

- [54] **BOTTOM HANDLING APPARATUS FOR STEEL CONVERTER VESSELS**
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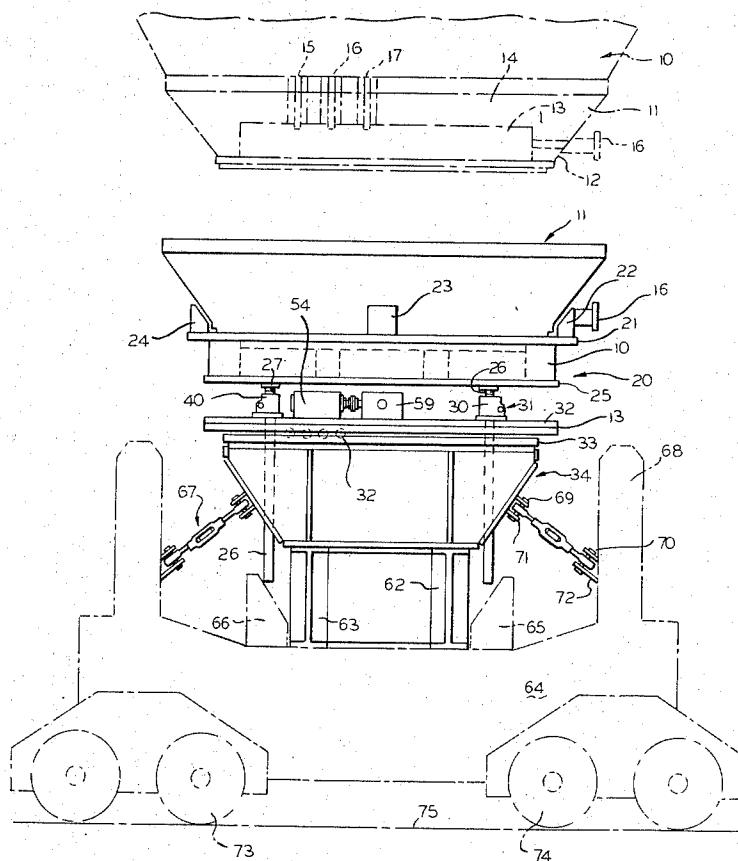
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[51] Int. Cl. **C21c 5/50**
[58] Field of Search..... 214/1 D, 1 H, 18 R;
105/177; 266/36 P

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[57] **ABSTRACT**
The bottom handling apparatus is adapted for being mounted on a ladle car or the like and comprises a base on which a turntable is rotatably mounted. A lift frame is supported on jacks which are in turn supported on the turntable. A single motor drives the jacks through speed reducers and individual clutches.

