

Oct. 5, 1965

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3,209,928

BULK MATERIAL HANDLING DEVICES

Filed Oct. 23, 1963

3 Sheets-Sheet 1

FIG. 1

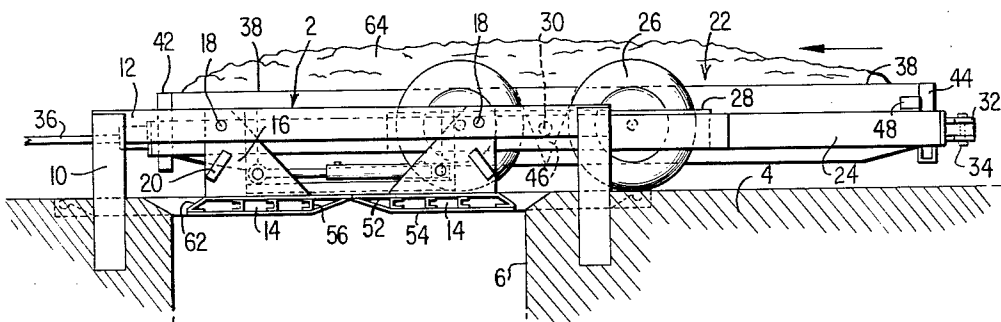


FIG. 2

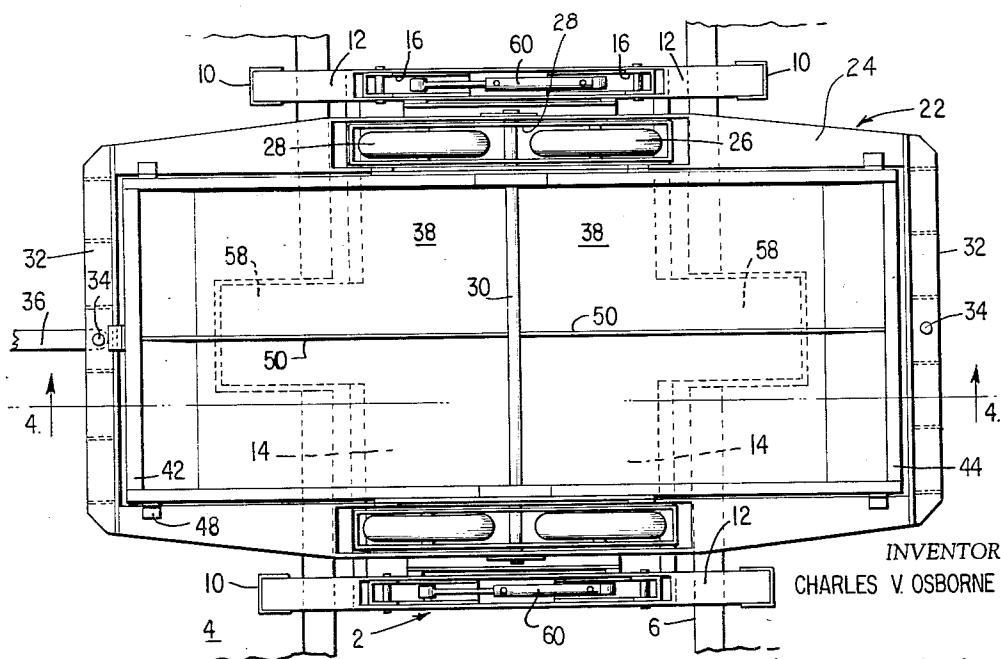
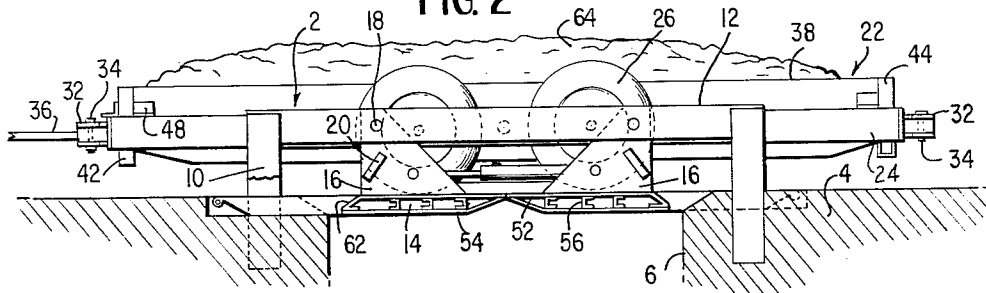


