March 21, 1939. J. D. PUGH 2,151,391

APPARATUS FOR TRANSFERRING MOLTEN MATERIALS

Filed May 29, 1936 3 Sheets-Sheet 1

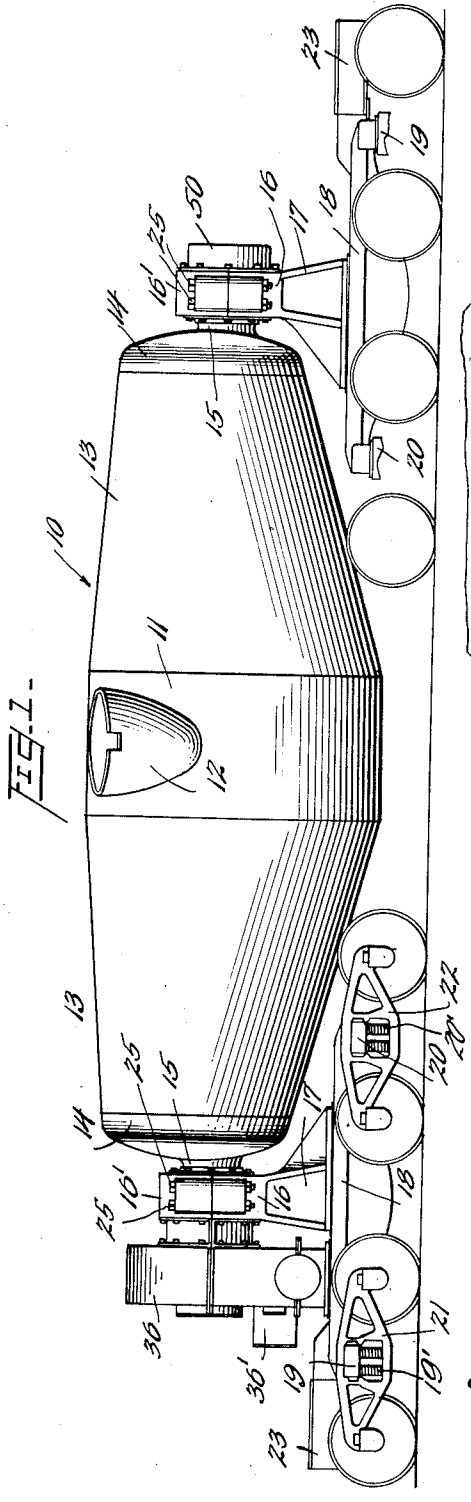


FIG. 1.

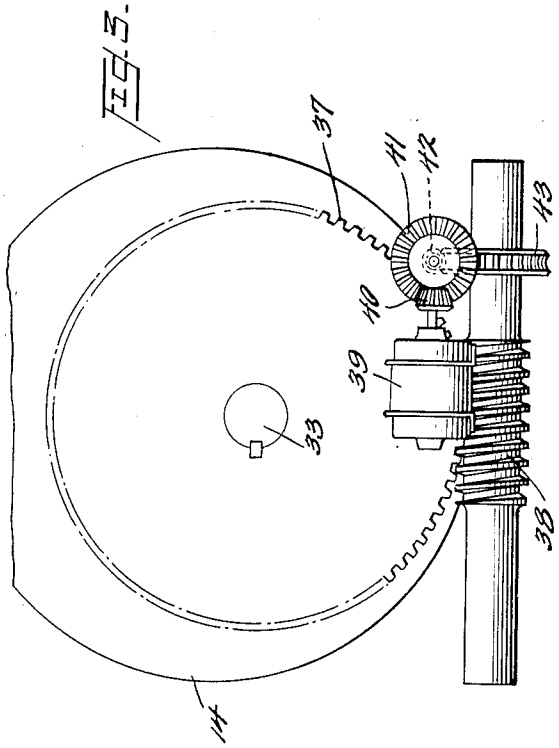


FIG. 3.

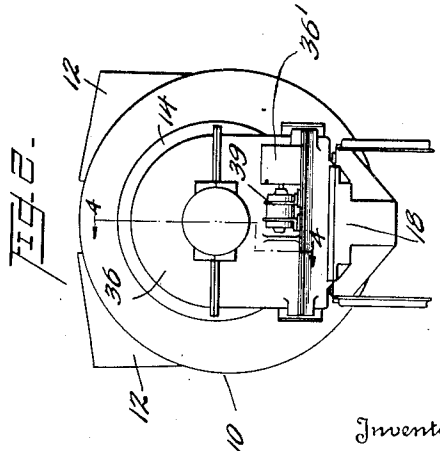


FIG. 2.

Inventor

John D. Pugh,

By Watson, Cole, Moore & Grindle

Attorneys

March 21, 1939. J. D. PUGH 2,151,391

APPARATUS FOR TRANSFERRING MOLTEN MATERIALS

Filed May 29, 1936 3 Sheets-Sheet 2

FIG. 4.

