United States Patent

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[72] Inventor **Herman A. Aquino**
Hobart, Ind.

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[73] Assignee **Pullman Incorporated**
Chicago, Ill.

[54] **HOPPER CLOSURE ACTUATING AND LATCHING MECHANISM**
10 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **105/240,** 105/244;248, 105/251;255, 105/290;299, 105/304:310

[51] **Int. Cl.** **B01d 7/04,** B01d 7/18, B61d 7/28

[50] **Field of Search** ..... 105/240, 241, 244, 247, 248, 250, 251, 255, 290, 299, 308 C, 377, 304, 310

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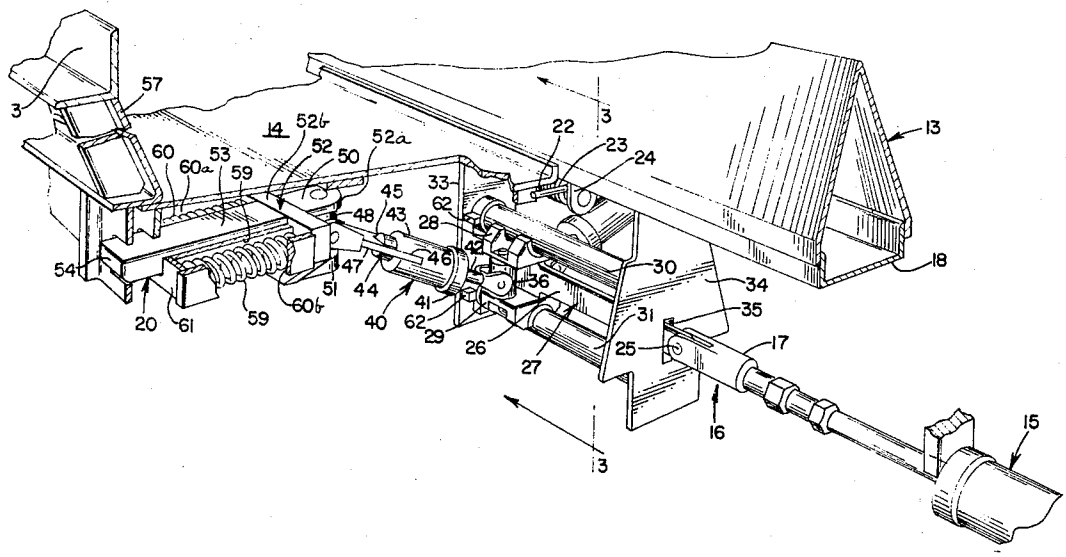
Primary Examiner—Arthur L. La Point
Assistant Examiner—Howard Beltran
Attorneys—Hilmond O. Vogel and Wayne Morris Russell

ABSTRACT: In a railroad hopper car, discharge door operating means including pneumatic drive means, longitudinally extending slide linkage, opposed transversely extending arm structures pivotally connected to the slide linkage and to respective door locking bar means, biasing means resisting locking of each bar means to the door to allow the pivoted doors to close before the respective arm structures are placed in the door closed and locked position, and counterbalancing spring means resisting fast gravity opening of the horizontal doors of the empty hopper but allowing the doors to open gradually and assisting door closing, said pneumatic drive means placing the arm structures in an over center door locking position and being double acting for moving the arm structures back past the over center position.



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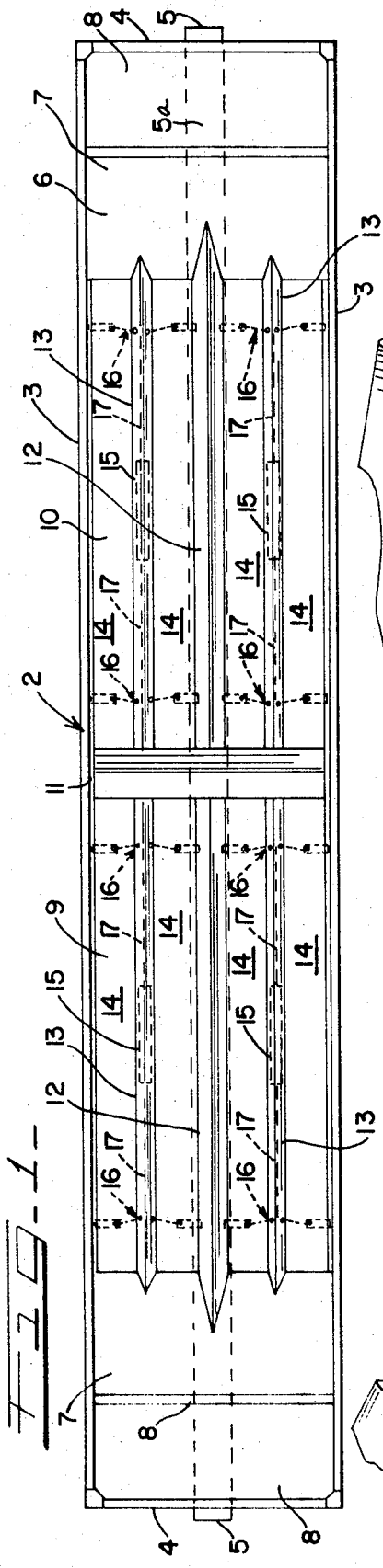

