March 21, 1939. J. D. PUGH 2,151,392

APPARATUS FOR THE TRANSPORTATION OF MOLTEN MATERIALS

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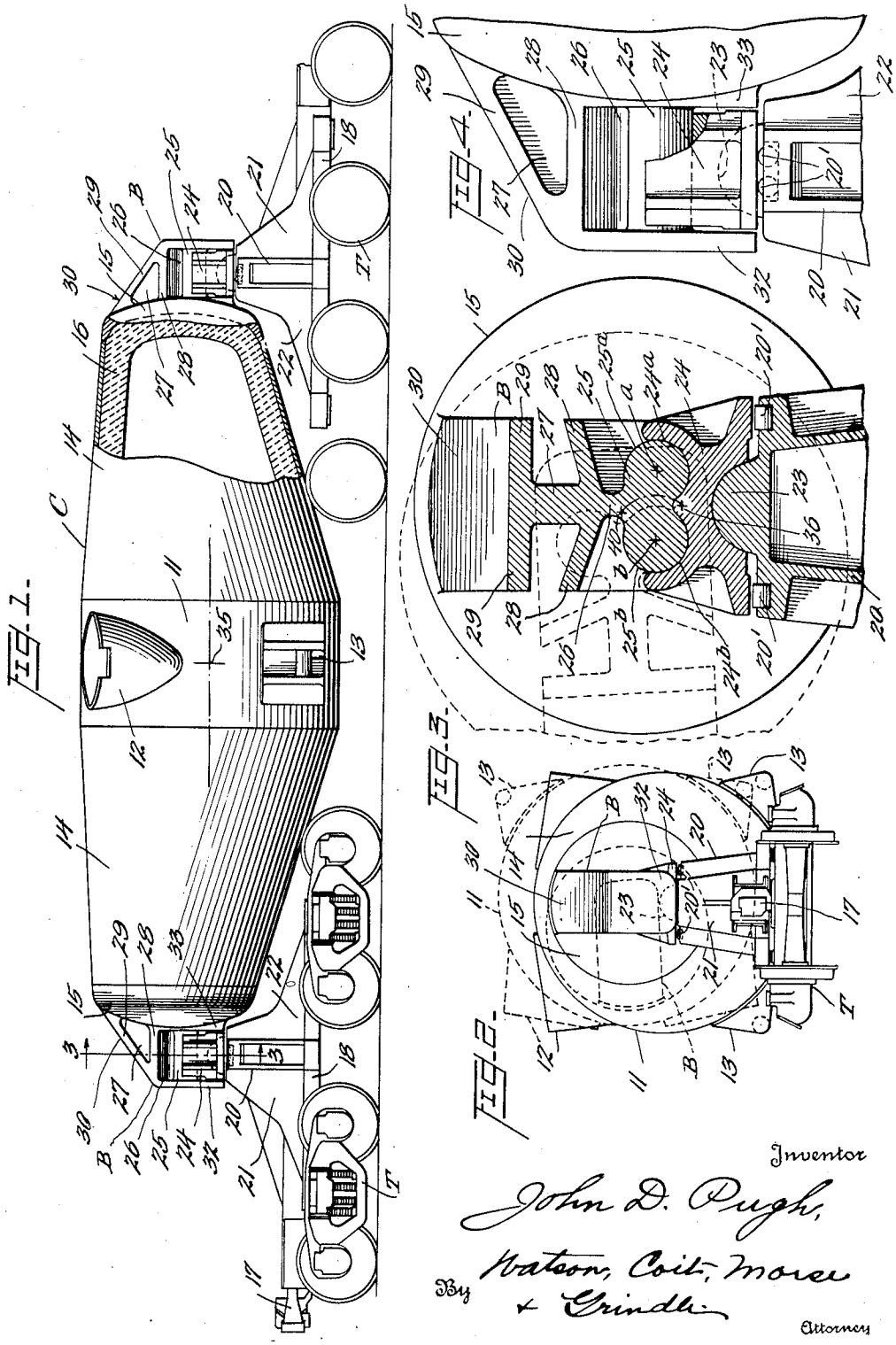

Inventor
John D. Pugh,
By Watson, Coit, Morse & Grindle
Attorneys

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FIG. 5.