FIG. 3

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FIG. 4

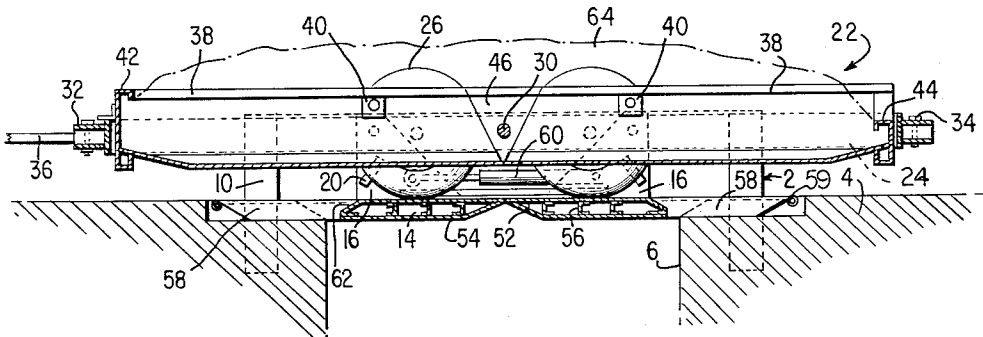


FIG.5

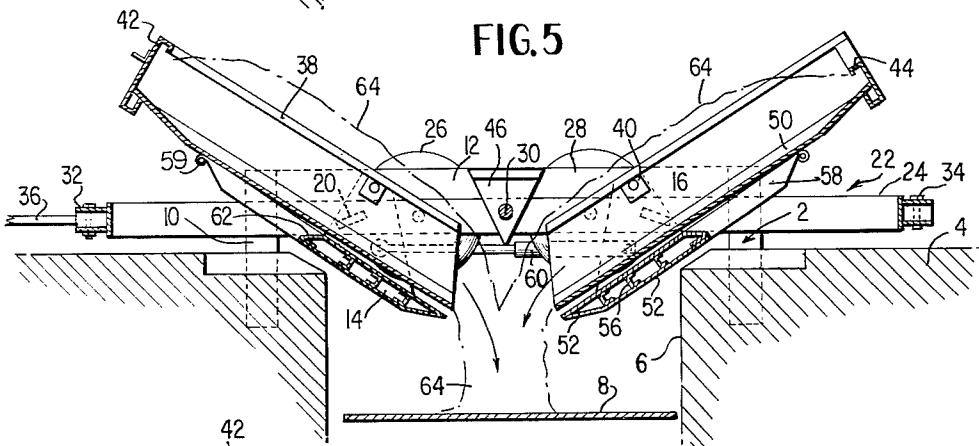
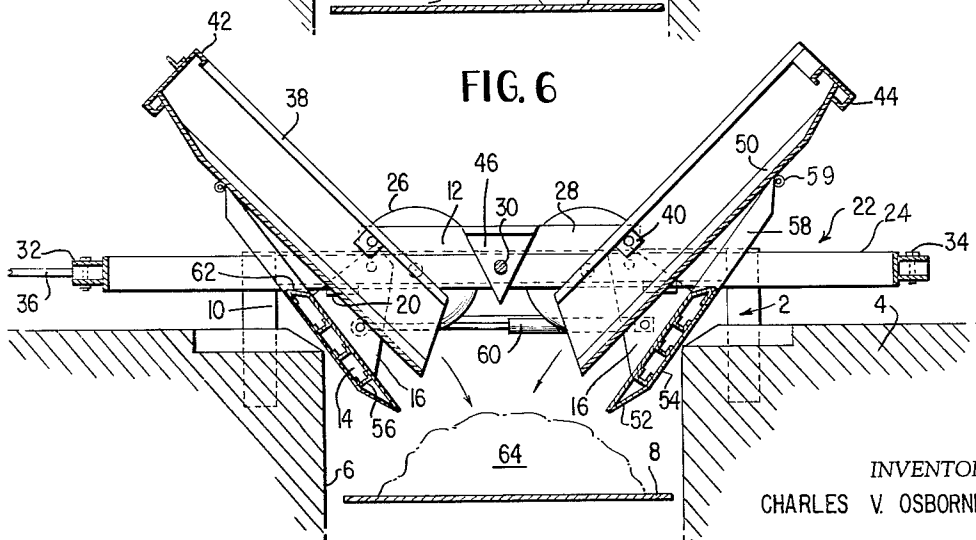


