June 25, 1940. C. P. ASTROM 2,205,940

LADLE

Filed May 2, 1939

FIG. 1.

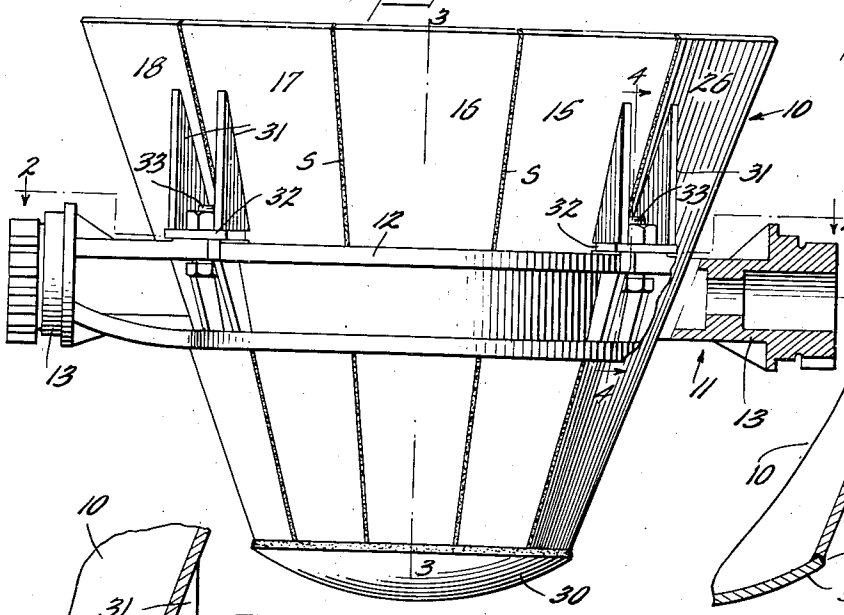


FIG. 3.

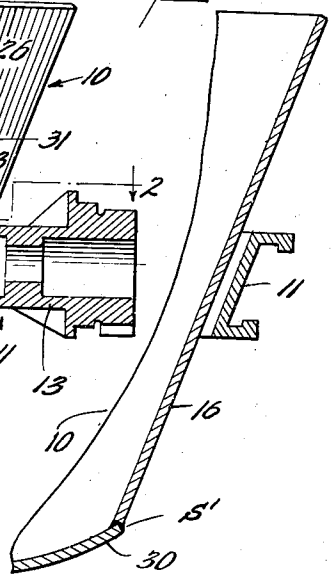


FIG. 4.

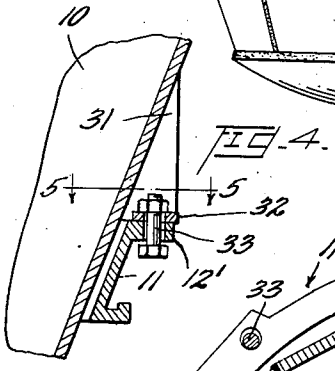


FIG. 2.

