Nov. 29, 1960 J. D. RUSSELL 2,962,176

LOW HEIGHT SHUTTLE CAR

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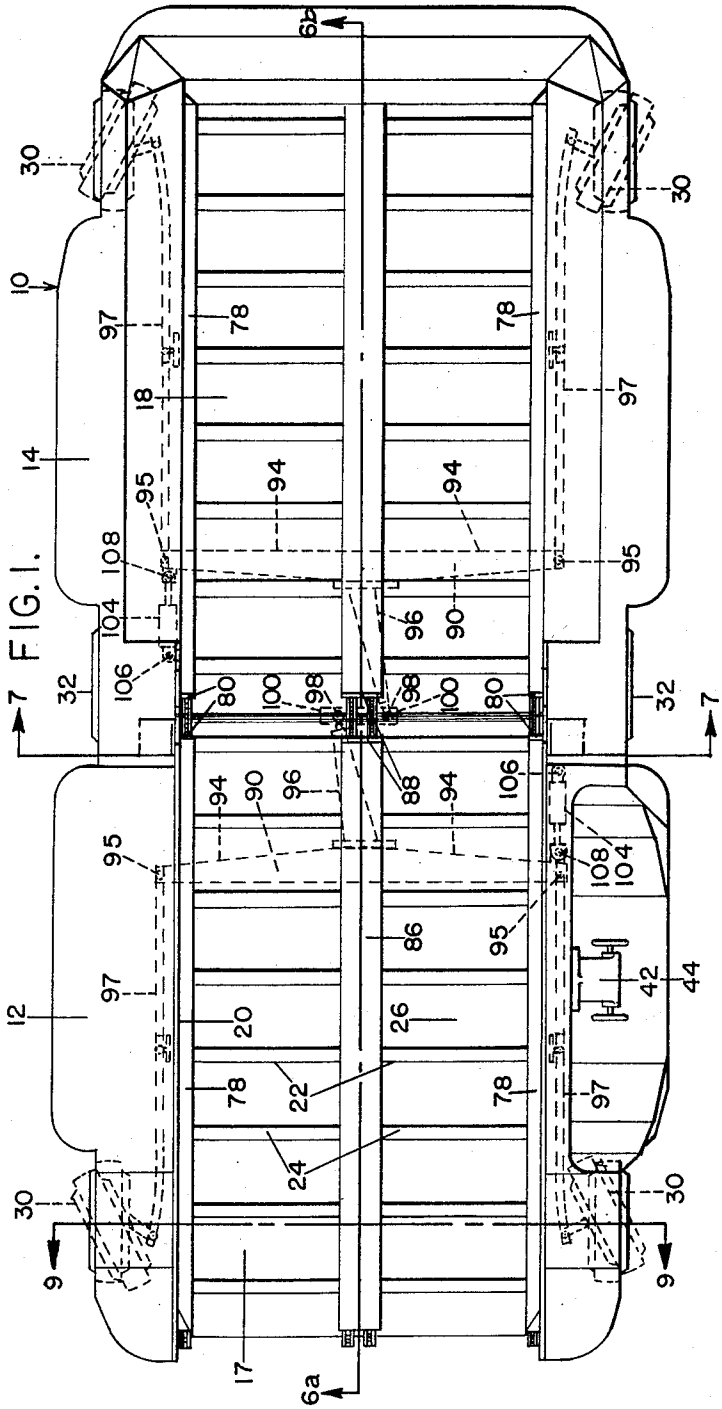

FIG. 1.

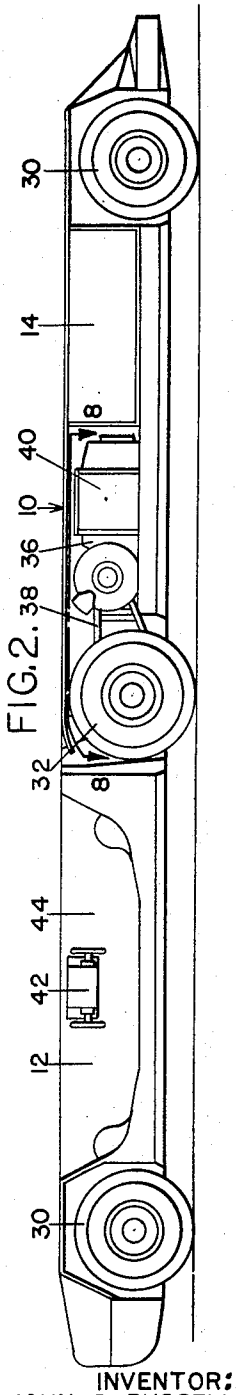

FIG. 2.

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Nov. 29, 1960 J. D. RUSSELL 2,962,176

LOW HEIGHT SHUTTLE CAR

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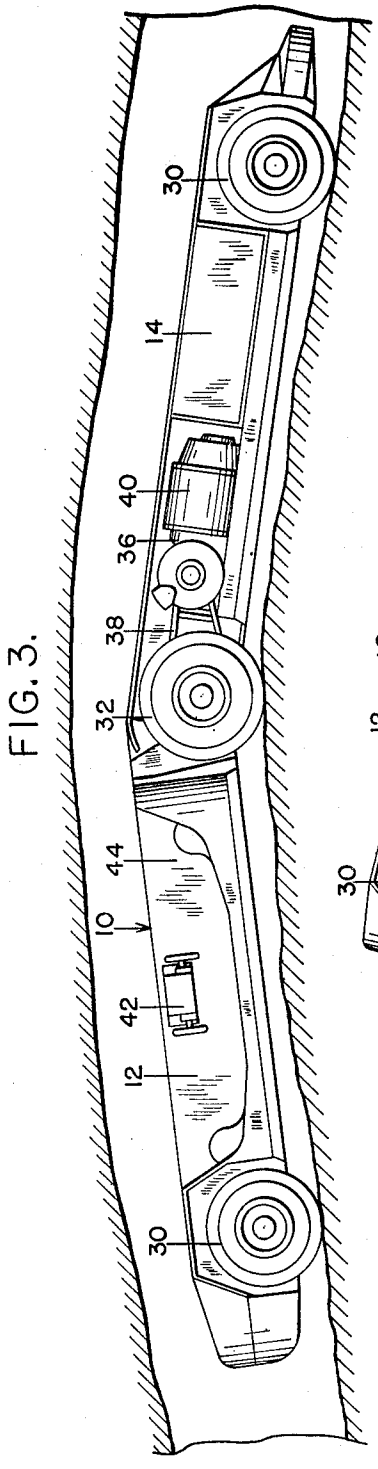

FIG. 3.