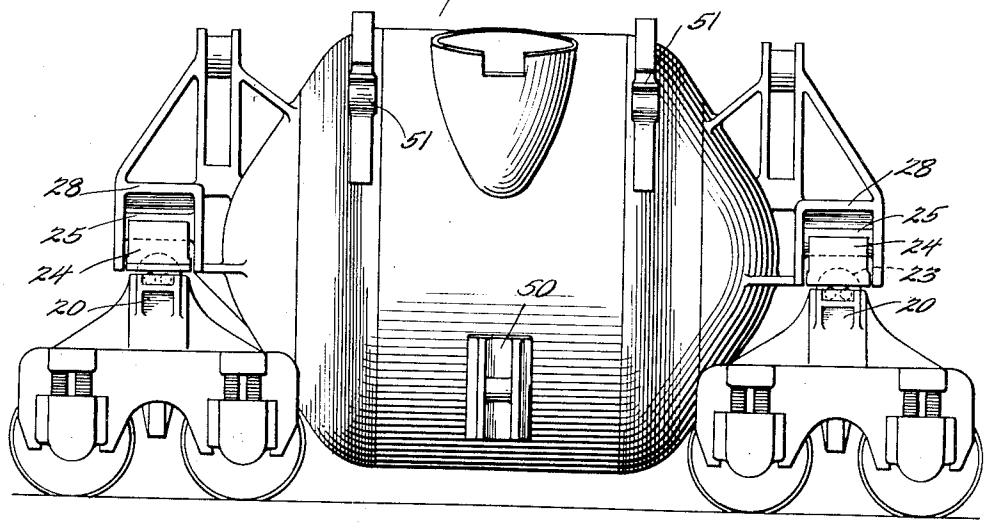
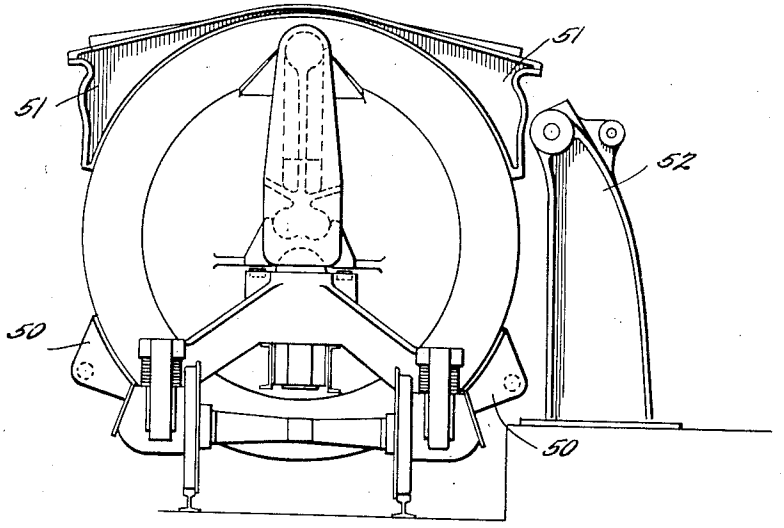


FIG. 6.



Inventor

John D. Pugh,

Watson, Coit, Morse & Grindle

By

Attorneys

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APPARATUS FOR THE TRANSPORTATION OF MOLTEN MATERIALS

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FIG. 7.

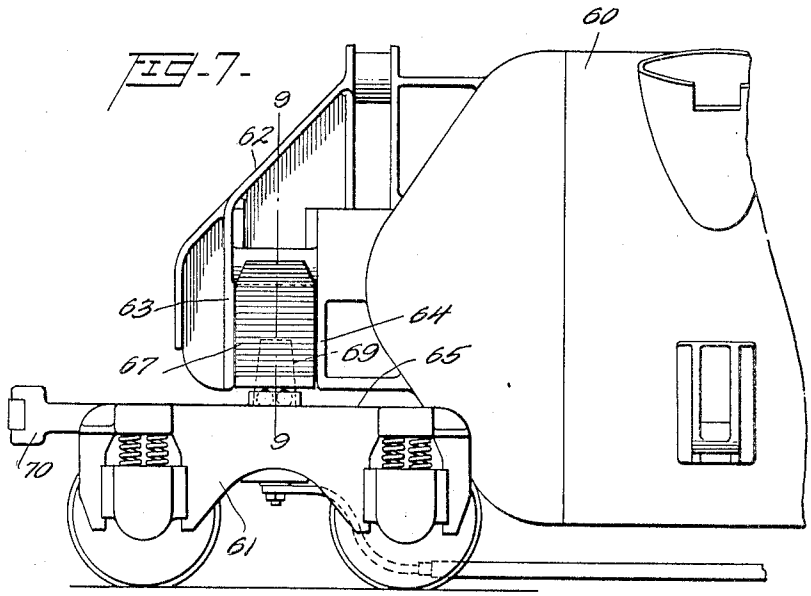
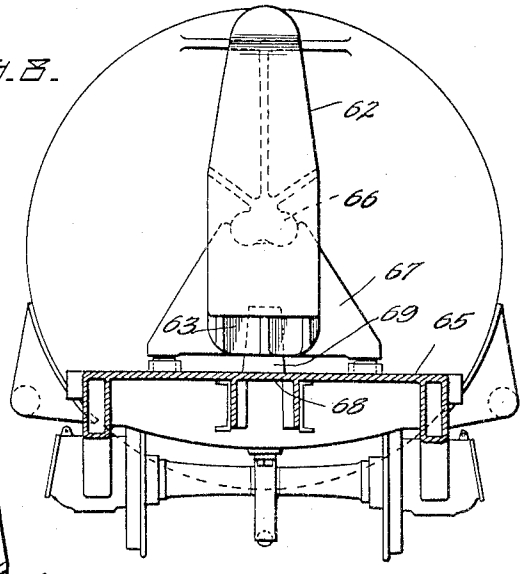


