ABSTRACT: Means is provided defining an opening to be closed. This opening may be a discharge outlet at the bottom of a railway hopper car. The closure means comprises a flexible closure member having fixed portions, the closure member being substantially continuous between these fixed portions, and the closure means may comprise an endless belt. A plurality of interconnected antifriction rollers are disposed within and confined by the closure member, and power operated means is connected with the rollers for moving the rollers along a guide track to progressively peel away the closure means from one end of the opening toward the other end thereof when it is desired to remove the closure means from the opening.
The present invention is directed to a unique closure means adapted to close off any suitable opening. The closure means of the present invention may be utilized in many different applications wherein it is desired to progressively peel away the closure means from an associated opening when the closure means is removed from such opening.

A closure means according to the present invention is of particular utility when it is employed in connection with openings such as those at the bottom of a hopper car wherein a relatively heavy load may be supported upon the closure means prior to removing the closure means from the opening as, for example, when it is desired to discharge a conventional railway hopper car.

The present invention may be readily employed as power operated discharge mechanism for bulk commodity rail cars so that many cars can be unloaded in a minimum amount of time making possible the fast turn around of complete trains. Automatic operation of the lading discharge means permits fast unloading of complete railloads of bulk material.

When a substantial load is disposed upon the closure means of a hopper car and the closure means is of the type which is progressively opened, such as a sliding-gate type mechanism, movement of the closure means is substantially impeded due to friction between the closure means and the lading supported thereabove. A particular objective of the present invention is to avoid the detrimental friction forces which are encountered with prior art constructions.

SUMMARY OF THE INVENTION

The closure means of the present invention comprises a flexible closure means member having fixed portions, the closure member being substantially continuous between these fixed portions.

An operating means is provided for progressively peeling away the closure means from one end of an opening toward the other end thereof when it is desired to remove the closure means from the opening. This operating means includes a plurality of antifriction rollers mounted on a rail car track and in engagement with the closure means, the rollers being interconnected with one another links. The rollers are guided by a track means in guiding the closure means disposed in surrounding containing relationship to the rollers as moved accordingly.

The rollers are suitable interconnected with power-operated means for moving the rollers in the desired manner. In a modification of the invention the roller means is provided on the closure member itself for engagement with an actuating member so as to cause movement of the rollers without the necessity of providing power-operated means.

The unique peeling away mode of operation of the closure means of the present invention overcomes the friction problems encountered with conventional sliding gate-like members and the like. Since the closure means simple peels away from an overlying load in the case of a hopper car or the like, there is no friction generated between the closure means and such load as the closure means is removed from the associated opening.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view illustrating the manner in which a valve means mounted on a rail car is adapted to be automatically operated.

FIG. 2 is a top perspective view illustrating a portion of the antifriction roller means of the present invention.

FIGS. 7, 8 and 9 are schematic views illustrating different operative positions of a closure means and associated operating means as illustrated in FIGS. 2 and 3.

FIGS. 10, 11 and 12 are schematic views illustrating different operative positions of a modified form of the invention.

FIGS. 13, 14 and 15 are schematic views illustrating various operative positions of a further modification of the invention.

FIGS. 16, 17 and 18 are schematic views illustrating various operative positions of still another modification of the invention.

FIGS. 19, 20 and 21 are schematic views of different operative positions of yet another embodiment of the present invention.

FIG. 22 is a view illustrating a means mounted on a track bed for cooperation with the arrangement shown in FIGS. 19-21 inclusive.

FIG. 23 is a sectional view illustrating the manner in which the apparatus of the present invention can be incorporated in a conventional existing covered hopper car;

FIG. 24 is a view similar to FIG. 23 with the actuator removed, but showing the flexible closure as comprising a single piece of material fixed at its opposite ends at one side of the discharge opening.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings wherein like reference characters designate corresponding parts throughout the several views, FIG. 1 illustrates the manner in which the closure means of the present invention can be employed with open top hopper rail cars connected in a train suited for fast turn-around operations, and wherein discharge of the hopper cars may be automatically controlled. A plurality of similar rail cars 30 are adapted to move along a conventional track 32, coupling means 34 serving to interconnect the various rail cars.

