March 21, 1939. S. W. RANDOLPH 2,151,393

APPARATUS FOR THE TRANSPORTATION OF MOLTEN MATERIALS

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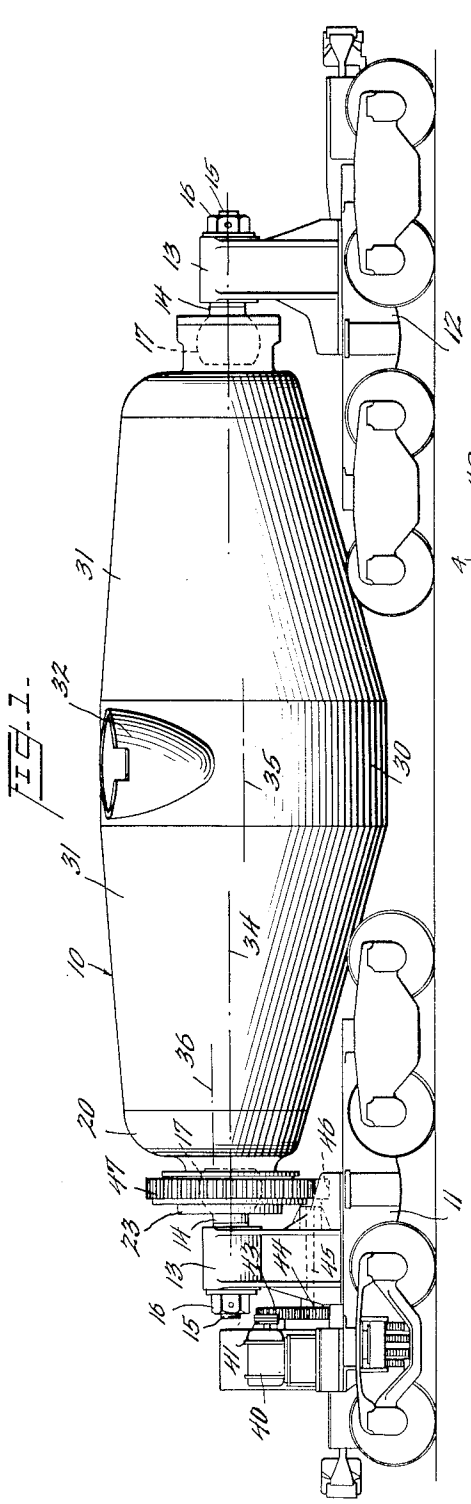

FIG. 1.

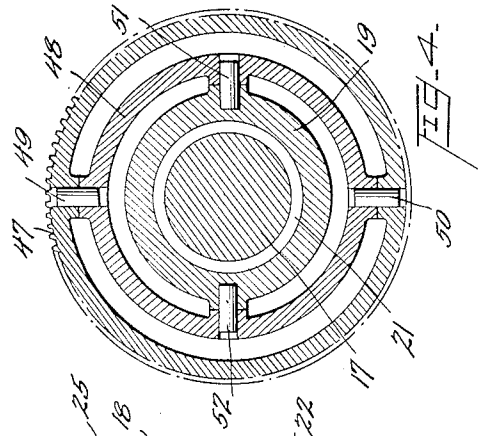

FIG. 4.

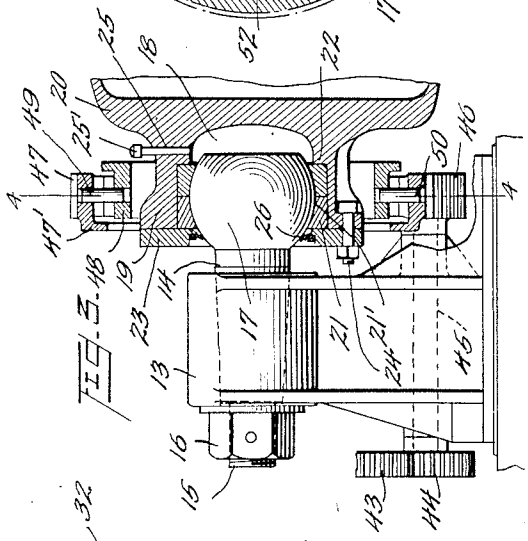

FIG. 3.