FIG. 8.



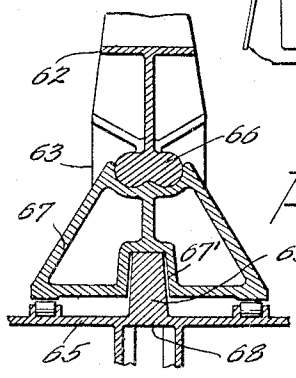


FIG. 9.

Inventor

John D. Pugh,

Watson, Coit, Morse & Grindle

By

Attorney

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APPARATUS FOR THE TRANSPORTATION OF 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 June 5, 1936, Serial No. 83,766

20 Claims. (Cl. 105—270)

The present invention relates to apparatus for the transportation of molten materials and particularly to mobile units of the type commonly designated hot metal cars and which are made use of in and around steel plants for the transportation of molten steel and iron, in some instances for substantial distances.

Apparatus of this general type has long been known and made use of, contributing greatly to the convenience and flexibility of operation of steel plants since by means of its use it is possible to transport steel or iron in molten condition from a permanently located furnace to any one of a number of points at which the molten material is to be cast or otherwise utilized. The modern tendency is to build such mobile transportation units, comprising containers mounted upon wheeled trucks, with tiltable ladles or containers of large size since it has been proven to be more economical to transport molten metal in large single bodies than in a plurality of smaller bodies, the larger single body having less heat loss enroute than the same amount of metal divided into two or more smaller bodies. Containers of the closed type, such for instance as disclosed in Patent No. 1,251,282, issued to me December 5, 1917, have been found to be quite efficient in operation since the heat lost by the metal during transportation is minimized, and for other reasons. Transportation apparatus of the type comprising a tiltable container mounted upon a wheeled support, or upon spaced trucks, may be further classified as to type with respect to the means employed for, or the method of, effecting tilting of the container and discharge of the molten contents thereof at its point of destination. Thus the container may be tilted about an axis by a power device forming a portion of the car or transportation apparatus itself, or the car or apparatus may have no such power device and instrumentalities permanently located at a destination point, such for instance as an overhead crane or the like, may be relied upon to effect the container tilting or dumping movements.

In the steel industry transportation units of the first mentioned type are known as motor dump cars and units of the last mentioned type are commonly designated crane dump cars. In the motor dump hot metal car the center of gravity of the container lies approximately upon its axis of rotation, or should theoretically be so located to reduce to a minimum the force which must necessarily be exerted upon the container to effect its rotation. With a unit of the crane dump type, however, the center of gravity of the container is located below the horizontal plane of the container supporting element in order that the container may be self-righting, that is, will assume a normal position with pouring apertures or spouts uppermost when released by the crane hooks employed for tilting purposes. Customarily containers of the motor dump type are mounted upon axially aligned trunnions, one at each end of the container, and containers of the crane dump type are supported at their ends upon spaced parallel trunnions, two at each end of the container, the corresponding trunnions at opposite ends being axially aligned with each other and the two sets of aligned trunnions being positioned upon opposite sides of, and equally spaced from, a vertical plane extending longitudinally of the container and passing through its center of gravity. With the crane dump type of container, therefore, discharge is effected by tilting or rotating the container about either one or the other of two parallel axes disposed upon opposite sides of a vertical longitudinally extending plane passing through its center of gravity.

