United States Patent

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[73] Assignee **United States Steel Corporation**

[54] **APPARATUS FOR HOISTING AND POSITIONING LADLES**
11 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **266/13,** 212/130, 214/657
[51] **Int. Cl.** **C21c 7/00**
[50] **Field of Search** 212/130; 214/313, 657, 658; 266/13; 164/281, 335

[56] **References Cited**

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2,519,313	8/1950	Haklin	214/313
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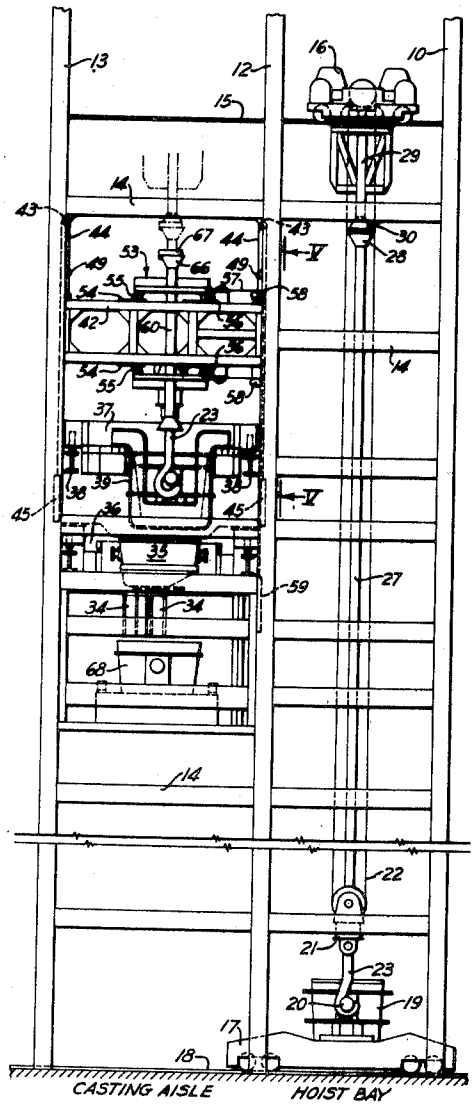
ABSTRACT: An apparatus for hoisting and positioning ladles of molten metal particularly for use in a continuous casting installation. The associated apparatus includes a crane which lifts a ladle of molten metal to the necessary height, transports the ladle horizontally and lowers it to a ladle car, after which the crane hooks are disengaged from the ladle and moved clear. The car then carries the ladle to a position over an intermediate vessel (for example a tundish), from which the metal can be teemed into a continuous-casting mold in the usual fashion. The novel structure is in the use of a vertically movable cage and a horizontally movable trolley mounted on the cage for guiding the ladle into the proper position on the car. Since the cage can move vertically, the ladle can be placed on cars at different heights, thus making it possible to use the same ladle-handling apparatus with receiving vessels of different vertical dimensions.