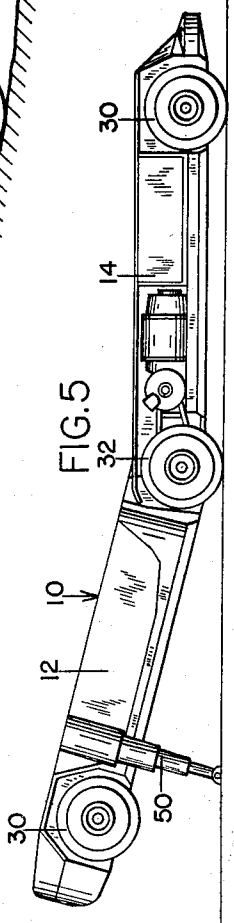

FIG. 5.

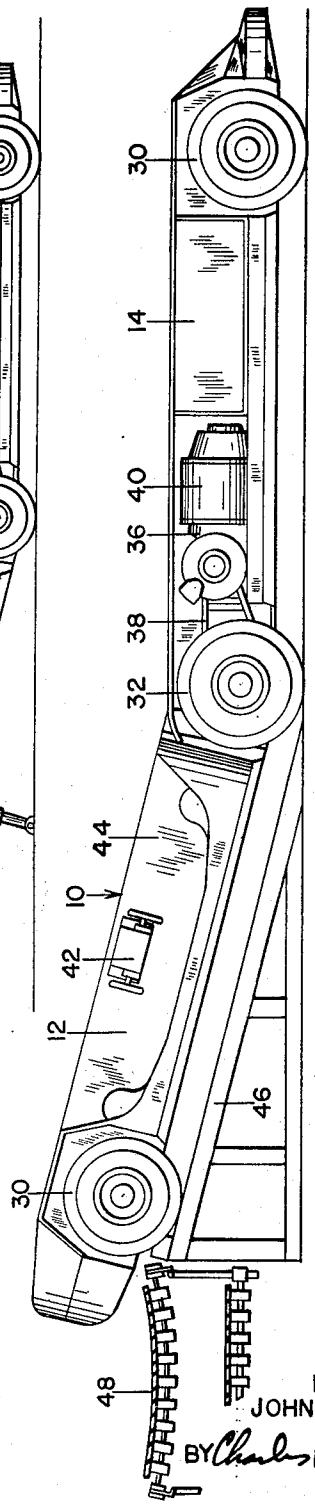

FIG. 4.

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LOW HEIGHT SHUTTLE CAR

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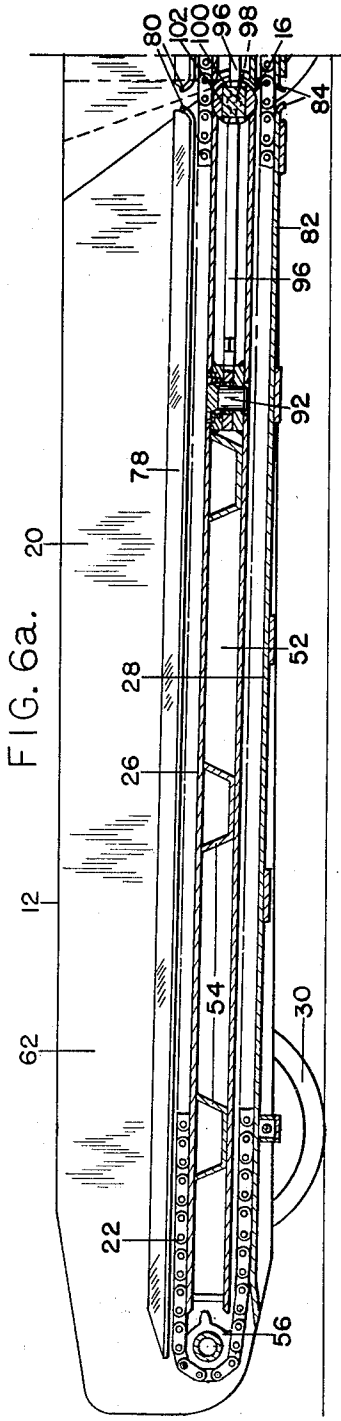

FIG. 6a.

