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(54) **Self-unloading train for bulk commodities.**

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Description

This invention relates to a train for the transportation of bulk commodities, which train has onboard facilities for the unloading of the bulk commodities; and to a method for rail transport of bulk commodities and the unloading of such commodities from the rail transport.

Rail transportation is generally recognized as being more economical than truck transportaton for bulk commodities such as aggregates. Large quantities of such commodities can be moved by a small crew at low cost. However, rail transportaton frequently loses out in competitive situations because of the cost of unloading, stock piling, and delivering the commodity to the ultimate destination.

Even though large quantities of bulk material can be transported at low cost from one terminal to another, the burden is placed on the unloading facility to maintain the economics of this method of transportation to the purchaser of the commodity. If the unloading is slow, and the train is therefore delayed for a substantial peroid of time for the unloading to be accomplished, there is an added investment cost per ton handled for the use of the railroad equipment. One problem, in this regard, is that rail transportation is a 24-hour operation while many of the industries it serves operate only during daylight hours. Often a train makes good speed from origin to destination, only to be delayed several hours waiting to be unloaded. Each hour of delay adds to the transportation cost as much as an additional 25 to 50 miles (40.2 to 80.4 km) of haul.

As an example of the efficiency of rail transport for bulk commodities, a train with a two-man crew pulling 1600 net tons (1451.5 M.T.) at 55 miles per hour (88.5 km per hour) would be producing 32 times as many ton-miles per hour (M.T.-km. per hour) as a dump truck driver hauling 25 tons (22.7 M.T.) at 55 miles per hour (88.5 km. per hour).

Another problem effecting the efficiency of rail transportation for bulk commodities is that, under current methods, the quick unloading of a commodity train requires high capacity equipment and facilities which are idle most of the time. Such high capacity equipment and facilities are expensive, and add sigificantly to the investment cost per ton handled.

The following are some of the methods which are currently used for the unloading of bulk materials from trains.

Bottom dumping hopper cars are equipped with automatic doors that are opened automatically as the cars move over a pit, where the pit facility includes a feeder and a conveyor. Either a pit or an elevated tresle is required for this method, so that this method is ruled out at many locations. Obviously the providing of a pit or trestle facilitity with associated conveyor systems is expensive.

Another method involves the use of rotary car dumpers; and these are commonly used for unloading coal at electric generating plants. Again, the equipment for unloading the cars is highly specialized and expensive.

Side dumping cars have been used for many years, but cannot be dumped on level ground. They require elevated track on a built up embankment for example, so that the dumped material will flow over the side of the embankment and not flow back over the track.

Finally, backhoes or other unloading equipment are used to unload standard gondola cars. These methods are generally slow, promoting the delay problems mentioned above.

To take maximum advantage of the efficiencies of rail transportation, a special type of train is needed to deliver bulk commodities on any track, at any time of the day or night, with no labor required other than the train crew. Such a train would make optimum use of labor while providing incentive wages for the crew, and thereby reduce overall labor costs.

A self-unloading train which overcomes many of the above discussed disadvantages of rail transportation for bulk materials may be a "unit train" consisting of a plurality of hopper cars and a trailer car, the unit train to be pulled by a conventional locomotive.

Each of the hopper cars may include several hoppers having bottom discharge openings and associated gates for discharging onto an endless belt conveyor which runs the entire length of the train. The trailer car includes a transfer conveyor which receives the material from the train conveyor, and is movable on the trailer car to transfer the material to a selected point relative to the train.

With the unit train moving along a straight section of track, the material may be deposited in a windrow alongside the track by the transfer conveyor. Alternatively, the unit train may be unloaded while stationary, with the transfer conveyor dicharging onto a portable stacking conveyor, for example, which will enable the deposit of the material in piles thirty feet (9 meters) high at least forty feet (12 meters) away from the track for example.

DE—A—2447635 discloses a self-unloading train for the transportation of bulk materials comprising:

a plurality of hopper cars coupled together, each hopper car including at least one hopper having an elongated bottom discharge opening with width at least half the distance between the hopper car wheels;

a train conveyor comprising an endless belt underlying said hopper discharge openings to receive material discharged therefrom, running the length of said plurality of hopper cars;

each of said hoppers having gate means for its discharge opening; said gate means being operable selectively to discharge material from said hoppers onto said train conveyor. The hopper walls are inclined at shallow angles. The hopper cars have bottoms on top of which is mounted the train conveyor, which includes

bottom rollers for supporting the return run, which rollers extend transversely under the full width of the return run. The self-unloading train of the present invention is characterized in that all the walls of the hopper are inclined at least 65° from the horizontal; each of the cars has a centre sill; the return run of said belt is supported by split return idlers disposed adjacent the lateral sides of said centre sills; and the supply run of said belt is supported by catenary troughing rollers disposed immediately above said return run.

Embodiments of the invention may achieve one or more of the following:

to provide improved equipment and methods for the rail transport and unloading of bulk materials;

to provide such improved equipment and methods whereby the unloading may be accomplished by the train crew at any time of the day or night, thereby eliminating idle time of the train equipment while waiting for the opening of an unloading facility or while waiting for the arrival of material receiving equipment or vehicles;

to provide such equipment and methods wherein the unloading does not require highly specialized and expensive unloading facilities or equipment;

to provide such apparatus and methods wherein the unloading of the train may be accomplished efficiently in a very short time;

to provide such equipment and methods to minimize the expense of unloading bulk material from a transport train;

to provide such equipment and methods wherein the equipment includes self-unloading apparatus;

to provide such equipment and methods wherein the equipment is a unit train having a train length conveyor;

to provide such equipment and methods which take advantage of the efficiency of rail transportation by eliminating the need for a specialized unloading facility.

The invention also provides a method for transporting bulk material by rail and unloading same which includes the step of loading the material into a plurality of hoppers of a plurality of hopper cars coupled together to form a train;

each of the hoppers having an elongated bottom discharge opening with a width at least half the distance between the wheels of said hopper cars;

discharging said material from said hoppers onto an endless belt train conveyor which underlies said hoppers and runs the length of said train;

conveying said material on said conveyor to one end of said train, for discharge of said material, from said train;

wherein all the walls of each hopper are inclined at least 65° from the horizontal; each of the cars has a centre sill; the return run of said belt is supported by split return idlers disposed adjacent the lateral sides of said centre sills; the supply run of said conveyor is supported by catenary troughing idlers disposed immediately above said return run.