FIG. 6



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FIG. 7

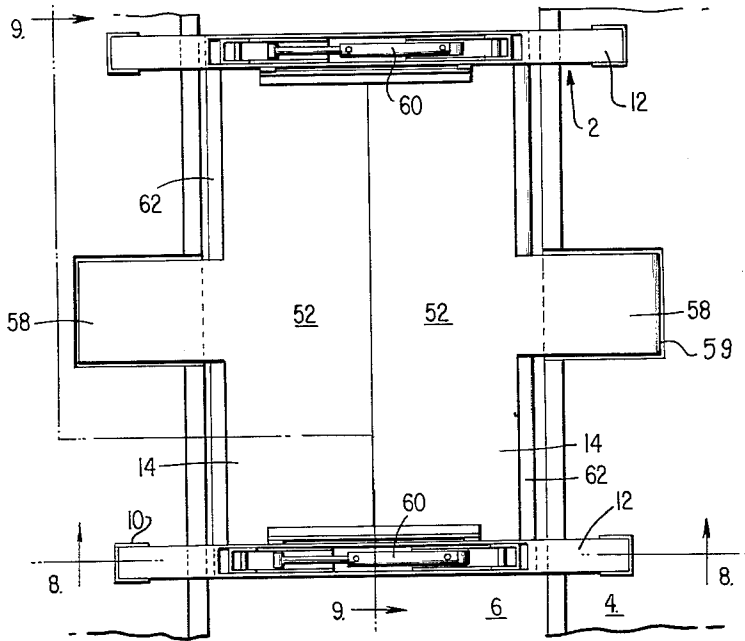


FIG. 8

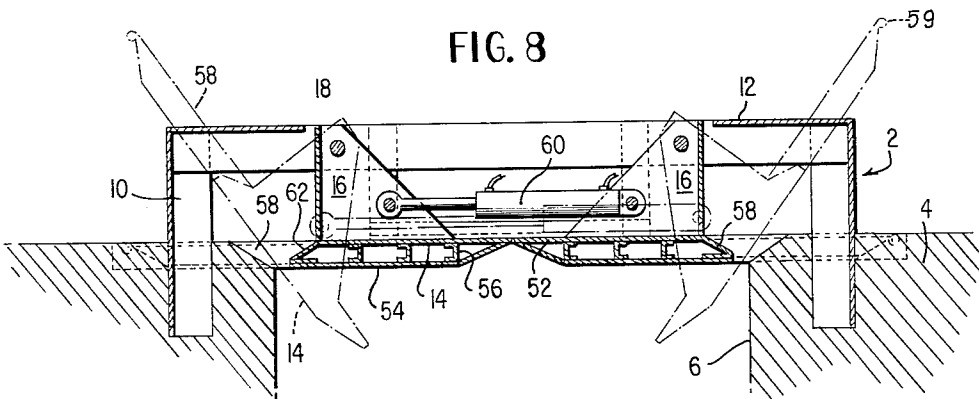
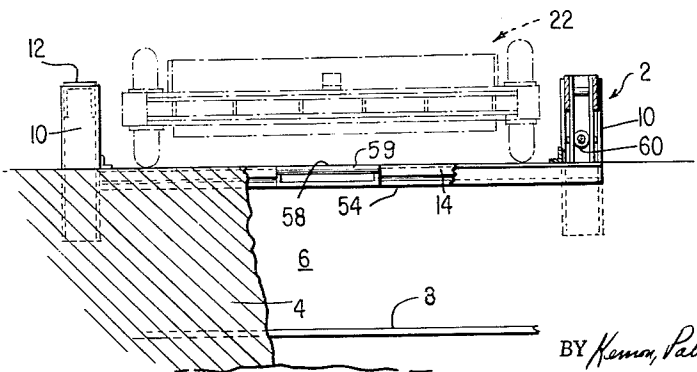


FIG. 9



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3,209,928
BULK MATERIAL HANDLING DEVICES
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Filed Oct. 23, 1963, Ser. No. 318,424
12 Claims. (Cl. 214-64)

This invention relates generally to improvements in bulk material handling equipment and more particularly to cars for transporting and dumping bulk material such as coal, ore, rock and the like and to devices for dumping the cars.

