Nov. 21, 1961 A. J. KOCH 3,009,725

LATCH

Filed Oct. 27, 1958 2 Sheets-Sheet 1

Fig. 1.

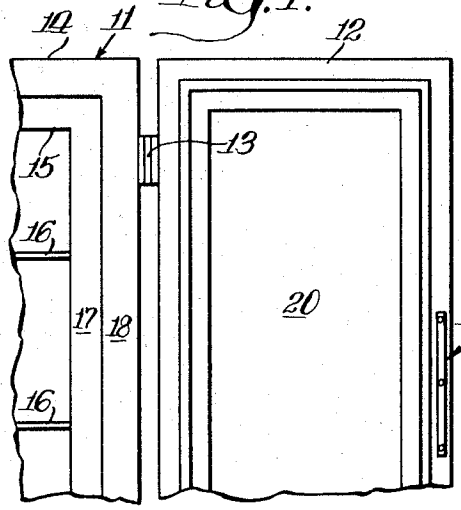


Fig. 2.

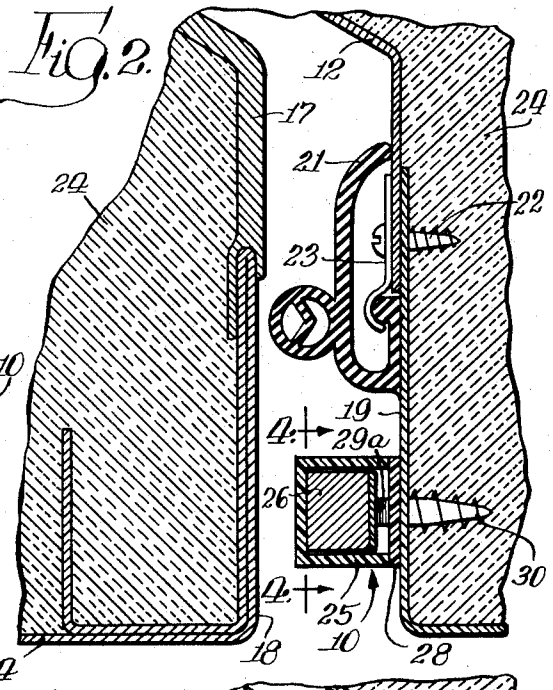


Fig. 3.

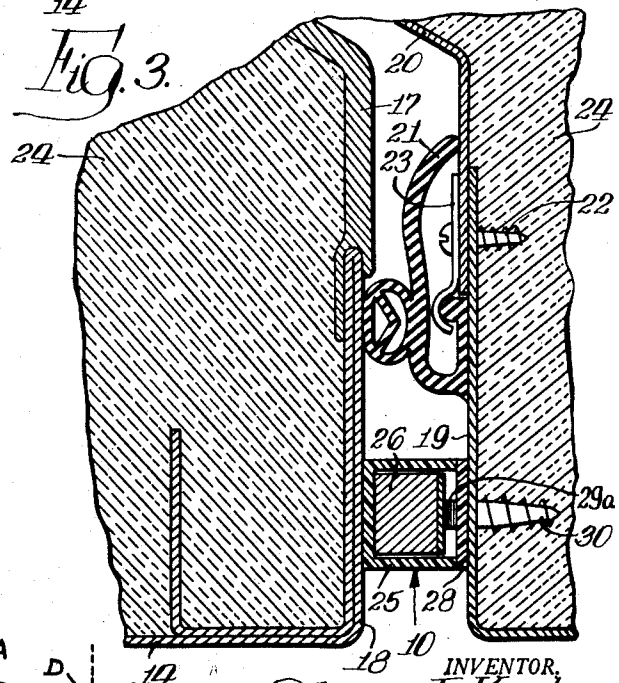
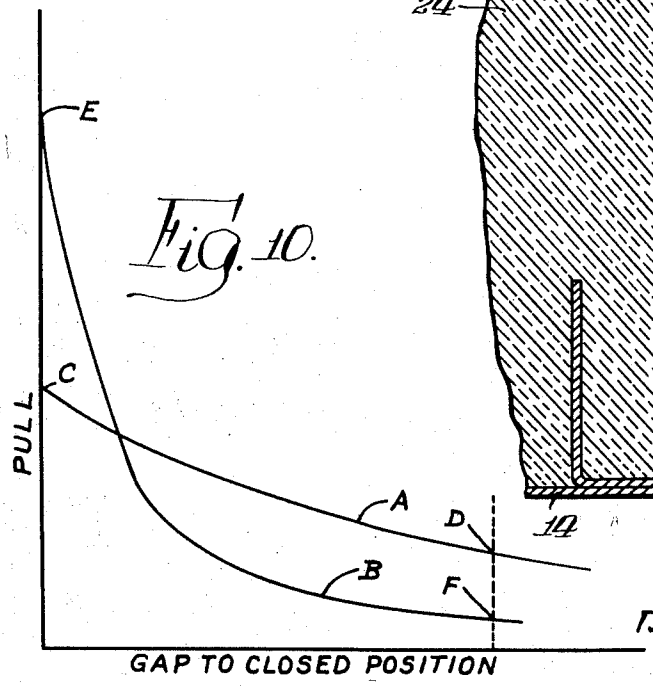