Each of the rail cars has a plurality of valve mechanisms 36 which are adapted to cooperate with fixed members 38 disposed adjacent to tracks and engageable with portions of the valve mechanisms for operating same upon relative movement of the rail cars past the fixed members.

Referring now to FIGS. 2 and 3, the details of construction of the hopper car are clearly illustrated. The hopper car is supported by conventional truck and wheel assemblies 39 at the bottom of the car. The truck includes sloping end sheets 40 at opposite ends thereof and side sheets 42 extending longitudinally of the car. Cross braces 44 are provided between the side sheets, and a further diagonal brace 46 is also provided. A transverse I-beam and cover arrangement 48 extends laterally of the car.

A pair of discharge openings 54 and 56 are defined at the bottom of the hopper car for discharging lading therefrom, these openings being disposed on opposite sides of the transversely extending structure 48.

As seen in FIG. 3, a pair of side sills 60 are provided at opposite sides of the car and are interconnected with the aforementioned side sheets. Conventional side stakes 62 are carried by the side sheets at opposite sides of the car.

A hopper side plate 66 extends downwardly from the junction of each of the side sills and the associated side sheets, and gusset plate 68 are provided at spaced points along the car to reinforce the structure.

A discharge outlet assembly is secured to the lower end of the hopper and includes a member 70 secured to each hopper side plate 66 and depending therefrom, with a track member 72 being supported at the lower end of each of members 70, these track members serving to support and guide the antifriction rollers of the operating means as hereinafter described.
Referring again to FIG. 2, the closure means of the present invention is indicated by reference character 80 and comprises a flexible member sideplate a suitable material such as rubber, metal or the like. This closure member is of elongated thin construction and is disposed in spanning relationship to opening 84 in a lateral and longitudinal direction with respect to the associated car. A similar closure member 82 is operatively associated with opening 56.

Closure member 80, as shown, comprises a continuous belt-like means which is fixed at a point 86α by suitable fastening means 87, this fastening means extending across the width of the closure member, whereby this portion or part of the closure member is fixed against movement. The closure member need not be in the form of a continuous beltlike means as shown, but it may include a single length of material 230' which has the opposite ends thereof fixed either adjacent one another or spaced somewhat apart as seen in FIG. 24.

In any event, the closure means includes fixed portions or parts which, as seen in FIG. 2, would be those adjacent to and on either side of point 86α and these portions may be either part of a continuous beltlike means, or actually at opposite ends of a single piece of material. The closure member is continuous between the fixed portions thereof.

The operating means for the closure means includes a plurality of antifriction rollers 84 which are disposed within and confined or encompassed by the continuous closure member. As seen in FIGS. 3 and 6, the opposite ends of each of rollers 84 have an outwardly directed reduced portion 86 which receiving connecting links 88 which connect adjacent rollers, these links being pivotally interconnected with portions 86 so that the rollers can follow an associated guide track means. As seen especially in FIG. 3, smaller antifriction rotatable roller bearings 90 are supported on portions 86 to run along the upper inner portions of tracks 72 to facilitate movement of the rollers along the tracks and rotation of the rollers as required, it also being noted that the links 88 are supported within the tracks whereby the tracks serve to guide rollers 84 for movement longitudinally with respect to the car.

As seen in FIG. 2, each of tracks 72 at opposite sides of the car includes an outwardly directed track portion 92 for guiding the rollers 84 in an outward direction when the closure means opens the bottom of the car. Track portions 92 are supported by laterally extending reinforcing stringers 94 secured to the under surface of the associated end sheet 40.

Various power-operated means such as motive power means may be employed for moving the rollers along the associated guide track means, and a well suited mechanism is a fluid pressure operated mechanism identified as a cable cylinder manufactured by Tol-O-Matic, 246 Tenth Avenue So., Minneapolis, Minn. This mechanism is shown in FIG. 4 and is indicated generally by reference numeral 100, it being noted that the construction shown in FIG. 4 is upside down from its operative position as shown in FIG. 2. Fluid for operating mechanism 100 is supplied through a line 101 as seen in FIG. 3 which is connected to a suitable source of fluid under pressure.

Power-operating mechanism 100 includes a cylinder 102 mounted between a pair of opposite end heads 104. A piston 106 is slidable within cylinder 102 and is connected with a wire cable 108 which extends outwardly around the cylinder and about a sheave 110, the opposite end of cable 108 being connected at point 112 to a clevis 114.