It has heretofore been suggested that in the construction of hot metal cars of the motor dump type the usual car underframes may advantageously be omitted, thus permitting the container itself to depend farther toward the trackway than is permissible where underframes are employed, making it possible to construct the container of larger diameter and greater capacity for a given length of car than is possible where underframes are made use of. The present invention contemplates a hot metal car construction of the crane dump type in which the various elements are so designed and arranged that the usual car underframes may be dispensed with and a container of large diameter and volume for a given length made use of. By the elimination of the underframes a great saving in weight is effected and the cost of the apparatus considerably reduced, as well as its capacity for a given length and height increased.

A further and an important purpose of the invention is to provide an apparatus of the type described which will require the expenditure of the least possible amount of energy in effecting the dumping thereof. The weight of container and contents is very substantial in many cases, certain containers being designed and constructed for the reception of as much as 150 tons of metal, or even more. The frictional forces exposing ro-

tation of such a container about the axis determined by two aligned trunnions are relatively great and substantial amounts of power must ordinarily be expended in effecting such tilting movements. Each pair of aligned trunnions has heretofore been customarily designed and constructed to withstand in and of itself the entire weight of the container and contents since, when the container is tilted, one pair of trunnions becomes ineffective and the entire weight of the container and contents is carried by the other pair. The trunnions have therefore heretofore been necessarily constructed relatively large in diameter and these large diameter trunnions are revolved with difficulty in the seats provided for their reception and support when the container is fully loaded, the larger the diameter of the trunnion, the greater the resistance which is offered to tilting movement.

In accordance with the present invention the frictional forces which resist tilting movement of a container of the crane dump type about either of its axes of rotation are minimized by so designing the supporting means that there is, in effect, only a single trunnion member at each end of the container. Such trunnion member is so constructed, however, as to have two cylindrical bearing surfaces centered about parallel axes so that the stability of the container and its self-righting properties are not lost. These novel trunnion members are made sufficiently strong to transmit without danger of failure the weight of the container and contents to the trunnion supports but, as these members never leave their respective supports, all portions of each of them are at all times effective in transmitting the weight of the container to the associated trunnion support, whether the container is tilted or not. It is clear that, when a trunnion construction such as just above described is made use of, having two axes and two bearing surfaces, that the effective area of each bearing surface may be very considerably reduced as compared with the bearing surface of a single trunnion of the type heretofore commonly employed, for a container of given weight and capacity. Hence the frictional forces opposing tilting movements of such container are reduced. This is true whether the container is being rotated by means of a crane hook for tilting purposes, or is being allowed to return toward normal position after a dumping operation. Hence it is possible to so design the container that its center of gravity is higher with respect to the plane of trunnion support than has been heretofore deemed to be advisable. When the container is tilted, of course, it is the pull of gravitational force, effective at its center of gravity, which tends to return it to normal position, this gravitational force having an effective lever arm equal to the horizontal distance between the center of gravity and the axis of rotation.

Where the frictional forces opposing self-righting of the container have been great, as generally experienced with constructions heretofore known or used, the lever arm of the center of gravity must be correspondingly large to overcome these forces and effect self-righting. With reduction in the frictional forces opposing self-righting of the container in accordance with my present invention, however, the lever arm of the center of gravity with respect to either axis of rotation may be greatly reduced without decreasing its self-righting ability and hence the parallel axes of rotation or tilt may be brought closer together. This in turn makes it possible to tilt the container for discharging purposes with the expenditure of less power than has heretofore been found necessary, since the center of gravity is relatively close to both axes of rotation and need be lifted only a short distance to effect even a complete tilting or dumping movement.

The advantage of reducing as far as possible the frictional forces opposing tilting of the container are thus apparent. I prefer to so form the trunnion members and so design the container which they support that the center of gravity of the container is closely adjacent the parallel axes of rotation and only slightly below the horizontal plane of these axes. Nevertheless in its broadest aspects, the invention will be found to be of advantage when the axes of rotation or tilting movement of the container are spaced apart substantial distances providing, of course, that but a single trunnion member at each end of the container is made use of, which trunnion is provided with two trunnion support engaging surfaces, as hereinbefore set forth.

The invention also makes it possible to effect substantial savings in weight over similar types of cars heretofore designed or suggested, the means at the ends of the container for transmitting the weight of the container to the spaced supporting trucks being so designed and constructed that not only may underframes be dispensed with but all draft moments are adequately taken care of by very simple means. Hot metal cars of the crane dump type and tiltable about either of two axes have heretofore been constructed with underframes and hot metal cars of the motor dump type not provided with underframes have been constructed with means at the ends of the container of large size and great weight for mounting the container ends upon the spaced trucks and at the same time adequately taking care of draft movements. It will be understood that draft moments of substantial magnitude may arise in a car in which the container end is connected to a truck at a point well above the coupler which is employed to connect the truck to an adjacent car or locomotive. The present invention contemplates a car of the crane dump type and without underframes which nevertheless is rigidly braced by relatively simple means against strain or injury due to draft forces or moments. The novel means which I employ to support the ends of the containers upon the spaced trucks may be varied considerably in the details of its design but in every instance provides full articulation between the container and each of its supporting trucks whereby the trucks are free to follow the inequalities in the trackway over which the unit is passing and to freely swing laterally with respect to the container, without cramping or straining any portion of the unit.