Preferably each gate has a long dimension parallel to the train conveyor of at least 80% of the longitudinal top dimension of the associated hopper.

The novel features and the advantages of the invention, as well as additional objects thereof, will be understood more fully from the following description when read in connection with the accompanying drawings, in which

Figure 1 is a diagrammatic perspective view of a self-unloading train embodying the invention, including hopper cars and a trailer car;

Figure 2 is a diagrammatic cross-sectional view of a typical hopper car;

Figure 3 is a diagrammatic side elevation view of the trailer car illustrated in Figure 1;

Figure 4 is a diagrammatic end view of the trailer car and associated transfer conveyor illustrated in Figures 1 and 3, with portions of the trailer car structure omitted, and illustrating one unloading method; and

Figure 5 is a diagrammatic side elevation view of a portable stacking conveyor used in association with the transfer conveyor of the trailer car, and illustrating another unloading method.

Figure 1 of the drawing is a diagrammatic perspective view illustrating the rear end of a self-unloading train according to the invention, illustrating three hopper cars 11, 12 and 13, and a trailer car 15 which, in the illustrated embodiment, is the last or rearmost car of the train.

The train, according to the invention, may be constructed as a "unit train", in the sense that the cars of the train are permanently coupled together, and would not be uncoupled unless it is necessary to remove one of the cars to a service facility. A self-unloading train according to the invention is particularly suitable for the transport of aggregates. By way of example, a train according to the invention may include ten hopper cars, each hopper having a net capacity of eighty tons (72.6 M.T.) of aggregate, and an associated trailer car. Such train, then, would have the capacity to haul eight hundred tons (726 M.T.) of aggregate; and such train would be pulled by one conventional locomotive.

Further by way of example, each hopper car may include three separate hoppers, each having a bottom discharge opening and an associated discharge gate.

The hopper cars are designed to support an endless belt train conveyor, which traverses the length of the train including the hopper cars and a portion of the trailer car; and this train conveyor underlies the discharge gates of the several hoppers.

Figure 2 is a diagrammatic cross-sectional view of a typical hopper car 11, the section being taken through one of the hoppers 21 of the hopper car. As seen in Figure 2, the hopper car 11 is of conventional construction including a main frame consisting of a center sill 22 and side beam members 23, which would be supported on trucks

24 in a conventional manner. While this particular form of basic rail car structure is illustrated, it will be understood that the hopper car may be constructed using other known techniques where the center sill is eliminated.

The hopper body 21 may be rectangular as viewed from the top, including planar side walls 26 and corresponding planar end walls. As seen in Figures 2 and 3, the hopper walls are inclined at least 65° and preferably at least 70° from the horizontal to assure the complete discharge of the aggregate or other material from the hopper. The hopper is supported by means of longitudinal channel stringers 27 supported at the outer ends of the side beams 23, in turn supporting vertical posts 28 which bear on angle brackets 29 suitably secured to the side walls 26 of the hopper.

The bottom discharge opening 31 of the hopper then is quite wide and quite long, the width being at least 50% of the distance between the hopper car wheels as illustrated in Figure 2, and the length being at least 80% of the longitudinal top dimension of the hopper as illustrated in Figure 3. The discharge opening is closed by a suitable clam shell gate 32 consisting of a pair of coacting members which are movable toward and away from each other in a direction transverse to the longitudinal axis of the hopper car. The hopper 21 is supported sufficiently high relative to the hopper car frame to allow for the support of the endless belt conveyor 40 as will now be described. The conveyor belt has a width substantially greater than that of the hopper discharge openings 31 about 33% greater for example, as illustrated in Figure 2. The supply belt 41, which is the upper run of the endless belt conveyor 40 is supported in the form of a trough by troughing idlers 42, which may be catenary troughing rollers. This trough of course confronts the discharge openings 31 of the several hoppers. The return belt 43, which is the return portion of the endless belt conveyor 40, is supported immediately under the supply belt in a flat condition by return idlers 44. As seen in Figure 2, the return idlers are split idlers mounted on either side of the car center sill 22 to support the return run 43 as close as possible to the upper surface of the center sill. The troughing idlers 42 are necessarily supported in catenary fashion to enable positioning of the supply run 41 as close as possible to the center sill. With this belt support arrangement, the entire hopper car structure will have the lowest possible centre of gravity.

The clam shell gates 32 are preferably operated between the closed and opened positions by power means such as hydraulic cylinders (not shown) which may be operated under the control of suitable control valves to be described subsequently.

As mentioned, the train conveyor 40 traverses the entire length of the hopper car portion of the unit train and a portion of the length of the trailer car 15 as best seen in Figure 3. The adjacent cars of the unit train have suitable support structures for supporting the train conveyor over the car couplers.

The trailer car 15 is a multi-purpose car and, as best seen in Figure 3, may consist of a conventional flat-bed car carrying certain structures to be described. The portion of the train conveyor 40 which is carried on the trailer car, is a lift portion 45 which elevates the conveyed material for discharge onto a transfer conveyor 50. This lift portion 45 is supported by a suitable frame structure 46 of the trailer car.

The transfer conveyor 50 is an elongated endless belt conveyor, having a length of about thirty feet (9 meters) for example, which is carried at the rearward end of the trailer car 15. The forward end of the transfer conveyor is mounted on a post 51 underlying the rearward end of the train conveyor 40, with the transfer conveyor being supported to rotate relative to the vertical axis of the post 51 to position its discharge end at any desired point. During transit, the transfer conveyor is carried as illustrated in Figure 3 in longitudinal alignment with the trailer car. The transfer conveyor is also pivotable, relative to the post 51, about a horizontal transverse axis, so that the rearward end of the conveyor may be elevated as desired; and this is accomplished by means of a hydraulic lift cylinder 52. The transfer conveyor is preferably provided with hydraulically powered means (not shown) for rotating the conveyor relative to the axis of the post 51. In this manner the discharge end of the transfer conveyor can be positioned where desired, to discharge the material from the train conveyor 40 into other transport vehicles, onto another conveyor, onto piles adjacent to the track or onto the track behind the trailer car.

