United States Patent [19]

Rosenbaum

[11] **3,759,573**

[45] **Sept. 18, 1973**

[54] **BOTTOM-DUMPING TRAILER WITH SHIFTABLE CLOSURE ASSEMBLY**

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[21] Appl. No.: **243,233**

[52] **U.S. Cl.** ..... **298/29**, 298/35 M

[51] **Int. Cl.** **B60p 1/56**

[58] **Field of Search** ..... 298/27, 29, 30, 35 R, 298/35 M

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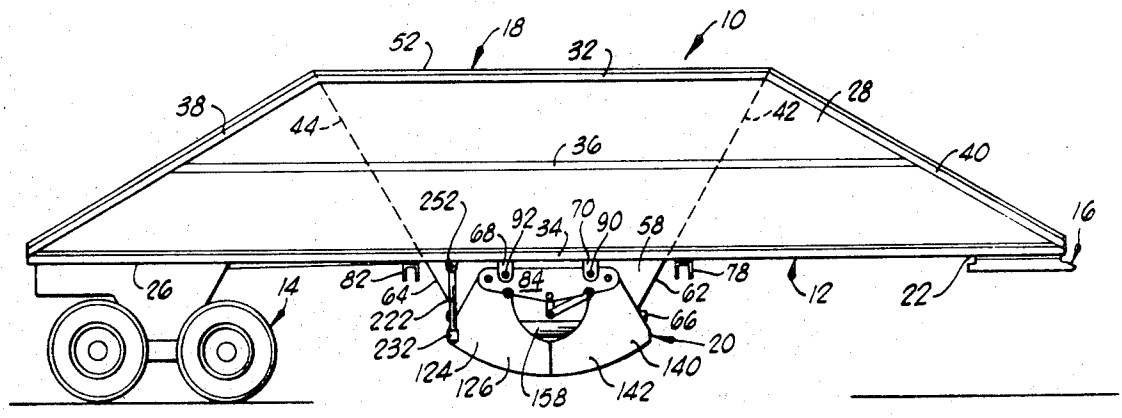
Primary Examiner—Richard J. Johnson

Attorney—Jerry J. Dunlap et al.

[57] **ABSTRACT**

A bottom-dumping semi-trailer including a closure assembly mounted beneath a hopper having an opening in the lower end portion thereof. The closure assembly is adapted to automatically open and close along a line either parallel to or transverse to the longitudinal axis of the trailer depending upon the positioning of the closure assembly relative to the trailer. Means are disclosed for controlling the movement of the two closure members of the closure assembly relative to each other. Also disclosed is a bottom-dumping semi-trailer including a second hopper with a second closure assembly mounted therebeneath.

8 Claims, 10 Drawing Figures



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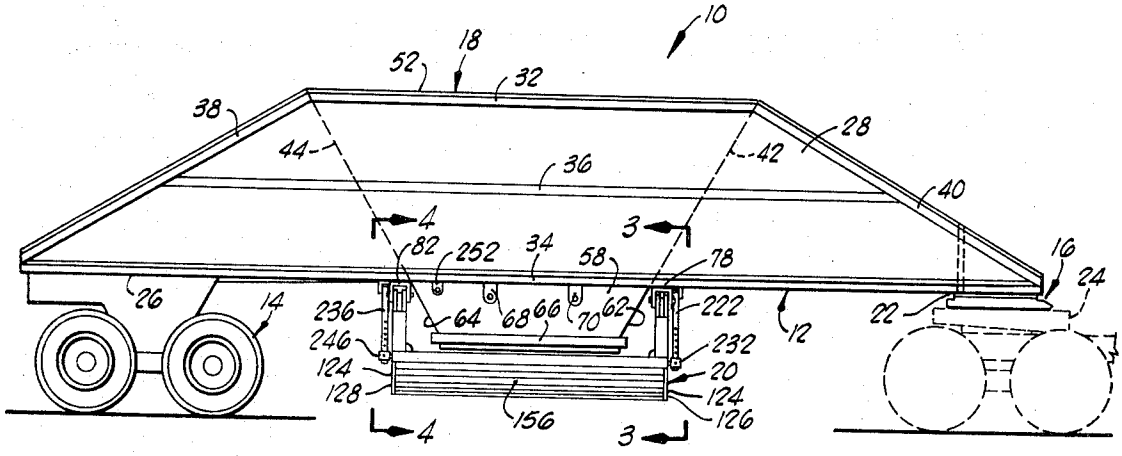