In the accompanying drawings several forms of the apparatus are illustrated by way of example, which embodiments will be hereinafter described in detail.

In the drawings:

Figure 1 is a side elevation, partly broken away, of one embodiment of the transportation apparatus;

Figure 2 is an end elevation of the same;

Figure 3 is a section on line 3—3 of Figure 1, but upon a larger scale and showing certain of the parts in different positions by means of full and dotted lines;

Figure 4 is an enlarged side elevation, partly

broken away of the container end and portion of its supporting means;

Figure 5 is a side elevation of a hot metal car of somewhat less capacity than that shown in Figures 1 and 2, showing the invention incorporated therein;

Figure 6 is an end view of the same;

Figure 7 is a side elevation of a hot metal car having a somewhat modified form of means for supporting the container ends upon the spaced trucks;

Figure 8 is an end view of the same; and

Figure 9 is a section on line 9—9 of Figure 7.

The exact shape of the container is not material to the invention which contemplates the use of containers of any desired size or shape. Nevertheless containers of the closed type, such as indicated at C, are preferred and the container may advantageously comprise the central cylindrical section 11, provided with the pouring spouts 12 and brackets 13 for engagement by crane hooks, the end sections 14 in the form of eccentric cones and the end plates 15, these end plates being preferably relatively heavy castings, the several sections of the container being rigidly secured together as by welding, and the container as a whole being lined with a suitable refractory material, such as indicated at 16.

Spaced trucks are indicated at T, T and these trucks may be of any suitable type. In the form of the invention shown in Figures 1 and 2, however, where the container C is relatively long and is of large capacity, I may advantageously use an eight wheeled truck at each end of the container in order that each truck may have great longitudinal stability under draft pull, despite the mounting of the container upon the trucks with its longitudinal axis spaced vertically a substantial distance above the coupling devices, one of which is indicated at 17. Each truck T includes a platform or bolster 18 upon each of which is fixed, midway of the length of the truck, a pedestal 20, this pedestal extending transversely of the truck but having reinforcing members or webs 21 and 22 extending longitudinally and serving to brace the pedestal and to render it rigid under all operating conditions.

The means for supporting the container ends upon the truck pedestals will now be described. Preferably the supports at the container ends are identical in construction and it is only necessary to describe in detail one of such supports.

By reference to Figure 3 it will be perceived that pedestal 20 has projecting upwardly from its upper surface a convex hemispherical member 23 which member is in the nature of a king pin. Immediately above the pedestal is a block 24 having a central downwardly opening concave hemispherical recess to closely receive the king pin 23. Block 24 may therefore swivel with respect to the pedestal and in the operation of the unit such swiveling action will constantly occur through limited distances as the trucks swing horizontally in following curvatures and rock slightly in vertical planes as the unit passes over track inequalities or over vertical curves in the trackway. Rollers 20' constitute limiting stops preventing excessive lateral tilting movements of block 24 upon pedestal 20 while at the same time preventing binding of the adjacent surfaces of block and pedestal should the truck upon which the pedestal is mounted swing horizontally while one lower surface or the other of block 24 is in contact with the adjacent sets of rollers 20'.

In the top of block 24 are formed two cylindrical recesses 24*a* and 24*b*, these surfaces being centered about horizontally disposed parallel axes passing through the points indicated at *a* and *b*, respectively. The trunnion member is indicated at 25, this member having two cylindrical surfaces, indicated at 25*a* and 25*b*, also centered about parallel axes which pass through the points indicated at *a* and *b*, the cylindrical surfaces, hereinafter designated bearing surfaces of the trunnion member, being closely seated upon the surfaces 24*a* and 24*b*, hereinafter designated seating surfaces. Trunnion member 25 is relatively short, as will be observed from an inspection of Figures 1 and 4 and is rigid with the container end. In reality it is formed as a double or twin trunnion the adjacent portions of which merge so as to form a single member. The trunnion block 24, being freely movable upon the king pin 23, will naturally accommodate itself to the trunnion so that interengaging surfaces of trunnion and trunnion block will be contiguous at all times save when the container is tilted, in which event one of the curved trunnion bearing surfaces will leave the corresponding seating surface and the other bearing surface will slide upon the seating surface with which it contacts.

