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SLIDING DOOR SEAL

Abstract

Certain embodiments of the present application relate to a sliding door system. An example sliding door system includes a frame, a sliding door, and a drop seal mechanism. The sliding door is mounted in the frame for sliding movement between an open position and a closed position. The drop seal mechanism is mounted within the sliding door, and has a deployed state in which the drop seal mechanism forms a seal with the frame, and a retracted state in which the drop seal mechanism does not form a seal with the frame. The frame comprises a projection configured to drive the drop seal mechanism from the retracted state to the deployed state as the sliding door slides from the open position to the closed position.

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Background/Summary

TECHNICAL FIELD

[0001] The present disclosure generally relates to seals for sliding doors, and more particularly but not exclusively relates to automatic drop seals for sliding doors.

BACKGROUND

[0002] Automatic drop seals are occasionally provided to doors to aid in generating a seal when the door is in the closed position. While automatic drop seals have been utilized in swing doors, these mechanisms often rely upon the large mechanical advantage provided at the hinge edge of the closure in order to effect the dropping of the seal. However, those skilled in the art will readily recognize that this mechanical advantage is not available in sliding doors, which has thus far hindered the advancement of drop seals in sliding doors. For these reasons among others, there remains a need for further improvements in this technological field.

SUMMARY

[0003] Certain embodiments of the present application relate to a sliding door system, comprising a frame, a sliding door, and a drop seal mechanism. The sliding door is mounted in the frame for sliding movement between an open position and a closed position. The drop seal mechanism is mounted within the sliding door, and has a deployed state in which the drop seal mechanism forms a seal with the frame, and a retracted state in which the drop seal mechanism does not form a seal with the frame. The frame comprises a projection configured to drive the drop seal mechanism from the retracted state to the deployed state as the sliding door slides from the open position to the closed position. Further embodiments, forms, features, and aspects of the present application shall become apparent from the description and figures provided herewith.

Description

BRIEF DESCRIPTION OF THE FIGURES

[0004] FIG. **1** is a perspective illustration of a closure assembly according to certain embodiments in an open state.

[0005] FIG. **2** is a perspective illustration of the closure assembly in a closed state.

[0006] FIG. **3** is a partially exploded view of a drop seal mechanism according to certain embodiments.

[0007] FIG. **4** is an end view of the drop seal mechanism.

[0008] FIG. **5** is an end view of the drop seal mechanism in an withdrawn state.

[0009] FIG. **6** is an end view of the drop seal mechanism in a deployed state.

[0010] FIG. **7** is a perspective illustration of a portion of the drop seal mechanism.

[0011] FIG. **8** is a cross-sectional view of the drop seal mechanism in the withdrawn state.

[0012] FIG. **9** is a cross-sectional view of the drop seal mechanism in the deployed state.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0013] Although the concepts of the present disclosure are susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and will be described herein in detail. It should be understood, however, that there is no intent to limit the concepts of the present disclosure to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives consistent with the present disclosure and the appended claims.

[0014] References in the specification to “one embodiment,” “an embodiment,” “an illustrative embodiment,” etc., indicate that the embodiment described may include a particular feature, structure, or characteristic, but every embodiment may or may not necessarily include that particular feature, structure, or characteristic. Moreover, such phrases are not necessarily referring to the same embodiment. It should further be appreciated that although reference to a “preferred” component or feature may indicate the desirability of a particular component or feature with respect

to an embodiment, the disclosure is not so limiting with respect to other embodiments, which may omit such a component or feature. Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to implement such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described.

[0015] As used herein, the terms “longitudinal,” “lateral,” and “transverse” may be used to denote motion or spacing along three mutually perpendicular axes, wherein each of the axes defines two opposite directions. In the coordinate system illustrated in FIG. **3**, the X-axis defines first and second longitudinal directions, the Y-axis defines first and second lateral directions, and the Z-axis defines first and second transverse directions. These terms are used for case and convenience of description, and are without regard to the orientation of the system with respect to the environment. For example, descriptions that reference a longitudinal direction may be equally applicable to a vertical direction, a horizontal direction, or an off-axis orientation with respect to the environment.