The trailer car 15 may also carry power generating apparatus for operating the conveyor system described. The train conveyor 40 and the transfer conveyor 50 are preferably driven, by suitable electric motors; and the power for these motors may be generated by a suitable electric generator 55 driven by a suitable internal combustion engine 56 such as a diesel engine. The generator 55 may also provide power for auxiliary apparatus such as portable stacking conveyor to be described.

The clam shell gates 32 for the hoppers will be quite long and heavy, and each gate of a pair of gates would be preferably operated by a pair of double acting hydraulic cylinders. The four cylinders would preferably be controlled simultaneously by a single hydraulic valve which may be a manual valve, or may be a solenoid actuated valve for example. High pressure hydraulic fluid for the operation of these gates 32 would be supplied from the trailer car 15 which would include a suitable electric motor driven hydraulic pump. The electric motor would receive its energy from the above mentioned generator 55. The controls for the hopper gates should be preferably located at the side of the hopper car in order to be conveniently actuated by a crew member. The controls so located would be either manually operable hydraulic valves or electric switch controls for operating the solenoid actuated valves.

Preferably, the hoppers will be emptied in sequence beginning with the hopper nearest the

trailer car. It is desirable that the hopper gates be operated under the manual and visual control of a crew member to assure that one hopper is completely empty before the gates of the succeeding hopper are opened. Where the load is being dumped in a windrow, this operator may also assist in controlling the speed of the train by signalling the locomotive engineer to assure the efficient stacking of the windrow.

The trailer car 15 may also include a suitable control panel or station for the operation and control of the several above described components incuding the generator 55, the generator driving engine 56, the motors for the train conveyor 40 and the transfer conveyor 50, the hydraulic mechanisms for both rotating and changing the height of the transfer conveyor, and possibly the mechanism for controlling the tension on the train conveyor 40.

For the operation of the train conveyor 40, the train must be on a straight section of track, since the conveyor belt cannot accommodate any curves during use. During such use the conveyor must be appropriately tensioned; and this may be accomplished by a suitable hydraulically controlled system which is associated with the lift portion 45 of the conveyor carried on the trailer car 15. This belt tensioning system may be conventional and need not be described further here. During the transit of the train, some slack must be imparted to the train conveyor to allow the belt to flex at the coupling points and enable the train to negotiate curves without damage to the belt. The control for that belt tensioning sytem may also preferably be included in the above mentioned control panel carried on the trailer car.

Figure 4 of the drawing is a diagrammatic end view of the trailer car, omitting certain structures of the trailer car but illustrating the transfer conveyor 50 in position to deposit the bulk material into a windrow alongside the track. The windrow might have a height of ten feet (3 meters) for example and the apex must be sufficiently removed from the track to prevent the material from running onto the track. For this operation, also illustrated in Figure 1, the material may be deposited in the windrow while the train is moving; and therefore the stretch of straight track must be sufficiently long to allow the train to move a sufficient distance to unload the entire load. For this operation, the hopper gates might be operated in sequence starting from the rear of the train to unload the entire train. It is believed that for this operation, the train would have an unloading rate of 1000 tons per hour (907.2 M.T. per hour) so that an entire 800 ton (726 M.T.) train load can be deposited in a windrow alongside the track in approximately forty-five minutes.

Figure 5 of the drawing ilustrates another method for unloading the train of the invention, which may be accomplished while the train is stationary. This method involves the use of a portable stacking conveyor 60 of a type which is commonly in use. This conveyor 60 is an elongated endless belt conveyor having a support frame 61 including support wheels 62 intermediate its ends, and having a receiving box 63 at its receiving end. This conveyor may be powered by a suitable electric motor; and may be connected to the above described generating system of the trailer car 15. Conceivably, such portable stacking conveyor could be carried with the self-unloading train of the invention; but more practically it would be transported to the unloading site by truck for example. Such portable stacking conveyor may be positioned relative to the trailer car to enable the stacking of an entire train load for example into a pile thirty feet (9 meters) high and forty feet (12 meters) away from the track. For a larger train load, adjacent piles may be made by moving the portable stacking conveyor, for example.

What has been described are improved equipment and methods for the transport of bulk materials by rail, and for the rapid and efficient unloading of those bulk materials when the train arrives at its destination. A particular feature and advantage of the invention is that the equipment and method are functionally independent of any particular kind of unloading facility and independent of unloading time. The train can be unloaded by the train crew without the necessity for any unloading facilities or equipment or personnel at the unloading site.

Where aggregates are to be delivered to a highway construction site for example, advantage may be taken of the fact that railroads frequently parallel highways; and the aggregates may be unloaded either on railroad right of way or highway right of way adjacent to the railroad and very close to the point of use of the aggregates. Additionally such aggregates may be delivered to that site weeks or even months ahead of the time that the aggregates will be used by the highway contractor.

A unit train as above described may be relatively small in terms of the number of hopper cars and overall train load; and this may be desirable to enable the train to be pulled by a relatively low powered locomotive. Where a large quantity of aggregates or materials are to be delivered to a particular destination, two or more such unit trains may be coupled together and either pulled by a larger locomotive or by multiple locomotives, one located at the front of the train and one located at the rear.

An important advantage of the invention is that such unit trains may be utilized to their maximum capacity, since there is no need for the train to remain on a siding for several days or longer waiting to be unloaded. An ancillary advantage to the receiver of the materials is that he has much more flexibility in arranging for the transfer of the materials from the rail siding to his storage or use location. He can schedule the use of his equipment much more efficiently, and need not be concerned about the cost of idle hopper cars sitting on a siding.

Another feature and advantage of the invention is that several different kinds or grades of material

can be shipped on the same train. Since the hoppers are unloaded sequentially, a first kind of material may be loaded onto the front portion of the train, a second kind of material may be loaded onto a middle portion of the train, and a third kind of material may be loaded onto the rear portion of the train. If the train is unloaded in a windrow, the three different kinds of materials will be located in identifiable sections of the windrow. If the material is unloaded in piles by a portable stacking conveyor, by moving the conveyor or the train or both, the different kinds of material may be stacked in separate piles.

An important advantage of the invention is that it takes advantage of the efficiencies of rail transportation. It allows for twenty-four hour operation of the rail facilities and equipment while requiring no specialized unloading facility.