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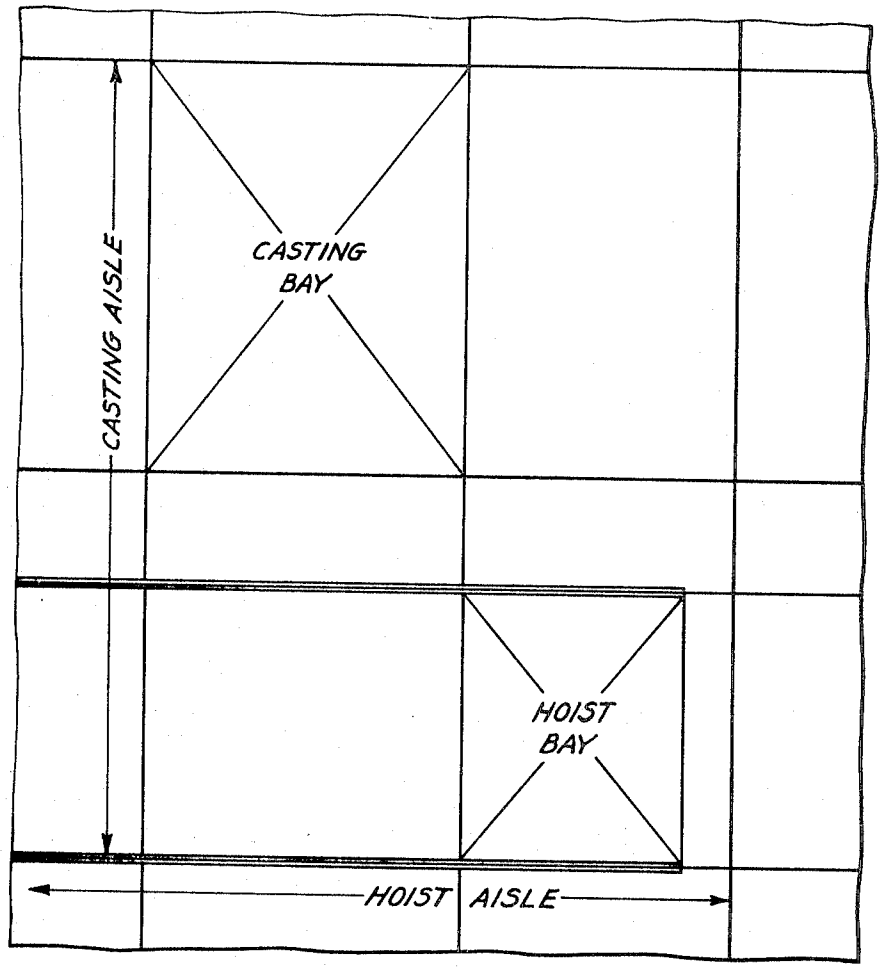