Fig. 10.



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LATCH

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Fig. 4.

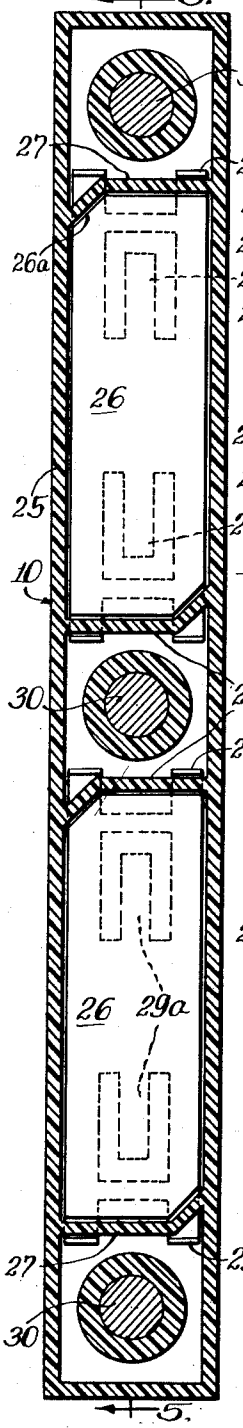


Fig. 5.

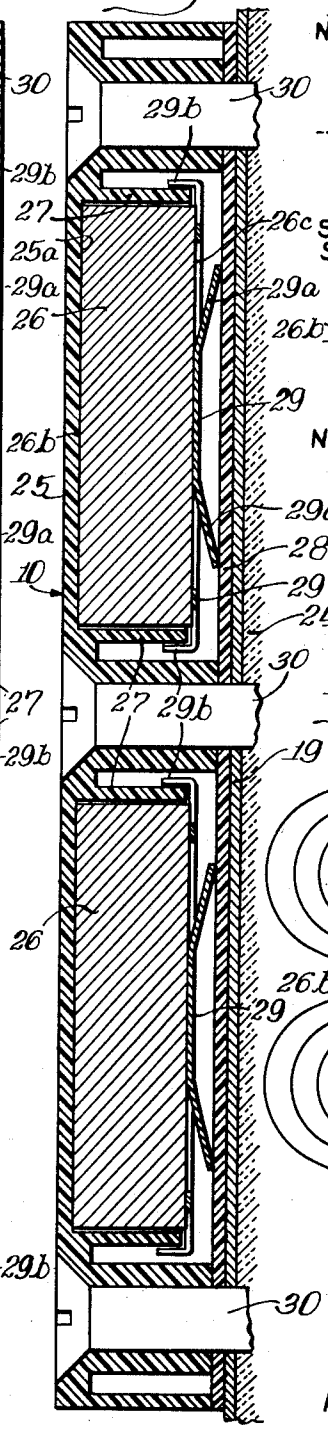


Fig. 6.

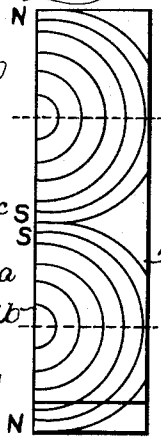


Fig. 7.