8 Claims, 3 Drawing Figures



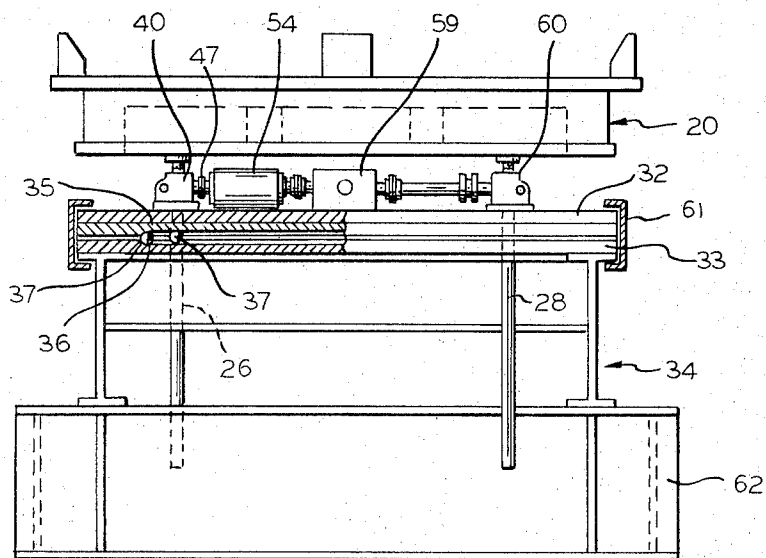
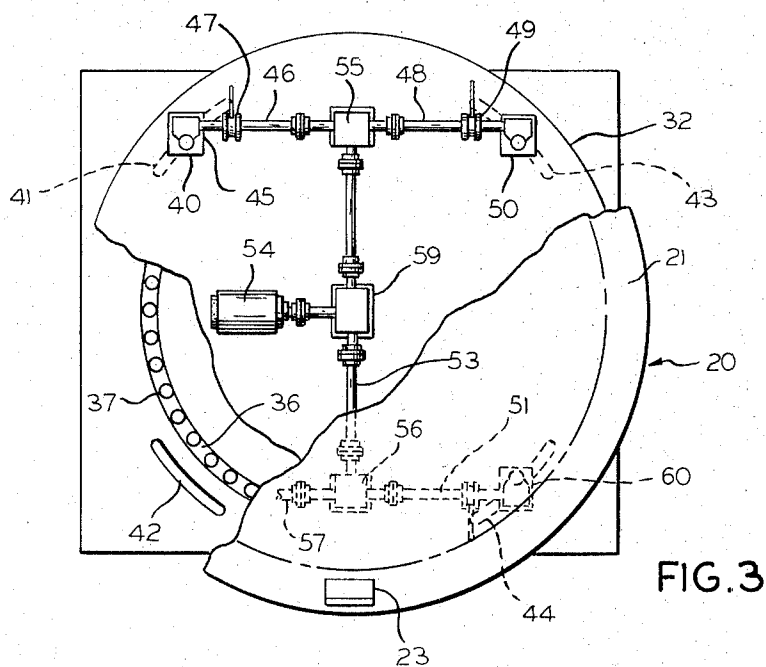


FIG. 2

BOTTOM HANDLING APPARATUS FOR STEEL CONVERTER VESSELS

BACKGROUND OF THE INVENTION

This invention relates to apparatus for handling the bottom assembly of a metallurgical vessel such as a bottom blown steel converter vessel. As is known, it is necessary periodically to remove the bottom assembly of a bottom blown steel converter vessel for the purpose of rebuilding the refractory bottom and for replacing its tuyeres. It is desirable that bottom removal and replacement be done in a minimum amount of time in order to minimize disruption of production. The procedure as carried out heretofore has been a laborious one which has involved having workmen position suitable props under the vessel so that the bottom assembly would remain in place while it was being uncoupled after which it was lowered by the most primitive means and eventually shifted to where it could be picked up by a crane for transport to the refurbishing station. Removal of the bottom assembly, its transport to and from the refurbishing station and its replacement has been very time consuming and has required a considerable number of workmen. Thus, the procedure has contributed to the increased cost of making steel.

SUMMARY OF THE INVENTION

An object of the present invention is to provide apparatus for making removal and replacement of bottom blown steel converter vessel bottom assemblies more convenient, faster and safer.

Another object of this invention is to provide a vessel bottom handling apparatus which may be mounted quickly on a ladle car or other available transport device in a steel mill and run under the vessel on tracks.

A more specific object of the invention is to provide bottom handling apparatus that is adapted for securing the bottom assembly while it is being uncoupled from the converter vessel and that is equipped with selectively operable jacks which permit level control of the bottom assembly when it is being removed or being fitted back in place.

How the foregoing and other more specific objects are achieved will appear throughout the course of a more detailed description of a preferred embodiment of the invention which will be set forth shortly hereinafter.

In general terms, the new bottom assembly handling apparatus comprises a lift frame which is adapted to engage and support the bottom of a converter vessel. The lift frame is supported on screw jacks in one embodiment and the bases of these jacks are mounted on a turntable. The turntable is supported on a structural base which is adapted for being placed on a teeming ladle car or the like in a position that might otherwise be occupied by a ladle. Means for securing and stabilizing the structural frame on the car are also provided.

Preferably, a single motor is mounted on the turntable and through a speed reducer it drives cross shafts which in turn drive additional speed reducers from which pairs of jacks are driven. Each jack has a clutch which allows it to be driven separately from the others so that the desired leveling of the bottom assembly may be obtained.