A second cable 116 is connected to the other side of piston 106 and extends outwardly around cylinder 102 about a sheave 118, the opposite end of cable 116 being connected at point 120 with clevis 114. Clevis 114 is in turn connected with the outwardly extending portion 86 of the end roller 84 as seen in FIG. 2.

Air lines 130 and 132 are in communication with opposite ends of cylinder 102, these air lines being connected with the associated guide track means 36 mounted on the railway car, this valve means, in turn, being interconnected with the train line air pipe 64.

As seen in FIG. 5, valve means 36 includes a plurality of radially outwardly extending arms 36' which are adapted to engage fixed member 38 secured in place adjacent the track. As the car passes a predetermined portion of the track, fixed member 38 will engage one of the arms 36' so as to actuate the valve mechanism and thereby cause the power-operated means to be operated in such a manner as to either open or close the opening in the bottom of the car by moving the antifriction rollers and thereby causing the closure member to move with respect to such opening.

The valve means at opposite ends of the car may be of such a construction as to automatically open and close the discharge opening in the hopper cars in accordance with the direction of movement of the car and the positioning of the fixed members 38.

As seen in FIG. 2, it is apparent that when the power-operated means is operated so as to move the operating means from its lowermost position illustrated upwardly so as to move the rollers 84 upwardly within guide tracks 92, the flexible closure member will be carried to the right, and the left-hand most portion of this flexible closure will be progressively peeled away from opening 54 and the lading thereabove while completely eliminating any friction between the closure means and such lading during such peeling away movement.

Referring now to FIGS. 7-9, this mode of operation will be clearly understood wherein the closure member 80 and 82 positioned wherein the openings 54 and 56 in the bottom of the hopper car are closed off by the two flexible closure members 80 and 82. As the operating mechanism 100 associated with the two closure members is operated, the closure members will move into an intermediate position as shown in FIG. 8 wherein the closure means closes off approximately half of the openings 54 and 56 and subsequently into a final operating position as shown in FIG. 9 wherein the closure means are in their fully opened position.

Referring now to FIGS. 10, 11, and 12, the operating mechanism 100 as shown in FIG. 2 has been replaced by a pneumatic cylinder 140 having a telescopic piston rod 142 operatively associated therewith and connected with the antifriction rollers of the closure member 80. In this case, as in that shown in FIG. 2, the means for moving the rollers is connected to the rollers at a point adjacent the fixed end of the closure means which is in the same position in each of these forms of the invention.

FIG. 10 shows closure means 80 in its closed position; FIG. 11 shows the closure means in an intermediate position; and FIG. 12 illustrates the closure means in its fully opened position.

Referring now to FIGS. 13-15, further form of the invention is illustrated employing a pneumatic cylinder 146 along with a telescopic piston rod 148. In this form of the invention, the piston rod is connected with the antifriction rollers at a point remote from the fixed end of the closure member. It will, of course, be understood that similar operating mechanisms are associated with the closure means at each end of the rail car in all forms of the invention. Additionally, similar guide tracks are employed in all forms of the invention.

FIG. 13 illustrates this modified form of the invention in its fully closed position. FIG. 14 illustrates the closure means in an intermediate position, and FIG. 15 illustrates the closure means in its fully opened position.

Referring now to FIGS. 16, 17, and 18 of the drawings, still another form of the invention is illustrated wherein a pair of operating mechanisms 150 are substantially identical to the operating mechanisms 100 previously described. In this form of the invention, each of operating mechanisms 150 is connected with the antifriction rollers at a point remote from the fixed portion of the closure member, the two mechanisms 150 being adapted to move in opposite directions so as to operate the two closure members. FIG. 16 illustrates the closure members in their fully closed position; FIG. 17 illustrates the closure members in an intermediate position; and FIG. 18 illustrates the closure members in their fully opened position.
Referring now to FIGS. 19-21 inclusive, still another embodiment of the invention is illustrated wherein the closure means is adapted to be mechanically operated by interengagement of portions of the mechanism with fixed portions supported on an associated array track so that operation of the closure means is performed substantially automatically as a car passes along the associated track.