An overall feature and advantage of the invention is that it provides for maximum economy in the business of transporting bulk materials since it utilizes the rail transportation to maximum advantage, utilizes the equipment to the fullest extent by eliminating idle time, and utilizes the crew more efficiently.

While the preferred embodiments of the invention have been illustrated and described, it will be understood by those skilled in the art that changes and modificiations may be resorted to without departing from the scope of the invention as defined in the claims.

Claims

1. A self-unloading train for the transportation of bulk materials comprising:

a plurality of hopper cars (11, 12, 13) coupled together, each hopper car (11, 12, 13) including at least one hopper (21) having an elongated bottom discharge opening (31) with a width at least half the distance between the hopper car wheels (24);

a train conveyor (40) comprising an endless belt (41, 43) underlying said hopper discharge openings (31) to receive material discharged therefrom, running the length of said plurality of hopper cars (11, 12, 13);

each of said hoppers (21) having gate means (32) for its discharge opening; said gate means (32) being operable selectively to discharge material from said hoppers (21) onto said train conveyor (40), characterized in that all the walls (26) of the hopper (21) are inclined at least 65° from the horizontal; each of the cars has a centre sill (22); the return run (43) of said belt is supported by split return idlers (44) disposed adjacent the lateral sides of said centre sills (22); and the supply run (41) of said belt is supported by catenary troughing rollers (42) disposed immediately above said return run (43).

2. A self-unloading train as set forth in Claim 1 wherein said gate means (32) comprises clam shell-type gates pivoted about axes parallel to said train conveyor (40); and hydraulic control means for effecting modulated opening of said gates to control the flow of material onto said train conveyor (40).

3. A self-unloading train as set forth in Claim 2 wherein each of said clam shell-type gates (32) has a long dimension parallel to said conveyor (40) of at least 80% of the longitudinal top dimension of its respective hopper (21).

4. A self-unloading train as set forth in any preceding claim wherein said train includes a trailer car (15); said train conveyor (40) extending to said trailer car (15), and said trailer car (15) supporting a lift portion (45) of said train conveyor at its discharge end sufficiently high to discharge said material to a transfer conveyor (50).

5. A self-unloading train as set forth in Claim 4 wherein a prime mover (56) is mounted on said trailer car (15) providing power for hydraulic and electric systems for operating said train conveyor (40) and said gate means (32).

6. A self-unloading train as set forth in Claim 4 or Claim 5 wherein a transfer conveyor (50) is mounted on said trailer car (15) for receiving material from said train conveyor (40) and for discharging said material at selected points surrounding said trailer car (15).

7. A method for transporting bulk material by rail and unloading same which includes the step of loading the material into a plurality of hoppers (21) of a plurality of hopper cars (11, 12, 13) coupled together to form a train;

each of the hoppers having an elongated bottom discharge opening (31) with a width at least half the distance between the wheels (24) of said hopper cars (11, 12, 13);

discharging said material from said hoppers (21) onto an endless belt train conveyor (40) which underlies said hoppers (21) and runs the length of said train;

conveying said material on said conveyor (40) to one end of said train, for discharge of said material from said train;

characterized in that all the walls (26) of each hopper (21) are inclined at least 65° from the horizontal; each of the cars (11, 12, 13) has a centre sill (22); the return run (43) of said belt is supported by split return idlers (44) disposed adjacent the lateral sides of said centre sills (22); the supply run (41) of said conveyor (40) is supported by catenary troughing idlers (42) disposed immediately above said return run (43).

8. A method according to Claim 7 wherein said material is conveyed on said train conveyor (40) to an end car (15) coupled to said plurality of hopper cars (11, 12, 13); elevated at said end car by means of a lift portion (45) of said conveyor (40) mounted thereon; discharged from said conveyor (40) to a transfer conveyor (50) mounted on said end car (15); and discharged from said transfer conveyor (50) to selected points surrounding said end car (15).

9. A method as set forth in Claim 7 or Claim 8 wherein the flow of said material from said hoppers (21) is controlled by means of clam

shell-type gates (32) pivoted about axes parallel to said train conveyor (40); and the opening of said gates (32) is controlled by hydraulic means for modulating the flow of material onto said train conveyor (40).

10. A method according to any one of Claims 7 to 9 wherein said hopper discharge openings (31) and said clam shell-type gates (32) are formed to have a long dimension parallel to said conveyor (40) of at least 80% of the longitudinal top dimension of the hopper (21).

Patentansprüche

1. Selbstentladerzug für den Transport von Schüttgut, umfassend:

eine Vielzahl von aneinandergekoppelten Trichterwagen (11, 12, 13), von denen jeder wenigstens einer Trichter (21) einschließt, der eine langgestreckte Bodenentladeöffnung (31) mit einer Breite von wenigstens der Hälfte des Abstandes zwischen den Trichterwagenrädern (24) aufweist;

einen Zugförderer (40) umfassend ein Endlosförderband (41, 43), das unter den genannten Tricherentladeöffnungen (31) liegt, um Material aus diesen aufzunehmen, und sich über die Länge der genannten Vielzahl von Trichterwagen (11, 12, 13) erstreckt;

wobei jeder der genannten Trichter (21) mit einer Schleuseneinrichtung (32) für seine Entladeöffnung versehen ist; die genannte Schleuseneinrichtung (32) selektiv betätigbar ist, um Material aus den genannten Trichtern (21) auf den genannten Zugförderer (40) zu entladen, dadurch gekennzeichnet, daß alle Wände (26) des Trichters (21) um wenigstens 65° zur Horizontalen geneigt sind; daß jeder der Wagen eine Mittelschwelle (22) aufweist; daß der Rücklauf (43) des genannten Förderbandes von geteilten Rücklaufspannrollen (44) abgetützt ist, die an den seitlichen Seiten der genannten Mittelschwellen (22) angeordnet sind; und daß der Zufuhrlauf (41) des genannten Förderbandes von Rollen (42) mit einer seil- bzw. kettenlinienförmigen Muldung abgestützt ist, die unmittelbar oberhalb des genannten Rücklaufs (43) angeordnet sind.

2. Selbstentladerzug nach Anspruch 1, worin die genannte Schleuseneinrichtung (32) Zweischalenschleusen, die um Achsen parallel zum genannten Zugförderer (40) verschwenkbar sind; und hydraulische Steuereinrichtungen für die Durchführung der modulierten Öffnung der genannten Schleusen für die Steuerung des Materialflusses auf den genannten Zugförderer (40) umfaßt.