[0016] Furthermore, motion or spacing along a direction defined by one of the axes need not preclude motion or spacing along a direction defined by another of the axes. For example, elements that are described as being “laterally offset” from one another may also be offset in the longitudinal and/or transverse directions, or may be aligned in the longitudinal and/or transverse directions. Moreover, the term “transverse” may also be used to describe motion or spacing that is non-parallel to a particular axis or direction. For example, an element that is described as being “movable in a direction transverse to the longitudinal axis” may move in a direction that is perpendicular to the longitudinal axis and/or in a direction oblique to the longitudinal axis. The terms are therefore not to be construed as limiting the scope of the subject matter described herein to any particular arrangement unless specified to the contrary.

[0017] Additionally, it should be appreciated that items included in a list in the form of “at least one of A, B, and C” can mean (A); (B); (C); (A and B); (B and C); (A and C); or (A, B, and C). Similarly, items listed in the form of “at least one of A, B, or C” can mean (A); (B); (C); (A and B); (B and C); (A and C); or (A, B, and C). Items listed in the form of “A, B, and/or C” can also mean (A); (B); (C); (A and B); (B and C); (A and C); or (A, B, and C). Further, with respect to the claims, the use of words and phrases such as “a,” “an,” “at least one,” and/or “at least one portion” should not be interpreted so as to be limiting to only one such element unless specifically stated to the contrary, and the use of phrases such as “at least a portion” and/or “a portion” should be interpreted as encompassing both embodiments including only a portion of such element and embodiments including the entirety of such element unless specifically stated to the contrary.

[0018] In the drawings, some structural or method features may be shown in certain specific arrangements and/or orderings. However, it should be appreciated that such specific arrangements and/or orderings may not necessarily be required. Rather, in some embodiments, such features may be arranged in a different manner and/or order than shown in the illustrative figures unless indicated to the contrary. Additionally, it should be appreciated that the inclusion of a structural or method feature in a particular figure is not meant to imply that such feature is required in all embodiments and, in some embodiments, may be omitted or may be combined with other features.

[0019] With reference to FIGS. **1** and **2**, illustrated therein is a sliding door closure assembly **100** according to certain embodiments. The closure assembly **100** generally includes a frame **110** and a door **120** slidably mounted to the frame **110**. The frame **110** generally includes a bottom track **112** that slidably receives a bottom edge **124** of the door **120** and aids in guiding the door **120** for sliding movement between an open position (FIG. **1**) and a closed position (FIG. **2**). As described herein, the frame **110** may include a projection **116** that projects upward from a floor of the bottom track **112** and into a channel **126** formed in the bottom edge **124** of the door **120**.

[0020] The door **120** is slidably mounted in the frame **110**, and generally includes a lower region **122** including the bottom edge **124**. A drop seal mechanism **200** is positioned within the lower region **122**, and is operable to be actuated by the projection **116**. The drop seal mechanism **200** has

a withdrawn or retracted state in which the drop seal mechanism **200** does not form a seal with the bottom track **112**, and a deployed state in which the drop seal mechanism **200** forms a seal with the bottom track **112**. As described herein, the drop seal mechanism **200** is configured to adopt the retracted state when the door **120** is in the open position (FIG. **1**), and to adopt the deployed state when the door **120** is in the closed position (FIG. **2**).

[0021] With additional reference to FIG. **3**, the drop seal mechanism **200** generally includes a channel member **210**, a seal member **220** movably mounted in the channel member **210**, an actuation lever **230** pivotably mounted in the channel member **210**, and a transmission **240** engaged between the seal member **220** and the actuation lever **230**. As described herein, the transmission **240** is configured to move the seal member **220** between a withdrawn position and a deployed position in response to movement of the actuation lever **230** between an unactuated position and an actuated position.

[0022] With additional reference to FIG. **4**, the channel member **210** is configured for mounting within the channel **126**, and generally includes a seal channel **212** in which the seal member **220** is movably mounted, a transmission channel **214** in which the transmission **240** is mounted, and a receiving channel **216** that slides along the projection **116** during opening and closing of the door **120**.