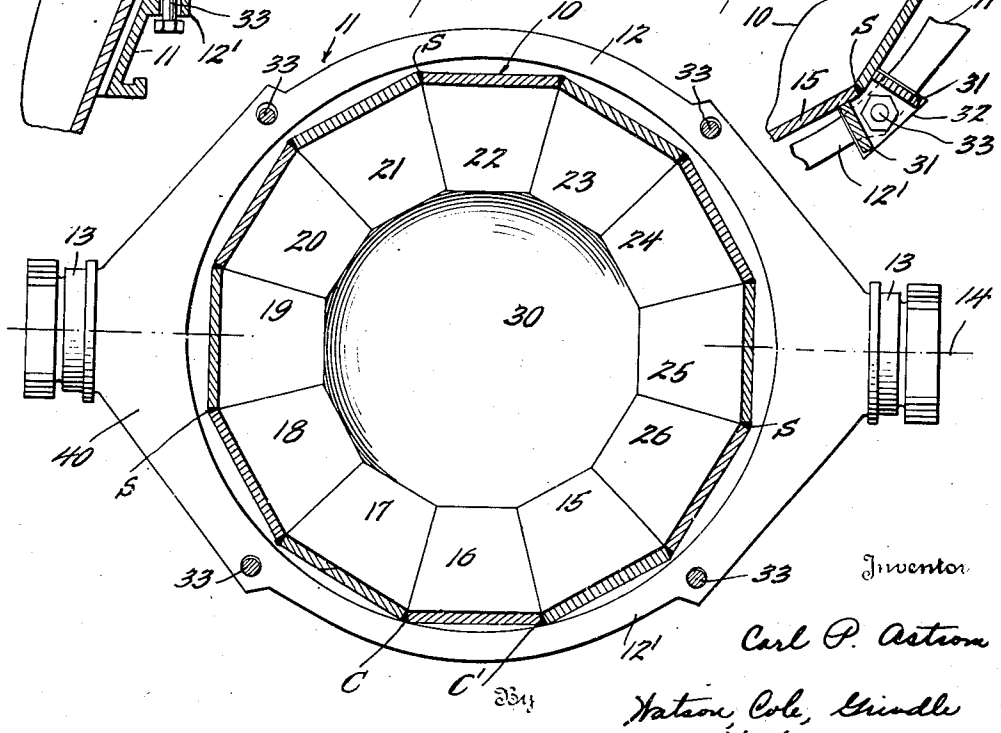


FIG. 5.

Inventor

Carl P. Astrom

Watson, Cole, Grindle & Watson

Attorney

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UNITED STATES PATENT OFFICE

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LADLE

Carl P. Astrom, East Orange, N. J., assignor to M. H. Treadwell Co., Inc., New York, N. Y., a corporation of New York

Application May 2, 1939, Serial No. 271,405

2 Claims. (Cl. 266—39)

This invention relates to apparatus for the transportation of molten materials and more particularly to that type of such apparatus which is generally designated a cinder ladle by those engaged in the steel industry and which is made use of in the transportation of slag from blast or open hearth furnaces to slag dumps.

The most commonly used cinder ladle comprises a ladle body in the form of an inverted frustrum of a cone, the relatively small opening at the lower end of the ladle body being closed by a disc-like bottom and the relatively large opening at its upper end being left open, the ladle body as a whole being mounted upon a frame which is tiltable in either direction of rotation about a horizontal axis, this frame being mounted upon wheeled trucks. The present invention relates particularly to apparatus of the character just described and has for its purpose the improvement of such apparatus in various respects whereby it is rendered more efficient in operation, less costly to fabricate in the first instance, and lighter in weight than ladles of similar type and the same capacities heretofore designed or suggested.

The tendency, of recent years, in the steel industry, has been toward the use of cinder ladles of greater and greater carrying capacity and with the increase in size of these ladles certain inherent difficulties, which have always existed but which have been relatively unimportant with ladles of small capacity, have become more and more troublesome. Thus, with increase in cubic carrying capacity, it has been necessary to increase the thickness of the metallic shell of the ladle body quite substantially and this in turn has greatly increased the weight of the apparatus and the difficulty involved in fabrication. As is well known to those familiar with the art, it is not possible to rigidly attach the shell or side wall portion of a cinder ladle of the type which includes a supporting frame member which encircles this side wall, to such frame member. The diameter of the ladle body varies substantially as its temperature changes and hence the attachment elements must be of such character as to permit the diametrical expansion and contraction of the ladle member itself within its supporting frame or bail. This means, of course, that when the ladle is dumped by revolution of the frame and ladle body together about a fixed horizontal axis, the ladle body will slide in the plane of its supporting frame or bail for a slight distance, or until that portion of the ladle body in the plane of the encircling bail which is most remote from the axis of rotation comes in contact with such frame part, whereupon the sliding motion ceases. As a result, the entire weight of the ladle body is transferred to the supporting frame at approximately one point, or over a very small area, and at this point large local reaction stresses are set up in the shell of the ladle.