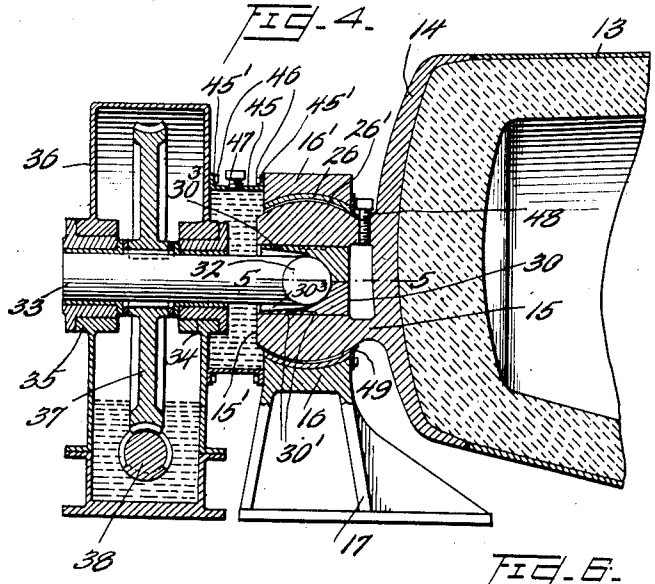


FIG. 5.

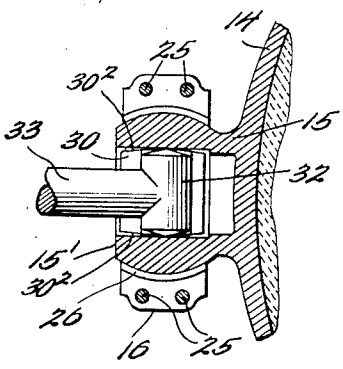


FIG. 10.

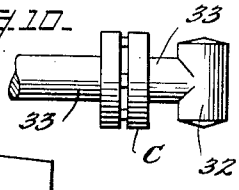


FIG. 6.

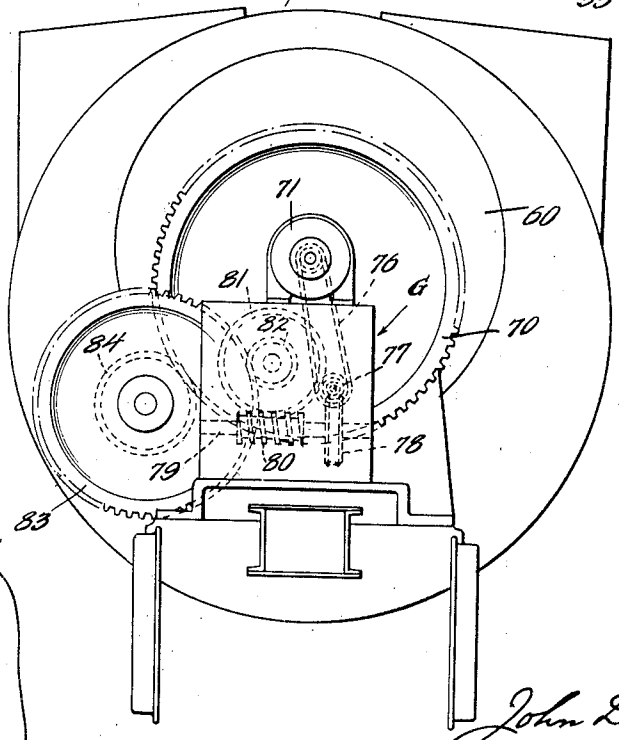
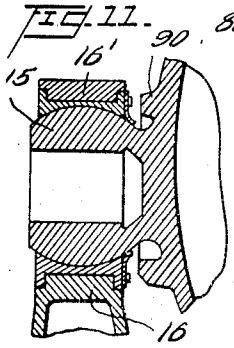


FIG. 11.



Inventor

John D. Pugh,

By Watson, Coit, Moore & Grindle

Attorneys

March 21, 1939. J. D. PUGH 2,151,391

APPARATUS FOR TRANSFERRING MOLTEN MATERIALS

Filed May 29, 1936 3 Sheets-Sheet 3

Fig. 7.

