TILTABLE CRUCIBLE OR CONVERTER FOR CARRYING OUT METALLURGICAL PROCESSES

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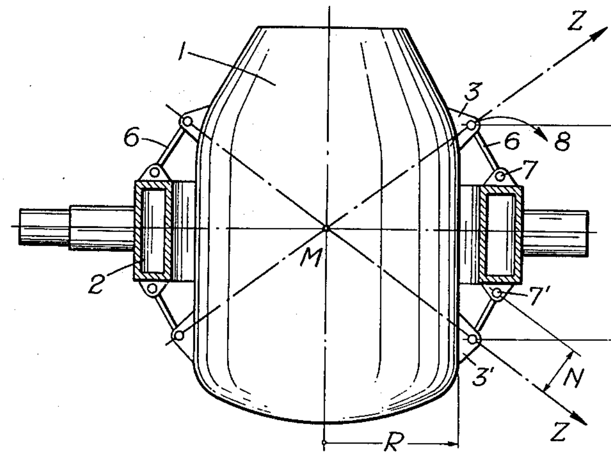

FIG. 1

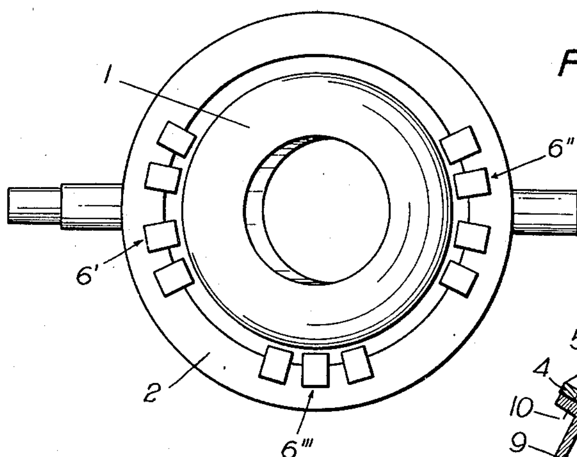

FIG. 2

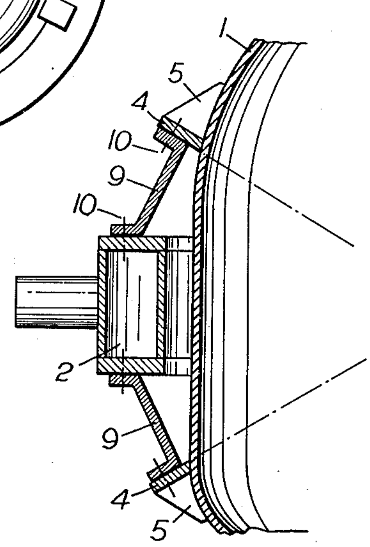

FIG. 3

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ABSTRACT OF THE DISCLOSURE

A bearing arrangement for a tiltable metallurgical vessel, comprising a carrying ring mounted to surround the shell of said vessel at a distance, a number of upper and lower supporting lugs spaced around the circumference of the vessel, and elastically deformable braces connecting said supporting lugs and said carrying ring to enable friction-free expansion of the vessel through complete compensation of thermal expansion differences by elastic deformation of said braces.

Tiltable crucibles or converters for refining pig iron comprise a refractory-lined cylindrical or pear-shaped vessel, the bottom part of which may be integral with the shell part, or it may be detachable. A carrying ring rigidly connected to two trunnions is mounted to surround the shell of such a crucible approximately at the height of the center of gravity of the charged crucible, said carrying ring being spaced from the crucible shell, so that air can circulate therebetween. The crucible must be tiltable from the substantially vertical blowing position into the upside-down position for complete discharging and back into the upright position by means of electric or hydraulic drives acting on the trunnions, and the carrying ring has the task of securely holding the crucible in any position and of transmitting to the crucible the forces exerted by the drive.