An illustrative embodiment of the new bottom handling apparatus will now be described in reference to the drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevation view of the bottom handling apparatus shown mounted on a ladle car and supporting a bottom assembly which is associated with a converter vessel that is shown fragmentarily above the apparatus;

FIG. 2 is an end elevation of the bottom handling apparatus separated from the ladle car on which it is depicted in FIG. 1, the handling apparatus being shown partly in section; and

FIG. 3 is a plan view of the bottom handling apparatus with parts broken away to reveal features of its construction.

DESCRIPTION OF A PREFERRED EMBODIMENT

In the uppermost part of FIG. 1, a fragment of a converter vessel 10 is illustrated. The means for mounting the vessel for tilting on a horizontal axis are not shown since they may be conventional. The bottom assembly is generally designated by the reference numeral 11. The means for clamping the bottom assembly 11 to the converter vessel 10 are omitted since they may also be conventional.

The bottom assembly 11 comprises a metal shell 12 which has an internal cavity 13 that is defined by a refractory lining 14. There are a set of tuyeres such as 15, 16 and 17 in the refractory bottom to permit injection of oxygen and fluxing materials entrained in oxygen into the molten metal within vessel 10 in connection with the basic oxygen process of converting impure molten ferrous metal to steel. A flanged pipe 16 communicating with the chamber 13 symbolizes that oxygen, gas entrained fine materials, and a hydrocarbon gas may be communicated to the separate passageways of the tuyeres and injected into the molten metal within the vessel. Bottom assemblies which are used with Bessemer converter vessels and bottom blown basic oxygen converter vessels are typical of those with which the new bottom assembly handling apparatus which will be described may be used. As is known, these bottom assemblies may be about 10 feet in diameter on 200 ton capacity vessels and they weigh many tons.

The bottom handling apparatus comprises a table means or lift frame 20 which has a flat top member 21. Welded on top member 21 are a plurality of circumferentially spaced lugs such as 22-24 which are beveled on their radially inward edges to allow registration of the beveled walls of bottom assembly 11 therein. The lugs may be differently shaped and might even be omitted in some cases. The lugs, of course, tend to centralize the bottom assembly on top member 21 and prevent any side shifting thereof during transport. Rotatably fastened to a bottom plate 25 of lift frame 20 are several jack screws two of which 26 and 27 are visible in FIG. 1. The jacks are similarly constructed so that only one of them needs to be described. In FIG. 1, one may see that the jack screw 26 extends through a jack body 30 in which there is a worm gear and wheel assembly, not shown, constituting jack operating means which effectuates rotation of jack screw 26. Driving power for each jack screw is delivered by means of a shaft 31 which extends laterally from the jack body 30. The jack

bodies such as 30 are secured on a turntable 32. The turntable 32 is supported on a bed plate 33 which is in turn anchored on a structural frame 34. The bottom of turntable 32 has an arcuate groove 35 and top of bed plate 33 also has an arcuate groove 36, the two grooves being aligned with each other. Within the grooves are a plurality of bearing balls 37 which accept the vertical thrust and facilitate limited turning of plate 32 on bed plate 33 about a nominally vertical axis. Those skilled in the art will appreciate that the turntable can be journaled for rotation with respect to stationary frame 34 with bearing means other than the ball and groove arrangement.

As can be seen particularly well in FIGS. 2 and 3, the jack bodies 30, 40, 50 and 60 are mounted on the top of turntable 32 and the jack screws 26-29 extend down through suitable holes in the planar turntable 32 and through arcuate slots 41, 42, 43 and 44 so that the turntable 32 may be rotated through a limited angle with respect to bed plate 33 without the jack screws encountering interference. This facilitates aligning the vessel bottom assembly 11 with the vessel 10 as required when the bottom assembly is being removed or reinstalled.