[0023] With additional reference to FIGS. **5** and **6**, the seal member **220** is movably seated in the seal channel **212** for vertical movement between a withdrawn position (FIG. **5**) and a deployed position (FIG. **6**). In the illustrated form, the seal member **220** generally includes a body portion **222**, a mounting portion **224** depending from the body portion **222**, and a seal strip **226** mounted to the mounting portion **224**. In the illustrated form, the seal member **220** includes a cutout **221** that causes the mounting portion **224** to extend beyond the end of the body portion **222**, which may include a transmission receiving channel **223** operable to receive a portion of the transmission **240**. As described herein, the cutout **221** may be provided to accommodate a portion of the actuation lever **230** while ensuring that the seal provided by the drop seal mechanism **200** extends along substantially the entire length of the door **120** (e.g., at least 90% or at least 95% of the length of the door **120** along the direction of sliding movement).

[0024] The mounting portion **224** may include a mounting channel **225**, and the seal strip **226** may include a corresponding mounting portion **227** configured for receipt in the mounting channel **225**. For example, each of the mounting channel **225** and the mounting portion **227** may have generally T-shaped cross-sections to facilitate the sliding insertion of the mounting portion **227** into the mounting channel **225**. The seal member **226** may include a seal portion **228** depending from the mounting portion **227** and configured to form a seal with a floor (e.g., the bottom track **112** of the frame **110**). While the illustrated seal portion **228** is generally elliptical, it should be appreciated that seal portions according to other embodiments may have other geometries. As described herein, the seal member **220** is configured to engage the bottom track **112** when in the deployed position to thereby form a seal at the bottom of the door **120**. When in the withdrawn position, the seal member **220** is disengaged from the bottom track **112** to facilitate the sliding movement of the door **120** while reducing the likelihood of damage to the seal member **220**.

[0025] With additional reference to FIG. **7**, the actuation lever **230** is pivotably mounted in the channel member **210** for pivotal movement between an unactuated position (FIG. **8**) and an actuated positon (FIG. **9**). For example, the lever **230** may be mounted for pivotal movement about an axle **231** that is mounted to the channel member **210**. As described herein, the actuation lever **230** is engaged with the seal member **220** via the transmission **240** such that the seal member **220** moves between the withdrawn position and the deployed position in response to movement of the actuation lever **230** between the unactuated position and the actuated position.

[0026] The actuation lever **230** is mounted for pivotal movement about a pivot axis **230′** defined by the axle **231**, and generally includes an input arm **232** operable to engage the projection **116** and an output arm **238** coupled with a rod **242** of the transmission **240**. The illustrated input arm **232**

includes a first portion **233** accommodated within the cutout **221**, a jog **234** connecting the first portion **233** with a second portion **235**, and a foot **236** projecting from the second portion **235**. The jog **234** extends in a direction of the pivot axis **230′**, and partially defines a void **234′**. The void **234′** allows the mounting portion **224** and seal strip **226** to extend beyond the end of the body portion **222** to thereby extend the effective length of the seal formed between the drop seal mechanism **200** and the frame **110**. The effective length L**232** of the input arm **232**, measured from the axis **230′** to the foot **236**, is greater than the effective length L**238** of the output arm **238**, measured from the axis **230′** to the point of engagement with the rod **242**. As a result, the actuation arm **230** is configured to translate a lesser first force F**232** on the foot **236** of the input arm **232** to a greater second force F**238** exerted by the output arm **238** on the rod **242**. As described herein, this force multiplication may reduce the amount of resistance that the user encounters during closing of the door **120**.