A first flexible cable 160 is attached at point 162 to one of the antifriction rollers associated with closure member 82. This cable extends around sheaves 164, 166 and 168, the opposing end of the cable being secured at point 170 to an antifriction roller associated with closure member 80. A second cable 180 is connected at point 182 with an antifriction roller associated with closure member 80, cable 180 extending around sheaves 184, 186 and 188, the opposite end of cable 180 being connected with an antifriction roller associated with closure member 82.

A pair of protruding members or cam fingers 192 and 194 are secured to and depend from cables 160 and 180 respectively, members 192 and 194 being adapted to engage fixed protruding cam fingers members 202 supported by an associated track.

The mechanical operating system as shown in FIG. 19 includes a pair of closure members interconnected with a common operating means including flexible cables and sheaves over which the cables are reeled.

Referring now to FIG. 22, a truss 200 is supported in fixed position on track 32 and includes the upwardly extending portions 202 which are adapted to engage depending members such as members 192 and 194 as described hereinabove.

As seen in FIG. 19, closure members 80 and 82 are in their fully closed position, and depending member 192 has just come into engagement with a portion 202 of a fixed truss. The car rail is assumed to be moving in the direction of the arrow indicated in FIG. 19.

As the car continues to move in the direction of the arrows, member 202 will carry member 192 into an intermediate position as shown in FIG. 20 wherein the closure members have been simultaneously moved in opposite directions so as to partly uncover the openings at the bottom of the car. It is apparent that the two closure members will be moved in unison since they are interconnected by cables 160 and 180.

The car will subsequently move to the position shown in FIG. 21 wherein the closure members have been moved into the fully opened position, and members 192 and 194 will move upwardly so as to be disengaged from member 202. It is apparent from an inspection of FIGS. 19-21 that the two closure members are adapted to be automatically opened upon relative movement between the car and associated truss secured to a track or the like.

Referring now to FIG. 23 of the drawings, a typical door-type covered hopper car is illustrated wherein the door has been removed and the closure means of the present invention has been substituted therefor. This figure illustrates in manner in which a conventional hopper car may be readily modified with the closure means of the present invention.

The car is indicated generally by reference numeral 210 and includes a cover or roof 212. One of the hoppers 214 is illustrated and includes a bottom discharge opening 216. A pair of fittings 218 and 220 are utilized for supporting the mechanism of the present invention including a flexible closure member 230 in the form of an endless belt which is fixed by fastening means 232 extending laterally across the closure member.

A plurality of antifriction rollers 234 similar to those previously described are disposed within and confined by the closure member and are suitably interconnected with one another, these rollers being guided by appropriate guide tracks as aforesaid. An operating mechanism 236 similar to operating mechanism 100 previously described is operatively connected with an endmost roller 234, whereby operation of mechanism 236 is adapted to move the rollers 234 linearly from the closed position as shown in FIG. 23 to an open position wherein the rollers and the closure members would be moved to the right as seen in this figure.

In FIG. 24, a closure similar to that shown in FIG. 23 is illustrated but rather than comprising an endless flexible belt, the closure comprises a single elongate piece of flexible material 230' with its opposite ends secured or fixed against movement by fastening means 232.

As this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within the metes and bounds of the claims or that form their functional as well as conjointly cooperative equivalents, are therefore intended to be embraced by those claims.

What is claimed is:

1. In a hopper having a discharge opening, support means at opposite sides of said discharge opening, a plurality of constantly spaced rollers supported by said support means, flexible closure means having an, inherently flexible upper portion and a spaced lower portion with said rollers therebetween, said rollers in contact with said upper portion from one side to the other side thereof, said upper portion comprising a means for closing said discharge opening, a part of said upper portion fixed against movement at one side of said discharge opening, and means to move said rollers across said opening to actuate said flexible closure means.

2. Apparatus as defined in claim 1, wherein said means to move said rollers includes motive power means for moving said rollers.

3. Apparatus as defined in claim 1, wherein another part of said closure means is fixed against movement at said one side of said opening.

4. Apparatus as defined in claim 3, wherein said closure means is continuous between said fixed parts.

5. Apparatus as defined in claim 1, including a pair of closure means disposed adjacent one another.

6. Apparatus as defined in claim 5, wherein said means for moving said rollers includes cables and sheaves interconnected with said closure means to cause movement of one closure means upon movement of the other closure means.