3. Selbstentladerzug nach Anspruch 2, worin jede der genannten Zweischalenschleusen (32) eine lange Dimension parallel zum genannten Förderer (40) von wenigstens 80% der oberen Längsdimension seines jeweiligen Trichters (21) aufweist.

4. Selbstentladerzug nach einem der vorhergehenden Ansprüche, worin der genannte Zug einen Beiwagen bzw. Anhänger (15) aufweist; sich der genannte Zugförderer (40) bis zum genannten Anhänger (15) erstreckt und der genannte Anhänger (15) einen Hebeabschnitt (45) des genannten Zugförderers an seinem Entladeende trägt bzw. abstützt, der hoch genug angeordnet ist, um das genannte Material auf einen Transfer- bzw. Überlade-Förderer (50) zu übertragen.

5. Selbstentladerzug nach Anspruch 4, worin eine Kraftmaschine (56) auf dem genannten Anhänger (15) montiert ist und Antriebskraft für hydraulische und elektrische System für die Betätigung des genannten Zugförderers (40) und der genannten Schleuseneinrichtung (32) erzeugt.

6. Selbstentladerzug nach Anspruch 4 oder 5, worin ein Transfer- bzw. Überlade-Förderer (50) auf dem genannten Anhänger (15) montiert ist, um Material vom genannten Zugförderer (40) aufzunehmen und das genannte Material an ausgewählten Punkten in der Umgebung des Anhängers (15) zu entladen.

7. Verfahren zum Eisenbahntransport von Schüttgut und Entladen desselben, umfassend den Schritt des Einladens des Materials in eine Vielzahl von Trichtern (21) einer Vielzahl von Trichterwagen (11, 12, 13), die aneinandergekoppelt sind, um einen Zug zu bilden;

wobei jeder Trichter eine langgestreckte Bodenentladeöffnung (31) mit einer Breite von wenigstens dem halben Abstand zwischen den Rädern (24) der genannten Trichterwagen (11, 12, 13) aufweist;

des Entladens des genannten Materials aus den genannten Trichtern (21) auf ein Endlos-Zugförderband (40), das unter den genannten Trichtern (21) liegt und sich über die Länge des genannten Zuges erstreckt;

Befördern des genannten Materials auf dem genannten Förderer (40) zu einem Ende des genannten Zuges für die Entladung des genannten Materials vom genannten Zug;

dadurch gekennzeichnet, daß alle Wände (26) jedes Trichters (21) um wenigstens 65° von der Horizontalen geneigt sind; daß jeder Wagen (11, 12, 13) eine Mittelschwelle (22) besitzt; daß der Rücklauf (43) des genannten Förderbandes durch geteilte Rücklaufspannrollen (44) abgestützt ist, die an den seitlichen Seiten der genannten Mittelschwellen (22) angeordnet sind; und daß der Zufuhrlauf (41) des genannten Förderers (40) durch Rollen (42) mit einer seil- bzw. kettenlinienförmigen Muldung abgestützt ist, die unmittelbar oberhalb des genannten Rücklaufs (43) angeordnet sind.

8. Verfahren nach Anspruch 7, worin das genannte Material auf dem genannten Zugförderer (40) zu einem Endwagen (15) befördert wird, der an die genannte Vielzahl von Trichterwagen (11, 12, 13) gekuppelt ist; das Material am genannten Endwagen mittels eines darauf montierten Hebeabschnittes (45) des genannten Förderers (40) hochgehoben wird; vom genannten Förderer (40) auf einen Transfer- bzw. Überlade-Förderer (50) Übertragen wird, der auf dem genannten Endwagen (15) montiert ist; und vom genannten Überlade-Förderband (50) an ausge-

wählten Punkten in der Umgebung des genannten Endwagens (15) entladen wird.

9. Verfahren nach Anspruch 7 oder 8, worin der Fluß des genannten Materials von den genannten Trichtern (21) mittels Zweischalenschleusen (32) gesteuert wird, die um Achsen parallel zum genannten Zugförderer (40) verschwenkbar sind; und die Öffnung der genannten Schleusen (32) durch hydraulische Einrichtungen zum Modulieren des Flusses von Material auf den genannten Zugförderer (40) gesteuert wird.

10. Verfahren nach einem der Ansprüche 7 bis 9, worin die genannten Trichterentladeöffnungen (31) und die genannten Zweischalenschleusen (32) ausgebildet sind, um eine lange Dimension parallel zum genannten Förderer (40) von wenigstens 80% der oberen Längsdimension des Trichters (21) aufzuweisen.

Revendications

1. Train auto-déchargeant pour le transport de matériaux en vrac, comprenant:

une pluralité de wagons tombereaux (11, 12, 13) couplés ensemble, chaque wagon tombereau (11, 12, 13) comportant au moins une trémie (21) ayant une ouverture d'evacuation de fond allongée (31) avec une largeur égale à au moins la moitié de la distance entre les roues du wagon tombereau (24);

un transporteur de train (40) comprenant une courroie sans fin (41, 43) disposé sous lesdites ouvertures d'évacuation des trémies (31) pour recevoir les matériaux qui en sont évacués, s'étendant le long de ladite pluralité de wagons tombereaux (11, 12, 13);

chacune desdites trémies (21) ayant des moyens formant porte (32) pour son ouverture d'évacuation; lesdits moyens formant porte (32) pouvant fonctionner de façon sélective pour évacuer les matériaux desdites trémies (21) sur ledit transporteur de train (40),

caractérisé en ce que toutes les parois (26) de la trémie (21) sont inclinées d'au moins 65° par rapport à l'horizontale; chacun des wagons présente un longeron central (22); le brin de retour (43) de ladite courroie est supporté par des roues folles de retour fendues (44) disposées de façon adjacente aux côtés latéraux desdits longerons centraux (22); et le brin d'alimentation (41) de ladite courroie est supporté par des rouleaux caténaires (42) disposés immédiatement au-dessus dudit brin de retour (43).

2. Train auto-déchargement selon la revendication 1, dans lequel lesdits moyens formant porte (32) comprennent des portes du type à coquille pouvant pivoter autour d'axes parallèles audit transporteur de train (40); et des moyens de commande hydrauliques pour effectuer l'ouverture modulée desdites portes pour commander l'écoulement des matériaux sur ledit transporteur de train (40).