According to known constructions, rows of upper and lower supporting elements in the form of rectangular brackets are provided for supporting the crucible, one flange of a bracket being mounted on the crucible shell and the other flange engaging the upper or lower side of the carrying ring and being also fixed thereto by means of screws or the like. With this known crucible mounting, however, a friction-free expansion of the carrying ring construction or a compensation for the difference in expansion between carrying ring construction and crucible shell, which latter is hotter, is not possible. Depending on the position of the crucible, whether upright or upside-down, the difficulty arises that the unstressed bracket, because of the longitudinal expansion of the vessel, is lifted off slightly from the bearing surface. The clearance is dependent upon the size of the crucible and also upon the size of the carrying ring. With large crucibles, the expansion clearance has the result that the crucible, during erecting or during tilting into the upside-down position, will rock to and fro, which causes a sudden impact and may lead to extensive wear of the supporting lugs.

To avoid these difficulties it is already known, according to a previous proposal, to design the bearing surfaces of the supporting lugs and of the carrying ring as inclined planes slanting towards the center of the ring. Such construction is already an improvement as compared with the afore-mentioned constructions, and a clearance-free expansion at the respectively unstressed bracket is possible. However, the clearance is not avoided, it is only diminished, and a shock or impact will still occur during

tilting or erecting, which, while smaller than before, still causes an excessive stress on the supporting lugs.

The invention has as its object to avoid the mentioned disadvantages and difficulties. In a converter of the aforementioned kind, it resides in that the supporting lugs and the carrying ring are connected by elastically deformable braces.

According to a preferred embodiment of the invention, the length of each brace from its fastening point on the upper or lower side of the carrying ring to the corresponding upper or lower supporting lug substantially corresponds to the distance normal to the theoretical thermal expansion direction emanating from the center of the crucible, the inclination of which towards the horizontal line is $D/2R$, D standing for the distance between upper and lower supporting lugs and R for the outer radius of the vessels, so that the crucible-side ends of the braces within the limits of the thermal expansion coincide with the direction of movement of the crucible during thermal expansion.

Preferably, the braces consist of U-shaped rails, one flange of which is connected, preferably by means of screws, to the upper or lower side of the carrying ring and the other flange to the upper or lower supporting lug designed as an abutment.

The invention is illustrated in more detail in the drawing by way of an embodiment. FIGS. 1 and 2 diagrammatically show a crucible according to the invention in side view and top view. FIG. 3 demonstrates the design of the bearing arrangement according to the invention in vertical sectional view.

In all figures, numeral **1** denotes a crucible or converter for refining pig iron, comprising a cylindrical middle part, a bottom part in the shape of a spherical cap, and a top part in the shape of a conic frustum. The carrying ring **2**, which is box-shaped, is mounted to surround the crucible shell **1** at a distance. Rows of upper supporting lugs **3** and lower supporting lugs **3'** are provided on the shell of the crucible, said supporting lugs, as shown in FIG. 3, being designed as abutments having supporting surfaces **4** and reinforcement ribs **5**. Braces **6** are provided, according to the invention, for connecting the upper or lower side of the carrying ring with the supporting lugs. As shown in FIG. 1 of the drawing, the length of these braces corresponds to the normal distance from fastening point **7** or **7'** of each brace to the straight line emanating from the center M of the crucible, which is designated by Z and represents the theoretical thermal expansion direction. This theoretical thermal expansion direction has an inclination of $D/2R$ towards the horizontal line, D being the distance between upper and lower supporting lugs and R standing for the outer radius of the vessel. With this kind of bearing arrangement, the crucible-side ends of the braces can move along a circular path tangential to the theoretical thermal expansion direction Z of the crucible. This is indicated by arrow **8** in FIG. 1.

The bearing arrangement according to the invention enables a virtually friction-free expansion of the crucible. Any differences in length that will result from the transformation of the linear movement into a circular path in the range of the thermal expansion path, can be accommodated because of their small order, by elastic deformation of the braces.