In contemporary coal mining and similar operations, the mined material is generally transported from the mine face through mine tunnels to conveyors, hoists, rail heads and the like in rubber tired car trains. It has heretofore been common practice to dump these cars at their terminal points by positioning them on a hydraulic tiltable platform and rotating them about their transverse axis to accomplish the discharge of the material therefrom. This method of dumping the cars incurs some rather serious disabilities in mining operations. First of all, the car must be disconnected from the train to accomplish the tilt-type dump operation. Individual coupling and uncoupling of each car in succession entails a delay in the dumping operation tying up equipment and requires additional labor on the part of the mine crew. A second disadvantage of this type of dumping scheme stems from the fact that at a mine tunnel dump point, overhead space is at a premium and elevating or rotating the car about its transverse axis requires overhead of the order of the mine car length. This requires either the removal of sufficient overhead at the dumping point to accommodate the car or the disposition of the dumping point outside the mine or at a point naturally suited for such an operation. This latter consideration generally imposes a longer run for the mine cars than would otherwise be necessary.

The above described type of dumping operation further requires a large amount of power to accomplish dumping. Where the car is rotated about a transverse axis proximate an end of the car, as is generally the case in present day practice, the actuating means for the tilting platform must have the capacity to lift not only the weight of the mine car, but the entire weight of the load.

It is, therefore, an object of this invention to provide a material hauling dump car and dumping apparatus which avoids the above-stated disadvantages.

It is a further object of this invention to provide a unique center dump material hauling car which requires a minimum amount of overhead for the dumping operation.

It is still another object of this invention to provide a material hauling dump car and dump apparatus for a dump car train, the contents of the car being dumpable without disconnection of the car from the train.

It is yet another object of this invention to provide a material hauling dump car and dump apparatus in which a minimum amount of power is required to effect the dumping operation.

These and other objects of the invention will be clearly understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like reference numbers indicate like parts throughout the figures thereof and wherein:

FIG. 1 is a side elevational view of a device embodying the features of the invention showing a loaded dump car partially in position on the dumping apparatus.

FIG. 2 is a side elevational view showing the dump car in position for dumping on the dumping apparatus.

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FIG. 3 is a top plan view of the dumping apparatus of FIG. 2 with the load removed.

FIG. 4 is a sectional view taken along the lines 4-4 of FIG. 3.

FIG. 5 is a sectional view similar to that of FIG. 4, showing the dumping apparatus and car in an intermediate position during the dumping operation.

FIG. 6 is a section view similar to FIG. 4 showing the dumping apparatus and the car in a full dumping position during the dumping operation.

FIG. 7 is a top plan view of the dumping apparatus.

FIG. 8 is a side elevational enlarged view in section taken along the lines 8-8 of FIG. 7.

FIG. 9 is a front elevational view of the dumping device partly in section and taken along the lines 9-9 of FIG. 7.

In general the invention provides a center dump mine car composed of a rigid box frame mounted on rubber tired wheels. The frame carries two pivotally mounted buckets which cooperate to form the material carrying member of the device when they are positioned in abutting aligned relationship with one another. The invention further provides, at the dump site, a unique dumping mechanism consisting, in essence, of a floor made up of a pair of pivotal doors, the doors pivoting in a manner similar to the pivoting action of the buckets of the car. The wheels of the car may be further disposed in such a manner as to bias the pivotal doors to their open position when the car is located on the doors. The doors further carry projecting arms which engage the bottom of the buckets as the floor is pivoted downwardly. By the pivoting motion of the doors, the arms pivot the buckets to dump the load through the open doors. This particular disposition of the pivot points and the wheels of the car provides a dumping mechanism for the car which requires very little, if any, power to operate. The dumping mechanism is provided, in one embodiment, with hydraulic actuators to control the operation of the pivotal floor members and to raise the floor to the initial condition once the dumping operation is completed.

Referring now to FIG. 1 particularly, a dumping device, shown generally at 2, is mounted in a mine floor 4 over a pit 6. A conveyor belt 8 (FIGS. 5, 6, and 9), or any other suitable conveyance such as railroad cars, trucks or the like, operates in the pit to transport dumped material to an intermediate or final destination. The dumping device 2 is mounted on upstanding legs 10 connected to the mine floor 4. The legs 10 support cross beams 12 across the pit at either side of the device. The legs and cross beam provide a bridge-like support for the dumping mechanism over pit 6. The members of this support may be fabricated from any suitable structural material. The drawing illustrates, as an example, welded steel U-shaped channels. Connection of supporting legs to the mine floor or ground surface may be accomplished by means other than that specifically illustrated such, for example, as bolted connections to concrete footings or the like.