The present invention contemplates an improved design of ladle body in which the side wall of the ladle, at the point where it comes into contact with the frame when being dumped, is locally reinforced and made stronger than intermediate sections of the ladle, or those portions of the ladle shell which are closer to the axis about which the ladle body is revolved. In this way, all portions of the ladle body may be made sufficiently strong to withstand all stresses to which they may be subjected at any time, particularly during the dumping operation, but those portions of the ladle body which are not subjected to large local stresses during dumping are of lighter section than those which are subjected to such stresses. In this way a very substantial saving in the amount of metal required in the fabrication of a ladle shell is made, the initial cost of the ladle decreased, and its weight lowered, for a given capacity of ladle.

The invention may be incorporated in ladles which are cast as well as those of the built-up type and is equally applicable to ladles the body portions of which are truly frusto-conical as well as to those having bodies which are pyramidal and not truly conical, being built up of a plurality of flat slabs. A further feature of the invention consists in the provision of a ladle the body of which is polygonal in cross-section, comprising a plurality of flat slabs welded, or otherwise suitably secured together, at their edges. It is particularly advantageous to construct a ladle body in the manner just described when the ladle is of large size since plates of sufficient thickness for ladles of such size can be worked into conical form only with the greatest difficulty.

One embodiment of the invention is illustrated in the accompanying drawing by way of example.

In the drawing:

Figure 1 is a side elevation of a ladle body and its supporting frame, the side wall of the ladle body comprising a plurality of flat slabs welded together;

Figure 2 is a section on line 2—2 of Figure 1;

Figure 3 is a section on line 3—3 of Figure 1;

Figure 4 is a radial section through the ladle

body securing means taken approximately on the line 4—4 of Figure 1; and

Figure 5 is a section on line 5—5 of Figure 4.

The ladle body is generally indicated by the numeral 10 and its supporting bail or frame is generally indicated by the numeral 11. The details of construction of the supporting frame or bail are relatively unimportant insofar as the present invention is concerned but it should be said that this frame comprises a portion 12 of generally circular form rigid with which are two diametrically opposed trunnions 13 by means of which the circular intermediate frame part 12 may be supported, and revolved about the axis indicated at 14. The frame is supported by means which is not illustrated so that the assembly may be moved from point to point. The axis 14 is horizontally disposed and may remain stationary during the dumping operation or may move laterally in a horizontal plane during such operation.

The ladle body 10 comprises a metallic shell which includes a wall porttion which is fabricated of flat metallic slabs, the adjacent edges of which are secured together by welds. The several slabs or plates are indicated by the numerals 15 to 26 inclusive, there being twelve such slabs illustrated. Each slab is wider at the top than at the bottom, as shown, and the welds connecting adjacent edges of the slabs are indicated by the letters S. The bottom of the laddle, indicated at 30, may be either flat or "bumped," being shown to be spherical in Figures 1 and 3 and to have its marginal edge connected by a weld S' to the lower edges of the several slabs or plates which together comprise the side wall. This bottom may be attached to the side wall portion of the ladle in any other suitable manner.

Attached to the side wall portion of the ladle are four or more pairs of triangular brackets 31 and to the lower edge surfaces of the brackets of each pair of brackets is welded, or otherwise suitably secured, a flat horizontally disposed bearing plate 32. The several bearing plates 32 rest upon the upper surface of the encircling bail or frame part 12 and the brackets 31 thus comprise means for transmitting the weight of the ladle body, and the contents thereof when filled, to the frame.