FIG. 1

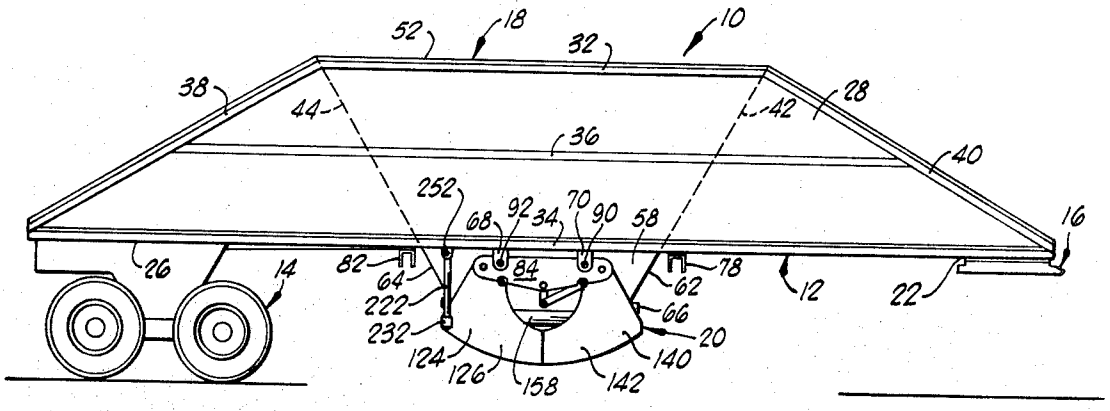

FIG. 2

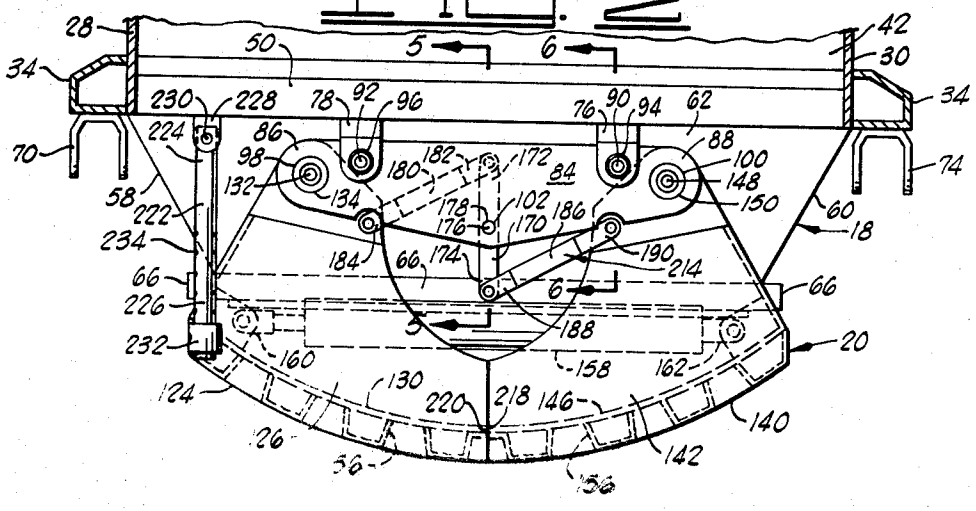

FIG. 3

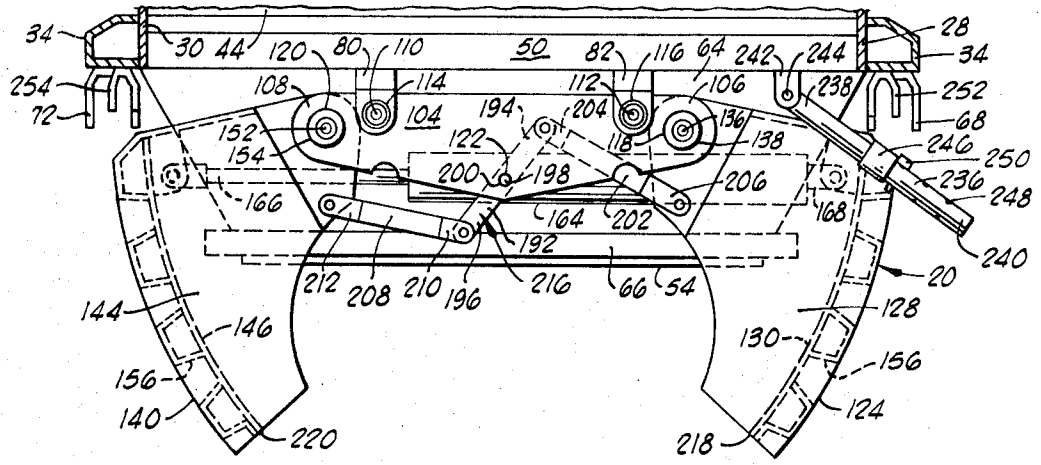

FIG. 4

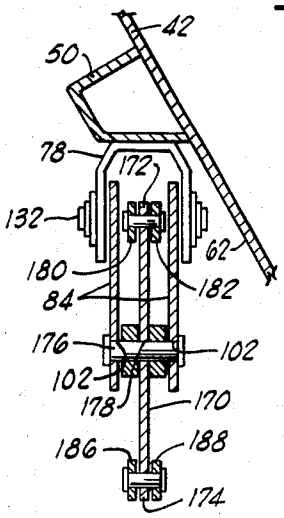

FIG. 5

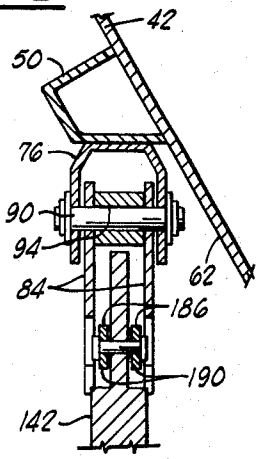

FIG. 6

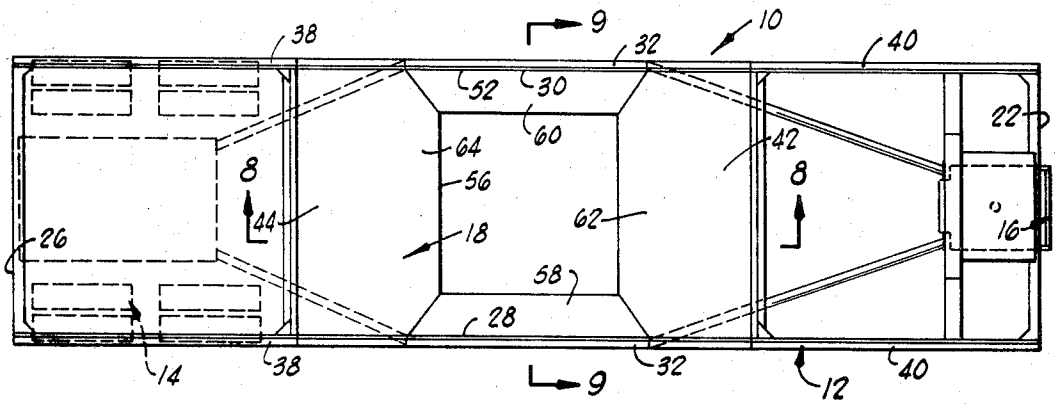

FIG. 7

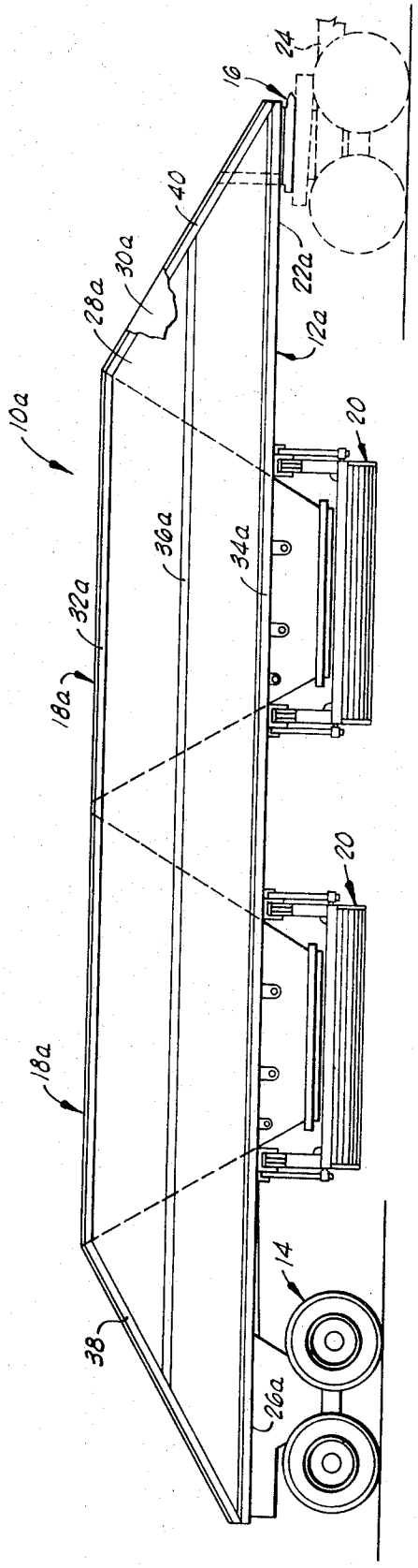

FIG. 10

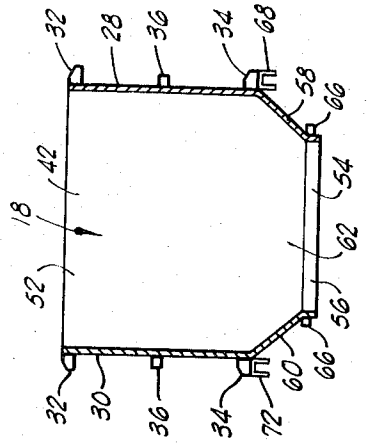

FIG. 9

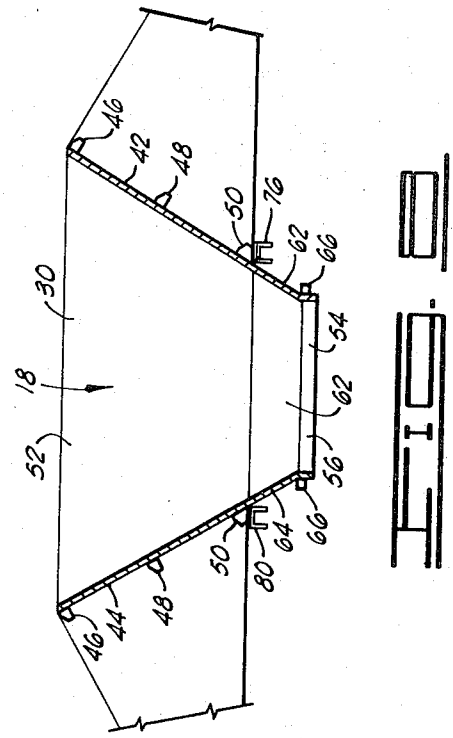

FIG. 8

BOTTOM-DUMPING TRAILER WITH SHIFTABLE CLOSURE ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to dump trucks for conveying and handling bulk materials and more particularly, but not by way of limitation, to dump trucks for conveying and handling materials such as soil, gravel, crushed rock, asphalt and the like for use in the construction of road beds of highways.

2. Description of the Prior Art

The prior art contains a number of teachings of dump trucks or trailers for conveying and handling bulk materials in which a hopper is supported by the vehicle and a closure means is disposed beneath the hopper to alternately close and open the bottom thereof. The prior art vehicles, however, display limited utility due to the fact that the closure means in each case is restricted to open and close along a line either parallel to the longitudinal axis of the vehicle or normal to the longitudinal axis of the vehicle.