3. Train auto-déchargeant selon la revendication 2, dans lequel chacune desdites portes du type à coquille (32) présente une dimension parallèle audit transporteur (40) longue d'au moins 80% de la dimension supérieure longitudinale de sa trémie respective (21).

4. Train auto-déchargeant selon l'une quelconque des revendications précédentes, dans lequel ledit train comporte un wagon remorque (15); ledit transporteur de train (40) s'étendant jusqu'au wagon remorque (15), et ledit wagon remorque (15) supportant une partie de levage (45) dudit transporteur de train à son extrémité d'évacuation de façon suffisamment élévée pour évacuer lesdits matériaux sur un transporteur de transfert (50).

5. Train auto-déchargeant selon la revendication 4, dans lequel un moteur primaire (56) est monté sur ledit wagon remorque (15) fournissant de la puissance pour des systèmes hydrauliques et électriques pour faire fonctionner ledit transporteur de train (40) et lesdits moyens formant porte (32).

6. Train auto-déchargeant selon la revendication 4 ou la revendication 5, dans lequel un transporteur de transfert (50) est monté sur ledit wagon remorque (15) pour recevoir les matériaux dudit transporteur de train (40) et pour évacuer lesdits matériaux en des points choisis entourant ledit wagon remorque (15).

7. Procédé pour transporter des matériaux en vrac par voie ferrée et décharger ceux-ci qui inclut l'étape consistant à charger les matériaux dans une pluralité de trémies (21) d'une pluralité de wagons tombereaux (11, 12, 13) couplés ensemble pour former un train;

chacune des trémies ayant une ouverture d'évacuation de fond allongée (31) avec une largeur égale à au moins la moitié de la distance entre les roues (24) desdits wagons tombereaux (11, 12, 13);

évacuer lesdits matériaux desdites trémies (21) sur un transporteur de train à courroie sans fin (40) qui se trouve sous lesdites trémies (21) et s'étend sur la longueur dudit train;

transporteur lesdits matériaux sur lesdits transporteurs (40) à une extrémité dudit train, pour évacuer lesdits matériaux dudit train;

caractérisé en ce que toutes les parois (26) de chaque trémie (21) sont inclinées d'au moins 65° par rapport à l'horizontale; chacun des wagons (11, 12, 13) présente un longeron central (22); le brin de retour (43) de ladite courroie est supporté par des roues folles de retour fendues (44) disposées de façon adjacente aux côtés latéraux desdits longerons centraux (22); le brin d'alimentation (41) dudit transporteur (40) est supporté par des rouleaux caténaires (42) disposés immédiatement au-dessus dudit brin de retour (43).

8. Procédé selon la revendication 7, dans lequel lesdits matériaux sont transportés sur ledit transporteur de train (40) à un wagon d'extrémité (15) couplé à ladite pluralité de wagons tombereaux (11, 12, 13); élevés à ce wagon d'extrémité au moyen d'une partie de levage (45) dudit transporteur (40) qui y est montée; évacués dudit transporteur (40) vers un transporteur de transfert (50) monté sur ledit wagon d'extrémité (15); et éva-

cués dudit transporteur de transfert (50) en des points choisis entourant ledit wagon d'extrémité (15).

9. Procédé selon la revendication 7 ou la revendication 8, dans lequel le flux desdits matériaux à partir desdites trémies (21) est commandé au moyen de portes du type à coquille (32) pouvant pivoter autour d'axes parallèles audit transporteur de train (40); et l'ouverture desdites portes (32) est commandée par des moyens hydrauliques pour moduler le flux des matériaux sur ledit transporteur de train (40).

10. Procédé selon l'une quelconque des revendications 7 à 9, dans lequel lesdites ouvertures d'évacuation des trémies (31) et lesdites portes du type à coquille (32) sont formées pour avoir une dimension parallèle audit transporteur (40) longue d'au moins 80% de la dimension supérieure longitudinale de la trémie (21).