A bracket rigid with the container end is generally indicated at B and it will be observed from an inspection of Figures 3 and 4 that this bracket has a central horizontal web 26 which merges with the top of the trunnion member 25 and also with a vertically disposed rib 27 directly above it, rib 27 having laterally extending stiffening flanges 28. The upper edge of rib 27 merges with diagonal strengthening member 30 which extends from the outer ends of flanges 29 upwardly and inwardly toward the top of container end 15, being rigid or integral with the container end adjacent the top thereof. From the outer end of diagonal member 30 there extends downwardly in a vertical transverse plane a plate 32 hereinafter designated a collar, plate 32 being integral with the outer end of the trunnion member 25. It also extends downwardly beyond the trunnion member, as shown most clearly in Figure 4, its horizontally disposed lower edge paralleling the lower outer corner of the trunnion block 24. Rigid with the container end and having a surface facing the inner surface of collar 32 and parallel thereto is a second collar 33, the collars 32 and 33 in reality forming a housing for the block 24 and preventing relative movement of the block and container in a direction longitudinally of the container. The bracket B, therefore, serves to support the trunnion member and also has a portion which comprises one of the two parallel collars for transmitting draft thrust or pull from the trunnion block 24 to the container or vice versa. It will be observed that the king pin 23 projects upwardly into the space intermediate the collars 32 and 33. This ensures that all draft forces are transmitted directly from the truck pedestal to one or the other of collars 32 and 33 and hence to the container without creating moments or imparting any additional strain to the trunnion.

A horizontal line passing through the center of gravity of the container, which center of gravity is indicated at 35 in Figure 1, and parallel to the longitudinal axis of the container as determined by its trunnions, will intercept a transverse plane passing through the trunnion block at the point 36, shown in Figure 3, only slightly below the trunnion axes, which axes pass through the points *a* and *b*, and is equidistantly spaced from these

axes. When the container is rotated or tilted about either trunnion axis, for instance through an angle which results in movement of the bracket and trunnions from full line position to dotted line position in Figure 3, the center of gravity will follow the path indicated in chain lines in that figure, moving from the point indicated at **36** to the point indicated at **40**, movement being about the trunnion axis passing through the point *b*.

The vertical distance between the points **36** and **40** is, however, relatively small and the amount of power which must be expended in lifting the container and its contents through this angle is not great, comparatively speaking. At the uppermost limit of its travel the center of gravity, while above the point *b*, nevertheless lies to the right of a vertical plane which includes the trunnion axis passing through the point *b* so that the container is still stable and, if released by the crane, will rotate in a clockwise direction back to its normal or full line position. It will not overturn, therefore, even if moved into position to fully discharge its liquid contents. The trunnion member and block being symmetrically disposed with respect to the center of gravity, it follows that the container may be tilted in the opposite direction to full dumping position without danger of overturning and will return to its normal position due to the influence of gravity alone. Whichever the direction of rotation of the container upon its support, one only of the trunnion bearing surfaces is effective, the other being lifted from the trunnion block, while at the same time the entire weight of the container is carried by the two trunnion members alone, one at each end, and all portions of each trunnion assist in transmitting the weight of the container to the trunnion block.

As has been previously pointed out, where the trunnions at the container end are separately formed and spaced apart each must be sufficiently strong to carry one-half of the weight of the container and contents. In accordance with the present invention the novel trunnion member **25** with its two trunnion block engaging surfaces carries one-half of the weight of the container and contents but at the same time force opposing rotation of the container is substantially lessened because the radius of the trunnion, and hence the moment arm of the resisting frictional force, is minimized. The container may be tilted with less effort, therefore, and will return to original or normal position quite freely, even though the center of gravity may be located closely adjacent the axis about which the container has been rotating, as shown in the drawings. Great saving in the amount of operating power necessary is therefore effected.

In the form of the invention shown in Figures 5 and 6 a hot metal car of somewhat smaller capacity is illustrated, the container being shorter and the supporting trucks, instead of being eight wheeled trucks, having four wheels only. In principle, however, the method of supporting the container ends upon the trucks is the same as in the case of the form of the invention first described, the container body being readily tilted to the desired angle by the application of relatively small forces through the instrumentality of crane hooks which are attached to the side brackets **59**. If desired, the container body may be provided with stand engaging brackets **51** designed and constructed to operatively engage, respectively, spaced pouring stands, one of which is indicated at **52**, and about the upper ends of which the container may be revolved to secure discharge of its contents at a relatively high level.