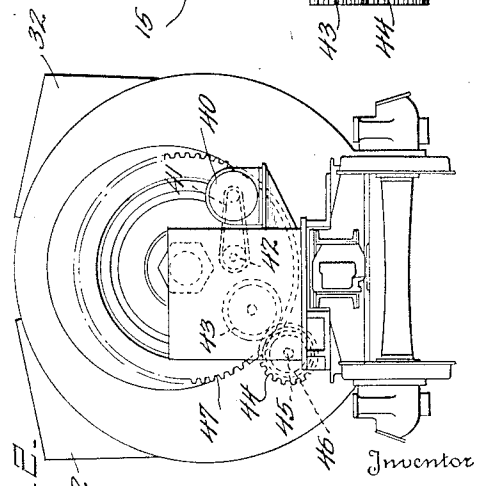

FIG. 2.

Inventor

S. W. Randolph,

By Watson, Coit, Morse & Grindle

Attorneys

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APPARATUS FOR THE TRANSPORTATION OF MOLTEN MATERIALS

Spottiswoode W. Randolph, Baltimore, Md., assignor, by mesne assignments, to Koppers Company, a corporation of Delaware

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4 Claims. (Cl. 266—39)

The present invention relates to apparatus for the transportation of molten materials and more particularly to mobile containers made use of in the steel industry for the transportation of molten steel or iron and commonly designated hot metal cars.

The invention contemplates the provision of a hot metal car having a hot metal container of large capacity and so designed and constructed that the body of molten material being transported is enclosed at practically all points to minimize the loss of heat by radiation. It is now well recognized that heat loss from molten materials in storage or transportation is lessened not only by enclosing the body of molten material within a heavily insulated container closed at all possible points, but that it is also desirable to store or transport the molten material in bodies or volumes which are as large as possible, since the rate of heat loss from a small body of metal is relatively greater than from a large body. Hence the recognized tendency in the art to make use of containers of the largest practical size. It has been suggested that such containers may advantageously be mounted at their ends upon spaced wheel trucks which trucks are not connected by any means other than the container itself, the usual underframes being dispensed with, thereby permitting the diameter of the container to be increased without increase in the overall height of the container.

The present invention contemplates particularly a hot metal car of this last mentioned type, the container being of the substantially closed type and supported at its ends for tilting movement about a horizontal axis, each container end supporting means including a coupling device having two principal parts, one rigid with the adjacent truck and the other with the container, and these two parts cooperating with each other in much the same manner as do the principal elements of a ball and socket joint. With a construction of this nature each truck is free to swivel in all directions with respect to the container while at the same time having the capacity to transmit draft forces and to permit free rotation of the container about its longitudinal horizontal axis. The improved coupling device by means of which an end of the container may be mounted upon and connected to a supporting truck embodies a number of novel and advantageous features.

While, broadly speaking, my invention contemplates a hot metal car of the self-dumping type and having means associated and movable with the car whereby tilting movement of the container on its axis may be effected, it is not so limited but may be incorporated in hot metal cars in which the containers are so designed and so mounted as to be self-righting, and which are tilted by mechanism external to the car, for instance, a crane operated hook or the like. In its preferred form, however, it embodies a power tilting device whereby the container may be tilted at the desired speed and through the desired angle by power taken from a power motor, preferably an electric motor. This motor is mounted upon one of the container supporting trucks and a driving connection of novel character is provided for transmitting the motion of the power motor to the container body.

Again, the invention contemplates a container body which in and of itself includes certain novel and advantageous features. The container body is elongated and substantially circular in all transverse sections, but has the central longitudinal axis of its central portion offset laterally from its axis of rotation. The center of gravity of the container taken as a whole is offset from its axis of rotation and hence the container is essentially of the self-righting type. Actually however, it may not be self-righting because of close proximity of the center of gravity to the axis of rotation, the moment developed by the gravitational force tending to right the container after tilting being insufficient to overcome the frictional forces of retardation developed at the container supporting means. In the hot metal car selected for disclosure the container is so designed and supported that power means must be employed to tilt and right the same. The principal object of offsetting the axis of the central portion of the closed container from the axis of rotation of the container is to provide a container the central part of which extends downwardly toward the trackway over which the car runs as far as possible without interference with the track structure. By so designing the container, and thus taking advantage of the fact that the usual car underframe is omitted, its central cross-sectional area may be considerably enlarged without increasing its overall height, thus providing a closed container having maximum capacity for a given length and overall height of car. Preferably the container is so formed that its central portion is cylindrical and its end portions shaped as truncated eccentric cones. A container formed in this manner may be easily and cheaply fabricated of sheet metal and maximum strength realized for a given weight. It is of course desired that the dead

weight of the container and its mobile supporting means be minimized in order that the wheel loads of the supporting trucks may be as small as possible, and one purpose of the invention is to so design not only the container itself but its supporting means that the weight of the entire assembly is the least possible, consistent with ample strength of all parts.

