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3,146,983

MOUNTING FOR INVERTIBLE VESSEL

Filed Nov. 8, 1961

2 Sheets-Sheet 1

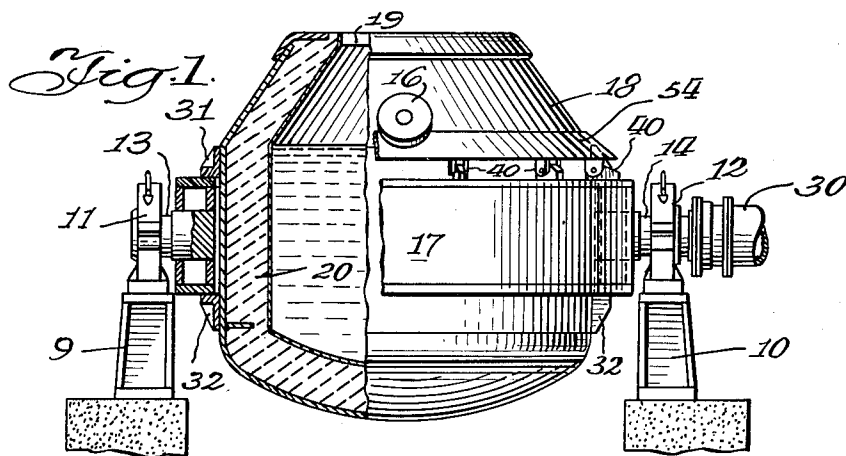
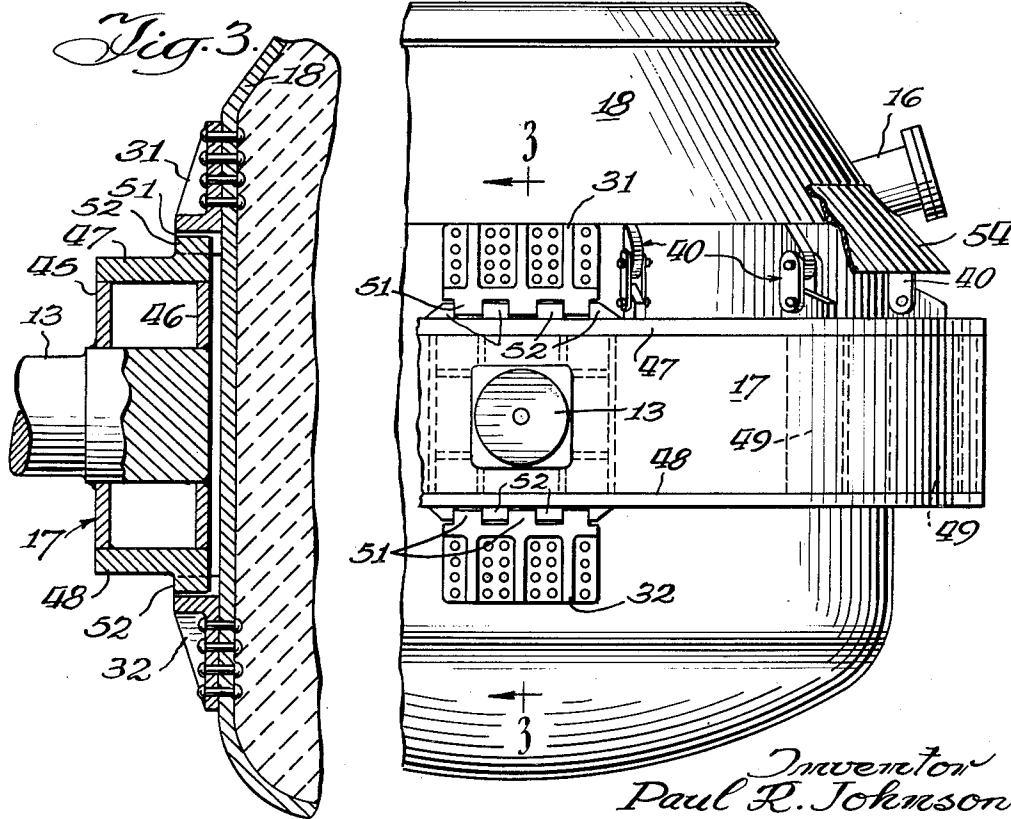


Fig. 2.