FIG. 1

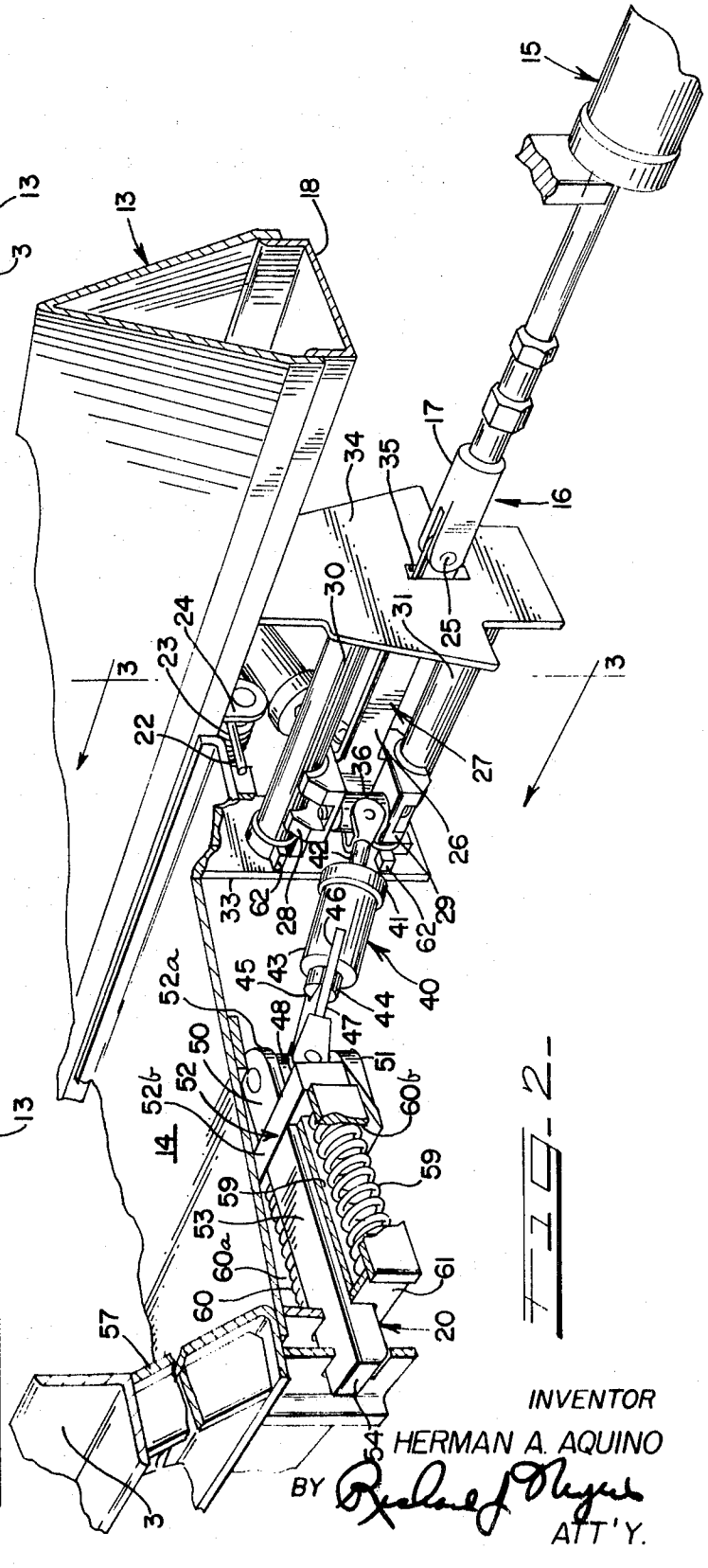

FIG. 2

INVENTOR
HERMAN A. AQUINO
BY Richard J. Myers
ATT'Y.