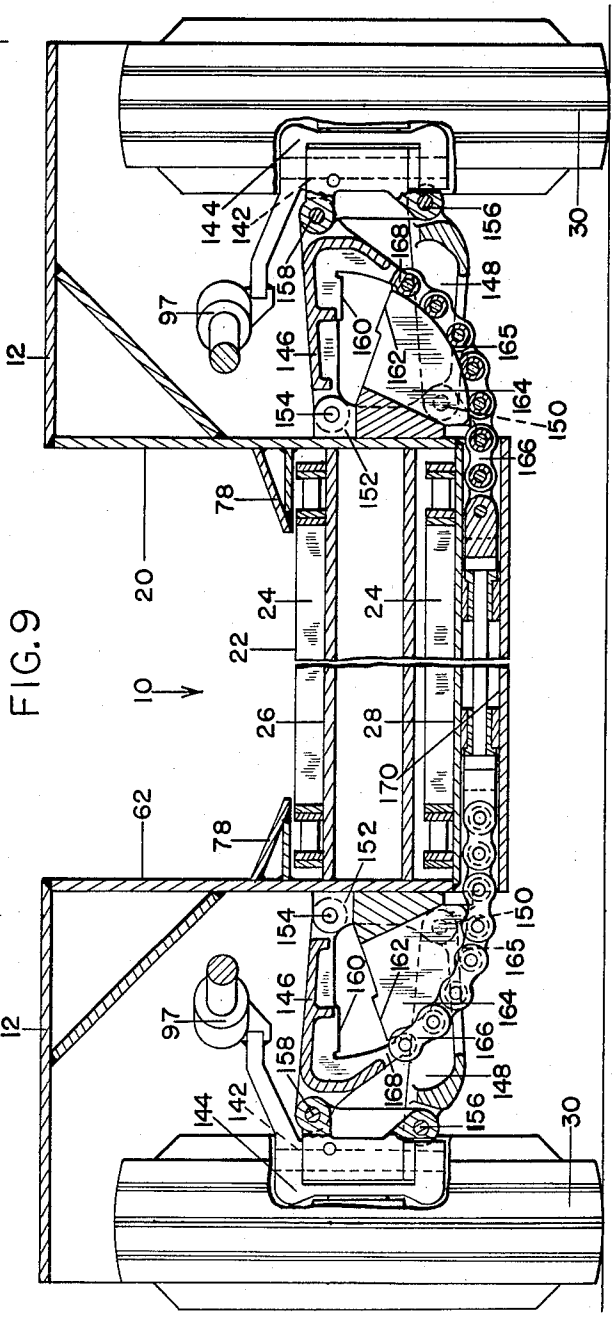

FIG. 9

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LOW HEIGHT SHUTTLE CAR

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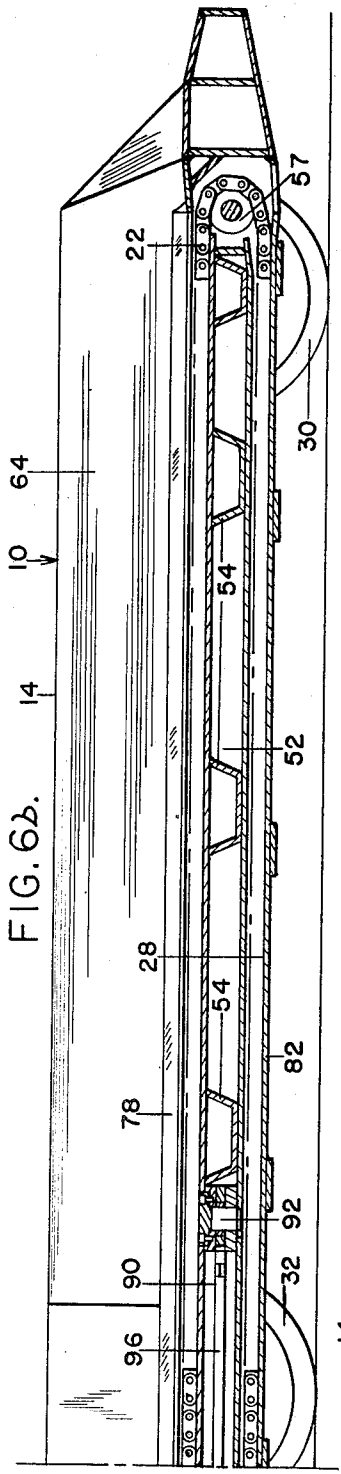

FIG. 6b.

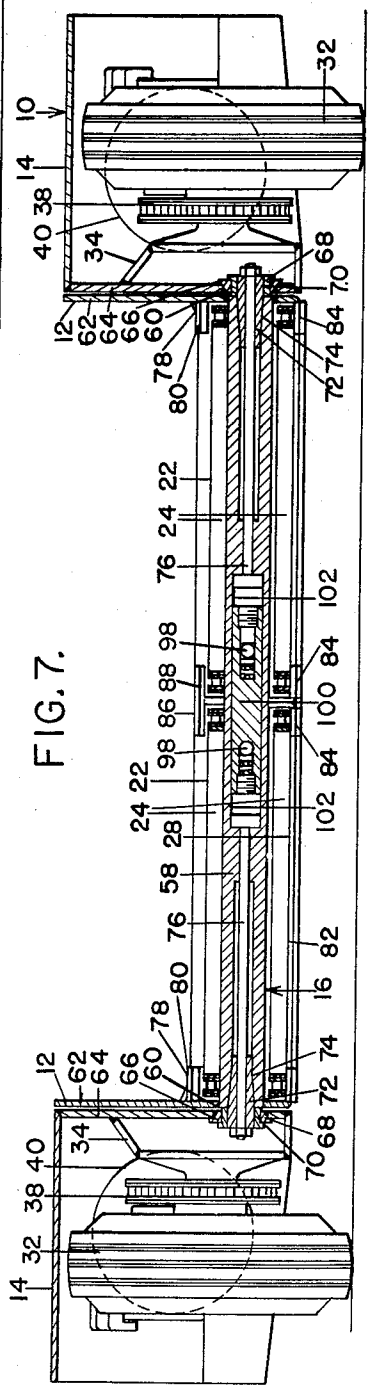

FIG. 7.

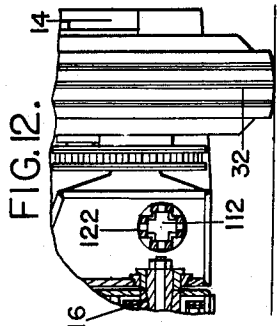

FIG. 12.