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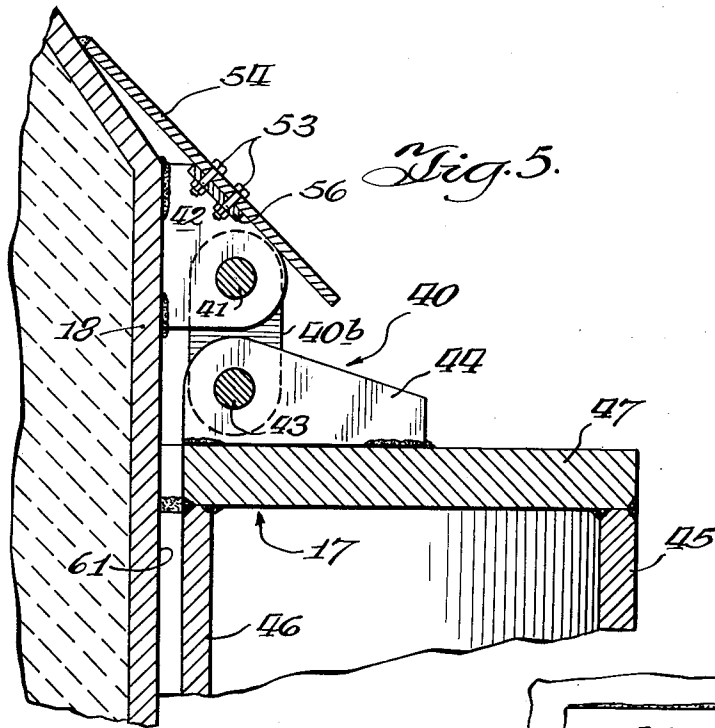


Fig. 5.

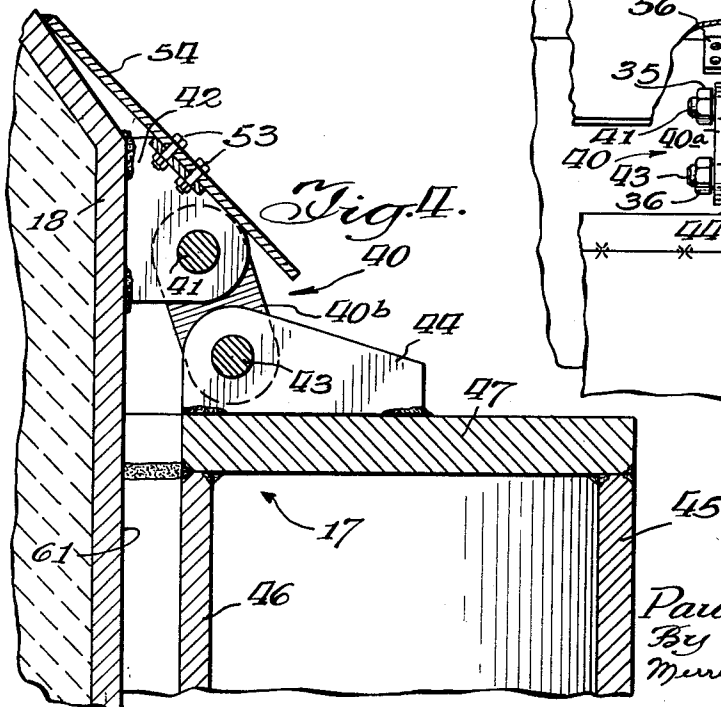


Fig. 4.

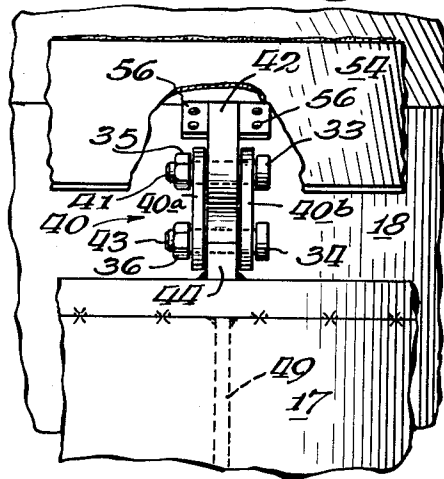


Fig. 6.