Bearing plates 32 are secured to the bail 12 by means of bolts 33, each of these bolts passing through an aperture in the associated plate 32 which is greater in diameter than the diameter of the bolt and also passing through an aperture in the upper horizontally extending flange 12' of the bail 12 which is of larger diameter than the bolt. The several bolts comprise means for permanently attaching the ladle body to the supporting frame, preventing total dislodgement of the ladle body when its contents are being dumped. These attachment devices, however, permit relatively slight sliding movements of the ladle body in the plane of the bail 12 and it is necessary that the means which connects the ladle body and frame or rail be of this character inasmuch as the ladle shell is subject to wide variations in temperature and hence diametrically expands and contracts.

By reason of the fact, however, that the ladle body can slide in the plane of the bail to a limited extent, it will always move downwardly during a ladle dumping operation until that portion of the side wall of the ladle which is in the plane of the bail and is most remote from the axis of rotation 14 comes into contact with the bail. In the case of the ladle illustrated, the side wall of which is fabricated of twelve similar flat slabs, two adjacent corners, indicated at C and C', come into contact with the bail and the entire weight of the ladle body, and its lining, are supported upon these two corners until the ladle is righted or substantially righted again. This means that large local reaction stresses are set up in the lowermost portion of the ladle, which includes the slabs indicated at 15, 16 and 17, and in accordance with the invention these slabs are made thicker than the adjacent sets of slabs indicated at 18, 19 and 20 and 24, 25 and 26, respectively. Thus in a ladle designed to have 400 cubic feet capacity and the wall of which is fabricated of twelve slabs as shown in the drawing, the three slabs 15, 16 and 17 will preferably be two and one half inches thick while the three slabs 18, 19 and 20 and likewise the three slabs 24, 25 and 26 will be two inches thick.

The slabs 21, 22 and 23 will be two and one-half inches thick, as are the slabs 15, 16 and 17 because the ladle may of course be tilted in either direction of rotation about the axis 14 and the large local reaction stresses will be set up in slabs 21, 22 and 23 when the ladle is tilted in the reverse direction. The saving of metal, however, which is realized by making one half of the slabs substantially thinner than the other slabs, is quite substantial, the initial cost being considerably lowered and the weight of a ladle of a given strength and capacity is minimized by the elimination of useless metal.

When a truly conical ladle is desired, it may be locally reinforced at those points which strike or contact the bail during dumping in largely the same manner as just described in connection with the polygonal type of ladle body. Relatively thick plates may be inserted into the conical ladle body at these points and the intermediate sections may be of lighter weight. These thickened portions of the conical wall of the ladle may extent from top to bottom thereof or only for a short distance above and below the bail or frame.

The plates which together comprise the side wall of the ladle are rolled but the bottom member 30 may be either cast, or rolled and shaped. It is known to be advantageous to make use of a cast ladle bottom and by building up the ladle in the manner described a cast bottom may be attached to a side wall comprising rolled slabs or plates welded together. With this combination of cast bottom and rolled plate side wall a highly efficient type of ladle is realized and, if a ladle of detachable bottom is desired, the bottom may be secured to the side wall by means of bolts, or by other equivalent means.

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

1. A cinder ladle comprising a substantially circular bail tiltable about a horizontal axis intersecting said ladle, a ladle body projecting through and encircled by said bail, the ladle body having, in the plane of the bail, a diameter slightly smaller than that of the bail and the ladle body being so supported on the bail that it can slide normally to the axis of tilt into contact with the bail when the ladle is dumped, the portions of said ladle body adjacent to and intersected by said axis of tilt being of relatively light section, and a portion of said ladle body adjacent said point of contact and circumferentially spaced from said

portions of lighter section being reinforced, for the purpose set forth.

2. In combination, a downwardly tapering open topped ladle body having a metallic side wall, diametrically opposed portions of said side wall being of relatively heavy section and intermediate portions being of lighter section, and means supporting said ladle body for tilting movement about a horizontal axis and limited movement transversely of said axis, movement of the ladle body transversely of the axis of tilt being limited by contact of one of the portions of heavier section with said means.

CARL P. ASTROM.