Fig. 1

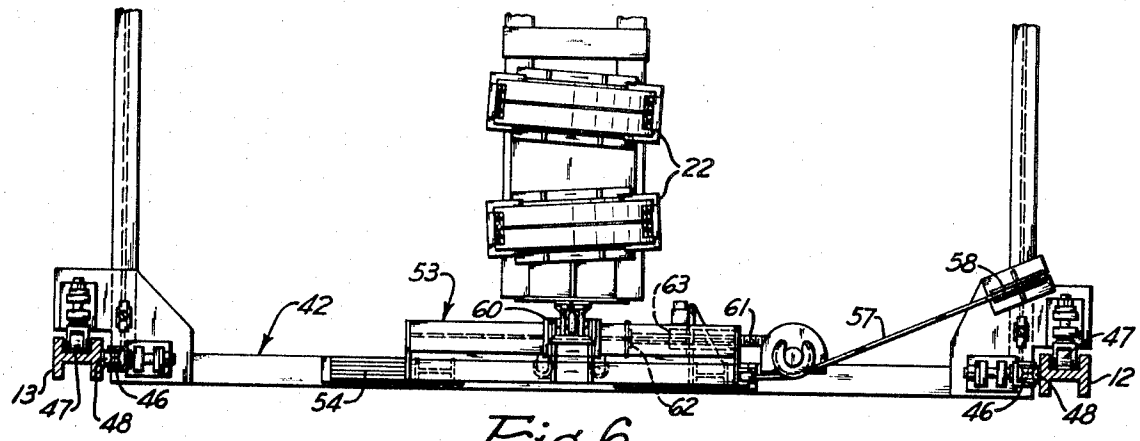

Fig. 6

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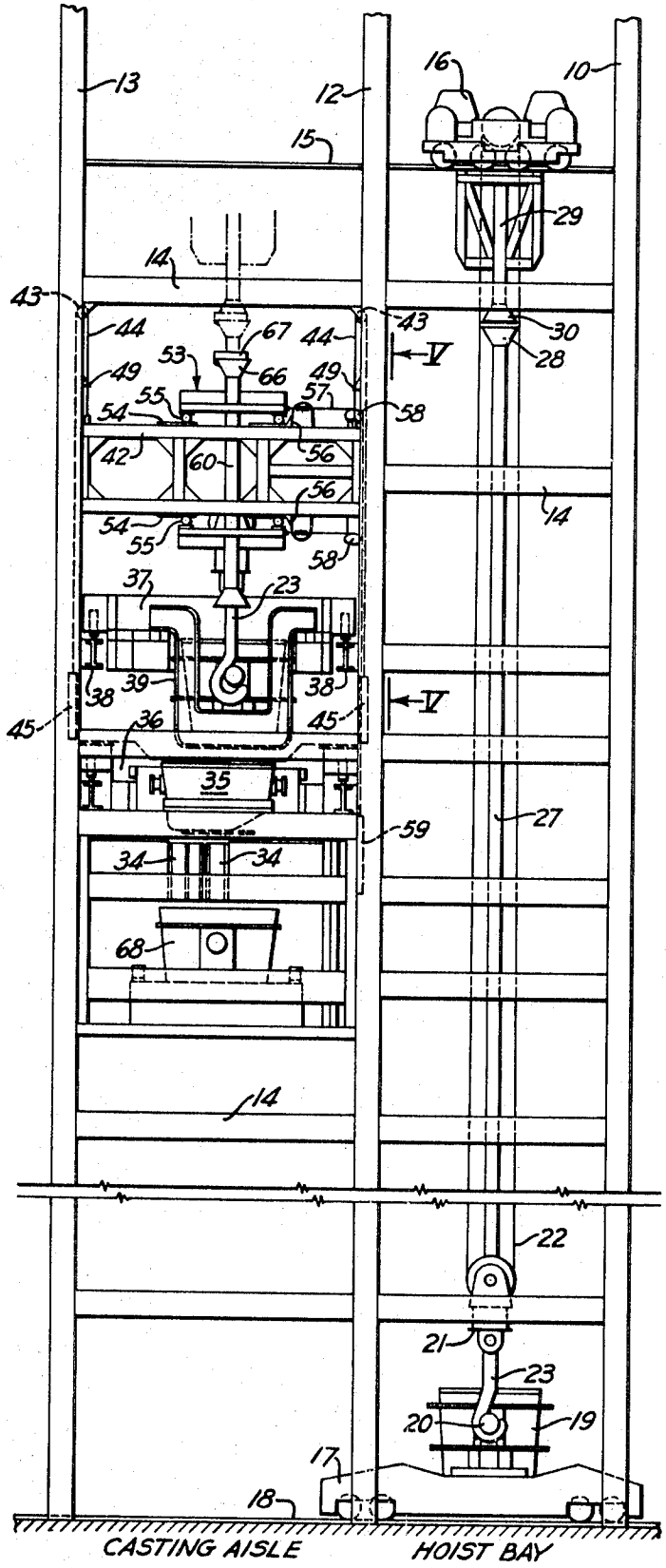