In the form of the invention illustrated in Figures 7 and 8, the means for supporting the ends of the container **60** upon the trucks **61** is somewhat modified. The bracket **62**, while generally similar to the bracket shown in Figures 1 to 4 inclusive is larger and the trunnion block confining abutment collars **63** and **64** are extended downwardly in parallel relationship to points relatively close to the upper surface of the truck platform or bolster **65**. The trunnion member **66** is formed substantially in the same manner as the trunnion member **25** shown in Figures 3 and 4, and the trunnion block **67** cooperates in the same manner as before with the trunnion member. As will be perceived, however, the trunnion block **67** instead of being a relatively shallow block, as in the first form of the invention, is vertically elongated, extending to the proximity of the truck platform. At its lower end block **67** is provided with a vertically extending downwardly opening recess **67'**, which recess receives with a loose fit, the slightly conical pin **69**, integral with the truck bolster **68**. This means of connecting the truck and block **67** permits free swiveling of the truck relatively to the block while at the same time the pin gives stability to the block whenever the ladle or container is removed. Also the pin prevents undue rocking movements of the trucks under draft loads and moments resulting therefrom.

The truck therefore may swivel relatively to the bracket and container about a point located approximately at the level of the truck platform or bolster upper surface and only slightly above the horizontal plane of the truck coupling, illustrated at **70**. The moments caused by the application of draft forces to the car are therefore minimized and trucks of relatively short wheel base may be employed even in cases where containers of large capacity are to be transported, and despite the fact that the container axis is located at a substantial distance above the truck platforms or bolsters.

In each embodiment of the invention selected for disclosure by way of example, the construction is such that the center of gravity of the container is close to the trunnion axes, thereby minimizing the lifting force necessary to effect dumping operations and, as previously pointed out, this lifting effort is further minimized by reduction in bearing areas of the trunnions as compared with those heretofore considered necessary in cars of like capacity.

It will be clear to one skilled in the art that the essentials of the invention may be incorporated in cars or apparatus for the transportation of molten material which differ widely in appearance from those illustrated and described, and also that the cars disclosed may be employed if desired in the transportation of materials other than molten iron and steel.

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 comprising spaced trucks, a container having its ends adjacent the trucks, and means mounting the container ends upon the trucks, respectively, one such means including a trunnion member rigid with the container end and a trunnion support mounted on the adjacent truck, the trunnion member having two cylindrically curved

bearing surfaces and the support having two correspondingly curved seating surfaces, the curved surfaces of the trunnion and support being normally in contact, respectively, and the container being tiltable about the axis of either such curved trunnion surface.

2. The combination with a container for molten materials of means supporting the same for tilting movement about either of two parallel axes, said means including trunnion members at opposite ends of the container and rigid therewith, and supports for said trunnion members, respectively, each trunnion member having two laterally spaced surfaces normally contacting with the associated support, one only of which surfaces remains in contact with its support when the container is tilted.

3. The combination with a container for molten materials which is symmetrical with respect to a vertical plane, of supporting means therefor, said means including trunnion members rigid with the container and located at opposite ends thereof, and supports for said trunnion members, respectively, each trunnion member having two bearing surfaces, one on each side of said plane, and the associated support having two bearing surfaces with which the bearing surfaces of the associated trunnion normally contact, whereby the container may be tilted about either of two axes, said axes being disposed upon opposite sides of said plane.

4. The combination with a container for molten materials which is symmetrical with respect to a vertical plane, of supporting means therefor, said means including trunnion members rigid with the container and located at opposite ends thereof, and supports for said trunnion members, respectively, said two trunnion members transmitting the entire weight of the container and contents to the supports, and each trunnion having a support engaging portion on each side of said plane, whereby the container may be tilted about either of two axes, said axes being located on opposite sides of said plane.

5. The combination set forth in claim 4 in which a bracing member extends from each trunnion to the container body above the trunnion.

6. The combination set forth in claim 4 in which each trunnion comprises two cylindrically shaped parts the adjacent sides of which merge to form one integral structure.

7. Apparatus for the transportation of molten materials comprising spaced trucks, a container, brackets rigid with the ends of the container each bracket having spaced mutually facing surfaces disposed transversely to the container axis and a downwardly facing surface intermediate said first mentioned surfaces, bearing blocks each having surfaces adapted to engage the aforementioned surfaces of the associated bracket, and means including a universal connection for supporting each such block upon the adjacent truck.

