter is in one of said positions thereof but being engageable with said detent in the other position thereof to prevent movement of said arm with respect to said detent, and means on said catch engageable with said arm for preventing rotation of said catch around its axis in a direction opposite to said first direction when said projection on said arm is in engagement with said detent.

8. A strike as set forth in claim 7, wherein said projection on said arm engages said detent when the latter is in said second position.

9. A strike as set forth in claim 7, wherein said projection on said arm engages said detent when the latter is in said first position.

10. A strike as set forth in claim 9, wherein said projection on said arm is L-shaped and the portion thereof spaced from said arm is spaced from the latter by an amount sufficient to permit said detent to pass between said arm and said portion when said detent is in said second position.

11. An electric strike comprising a relatively long and narrow base, a catch pivotally mounted from said base with its pivot axis extending transversely to the length of said base, stop means on said base for limiting movement thereof in a first direction around the pivot axis thereof, spring means acting between said base and said catch and urging said catch in said first direction, an electrically energizable solenoid with an axially movable core mounted on said base with the axis thereof extending transversely to the pivot axis of said catch, with the solenoid spaced from said catch in the direction of the length of said base and with a portion of said core extending from said solenoid on the side thereof opposite from said catch, said portion of said core moving in a direction toward the interior of said solenoid upon energization of the latter, a detent pivotally mounted from said base intermediate said solenoid and said catch and with the pivot axis thereof extending substantially parallel to the pivot axis of said catch, a lever pivotally connected at one end to said portion of said core and extending to and being pivotally connected to a portion of said detent spaced from the pivot axis thereof, said lever moving said detent from a first position nearer said solenoid to a second position nearer said catch upon energization of said solenoid, spring means urging said detent and said portion of said core away from said catch and urging said detent into said first position thereof, an arm pivotally mounted from said base with its pivot axis spaced from the pivot axis of said catch and extending substantially parallel thereto, said arm having a projection thereon extending, at least in part, toward said detent and being free to move with respect to said detent when the latter is in one of said positions thereof but being engageable with said detent in the other position thereof to prevent movement of said arm with respect to said detent, and means on said catch engageable with said arm for preventing rotation of said catch around its axis in a direction opposite to said first direction when said projection on said arm is in engagement with said detent.

12. A strike as set forth in claim 11, wherein said projection on said arm engages said detent when the latter is in said second position.

13. An electric strike comprising a pivotally mounted catch, a detent pivotally mounted for movement of a portion thereof from a first position near said catch to a second position farther from said catch, means controlled by said catch and engageable with said portion of said detent in one of said positions for preventing rotation of said catch and movable with respect to said portion of said detent in the other position thereof to permit rotation of said catch, an electrically energizable solenoid with a movable core therein with a portion thereof extending from one end of said solenoid, said solenoid, when energized, causing said portion of the core to move in a direction toward the interior of said solenoid and said solenoid being mounted with its opposite end adjacent said detent, and interconnecting means pivotally connected at a first portion thereof to said core and pivotally connected at a second portion thereof spaced from said first portion in a direction generally parallel to the direction of movement of said core to said detent for moving said detent from said second position to said first position upon movement of said core in said direction.

14. An electric strike comprising a pivotally mounted catch, a detent pivotally mounted for movement of a portion thereof from a first position near said catch to a second position farther from said catch, means controlled by said catch and engageable with said portion of said detent in one of said positions for preventing rotation of said catch and movable with respect to said portion of said detent in the other position thereof to permit rotation of said catch, an electrically energizable solenoid with a movable core therein with a portion thereof extending from said solenoid, said solenoid being mounted with said portion of said core and said detent at the same side thereof and said solenoid, when energized, causing said portion of the core to move in a direction toward the interior of said solenoid, and a U-shaped rod pivotally connected at one end to said portion of said core and at its opposite end to said detent for moving said detent from said second position to said first position upon movement of said core in said direction.

15. An electric strike comprising a pivotally mounted catch, a detent plate pivotally mounted for movement of a portion thereof from a first position near said catch to a second position farther from said catch, the pivot axis of said plate extending transversely to the pivot axis of said catch, said catch having a projection
thereon in the form of a pin which extends generally parallel to said pivot axis of said catch, said detent plate having a surface which extends radially from the pivot axis of said plate and said pin being engageable with said surface of said plate in one of said positions for preventing rotation of said catch and movable with respect to said surface of said plate in the other position thereof to permit rotation of said catch, an electrically energizable solenoid with a movable core therein with a portion thereof extending from said solenoid, said solenoid, when energized, causing said portion of the core to move in a direction toward the interior of said solenoid, and interconnecting means pivotally connected at a first portion thereof to said core and pivotally connected at a second portion thereof spaced from said first portion in a direction generally parallel to the direction of movement of said core to said detent plate for moving said detent plate from said second position to said first position upon movement of said core in said direction.

16. An electric strike comprising a pivotally mounted catch, a detent mounted for movement from a first position near said catch to a second position farther from said catch, means controlled by said catch and engageable with said detent in one of said positions for preventing rotation of said catch and movable with respect to said detent in the other position thereof to permit rotation of said catch, said means comprising a pivotally mounted arm having its pivot axis parallel to the pivot axis of said catch and having an upstanding L-shaped projection thereon engageable with said detent in said second position thereof and permitting said detent to pass between said projection and said arm in the first position of said detent, an electrically energizable solenoid with a movable core therein with a portion thereof extending from said solenoid, said solenoid, when energized, causing said portion of the core to move in a direction toward the interior of said solenoid and interconnecting means pivotally connected to said core and to said detent for moving said detent from said second position to said first position upon movement of said core in said direction.

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