Fig. 2

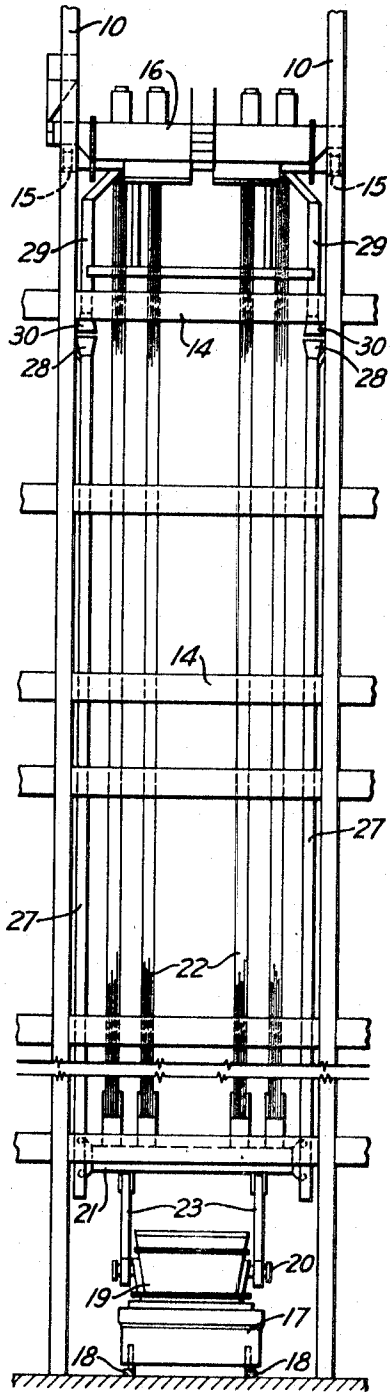

Fig. 3

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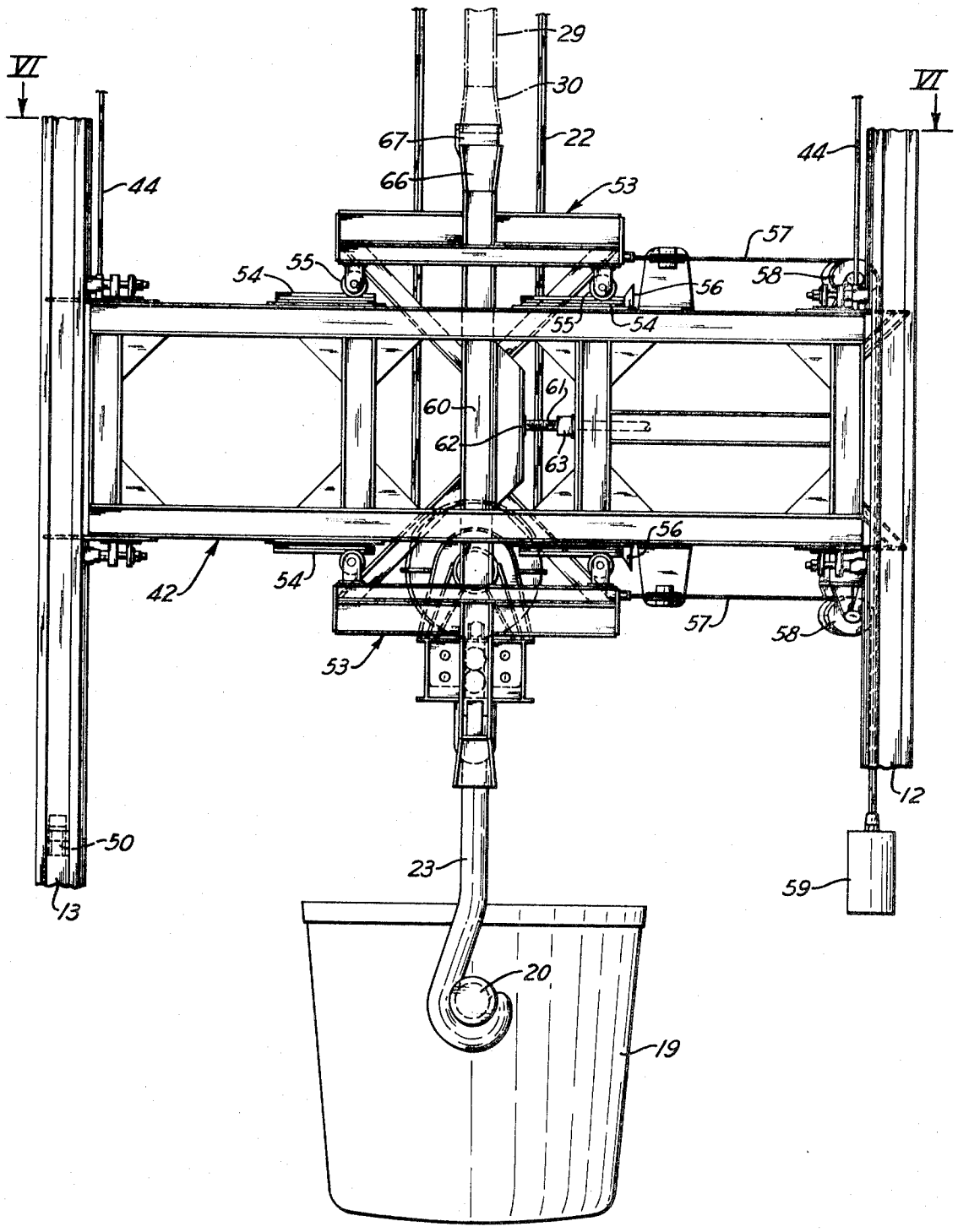