[0027] With additional reference to FIGS. **8** and **9**, the transmission **240** is configured to move the seal member **220** from the withdrawn position (FIGS. **5** and **8**) to the deployed position (FIGS. **6** and **9**) in response to movement of the actuation lever **230** from the unactuated position (FIG. **8**) to the actuated position (FIG. **9**). In the illustrated form, the transmission **240** generally includes a rod **242** connected with the actuation lever **230**, a sliding block **244** connected with the rod **242** and slidably mounted within the transmission channel **214**, a fixed block **246** secured to the channel member **210** within the transmission channel **214**, and a leaf spring **248** connected between the sliding block **244** and the fixed block **246**. The sliding block **244** is coupled with a first end **245** of the leaf spring **248**, and the fixed block **246** is coupled with an opposite second end **247** of the leaf spring **248**. The sliding block **244** and the fixed block **246** are longitudinally offset from one another by a distance that defines the effective longitudinal length of the leaf spring **248**. The leaf spring **248** is provided with a curved portion **249** that extends away from the transmission channel **214** and into engagement with the seal member **220**. In certain forms, the curved portion **249** may include a valley **249′** that receives a pin **229** coupled to the seal member **220** to facilitate the movement of the seal member **220** from its deployed position to its retracted position.

[0028] FIG. **8** illustrates the drop seal mechanism **200** when the door **120** is in the open position. In this state, the actuation lever **230** is in its unactuated position, and the seal member **220** is in its withdrawn position. When in the withdrawn position, the seal member **220** is offset from the transmission channel **214** by a first offset distance d**220**. In certain forms, the first offset distance d**220** may be measured from the transmission channel **214** in which the blocks **244**, **246** are seated to the point of engagement between the valley **249′** and the seal member **220**. In such forms, the first offset distance d**220** may be referred to as the lateral dimension of the leaf spring **248**. Additionally, the sliding block **244** is offset from the fixed block **246** by a first distance corresponding to a first effective longitudinal length L**248** of the leaf spring **248**. As described herein, contraction of the longitudinal length dimension L**248** generally results in expansion of the lateral dimension d**220** and deployment of the seal member **220**, and expansion of the longitudinal length dimension L**248** generally results in contraction of the lateral dimension d**220** and withdrawal of the seal member **220**.

[0029] In order to transition the drop seal mechanism **200** from the retracted state (FIGS. **5** and **8**) to the deployed state (FIGS. **6** and **9**), the user may simply slide the door **120** from its open position (FIG. **1**) to its closed position (FIG. **2**). During closing movement of the door **120**, the projection **116** engages the foot **236** and thereby applies a first force F**232** to the input arm **232**. This first force F**232** causes the actuation lever **230** to pivot from its unactuated position (FIG. **8**) to its actuated position (FIG. **9**) while exerting on the transmission rod **242** a second force F**238**. The actuation lever **230** is configured to provide a mechanical force advantage such that the output force F**238** is greater than the input force F**232**. The second force F**238** causes the transmission rod **242** to drive the sliding block **244** toward the fixed block **246**, thereby reducing the effective longitudinal length of the leaf spring **248** from a first effective length L**248** (FIG. **8**) to a second