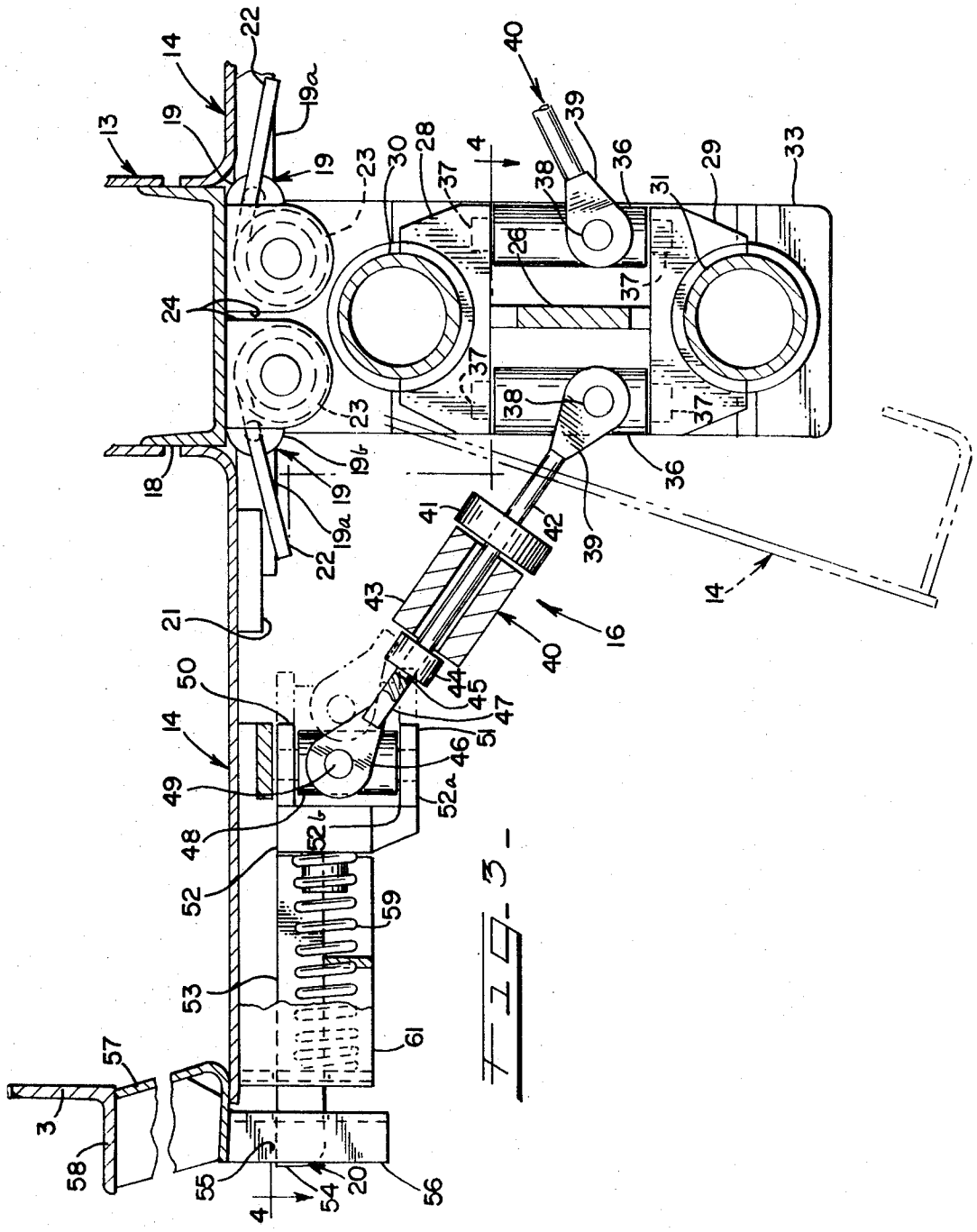

FIG. 3

INVENTOR
HERMAN A. AQUINO
BY Richard J. Myers
ATT'Y.