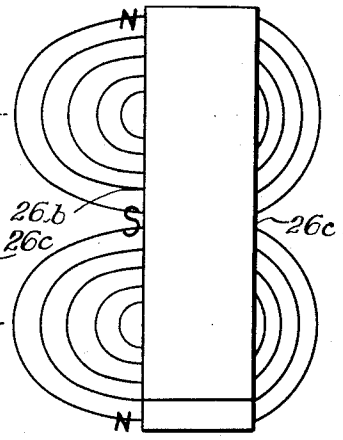


Fig. 9.

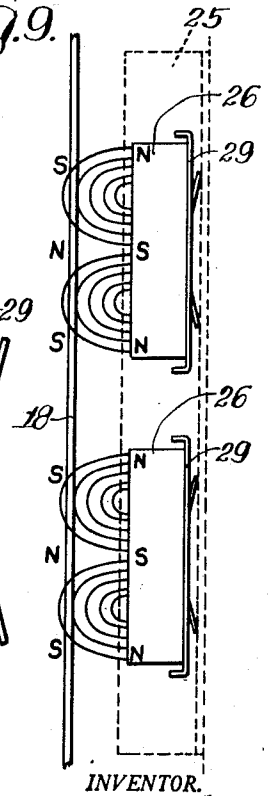
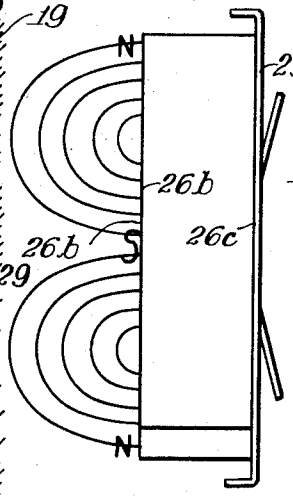


Fig. 8.



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3,009,725

LATCH

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Filed Oct. 27, 1958, Ser. No. 769,635
7 Claims. (Cl. 292—251.5)

This invention relates to a magnetic latch for a refrigerator or the like structure.

One of the features of this invention is to provide an improved magnetic latch for a refrigerator or the like structure having a door opening framed by a jamb and a door normally closing the opening having an edge facing and a hinge mounting on one side of the door, the latch comprising a magnet mounted on one of the jamb and facing located adjacent to the outer edge of the door opposite to the hinge, an armature for the magnet located on the other of the jamb and facing and a sealing gasket between the jamb and facing of the closed door, the magnet being located outwardly of the gasket.

Another feature of the invention is to provide an improved magnetic latch comprising a magnet mounted on one of the jamb and facing of a door opening and door in which the latch is located substantially entirely between the exterior surfaces of the jamb and facing when the door is closed and the other of the jamb and facing opposite to the magnet is relatively thin magnetic metal operating as an armature for the magnet.

A further feature of the invention is to provide an improved magnetic latch comprising a magnet mounted on one of said jamb and facing with the magnet having a front side with a relatively strong magnetic field and a back with a relatively weak field, a member of magnetic material at this back to concentrate the weak field therein and a relatively thin armature in the other of the jamb and facing located opposite the magnet when the door is closed.

Another feature of the invention is to provide an improved magnetic latch comprising an elongated housing of non-magnetic material adapted to be mounted on one of the jamb and facing opposite to an armature on the other of the jamb and facing with the housing having a compartment to receive a magnet and an open back, a removable closure means for this back retaining the magnet in the compartment and securing means passing through the housing and closure means exteriorly of the magnet for both holding the assembly of housing, magnet and closure in assembled relationship and for securing the assembly on the structure.

A further feature of the invention is to provide an improved magnetic latch including the housing compartment and magnet in which both the compartment and magnet are asymmetric in order that the magnet will fit in the compartment in only one position.

Other features and advantages of the invention will be apparent from the following description of one embodiment thereof taken in conjunction with the accompanying drawings. Of the drawings:

FIGURE 1 is a fragmentary elevational view showing an open refrigerator including a magnetic latch embodying the invention.

FIGURE 2 is a fragmentary enlarged horizontal sectional view showing the refrigerator cabinet and door in closely spaced but open position with the section being taken through the magnetic latch and adjacent portions of the structure.

FIGURE 3 is a view similar to FIGURE 2 but showing the door in fully closed position.

FIGURE 4 is a sectional view taken substantially along line 4—4 of FIGURE 2 showing the magnetic latch only.

FIGURE 5 is a sectional view taken substantially along line 5—5 of FIGURE 4.

FIGURE 6 is a plan view illustrating the interior magnetic field of a preferred magnet in the latch of this invention.