effective length L**248′** (FIG. **9**). Because the true length of the leaf spring **248** remains relatively constant, the leaf spring **248** deforms such that the curved portion **249** flexes downward as a result of the reduced effective length L**248′**. As a result of this flexing, the leaf spring **248** drives the seal member **220** downward from its withdrawn position (FIG. **8**) to its deployed position (FIG. **9**).
[0030] FIG. **9** illustrates the drop seal mechanism **200** when the door **120** is in the closed position. In this state, the actuation lever **230** is in its actuated position, and the seal member **220** is in its deployed position. When in the deployed position, the seal member **220** is offset from the transmission channel **214** by a second offset distance d**220′** greater than the first offset distance d**220**. Additionally, the sliding block **244** is offset from the fixed block **246** by a second distance corresponding to the second effective longitudinal length L**248′** of the leaf spring **248**. As noted above, the leaf spring **248** is in a deformed state when the drop seal mechanism **200** is in its deployed state. Accordingly, the leaf spring **248** exerts a bias force urging the actuation lever **230** toward its unactuated position. As long as the door **120** remains in its closed position, however, the projection **116** maintains the actuation lever **230** in its actuated position.
[0031] In order to transition the drop seal mechanism **200** from the deployed state (FIGS. **6** and **9**) to the withdrawn state (FIGS. **5** and **8**), the user may simply slide the door **120** from its closed position (FIG. **2**) to its open position (FIG. **1**). During opening movement of the door **120**, the projection **116** disengages from the foot **236**, and thereby permits the leaf spring **248** to drive the actuation lever **230** toward its unactuated position as the leaf spring **248** returns to a less-deformed state. Such return of the leaf spring **248** to the less-deformed state causes the valley **249′** to move upward, thereby driving the pin **229** upward such that the seal member **220** returns to its retracted position (FIG. **8**).
[0032] In the illustrated form, the transmission **240** comprises a leaf spring **248** configured to translate longitudinal forces on the rod **242** to lateral forces on the seal member **220**. More particularly, a proximal force F**242** on the rod **242** (e.g., in response to the projection **116** driving the actuation lever **230** to its actuated position) results in a downward force F**220** on the seal member **220**. When the leaf spring **248** is deformed, the leaf spring **248** exerts a distal force F**242′** on the rod **242**, and exerts an upward force F**220′** on the seal member **220**. As the actuation lever **230** moves to its unactuated position (e.g., during opening movement of the door **120**), the forces F**242′**, F**220′** drive the seal member **220** toward its withdrawn position.
[0033] While one form of transmission **240** is illustrated in the drawings, it should be appreciated that other forms of transmission may be utilized to translate a longitudinal (e.g., horizontal) force exerted by the actuation lever **230** to a lateral (e.g., vertical) force on the seal member **220**. As one example, the transmission **240** may instead one or more ramps and/or one or more cams that cause the seal member **220** to move between its withdrawn position and its deployed position in response to movement of the actuation lever **230** between its unactuated position and its actuated position.
[0034] Although other forms of transmission are contemplated, it should be appreciated that the illustrated embodiment may provide one or more advantages that may not necessarily be present in other embodiments. By way of illustration, it has been found that the illustrated transmission **240** may reduce or eliminate the need for precise adjustment of the parts relative to one another. For example, if the actuation lever **230** is pushed while the seal is fully pressed against the ground, the leaf spring **248** can simply flex to take up some of the slop and reduce the necessity for adjustment.
[0035] From the foregoing description, it should be evident that in the illustrated form, the working components of the drop seal mechanism **200** are wholly concealed within the door **120**. This is in contrast to certain existing sliding door drop seal mechanisms, which require that an actuator extend from the door to actuate the drop seal. As will be appreciated by those skilled in the art, such an arrangement can pose hazards related to tripping and/or catching items on the actuator. As such, in addition to providing the aesthetic advantages of providing a door that does not appear to have been modified, the provision of a drop seal mechanism that is concealed within the door **120** may provide functional advantages not available in existing devices.

[0036] While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiments have been shown and described and that all changes and modifications that come within the spirit of the inventions are desired to be protected.
[0037] It should be understood that while the use of words such as preferable, preferably, preferred or more preferred utilized in the description above indicate that the feature so described may be more desirable, it nonetheless may not be necessary and embodiments lacking the same may be contemplated as within the scope of the invention, the scope being defined by the claims that follow. In reading the claims, it is intended that when words such as “a,” “an,” “at least one,” or “at least one portion” are used there is no intention to limit the claim to only one item unless specifically stated to the contrary in the claim. When the language “at least a portion” and/or “a portion” is used the item can include a portion and/or the entire item unless specifically stated to the contrary.