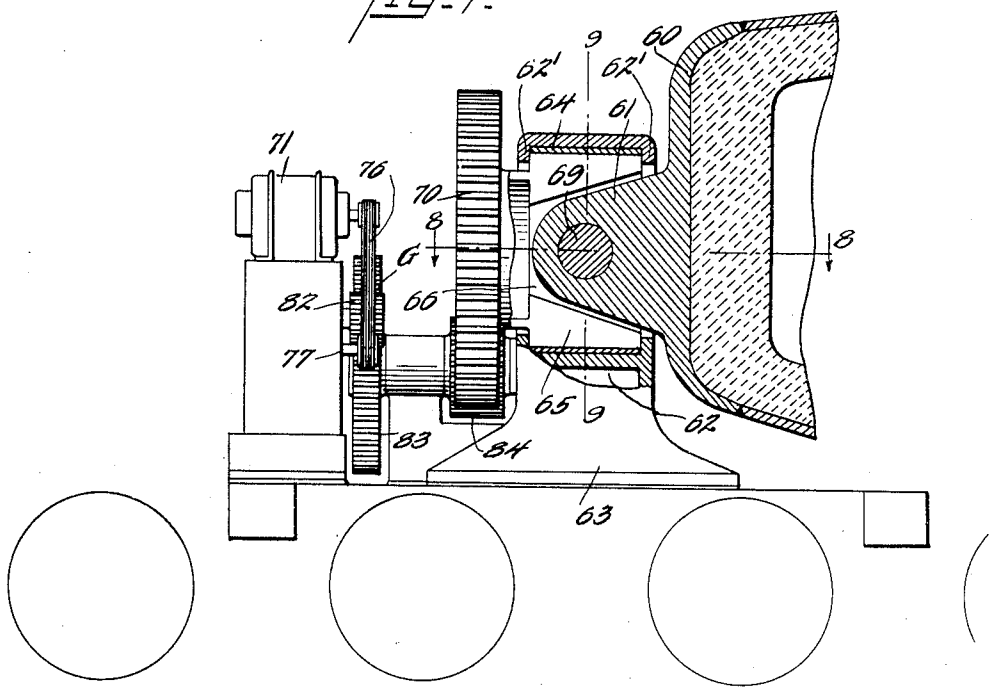


Fig. 8.

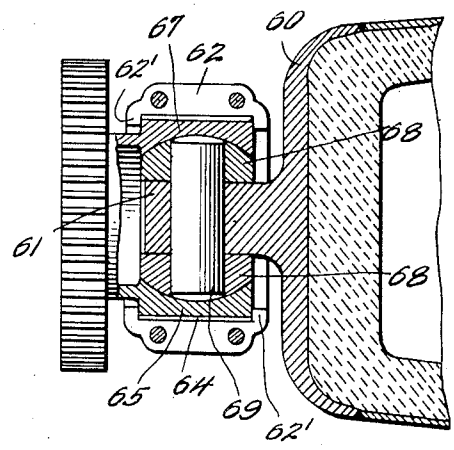
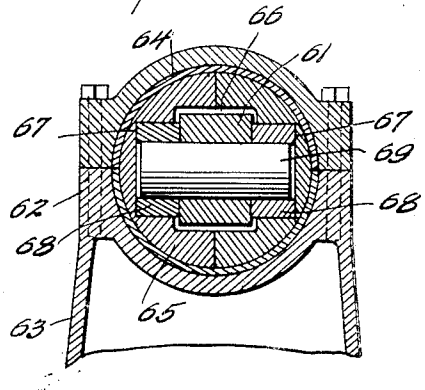


Fig. 9.



Inventor

John D. Pugh,

By Watson, Coit, Morse & Grindle

Attorneys

Patented Mar. 21, 1939 2,151,391

UNITED STATES PATENT OFFICE

2,151,391

APPARATUS FOR TRANSFERRING MOLTEN MATERIALS

John D. Pugh, Baltimore, Md.; Addie A. Pugh and F. Howard Smith, executors of said John D. Pugh, deceased, assignors to Addie A. Pugh, Baltimore, Md.

Application May 29, 1936, Serial No. 82,656

24 Claims. (Cl. 105—270)

This invention relates to apparatus for the transportation of molten materials or other fluids and more particularly to apparatus for the storage and transportation from point to point of molten iron or steel.

Apparatus of this character has been heretofore used in and around steel plants for the purpose of transporting large volumes of molten iron or steel from blast furnaces to points more or less distant and at which the molten material is cast or otherwise utilized. One such apparatus, commonly designated a hot metal car, and which has proven to be highly satisfactory in use, is disclosed in Patent No. 1,251,282, granted to me December 5, 1917. The present invention contemplates an improved type of apparatus for the transportation of molten materials embodying a number of novel features of construction which, taken together, make it possible for the user to more economically and satisfactorily transport molten materials than has heretofore been possible. It is known to those skilled in the art that molten material can be more economically and cheaply transported in large volumes than in small volumes since the heat loss by radiation is decreased relatively as the mass or volume of the body of molten material is increased. For that reason it is considered to be desirable to construct the container body of such a transportation apparatus so as to have as large a capacity as possible within the permissible limits of size and weight which obtain in the locality where the apparatus is to be used. This has led to the adoption and use of a container supported for transportation at its ends only and upon spaced railway trucks not connected to each other by the customary car underframe, the elimination of the underframe permitting the container to depend more toward the track construction and hence to be increased greatly in transverse cross-sectional area, and capacity, for a given length. Practical considerations have operated to establish a rather definite maximum length for such containers. Nevertheless mobile containers for molten materials have been constructed to have capacities of upward of 150 tons of molten iron or steel, which containers have not proven unwieldy or inconvenient in use, the containers of larger size being generally supported on spaced trucks without connecting underframes and hence relatively large in diameter.

While the essential features of my invention may be employed advantageously in connection with apparatus of this type which has much less capacity than that just referred to, the present invention is primarily directed to the improvement of apparatus embodying containers of the largest sizes. Again, while certain features of the invention may be very usefully employed in the construction of hot metal cars of the type embodying containers which are intended to be tilted or revolved for dumping purposes by means of crane operated hooks, the present invention is particularly useful when incorporated in hot metal cars of the type which includes a power driven container rotating or dumping mechanism as part of the car or apparatus. The present design of molten material transportation apparatus is such that a power means for tilting the container, such for instance as an electric motor, may be readily combined therewith.