Fig. 4

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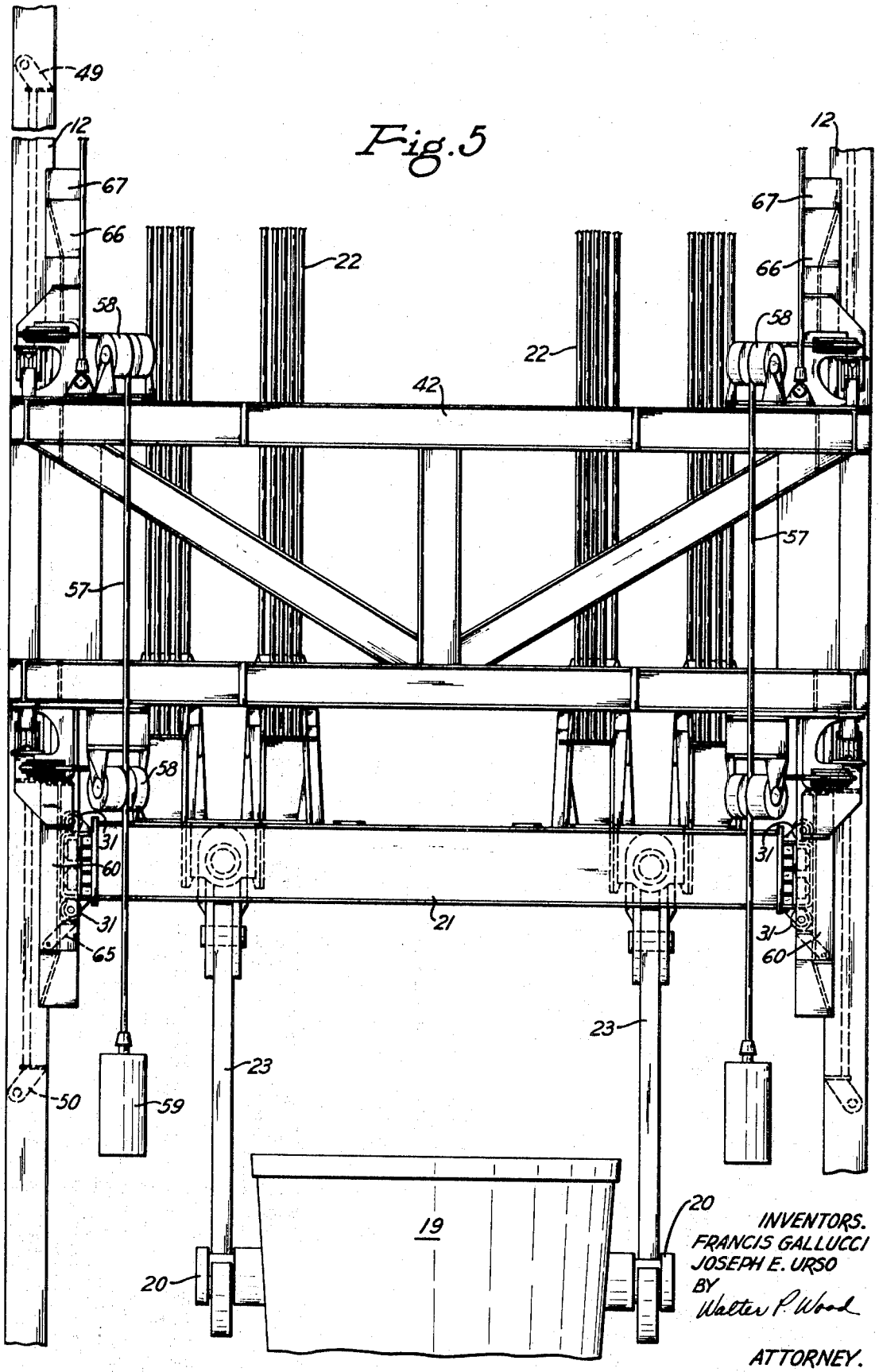
Fig. 5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APPARATUS FOR HOISTING AND POSITIONING LADLES

This invention relates to an improved apparatus for hoisting and positioning ladles from which molten metal is to be poured.