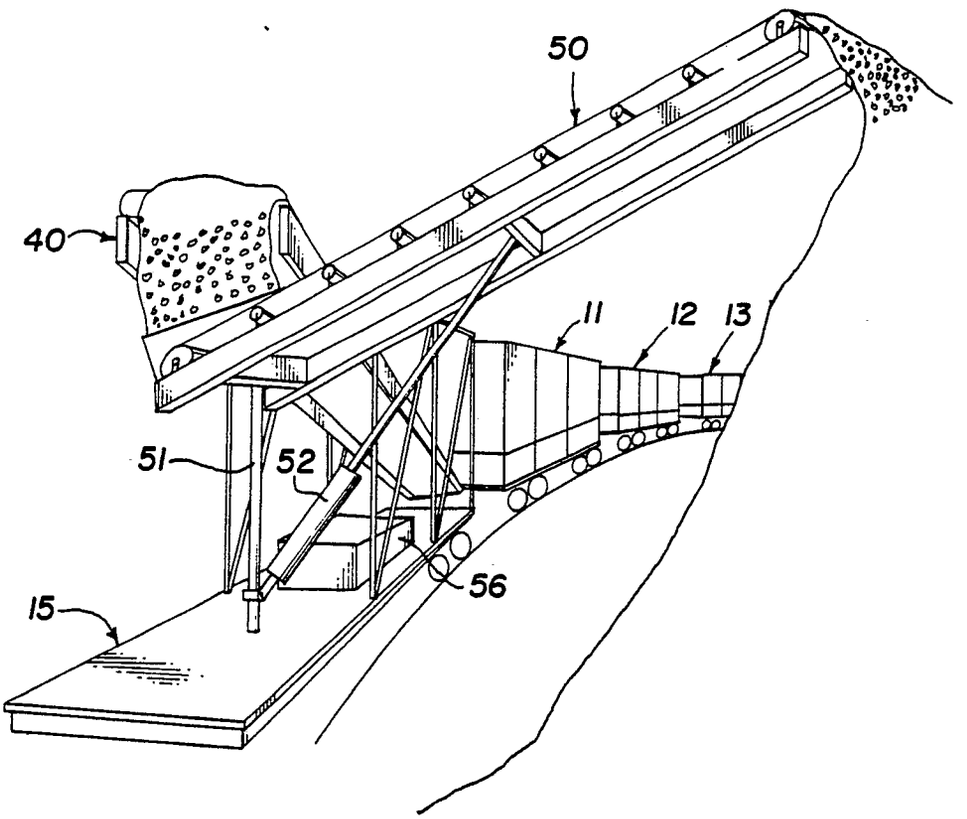

Fig. 1

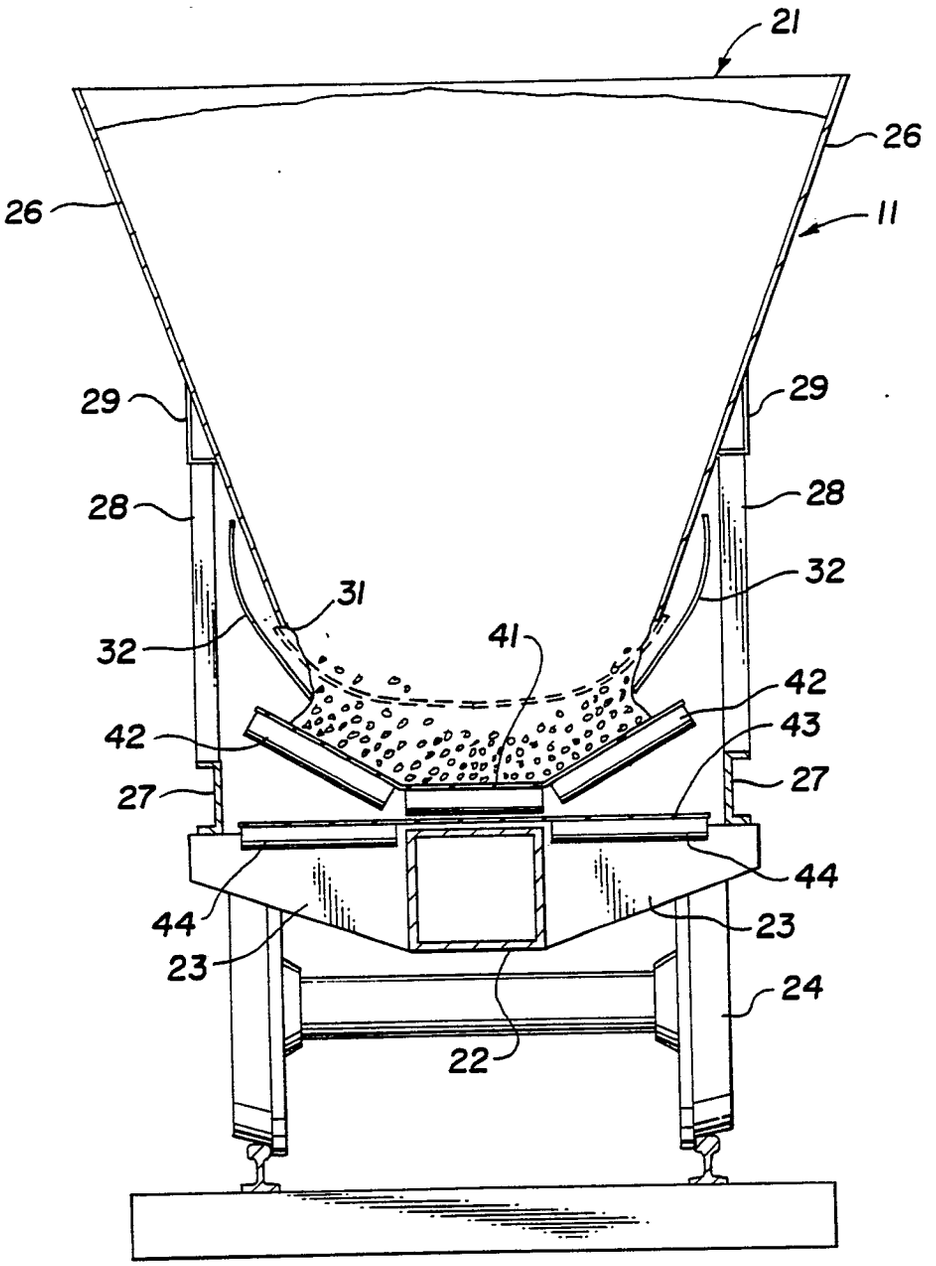

Fig. 2

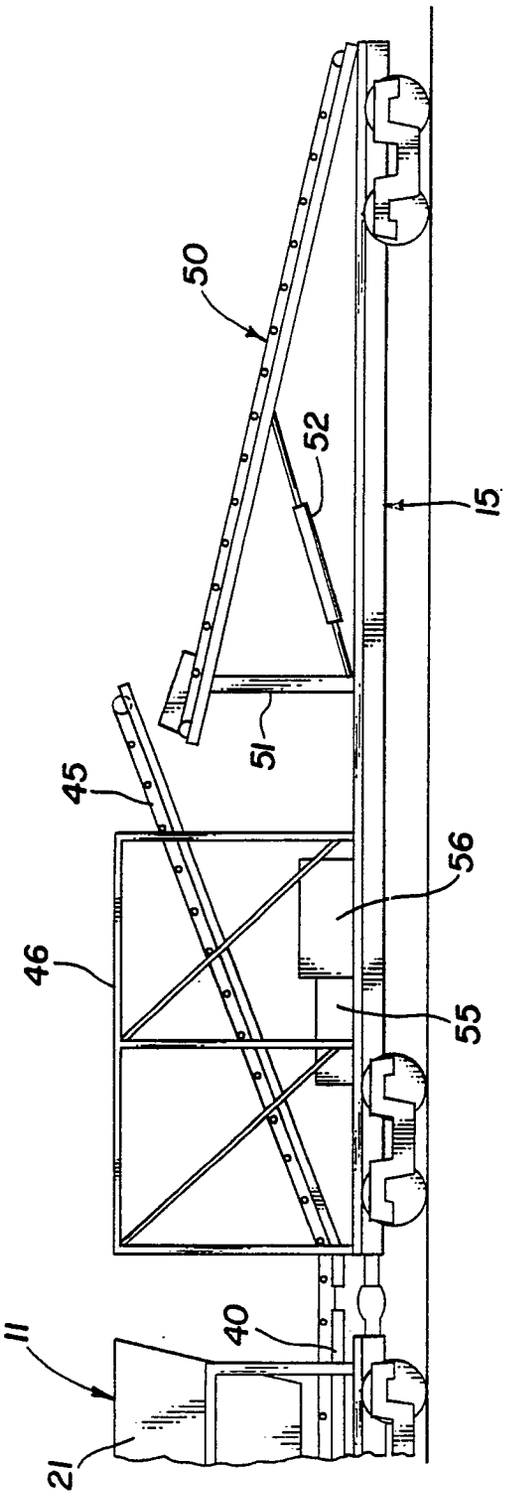