The invention likewise makes it possible to transport a given weight or body of molten material by means of an apparatus which is itself of the lightest possible construction, thus reducing the wheel loads and the initial cost. Again, operating and maintenance costs are reduced by reduction in number of the bearings interposed between the tiltable container body and the supporting trucks, the invention contemplating the use of but a single coupling device between each truck and the adjacent end of the container, which coupling device not only supports the container for rotation, for dumping purposes, but likewise transmits the draft pull of the locomotive which is made use of to push or pull the car, and which also supports the container upon the trucks in such a way that the trucks may freely follow the track, swiveling about a vertical axis in following track curvatures and tilting in passing over track inequalities. Finally, the coupling permits any natural sagging tendency of the container body to freely occur and without resulting in the imposition of any additional strains upn the bearing parts of the coupling means.

The invention is susceptible of considerable modification insofar as its details of construction are concerned, as will be apparent to one skilled in the art, but may be said to broadly comprise in all of its forms the container body, two spaced trucks, and means including a coupling device for connecting the ends of the containers to the trucks, respectively, this coupling device supporting the container for rotation about a horizontal axis for discharging purposes, transmitting the draft strains to and from the trucks to the container body and vice versa, and permitting free movements of the trucks relatively to the container body, as heretofore pointed out.

It has heretofore been suggested that apparatus for the transportation of molten materials might advantageously be constructed by mounting the ends of a container upon spaced trucks, the container constituting the sole means for transmitting draft forces from one truck to the other. It has also been proposed that the container ends be supported in bearings to permit it to be tilted about its longitudinal axis for discharging purposes and that the bearings be mounted upon a platform or underframe which is in turn supported by a wheeled truck, the connection between platform and truck including a universal joint in order that the truck may swivel freely with respect to the platform. In such construction the bearings are so designed that the container and platform may have no relative movements save that of relative rotation about the container axis, the platform in reality forming part of the car body and the power means employed for effecting tilting of the container being mounted on the platform and directly connected to the container end.

As distinguished from cars or apparatus of the above type, in which the total articulation at each end is divided between two bearings, the present invention contemplates the use of but a single articulating bearing or coupling at each end which permits the adjacent truck to swivel freely relatively to the container and thus follow the curvatures and inequalities of the trackway while at the same time functioning as a means for the transmission of draft forces from the truck to the container or vice versa. The power means which I preferably employ for tilting the container is mounted directly upon and is movable with a truck member and is also connected to the container by a power transmission mechanism which includes a universal joint so that, despite relative movements of power means and container no strains can be imposed upon the power means due to such movements. This type of construction eliminates the necessity for the use of platforms intermediate the container and the trucks and furthermore makes its unnecessary to rigidly attach any portion of the container tilting mechanism to the container. The driving connection between power means and container is designed to permit substantial misalignment of several parts, due to change in relative positions of the power means and container, without causing the power means to be strained or cramped in any way. The trucks are so designed that they are quite able to resist draft load moments or, in other words, are longitudinally stable under draft load, being preferably relatively long, especially when the container body is relatively large in cross-section, thus causing the articulating couplings to be spaced substantial distances above the trucks.

In a preferred form, the container end is provided with a rigid trunnion projecting therefrom and the adjacent truck has rigidly supported thereon a trunnion supporting means. The trunnion supporting means is provided with spherical runnion engaging surfaces and the trunnion itself has a spherical outer surface closely engaging the trunnion receiving surface of the pedestal. The coupling between the container end and the adjacent truck, therefore, is in the nature of a universal joint which permits free movement of the truck relatively to the container body while at the same time is so constructed as to transmit draft strains. The means for applying power to the container to effect its tilting movement may be conveniently mounted upon one of the truck bolsters and connected to the container trunnion by means which includes a second universal joint so that power for effecting rotation of the trunnion may be applied at any time, regardless of the relative positions of the truck and the container body, the arrangement being such that no straining of the power driven tilting mechanism results from change of relative positions of the truck and container body. While I prefer to employ a coupling of the type just described, in which the trunnion member is integral or rigid with the container end, and the supporting bearing is mounted upon the truck, these members may be reversed in position, the trunnion member being placed upon the truck and the bearing member upon the container.

In the accompanying drawings two forms of this novel coupling mechanism are illustrated by way of example.

Figure 1 shows in side elevation one form of the conveying apparatus;

Figure 2 is an end view of the same, as seen from the left, (Figure 1);

Figure 3 is an enlarged view of certain of the parts shown in Figure 2, other parts being omitted for the purpose of clearly showing the container tilting or dumping means;

Figure 4 is a partial section on line **4—4** of Figure 2;

Figure 5 is a section on line **5—5** of Figure 4;

Figure 6 is a view generally similar to Figure 2 but on a larger scale and showing the various elements of a slightly modified form of driving mechanism for effecting tilting of the container;

Figure 7 is a side view, partially in elevation and partially in section, of a modified form of coupling and tilting mechanism;

Figure 8 is a section on line **8—8** of Figure 7;

Figure 9 is a section on line **9—9** of Figure 7;

Figure 10 is a partial plan view of a slightly modified form of container tilting mechanism; and

Figure 11 is a partial axial section through a container end, showing means for limiting the angular movement of the adjacent truck relatively to the container.