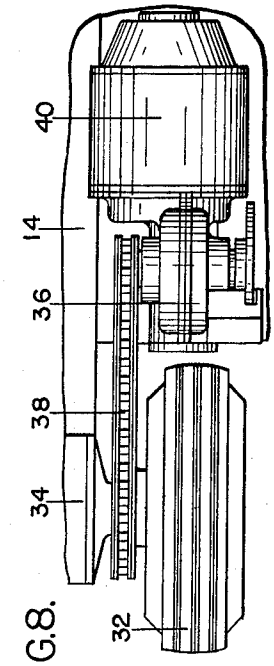

FIG. 8.

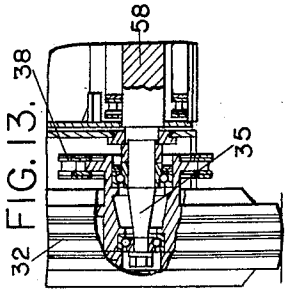

FIG. 13.

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LOW HEIGHT SHUTTLE CAR

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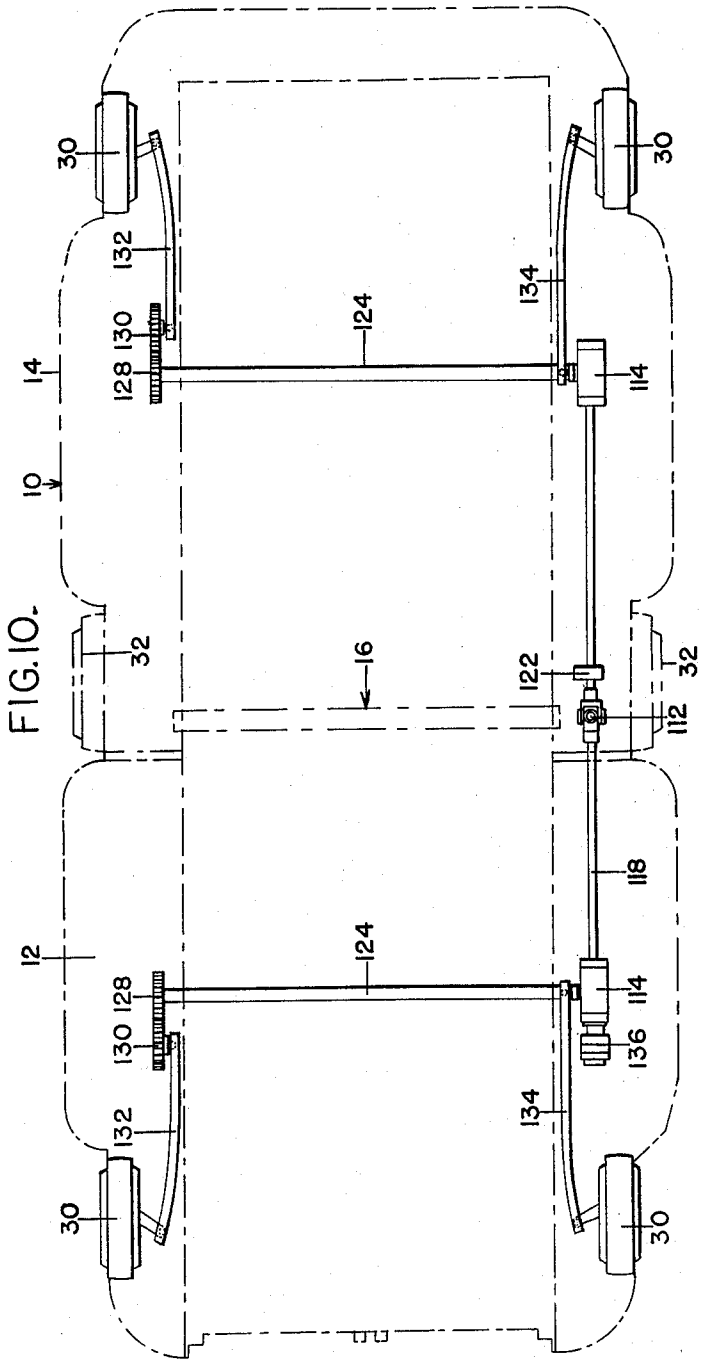

FIG. 10.

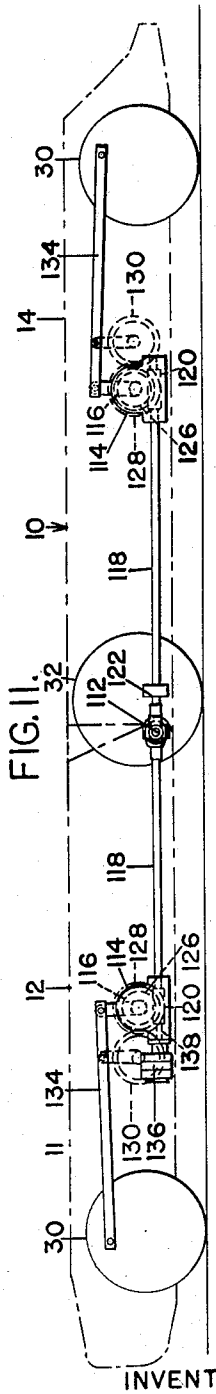

FIG. 11.

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United States Patent Office 2,962,176 Patented Nov. 29, 1960

2,962,176

LOW HEIGHT SHUTTLE CAR

John D. Russell, Bradford Woods, Pa., assignor to Joy Manufacturing Company, Pittsburgh, Pa., a corporation of Pennsylvania

Filed Aug. 29, 1957, Ser. No. 681,004

12 Claims. (Cl. 214—83.36)

This invention relates to material haulage vehicles and more particularly to improvements in the type commonly known as "shuttle cars" for hauling loose material in underground trackless mines.