In the road construction industry, it is often desirable for the user of such material conveying vehicles to be able to discharge the material from the material-carrying hopper either along a line parallel to the longitudinal axis of the vehicle as the vehicle is moved along the ground in order to provide a controlled size windrow, or to discharge the material from the hopper along a line normal to the longitudinal axis of the vehicle, in what is normally called cross-flow position, in order to spread the material along the ground as the vehicle rolls thereover in a controlled flow. Users of the prior art vehicles must, therefore, have a separate vehicle for windrowing the contents thereof and another vehicle for cross-flow spreading the contents thereof.

Prior to the present invention, material-hauling vehicles having volume capacity substantially equal to that of the present invention were limited in pay load capacity due to their heavy construction. Therefore, many of the prior art vehicles are not capable of carrying the maximum legal pay load during over-the-highway use.

SUMMARY OF THE INVENTION

The present invention generally contemplates a bottom-dumping semi-trailer comprising a longitudinal frame having front and rear end portions; and a hopper carried by said longitudinal frame intermediate the front and rear portions thereof having closed sides, a lower end portion, and an upper end portion. A substantially rectangular opening is formed in the lower end portion of said hopper, said rectangular opening having a first pair of parallel sides in parallel alignment with the longitudinal axis of said longitudinal frame and a second pair of parallel sides aligned normal to the longitudinal axis of said longitudinal frame, the length of each of the sides of said rectangular opening being substantially equal. A closure assembly is disposed beneath said longitudinal frame adjacent to said rectangular opening, said closure assembly having opposite end portions. Said closure assembly further includes: a first support member disposed adjacent to one end portion of said closure assembly, a second support member disposed adjacent to the opposite end portion of said closure assembly; a first closure member pivotally secured at the opposite ends thereof to said first and second support members respectively for rotation about a substantially horizontal axis; a second closure member pivotally secured at the opposite ends thereof to said first and second support members respectively for rotation about a substantially horizontal axis parallel to the rotational axis of said first closure member; and means carried by said closure assembly for rotating said first and second closure members about their respective rotational axes alternately from a position closing said rectangular opening to a position opening said rectangular opening along a line parallel to the rotational axes of said closure members. The bottom-dumping semi-trailer further includes means for securing said closure assembly to said longitudinal frame with the rotational axes of said closure members, alternately, in parallel alignment with the first pair of parallel sides of said rectangular opening or in parallel alignment with the second pair of parallel sides of said rectangular opening.

One object of the present invention is to provide a bottom-dumping trailer of light-weight construction which is capable of dumping the contents thereof along a line either parallel to or normal to the longitudinal axis thereof.

Another object of the present invention is to provide a light-weight bottom-dumping trailer capable of carrying the maximum legal pay load when transporting material over the highways.

One other object of the present invention is to provide a light-weight bottom-dumping trailer which will provide to the user maximum flexibility and economy from a single vehicle.

Yet another object of the present invention is to provide a light-weight bottom-dumping trailer which is simple in construction, economical in operation, and inexpensive to maintain.

The foregoing and additional objects and advantages of the present invention will be more apparent as the following detailed description is read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view of the present invention showing the closure assembly in position to dump the contents of the hopper along a line parallel to the longitudinal axis of the trailer.

FIG. 2 is a side elevation view of the present invention showing the closure assembly in position to dump the contents of the hopper along a line normal to the longitudinal axis of the trailer.

FIG. 3 is a cross-sectional view taken along lines 3—3 of FIG. 1 and illustrating the closure assembly in its closed position.

FIG. 4 is a cross-sectional view taken along lines 4—4 of FIG. 1 illustrating the closure assembly in its opened position.

FIG. 5 is a fragmentary cross-sectional view taken along lines 5—5 of FIG. 3 more clearly illustrating the construction of the closure assembly.

FIG. 6 is a fragmentary cross-sectional view taken along lines 6—6 of FIG. 3 to more clearly illustrate the typical means of attachment of the closure assembly to the trailer frame assembly.

FIG. 7 is a plan view of the present invention with the closure assembly in its fully opened position.

FIG. 8 is a fragmentary cross-sectional view taken along line 8—8 of FIG. 7 with the closure assembly re-

moved to more clearly illustrate the construction of the hopper.

FIG. 9 is a fragmentary cross-sectional view taken along the line 9—9 of FIG. 7 with the closure assembly removed to more clearly illustrate the construction of the hopper.

FIG. 10 is a side elevational view of another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings and to FIGS. 1–9, in particular, the apparatus of the present invention is generally designated by the reference character 10. The apparatus 10 defines a bottom-dumping trailer comprising a trailer frame assembly 12, a support wheel assembly 14, a conventional trailer hitch assembly 16, a hopper 18, and a demountable closure assembly 20.

The conventional trailer hitch assembly 16 is mounted on the front end portion 22 of the trailer frame assembly 12 in a conventional manner to provide means for connecting the apparatus 10 to a draft vehicle 24. The support wheel assembly 14 is mounted on the rear end portion 26 of the trailer frame assembly 12 to support the apparatus 10 on the ground. The frame assembly 12 includes a pair of parallel side panels 28 and 30 each lying in a substantially vertical plane. Each side panel 28 and 30 is preferably formed of steel plate and is suitably reinforced by means of steel channel members 32, 34, 36, 38 and 40 welded to the exterior surfaces thereof.

A front panel 42 and a rear panel 44, preferably formed of steel plate, are each disposed transversely between the side panels 28 and 30. The front and rear panels 42 and 44 are welded to the side panels 28 and 30 along their respective lines of intersection therewith. The front and rear panels 42 and 44 are each suitably reinforced by means of steel channel members 46, 48 and 50 which are welded to the outer surfaces of the respective front and rear panels 42 and 44.