Doors 14 are pivotally connected to the beams 12 through arms 16. The arms are, in turn, connected to the beam through pivots 18. The arms 16 may be further provided with stops 20 mounted on a side thereof to limit the maximum opening of the doors 14 by contact with the beam 12 (FIG. 6).

The doors 14 are formed to effectively bridge, in their horizontal closed position, the pit 6 and to support a dump car shown generally at 22 thereover. The dump car consists of a box frame 24 mounted, through any conventional suspension system to tandem wheels 26.

The drawings show, as an example, a suspension system including rectangular supporting frames 28 mounted within the side members of box frame 24 through torsion bar 30. The suspension system is described in more detail in applicant's United States Patent No. 2,978,252.

Although the preferred embodiment of the dump vehicle, as shown, incorporates a tandem wheel arrangement, a single wheel on each side of the vehicle would be adequate if desired.

The box frame 24 is provided at either end with bumper members 32. The bumper members are provided, at their mid-portion, with connecting pins 34 which serve to afford a pivotal connection through coupling link 36 to a mine tractor (not shown), preceding or succeeding dump cars or the like.

Referring now specifically to FIGS. 4 through 6, the material carrying container consists of a pair of oppositely disposed buckets 38 hingedly mounted on the box frame 24 at the pivots 40. The pivots are preferably spaced apart, longitudinally, a distance equal to the spacing of the door pivots 18 for purposes to be described below. Although the pivots may be disposed longitudinally on the buckets at any desired point, they are preferably located toward the longitudinal center of the car from the center of gravity of the individual buckets. This disposition of the pivots biases the buckets in a closed condition whether loaded or unloaded.

Although the buckets may be identical in configuration, they may also be provided with different end plates 42 and 44 as shown. The end plate 42 is equal to the height of the side walls of the buckets while the end plate 44 is approximately one-half the height of the bucket side walls. This provides a partially open end in the car to allow loading where minimal tunnel height exists at the loading point.

Wedge shaped plates 46, defining a portion of the wall of the container formed by buckets 38 are fixed to either side of the members of the box frame 24. The innermost ends of buckets 38 have a tapered cut-out along the side walls thereof to mate with plates 46 to form a closed rectangular container when they are in a horizontal position. The purpose of this configuration is to accommodate the torsion bar 30 in a non-moving section of the container and to provide clearance for the end faces of buckets 38 during the opening and closing thereof. Obviously other structural configurations of these walls would also be suitable to accomplish the above objectives.

Projecting ears 48 (FIG. 1 through 3) may be provided on the sides of the outer ends of the buckets 38 as shown. These ears afford a stop and support point for the buckets 38 in a closed condition and operate, in conjunction with the mating of the inner ends of the buckets 38, to support a load 64 carried in the buckets. This latter objective, of course, can be achieved through direct contact of the buckets with the frame 24 or by other suitable means.

The form and fabrication of the structural members of the device, as so far described, may incorporate any suitable structural material or structural shape. In the embodiment shown in the figures it is contemplated that common low carbon steel be used. The frame member 24 is fabricated from steel channels while the bumper member 32, wheel supporting frames 28 and like structural members may be fabricated from sheet or plate steel. The buckets 38 are preferably fabricated from sheet steel and formed by die pressing. In the preferred embodiment shown, each bucket 38 is composed of two longitudinal die formed sections welded together at centrally disposed flanges to form an upstanding reinforcing rib 50 along the center line of the car. This method of fabrication provides a bucket structure which can be formed on a smaller press than that which would be required for the formation of the entire bucket member. A convenient point for joining of the component parts

as well as a structural stiffening rib for better support of the loads carried down the center of each bucket member is also provided by this mode of fabrication. Joining of the various components of the device may be accomplished by any method normally used in the fabrication of similar structures. Although welding of preformed submembers is a preferable mode of joining the components, obviously bolting, riveting or like methods of connection may be used without altering the practice of the invention.