Shuttle cars have to meet height and space limitations encountered in underground mines and still provide large capacity along with rapid loading, carrying and delivery of loose material in great tonnages from place to place in and from the mines. In some low height mines, it would be physically impossible for nonarticulating shuttle cars of comparable capacity to negotiate such mines. See the clearance condition indicated by Fig. 3.

It is therefore the major object of the present invention to provide an improved shuttle car with articulating pivot means between two main body parts.

Another object of the present invention is to provide a novel low height six-wheel articulated shuttle car of great capacity with conveyor means extending along the compartment bottom.

Another object is to provide driven wheels near the articulated center of an articulating shuttle car and to insure correct weight distribution for adequate driving traction.

A further object is to provide nonsteering center drive wheels and to therefore provide a simplified driving means and also for increased shuttle car conveyor and material receiving compartment width.

A still further object is to provide positive steering of front and rear wheels controllably tied together so as not to be affected by articulation of the shuttle car.

Another object is to provide for suitable weight distribution and thereby for proper steering.

A further object is to provide the equivalent of three-point suspension of each half of an articulated shuttle car.

Another object is to provide means for elevated discharge of these new improved articulated shuttle cars.

Further objects of my invention will appear as the description proceeds in connection with the appended claims and the following drawings in which:

Fig. 1 is a top plan view showing the preferred embodiment of my improved shuttle cars.

Fig. 2 is a side elevational view of the shuttle car of Fig. 1.

Fig. 3 is a side elevational view showing the shuttle car of Figs. 1 and 2 in an articulated state as the car is proceeding over a mine floor rise.

Fig. 4 shows an end of my improved shuttle car articulated upward by having run up a ramp for elevated load discharge to a conveyor.

Fig. 5 shows an end of the car articulated upward for elevated load discharge by car mounted ground engaging jacks.

Figs. 6*a* and 6*b* together form a longitudinal vertical sectional enlarged scale view taken along line 6*a*—6*b* of Fig. 1.

Fig. 7 is an enlarged cross sectional view taken substantially along line 7—7 of Fig. 1, showing shuttle car articulating means and steering detail.

Fig. 8 is a partial plan view showing drive wheel and drive means detail.

Fig. 9 is an enlarged cross sectional view taken substantially along line 9—9 of Fig. 1 showing a steering axle embodiment which gives a pivoted axle effect at an end of the car.

Figs. 10 and 11 show in top plan and side elevation schematic views of an alternate steering embodiment for my improved shuttle cars.

Fig. 12 is a partial enlarged cross sectional view similar to Fig. 7 and also taken along a portion of the line 7—7 of Fig. 1 showing detail and positioning of steering means used in the steering embodiment of Figs. 10 and 11.

Fig. 13 is a partial view similar to Fig. 7 and also taken along a portion of the line 7—7 of Fig. 1 showing a drive traction wheel embodiment rotatably mounted on axle spindle extensions of the vehicle articulating pivot means.

In my improved mine haulage vehicle (generally called a "shuttle car" by those familiar with the art) embodiment of Figs. 1, 2 and 3, the vehicle generally comprises a material carrying body **10** divided into two relatively articulating body sections **12** and **14** hinged together by hinged articulating pivot means **16** extending transversely across in the center region of the car. Said relative articulating body sections **12** and **14** have chambers **17** and **18** which cooperate to provide a material receiving compartment or bin **20** extending lengthwise of the vehicle. It will be understood that compartment as referred to by those in the art is a trough shaped member having a bottom and two side extensions. Endless conveyor means **22** with scraper flights **24** extends along the compartment bottom or deck **26**. Compartment bottom deck **26** is provided with conveyor return chamber **28** in a customary manner. In lieu of the endless flight conveyor disclosed, it will be evident that various other conventional forms of conveyors may be employed, but in all forms it is desirable that the point of articulation between the body parts be disposed below the effective conveying portion of the conveyor near the intermediate traction wheels.

The shuttle car body **10** is provided with end steering wheels **30** and centrally located or intermediate traction wheels **32** disposed near the point of articulation between shuttle car body sections **12** and **14**. Non-steering traction wheels **32** are rigidly mounted to the sides of body section **14** by frame mounting means **34**, and each traction wheel **32** is provided with its own positive driving means **36** including a drive chain **38** driven from the respective electric drive motor **40** mounted to the respective side of shuttle car body section **14**. In other embodiments (see Fig. 13) of my improved mine haulage vehicle, the rotative centers of traction wheels **32** would be substantially on the axis of articulation of said articulating pivot means **16**. In fact, for some embodiments traction wheels **32** would be rotatably mounted as shown on axle spindle extensions **35** from the articulating pivot means **16**. The shuttle car body **10** is provided with steering control **42** within an operator's compartment **44** at the side of body section **12**.

Due to the provision of six wheels instead of the usual four, on a car of a given capacity, the contact pressure of the wheels with the floor or ground is substantially reduced thereby improving the operation of the car while traveling over a soft bottom while at the same time keeping the lateral turning spaces for the steering wheels at a minimum by eliminating any need for larger tires. Further, if desired, the intermediate traction wheels may have conventional dual tires at each side further to decrease the square inch contact pressure with the ground without increasing the lateral dimensions or height of the car.