The side panels 28 and 30 and the front panels 42 and 44 define the hopper 18. The hopper 18 is open at its upper end portion 52 to facilitate loading of the hopper. The lower end portion 54 of the hopper 18 extends downwardly from the trailer frame assembly 12 and terminates in a substantially square opening 56, which opening 56 lies in a substantially horizontal plane. The lower end portion 54 of the hopper 18 comprises four side panels 58, 60, 62 and 64 which extend downwardly and inwardly from the side panels 28 and 30 and the front and real panels 42 and 44, respectively. The opening 56 is reinforced by means of four steel channel members 66 welded to the respective lower margin of the side panels 58, 60, 62 and 64 about the outer periphery of the opening 56.

Brackets 68 and 70, each having horizontally aligned apertures formed therein, are fixedly secured to the steel channel member 34 of the side panel 28 and extend downwardly therefrom. The brackets 68 and 70 are disposed in spaced relation proximate to the outer surface of side panel 58.

Brackets 72 and 74, each having horizontally aligned apertures formed therein, are fixedly secured to and extend downwardly from the steel channel member 34 of side panel 30. The brackets 72 and 74 are disposed in spaced relation proximate to the outer surface of side panel 60.

Brackets 76 and 78, each having horizontally aligned apertures formed therein, are fixedly secured to and extend downwardly from the steel channel member 50 of front panel 42. The brackets 76 and 78 are disposed in spaced relation proximate to the outer surface of side panel 62.

Brackets 80 and 82, each having horizontally aligned apertures formed therein, are fixedly securecd to and extend downwardly from the steel channel member 50 of the rear panel 44. The brackets 80 and 82 are disposed in spaced relation proximate to the outer surface of side panel 64.

The closure assembly 20 is adapted to be mounted on the apparatus 10 by means of the previously described brackets 68, 70, 72, 74, 76, 78, 80 and 82. It should be noted at this point that one of the novel aspects of the present invention is that the closure assembly 20 may be mounted on the apparatus to either open and close along a line parallel to the longitudinal axis of the trailer frame 12, or along a transverse axis normal to the longitudinal axis of the trailer frame 12, depending upon the particular needs of the user at a given time. If it is desired that the closure assembly 20 open and close along the longitudinal axis of the trailer frame 12, the closure assembly 20 will be secured to the apparatus 10 by means of the brackets 76, 78, 80 and 82. If, however, it is desired that the closure assembly 20 open and close along a line normal to the longitudinal axis of the trailer frame assembly 12, the closure assembly 20 will then be secured to the apparatus 10 by means of the brackets 68, 70, 72 and 74. The apparatus 10 will initially be described with the closure assembly 20 mounted in a position to open and close along a line parallel to the longitudinal axis of the trailer frame assembly 12.

The closure assembly 20 comprises a first support member 84 having opposite end portions 86 and 88. The first support member 84 is secured to the brackets 76 and 78 by means of pins 90 and 92 which extend respectively through the aligned apertures formed in the brackets 76 and 78 and the mating apertures 94 and 96 formed in the first support member 84. Apertures 98 and 100 are formed respectively in the end portions 86 and 88 of the first support member 84 and aligned apertures 102 are formed in the medial portion of the first support member 84.

A second support member 104 of the closure assembly 20 having opposite end portions 106 and 108 is secured to the apparatus 10 by means of pins 110 and 112 which extend respectively through the aligned apertures formed in the brackets 80 and 82 and the respective mating apertures 114 and 116 formed in the second support member 104. Apertures 118 and 120 are formed respectively in the end portions 106 and 108 of the second support member 104 and aligned apertures 122 are formed in the medial portion of the second support member 104.

A first closure member 124, comprising a first end plate 126, a second end plate 128 and an arcuately shaped floor section 130 rigidly interconnecting the end plates 126 and 128, is pivotally secured to the first and second support members 84 and 104. The first end plate 126 is pivotally secured to the first support member 84 by means of a pin 132 which extends through aperture 98 of the first support member 84 and mating

aperture 134 formed in the first end plate 126. Similarly, the second end plate 128 is pivotally secured to the second support member 104 by means of a pin 136 which extends through aperture 118 of the second support member 105 and mating aperture 138 formed in the second end plate 128. It will be readily apparent from the drawings that the first closure member 124 is free to rotate about a substantially horizontal axis parallel to the longitudinal axis of the trailer frame assembly 12.

A second closure member 140, comprising a first end plate 142, a second end plate 144, and an shaped floor section 146 rigidly interconnecting the first and second end plates 142 and 144, is pivotally secured to the first and second support members 84 and 104. The first end plate 142 is pivotally secured to the first support member 84 by means of a pin 148 which extends through aperture 100 formed in the first support member 84 and mating aperture 150 formed in the first end plate 142. The second end plate 144 is pivotally secured to the second support member 104 by means of pin 152 which extends through aperture 120 formed in the second support member 104 and aperture 154 formed in the second end plate 144. It will be readily apparent that the second closure member 140 is free to rotate about a substantially horizontal axis parallel to the longitudinal axis of the trailer frame assembly 12 and parallel to the axis of rotation of the first closure member 124.

The floor sections 130 and 146 of the first and second closure members 124 and 140, respectively, are preferably formed of steel plate and are preferably reinforced with a plurality of steel channels 156 welded along the lower surfaces thereof and butt welded to the respective end plates 126, 128, 142 and 144.

A conventional expansible two-way power cylinder 158 having a rod end 160 and a cydinder end 162 is horizontally disposed between the first end plates 126 and 142 and the side panel 62 of the hopper 18. The rod end 160 is pivotally secured to the first closure member 124 proximate to the first end plate 126 thereof. The cylinder end 162 is pivotally secured to the second closure member 140 proximate to the first end plate 142 thereof.