A drive shaft such as 45 extends from each of the jack bodies 30, 40, 50 and 60 such as typified by jack body 40 as can be seen particularly well in FIG. 3. Shaft 45 is coupled to another shaft 46 through the agency of a clutch mechanism 47. The clutches enable the various jacks to be driven selectively so that the jack screws can be extended by different amounts to enable leveling of the lift frame 20 or to enable tilting it to a limited extent if desired for engaging a bottom assembly which may be distorted or otherwise not exactly level when it is engaged with the vessel 10.

All of the jacks are driven by a single motor 54 which is mounted on the top of turntable 32. The motor could be mounted alternatively on the bottom of the lift frame 20. Motor 54 is coupled with a worm and wheel type speed reducer 59 which is also mounted on the top of turntable 32. Power output shafts 52 and 53 extend from opposite sides of the speed reducer 59. As can be seen in FIG. 3, shaft 52 typically couples with another speed reducer 55 from which drive shafts 46 and 48 extend. Shaft 46 is coupled with its jack body 40 through clutch 47. Shaft 48 is coupled with its associated jack body 60 through clutch 49. Similarly, from centrally located speed reducer 59 there is an output shaft 53 which operates a speed reducer 56 that in turn has output shafts 51 and 57 extending respectively to jack bodies 60 and 30. Separation of turntable 32 from its base 33 is precluded by use of a circular member 61 which is channel shaped in cross section as can be seen in FIG. 2, and has its lower flange welded to the beams which comprise structural base 34.

The main base 34 for supporting the bottom assembly handling apparatus includes a pair of I-beams 62 and 63. Thus, the apparatus may be set on a ladle car 64 which is ordinarily located in a pit underneath the converter vessel 10 and its bottom 11. Extending from the top of the ladle car bed are several upstanding beveled lugs, two of them 65 and 66 being visible in FIG. 1. The lugs are spaced apart by such distance that the structural base I-beams 62 and 63 fit between them and allow the lifting apparatus to be placed squarely on the top of car 64. The lifting apparatus is preferably stabilized on car 64 by use of several turnbuckle assemblies

such as 67. The turnbuckle assemblies may be rapidly connected with a supporting frame 34 and posts 68 which extend upwardly from car 64 by inserting pins 69 and 70 into suitable lugs 71 and 72 which are welded or otherwise fastened to frame 34 and post 68, respectively. Car 64 has wheel assemblies such as 73 and 74 which run on tracks 75 that are in the bottom of a pit, not shown, which is underneath the vessel 10. The car may be shifted to a position where it is accessible from the open top of the pit adjacent the vessel and, after removing the ladles which are ordinarily thereon, the bottom handling apparatus which is shown isolated in FIG. 2 may be set on the car as illustrated in FIG. 1. After the lifting apparatus is stabilized with turnbuckles it may be shifted on the car to a position underneath vessel 10. The screw jacks are then operated to elevate the lift frame means 20 until engagement is made with the bottom assembly 11 which is shown in phantom in FIG. 1. Firm and square engagement between the lift frame 20 and bottom assembly 11 may be obtained by differential operation of the jack screws which is obtained by selectively operating the clutches which couple them with their driving means. After the bottom assembly 11 is disconnected from vessel 10, the assembly is lowered by operating the jacks and the car is transferred to a position in the pit where it is made accessible to a crane by which the bottom assembly may be removed from the handling apparatus and transported to the refurbishing station. Reinstallation of the bottom assembly involves a procedure converse to that which has just been outlined.

Those skilled in the art will appreciate that hydraulic jacks could be used in place of the screw jacks which are used to exemplify the invention and that the turntable. The supporting bearings and the base can be variously developed. Accordingly, the lifting or bottom handling apparatus which has been described should be considered illustrative rather than limiting for the invention may be variously embodied and is to be limited only by interpretation of the claims which follow.

I claim:

1. Apparatus for handling a vessel bottom which is attachable to and detachable from a metallurgical vessel, said apparatus comprising:

- a. means adapted to receive and support a vessel bottom,
- b. turntable means mounted for rotation about a nominally vertical axis,
- c. a plurality of screw jacks mounted on said turntable means radially outwardly from its axis of rotation and having movable load bearing screws on which said receiving and supporting means is supported, said jacks being operable to advance and retract said supporting and receiving means,
- d. motor means,
- e. jack operating means associated with each screw jack and means operatively coupling each operating means to said motor means, and
- f. clutch means in each said operative coupling means, said clutch means being selectively engageable and releasable to thereby enable advancing and retracting said screw jacks by different amounts.