Articulating pivot means 16 permits body sections 12 and 14 to articulate relative one to the other so that the end steering wheels 30 and the traction wheels 32 conform to the mine floor as shown in Fig. 3. A four-wheel nonarticulating stiff frame shuttle car of comparable capacity attempting to proceed over the mine floor rise of Fig. 3 would either scrape bottom or wedge a top of a car end against the mine roof. In such a four-wheel nonarticulating stiff frame shuttle car, the increased longitudinal span between the supporting wheels would require increased ground clearance which in turn increases compartment bottom deck height to thereby lessen available load carrying capacity. In addition, a four-wheel nonarticulating stiff frame shuttle car of comparable capacity would require extensive structural additions over the six-wheel articulated shuttle car for adequate strength thereby increasing car weight and possibly encroaching upon capacity, such as by increased compartment deck height. Articulating pivot means 16 also permits the operator to run body section 12 up a ramp 46 as shown in Fig. 4 for elevated discharge to conveyor means 48. Fig. 5 shows another embodiment wherein body section 12 is articulated upward by telescoping ground engaging jack means 50 for elevated discharge.

Referring now to Figs. 6*a* and 6*b*, both body sections 12 and 14 are equipped with a structural body reinforcing and stiffening spacing chamber 52 between the bottoms 26 of compartment 20 and conveyor return chamber 28. Each body chamber 52 which contains multiple reinforcing and stiffening means 54 extends in respective body sections 12 and 14 from conveyor chain drive sprocket 56 in body section 12 and from conveyor chain idler roller 57 in body section 14 at the outer ends of the shuttle car inwardly to the articulating pivot means 16 centrally of the vehicle.

Referring to Fig. 7, pivot means 16 which is aligned with chambers 52 is comprised of a tubular member 58 fixed as by welding 60 to side plates 62 of the body section 12 of material receiving compartment 20. Each side plate 64 of the body section 14 of material receiving compartment 20 has a bearing insert receiving member 66 fixed nonrotatably thereto. Flanged 68 bearing inserts 70 are non-rotatably mounted to respective bearing insert receiving members 66 and are pivotally supported trunnionlike on respective conical mount members 72. Each conical mount member 72 may be tightened into nonrotatably mounting position in a conical opening 74 in the ends of tubular member 58 by a respective nut and stud assembly 76.

Endless conveyor guiding element 78 are mounted on the side plates 62 and 64 and are provided with upwardly turned spaced ends 80 near the point of shuttle car articulation to provide conveyor guides through the full range of vehicle articulation. Bottom plates 82 on body sections 12 and 14 which enclose conveyor return chambers 28 have downwardly turned ends 84 near the point of articulation spaced one from the other to permit vehicle articulation and provide conveyor chain guidance throughout the range of vehicle articulation.

As shown in Figs. 1 and 7, increased width of material receiving compartment or bin 20 permitted by the fixed frame mounting means 34 having mounted traction wheels 32 at the sides of the vehicle permits beneficial use of two side by side endless conveyor means 22, in place of one, with which I use additional conveyor T-shaped guiding elements 86 fixed longitudinally along the conveyor compartment bottoms 26 spaced one from the other and provided with upturned ends 88 near the point of articulation between body sections 12 and 14 to provide for vehicle articulation and conveyor guidance through the entire range of vehicle articulation.

The preferred steering embodiment of Figs. 1, 6*a* and 6*b*, 7 and 9, which has been developed by Mr. Paul R. Johnson and is the subject matter of a co-pending application Serial No. 680,951 filed on the same date, is shown to have T-shaped lever members 90 pivotally supported and aligned within body chamber 52 of the respective body sections 12 and 14 near the articulating pivot means 16 by pivot mounting means 92. Each T-shaped lever member 90 has two arms 94 which extend from pivot mounting means 92 within body chamber 52 to each side of the vehicle where they are pivotally connected 95 to the respective conventional type steering linkage means 97 extending and operatively connected to the respective end steering wheels 30. An arm 96 of each T-shaped lever member 90 projects to a universal ball connection 98 with a rectangular block 100 slidably retained within the slot 102 of tubular member 58 for axial movement within and along the slot 102. Power steering cylinders 104 mounted 106 to the respective body sections 12 and 14 are operatively connected at 108 to the steering means 97 of the respective body sections 12 and 14. Steering control 42 is provided with valving for the control of power steering cylinders 104. Operation of steering control 42 operates power steering cylinders 104 to pivot lever members 90 about their respective pivot mounting means 92 and transmit such pivot motion through arms 96 and the respective universal ball connections 98 to rectangular block 100 which acts to coordinate such motion to the same degree with both lever members 90 for correct synchronized steering of steering wheels 30 at one end of the vehicle as related to the steering wheels 30 at the other end of the vehicle. The universal connections 98 of arms 96 with block 100 fall at all times substantially along the axis of articulation between the body sections 12 and 14. This tie between the steering system of body section 12 and body section 14 insures positive steering control to all steering wheels 30 without an articulation steering effect being imposed upon the steering wheels 30 in any vehicle articulated state throughout the entire range of articulation between body sections 12 and 14.

Please refer now to Figs. 10, 11 and 12 wherein there is shown a six-wheel articulating shuttle car steering embodiment using a universal joint 112 which has its center of articulation oriented substantially on the axis of articulation between the body sections 12 and 14. In this embodiment, at the universal joint 112 side of the shuttle car are mounted two worm gear casing 114 each containing a worm gear set 116, one on each of the body sections 12 and 14. Rotative rods 118 drivingly connect the respective worm 120 of worm gear sets 116 to universal joint 112. Worm gear casings 114 support the respective rotative rods 118 on the respective body sections 12 and 14 and axially position said worms 120 and respective rotative rods 118 relative to the respective body sections 12 and 14 and thereby the axial position of the universal joint relative to the axis of vehicle articulation. Said rotative rods 118 and universal joint 112 are additionally supported and maintained in alignment by a bearing bracket means 122 with the articulated center of universal joint 112 falling on the axis of articulation of the body sections 12 and 14.