A second conventional expansible two-way power cylinder 164 having a rod end 166 and a cylinder end 168 is horizontally disposed between the second end plates 128 and 144 and the side panel 64 of the hopper 18. The cylinder end 168 is pivotally secured to the first closure member 124 proximate to the second end plate 128 thereof. The rod end 166 is pivotally secured to the second closure member 140 proximate to the second end plate 144 thereof.

A first rigid link 170 having a first end 172 and a second end 174 is pivotally secured at the medial portion thereof to the first support member 84 by means of a pin 176 extending through the aligned apertures 102 formed in the first support member 84 and an aperture 178 formed in the medial portion of the first link 170. A second rigid link 180 having a first end 182 and a second end 184 is pivotally secured at the first end 182 thereof to the first end 172 of the first link 170. The second link 180 is pivotally secured at the second end 184 thereof to the first end plate 126 of the first closure member 124. A third rigid link 186 having a first end 188 and a second end 190 is pivotally secured at the first end 188 thereof to the second end 174 of the first link 170. The second end 190 of the third link 186 is pivotally secured to the first end plate 142 of the second closure member 140.

A fourth rigid link 192 having a first end 194 and a second end 196 and is pivotally secured at the medial portion thereof to the second support member 104 by means of a pin 198 which extends through the aligned apertures 122 formed in the second support member 104 and a mating aperture 200 formed in the medial portion of the fourth link 192. A fifth rigid link 202 having a first end 204 and a second end 206 is pivotally secured at the first end 204 thereof to the first end 194 of the fourth link 192. The second end 206 of the fifth link 202 is pivotally secured to the second end plate 128 of the first closure member 124. A sixth rigid link 208 having a first end 210 and a second 212 is pivotally secured at the first end 210 thereof to the second end 196 of the fourth link 192. The second end 212 of the sixth link 208 is pivotally secured to the second end plate 144 of the second closure member 140.

The first, second, and third links 170, 180, and 186, connected as described above, comprise a first linkage assembly 214 which interconnects the first and second closure members 124 and 140 and the first support member 84. The fourth, fifth, and sixth links 192, 202, and 208, connected as described above, comprise a second linkage assembly 216 which interconnects the first and second closure members 124 and 140 and the second support member 104. The first and second linkage assemblies 214 and 216 control the rotation of the first and the second closure members 124 and 140 about their respective horizontal rotational axes such that upon the extension of the power cylinders 158 and 164, the first and second closure members 124 and 140 rotate relatively apart simultaneously in equal angular amounts. Conversely, upon the retraction of the power cylinders 158 and 164, the first and second closure members 124 and 140 rotate toward each other through an equal angular amount, due to the control of the linkage assemblies 214 and 216.

The closure assembly 20 is in its closed position closing the opening 56 in the lower end portion 54 of the hopper 18 as shown in FIG. 3, when the power cylinders 158 and 164 are fully retracted and the lower margins 218 and 220 of the respective floor sections 130 and 146 are engaged along their full length.

The closure assembly 20 is in its fully opened position providing no restriction to the opening 56 in the lower end portion 54 of the hopper 18, as shown in FIG. 4, when the power cylinders 158 and 164 are fully extended and the first and second closure members 124 and 140 are rotated about their respective horizontal axes of rotation outwardly and upwardly away from each other. It will be readily apparent that the closure assembly 20 may be positioned in an infinite number of opened positions between the previously described closed position and the fully opened position by varying the amount of extension of the power cylinders 158 and 164. The power cylinders 158 and 164 are preferably two-way hydraulic cylinders of conventional design which may be extended and retracted by means of any number of well known conventional hydraulic control systems which need not be described in detail herein.

As shown in FIG. 3, a strut 222 having an upper end portion 224 and a lower end portion 226 is pivotally secured at the upper end portion 224 thereof to a bracket 228 formed on the steel channel member 50. The piv-

otal securement between the strut **222** and the bracket **228** is accomplished by means of a removable pin **230**. The lower end portion **226** of the strut **222** is slidably disposed in a strut receiving bracket **232** secured to the first end plate **126** of the first closure member **124**. A plurality of aligned pairs of apertures **234** are formed in the strut **222** with their axes of alignment normal to the longitudinal axis of the strut **222**. The bracket **232** is mounted on the first end plate **126** in such a manner that as the first closure member **124** is rotated clockwise about its axis of rotation as viewed in FIG. **3**, the strut **222** will slide through the bracket **232**.

As shown in FIG. **4**, a strut **236**, identical to the previously described strut **222**, and having an upper end portion **238** and a lower end portion **240** is pivotally secured at the upper end portion **238** thereof to a bracket **242** formed on the steel channel member of the rear panel **44**. The pivotal securement of the strut **236** to the bracket **242** is accomplished by means of removable pin **244**. The lower end portion **240** of the strut **236** is slidably disposed in a strut receiving bracket **246** secured to the second end plate **128** in a manner such that the strut **236** will slide readily through the bracket **246** as the first closure member **124** is rotated about its axis of rotation.