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MOUNTING FOR INVERTIBLE VESSEL

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10 Claims. (Cl. 248—141)

The present invention relates generally to mountings for invertible vessels such as converter vessels used in the oxygen process of steel-making, and more particularly to a mounting which accommodates thermal expansion of the vessel and avoids a vertical drop by the vessel, relative to its mounting, when the vessel is inverted.

Converters used in the oxygen steel-making process generally comprise an open-top vessel, a peripheral ring connected to the vessel and spaced radially therefrom to accommodate thermal expansion by the vessel in a radial direction, a pair of trunnions extending in opposite directions from the ring, and a pair of standards each rotatably mounting one of said trunnions. Conventional converter vessels are mounted on the peripheral ring by upper and lower brackets each rigidly attached to the converter and connected to the ring.

During the steel-making operation the shell of the vessel becomes hotter than the radially spaced peripheral ring and undergoes greater expansion, in both vertical and radial directions, than does the ring. As a result, the upper and lower brackets, rigidly attached to the shell of the vessel, are moved further apart in a vertical direction. This causes a loosening of the connection between the brackets and the ring. Accordingly, when the converter is inverted to pour out the molten steel, there is a vertical drop by the vessel relative to the ring and equal to the difference between the distances separating the upper and lower brackets before and after expansion. This drop causes a substantial impact shock to the ring and the vessel, said shock being of a magnitude which can damage the converter.

The present invention provides an arrangement which mounts the vessel to the ring, which accommodates both radial and vertical expansion of the vessel relative to the ring, and which avoids a vertical drop by the vessel, and its resultant impact shock, when the converter is inverted. The mounting arrangement of the present invention also maintains the converter vessel centrally within the trunnion ring under all conditions of expansion and in all positions of rotation.

Other features and advantages are inherent in the structure claimed and disclosed or will become apparent to those skilled in the art from the following detailed description in conjunction with the accompanying diagrammatic drawings, wherein:

FIGURE 1 is a front elevational view, partly in section, of a steel-making converter including an embodiment of a mounting arrangement, for the converter vessel, constructed in accordance with the present invention;

FIGURE 2 is an enlarged fragmentary side view of a portion of the converter of FIGURE 1;

FIGURE 3 is a sectional view taken along line 3—3 in FIGURE 2;

FIGURE 4 is a fragmentary sectional view illustrating in detail an embodiment of the subject mounting arrangement when the converter is in an unheated condition;

FIGURE 5 is a view similar to FIGURE 4, illustrating the mounting arrangement with the converter in a heated condition; and

FIGURE 6 is a fragmentary front view of the mounting arrangement of FIGURES 4 and 5.

FIGURE 1 illustrates a typical steel-making converter vessel 18 having an upper opening 19, a tap-hole nozzle 16, an interior lining of refractory material 20, and con-

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nected to a radial spaced peripheral ring 17 by a plurality of peripherally spaced hinged connections 40. Extending outwardly from ring 17 in opposite directions are a pair of horizontal trunnions 13, 14, journaled in bearings 11, 12 supported by standards 9, 10. Trunnion 14 is connected by a coupling 30 to means (not shown) for rotating the trunnions and inverting converter vessel 18.

Hinged connections 40 entirely support vessel 18 when the latter is in a vertical position, right side up as in FIGURE 1 or inverted, and partially support vessel 18 when it is tilted. Located above and below each trunnion 13, 14 are lugs 31, 32 respectively, each attached to vessel 18 (FIGURES 2 and 3). When the vessel is in a horizontal tilted position, the lugs 31, 32 rest on ring 17 to provide substantially the entire support for the vessel, and when the vessel is tilted to an inclined position it is partially supported by the lugs.

The shell of vessel 18 becomes hotter during the steel-making operation than does ring 17, spaced outwardly from vessel 18. Accordingly, vessel 18 undergoes a greater amount of thermal expansion in both radial and vertical directions than does ring 17. FIGURES 4 to 6 illustrate in detail hinged connecting means 40 which mount the converter 18 on the ring 17, which accommodate the difference in radial and vertical expansion between vessel 18 and ring 17, and which avoid a vertical drop by vessel 18, relative to ring 17, when the converter is inverted.