A rod 124 extends transversely from each worm gear 116 through body chamber 52 of the respective body sections 12 and 14 to a spur gear 128, on the opposite side of the respective body sections 12 and 14, each of which operatively engages another spur gear 130. Each spur gear 130 is operatively connected by a conventional steering means 132 to the respective end steering wheels 30 on that side of the shuttle car. Worm gear set 116 is operatively connected by conventional linkage means 134 to respective end steering wheels 30 on the worm gear set 116 and the universal joint 112 side of the shuttle car. A reversible motor 136, preferably hydraulic, is mounted on the front of worm gear casing 114 of body section 12 and is drivingly connected by shaft 138 to the front of worm 120 of body section 12, and thereby in driving connection with the steering system described. The reversible motor 136 is actuated and

controlled by conventional means (not shown) from the steering control 42 shown in Figs. 1 and 2.

Please refer now to Fig. 9 for a steering wheel suspension means which has been developed by Mr. John R. Sibley and is the subject matter of a co-pending application Serial No. 681,007, filed on the same date herewith and of common ownership. This steering wheel suspension means embodiment within the limits of travel upwards and downwards of the steering wheels equalizes the weight of the vehicle in substantially a balanced ratio on the steering tires from side to side at the respective vehicle end. The kingpin 142 of each end steering wheel 30 is rotatably mounted in a kingpin housing 144 which is mounted for vertical up and down movement by parallelogram upper 146 and lower 148 linkage members. The lower parallelogram linkage member 148 is pivotally mounted at 150 to a frame member 152 for articulating movement in a vertical plane perpendicular to the side of the shuttle car. Upper parallelogram linkage member 146 is likewise pivotally mounted at 154 to the frame member 152. Parallelogram linkage members 146 and 148 are pivotally hinged at their outer ends at the bottom 156 and the top 158 respectively to the kingpin housing 144. Each upper parallelogram linkage member 146 is provided with a stop contact surface 160 which comes into abutment with a stop surface 162 on a chain guide bracket 164 to limit downward travel of the respective steering wheel 30. Chain guide brackets 164, one of which is mounted on the shuttle car for each steering wheel 30, have chain guiding arcuate surfaces 165. Each surface 165 guides and directs suspension chain means 166 from its pivotal end connection with arm 168 of the upper parallelogram linkage member 146 to a suspension chain means guiding chamber 170 mounted transversely across the bottom of the respective body sections 12 and 14.

This structure provides a suspension chain means 166 which absorbs and counteracts the upward thrust transmitted to steering wheels 30, transmits this force across and moves to maintain a dynamic balance between the two steering wheels 30 to which it is connected at the respective end of the shuttle car. This then, in effect, is one-point support for each end of the shuttle car which gives, in turn, effectively three-point suspension (modified only as explained below) for body section 14 from this steering wheel 30 suspension of body section 14 and through both traction wheels 32 and, in effect, three-point suspension (modified only as explained below) for body section 12 by the steering wheel 30 suspension of the body section 12 and through the articulating pivot means 16 of the shuttle car to both traction wheels 32. This three-point suspension effect for body sections 12 and 14 is modified only by one body section tending to twist to a different degree or in the opposite direction from the other body section when the suspension chain means 166 of one or both have reached the limit of travel one side or the other with the tendency of one body section to twist counteracting the tendency of the other to twist through the common articulating hinge pivot means. Normally, the side tilt of the whole shuttle car would be determined by traction wheels 32 with suspension chain means 166 moving steering wheels 30 at each end of the car in dynamic balance for such side tilt.

I have herein provided improved low height articulating shuttle cars of great capacity and heavy load capabilities which can negotiate low height underground mines through which passage would be physically impossible for non-articulated shuttle cars of comparable capacity. I use non-steering, rigidly mounted driven wheels near the articulated center of my improved cars thereby providing for improved simplified driving means and insuring a correct weight distribution for adequate driving traction. In addition, my rigidly mounted non-steering wheels provide for increased shuttle car conveyor and material receiving compartment or bin width.

I also provide positive steering for front and rear wheels of an articulated shuttle car controllably tied together through the axis of shuttle car articulation in such a manner so that there is no steering component superimposed on the steering linkage of the vehicle by articulation thereof. I have also provided an articulated shuttle car with proper weight distribution to give effective steering with front and rear steering wheels.

While I have shown and described certain embodiments of my invention, various changes and modifications may be effected without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A mine haulage vehicle comprising, an elongated body having a pair of tandem body parts which are connected at adjacent ends by pivot means to permit said body parts to freely pivot relative to each other about a pivot axis extending laterally of said body, said elongated body having steerable wheels at each end thereof and intermediately located traction wheels, said traction wheels being located adjacent said pivot means, said body parts having cooperating chambers extending longitudinally of said body parts respectively to provide a trough shaped compartment extending substantially throughout the length of said elongated body, an endless conveying means extending along the bottom of said compartment and guided on said body parts for movement relative thereto for loading material into the trough shaped compartment and for discharging material therefrom and said conveying means being flexible for vertical movement throughout the length thereof.

2. A mine haulage vehicle comprising, an elongated body having a pair of body parts which are connected at adjacent ends by a pivot axis for permitting said body parts to freely pivot relative to each other about said axis which extends laterally of said body, said body parts having cooperating chambers extending longitudinally of said body parts respectively to provide a series of open ended trough shaped material receiving and discharging compartments, said compartments having a bottom extending substantially throughout the length of said body, said body having end steerable wheels and intermediately located traction wheels, said traction wheels being located adjacent said pivot axis, said pivot axis extending parallel to the axis of said traction wheels, said pivot axis being located below said compartment bottom and below said traction wheel axis, an endless conveying means extending along said compartment bottom and guided on said body parts for movement relative thereto for loading material into the compartments and for discharging material therefrom and said conveying means being flexible for vertical movement throughout the length thereof.