Claims

1. A seal mechanism for a sliding door, the seal mechanism comprising: a channel member configured for mounting to the sliding door; a seal member movably mounted in the channel member for movement between a withdrawn position and a deployed position; an actuation lever pivotably mounted in the channel member for movement between an unactuated position and an actuated position; and a transmission configured to move the seal member between the withdrawn position and the deployed position in response to movement of the actuation lever between the unactuated position and the actuated position.
2. The seal mechanism of claim 1, wherein the actuation lever is configured to translate an input force on the actuation lever to an output force on the transmission; and wherein the actuation lever is configured to provide a mechanical force advantage such that the output force is greater than the input force.
3. The seal mechanism of claim 1, wherein the transmission comprises a leaf spring.
4. The seal mechanism of claim 3, wherein the leaf spring comprises a curved portion; wherein the curved portion is configured to drive the seal member toward the deployed position in response to a reduction in an effective longitudinal length of the leaf spring; and wherein the curved portion is configured to drive the seal member toward the withdrawn position in response to an increase in the effective longitudinal length of the leaf spring.
5. The seal mechanism of claim 4, wherein the curved portion comprises a valley that is received in a channel of the seal member; and wherein the seal member comprises a pin received in the valley.
6. The seal mechanism of claim 3, wherein the transmission further comprises: a sliding block slidably mounted in the channel member and engaged between the actuation lever and a first end of the leaf spring; and a fixed block secured within the channel member and coupled with a second end of the leaf spring opposite the first end of the leaf spring.
7. The seal mechanism of claim 1, wherein the channel member extends in a longitudinal direction; wherein the withdrawn position and the deployed position are offset from one another in a lateral direction transverse to the longitudinal direction; and wherein the transmission is configured to translate a longitudinal force exerted by the actuation lever to a lateral force on the seal member.
8. The seal mechanism of claim 1, wherein the actuation lever comprises a jog that partially defines a void; and wherein a portion of the seal member extends through the void.
9. A sliding door system, comprising: a frame; a sliding door mounted in the frame for sliding movement between an open position and a closed position; and a drop seal mechanism mounted within the sliding door, the drop seal mechanism having a deployed state in which the drop seal mechanism forms a seal with the frame, the drop seal mechanism having a retracted state in which the drop seal mechanism does not form a seal with the frame; wherein the frame comprises a

projection configured to drive the drop seal mechanism from the retracted state to the deployed state as the sliding door slides from the open position to the closed position.

10. The sliding door system of claim 9, wherein the drop seal mechanism is concealed within the sliding door.

11. The sliding door system of claim 9, wherein the drop seal mechanism comprises an actuation lever pivotably mounted in the sliding door; and wherein the actuation lever is wholly concealed within the sliding door.

12. The sliding door system of claim 9, wherein the drop seal mechanism comprises: an actuation lever pivotably mounted in the sliding door for movement between an unactuated position and an actuated position; and a rod pivotably connected with the actuation lever.

13. The sliding door system of claim 12, wherein the actuation lever is configured to provide a mechanical force advantage such that a lesser input force exerted by the projection on the actuation lever results in a greater output force exerted by the actuation lever on the rod.

14. The sliding door system of claim 12, wherein the drop seal mechanism further comprises: a seal member mounted for movement between a withdrawn position and a deployed position; and a transmission configured to move the seal member between the withdrawn position and the deployed position in response to movement of the actuation lever between the unactuated position and the actuated position; wherein the transmission comprises the rod.

15. The sliding door system of claim 14, wherein the transmission further comprises a leaf spring extending in a longitudinal direction; wherein the leaf spring comprises a curved portion extending at least partially in a lateral direction transverse to the longitudinal direction; and wherein contraction of the leaf spring in the longitudinal direction causes expansion of the leaf spring in the lateral direction to thereby urge the seal member from the withdrawn position to the deployed position.

16. A method of forming a seal between a sliding door and a frame, the method comprising: during sliding movement of the sliding door from an open position to a closed position, causing a portion of the frame to exert a first force on an actuation lever pivotably mounted within the sliding door; in response to the first force on the actuation lever, causing the actuation lever to exert a second force on a transmission, thereby causing the transmission to drive a seal member from a withdrawn position, in which the seal member does not form the seal between the sliding door and the frame, to a deployed position, in which the seal member forms the seal between the sliding door and the frame.

17. The method of claim 16, further comprising providing a mechanical force advantage with the actuation lever such that the second force is greater than the first force.

18. The method of claim 16, wherein the transmission comprises a leaf spring including a curved portion; and wherein causing the transmission to drive the seal member from the withdrawn position to the deployed position comprises reducing an effective longitudinal length of the leaf spring to thereby cause the curved portion to urge the seal member toward the deployed position.

19. The method of claim 16, wherein the actuation lever comprises a void; and wherein a portion of the seal member travels within the void as the seal member moves between the withdrawn position and the deployed position.