Referring to FIGURES 2 and 3, in the illustrated embodiment, ring 17 is hollow and comprises outer and inner walls 45, 46 respectively, upper and lower walls 47, 48 respectively, and internal rigidifying diaphragms 49. Referring now to FIGURES 4 to 6, rigidly attached to ring upper wall 47, as by welding, is an element 44 the upper part of which is pivotally connected by a pin 43 to the lower end of each of a pair of link members 40a, 40b each each disposed on an opposite side of element 44. The upper end of each link member 40a, 40b is in turn pivotally connected by a pin 41 to the lower part of a substantially triangular shaped element 42 located between the two link members, rigidly connected to the shell of vessel 18, and vertically aligned with element 44. Pins 41, 43 include head portions 33, 34 and have nuts 35, 36 threaded thereon to maintain them in place (FIGURE 6). Pin 41 has an axis which, except for the slight spacing of pin 41 from the surface of vessel 18, is tangential to or extends alongside the surface of vessel 18. Pin 43 has an axis parallel to the axis of pin 41. Both pin axes are substantially horizontal when the vessel is in the upright position shown in the figures. The pin axes are horizontal when the ring is horizontal. The pins 41, 43 and their respective axes are spaced apart a predetermined distance, and this distance is maintained for all positions of rotation of the converter vessel by virtue of the construction of connecting means 40.

FIGURE 4 illustrates the relative positions of ring 17, vessel 18 and hinged connecting means 40 before thermal expansion, while FIGURE 5 illustrates the relative position of the ring, the vessel and the hinged connecting means after thermal expansion. Converter vessel 18 undergoes thermal expansion in both a radial and vertical direction, said expansion being substantially greater than that undergone by ring 17. Accordingly, the walls of converter vessel 18 expand radially and vertically relative to ring 17. This expansion is accommodated by the clearance 61 existing between inner wall 46 of ring 17 and the shell of vessel 18, and by hinged connecting means 40 which maintain the desired connection between the ring and the vessel during this differential expansion and avoid a vertical drop on the part of vessel 18 when the converter is inverted.

The link members 40a, 40b, by virtue of being posi-

tioned on each side of and attached to both element 44 on ring 17 and element 42 on vessel 18, act as guides for these elements during expansion and help maintain the alignment between the elements during expansion. This in turn helps maintain converter vessel 18 centrally within trunnion ring 17 during expansion and rotation. Other guide means which help to maintain vessel 18 centrally within the trunnion ring under all conditions of expansion and in all positions of rotation are located above and below trunnions 13, 14 on lugs 31, 32 and ring 17.

Referring to FIGURES 2 and 3, lugs 31, 32 each include peripherally spaced outwardly extending portions 51, and mounted on ring upper and lower walls 47, 48 are peripherally spaced, normally vertically extending members 52. Each portion 51 is received and confined between a pair of members 52 which act as guides for portion 51 as the latter moves outwardly during radial expansion of converter vessel 18.

It should be noted that neither portions 51 nor any other portions of the lugs rest on ring upper wall 47 when vessel 18 is in an upright vertical position, or on ring lower wall 48 when the vessel is in an inverted vertical position. However, when the vessel is in other than a vertical position, portions 51 rest on members 52, and when the vessel is in a horizontal position the sole support for the vessel is provided by lug portions 51 resting on members 52.

Each of the peripherally spaced hinged connections 40 is protected from the heat emanating from the vessel's upper opening 19 and from particles blown outwardly through the opening 19 by a downwardly and outwardly flaring peripheral shield 54 connected to the shell of converter vessel 18 by fasteners 53 attaching the shield to plates 56 on elements 42.

There has thus been described an arrangement which mounts a converter vessel on a spaced peripheral ring, which accommodates for the difference in expansion between the vessel and the ring during heat-generating operations inside of the vessel, and which avoids a vertical drop on the part of the vessel relative to the ring when the converter is inverted.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, as modifications will be obvious to those skilled in the art.

What is claimed is:

1. In combination:

a vessel;
a peripheral ring spaced radially from said vessel;
a plurality of means hingedly connecting said vessel to said ring;

and means mounting said ring for rotation, together with said vessel, between an upright vessel position and an inclined vessel position;

each of said connecting means comprising:

a link member;

means connecting a first end of said link member to said vessel and mounting the link member for pivotal movement about a first axis extending alongside the surface of the vessel and disposed substantially horizontally when the ring is horizontal;

and means connecting a second end of said link member to said ring and mounting the link member for pivotal movement about a second axis spaced a predetermined distance from and parallel to said first axis;

said hingedly connecting means including means for maintaining said predetermined distance between said first and second axes in all positions of rotation of said vessel.