The container body is indicated generally at **10** and comprises a central cylindrical portion **11**, provided with charging and pouring spouts **12**, and two generally conical end portions **13**, the container ends comprising cup or dish shaped members **14**. Preferably the members **11** and **13** are fabricated of sheet metal and the heavier ends **14** formed by casting, the several parts being subsequently welded together. Members **13** may be true cones or eccentric cones, such as are illustrated. When shaped as shown the center of gravity of the container is below the longitudinal axis of the dish shaped members **14** and its lowermost portion is relatively close to the trackway, no underframe being necessary or used. The cross-sectional area and cubic contents of the container are therefore relatively great while the container body remains within limits determined by clearance requirements. The details of the container body, however, form no portion of the present invention and, in fact, any other suitable type of container may be substituted for that thus far described.

The means for supporting the container ends are preferably identical except in that there is connected to one such means the power operated device for effecting rotation of the container body about a horizontal axis. Only this last men-

tioned supporting means will, therefore, be specifically described.

Referring now to Figures 4 and 5, it will be perceived that the container end 14 has projecting therefrom in a generally horizontal direction a trunnion member 15. This trunnion has a spherical outer surface which is received within a bearing 16 carried by a pedestal 17 rigidly mounted upon truck span bolster 18. The ends of this truck bolster are pivotally mounted centrally upon bolsters 19 and 20 of four-wheel trucks, generally indicated at 21 and 22, respectively, springs 19' and 20' being interposed between the ends of bolsters 19 and 20 and the associated truck side frames, in the usual manner The bolster 18 carries at its outer end a draft coupling member 23 of conventional type and by which the car illustrated may be connected to an adjacent car or to a locomotive.

For the purpose of assembly, the bearing is formed in two parts, a lower portion 16 integral with the pedestal 17 and an upper portion or cap 16' securely bolted thereto as by means of the large bolts 25. Interposed between the mutually facing surfaces of the trunnion 15 and bearing 16 is a spherical anti-friction sleeve 26, which may be formed in two or more parts, the spherical inner surface of this bushing being grooved at 26' to permit the transmission of lubricant to the mutually engaging wearing surfaces of trunnion and bushing. The coupling so far described may be said to comprise a connection of the nature of a ball and socket joint, which not only effects the transfer of the weight of the container to the supporting truck but which also transmits the draft pull or push of the locomotive from the truck to the container or the draft push or pull of the container to the truck, as the case may be, and permits the trucks to swivel either horizontally or vertically with respect to the container.

This coupling construction is of utility in and of itself as applied to hot metal car constructions but is particularly useful in combinations such as shown in Figure 4, in which means for rotating the container is connected to the trunnion. It will be perceived that the trunnion 15 is provided with a relatively large recess which extends from the flat outer end surface 15' of the trunnion inwardly to the container end 14 and which is rectangular in cross-section. Within this recess is positioned a two-part block 30, comprising similarly formed halves. The flat upper and lower surfaces of block 30 fit rather closely against the upper and lower surfaces of the recess formed in the trunnion 15 and are provided with grooves 30' for the transmission of lubricant to reduce the possible wear of these interengaging surfaces to a minimum. The lateral surfaces 30^2 of block 30 are curved, as shown in Figure 5, so that the block may be rotated through an angle in either direction about a vertical axis, relatively to the trunnion 15, or, what amounts to the same thing, the container body and trunnion may move angularly, in a horizontal plane, with respect to the block. It will be understood that the terms "vertical" and "horizontal" are used only for convenience, the block and trunnion bearing at all times substantially the same relationship to each other despite changes of angular position which occur when the container is rotated.

The halves of block 30 are provided with registering semi-cylindrical recesses, respectively, to receive with a relatively close fit a transversely extending member 32 in the form of a short cylinder with rounded ends, and also are provided with outwardly flaring recesses 30^3 to receive the shaft 33 which extends axially of the trunnion and the inner end of which is integral with cross member 32. The vertical clearance between the upper and lower surfaces of shaft 33 and the adjacent walls of the recesses 30^3 formed in the halves of the block 30 permits substantial relative rocking movements of the block and shaft in a plane normal to the axis of cross member 32. It is clear that, by means of the members just above described, the shaft 33 and trunnion 15 are connected in such manner that either may move angularly with respect to the other in any direction. The permissible relative angular movement is sufficiently large to insure that no binding or cramping of the parts can occur even when the relative movements of the container and truck are greatest.

Outwardly of trunnion 15 shaft 33 is supported in spaced bearings 34 and 35 which preferably comprise integral portions of the housing 36 which is rigidly secured to the truck bolster 18. Keyed upon shaft 33 within the housing 36 is the large worm wheel 37 the teeth of which mesh with threads formed upon the horizontally extending worm shaft 38, the ends of which shaft are suitably supported in bearings (not illustrated) which are carried by the housing 36. Shaft 38 is adapted to be driven by an electric motor 39, which motor is operatively connected to this shaft by means of bevel pinion 40, bevel wheel 41, worm shaft 42 and worm wheel 43, fixed upon shaft 38. The bevel gears 40 and 41 are enclosed in a chamber 36' which comprises an extension of the housing 36, all moving parts of the operating mechanism being therefore maintained constantly lubricated and shielded from dirt. Motor 39 is reversible so that, through the gearing shown, the shaft 33 may be driven in either direction of rotation. Of course, the shaft is locked by the worm gearing just described in the position which it occupies when the operation of the motor is discontinued, until such time as the motor is again operated.