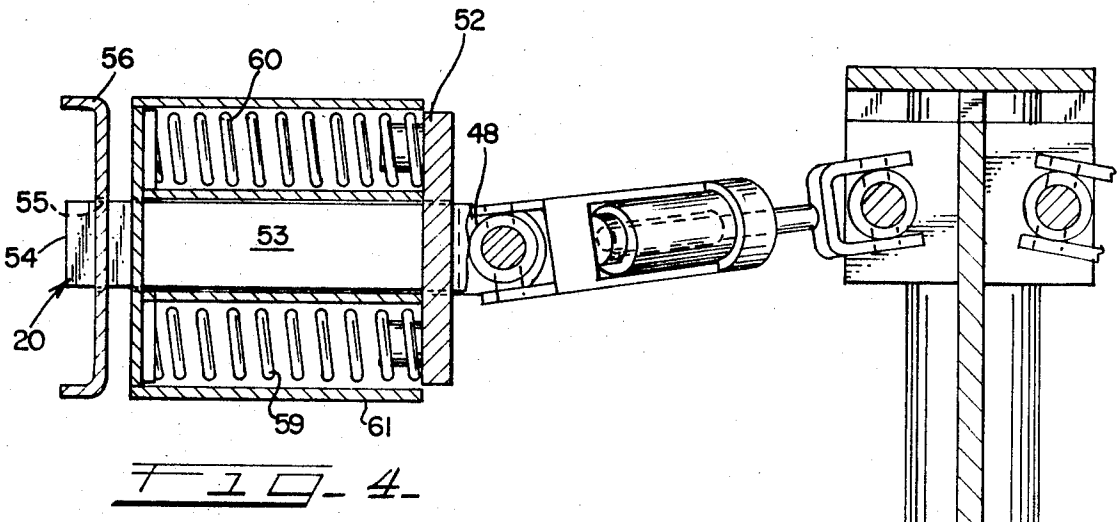

FIG. 4

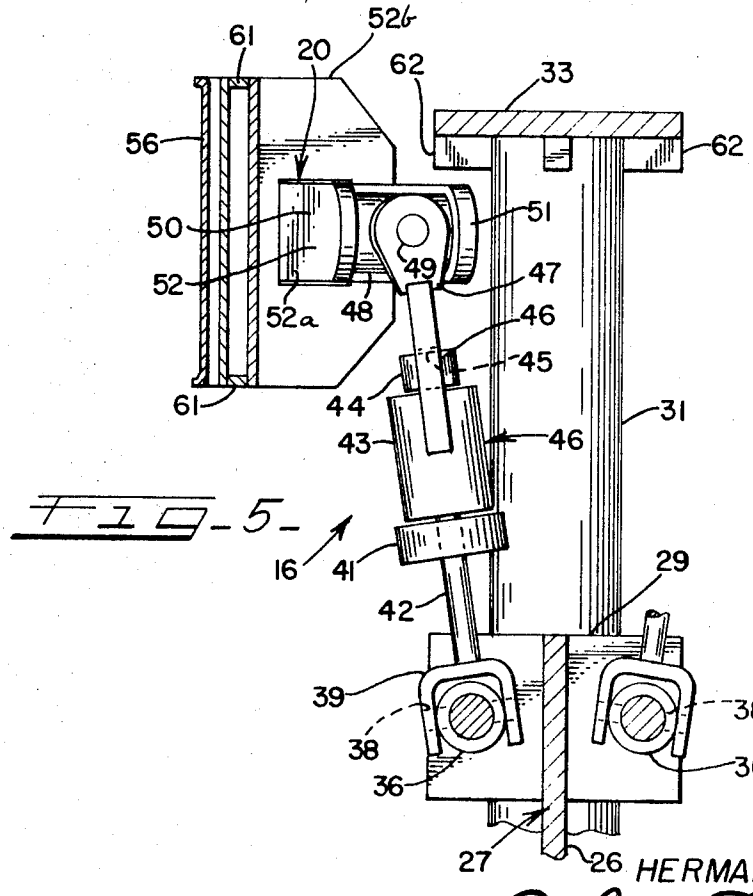

FIG. 5

INVENTOR
HERMAN A. AQUINO
BY Richard J. Thyne
ATT'Y.

HOPPER CLOSURE ACTUATING AND LATCHING MECHANISM

SUMMARY OF THE INVENTION

It is a general object of this invention to provide a vehicle discharging operating arrangement and in particular to provide for a railroad hopper car discharge door operating arrangement including a longitudinal slide pivotally carrying a pair of opposed laterally extending arm structures each of which is pivotally connected to a respective door locking bar, each door locking bar overcoming a biasing means in an over center position of the respective arm structure with the slide to lock the hopper discharge door to the side of the car.

It is a further object of this invention to provide for counterbalancing means resisting gravitational opening of the doors when the arm structure has passed back of the over center position to allow gradual descent of the door downward.

Another object of the invention is to provide for pneumatic slide drive means for operating the slide in either direction and in and out of the over center position of each arm structure with respect to the slide.

Another object of the invention is to place the door operating structure below the horizontally placed doors to increase the floor of the hopper and thereby increase the cubic capacity of the hopper.

Still another object of this invention is to provide for arm structures each of which are so connected with the slide and with the door locking bar as to be pivoted with respect thereto in several planes to facilitate minimal operational space of the arm structures by allowing folding of the arm structures between transversely extending door locked positions and longitudinally collapsed and stored door opened positions.

It is a further object of this invention by such a construction as aforesaid to minimize sloping of the hopper slope sheets so that the load to be discharged can move more quickly out of the discharge opening. Also the minimizing of the sloping of the slope sheets increases the cubic capacity of the hopper.

These and other objects, purposes and advantages of the invention will become more readily apparent from reference to the following description, attached drawings and appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view generally and diagrammatically illustrating the relationship of the hopper door operating means on the hopper car;

FIG. 2 is a partial perspective view of the door operating means;

FIG. 3 is a sectional view taken along line 3–3 of FIG. 2;

FIG. 4 is a partial sectional view taken along line 4–4 of FIG. 3 showing the door operating means in the door closed position; and

FIG. 5 is a partial view similar to FIG. 4 but with the door operating means shown in the door opened positioned.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to the FIGS. and in particular with reference to FIG. 1, there is shown a vehicle or railroad hopper car 2 provided with sidewall structures 3 and end wall structures 4 and end draft gear structure 5. The end and sidewall structures define a hopper portion 6 provided with end slope sheets 7 adjacent elevated end platform areas 8. Between the slope sheets and the sidewall structures are located two longitudinally spaced hopper areas 9 and 10 separated from one another by the central slope sheet and cross ridge arrangement 11. Each hopper area 9 or 10 is provided with a central longitudinally extending inverted V-shaped hood 12 and a pair of smaller longitudinally extending inverted V-shaped side hoods 13, one on each side of the central hood. The hoods extend between the cross ridge structure 11 and a respective end slope sheet 7. A horizontally longitudinally extending hopper door structure 14 extends between each of the sidewall structures 3 and each side hood 13 and between each side hood 13 and each central hood 12 in each hopper section 9 or 10, the doors in each hopper area or section extending longitudinally of the car and being spaced longitudinally of the doors in the other hopper section. Each of the two door structures 14 on each side of the car in each hopper section 9 or 10 are power opened by a common power driving means or pneumatically operated or air operated cylinder means 15 which drives each door operating mechanism 16 connecting with each end of the pneumatic means 15. Thus, each car is provided with eight such door operating mechanisms driven by four pneumatic drive means 15 through appropriate drive connecting linkage 17.

With reference now to FIGS. 2 and 3, it will be seen that each door structure is pivotally connected to a longitudinally extending reinforcing stringer member or channel beam 18 by door hinge structure 19 (which includes the door mounted underside plate 19*a* and car mounted hinge means 19*b* connected to the under plate 19*a* as seen in FIG. 3) to allow the door structure 14 to swing from the horizontal closed or locked position (as seen in solid line) to the downwardly extending or door opened position (as seen in dotted line). The travel of the door from the horizontal or outwardly extending closed position to the downwardly inwardly extending or opened position occurs when the locking bar structure 20 is pulled away from the side of the car and the door structure is allowed to fall to the down position due to gravity acting on the weight of the door. The rate at which the door falls to the open position is reduced by engagement of the underside of door abutment 21 (as seen in FIG. 3) with the spring arm 22 of the coil spring or counterbalancing spring means 23 carried by spring support structure 24 depending from the underside of the channel member 18. As seen in FIG. 3, the abutment 21 is spaced above and away from the spring arm 22 when the door structure 14 is in the horizontal position and when the door is allowed to fall after releasing of the locking bar mechanism 20, the door deflects the arm 22 downward and the door swings slowly down to the dotted line position.

The pneumatic ram unit or jack 15 is coupled with the connecting linkage 17 having a pin connection 25 with the driven slide link 26 of the slide assembly 27 of the door operating mechanism 16. The slide assembly 27 is further provided with upper and lower cradle shaped slide elements 28 and 29 attached to the forward end of the slide link 26 and being respectively guided along longitudinally extending guide rods 30 and 31 carried on and between depending supports 33 and 34 depending from the channel member 18. The right hand support 34, as seen in FIG. 2, is provided with slot 35 to permit reciprocating action of the slide link 26 therethrough. As seen in FIGS. 2 through 5, on each side of the slide link 26 and between the upper and lower slide elements 28 and 29 there is provided a pivot pin 36 each having upper and lower projections 37 mounted in the respective slide elements 28 and 29 for permitting pivotal movement of each pin 36 about a vertical axis, as seen in FIG. 3. Each pivot pin 36 has a horizontal pin 38 extending therethrough intermediate its ends. Each horizontal pin has attached to it a clevis element 39 of a transversely extendable arm structure 40, the clevis element being pivotal about the horizontal pin 38 to thereby provide for pivotal movement in vertical and horizontal planes of the arm structure 40 with respect to the guide structure 27 which carries each arm structure 40. Each arm structure 40 extends outwardly of the guide structure 27 toward respective sides of the car 2.

Each arm structure 40 is provided with an annular stop 41 fixedly mounted on the shaft 42 of the clevis element 39, the shaft 42 extending through the tubular or cylindrical element 43 and rotatable with respect thereto, the outer or free end of the shaft 42 extending beyond the cylinder element 43 and having thereon a retainer block 44 engageable with the end of the cylinder element 43 but rotatable with respect thereto in the slotted portion 45 of the bifurcated portion 46 of the clevis element 47, the bifurcated portion 46 extending about and connected with the outer surface of the barrel or cylindrical

member 43. The clevis element 47 is on the same axis as the clevis element 39 and because of such construction and arrangement of the elements 41, 42, 43, 44 and 46 the clevis element 47 is rotatable with respect to the clevis element 39 about the same axis which allows the clevis element 47 to be moved in three planes or to have a universal action with respect to the slide structure 27. The clevis element 47 is pivotally connected to upright locking bar pin 48 for pivotal movement about a horizontal axis by pivot pin 49 connecting with the clevis element 47 and with the pivot pin 48, as seen in FIG. 3. The pivot pin 48 is in an upright position and is pivotally mounted for rotation about a vertical axis in the upper and lower ears 50 and 51 of the end clevis member or part 52 of the locking bar structure 20. Therefore, the locking bar structure 20 has pivotal movement in three planes or universal movement with respect to the clevis element 47.

The end clevis member 52 forms the connection of locking bar structure 20 to the clevis element 47 of arm structure 40, the bar 53 being fixedly attached to the end clevis member 52. The free end 54 of the locking bar 53 of structure 20 is extendable into the aperture 55 of the depending lock plate 56 attached to the underside of the downwardly inwardly sloping side sill apron member 56 (as seen in FIG. 2 or FIG. 3) attached and depending from the side sill 58 on each side of the car 2. As seen in FIGS. 2 and 3, the end clevis member 52 in addition to having the clevis portion 52*a* for holding the pin 48 has a retainer member 52*b* which extends longitudinally of the car and engages compression springs 59 and 60 contained in box structure 61 encompassing the bar 53, the box structure 61 being connected to the underside of the door 14. The box structure 61 not only houses the springs 59 and 60 in respective box chambers 60*a* and 60*b* but also acts as a stop for the retainer element 52*b* and also has a carrier structure for the locking bar structure 20 on the underside of the door. Movement of the locking bar structure in the locking bar support housing 61 from door locked position to door unlocked position is shown in FIG. 3, where the solid line position of the clevis member 47 shows the locked position with the end 54 of the locking bar 53 extending into the sidewall portion or depending apron portion 56 of the side sill structure to the door unlocked or dotted line position where the end portion 54 of the locking bar 53 is withdrawn from the aperture 55 of the depending member 56 to allow the door to fall downwardly when the linkage 17 further carries the slide bar structure 27 toward the pneumatic drive means 15. Movement of the slide assembly 27 to the door closed and locked position is terminated by engagement of the members 28 and 29 with the stops 62 as seen in FIGS. 2 and 4.

The operational movements of the linkage of the door operating mechanism can be seen in FIGS. 2, 3, 4 and 5. FIGS. 2—4 are views showing the door in the raised, closed, locked position whereas FIG. 5 is a partial view of the door operating mechanism showing the door in the opened position. In the door locked position the end 54 of the lock bar 53 extends into the side portion 56 of the car 2, the arm structure or linkage 40 having previously raised the door 14 also against the depending side structure 57 before the arm structure 40 compressed the springs 59, 60 to extend the bar 53 into the side of the car. The compressing of the springs 60 and the movement of the bar 53 into the opening 55 occurs only after the door 14 itself is raised up adjacent the under side of the depending member 57 by the arm structure 40. If the projecting end 54 of the door bar were to engage the aperture 55 at an earlier time, upper travel of the door would terminate and closure of the door would not occur. It is therefore seen that the compression springs serve the function of preventing accidental and premature closing of the door because a greater force is required to cause the final locking to occur. Each of the arm structures 40, in going from the open position as seen in FIG. 5 to the closed position as seen in FIGS. 2—4, has a universal action with respect to lock bar structure 52 and with the slide structure 27 wherein the arm structure or linkage 40 has its one portion rotating relative to its other portion about the same axis as well as having end connecting portions having connection with the lock bar and the slide structure 27 such that movement occurs in two planes to provide three plane movement of the arm structure 40 with respect to the lock bar 52 and with respect to the slide assembly 27. In FIG. 4 the arm structure is in the closed position of the door and is substantially transverse of the car or generally perpendicular with respect to the slide assembly 27 except that the right end clevis 39 is slightly above the left end clevis 47, that is, the arm structure 40 is slightly over center with respect to the pivot pin 36. This over center condition of the arm structure 40 with respect to its connection with the slide bar assembly 27 insures that the door cannot become unlocked and fall down from its underposed position against the under side of the depending side portion 57. The double acting pneumatic cylinder means 15 in closing the door causes this over center position by moving the slide assembly 27 longitudinally of the car (upwardly as viewed in FIG. 4). The return stroke of the double acting cylinder means causes the slide assembly to move down, as seen in FIG. 4, to snap or pass by the over center position whereupon the door locking bar is withdrawn by the action of the compression springs 59 and 60 and the door becomes unlocked and it then starts to descend downwardly about its pivot means 19, the weight of the door pushing the slide assembly downwardly, as seen in FIG. 4, or to the right as seen in FIG. 2, until the door assumes the dotted line position shown in FIG. 3, the rapid descent of the door being broken by the counterbalancing spring means 23 (which is wound up by descent of the door).

Each arm structure 40, in going from the longitudinally collapsed position where the door is opened to the transversely extended position where the door is closed, raises the door from a lowered position to a door closed position and once the door is closed further movement of the arm transversely outwardly of the slide assembly causes the arm to compress the spring and move the lock bar structure. Prior to closing of the door the arm structure takes the path of least resistance which is raising the weight of the door to the closed position and not to move the lock bar structure to locking position because of the resistance offered by the compression springs. The longitudinally collapsing position of the arm structures provides for out of the way storage of the arm structures.

The addition of the downward depending member 57, and the extending of the door structures 14 underneath the member 57 and to the bottom of the member 18 which would be in line with the bottom of the center sill structure 5*a* of the car, increases the cubic capacity of the hopper vehicle.

The foregoing description and drawings are given merely to explain and illustrate the invention, and the invention is not to be limited thereto since those skilled in the art who have the disclosure before them will be able to make modifications and variations therein without departing from the scope of the invention.

What I claim is:

1. In a hopper means having bottom discharge means, door operating mechanism for hopper discharge door means,

power driven longitudinally reciprocal slide means,

force transfer link means having a pivotal connection with said slide means and with said door means for movement of the link means in multiple planes from a longitudinally generally horizontally extending collapsed door opened position to a transversely upwardly and outwardly directed extended door closed position,

door locking means being mounted on said door means and pivotally connecting with said force transfer link means and being moved by the link means for reciprocal movement transverse of the slide means toward and away from the side of the hopper means for engagement therewith pursuant to locking the door in the closed position of the door,

said door locking means having biasing means urging said locking means from the door locked position to the door unlocked position away from engagement with the side of

the hopper means to sequentially delay the seating of the door locking means by the force transfer link means, said force transfer link means in moving from the longitudinal direction to the transverse direction moving said locking means and overcoming the force of the biasing means to place the locking means into the door locking position.

2. The invention according to claim 1, and

said bottom door means being in a general horizontal plane and opening from the horizontal plane to a generally downwardly extending plane,

said locking means being mounted on the underside of said bottom door means and being released by said force transfer link means to allow the door means in its horizontal closed position to fall as by gravity to the downward open position.

3. The invention according to claim 1, and

said door locking means including a locking member mounted on the underside of said door means and having said biasing means urging said locking member from the door locked position to the door unlocked position.

4. The invention according to claim 3, and

said biasing means comprising spring means urging the locking member out of engagement with the side of the hopper means.

5. The invention according to claim 1, and

slide operating power means in the form of a fluid pressure operated jack being spaced in longitudinal alignment with respect to said slide means and connecting therewith for reciprocatively operating said slide means in longitudinal direction pursuant to opening and closing of said hopper door means.

6. The invention according to claim 1, and

power means moving said slide means in an over center door holding position with respect to the connection of the slide means with said force transfer link means for maintaining said door means in the raised closed and locked position and moving over said over center door holding position to allow said door means to fall by gravity.

7. A railroad hopper car having a hopper provided with horizontally extending bottom hopper door means,

door operating means being disposed beneath said hopper,

said door operating means comprising:

door operating power means,

longitudinally spaced driven slide means reciprocally moved longitudinally of the car by said power means and operatively connected therewith,

force transfer link means operatively connected with said driven slide means and having longitudinally extending collapsed position along the sides of said driven slide means and having a transverse extended position outwardly of the side of the driven slide means,

locking bar means mounted on the underside of said door means and operatively connected with said force transfer link means and reciprocally movable for releasably engaging said locking bar means in the sides of said car,

biasing means mounted on the underside of said door means and engageable with said locking bar means for limiting movement of said locking bar means into locking position in the sides of said car until said force transfer link means have raised said door means from a downward position to a raised closed position, the locking bar means being sequentially biased by the biasing means to sequentially delay the seating of the locking bar means by the link means in the door locked position, whereupon the force of resistance of the biasing means is overcome for the locking of said locking bar means in the side of the car,

first pivot means operatively connecting said force transfer link means with said locking bar means and second pivot means operatively connecting said force transfer link means with said driven slide means to provide for universal movement between said locking bar means and said force transfer link means and between said force transfer link means and said driven slide means,

the pivotal connection of the driven slide means with the force transfer link means being in an over center position to prevent falling of the door means in the door closed position, said power means being two way acting type whereby said power means moves said transfer link means in the over center position with respect to said slide means upon closing of said door means and moves said transfer link means back past the over center position to permit falling of said door means by gravity.

8. The invention according to claim 7, and

said driven slide means comprising a slide block and longitudinal guide rod means carrying said slide block, and support structure depending from said car and carrying said guide rod means and having abutment means limiting movement of said slide block for closing of the door means.

9. The invention according to claim 7, and

said force transfer link means comprising a pair of arm structures each extending from a respective side of said driven slide means, each arm structure having first and second spaced arm end parts rotatably journaled on a common axis and relatively rotatable with respect to one another, said first arm end part being pivotally connected with said locking bar means and said second arm end part being pivotally connected with the driven slide means, said first pivot means including a first pin rotatably mounted on the locking bar means and a clevis pin connected with said first pin and pivotally connected with said pin and forming part of said first arm end part and said second pivot means comprising a second pin rotatably connected on said driven slide means and including a clevis member forming part of said second arm part and connecting with the pin of the second pivot means whereby said arm structure has a universal connection with said locking bar means and with said driven slide means.

10. The invention according to claim 7, and

said door means being hingedly connected to said car for swinging movement from a horizontal position to a downward depending position and counterbalancing means mounted on said car and operatively engageable with said door means to limit the rate of descent of said door means from the closed position to the open position due to the falling of the door means from the closed to the open position whereby the descent of said door means is made more gradual.