2. In the combination of claim 1 wherein said first axis is substantially tangential to the surface of said vessel.

3. In combination:

a vessel;

a peripheral ring spaced radially from said vessel;

a plurality of means hingedly connecting said vessel to said ring;

and means mounting said ring for rotation, together with said vessel, between an upright vessel position and an inclined vessel position;

each of said connecting means comprising:

a first pin;

means connecting said first pin to said vessel and mounting said first pin with the axis thereof substantially tangential to the surface of the vessel and in a horizontal disposition when the ring is horizontal;

a second pin;

means connecting said second pin to said ring and mounting said second pin a predetermined distance from and substantially parallel to said first pin;

and a link member having a first end pivotally mounted on said first pin and a second end pivotally mounted on said second pin;

said hingedly connecting means including means for maintaining said predetermined distance between said first and second pins in all positions of rotation of said vessel.

4. In combination:

a vessel;

a peripheral ring spaced radially from said vessel;

a plurality of means hingedly connecting said vessel to said ring;

and means mounting said ring for rotation, together with said vessel, between an upright vessel position and an inclined vessel position;

each of said connecting means comprising:

a first pin having an axis extending substantially tangential to said vessel and lying in a horizontal disposition when the ring is horizontal;

a first element pivotally mounted on said first pin and connected to said vessel;

a second pin parallel to and spaced a predetermined distance from said first pin;

a second element pivotally mounted on said second pin and connected to said ring;

and a pair of link members each having a first end pivotally mounted on said first pin and a second end pivotally mounted on said second pin;

said hingedly connecting means including means for maintaining said predetermined distance between said first and second pins in all positions of rotation of said vessel.

5. A combination as recited in claim 4 wherein said first and second elements are in vertical alignment and are located between said link members.

6. A combination as recited in claim 5 and comprising:

guide means on said vessel and said ring;

said guide means comprising an outwardly extending portion on said vessel, and a pair of peripherally spaced members on said ring for receiving and confining said outwardly extending portion therebetween.

7. A mounting arrangement for a converter vessel rotatable between upright and inclined positions, said arrangement comprising:

a peripheral ring spaced radially from said vessel;

and a plurality of means hingedly connecting said vessel to said ring, each of said connecting means comprising:

a link member;

means for connecting a first end of said link member to the vessel and mounting the link member for pivotal movement about a first axis extending alongside the surface of the vessel and in a horizontal disposition when the ring is horizontal;

and means connecting a second end of said link member to said ring and mounting the link member for

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pivotal movement about a second axis spaced a predetermined distance from and parallel to said first axis;

said hingedly connecting means including means for maintaining said predetermined distance between said first and second axes in all positions of rotation of said vessel. 5

8. An arrangement as recited in claim 7 wherein said first axis is substantially tangential to the surface of said vessel. 10

9. A mounting arrangement for a converter vessel rotatable between upright and inclined positions, said arrangement comprising:

a peripheral ring spaced radially from said vessel; and a plurality of means hingedly connecting said vessel to said ring, each of said connecting means comprising: 15

a first pin;

means for connecting said first pin to said vessel and mounting said pin with the axis thereof substantially tangential to the surface of said vessel and in a horizontal disposition when the ring is horizontal; a second pin; 20

means connecting said second pin to said ring and mounting said second pin a predetermined distance from and substantially parallel to said first pin; 25

and a link member having a first end pivotally mounted on said first pin and a second end pivotally mounted on said second pin;

said hingedly connecting means including means for maintaining said predetermined distance between said first and second pins in all positions of rotation of said vessel. 30

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10. A mounting arrangement for a rotatable converter vessel rotatable between upright and inclined positions, said arrangement comprising:

a peripheral ring spaced radially from said vessel; and a plurality of means hingedly connecting said vessel to said ring, each of said connecting means comprising:

a first pin having an axis extending substantially tangential to the surface of said vessel and disposed horizontally when the ring is horizontal;

a first element pivotally mounted on said first pin and including means for connection to said vessel;

a second pin spaced a predetermined distance from and disposed parallel to said first pin;

a second element pivotally mounted on said second pin and connected to said ring;

and a pair of link members each having a first end pivotally mounted on said first pin and a second end pivotally mounted on said second pin;

said hingedly connecting means including means for maintaining said predetermined distance between said first and second pins in all positions of rotation of said vessel.

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