Although our invention is not thus limited, our apparatus is particularly useful for handling ladles used to pour steel into an intermediate vessel (for example a tundish) preceding a vertical continuous-casting operation. The casting equipment includes a mold which is supported within a tower at a considerable height (80 feet or more) above ground level. Steel is teemed into the mold from an intermediate vessel supported thereabove. The vertical dimension of different intermediate vessels may vary. The operation necessitates hoisting ladles filled with molten steel to a ladle car, which runs on an elevated track above the mold and vessel. The height at which the ladle is placed on the car varies with the vertical dimension of the vessel. After the ladle car receives each ladle, the hoisting equipment is disengaged from the ladle, and the car transports the ladle horizontally to a position directly over the intermediate vessel, thus enabling the contents of the ladle to be poured into the vessel and thence teemed into the mold.

An object of our invention is to provide a hoisting and positioning apparatus which is capable of spotting a full ladle accurately and expeditiously at varying heights over a ladle car.

A further object is to provide a hoisting and positioning apparatus which can move a full ladle both horizontally and vertically with respect to a ladle car for accurate spotting.

A further object is to provide an apparatus which affords the foregoing advantages, yet allows the hoisting equipment to be disengaged and cleared from the ladle as soon as the ladle is positioned on the ladle car. In the drawings:

FIG. 1 is a diagrammatic top plan view of the layout of a continuous-casting installation, illustrating the relation of bays and aisles;

FIG. 2 is a partly diagrammatic side elevational view of our apparatus;

FIG. 3 is partly diagrammatic end elevational view from the right of FIG. 2;

FIG. 4 is side elevational view on a larger scale of a portion of the apparatus;

FIG. 5 is a vertical sectional view on line V—V of FIG. 2 on a scale similar to FIG. 4; and

FIG. 6 is a horizontal sectional view on line VI—VI of FIG. 4. FIG. 1 shows a portion of the layout of a continuous-casting installation. As the legends indicate, a hoist aisle extends east and west of the figure and a casting aisle north and south. The east portion of the hoist aisle constitutes a hoist bay. The north portion of the casting aisle constitutes a casting bay. The two aisles intersect. The west portion of the hoist aisle and the south portion of the casting aisle occupy the intersection. It should be understood that our reference to points of the compass is only to facilitate our description and is not limiting.

FIGS. 2 and 3 show portions of the tower of the installation, which may be conventional apart from our ladle hoist and positioning apparatus. The tower includes pairs of columns 10, 12 and 13 of considerable height, and a plurality of horizontal beams 14 connecting the columns to form a rigid framework. The space defined by the three pairs of columns shown constitutes the aforementioned hoist aisle of the tower. The upper portion of the tower carries a horizontal track 15 (shown only diagrammatically) on which a conventional overhead crane 16 runs for movement along the hoist aisle between a first position over the hoist bay and a second position over the intersection of the two aisles. A conventional ladle car 17 runs along a track 18 at the bottom of the hoist aisle and is shown carrying a ladle 19 which has trunnions 20. A spreader bar 21 is suspended from the crane 16 through a cable and sheave mechanism 22 and carries a pair of hooks 23 which may engage trunnions 20 for lifting, lowering or transporting ladle 19 (FIGS. 2 and 3).

The horizontal beams 14 at opposite sides of the hoist bay carry a pair of vertically extending guide channels 27, the upper and lower ends of which has funnel-shaped extensions 28 (only the upper extensions are shown). Crane 16 carries a pair of vertically extending guide channels 29, the lower ends of which have funnel-shaped extensions 30. When crane 16 is in its first position over the hoist bay, channels 27 and 29 are aligned, the edges of their extensions 28 and 30 are closely adjacent, and the aligned guide channels may receive the ends of the spreader bar 21 for guiding its vertical movement. Preferably the ends of the spreader bar have rollers 31 (FIG. 5) riding within the channels to facilitate such movement. As the crane raises or lowers the spreader bar, the funnel-shaped extensions 28 and 30 facilitate transfer of the spreader bar between channels 27 and 29.

One or more open-ended molds 34 are located in the casting bay. A tundish 35 is supported on a car 36 above the molds. These parts per se are not part of the present invention, but may be of conventional construction, and hence are not shown in detail. A ladle car 37 rides within the casting aisle on an elevated track 38 below track 15. The ladle car has a cradle 39 for receiving and supporting ladle 19. The car can carry the ladle horizontally along the casting aisle between a first position within the intersection of the two aisles and a second position within the casting bay over the tundish. Reference can be made to Britcher et al. U.S. Pat. No. 3,459,312 for a detailed showing of a suitable ladle car.