The struts **222** and **236** are provided so that the closure assembly **20** may be securely retained in any one of a number of preselected open positions by the positioning of a pin **250** through a selected aligned pair or apertures **234** and **248**, respectively, just below the respective brackets **232** and **246**. FIG. **4** clearly illustrates the above-described positioning of the pin **250** in the strut **236** which positioning is typical for the strut **222** (not shown). The positioning of the pins **250** in struts **222** and **236** as described, permits the positive retention of the closure assembly in any of a number of open positions without the application of hydraulic power to the power cylinders **158** and **164**. The positioning of the pins **250** in the apertures **234** and **248** of the struts **222** and **236** above the brackets **232** and **246** will also provide a positive stop to restrict opening of the closure assembly **20** to a predetermined amount upon extension of the power cylinders **158** and **164**.

OPERATION OF THE PREFERRED EMBODIMENT

An important aspect of the present invention is that the closure assembly **20**, installed as previously described and as clearly shown in FIG. **1**, may be quickly and easily separated from the trailer frame assembly **12**, lowered from the trailer assembly **12** and rotated 90°, and resecured to the trailer frame assembly **12** as shown in FIG. **2**. In order to accomplish this, the pins **90, 92, 110** and **112** are removed respectively from the brackets **76, 78, 80** and **82** while the closure assembly **20** is supported by other suitable auxiliary means such as a fork-lift truck. At the same time, pins **230** and **244** are removed thus freeing the struts **222** and **236** from their connection with the trailer frame assembly **12**. The closure assembly **20** is then lowered by the auxiliary support means (fork-lift truck), rotated 90° in a horizontal plane and raised again into proper position below the hopper **18**.

The closure assembly **20** is then secured to the trailer assembly **12** by means of the same pins **90, 92, 110** and **112**. The first support member **84** will now be secured to the trailer frame assembly **12** by the pins **90** and **92** extending respectively through the brackets **70** and **68** and the apertures **94** and **96** in the first support member **84**. Similarly, the second support member **104** will now be secured to the trailer frame assembly **12** by means of the pins **110** and **112** extending respectively through brackets **74** and **72** and the apertures **114** and **116** formed in the second support member **104**. The struts **222** and **236** will be pivotally secured to respective brackets **252** and **254** by means of pins **230** and **244** in a manner similar to that described above for the brackets **228** and **242**.

The hopper **18** may be loaded when the closure assembly **20** is closed with the power cylinder **158** and **164** in their fully retracted positions. The contents of the hopper **18** may be dumped by opening the closure assembly **20** by extending the power cylinders **158** and **164** the desired amount thereby rotating the first and second closure members **124** and **140** away from each other about their respective horizontal axes of rotation.

It will be readily apparent that the capability of the present invention for mounting the closure assembly **20** to either open and close along the line parallel to the longitudinal axis of the trailer frame a ssembly **12** or along the line normal to the longitudinal axis of the trailer frame assembly **12** affords the user maximum flexibility from a single piece of equipment while employing a relatively simple trouble-free mechanism to provide this flexibility.

DESCRIPTION OF THE EMBODIMENT OF FIG. 10.

FIG. **10** illustrates a variation of the present invention which will be designated by the reference character **10*a***. Many of the components of the apparatus **10*a*** are identical to those described above for the apparatus **10** and will, therefore, be given the same reference characters as used above. The apparatus **10*a*** defines a bottom-dumping trailer comprising a slightly modified trailer frame assembly **12*a***, a support wheel assembly **14**, a conventional trailer hitch assembly **16**, a pair of hoppers **18*a***, and a pair of demountable closure assemblies **20**.

The conventional trailer hitch assembly **16** is mounted on the front end portion **22*a*** of the trailer frame assembly **12*a*** in a conventional manner to provide means for connecting the apparatus **10** to a draft vehicle **24**. The support wheel assembly **14** is mounted on the rear end portion **26*a*** of the trailer frame assembly **12*a*** to support the apparatus **10*a*** on the ground. The trailer frame assembly **12*a*** includes a pair of slightly modified parallel side panels **28*a*** and **30*a*** each lying in a substantially vertical plane. Each side panel **28*a*** and **30*a*** is preferably formed of steel plate and is suitably reinforced by means of steel channel members **32*a*, 34*a*, 36*a*, 38** and **40** welded to the exterior surfaces thereof.

As may be readily seen without further detailed explanation, the two hoppers **18*a*** are substantially identical to the previously described hopper **18** and the apparatus **10*a*** differs from the previously described apparatus **10** only in the fact that the trailer frame assembly **12*a*** is elongated a sufficient amount to carry two hoppers **18*a***. The mounting of the two closure assemblies **20** beneath the two hoppers **18*a*** is substantially identical to that described above for the apparatus **10** and need not be explained in detail again. It should suffice to say that each of the closure assemblies **20** may be mounted beneath the respective hopper **18*a*** such that the closure assembly **20** may open and close along a

line either parallel to or normal to the longitudinal axis of the trailer frame assembly **12***a*, depending on the desires of the user.

It will be readily apparent that the apparatus **10***a* provides the additonal advantage of being capable of transporting approximately twice the volume of the apparatus **10**. A further advantage of the apparatus **10***a* is that each hopper **18***a* may be loaded with a different material. Yet another advantage of the apparatus **10***a* is that, depending upon the desires of the user, each closure assembly **20** may be mounted beneath its respective hopper **18***a* to provide different unloading characteristics in comparison with its counterpart.

OPERATION OF THE EMBODIMENT OF FIG. 10

Operation of the apparatus **10***a* is substantially identical to that described for the apparatus **10** except that the hoppers **18***a* may be unloaded either separately or simultaneously by independent operation of the respective closure assemblies **20** as described above for the apparatus **10**. The hoppers **18***a* may be arranged to both open and close along a line parallel with or normal to the longitudinal axis of the trailer frame assembly **12***a*, or one hopper may be arranged to open longitudinally while the other is arranged to open normal to the longitudinal axis of the trailer frame assembly **12***a*.