In the accompanying drawing a preferred form of hot metal car, including a power tilting mechanism, is illustrated. It will be appreciated by one skilled in the art, however, that the car disclosed is by way of example only, and that numerous changes may be made in the design and arrangement of the component elements of the car without departure from the invention.

In the drawing:

Figure 1 is a side elevation of a hot metal car embodying the invention;

Figure 2 is an end view of the same;

Figure 3 is an axial vertical section through one end of the container, portions of the container supporting means being shown in elevation and this view also showing in section a portion of the driving connection between the power motor and the container; and

Figure 4 is a section on line 4—4 of Figure 3.

The container itself is indicated at 10 in Figure 1 of the drawing and the trucks upon which the container is mounted are indicated at 11 and 12, respectively, these trucks being preferably, but not necessarily, identical, and each having a portion extending beneath the adjacent end of the container, as shown. In details of construction the supporting trucks may vary widely, it being only necessary to provide trucks which are longitudinally stable under draft forces, have a sufficient number of wheels to ensure that the wheel loads are not excessive, and have bolsters which are sufficiently strong and rigid to withstand the stresses arising from the heavy loads which they are called upon to support. By the term bolster as used herein is meant 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.

Upon each bolster is rigidly fixed a vertically extending pedestal 13 and mounted upon pedestals 13 are the horizontally extending elements 14, each of these elements having a generally conical midsection closely fitting within a correspondingly formed recess in the pedestal 13 and extending longitudinally of the bolster. Each element 14 extends fore and aft of the pedestal 13, upon which it is mounted, one end being threaded as at 15 and carrying a nut 16 by means of which it is securely retained within the recess in the pedestal provided for its reception. At its inner end each element 14 is provided with an enlargement or head 17, the outer surface of which is substantially spherical. Each head 17 lies within a recess 18 (Figure 3) extending axially of the generally cylindrical member 19 which projects horizontally from the adjacent container end 20.

Within recess 18, and encircling the head 17, is a bearing member 21, formed in two or more parts for convenience of assembly, the wall of the cylindrical projection 19 being interiorly counterbore to receive this bearing, the terminal shoulder 22 of the counterbore being designed to absorb thrust of the bearing member resulting from the application of longitudinal draft forces directed toward the container. The inner surface of bearing 21 has a concave spherical surface 21' within which the convex spherical surface of head member 17 closely fits, the interengagement of these parts being, however, sufficiently free to permit rotation of the bearing upon the supporting member, and relative angular movement of these two parts in all directions. An annular locking member is indicated at 23, this member being secured to the outer end of the cylindrical projection 19 by means of bolts 24 and its annular inner margin engaging the annular outer end of bearing 21, which bearing is thereby prevented from escaping from the counterbore or recess within which it is located. Any suitable means for introducing lubricant into the space 18, for the purpose of maintaining the interengaging surfaces of members 17 and 21 properly lubricated, may be employed, for instance a lubricant duct such as 25, which duct is normally closed by a cap 25'. An annular flexible fabric ring 26 is secured to the locking ring 23 in any suitable manner and the inner margin of this ring closely engages the spherical outer surface of member 17, preventing the escape of lubricant and the entrance of dirt.

The container body is relatively long and comprises in addition to the end members 20, a midsection 30 which is cylindrical and conical end sections indicated at 31. The midsection is provided with charging and pouring spouts, indicated at 32. Sections 31 are formed as truncated oblique cones, the larger end of each section being rigidly secured to the cylindrical midsection 30, as by welding, and the smaller end of each being rigidly secured to the adjacent container end 20, which last mentioned member is preferably a casting.

The axis of rotation of the container is horizontal and includes the centers of the spherical supporting members 17, which axis is indicated at 34 in the drawing, Figure 1. The longitudinal central axis of the cylindrical portion 30 of the container is indicated at 35, being offset from the axis 34 of container rotation. The container design is therefore such that its center of gravity lies below its axis of rotation and, while the container is circular in all transverse sections, that portion thereof which is lowermost when the container is in normal position, as shown in Figure 1, lies relatively close to the track structure. Hence this central portion may have a maximum diameter for a given container height and the container as an entirety may be made shorter for a given capacity, or have increased capacity for a given length, as compared with containers of the type which are circular in transverse section but symmetrically formed at all points about the axis of rotation.