2. The invention defined in claim 1 wherein:

- a. said turntable means includes an element that is rotatable about said nominally vertical axis and a

stationary base means on which said element is rotatable,

- b. said base means including means that are constructed and arranged for being removably received by and supported on a car.

3. The invention defined in claim 2 wherein:

- a. there are a plurality of balls arranged in an arc about the turntable rotational axis, said balls serving as bearing means and being interposed between said rotatable element and said base means.

4. The invention defined in claim 2 including:

- a. means engageable with said base means and said car to stabilize said base means thereon, said engageable means including adjusting means for varying the length of said engageable means.

5. Apparatus for handling a bottom which is attachable to and detachable from a bottom blown steel converter vessel, said apparatus comprising:

- a. a base means that is adapted for being received and supported on a car,
b. turntable means journaled for rotation on said base means about a nominally vertical axis,
c. a plurality of screw jacks each of which has associated operating means for turning said screw jacks and having extensible means, said jacks being disposed on said turntable means,
d. a lift frame means supported on the plurality of extensible means, said lift frame means being adapted to engage and support a vessel bottom,
e. a single motor means mounted between said turntable means and said frame means, and
f. clutch means operatively coupled to each jack operating means and to the motor means, said clutch means being operable to selectively actuate said screw jacks whereby to control the level of said lift frame means.

6. Apparatus for handling a vessel bottom which is attachable to and detachable from a metallurgical vessel, said apparatus comprising:

- a. receiving means adapted to receive and support a vessel bottom,
b. turntable means mounted for rotation about a nominally vertical axis,
c. means for elevating and selectively tilting said vessel bottom consisting solely of a plurality of reversible elevating means mounted on said turntable means and being disposed radially outwardly from its axis of rotation and in spaced apart relation, said reversible means each engaging a separate portion of said receiving means and each being operable individually to advance and retract said respective portions of said receiving means,
d. motive means,

- e. coupling means for selectively operatively coupling each of said reversible means with said motive means for selectively advancing and retracting said reversible means individually by different amounts whereby to adjust the level of said receiving means and to tilt the same relative to a horizontal plane.

7. Apparatus for handling a bottom which is attachable to and detachable from a bottom blown steel converter vessel, said apparatus comprising:

- a. a non-elevatable base means,
b. turntable means journaled for rotation on said base means about a nominally vertical axis,
c. a plurality of spaced apart, reversible elevating means mounted on said turntable means and each having associated operating means, each of said operating means being individually and selectively operable for advancing and retracting said elevating means,
d. a lift frame means supported on the plurality of elevating means, said lift frame means being adapted to engage and support a vessel bottom,
e. a single motor means mounted between said turntable means and said frame means, and
f. coupling means operatively connected to each operating means and to the motor means, said coupling means being operable to selectively actuate said elevating means whereby to adjust the level of said lift frame means and to tilt the same relative to a horizontal plane.

8. Apparatus for handling a bottom which is attachable to and detachable from a bottom blown steel converter vessel, said apparatus comprising:

- a. a base means,
b. turntable means journaled for rotation on said base means about a nominally vertical axis,
c. a plurality of spaced apart, reversible jack means mounted on said turntable means and each having associated operating means for actuating said jack means and having extensible means, said jack means being disposed on said turntable means,
d. a lift frame means supported on the plurality of extensible means, said lift frame means being adapted to engage and support a vessel bottom,
e. a single motor means mounted between said turntable means and said frame means, and
f. clutch means operatively coupled to each operating means and to the motor means, said clutch means being individually and selectively operable to selectively actuate said jack means whereby to adjust the level of said lift frame means and to tilt the same relative to a horizontal plane.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,820,665 Dated June 28, 1974

Inventor(s) Howard M. Fisher

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

Claim 6, column 5, line 46, delete "elevating"

Signed and sealed this 31st day of December 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents