United States Patent

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[54] **AERATED HOPPER DISCHARGE APPARATUS FOR RAILROAD CARS**
3 Claims, 10 Drawing Figs.

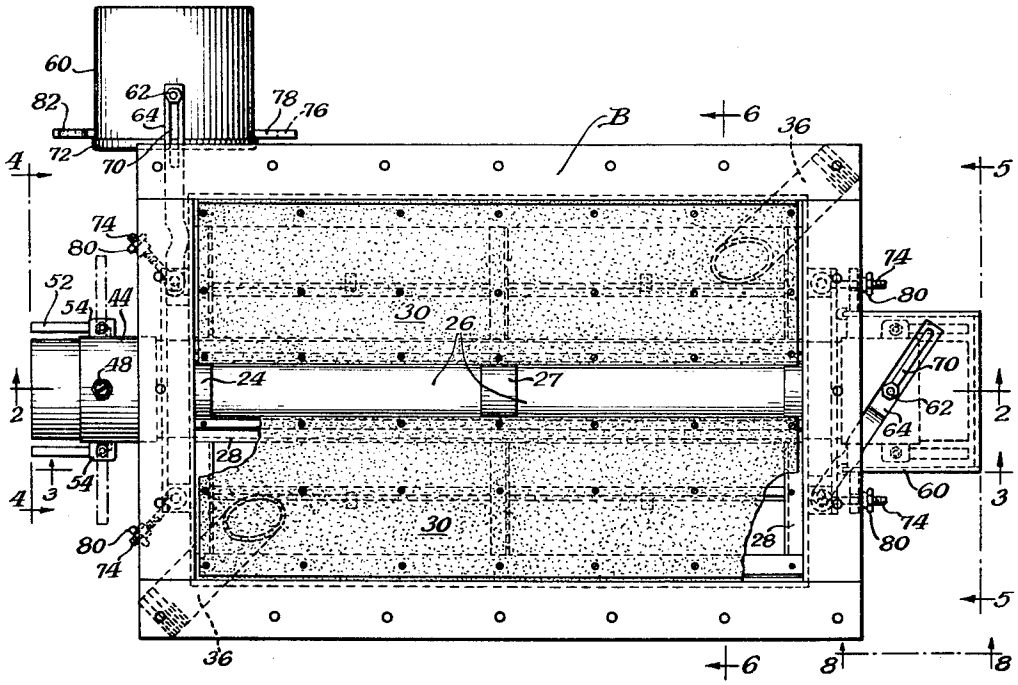
[52] **U.S. Cl.** **302/52,** 214/83.28
[51] **Int. Cl.** **B65g 53/40**
[50] **Field of Search** 302/17, 29, 52, 53; 214/17.82, 83.28

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ABSTRACT: Discharge apparatus for hoppers such as those embodied in railroad cars for discharge of dry bulk commodities from the hoppers by the use of vacuum hose connections.



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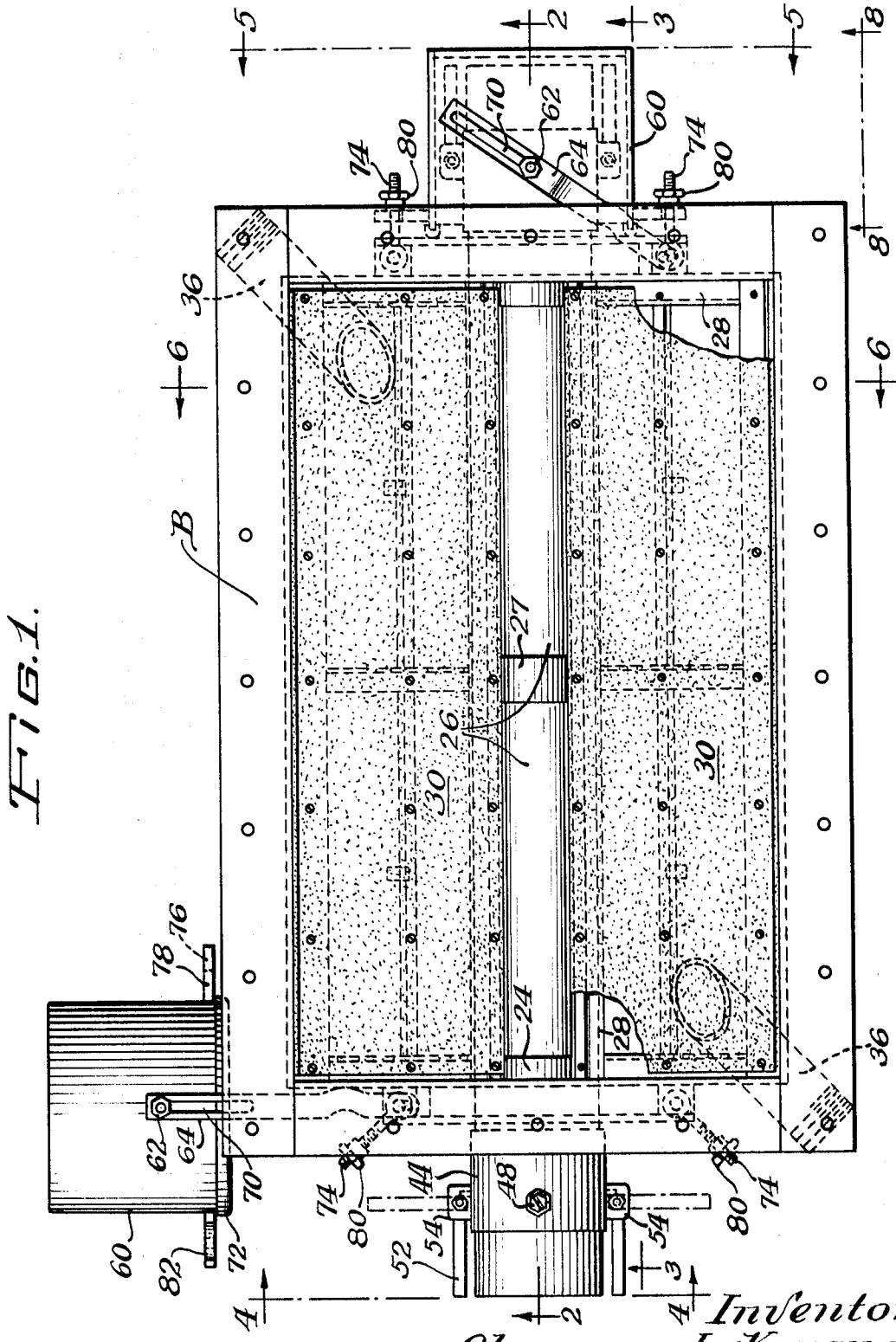


FIG. 1.

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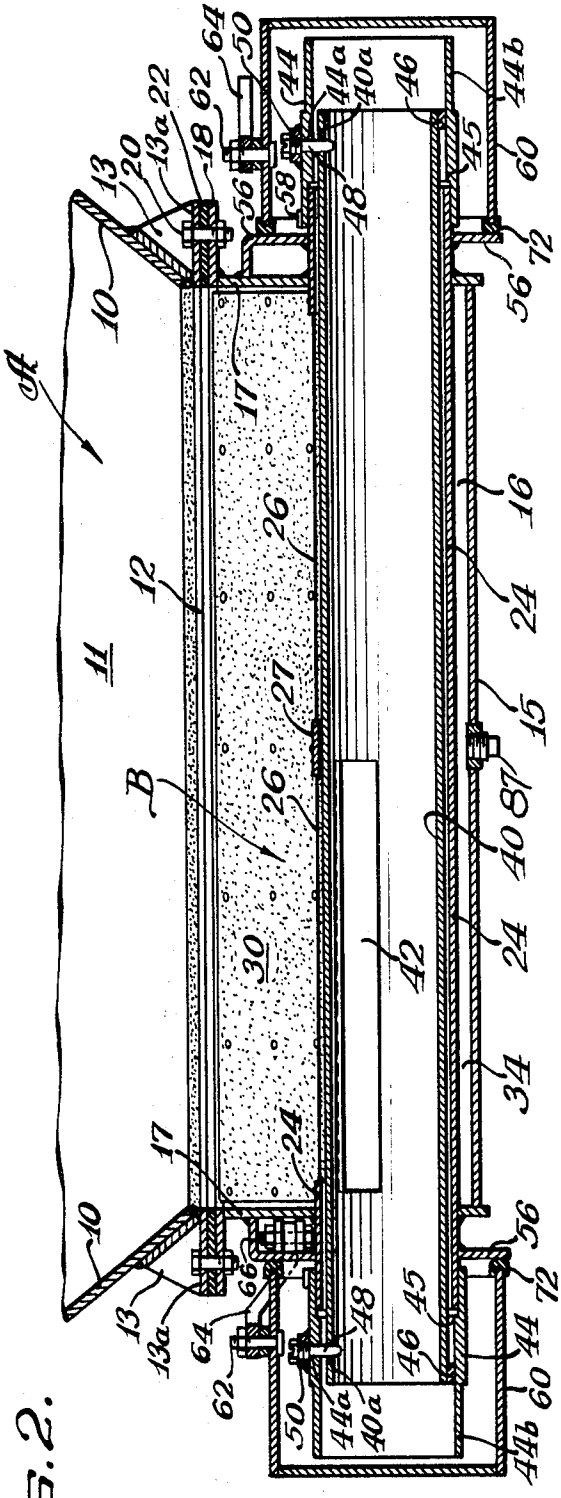


FIG. 2.

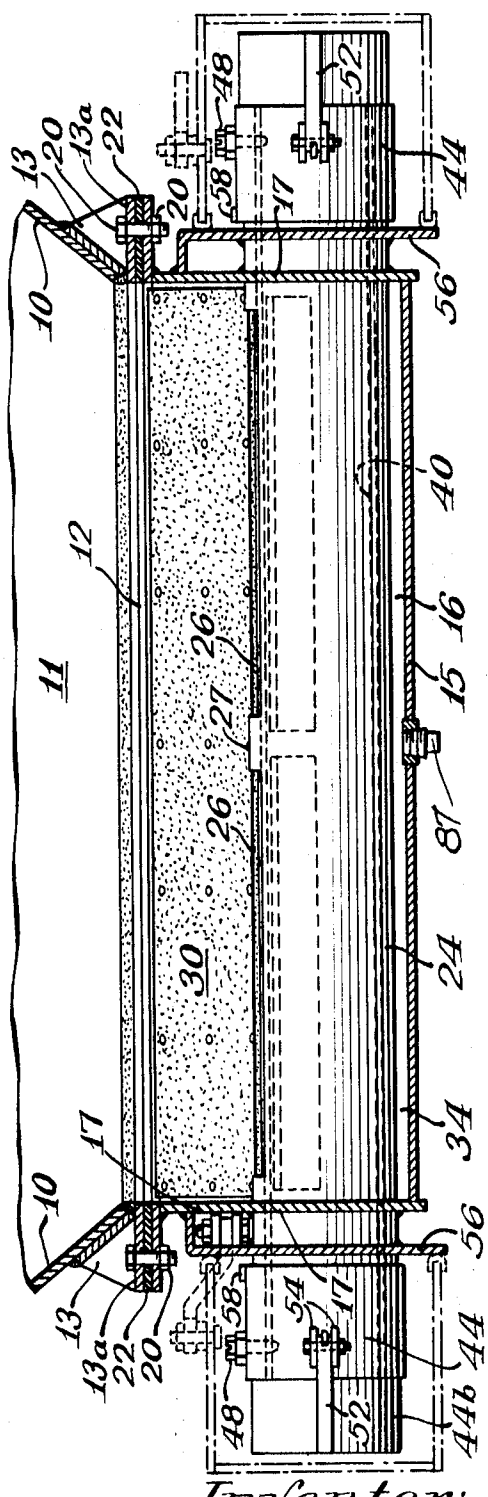


FIG. 3.

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FIG. 4.

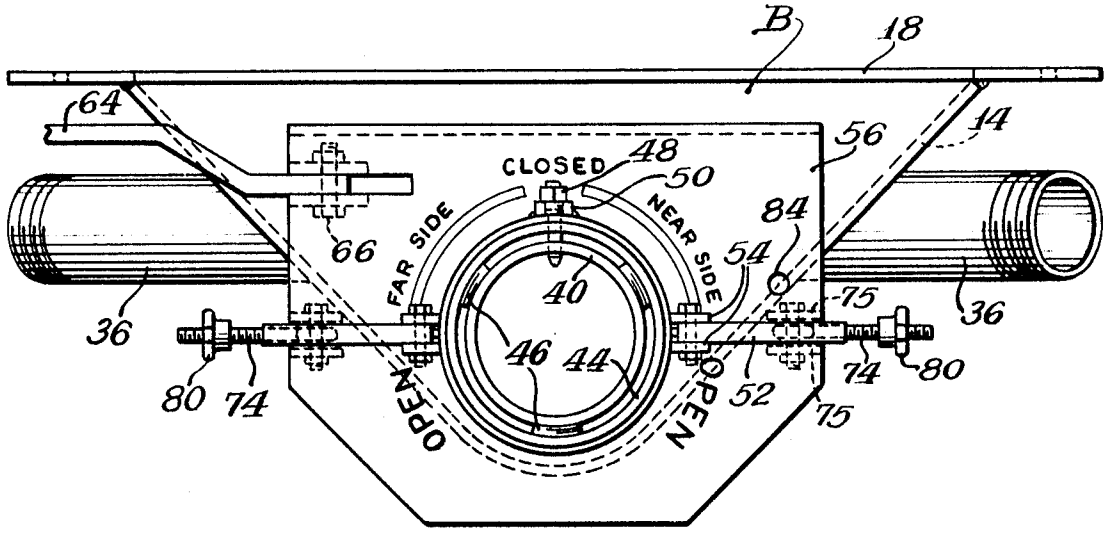
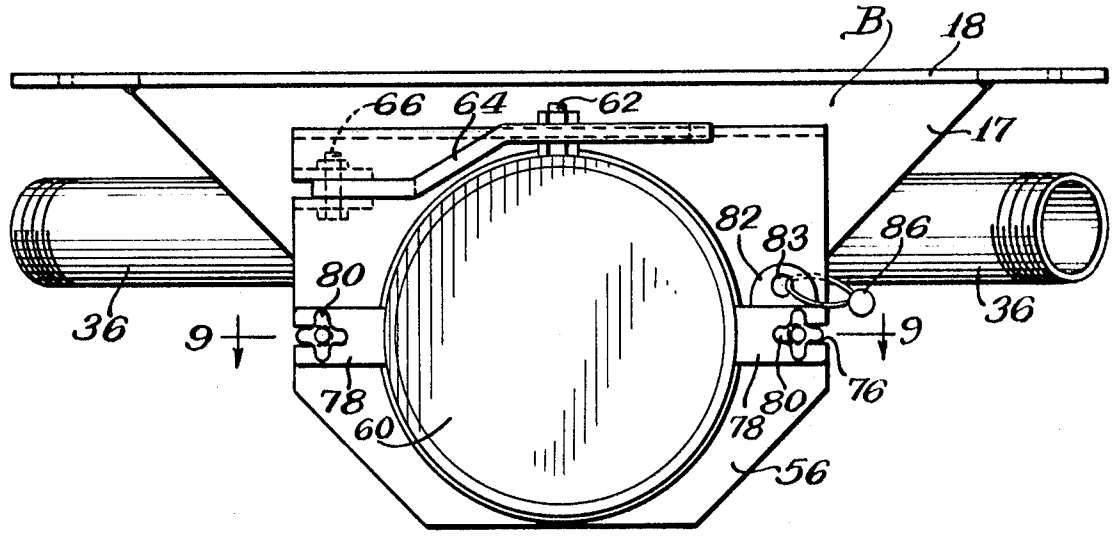


FIG. 5.



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FIG. 6.

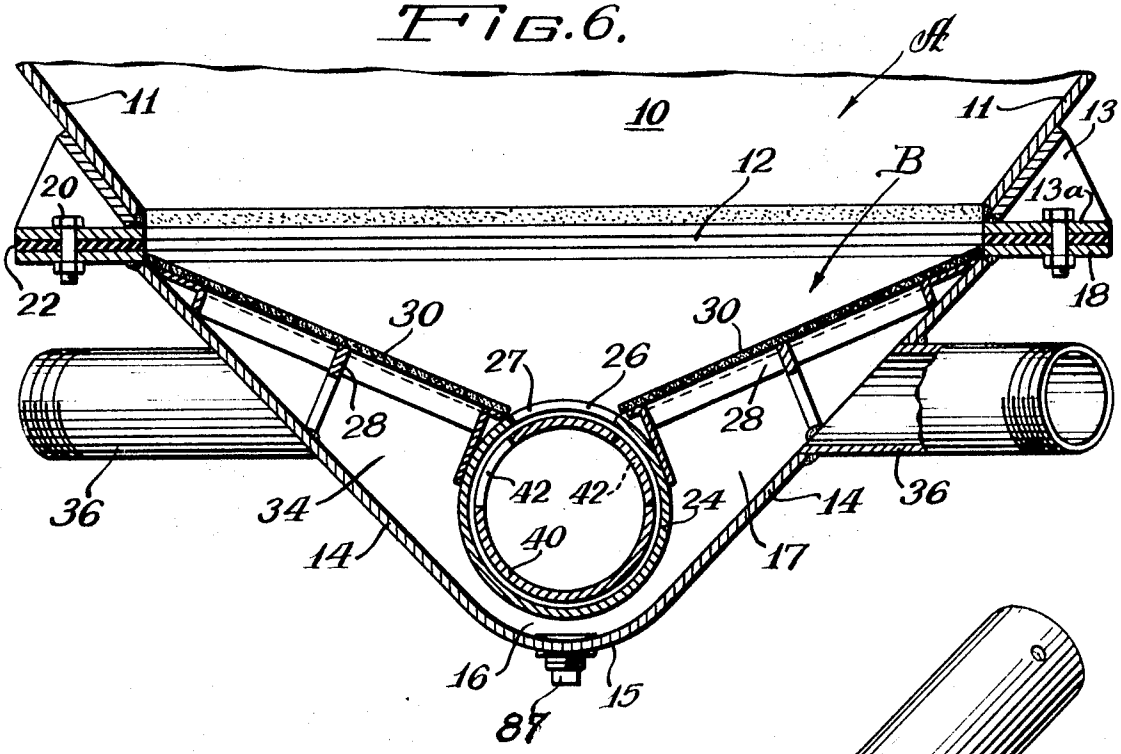
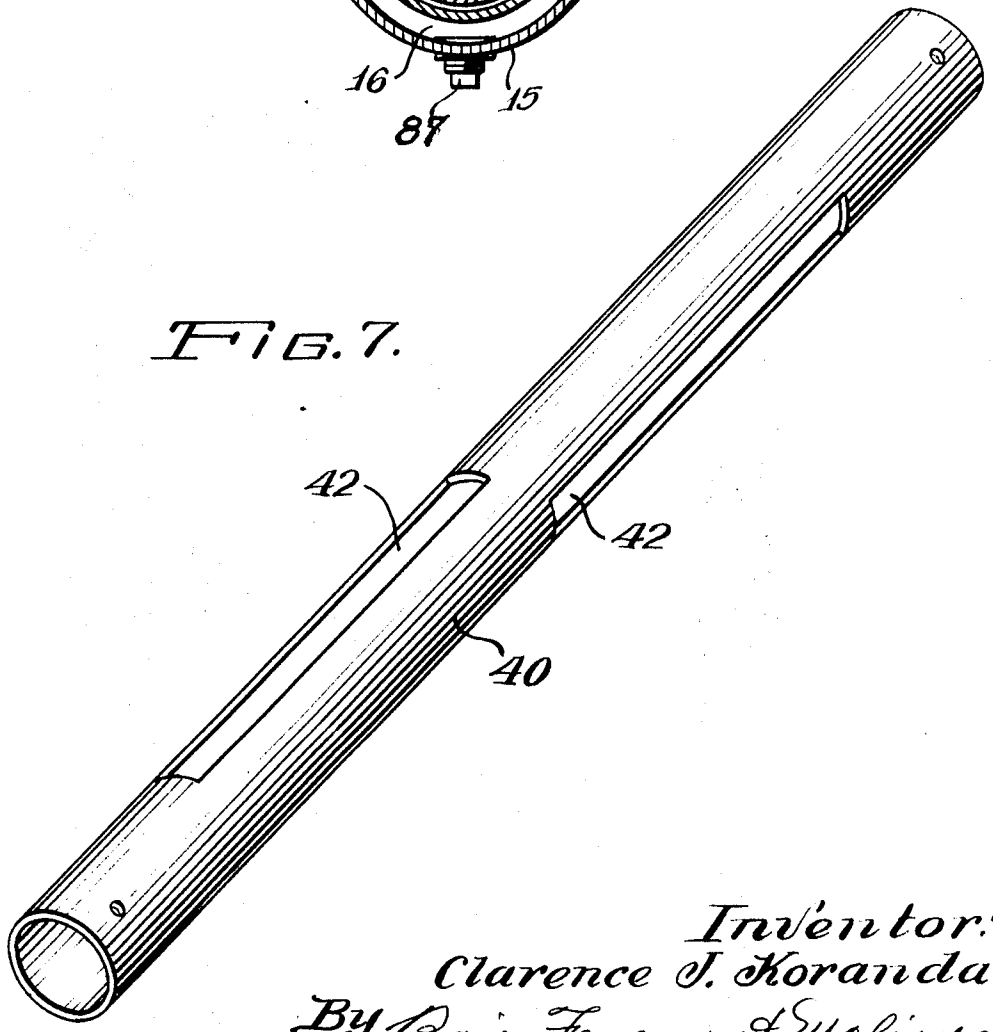


FIG. 7.



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FIG. 8.

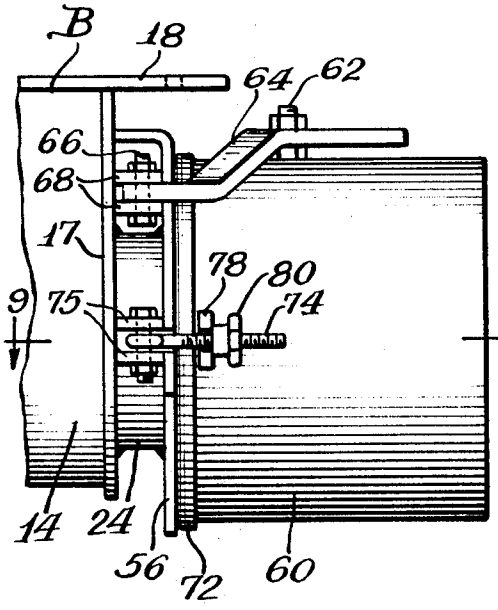


FIG. 9.

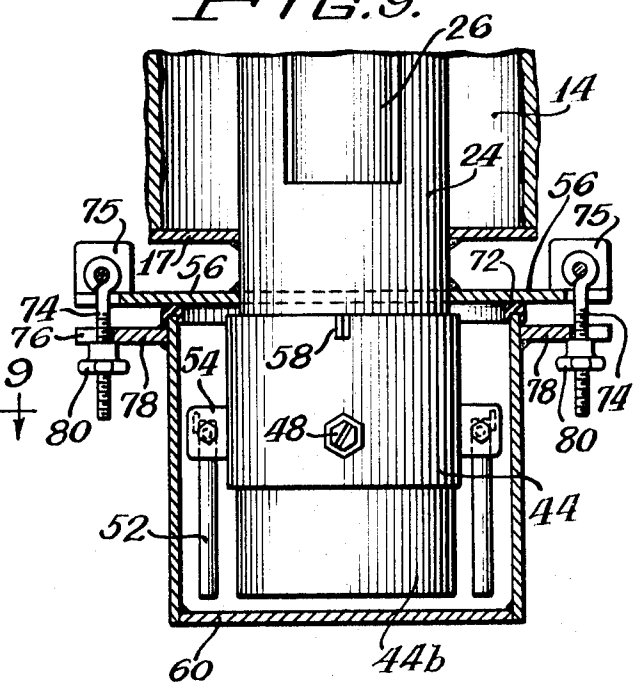
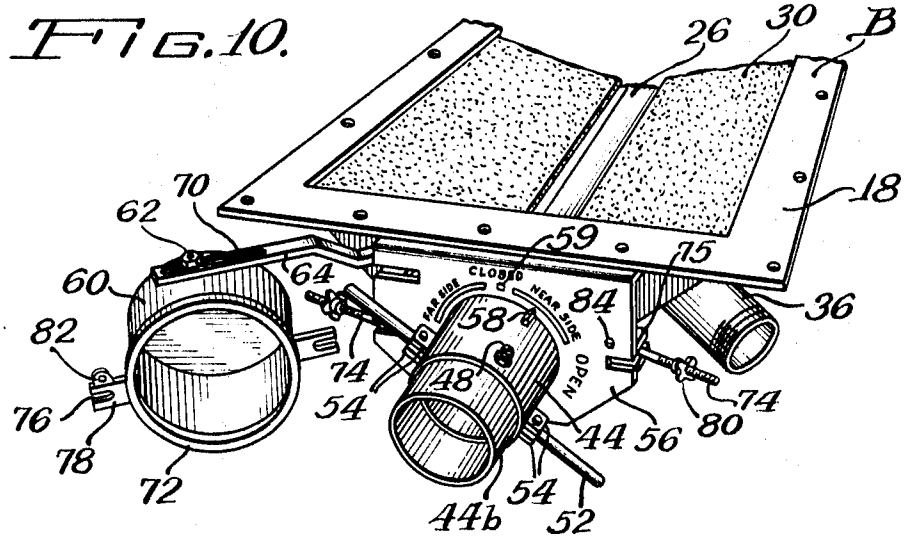


FIG. 10.



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AERATED HOPPER DISCHARGE APPARATUS FOR RAILROAD CARS

BACKGROUND OF THE INVENTION

This invention relates to hopper discharge apparatus and more particularly to discharge apparatus of the type for use in covered hopper-type railroad cars for handling various types of dry bulk commodities such as pulverulent, granular and pellet types of material and discharging them by the use of conventional vacuum hose connections.

Heretofore there has been available hopper-type railroad cars provided with various types of discharge apparatus. Some of such cars are specially designed for use in connection with granular- or pellet-type materials, and in which the materials are caused to flow downwardly in the hopper into a trough provided at the bottom of the discharge apparatus from which the materials are drawn out of the hopper in a stream of air. Another but different type of hopper-type railroad car has been used in connection with granular and pulverulent materials in which the material is caused to become a slurry or a solution while in the hopper prior to its discharge therefrom. There has also heretofore been employed a special non-hopper-type railroad car for handling dry pulverulent materials and discharging the materials in dry form, such as for example flour. However, in such a car construction the discharge and associated apparatus utilized in such cars is relatively expensive to manufacture and install and more importantly, occupies a very substantial part of the normal storage capacity of the cars, thus greatly reducing the load carrying capacity for such cars, resulting in high shipping costs.

Such prior types of railroad cars and discharge apparatus, in the main, have been restricted for separate use in handling only a material of certain characteristics such as granular, pellet or pulverulent type and because of such restricted use, a substantial investment must be made in separate and different types of cars for handling of materials of different physical characteristics.

One of the objects of the present invention is to provide a novel form of hopper discharge apparatus which permits the hoppers of the railroad cars to be utilized for transporting either dry bulk materials such as granular, pellet or pulverulent types, and wherein the discharge apparatus is totally embodied in a unitary bottom hopper section which may be quickly and easily attached to the lower end of a main hopper body of a car. By virtue of this construction, the bottom hopper section embodying the novel discharge apparatus may be used to replace a conventional slide-gate-type bottom section of a hopper of a conventional hopper-type railroad car, or a hopper car having a bottom section embodying the present invention may be quickly and easily replaced by a conventional slide-gate-type bottom section, depending upon the nature of the material to be transported in the hoppers of the car.

Another object is to provide a novel form of discharge apparatus for hoppers adapted to contain granular or pellet or pulverulent materials and wherein the discharge apparatus may be quickly and easily adjusted from either side of the car to readily accommodate the discharge and the handling of materials of different flow characteristics in an efficient manner, and for effecting efficient and complete removal of all material from the hopper body.

Another object is to provide a novel form of discharge apparatus utilizing a sleeve valve and having externally operable means for adjusting the valve together with closure means for totally enclosing the discharge outlets associated with the discharge apparatus to insure against possible contamination of the load of material in the hopper as may be caused by the entry of water, dust and foreign materials while the car is in transit.

Still another object of this invention is to provide an improved hopper discharge apparatus of the character indicated wherein a sleeve valve is provided with two longitudinally and circumferentially spaced apart elongated port openings by virtue of which upon adjustment, it effects a selective removal of the commodity from opposite portions of the hopper and thus insures complete and efficient removal of all commodity from the hopper.

Other objects and advantages of this invention will be apparent from the following description, taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. ! is a top plan view of a bottom hopper section provided with the discharge apparatus embodying the present invention.

FIG. 2 is a transverse vertical sectional view through the lower portion of the hopper of a railroad car provided with discharge apparatus embodying the present invention, taken as indicated at line 2–2 on FIG. 1.

FIG. 3 is a transverse vertical sectional view through the lower portion of the hopper of a railroad car provided with my novel discharge apparatus, taken as indicated at line 3–3 on FIG. 1 with the end closures for sealing the outlets of the apparatus being shown in dot and dash outline.

FIG. 4 is an enlarged end elevational view of the bottom hopper section, taken substantially as indicated at line 4–4 on FIG. 1.

FIG. 5 is a view similar to FIG. 4, taken substantially as indicated at line 5–5 on FIG. 1, with the discharge outlet completely sealed and enclosed by a closure cap.

FIG. 6 is an enlarged vertical sectional view through the bottom of the hopper, taken substantially as indicated at line 6–6 on FIG. 1.

FIG. 7 is a perspective view of the sleeve valve.

FIG. 8 is a fragmentary, side elevational view of a portion of the bottom hopper section with a closure cap in operative position.

FIG. 9 is a horizontal sectional view, taken substantially as indicated at line 9–9 on FIG. 8.

FIG. 10 is a fragmentary perspective view of the bottom hopper section provided with the discharge apparatus embodying the present invention with the handles extended preparatory to rotatably adjusting the sleeve valve to a selected opening position.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As may be seen in the drawings, the hopper comprises a main hopper body A and a bottom hopper section B. The main hopper body is formed with interconnected lower side and end walls 10 and 11 respectively which taper downwardly and inwardly to define a generally rectangular opening 12 through which the material frame the main body of the hopper flows into the bottom hopper section. It is to be understood that hopper bodies of a railroad car are generally provided at their upper closed ends or tops with a pair of normally covered inlet openings. The main hopper bodies of such hoppers may be of the type that are generally rectangular in horizontal section or of the type which are of inverted pear shape in transverse vertical section. Secured externally to the lower edges of the side and end walls of the main hopper body, as by welding, is an angle iron frame 13, totally surrounding the main hopper body and which frame includes a laterally extending mounting flange 13*a*.

The hopper discharge apparatus embodying the present invention is formed as a unitary part of the bottom hopper section B. The bottom hopper section is formed with end walls 14 tapering downwardly and inwardly at approximately the same angle as the end walls 11 of the main hopper section and the lower portions of said walls are joined by an arcuate bottom section 15 to form an elongated, transversely extending trough 16. As may be seen in FIG. 6 of the drawings, the end walls 14 and the arcuate section 15 are formed from a single piece of sheet metal. Vertically positioned sidewalls or plates 17 are welded to the adjacent edges of the end walls 14 to complete the exterior body portion of the bottom hopper section. On

the upper ends of the end walls 14 and sidewalls 17 is secured, as by welding, a horizontally extending flange or frame 18 of generally rectangular outline, which is adapted to register with and be secured to the flange 13*a* of the main hopper section A. The respective flanges 13*a* and 18 are suitably apertured with the apertures positioned in registration and the flanges are rigidly secured together for attaching the two hopper sections by means of bolts 20 extending through aligned sets of apertures, with a gasket 22 interposed between the flanges. It will thus be seen that the main opening of the bottom hopper section is in complete registration with the rectangular opening 12 of the main hopper section A.

A tubular conduit 24 extends transversely of the bottom hopper section with its ends extending through openings formed in the end plates 17 and is welded thereto. The upper wall of the tubular conduit is formed with a pair of longitudinally spaced-apart elongated slots 26, separated by a band of metal 27. If desired, in lieu of the pair of slots 26, one continuous elongated slot could be satisfactorily utilized. These upwardly open slots 26, as may be seen in FIG. 6 of the drawings, constitutes a material discharge opening. Fixedly mounted within the bottom hopper section, at opposite sides of the tubular conduit 24, are framing structures 28 on which are fixedly attached as by screws, panels of porous sintered material 30 such as bronze, which extend substantially the full transverse dimension of the bottom hopper section in downwardly converging relation, as seen in FIGS. 1 and 6, with the lower edges of said panels terminating in registration with the edges of the discharge openings formed by the slots 26 in the tubular conduit 24, as seen in FIG. 6 of the drawings. The framing structures 28 are supported directly against and secured to the inner surface of the end walls 14 as by welding, and are also seated against the outer surface of the tubular conduit. The porous sintered panels 30 constitute material supporting members and due to their downward inclination, tend to direct the flow of material toward the discharge openings in the tubular conduit.

As may be seen in FIG. 6, the tubular conduit 24 is disposed in spaced-apart relation to the bottom or interconnecting portion 15 of the sidewalls 14 and the area beneath the sintered panels 30 constitutes a plenum chamber 34, into which compressed air in the range of 3 to 5 p.s.i. is introduced for passage through the porous sintered panels 30 for aerating the material on the panels and effecting and aiding in the flow of the material downwardly toward the discharge openings 26 in the tubular conduit. A pair of compressed air supply conduits 36 are connected to and open through the end walls 14 and are secured in place as by welding as seen in FIG. 6 of the drawings. For convenience, these supply conduits are arranged diagonally opposite each other, as seen in FIG. 1 of the drawings, and the outer ends are threaded to receive a conventional closure cap. Depending upon the nature of the material contained in the hopper, when the railroad car is positioned at a siding preparatory to discharging the material from the hopper of the car, the cap on the adjacent compressed air supply conduit is removed and a suitable compressed air supply hose is connected to the end thereof. The connection of a source of compressed air into the plenum chamber 34 is highly desirable when the character of the material is of such form as to necessitate aeration thereof to facilitate loosening and effecting a free flow of the material into the discharge openings 26. Pulverulent materials such as flour, sugar, bentonite and the like tend to pack as solid bodies and lumps, and such materials will be more expeditiously discharged from the hopper by injecting compressed air into the material for aerating it and causing it to readily flow into the discharge openings 26 of the tubular conduit for removal from the hopper.

Rotatably mounted within the tubular conduit 24 is a tubular sleeve valve 40, having a pair of elongated openings 42, disposed in axial and circumferentially spaced-apart relation, as seen in FIGS. 6 and 7 of the drawings, with the portion of the material located circumferentially between said slots 42 serving as a valve, which when registered with the openings 26 in the tubular conduit, constitutes a closure therefor. The outer ends of the sleeve valve extend a substantial distance outwardly beyond the ends of the tubular conduit 26 as seen in FIG. 2 of the drawings. Rotatably journaled on the outer ends of the tubular conduit 24 are tubular sleeve members 44, and welded to the outer ends of the sleeve valve are a plurality of circumferentially spaced-apart guide bars 46 engaging the inner surface of the tubular sleeve member 44, and providing support for the sleeve valve within the tubular conduit 24, and maintaining it in desired spaced relation with respect to the tubular conduit 24. The inner surface of the sleeve members are shouldered as indicated at 45 in FIG. 2, so as to provide close spacing of the shoulders with respect to the ends of the tubular conduit for limiting axial movement of the sleeve valve within the tubular conduit. Each of the sleeve members 44 are detachably connected to the respective ends of the sleeve valve by a threaded stud member 48, extending through aligned openings 40*a* and 44*a* in the sleeve valve and the sleeve member. The stud 48 is threaded in a nut 50, welded on the exterior of the sleeve member, as seen in FIG. 2 of the drawings. By virtue of this construction, it is possible to quickly and easily remove the sleeve valve in its entirety from within the tubular conduit 24 by merely removing the threaded stud 48 at the end opposite that from which the sleeve is to be withdrawn. This is an important feature for the purposes of cleansing of the sleeve valve and the interior of the tubular conduit to insure removal of all material and thus eliminate possible contamination of the next and possibly vastly different load of commodity placed in the hopper. The extreme outer ends of the sleeve members 44 are reduced in diameter as indicated at 44 *b* for the reception of a conventional fitting on the end of a vacuum discharge hose which may be attached to said member, incident to removing the commodity from the hopper in a stream of air.

Because of the size and weight of the sleeve valve which desirably is rotatable to a selected position of adjustment, I have provided each of the sleeve members 44 with a pair of oppositely disposed handles 52, the inner ends of which are pivotally supported between pairs of lugs 54 welded to the outer surface of the sleeve member. The handles may be extended radially outwardly as seen in FIGS. 4 and 10 of the drawings so that they may be conveniently grasped to effect a rotary movement of the sleeve valve. When the sleeve valve has been adjusted to its desired open or closed position, the handles may be folded downwardly about their pivot connections to a position in close, spaced relation to the sleeve member 44 as seen in FIGS. 1, 3 and 9 of the drawings.

Secured as by welding to the outer surface of the end plates 17 are a pair of auxiliary end plates 56 which surround and are welded to the outer end portion of the tubular conduit 24. Secured, as by welding, to the outer surface of each of the sleeve members 44 is a lug or index feature 58 which cooperates with indicia applied on the outer surface of each of the auxiliary end plates 56. When the index feature 58 is in registration with the central indicia indicated at 59, the sleeve valve is in closed position with respect to the discharge openings 26 in the tubular conduit as seen in FIGS. 1, 2 and 6 of the drawings. By virtue of the index feature and the indicia, any rotative adjustment of the sleeve valve, by rotation of either sleeve member through the medium of the handles 52, immediately indicates the location of each of the port openings 42 of the sleeve valve 40 relative to the discharge openings 26 in the tubular conduit 24. Likewise, said index feature will serve to clearly indicate the extent or degree of registration of either of said port openings with the discharge openings 26 of the tubular conduit. This feature is of utmost importance for insuring a proper adjustment of the sleeve valve for the most efficient removal of a particular type of commodity from the hopper. It is desired at all times that the effective discharge opening, as determined by the position of adjustment of the sleeve valve be indicated so that the operator can properly control the effect of the vacuum in the

discharge hose to preclude packing of the material and erratic feeding of the material in chunks or slugs, or clogging or plugging of the vacuum discharge hose so as to obtain a smooth, continuous, uniform flow of material from the hopper under the influence of vacuum in the vacuum discharge hose. Vacuum gauges are observed by the operator as to the effect of pull of the commodity and if gauges show a drop in vacuum, the operator knows that air is directly entering the line and the sleeve valve may then be readjusted. It is to be understood that prior to the application of the vacuum hose to the end of a sleeve member **44**, one or both of the loading openings in the top of the hopper desirably should be opened so as to permit atmospheric pressure to cooperate with the vacuum action in forcibly withdrawing the commodity or material from the hopper body.

The use of two port openings in the sleeve valve for unloading material from the hopper is deemed to be extremely important. Such an arrangement permits properly adjusting the sleeve valve in a desired extent of registration of one of its port openings **42** with a discharge opening **26** of the tubular conduit, so that the major portion of the contents of the hopper are discharged through the port opening as thus adjusted, under the effect of vacuum at the bottom and air pressure on top of the commodity in the hopper. However, since the effect of vacuum is that it always tends to take the path of least resistance, it is not possible to totally remove all commodity from the body of the hopper when the sleeve valve is provided with a single port opening extending the total length of the discharge openings in the tubular conduit because as the material is removed from an adjacent half of the hopper body, air will then be permitted to pass directly downwardly through the hopper body into the discharge opening and the vacuum hose, and thus it will not have any appreciable effect on the remaining part of commodity still remaining in the other half of the hopper body. This condition is particularly existent when the commodity is of a pulverulent nature and because of its packing characteristics. Therefore, after the major portion of the commodity has been removed from the hopper body by the registration of one of the port openings **42** of the sleeve valve **40** with the discharge opening **26**, the sleeve valve is readjusted to register the other port opening **42** with the discharge opening of the tubular conduit for effecting the complete removal of the balance of the commodity remaining in the hopper.

Frequently hopper-type railroad cars in transit with a load of commodity moved through various weather zones such as areas subject to dust or in flood areas, and it sometimes happens that foreign material such as dust, etc., as well as water enters the discharge outlets of the discharge apparatus on such cars, it results in contamination of the load. Sometimes a complete load of material, by reason of such contamination, is refused by the consignee and hence the shipper is subject to substantial loss by reason of the refusal of the contaminated commodity. Because the handles **52** on the sleeve members **44** are foldable into compact position, occupying a minimum amount of space, I have found it possible to provide a substantial closure and seal for the entire outlet ends of the discharge apparatus. For this purpose a cup-shaped closure member **60** is utilized for totally surrounding each entire outlet end of the discharge apparatus including the handles **52**, as seen in FIGS. **2**, **8** and **9** of the drawings. Pivotally connected to the top of the cup-shaped member, as indicated at **62**, is a supporting arm **64** which in turn has its opposite end pivotally connected at **66** between a pair of spaced apart lugs **68**, welded on the end plate **17** as seen in FIG. **8** of the drawings. The arm **64** is provided with an elongated slot **70** so as to permit free movement of the closure member **60** in moving into and out of sealing relation to the discharge outlet of the discharge apparatus. The free marginal edge of the cup-shaped member is provided with a resilient gasket **72** adapted to be firmly pressed against the adjacent surface of the auxiliary end plate **56**, to form a complete watertight seal around the outlet portion of the discharge apparatus. The closure is firmly secured in sealed relation by means of a pair of eyebolts **74**, swivelly attached between a pair of lugs **75** on the auxiliary end plate **56**, with their intermediate portions being movable into slots **76**, formed in a pair of outwardly extending lugs **78**, located at opposite sides of the closure **60**. A hand nut **80** is threaded on the outer end of each of the eyebolts to exert pressure on said lugs **78**, and thus urge the cup-shaped member toward auxiliary end plate **56** to provide and maintain a tight sealing engagement of the gasket **72**, against the outer surface of the auxiliary end plate **56**. One of the lugs **78**, opposite the hinge connection **66**, is provided with an upstanding lug **82**, formed with an aperture **83**, adapted to be registered with an aperture **84** provided in the auxiliary end plate **56** and through which registered openings a conventional lead-wire seal **86** is attached to visibly indicate whether or not the closure has been tampered with prior to its opening at the place of destination of the hopper car.

The interconnecting portion **15** between the walls **14** constitutes a trough or sump and a removable drain plug **87** is provided in said trough or sump portion so that any liquid that accumulates in said sump portion may be quickly and easily drained therefrom. Sometimes, due to the ambient humidity while unloading a hopper, moisture is caused to collect and condense in the plenum chamber **34**. Moisture may also tend to collect in the sump portion as a result of washing of the interior of the hopper after it is emptied for purposes of cleansing it prior to the reception of a new load of commodity. It is therefore desirable to remove all excess moisture from time to time to insure against possible contamination of subsequent loads of commodity in the hopper.

While I have herein shown and described certain preferred embodiments of my invention, manifestly it is capable of modification and rearrangement of parts without departing from the spirit and scope thereof. I do not, therefore, wish to be understood as limiting this invention to the precise embodiments herein disclosed, except as I may be so limited by the appended claims.

I claim:

1. In a hopper discharge apparatus for a hopper body having a main hopper section provided with downwardly converging sidewalls terminating in a bottom opening and a bottom hopper section adapted to be secured to the lower end of the main hopper section, in registration with said bottom opening; the improvement wherein the bottom hopper section includes a pair of transversely spaced-apart upright end walls, a pair of opposite, downwardly converging material-supporting members having their lower edges terminating in spaced relation to define a transversely extending, elongated, material discharge opening, a transversely extending tubular conduit secured to and extending through said end walls, said conduit having one or more elongated openings registering with the discharge opening formed by the spacing of the lower edges of the material-supporting members, a tubular sleeve valve rotatably mounted within the conduit and having a pair of elongated port openings spaced apart in axial and totally nonaligned circumferential directions, and openings being selectively and separately registerable respectively with opposite halves of the length of said elongated material discharge opening, said sleeve valve having opposite portions extending outwardly beyond the ends of said conduit, and means operably connected to the outer ends of the sleeve valve for rotating it from either end, in either direction, to selectively and separately cause either of said port openings to register to a selected extent with said material discharge opening, the supporting members including sintered panels for passage of air therethrough and the bottom hopper section being provided with a pair of oppositely disposed sidewalls tapering downwardly toward each other and interconnected and surrounding, in spaced apart relation said tubular conduit and connected to said end plates and said sidewall end walls together with said supporting members forming a plenum chamber.

2. A hopper discharge apparatus as set forth in claim 1, wherein a drain plug is provided in the bottom interconnecting portion of said sidewalls.

3. In a hopper discharge apparatus for a hopper body having a main hopper section provided with downwardly converging sidewalls terminating in a bottom opening and a bottom hopper section adapted to be secured to the lower end of the main hopper section, in registration with said bottom opening; the improvement wherein the bottom hopper section includes a pair of transversely spaced-apart upright end walls, a pair of opposite, downwardly converging material-supporting members having their lower edges terminating in spaced relation to define a transversely extending, elongated, material discharge opening, a transversely extending tubular conduit secured to and extending through said end walls, said conduit having one or more elongated openings registering with the discharge opening formed by the spacing of the lower edges of the material-supporting members, a tubular sleeve valve rotatably mounted within the conduit and having a pair of elongated port openings spaced apart in axial and totally nonaligned circumferential directions, said openings being selectively and separately registerable respectively with opposite halves of the length of said elongated material discharge opening, said sleeve valve having opposite end portions extending outwardly beyond the ends of said conduit, means operably connected to the outer ends of the sleeve valve for rotating it from either end, in either direction, to selectively and separately cause either of said port openings to register to a selected extent with said material discharge opening, said means comprising sleeve members operably connected to the ends of said sleeve valve and journaled on the outer ends of the tubular conduit, and said means including handles pivotally connected to the exterior of the sleeve members, said handles being foldable against the sleeve members, and closure caps pivotally supported on the bottom hopper section and movable over and sealingly enclosing the ends of said sleeve valve and said sleeve members and the handles when the latter are in folded position.