Our apparatus comprises a floating cage 42 which we support for vertical movement within the intersection of the two aisles. The support means includes four sheaves 43 journaled near the tops of the respective columns 12 and 13, but preferably below track 15, cables 44 attached at one end to the top of the cage and running over the respective sheaves, and vertically movable counterweights 45 attached to the other ends of the cables. The counterweights are sufficiently heavy that they normally hold the cage in a raised position. However, when we add the weight of the spreader bar 21 to the cage, as hereinafter described, the cage and spreader bar overbalance the counterweights, and the cage descends. Preferably the cage carries V-rollers 46 and flat-faced rollers 47 at each corner top and bottom (FIG. 6). The V-rollers ride on vertical tracks 48 fixed to the flanges of columns 12 and 13, and the flat-faced rollers ride on the webs of the vertical travel of the cage. The columns also carry upper and lower sets of retractable stops 49 and 50, which the cage can engage to limit its upward and downward travel.

We mount a trolley 53 on the cage 42 for horizontal movement relative to the cage. The upper and lower faces of the cage carry tracks 54 and the trolley has rollers 55 which ride on these tracks. Stops 56 project upwardly and downwardly from the cage for limiting travel of the trolley toward the right, as viewed in FIGS. 2 and 4. We attach cables 57 to the right side of the trolley, which cables run over sheaves 58 journaled to the cage and extend downwardly to counterweights 59. The latter counterweights are sufficiently heavy that they normally hold the trolley to the right and to the limit permitted by stops 56. The trolley includes a pair of vertically extending guide channels 60. Motor operated jackscrews 61 are journaled in bearings 62 mounted on the sides of these channels and are threadedly engaged with nuts 63 mounted on the cage for moving the trolley to the left against the action of the counterweights 59.

Channels 60 have retractable stops 65 (FIG. 5) at their lower ends and funnel-shaped extensions 66 at their upper ends (FIG. 4). We insert removable guide frames 67 in the extensions 66. Frames 67 are open at the top and right sides. When cage 42 is in its raised position and trolley 53 in its normal position at the right of the cage, the open sides of the frames 67 are positioned for receiving the extensions 30 of the channels 29 on crane 16. After the crane lifts the spreader bar 21 and ladle 19 to a position in which the bar is within channels 29, the crane carries the bar and ladle to the left until the extensions 30 lie within frames 67. Trolley 53 can move to the left against the action of the counterweights 59 to absorb any overrun. Thus the spreader bar moves into alignment with channels 60. The crane then lowers the bar through channels

29 and 60 until rollers 31 on the bar engage the stops 65. Thereafter continued lowering of the bar and ladle forces the cage 42 downwardly against the action of counterweights 45 until the ladle seats on cradle 39. We adjust the jackscrews 61 as needed to shift the ladle horizontally for proper seating on the cradle. Preferably we provide an emergency ladle 68 under ladle 19 to receive the contents in the event of trouble (FIG. 1).

After the ladle 19 is seated on cradle 39, cage 42 continues to descend until it engages the stops 50, whereby the crane hooks 23 drop below the trunnions 20. We operate the jackscrews 61 to move the trolley 53 to the left and thus push the hooks to the left away from the trunnions. Thereafter we operate the crane to raise the spreader bar 21 sufficiently that hooks 23 clear the ladle. The ladle car 37 then carries the ladle to a position over the tundish 35 so that its contents can be poured into the tundish in the usual fashion. To remove an empty ladle, we perform the foregoing steps in reverse order.

From the foregoing description it is seen that our invention affords a simple reliable apparatus for transferring a ladle filled with molten steel from ground level to an elevated ladle car for continuous casting. Although we have illustrated the intermediate vessel which receives steel from the ladle as a tundish, it is apparent an in-line vacuum degassing vessel could be used. Different intermediate vessels may have different vertical dimensions, which necessitate placing the ladle at different heights on the ladle car. Since the cage is vertically movable, our apparatus can place the ladle at any desired height on the car. By duplicating the cage structure in the hoist bay, we can adapt out apparatus for use with ladles or pouring vessels of different vertical dimensions.