In practical use of the bearing arrangement, braces as shown in FIG. 3 have proved suitable. These braces are U-shaped rails **9**, the flanges projecting from the web of rail **9** at an obtuse angle. One of the flanges is fixed to the upper or lower wall of the box-shaped carrying ring and the other flange to the supporting surface **4** of the corresponding supporting lug by means of screws **10**.

In a preferred embodiment as evident from FIG. 2, the braces and supporting lugs are arranged in three groups, two of these, **6'** and **6''**, being arranged opposite each other in the range of the trunnion axis, and the third group, **6'''**, vertical thereto. In this way, a support suiting the three-point principle, which is statically especially advantageous, is achieved.

The crucible mounting of the invention enables complete compensation of thermal expansion differences by elastic deformation of the braces. As the crucible is free to expand independent of frictional forces, no danger from undefined frictional forces or jamming can arise. The forces acting upon the carrying ring are easily identifiable, due to resilient deformation.

This has hitherto not been accurately possible with any other kind of bearing arrangement, as the frictional forces vary over a large range under thermal influence. Development of a clearance and occurence of shock stresses are reliably avoided. A further advantage of the bearing arrangement according to the invention is a very favourable transmission of forces to the vessel, as the point of force introduction at the supporting lugs **3** and **3'** is very close to the sheet-metal shell of the crucible, and thus only small force transition moments result. Besides, with the crucible design customary at present, the abutment members are arranged in especially firm zones of the vessel, i.e. the upper frusto-conical zone and the lower torus zone, respectively. Good deformability without danger of breakage is safeguarded, which is particularly valuable during occasional strong deformations of the vessel. The braces are quickly and easily exchangeable, which is of special importance during an eventual disorder or a standstill. As the clearance of the carrying ring is not covered by any bracket flanges, cooling conditions of the crucible are also improved, as the air can circulate more freely.

What I claim is:

1. A tiltable metallurgical vessel comprising a substantially cylindrical shell, a carrying ring mounted to surround said shell in spaced relationship, and a number of upper and lower supporting lugs designed as abutments spaced around the circumference of said vessel and spaced respectively above and below said ring, each of said supporting lugs being connected to said carrying ring by an elastically deformable brace, the length of each of said braces from its fastening point on said carrying ring to

the corresponding supporting lug on the vessel substantially corresponding to the distance normal to the theoretical thermal expansion direction emanating from the center of said vessel and having an inclination towards the horizontal line of $D/2R$, D standing for the distance between said upper and lower supporting lugs, and R for the outer radius of said vessel, and the fastening point of said brace on the corresponding supporting lug lying substantially along the path of said theoretical thermal expansion emanating from the center of said vessel and having said inclination.

2. A vessel as set forth in claim **1** comprising a cylindrical middle part, a torus-shaped bottom part, and a frusto-conical top part, wherein said upper supporting lugs are mounted on said frusto-conical top part and said lower supporting lugs are mounted on said torus-shaped bottom part.

3. A tiltable metallurgical vessel comprising a substantially cylindrical shell, a carrying ring having a box-type section mounted to surround said shell in spaced relationship, and a number of upper and lower supporting lugs designed as abutments spaced around the circumference of said vessel, said supporting lugs and said carrying ring being connected by elastically deformable braces in the form of U-shaped rails, one flange of each of said rails being fastened to said carrying ring and the other flange being fastened to one of said supporting lugs.

References Cited

UNITED STATES PATENTS

2,406,380	8/1946	Johnston	266—39
3,163,696	12/1964	Johansson et al.	
3,201,108	8/1965	Kramer.	
3,288,453	11/1966	Buesing et al.	
3,337,205	8/1967	Puxkandl	266—39 X
3,191,922	6/1965	Puhringer.	

FOREIGN PATENTS

241,503	7/1965	Austria.
1,355,699	2/1964	France.

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