3. A mine haulage vehicle as set forth in claim 2 wherein said body parts are substantially the same length.

4. A mine haulage vehicle comprising an elongated body having body parts which are freely connected at adjacent ends by laterally extending pivot axis means to permit said body parts to freely pivot relative to each other about said laterally extending pivot axis means, said pivot axis means being the sole means for connecting said body parts, said body having end steerable wheels and intermediately located traction wheels, said traction wheels being located adjacent said pivot axis, said body parts having upwardly facing deck surfaces extending substantially throughout the length of said body parts respectively to provide a substantially continuous surface extending longitudinally through said body, said pivot axis extends substantially in the same plane as said upwardly facing deck surfaces, endless conveying means with an upper conveying run portion traveling along said substantially continuous deck surfaces and a lower return run portion traveling below and closely adjacent said substantially continuous surface, said means for connecting said body parts extending between said upper run portion and said lower run portion of said conveying

means, said run portions each having a portion of their path of movement located closely adjacent said means for connecting said body parts and said conveying means being flexible for vertical movement throughout the length thereof.

5. A mine haulage vehicle as set forth in claim 4 wherein the distance between the axis of the intermediately located traction wheels and the axes of the respective end steerable wheels is substantially the same length to provide substantially equal wheel bases for said body parts.

6. A mine haulage vehicle as set forth in claim 4 wherein the rotative centers of said traction wheels are substantially on said laterally extending pivot axis.

7. A mine haulage vehicle comprising at least two elongated body sections, each of said body sections having a bottom horizontal plate and upwardly extending side plates, said bottom plates lying in substantially the same plane, an endless conveying means having a top conveying run and a return bottom run, said conveying run supported by said bottom plates, said return run lying adjacent and below said bottom plates and said conveying means being flexible for vertical movement throughout the length thereof, pivot means located between said conveying run and said return run for connecting adjacent ends of said body sections together to provide a continuous material carrying compartment, said pivot means being the sole connecting means for connecting said body sections together for unrestricted vertical pivotable action relative to each other, and said body sections having steerable wheels at the remote ends thereof and intermediately located traction wheels closely adjacent said pivot means.

8. A self-propelled shuttle car comprising body sections, each of said body sections having steerable wheels at one end thereof, a pivot axis means connecting the other ends of said body sections, traction driven wheels mounted on one of said body sections closely adjacent said pivot axis means, said pivot axis means and the axis of said traction driven wheels lying in parallel relationship, said body sections having upwardly facing decks extending substantially throughout the length of said body sections respectively to provide a substantially continuous deck surface which extends longitudinally throughout the entire length of said connected body sections, each of said body sections having upwardly extending side plates to cooperate with said deck surface to provide a trough shaped material compartment, said upwardly extending side plates and the tops of said wheels extend substantially to the same height to define a low height shuttle car, conveying means having an upper conveying run and a lower return run that are closely adjacent to each other, said pivot means lying between said upper run and said lower run and said conveying means being flexible for vertical movement throughout the length thereof.

9. A mine haulage vehicle comprising, an elongated body having body sections connected at adjacent ends by laterally extending pivot means to permit said body sections to freely pivot relative to each other, said elongated body having steerable wheels at each end thereof and traction wheels mounted on said elongated body adjacent said pivot means for propelling said elongated body as a unit, said body sections having cooperating chambers extending longitudinally of said body sections respectively to provide a trough shaped compartment extending substantially throughout the length of said elongated body, and an endless conveying means extending along the bottom of said compartment and guided on said body sections for movement relative thereto for loading material into said compartment and for discharging material therefrom and said conveying means being flexible for vertical movement throughout the length thereof.

10. A mine haulage vehicle comprising an elongated body having body sections connected at adjacent ends by laterally extending pivot axis means to permit said body sections to freely pivot relative to each other, said elongated body having steerable wheels at each end thereof and traction wheels mounted on said elongated body adjacent said pivot axis means, said body sections having upwardly facing decks extending substantially throughout the length of said body sections respectively to provide a substantially continuous surface extending longitudinally through said elongated body, endless conveying means with an upper conveying run portion traveling along said substantially continuous deck surface and a lower return run portion traveling below and closely adjacent said substantially continuous surface, said laterally extending pivot axis means extending between said upper run portion and said lower run portion of said conveying means, said run portions each having a portion of their path of movement located closely adjacent said means for connecting said body sections and said conveying means being flexible for vertical movement throughout the length thereof.

11. A mine haulage vehicle comprising, an elongated body having a pair of tandem body parts which are connected at adjacent ends by pivot means to permit said body parts to freely pivot relative to each other about a pivot axis extending laterally of said body, said elongated body having supporting wheels at each end thereof and intermediately located supporting wheels, said intermediately located supporting wheels being located adjacent said pivot means, said body parts having cooperating chambers extending longitudinally of said body parts respectively to provide a trough shaped compartment extending substantially throughout the length of said elongated body, an endless conveying means extending along the bottom of said compartment and guided on said body parts for movement relative thereto for loading material into the trough shaped compartment and for discharging material therefrom, said conveying means being flexible for vertical movement throughout the length thereof, certain of said supporting wheels being traction wheels, and certain of said supporting wheels being steerable wheels.

12. A mine haulage vehicle comprising, an elongated body having body sections connected at adjacent ends by laterally extending pivot means to permit said body sections to freely pivot relative to each other, said elongated body having supporting wheels at each end thereof and supporting wheels mounted on said elongated body adjacent said pivot means, certain of said wheels being traction wheels for propelling said elongated body as a unit, certain of said wheels being steerable wheels, said body sections having cooperating chambers extending longitudinally of said body sections respectively to provide a trough shaped compartment extending substantially throughout the length of said elongated body, and an endless conveying means extending along the bottom of said compartment and guided on said body sections for movement relative thereto for loading material into said compartment and for discharging material therefrom, said conveying means being flexible for vertical movement throughout the length thereof.

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