Referring now specifically to FIGURES 7 through 9, the load dumping mechanism of the invention is shown in detail. The doors 14, in the illustrated embodiment, are built up from a floor plate 52, a backup plate 54 and transverse channel members 56. In plan view, as shown in FIG. 7, the floor plate 52 is T-shaped having a member 58 projecting longitudinally therefrom. The member 58 is smaller in width than the inside width of the box frame 24 of car 22 (FIG. 3) and serves a purpose which will be indicated in the description of the operation of the device. The projecting member 58 is provided with a rolled edge 59 along the transverse end thereof. The structural composition of the member 58 may be similar to that of the doors 14 with extensions of the floor plate 52 and the back-up plate 54 forming the upper and lower surfaces thereof, the floor plate 52 being deformed to provide the side members of the projecting portion.

A hydraulic actuator 60, suitably connected to a control and source of hydraulic pressure (not shown), is connected between the arms 16 of the doors. The actuator is located to place the doors in a closed position when it is in its retracted condition (FIG. 8) and in an open pivoted positions as shown in phantom lines (FIG. 8) in its fully extended condition. Although the preferred embodiment utilizes a hydraulic motor to accomplish the tilting of the door members, the motive source could, of course, be drawn from any suitable actuators, such, for example, as pneumatic motors, individual door actuators, cable connected winches, mechanical jacks or the like. The controls also could be manual or automatic as desired. An automated control could sense the position of the car and actuate the mechanism accordingly.

The doors 14, also, incorporate, at their outermost ends wedge configured end walls 62 which may be formed by suitable bending of the floor plate 52. The configuration of this edge provides smooth entry of the wheels of the dump car 22 onto the door surface regardless of the level of floor 4 as well as other benefits to be described later.

As was set forth above for the construction and structural fabrication of the dump car, the specific structural make up of the dumping mechanism of the invention may take any suitable form. Preferably, as illustrated in the drawings, the structure is made up of plate or sheet steel formed to the proper configuration and fabricated by welding.

In operation, the dumping device is located at the desired unloading station in or near a mine. As before described, the unloading station is located over a drop. A suitable device for transporting the material to a final or intermediate destination operates in this drop. In this embodiment conveyor belt 8 (FIGS. 5, 6, and 9) operates transversely of the unloading station to convey material dumped. An individual mine car or a train of mine cars carrying a load 64 is then towed by suitable means onto the doors 14 until the car is aligned in the position shown in FIG. 2 of the drawings. At this point the load 64 is concentrated on the doors 14 through the wheels 26. In the illustrated configuration the center of loading on the doors is inwardly of door pivots 18. This disposition tends to bias the door 14 open, however, the doors are retained in their closed position by the hydraulic actuators 60.

When it is desired to unload the car 22, the hydraulic

actuators 60 are fully extended by a suitable control mechanism (not shown). Referring to FIG. 5, actuation of the member 60 in conjunction with the action of the load disposed on the doors through wheels 26, pivots doors 14 downwardly and outwardly as shown. The projecting members 58, since they are integral with the doors 14, pivot upwardly and inwardly in conjunction with the downward pivoting of the doors. The upward pivoting of members 58 brings them into contact with the bottom of buckets 38 proximate the outer-most ends thereof and continued pivoting causes pivoting of the buckets themselves as shown with the consequent initiation of discharge of load 64 onto conveyor belt 8. Although the initial pivoting of doors 14 result in a downward drop of car 22, the upward pivoting motion of the outer portion of door 14 ultimately brings the wedge shaped end wall 62 of the door into contact with box frame 24 thereby supporting the car 22 and, as pivoting continues, these edges lift the frame to return it to approximately its initial position (FIG. 6). In the configuration shown, the total drop of the car is intended not to exceed the capability of the couplings to the adjacent cars or the tractor to follow the vertical movement. This eliminates the need to disconnect the cars of the train during the unloading operation.

Referring now to FIG. 6 of the drawings, the dumping device as shown in the fully dumped condition with the hydraulic actuator 60 fully extended and load 64 deposited on belt 8. In this configuration the full dump angle of dump buckets 38 is approximately 45° with the horizontal thereby insuring full discharge of any load, wet or dry, in the buckets. In actuality, a dry load will dump at approximately 30° bucket angle, however, a 45° angle of dump is desirable for speed and for uniformity of dumping regardless of the load condition.

As before stated, the geometry of the embodiment shown in the drawings provides a condition in which the doors 14 could actually be opened without power from the hydraulic system. It has been experimentally determined that the buckets will seek an angle of tilt at about 30° with the horizontal without the use of power in the actuators. The actuator, however, serves to hold the doors closed until dumping is desired and to quickly open the doors to provide a 45° dumping angle for the buckets. This results in an extremely low power requirement for operation of the unloading device. In prior devices where the mine car as a whole is dumped, the hydraulic system has had a power requirement of the order to 20 H.P. It has been determined, with this device, that an equivalent load can be dumped from the mine car in approximately 4 seconds with a 1½ H.P. motor.