Fig. 3

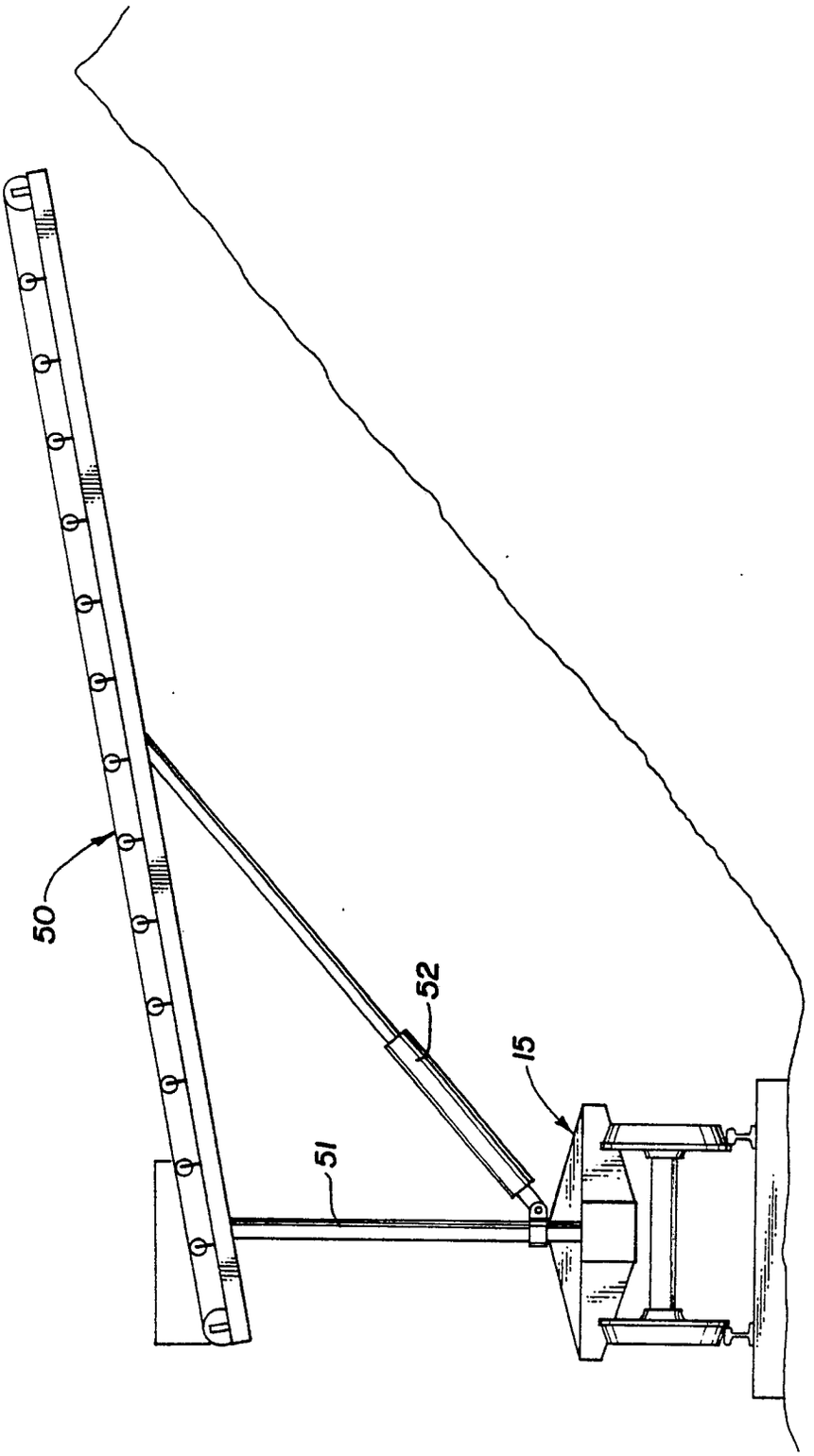

Fig. 4

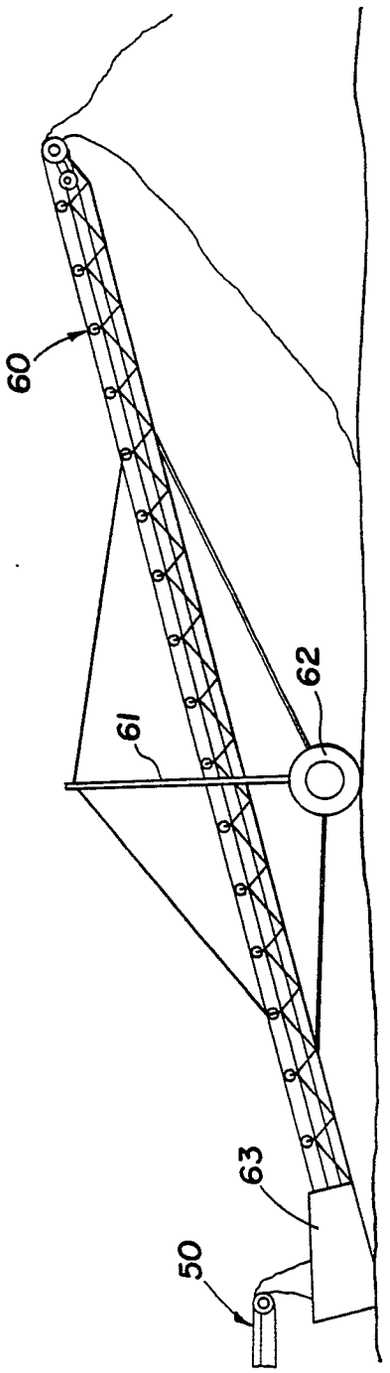

Fig. 5