We claim:

1. In continuous-casting installation, the layout of which includes intersecting hoist and casting aisles, a portion of said hoist aisle constituting a hoist bay, a portion of said casting aisle constituting a casting bay, said installation including columns defining said aisles, an overhead crane supported at the upper portion of said columns for horizontal movement along said hoist aisle between a first position over said hoist bay and second position over the intersection of said aisles, a spreader bar suspended for vertical movement from said crane, ladle-engaging hooks carried by said bar, and a ladle car supported within said columns below said crane for horizontal movement along said casting aisle between a first position within the intersection and a second position within the casting bay, the combination therewith of a ladle-positioning mechanism comprising a cage supported for vertical movement in the intersection, means connected to said cage normally holding it in a raised position relative to said columns, a trolley supported on said cage for horizontal movement relative thereto, guide means on said trolley for receiving said bar when said crane is in its second position and guiding a ladle engaged by said hooks into a position supported on said car when the car is in its first position, and stop means limiting upward movement of said cage relative to said columns and downward movement of said bar relative to said guide means.

2. A combination as defined in claim 1 comprising in addition guide means carried by said columns in said hoist bay adapted to receive said bar when said crane is in its first position, and guide means carried by said crane to be aligned with the guide means carried by said columns when said crane is in its first position, and with the guide means carried by said trolley when said crane is in its second position.

3. A combination as defined in claim 2 in which the three guide means are in the form of channels, and including funnel-shaped extensions at the upper ends of said first and second-named guide means and at the lower end of said third-named guide means to facilitate transfer of said bar between the different guide means.

4. A combination as defined in claim 1 in which the means normally holding said cage in a raised position includes cables each attached at one end to said cage. Sheaves journaled to said columns over which said cables run, and vertically movable counterweights attached to the other ends of said cables, the weight of said bar being sufficient to overbalance said counterweights when added to the weight of said cage.

5. A combination as defined in claim 1 comprising in addition tracks on the top and bottom of said cage, stop means extending from said tracks, said trolley having wheels riding on said tracks, and means connected to said trolley normally holding it in engagement with said last-named stop means.

6. A combination as defined in claim 5 in which the means normally holding said trolley in engagement with said last-named stop means includes cables each attached at one end to said trolley, sheaves journaled to said cage over which said cables run, and vertically movable counterweights attached to the other ends of said cables.

7. A combination as defined in claim 5 comprising in addition jackscrews operatively connected to said trolley for moving it away from said stops.

8. A combination as defined in claim 1 in which vertical movement of said cage enables the height at which the ladle is positioned on the car to be varied.

9. In an installation for handling ladles of hot metal, which installation includes a plurality of columns, an overhead crane supported at the upper portion of said columns for horizontal movement, a spreader bar suspended for vertical movement from said crane, ladle-engaging hooks carried by said bar, and a ladle car supported within said columns below said crane for horizontal movement, the combination therewith of a ladle-positioning mechanism comprising a cage supported for vertical movement within the space defined by said columns, means connected to said cage normally holding it in a raised position relative to said columns, a trolley supported on said cage for horizontal movement relative thereto, guide means on said trolley for receiving said bar from said crane and guiding a ladle engaged by said hooks into a position supported on said car, and stop means limiting upward movement of said cage relative to said columns and downward movement of said bar relative to said guide means.

10. A combination as defined in claim 9 in which the means normally holding said cage in a raised position includes cables each attached at one end to said cage, sheaves journaled to said columns over which said cables run, and vertically movable counterweights attached to the other ends of said cables, the weight of said bar being sufficient to overbalance said counterweights when added to the weight of said cage.

11. A combination as defined in claim 9 comprising in addition tracks on the top and bottom of said cage, stop means extending from said tracks, said trolley having wheels riding on said tracks, and means connected to said trolley and normally holding it in engagement with said last-named stop means.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,627,292 Dated December 14, 1971

Inventor(s) Francis Gallucci, et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 39, before "partly" insert -- a -- ; line 41, before "side" insert -- a -- . Column 2, line 41, before "vertical" insert -- columns to facilitate -- .

Signed and sealed this 31st day of October 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.