After the load is dumped, hydraulic actuators 60 are retracted to a closed condition. The doors are tilted upwardly and inwardly and, repeating the above-described cycle in reverse, bring the buckets 38 back into the closed load carrying position. The empty buckets, because their centers of gravity are disposed outwardly in this embodiment, are biased in the closed-load carrying condition and require no additional loading device to maintain them in that configuration. If the respective centers of gravity of the buckets were located to bias the buckets in the open condition, then, of course, latch means could be provided to retain them in the load carrying configuration. After the device is returned to its initial configuration, the train may be moved to bring the next succeeding car into position for a repeat unloading cycle.

Certain variations may be made in the arrangement of the dump containers without altering the low ceiling dump capability of the vehicle. On such variation could include a vehicle having both dump containers swinging or rotating in the same angular direction by engagement with properly disposed dump doors swinging in the same direction. The preferred embodiment as set forth, however, realizes an additional advantage in that the inwardly

swinging center dump feature reduces the spread of the dumped material.

While a preferred embodiment of the present invention has been herein drawn and described, applicant claims the benefit of a full range of equivalents within the scope of the appended claims.

I claim:

1. In a bulk material-handling system: a load dumping device for center dump tandem wheel vehicles comprising:

- (A) a bridge-like frame to support said device over a dumping area;
- (B) doors hingedly mounted on said frame on transverse spaced axes, said doors being oppositely swingable between closed and dumping positions;
- (C) dump actuating members extending in a coplanar fashion from the hinge axes of said doors, said members being engageable with the load carrying portion of said vehicle when said doors are swung downwardly from the horizontal position;
- (D) and means to actuate said doors to swing between a horizontal position in which they co-operate to support a vehicle by engagement with the wheels thereof and a tilted position in which they co-operate to suspend said vehicle and engage said load carrying portion to dump said load between said doors.

2. A bulk material handling system comprising, in combination:

(A) a bulk material conveying dump vehicle comprising:

- (1) an open box frame having transverse end members connecting a pair of spaced side members, ground engaging tandem wheels disposed transversely within said side members substantially mid-way between said end members;
- (2) a pair of material-carrying buckets tiltably mounted within the area defined by said members, said buckets being oppositely tiltable on transverse spaced axes between a position in which they cooperate to carry a load and a position in which the load is discharged therebetween, said transverse axes being disposed between the mid-portion of said side members and the center of gravity of their respective buckets, said transverse axes further being disposed between the axis of the adjacent of said wheels and the adjacent end of said side members;
- (3) coupling members disposed substantially mid-way between the ends of said end members for coupling said vehicle to succeeding and preceding vehicles;

(B) stationary unloading means separate from but engageable with said buckets on said vehicle comprising:

- (1) a bridge-like frame to support said device over a dumping area;
- (2) doors hingedly mounted on said frame and oppositely swingable on spaced axes between a horizontal position in which they cooperate to support said vehicle over said dump area by engagement with said wheels and a downward tilted position in which they cooperate to dump said vehicle while providing support thereof by engagement with said frame, said axes being spaced apart a distance equal to the distance between the transverse axes of said buckets;
- (3) dump actuating members extending in a coplanar fashion from the hinge axes of said doors, said members being engageable with the buckets of said vehicles when said doors are moved toward said downward tilted position to tilt the buckets of said vehicle;
- (4) vertical arms disposed on either end of said doors;