While the foregoing detailed description of the preferred embodiments of the present invention envision the utilization of a semi-type trailer as the support means for the hopper and the closure assembly associated therewith, it will be readily apparent to one skilled in the art that such apparatus may, in certain applications, be advantageously constructed on a self-propelled vehicle chassis without departing from the spirit and scope of the invention. Furthermore, it may be advantageous in certain applications to secure more than one apparatus **10** or **10***a* to a draft vehicle for over the road hauling in states where the law permits.

Changes may be made in the construction and arrangement of parts or elements of the various embodiments described herein without departing from the spirit and scope of the present invention as defined herein.

What is claimed is:

1. In a bottom-dumping semi-trailer comprising a longitudinal frame having front and rear end portions, the improvement comprising:

a hopper carried by said frame intermediate the front and rear end portions thereof, said hopper having a lower end portion with a rectangular opening formed therein having sides of substantially equal length;

bracket means carried by the frame adjacent to each of the four sides of said rectangular opening; and

closure means disposed beneath said hopper for alternately closing and opening the rectangular opening in said hopper, said closure means being selectively removably secured to said bracket means on opposite sides of the rectangular opening, whereby said closure means may be selectively secured to said bracket means to open and close along a line substantially parallel to the longitudinal axis of said longitudinal frame or, alternately, to open and close along a line substantially normal to the longitudinal axis of said longitudinal frame.

2. A bottom-dumping semi-trailer as defined in claim **1** wherein said closure means is characterized further to include:

a first support member selectively removably secured to a first one of said bracket means;

a second support member selectively removably secured to a second one of said bracket means on the opposite side of the rectangular opening from the first one of said bracket means;

a first closure member pivotally secured at the opposite ends thereof to said first and second support members, respectively, for rotation about a substantially horizontal axis;

a second closure member pivotally secured at the opposite ends thereof to said first and second support members, respectively, for rotation about a substantially horizontal axis parallel to the rotational axis of said first closure member; and

actuating means carried by said closure means for rotating said first and second closure members about their respective rotational axes to open and close the opening in said hopper along a line parallel to the rotational axes of said closure members.

3. A bottom-dumping semi-trailer as defined in claim **2** characterized further to include:

linking means carried by said closure means and responsive to said actuating means for controlling the rotation of said first and second closure members so that said first and second closure members simultaneously rotate toward each other in substantially equal amounts to close the opening in said hopper and, alternately, said first and second closure members simultaneously rotate away from each other in substantially equal amounts to open the opening in said hopper.

4. A bottom-dumping semi-trailer as defined in claim **3** wherein said actuating means is characterized further to include:

a first extensible power cylinder having opposite end portions, said first power cylinder having one end portion thereof pivotally secured to said first closure member and having the opposite end portion thereof pivotally secured to said second closure member;

a second extensible power cylinder having opposite end portions, said second power cylinder having one end portion thereof pivotally secured to said first closure member and having the opposite end portion thereof pivotally secured to said second closure member;

said first extensible power cylinder being disposed proximate to said first support member; and

said second extensible power cylinder being disposed proximate to said second support member.

5. A bottom-dumping semi-trailer as defined in claim **3** wherein:

said first closure member is characterized further to include a first end portion, a second end portion, and a floor portion interconnecting said first and second end portions, the first and second end portions thereof being pivotally secured to said first and second support members, respectively, for rotation of said first closure member about a substantially horizontal axis;

said second closure member is characterized further to include a first end portion, a second end portion, and a floor portion interconnecting the first and

second end portions, the first and second end portions thereof being pivotally secured to said first and second support members, respectively, for rotation of said second member about a substantially horizontal axis parallel to the rotational axis of said first closure member; and

said linking means is characterized further to include:

a first link, having a first end and a second end, pivotally secured at the medial portion thereof to said first support member intermediate the pivotal securements of said first and second closure members thereto;

a second link, having a first end and a second end, pivotally secured at the first end thereof to the first end of said first link and pivotally secured at the second end thereof to the first end portion of said first closure member; and

a third link, having a first end and a second end, pivotally secured at the first end thereof to the second end of said first link and pivotally secured at the second end thereof to the first end portion of said second closure member.

6. A bottom-dumping semi-trailer as defined in the claim **5** wherein said linking means is characterized further to include:

a fourth link, having a first end and a second end, pivotally secured at the medial portion thereof to said second support member intermediate the pivotal securements of said first and second closure members thereto;

a fifth link, having a first end and a second end, pivotally secured at the first end thereof to the first end of said fourth link, and pivotally secured at the second end thereof to the second end portion of said first closure member; and

a sixth link, having a first end and a second end, pivotally secured at the first end thereof to the second end of the said fourth link, and pivotally secured at the second end thereof to the second end portion of said second closure member.

7. A bottom-dumping semi-trailer as defined in claim **6** wherein said actuating means is characterized further to include:

a first extensible power cylinder having opposite end portions, said first power cylinder having one end portion thereof pivotally secured to said first closure member and having the opposite end portion thereof pivotally secured to said second closure member.

8. A bottom-dumping semi-trailer as defined in claim **7** wherein said actuating means is characterized further to include:

a second extensible power cylinder having opposite end portions, said second power cylinder having one end portion thereof pivotally secured to said first closure member and having the opposite end portion thereof pivotally secured to said second closure member;

said first extensible power cylinder being disposed proximate to said first support member; and

said second extensible power cylinder being disposed proximate to said second support member.

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