The torque transmitted to shaft 33 is of course communicated through cross member 32 and block 30 to the trunnion 15, and hence to the container body, and by means of the mechanism just described the container body may be revolved through any desired angle to effect discharge of its molten contents and thereafter returned to its normal position. It is obvious also that the tilting or dumping mechanism is so connected to the trunnion as to be freely operable quite regardless of the fact that the axis of the trunnion may be disposed at an angle to the axis of shaft 33, due either to the natural sagging of the container body or the tilting of the truck bolster 18 with respect to the container body because of track inequalities. The advantages of this simple form of power connection are readily apparent.

In the event that it appears desirable to do so for any reason, an additional flexible coupling such as indicated at C in Figure 10 may be interposed in the driving connection between block 30 and the motor. In this construction the shaft 33 may be formed in two parts, which parts may be connected by any suitable flexible coupling. Conveniently the coupling may be positioned in the lubricant chamber in order that it may be thoroughly lubricated at all times.

It is desired that the coupling members and all

moving parts of the driving mechanism be maintained adequately lubricated and sealed against outside dirt at all times and to this end a lubricant containing chamber encircles shaft 33 intermediate housing 36 and the trunnion supporting pedestal. A two-part cylindrical casing 45 encircles shaft 33, this casing having annular flanges 45' at its ends which flanges are secured by bolts 46 to the mutually facing surfaces of the housing and pedestal. A suitable lubricant may be introduced into this casing through the capped port 47, the interior of the casing being preferably completely filled with lubricant, which is replenished from time to time to maintain this condition. The lubricant not only flows through the grooves 26' to lubricate the interengaging surfaces of trunnion 15 and bushing 26 but likewise flows through the grooves 30' to lubricate the outer surfaces of block 30, which surfaces have some slight sliding motion with respect to the surfaces of the trunnion recess. A capped lubricant port is indicated at 48 and through this port or duct lubricant may be introduced into the inner end of the trunnion recess, beyond the inner end of the two-part block 30. To prevent escape of lubricant from between the interengaging spherical surfaces of trunnion 15 and bushing 26, an annular lubricant guard 49 is provided, this guard being formed of flexible fibre or other suitable material and sealing at all times the annular joint at the inner end of the spherical bushing 26.

While I may employ at the opposite end of the container a coupling of specifically different type, I preferably employ one identical with that shown in Figures 4 and 5 of the drawings, it being unnecessary, however, to also provide at said end an additional power means for effecting rotation of the container. Such other trunnion need not therefore be recessed and will be recessed only in the event that it is desirable to lighten the weight of the structure. It may be provided, however, with a chamber for lubricant, generally similar in function to the lubricant chamber which encircles the shaft 33, this chamber being indicated at 50 in Figure 1.

It will be perceived that the vertical axis of the pedestal 17 is shown to be, in Figure 1, substantially midway between bolsters 19 and 20 of the supporting truck. It is desired that the loads transmitted to the several supporting wheels shall be equal and hence that the resultant of the weights imposed upon the truck by the container and also by the container tilting mechanism be midway betwen the truck bolsters. Hence pedestal 17 may be located slightly inwardly of the mathematical center of bolster 19 in view of the fact that the weight of the motor, housing and driving gearing also mounted upon the platform 18 is outwardly of the mid-point of the pedestal.

In the form of the invention shown in Figures 6, 7, and 8, the container end 60 is shown to have an axially projecting lug 61 which is not spherical but which, on the other hand, tapers outwardly and is rectangular in cross-section at all points. Lug 61 extends into a bearing 62 supported upon a pedestal 63 mounted upon the truck bolster. Bearing 62 is formed in two parts as shown and is cylindrical. Within the bearing is a cylindrical bushing 64 and closely fitting within bushing 64 is a two-part cylindrical block 65.

The two halves of block 65 are provided with similar registering recesses 66 which, taken together, form an outwardly tapering recess within which the outwardly tapering lug 61 is received, with a clearance above and below the same, as shown in Figure 7. Each half of block 65 is further interiorly recessed or slotted as indicated at 67, the slots being rectangular in vertical section as shown in Figure 9 and cylindrical in horizontal section, as shown in Figure 8. Snugly fitting in slots 67 are shoes 68 having cylindrically curved outer faces and flat inner faces which rest against the sides of lug 61. A pin 69 extends through registering cylindrical apertures in lug 61 and shoes 68.

It will be perceived that block 65 is positively retained within bearing 62 by the bearing flanges 62', but may freely rotate. Also that the shoes 68 are securely retained by the block 65 and lug 61 against movement axially of the bearing. Finally the lug 61 is securely anchored to blocks 68 by pin 69. It is clear, therefore, that the construction shown constitutes a coupling through which draft forces may be communicated to the container from the truck, or vice versa, which permits the container to be revolved on its horizontal axis when this is necessary, and which likewise permits free universal movement of the truck relatively to the container. This coupling functions similarly, therefore, to that form of coupling first described.