If the center of gravity of the container is sufficiently far offset from the axis of rotation, the container will be substantially self-righting, but the container shown is not so designed, the horizontal axes 36 of the end members 30 being actually raised somewhat above the axis of rotation 34 in order to keep the center of gravity of the container as an entirety relatively close to the axis of rotation. This arrangement has the further advantage of causing the pouring spouts to be projected laterally greater distances than they otherwise would when the container is tilted, thus facilitating pouring or discharge of the molten contents thereof.

The container tilting mechanism disclosed in Figures 1 and 2 comprises the electric motor 40

which motor is connected by means of a chain 41 to a pinion 42. Gear 42 is in turn operatively connected by horizontal gears 43 and 44 to the horizontal shaft 45. Shaft 45 has upon its inner end a gear 46 the teeth of which mesh with those of the relatively large external gear 47 encircling the cylindrical projection 19. Gear 47 is preferably connected to this member 19 by means which permits the gear to rock relatively thereto in all planes which include the axis of rotation of the container. Such a means is shown in Figure 4 and is seen to comprise a gimbal joint, including an intermediate ring 48 to which the gear is pivotally connected at 49 and 50 for rocking movement about a vertical axis, ring 48 being in turn pivotally connected by members 51 and 52 to member 19, whereby ring 48 may rock relatively to this member about a horizontal axis.

By the construction shown, therefore, a driving connection is provided which is of such nature that the container may be tilted at any time for material discharging purposes, yet it is not possible for the container, due to sagging intermediate its points of supports, or for any other reasons, to cause any binding of the gears or the transmission of any cramping forces back to the driving mechanism.

As the car moves along the trackway, the trucks may swivel with respect to the container in any and all directions in following curvatures of the track and inequalities of the rails. The coupling devices at the ends of the car not only permit this swiveling movement but transmit all draft forces from the trucks to the container and vice versa. The trucks are longitudinally stable against the moments developed by draft forces while the car as an entirety has a comparatively light weight for its capacity.

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

1. A container adapted for use in the transportation of molten materials comprising a cylindrical mid-section in which a pouring aperture is formed, conical end sections the larger end of each of which is secured to the mid-section, and means at the outer ends of the conical end sections for supporting the container for rotation about a horizontal axis, the axis of the mid-section being parallel to and spaced from the axis of rotation of the container and the axes of the conical end sections being disposed in the plane which includes the said axis of rotation and the axis of the mid-section and being inclined to said axes, the axis of the mid-section being below the axis of rotation of the container when the pouring opening is in its uppermost or non-pouring position and the axes of the end sections sloping upwardly, respectively, from the ends of the axis of the mid-section, the outer ends of said end section axes being spaced above the axis of rotation of the container when the container pouring opening is in non-pouring position.

2. An elongated container adapted for use in the transportation of molten materials, said container being wholly closed save for a pouring opening formed in the wall thereof, and including two oppositely tapering conical end sections with relatively inclined axes disposed in a plane which axes, when prolonged, intersect midway between the container ends, and means for supporting the container at its ends for rotation about a horizontal axis passing above the point of intersection of the axes of the end sections when the container is in non-pouring position, the outer ends of the axes of the end sections being above the axis of container revolution when the container is in this non-pouring position.

3. A container of the enclosed type adapted for use in the transportation of molten materials, said container comprising a horizontally elongated shell substantially circular in all transverse sections and having elements secured to its ends by means of which it may be supported for rotation about a horizontal axis, the central part of the shell being cylindrical and the end sections tapering outwardly from said central portion toward the container ends, the locus of centers of all transverse sections through the container inclining upwardly from said central portion to the ends thereof, and the cylindrical central part having a pouring opening formed in that portion thereof which is closest to the axis of rotation of the container.

4. A container of the enclosed type adapted for use in the transportation of molten materials, said container comprising a horizontally elongated shell substantially circular in all transverse sections and having elements secured to its ends by means of which it may be supported for rotation about a horizontal axis, the central part of the shell being cylindrical and the end sections tapering outwardly from said central portion toward the container ends, the locus of centers of all transverse sections through the container inclining upwardly from said central portion to the ends thereof, and intersecting the axis of rotation at two points, within the tapering end sections respectively, and the cylindrical central part having a pouring opening formed in that portion thereof which is closest to the axis of rotation of the container.

S. W. RANDOLPH.