7. Apparatus as defined in claim 5, including common operating means for actuating the two closure means.

8. Apparatus as defined in claim 1, wherein said plurality of rollers includes an endmost roller beyond the side of said opening opposite said fixed part of said upper portion of said closure, said closure extended around said endmost roller in contact therewith and following the contour thereof over an adjacent convex portion of said endmost roller, said closure moving around said endmost roller and peeling from said opposite side of said discharge opening toward said one thereof to enlarge the discharge opening simultaneously with movement of said rollers across said discharge opening from said opposite side toward said one side thereof.

9. Apparatus as defined in claim 8, wherein said closure means comprises an endless belt disposed around said plurality of roller means.

10. Apparatus as defined in claim 9, wherein said support means comprises guide track means at opposite sides of said discharge opening, the opposite ends of said rollers disposed in and guided by said guide track means, said plurality of rollers lying in a plane parallel to the plane of said discharge opening at least in the space spanned by said discharge opening.

11. Apparatus as defined in claim 1, wherein said rollers engage said closure member for moving said closure member.

12. Apparatus as defined in claim 11, wherein said rollers are disposed within and encompassed by said flexible closure member.

13. Apparatus as defined in claim 11, including means interconnecting said rollers with one another, said means to move said rollers being connected to said rollers adjacent said fixed part of the closure member.

14. Apparatus as defined in claim 11, including means interconnecting said rollers with one another said means to move
said rollers being connected with said rollers at a point remote from said fixed part of said closure member.

15. Apparatus as defined in claim 11, wherein said means for moving said rollers have a direction of movement substantially parallel with the plane of said opening.

16. Apparatus as defined in claim 11, wherein said means for moving said rollers is movable in a direction at an oblique angle to the plane of said opening.

17. Apparatus as defined in claim 11, wherein said rollers comprises a plurality of antifriction rollers, link means interconnecting said rollers with one another.

18. Apparatus as defined in claim 17, wherein said support means includes guide means for guiding movement of said rollers.

19. In a railway hopper car having a discharge outlet assembly with sides forming a discharge opening, support means at opposite sides of said discharge opening, a plurality of constantly spaced rollers supported by said support means, flexible closure means having a continuous, inherently flexible upper portion and a spaced lower portion with said rollers therebetween, said rollers in contact with said upper portion from one side to the other side thereof, said upper portion comprising a means for closing said discharge opening, a part of said upper portion fixed against movement at one side of said discharge opening, and means to move said rollers across said opening to actuate said flexible closure means.

20. Apparatus as defined in claim 19, wherein another part of said closure means is fixed against movement of one side of said opening, said closure member being substantially continuous between said fixed parts, a plurality of antifriction rollers disposed within and encompassed by said closure member, said means for moving said rollers including motive power means, and said support means comprising guide track means supported by said rail car for guiding the movement of said rollers and said closure member.

21. In a hopper having a discharge opening, support means at opposite sides of said discharge opening, a plurality of constantly spaced rollers supported by said support means, flexible closure means having an inherently flexible upper portion and a spaced lower portion with said rollers therebetween, said rollers in contact with said upper portion from one side to the other side thereof, said upper portion comprising a means for closing said discharge opening, a part of said upper portion fixed against movement at one side of said discharge opening, and actuating means to move said rollers across said opening to actuate said flexible closure means, said actuating means including a protruding means connected with said closure means and adapted to engage an actuating member to cause movement of said rollers and said closure means.

22. In a railway hopper car having a discharge outlet assembly with sides forming a discharge opening, support means at opposite sides of said discharge opening, a plurality of constantly spaced rollers supported by said support means, flexible closure means having a continuous, inherently flexible upper portion and a spaced lower portion with said rollers therebetween, said rollers in contact with said upper portion from one side to the other side thereof, said upper portion comprising a means for closing said discharge opening, a part of said upper portion fixed against movement at one side of said discharge opening, and actuating means to move said rollers across said opening to actuate said flexible closure means, said actuating means including a protruding means connected with said closure means and adapted to engage an actuating member to cause movement of said rollers and said closure means.

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