8. Apparatus for the transportation of molten materials comprising a container, spaced trucks, one at each end of the container, and means mounting the container ends upon the trucks, one such means including a block mounted upon the truck for universal movement relatively thereto and a member rigid with the container for transmitting the weight of the container end to said block said member having portions adapted to engage the inner and outer oppositely facing surfaces of the block in the horizontal plane of the universal connection between the block and truck, to prevent the block from moving axially relatively to the container.

9. Apparatus for the transportation of molten materials comprising a container, spaced trucks, one at each end of the container, and means mounting the container ends upon the trucks, one such means including a block mounted upon the truck for universal movement relatively thereto and a member rigid with the container and enclosing the block so as to prevent relative movement of the block and container longitudinally of the container, a portion of said member also comprising a bearing surface slidably engaging the upper surface of the block to permit tilting of the container.

10. Apparatus for the transportation of molten materials comprising a container, spaced trucks, one at each end of the container, and means mounting the container ends upon the trucks, one such means including a block mounted upon the truck for universal movement relatively thereto and a member rigid with the container and having block engaging surfaces for engaging the upper, outer and inner surfaces of the block, and a surface engaging the upper surface of the block and slidable thereon to permit tilting of the container, said member transmitting draft forces to the container from the block and vice versa.

11. Apparatus for the transportation of molten materials comprising a container, spaced trucks, and means mounting the container ends upon the trucks, one such means including a bracket-like extension rigid with a container end and having a downwardly opening recess, a pedestal mounted upon the adjacent truck and having a king pin projecting upwardly into said recess, and a member fitting in said recess, said member having a recess in its underside to receive said king pin and a bearing surface upon its upper side upon which said bracket-like extension rests, the container being thereby supported for tilting movement.

12. In a hot metal car, in combination, a container having brackets at its ends, each bracket having a downwardly opening recess, spaced trucks for supporting the container at its ends, blocks within said recesses and constrained by the walls thereof to move with the container when the container moves axially, said blocks supporting the container for tilting movement about either of two parallel axes, and a universal connection between each block and the adjacent truck.

13. In a hot metal car, in combination, a container, spaced trucks for supporting the container at its ends, and means mounting the container ends upon said trucks, respectively, one such means including a member separate from the container and truck and connected to the truck by means permitting universal relative movement of member and truck, said member being interconnected with the container so as to be movable longitudinally therewith and supporting the container end for tilting movement about either of two longitudinally extending axes.

14. A container for molten materials and means for supporting the same for tilting movement about either of two parallel axes, said means including aligned trunnions at the ends of the container respectively, each trunnion having two downwardly facing bearing surfaces disposed upon opposite sides of a vertical plane passing through the longitudinal axis of the container, and a bearing member for each trunnion, each

bearing member having two trunnion receiving surfaces.

15. In a hot metal car, in combination, a container, spaced trucks, one at each end of the container, and means mounting the container ends upon the trucks, respectively, one such means including a member which extends vertically from the truck platform upwardly to a point above the center of gravity of the container, said member having a universal connection with the truck at approximately the level of the truck platform, and means rigid with the container end for constraining said member to move longitudinally with the container and for mounting the container upon the upper surface thereof in such manner that the container may be tilted about either of two parallel axes.

16. A hot metal car end construction comprising, a container, a trunnion horizontally projecting from the container end above the level of the center of gravity thereof, a truck below the trunnion, said truck having a platform or bolster, a block extending from said platform to said trunnion for transmitting the weight of the container to the platform, the trunnion resting upon the upper end of said block, a universal connection between said block and the truck platform, means rigid with the container for preventing relative movement of container and block axially of the container, and means for applying draft forces to the platform or bolster.

17. The combination set forth in claim 16 in which the lower surface of the block extends generally parallel to the truck platform upper surface and anti-friction rollers are interposed therebetween, for the purpose set forth.

18. Apparatus for the transportation of molten materials comprising spaced trucks, a container, and means mounting the container ends upon the trucks for tilting movement about either of two parallel axes, said means also transmitting draft forces from the truck to the container and vice versa.

19. Apparatus for the transportation of molten materials comprising spaced trucks, a container, means including trunnion members mounting the container ends upon the trucks for tilting movement about either of two parallel axes, said means being designed and constructed to cause draft forces to be transmitted by the trunnion members.

20. A hot metal car comprising, spaced trucks, a container having its ends adjacent the truck platforms, trunnion means rigid with each container end and overlying the adjacent truck platform, abutment collars rigid with each container end, means intermediate each pair of abutment collars, and restrained thereby, carrying the associated trunnion, said means having a swivel connection to the truck, and means for applying draft forces to the truck, the vertical draft moments being resisted by the trucks and the abutment collars.

JOHN D. PUGH.