Rotation of the container to effect discharge of its contents may be brought about by rotating the bearing block 65, the rotary motion of which is of course simultaneously communicated to the lug 61 and container body. To block 65 is rigidly secured external gear 70 and power for the operation of block 65 and the container is transmitted from the reversible electric motor 71 to gear 70 through suitable intermediate gearing, indicated generally at G. The speed of the motor must of course be greatly reduced by the action of the gearing as the large and heavy container must be revolved very slowly indeed, particularly when discharging metal. I have found it desirable to use for this purpose, in some cases, a reduction gearing having two worm wheels and two worms, such as that illustrated in Figure 6. Here the motor 71 is connected by chain 76 to worm shaft 77 which is geared to worm wheel 78. Worm wheel 78 is fixed on shaft 79 to which shaft is also keyed worm 80. Worm 80 operates worm wheel 81 and this last worm wheel is operatively connected to the large trunnion or container revolving gear by means of pinion 82, gear 83 and small gear 84.

It sometimes happens that derailment occurs, due to trackway defects, and it may therefore be desirable to provide means to prevent excessive angular movement of the trucks with respect to the container such as might result were such means not provided, and which excessive angular movement might result in injury to or breakage of the container tilting mechanism. To this end I may provide an abutment member upon the container end, for instance a circular collar or ring such as indicated at 90 in Figure 11, concentric with the trunnion 15 and integral with or rigidly attached to the container end wall. Upon a straight level trackway the annular face of this collar will be substantially equidistantly spaced at all points from the inner face of the bearing comprising members 16 and 16'. In the ordinary operation of the apparatus no part of the trunnion bearing will strike the abutment ring but, should derailment occur and the truck tend to swivel excessively with respect to the container body the bearing will contact at one point or another

with the ring **90**, the ring acting as an abutment limiting this swinging motion of the truck and preventing injury to the container tilting mechanism. Obviously the abutment member may be formed in other ways if desired and, in fact, numerous elements of the apparatus may be modified materially in shape and position without departure from the spirit and scope of the invention.

Throughout the specification the term bolster is used to indicate the main supporting beams, extending either longitudinally or transversely, of a truck structure which in transit will substantially conform to track variations and therefore assume various angular positions with respect to the container body.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. Apparatus for the transportation of molten materials or other fluids comprising an elongated container, wheeled trucks at the ends of the container, and a connection between each truck and the adjacent end of the container, each such connection including a coupling having the nature of a universal joint, said coupling being positioned on the extended axis of the container.

2. A hot metal car comprising an elongated container adapted to transmit draft forces and spaced wheeled trucks for supporting the container at its ends, and supporting connections between the trucks and container ends, one such connection including a universal coupling adapted to transmit draft forces to and from the container.

3. A hot metal car comprising an elongated container and spaced wheeled trucks for supporting the container at its ends, and supporting connections between the trucks and container ends, one such connection including a member rigid with the container end and having a spherical outer surface, and a member mounted on the truck and having a spherical bearing surface which engages the spherical outer surface of said first member, whereby the container is connected to the trucks for the transmission of draft forces therebetween, and is supported for universal movement relatively to the trucks and for rotation about an axis for discharging purposes.

4. A hot metal car comprising an elongated container and spaced wheeled trucks for supporting the container at its ends, means connecting the container ends to the trucks respectively whereby the container is supported directly on the trucks for rotation about a generally horizontal axis, and power means mounted directly upon one of the trucks and connected to the container by a torque transmitting element disposed axially of the container and connected to the container for universal movement relatively thereto.

5. A hot metal car comprising an elongated container and spaced wheeled trucks for supporting the container at its ends, means connecting the container ends to the trucks respectively whereby the container is supported on the trucks for universal movement and rotation about its longitudinal axis, and power means rigidly mounted upon one of the trucks and connected to the container end by a power transmission line which includes a torque transmitting element and a universal joint.

6. The combination set forth in claim 5 in which the means for supporting the container end upon one of the trucks includes an axially extending trunnion rigid with the container body, and a bearing therefor mounted on the truck, the power transmission line having an element disposed axially of the trunnion and having a universal connection to the trunnion.

7. A hot metal car comprising an elongated container and spaced wheeled trucks for supporting the container at its ends, means supporting the container ends upon the trucks for universal movement, one such means including a trunnion rigid with one end of the container and having a spherical outer surface and a spherical bearing mounted upon the truck and encircling the trunnion, and power means mounted on the truck and operatively connected to the trunnion by a power transmission connection which includes a universal joint.

8. A hot metal car comprising an elongated container and spaced wheeled trucks for supporting the container at its ends, means supporting the container ends upon the trucks for universal movement, one such means including a trunnion rigid with one end of the container and having a spherical outer surface and a spherical bearing mounted upon the truck and encircling the trunnion, power means mounted on the truck for rotating the container, and a power transmission connection between said power means and said trunnion, said connection having a shaft disposed axially of the trunnion and operatively connected thereto through a universal joint.

9. The combination set forth in claim 8 in which the trunnion has an axially disposed recess non-circular in cross-section and the universal joint includes a block of non-circular cross-section positioned within said recess.

10. Means for mounting the end of a hot metal container upon a wheeled truck comprising a trunnion rigid with the container, a trunnion bearing rigid with the truck, and a chamber for lubricant secured to the bearing and open to the joint between trunnion and bearing.