FIGURE 7 is a view similar to FIGURE 6 but illustrating the exterior magnetic field of the magnet.

FIGURE 8 is a view similar to FIGURE 7 with the addition of a magnet retainer of magnetic metal illustrating the exterior magnetic field when this retainer is in position.

FIGURE 9 is a semi-diagrammatic view illustrating the magnetic lines of force from a magnetic latch embodying the invention when the door and attached latch are in slightly open position.

FIGURE 10 is a graph illustrating the "pull" characteristics of a magnetic latch embodying the invention as compared to a conventional magnetic latch.

The magnetic latch of this invention as shown in the accompanying drawings has a number of important advantages over prior latches designed for holding doors, and particularly refrigerator doors in closed position. The latch is compact and relatively thin yet is rigid and unyielding. In its preferred embodiment it is adapted to be located entirely between the door jamb and door facing without requiring recesses or other construction features or alterations of the door or jamb. This latch avoids the necessity of providing an access opening in the inner door panel or facing or in the door jamb that surrounds the door opening. In addition there is no necessity to provide voids or recesses in the insulating material of the door or cabinet to provide space for the parts of the latch.

There is no necessity for an expensive and bulky latch assembly on the door or cabinet and no expensive and bulky armature of special design in the other of the door and cabinet. The latch may be mounted either on the door edge facing or on the cabinet jamb surrounding the door opening, as desired. The latch can be made quite thin and operates as a stop to protect the sealing gasket that is usually provided between the jamb and facing. This protection prevents excessive compression of the gasket by the door especially during shipment and handling of the refrigerator or the like structure.

In an embodiment of the invention the use of a separate armature as a part of a latch is avoided as the metal of the cabinet is used as the armature. This greatly simplifies construction and provides a relatively thin armature. By using a magnet with a large pole face area, a relatively flat pull curve is obtained as shown in FIGURE 10 indicating a greater pull over a fixed gap as compared to conventional magnetic latches. Thus at zero gap between the magnet portion of the latch and the armature, the pull of the magnets is relatively small but is sufficient to hold the door closed without requiring excessive effort to open it. When the door is approaching closed position, the pull is large enough, however, to cause the door to move firmly into position even when the gap is relatively great. The difference between the pull when the door is in these two positions is much less than in prior latches, and the amount of pull when the door is in the approaching position is greater than in prior latches for a given distance.

In one embodiment of the invention the magnets are located at the edge of the closed door beyond the outside of the gasket in order to locate the magnets at the maximum possible distance from the pivotal axis of the door mounting. This increases the door closing force as the leverage is increased thereby permitting the use of smaller power magnets for any given closing force. This location of the magnets also causes increased force on the gasket to provide a better seal between the door and the cabinet.

In the embodiment of the invention shown in the draw-

ings, the magnetic latch 10 is shown installed on a refrigerator. The refrigerator which is of the household type includes a cabinet 11 and a door 12 joined as by hinges 13. The cabinet includes an outer wall 14 and an inner wall 15 forming the usual food storage compartment which may be provided with a plurality of shelves 16 of usual construction.

The space between the outer wall 14 and the inner wall 15 is provided with a breaker strip 17 which is joined to an inwardly extending section 18 of the thin sheet metal outer wall 14 of the cabinet. The breaker strip 17 and section 18 forms a jamb framing the door opening leading to the interior food storage compartment.

The door 12 is provided with an inturned flange 19 to which is attached the door inner panel 20. The flange 19 forms an edge facing for the door in conjunction with the panel 20. Mounted on the door 12 at an area adjacent to the junction of the flange 19 and panel 20 is a customary sealing gasket 21 held in place by a series of screws 22 engaging a clamp 23. The screws and the clamp are hidden by an overlying portion of the gasket.

Both the cabinet 11 and the door 12 are provided with the customary insulating material 24.

The magnetic latch includes an elongated housing 25 of a non-magnetic, preferably plastic, material such as rigid polystyrene and a plurality of magnets 26 here shown as two. The housing is formed to provide a compartment 25*a* for each magnet 26, defined by the side walls and top walls of the housing and by end partitions 27. The back of the housing is open for the insertion of the magnets 26 and in the embodiment shown is closed by a removable closure strip 28. Each magnet 26 is held in position by a spring retainer 29 in the form of a flat plate of magnetic metal having end spring fingers 29*a* struck from the retainer bearing against the closure 28 to hold its magnet 26 tightly in position within the housing. The ends of each retainer 29 are provided with upturned flanges 29*b* located to engage the end partitions 27 and aid in locating the retainers within the housing. As can be seen from FIGURE 5, the end partitions 27 have a length that is less than the thickness of the magnet 26 in order that the retainer will bear against the magnet with full force.

Each magnetic latch is held in position on the door facing 19 by fastening means such as a plurality of screws 30. These fastening means not only serve to mount the magnetic latch in position, but also serve to hold the assembly of housing, magnets, closure, and retainers in their properly assembled relationship. The screws are spaced from the magnets. Thus in the embodiment shown one screw is located between the two magnets, while the other two screws are located opposite the outer ends of the two magnets.

Each magnet 26 and its corresponding compartment 25*a* is asymmetric so that the magnet will fit in the compartment in only one position. Thus in the embodiment shown this is caused by cutting off two diagonally opposite corners 26*a* of each magnet and forming the compartment 25*a* to a similar shape. With this construction, the front 26*b* of the magnet always faces outwardly, while the back 26*c* of the magnet engages its metal retainer 29.

The internal lines of force of each magnet are illustrated in FIGURE 6. The external lines of force or magnetic field are illustrated in FIGURE 7. As can be seen here there is a considerably stronger field at the front 26*b* of the magnet than there is at the back 26*c*. The magnet is purposely made thin so that not all of the external lines of force are contained within the magnet at the back 26*c*. In order to compensate for this, the magnet retainers 26*c* are made of a magnetic material, preferably soft steel, so as to provide a confining flux path for the lines of flux at the back of the magnet as is illustrated in FIGURE 8. This confining of the back lines of flux serves to enlarge and increase the magnetic field at the front of the magnet.

Each magnet may of course be provided with any desired number of poles on its front face. In the embodiment shown, there are four poles as is illustrated in FIGURE 6 with two north end poles and two center south poles. As the two center south poles form a common south pole, the magnet may be considered as having only 3 poles. The number of poles, of course, has a direct bearing on the characteristic pull of the magnet on the latch in closing the door and in pulling it closed. Experiments have shown that the 3-pole magnet is preferred as it provides a sufficiently strong holding force to maintain the door closed and also provides sufficient pull on the door when it is approaching closed position to aid in the closing of the door.

In the embodiment shown the magnet material of each magnet is produced by sintering barium carbonate with ferric oxide to produce the compound of the formula $BaFe_{12}O_{19}$.

FIGURE 9 illustrates semi-diagrammatically the magnetic field relationships when a door having the latch of this invention attached thereto approaches closed position. When this occurs, the sheet metal section 18 of the cabinet acts as an armature and becomes magnetized with poles opposite to those in the magnet themselves. This causes the unlike poles to attract each other causing a pull on the door. As the door approaches closer and closer to the cabinet the strength of the field induced in the portion of the cabinet acting as an armature increases thereby increasing the pull exerted on the door.

The results achieved with the magnetic latch of this invention are illustrated by curve A of FIGURE 10. In this curve, the relative width of the gap between the magnets and their armature is the abscissa while the relative pulling force is the ordinate. The force of the pull at zero gap or closed position is indicated by the letter C. In order to achieve this force when the door is closed to provide a satisfactory seal against the gasket 21, it is only necessary to supply the correct number of magnets which of course will be determined by the physical size of the door, the resiliency of the gasket, and similar well known factors. The force of the door as it approaches the closed position is shown at D on curve A.

Curve A in FIGURE 10 illustrates that the magnetic latch of this invention utilizes a magnet with three poles in such a manner that the flux is divided as compared to a two pole magnet, thus resulting in a large pole face area with more flux lines engaging the relatively thin armature as the door approaches a closed position. This relatively thin armature is preferably the adjacent portions of the metal shell of the cabinet. By employing these principles, the pull on the door as it approaches a closed position as indicated by the letter D is of considerable magnitude in order to aid in closing the door. For the same reason, the pull as indicated by the point C after the door has been closed is not excessively greater than is the pull at D. The pull at C, however, is sufficient to hold the door closed.

In contrast with the above results achieved with the magnetic latch of this invention, the results achieved with the prior magnetic latches are illustrated by the curve B on FIGURE 10. In these prior latches, the pull as indicated by the point F on curve B is relatively small when the door approaches closed position. However, when the door is completely closed the pull as indicated by the letter E is excessive causing the door to be difficult to open. In order to increase the pull indicated by the point F, many prior magnetic latches have used various complicated and expensive arrangements such as apparatus permitting movement of the armature forward toward the magnet during the closing of the door. The improved magnetic latch of this invention which has a strong pull when the door approaches closed position and a somewhat stronger but not excessive pull when

the door is in closed position successfully avoids the necessity for such complicated and expensive structures.

During the assembly process and at any time subsequent, the height of the magnetic latch of this invention may be adjusted to correspond to the optimum sealing height of the gasket by simply either removing the closure plate 28 entirely or by using a smaller closure plate so that the spacing between the door and the cabinet is reduced.

Having described my invention as related to the embodiment shown in the accompanying drawings, it is my intention that the invention be not limited by any of the details of description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a refrigerator or the like structure having a door opening framed by a jamb, a door normally closing the opening having an edge facing and a hinge mounting on one side of the door, a magnetic latch comprising: a magnet mounted on one of the jamb and facing located adjacent the outer edge of the closed door opposite the hinge, the magnet having a front side with at least three poles providing a relatively strong magnetic field and a back side relatively closed spaced from the front side to cause a portion of the magnetic field to pass outwardly through the back side thereby defining a relatively weak field rearwardly of the magnet; a thin member of magnetic material spaced from said front side and facially engaging said back side to provide a low reluctance path for said weak field; and an armature at the other of said jamb and facing confronting the front side of the magnet when the door is closed.

2. The magnetic latch structure of claim 1 wherein a major portion of the surface of said thin member confronting said magnet is in facial engagement therewith.

3. The magnetic latch structure of claim 1 wherein the surface area of the front side of said thin member is at least as great as a major portion of the surface area of said back side of the magnet.

4. In a refrigerator or the like structure having a door opening framed by a jamb, a door normally closing the opening having an edge facing and a hinge mounting on one side of the door, a magnetic latch comprising: a magnet mounted on one of the jamb and facing located adjacent the outer edge of the closed door opposite the hinge, the magnet having a front side with at least three poles providing a relatively strong magnetic field and a back side relatively closely spaced from the front side to cause a portion of the magnetic field to pass outwardly through the back side thereby defining a relatively weak field rearwardly of the magnet; a housing of non-magnetic material enclosing the magnet and having a front wall and a back wall; a thin member of magnetic material spaced from said front side and facially engaging

said back side to provide a low reluctance path for said weak field, said member including a springy portion engaging said back wall of the housing and urging the magnet forwardly into facial engagement with said front wall of the housing; and an armature at the other of said jamb and facing confronting the front side of the magnet when the door is closed.

5. The magnetic latch of claim 4 wherein the back wall of the housing is removable therefrom and screws extend through the housing to secure the housing and back wall in assembled relationship on said one of the jamb and facing, said screws being juxtaposed to the opposite ends of the magnet to extend through the plane of said front side and through the plane of said rear side of the magnet, said screws further being substantially spaced from the ends of said member.

6. The magnetic latch of claim 4 wherein the housing extends fully between the jamb and facing when the door is closed.

7. In a refrigerator or the like structure having a door opening framed by a jamb, a door normally closing the opening having an edge facing and a hinge mounting on one side of the door, a magnetic latch comprising: a magnet mounted on one of the jamb and facing located adjacent the outer edge of the closed door opposite the hinge, the magnet having a front side with at least three poles providing a relatively strong magnetic field and a back side relatively closely spaced from the front side to cause a portion of the magnetic field to pass outwardly through the back side thereby defining a relatively weak field rearwardly of the magnet; a thin member of magnetic material spaced from said front side and facially engaging said back side to provide a low reluctance path for said weak field; an armature at the other of said jamb and facing confronting the front side of the magnet when the door is closed; and spring means between the magnet and said one of the jamb and facing on which the magnet is mounted, yieldably urging the magnet to a forward disposition.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,009,725 November 21, 1961

Alan J. Koch

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 5, line 27, for "closed" read -- closely --.

Signed and sealed this 1st day of May 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

UNITED STATES PATENT OFFICE

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