- (5) hydraulic motors disposed between said arms to actuate said doors between said positions;
 (6) and means to controllably actuate said motors.
3. In a bulk material-handling system; a load dumping device for center dump tilting bucket tandem wheel vehicles comprising:
- (A) a bridge-like frame to support said device over a dumping area;
 - (B) doors hingedly mounted on said frame and oppositely swingable on spaced transverse axes between a horizontal position in which they cooperate to support a vehicle over said dump area and a downward tilted position in which they operate to dump said vehicle, said axes being spaced apart a distance substantially equal to the distance between the tilting axes of said vehicle;
 - (C) dump actuating members extending in a co-planar fashion from the hinge axes of said doors, said members being engageable with the buckets of said vehicles when said doors are moved toward said downward tilted position to tilt the buckets of said vehicle;
 - (D) vertical arms disposed on either end of said doors;
 - (E) hydraulic motors disposed between said arms to actuate said doors between said positions;
 - (F) and means to controllably actuate said motors.
4. An unloading device for vehicles having a pair of dump buckets rotatably mounted intermediate the side frame members thereof comprising:
- (A) a bridge-like framework to support said device over a dumping area;
 - (B) door members forming a load carrying door and rotatably mounted in said framework on transverse spaced axes, said doors being swingable between a closed vehicle supporting position and an open material receiving position, said door members including an end actuating portion adapted to engage and dump each of said dump buckets.
5. An unloading device in accordance with claim 4 wherein means are provided to rotate said door members to define a material receiving opening.
6. An unloading device in accordance with claim 4 wherein the door members are pivotally mounted to rotate in opposite directions to define a single material receiving opening therebetween.
7. An unloading device in accordance with claim 4 wherein said door members further include a portion configured to engage and support the frame of said vehicle during the unloading operation.
8. A material unloading device in accordance with claim 6 including power means disposed to actuate door members between a closed position and an open position and means to selectively actuate said power means.
9. An unloading device in accordance with claim 4 wherein the transverse axis of said door members are disposed between the center of gravity and the end portion which is disposed opposite to said end actuating portion.
10. In a bulk material-handling system, a load dumping device for center dump vehicles comprising:
- (A) a bridge-like frame to support said device over a dumping area;
 - (B) doors hingedly mounted on said frame on transverse spaced axes, said doors being oppositely swingable between closed and dumping positions;
 - (C) dump actuating members extending in a co-planar fashion from the hinge axes of said doors, said members being engageable with the load carrying portion of said vehicle when said doors are swung downwardly from the horizontal position;
 - (D) and means to actuate said doors to swing between a horizontal position in which they co-operate to support a dump vehicle by engagement with the wheels thereof and a tilted position in which they

cooperate to suspend the framework of said car and to engage said load carrying portion to dump said load between said doors.

11. A bulk material handling system comprising, in combination:

(A) a bulk material conveying dump vehicle comprising:

- (1) an open frame having transverse end members connecting a pair of spaced side members, ground engaging wheels disposed transversely within said side members substantially mid-way between said end members;
- (2) a pair of material-carrying buckets tiltably mounted within the area defined by said members, said buckets being oppositely tiltable on transverse spaced axes between a position in which they co-operate to carry a load and a position in which the load is discharged therebetween, said transverse axes being disposed between the mid-portion of said side members and the center of gravity of their respective buckets, said transverse axes further being disposed between the axis of the adjacent wheel and the adjacent end of said side members;
- (3) coupling members disposed on said end members for coupling said vehicle to succeeding and preceding vehicles;

(B) stationary unloading means separate from but engageable with said buckets on said vehicle comprising:

- (1) a bridge-like frame to support said device over a dumping area;
- (2) doors hingedly mounted on said frame and oppositely swingable on spaced axes between a horizontal position in which they co-operate to support said vehicles over said dump area by engagement with said wheels and a downward tilted position in which they co-operate to dump said vehicle while providing support thereof by engagement with said frame, said axes being spaced apart a distance substantially equal to the distance between the transverse axes of said buckets;
- (3) dump actuating members extending in a co-planar fashion from the hinge axes of said doors, said members being engageable with the buckets of said vehicles when said doors are moved toward said downward tilted position to tilt the buckets of said vehicle;
- (4) vertical arms disposed on either end of said doors;
- (5) actuating means disposed between said arms to actuate said doors between said positions;
- (6) and means to controllably actuate said actuating means.

12. A bulk material handling system including a conveying dump vehicle comprising:

- (1) an open box frame having a pair of spaced side members, ground engaging wheels disposed on said frame;
- (2) a pair of material-carrying buckets tiltably mounted between said members, said buckets being oppositely tiltable on parallel spaced transverse axes between a position in which they cooperate to carry a load and a tilted load discharging position;

and stationary unloading means comprising:

- (1) a bridge-like framework to support said vehicle over a dumping area;
- (2) door members forming a load carrying door and rotatably mounted in said framework on transverse spaced axes, said doors supporting said vehicle in a closed position and being swingable to an open material receiving position, said door members including an end actuating portion adapted to engage

and dump each of said buckets when swung to said open material receiving position.

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