11. A hot metal car construction comprising a wheeled truck, a bearing rigidly mounted on the truck, a housing rigidly mounted on the truck adjacent the bearing, a power shaft extending through the housing wall and into the bearing, and a container trunnion extending into the bearing from the opposite direction, said trunnion and shaft having a universal driving connection within the bearing.

12. The combination set forth in claim 11 in which the power shaft is encircled by a casing secured to the housing and bearing and defining therewith a tight chamber for a lubricant.

13. A hot metal car comprising an elongated container, wheeled trucks, and a ball and socket coupling between each end of the container and the adjacent truck located on the extended axis of the container, said couplings supporting the container for rotation about a horizontal axis and permitting free vertical distortion of the container when it tends to sag or deflect because of its own weight and the weight of its contents.

14. A hot metal car construction comprising a container and spaced trucks, the ends of the container being secured to the trucks by couplings which permit rotation of the container about a horizontal axis, transmit draft pull, and permit universal movement of each truck relatively to the container, one such coupling including a cylindrical bearing secured to a truck, a cylindrical block secured within the bearing and a universal connection between the block and container end.

15. A hot metal car comprising an elongated

container and spaced wheeled trucks for supporting the container at its ends, means supporting the container ends upon the trucks for universal movement, one such means including a trunnion rigid with one end of the container and having a spherical outer surface and a spherical bearing mounted upon the truck and encircling the trunnion, and abutment means rigid with the container for limiting, by contact with the bearing, the angular movement of the truck with respect to the container.

16. The combination set forth in claim 15 in which said abutment member comprises a ring which encircles and is centered upon the trunnion axis.

17. Apparatus for the transportation of molten materials or other fluids comprising a container, wheeled trucks at the ends of the container, and means associated with each truck for transmitting thereto portion of the weight of the container and contents, one such means including a single coupling device comprising two relatively movable interlocking members, one rigid with the container and the other with the truck, said device supporting the container for rotation about a generally horizontal axis while permitting swinging movement of the truck relatively to the container.

18. Apparatus for the transportation of molten materials or other fluids comprising a container, wheeled trucks at the ends of the container, and means associated with each truck for transmitting thereto portion of the weight of the container and contents, one such means including a single coupling device comprising two relatively movable interlocking members, one rigid with the container and the other with the truck, said device supporting the container for rotation about a generally horizontal axis while permitting the truck to have universal movement with respect to the container.

19. Apparatus for the transportation of molten materials or other fluids comprising a container, wheeled trucks at the ends of the container, and means associated with each truck for transmitting thereto portion of the weight of the container and contents, one such means including a single coupling device comprising two relatively movable interlocking members, one rigid with the container and the other with the truck, said device supporting the container for rotation about a generally horizontal axis, transmitting draft forces from the truck to the container, and permitting the truck to swivel relatively to the container, the trucks not being connected by means other than the container.

20. Apparatus for the transportation of molten materials or other fluids comprising a container, wheeled trucks at the ends of the container, means associated with each truck for transmitting thereto portion of the weight of the container and contents, one such means including a single coupling device comprising two relatively movable interlocking members, one rigid with the truck and the other rigid with the container, said device supporting the container for revolution about a generally horizontal axis while permitting the truck to swing relatively to the container, and means for limiting the swinging movement of the truck relatively to the container.

21. Apparatus for the transportation of molten materials comprising a container and spaced wheeled trucks for supporting the container at its ends, each supporting truck including a longitudinally extending bolster, pivot supported means rigid with and disposed above each bolster, a pivot connecting each such means to the adjacent end of the container, and means resiliently supporting each bolster at longitudinally spaced points upon the truck of which it forms a part, whereby the bolster may have a limited rocking movement about said pivot when draft forces are applied to said truck.

22. Apparatus for the transportation of molten materials comprising a container and spaced wheeled trucks for supporting the container at its ends, each supporting truck including a bolster extending longitudinally thereof, a pedestal rigidly secured to said bolster and extending upwardly therefrom, pivot means connecting the upper end of each pedestal to the adjacent end of the container, and means resiliently supporting each bolster at longitudinally spaced points upon the truck of which it forms a part so that the bolster and pedestal may rock slightly about said pivot means when draft forces are applied to said truck.

23. Apparatus for the transportation of molten materials comprising a container and spaced wheeled trucks for supporting the container at its ends, each supporting truck including a longitudinally extending bolster, a pedestal rigidly secured to said bolster and extending upwardly therefrom, a ball and socket connection between the upper end of each pedestal and the adjacent end of the container, and means resiliently supporting each bolster at longitudinally spaced points upon the truck of which it forms a part so that the bolster and pedestal may rock slightly about said connection when draft forces are applied to said truck.

24. Apparatus for the transportation of molten materials comprising a container and spaced wheeled trucks for supporting the container at its ends, each supporting truck including a longitudinally extending bolster, pivot supporting means rigid with and disposed above each bolster, a pivot connecting each such means to the adjacent end of the container, and springs supporting the ends of each bolster upon the truck of which it forms a part whereby the bolster may have a limited rocking movement about said pivot means, against the action of the springs at one end thereof, when draft forces are applied to said truck, the entire weight of the container being at all times transmitted to the trucks through said springs.

JOHN D. PUGH.