SLINGER APPARATUS FOR LINING THE INTERIOR OF A VESSEL

19 Claims, 3 Drawing Figs.

ABSTRACT: Slinger apparatus for lining the interior of a vessel. The apparatus includes a support for holding the vessel, an applicator head for slinging the material with which the vessel is to be lined, and a support for holding the applicator head, either the vessel support or the applicator head support providing a means for movably supporting the vessel or applicator head, respectively. The apparatus also includes means for producing relative motion between the applicator head and the vessel and a means having a configuration matching that of the contour of the mouth of the vessel for guiding the applicator head, during the relative movement between the applicator head and the vessel, along a path matching that of the contour of the vessel.
SLINGER APPARATUS FOR LINING THE INTERIOR OF A VESSEL

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for producing a shell lining on the interior of a vessel. Such a lining, if made of heat resistant material, for example, may form the refractory lining in a vessel used to contain molten matter.

"Slinger" is a name given to a certain type of apparatus, which employs rotary impellers to project or "sling" material such as sand at a desired speed in a desired direction. Such apparatus is well known in the foundry art, where it is used to sling various compositions of molding sand into corresponding forms or molds. By properly choosing the speed with which the composition impinges on the surface of the form it is possible to uniformly fill the form and thoroughly pack the composition.

SUMMARY OF THE INVENTION

An object of the present invention is to provide apparatus which can mechanically line the interior of a vessel in a more efficient and less expensive manner than is possible with the manual operations now used in the art.

A more particular object of the present invention is to utilize slinger apparatus, various embodiments of which are employed in the foundry art, in a practical way, to manufacture linings on the interior vessels, and, in particular, to manufacture high temperature resistant linings on containers to be used for carrying and working molten material, e.g., steelmaking ladles, electric furnaces, and the like.

These as well as other objects which will become apparent in the discussion that follows are achieved, according to the present invention, by providing a support for holding a vessel and a support for holding an applicator head which slings the material with which the vessel is to be lined such that the vessel support or the applicator head support provides means for movably supporting the vessel or applicator head, respectively. Means are also provided, according to the invention, for producing relative motion between the vessel and the applicator head and for guiding the applicator head, during its relative movement with the vessel, along a path matching the contour of the mouth of the vessel. The guide means can take the form of a rail, having a configuration matching the contour of the mouth of the vessel, supported in the region of the vessel and reinforced by braces which absorb the forces which are transferred to the rail.

It is possible, with the apparatus according to the invention, to choose the relative motion between the applicator head and the vessel and choose the "ramming" speed of the material slumps from the applicator head so that the vessel moves continuously in one relative direction with respect to the vessel, the material forming the entire height of the lining will be sufficiently packed. According to a preferred embodiment of the present invention the relative motion is maintained between 1.2 and 1.5 meters per second and the ramming speed maintained between 40 and 60 meters per second.

A further object of the present invention is an apparatus for heat-proof interior lining of vessels for fusible material comprising supporting means for holding an applicator head with a rotary impeller and driving elements as well as feeding means for feeding the lining material to the rotary impeller, and further comprising a guide element adjacent the vessel following a path, which matches the contour of the mouth of said vessel and generating a closed endless conducting line for guide rollers connected to the applicator head, means for generating a relative movement between applicator head and vessel, spokelike arms for compensating the power transmitted to the guide rollers and having such values of the speed of relative movement between applicator head and vessel and the outlet speed of the lining material in the rotary impeller means, that during continued relative movement between applicator head and vessel in same sense of direction, there is generated an interior vessel lining with sufficiently equal compressing of the lining material.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view, partly cut away, of a slinger having means for rotating the applicator head, according to one preferred embodiment of the present invention.

FIG. 2 is an elevational view of a slinger having means for rotating the vessel, according to another embodiment of the present invention.

FIG. 3 is a top view of the slinger of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, in the embodiment illustrated in FIG. 1 the relative movement between the material applicator or ramming head and the vessel is effected by rotational motion of the ramming head. The shell lining form and the vessel remain stationary. In this arrangement, the ramming beam of material describes successive closed paths, following the contour of the mouth of the vessel, without a change of direction. The axis of rotation of the ramming head lies along the axis of symmetry of the vessel.

The vessel 1 which is illustrated in FIG. 1 is a rotationally symmetric steelmaking crucible or ladle having slightly conical upright wall surfaces. Attached to a stand 2 is a projecting arm 3 which carries a pivot mount 4, a ramming head 5 with a drive linkage 6 and an electric drive motor 7. The ramming head 5 may be pivoted about pivot mount 4 in a known manner by any suitable known device, such as an electric motor 28. The radius of rotation and the swivel attitude of the ramming head 5 may be regulated by appropriate adjustment mechanisms 8 and 8a, respectively. It is possible, in this way, to insure that the material to be rammed is directed into the shell lining form, created by the vessel 1 and the internal mold 20, parallel to the walls of the form.

The material to be rammed is fed to the ramming head by means of conveyor belts 9 and 10. The conveyor belt 9 carries the material to a cylindrical hole passing through the pivot mount 4. After the material drops through this hole, the conveyor belt 10 feeds it to the rotary impeller 27 arranged in the ramming head 5. This impeller slings the material downward into the shell lining form.

A circular rail 11 is mounted in the region of the upper edge of the vessel 1 to guide the ramming head 5. Guide rollers 12 and 13 rigidly connected to the ramming head 5 by a supporting member 14 permit the ramming head 5 freedom of movement in the circumferential direction only. The circular rail 11 is braced with spokelike arms 15 which absorb the forces applied against the rail by the guide rollers 12 and 13. These arms 15 extend outward to the rail 11 from a centering member 16.

An engaging pin 19 is inserted in a corresponding opening in the centering member 16 before the rotational motion of the ramming head 5 is initiated. This part 19 may be vertically adjusted by an advance mechanism 18 which includes a self-locking worm gear arrangement that moves a slide which carries the rack and pinion drive. The centering member 16, the advance mechanism 18, and the engaging pin 19 as well as the ramming head 5 are mounted on a fork-shaped pivot mount 17.

The thickness of the shell lining is determined by the distance between the internal mold or form 20 and the vessel. Lining material which has already been rammed into the form is designated with the reference numeral 21.

FIGS. 2 and 3 illustrate a second embodiment of the slinger according to the present invention where the relative motion between the ramming head and the vessel is effected by rotating the vessel on a turntable. The parts of this embodiment which are identical to the parts of the embodiment illustrated in FIG. 1 are designated with the same reference numerals.

In this embodiment the vessel 22 has an elliptical cross section and is mounted on a turntable 24 driven by an electric motor 23.
As with the slinger embodiment illustrated in FIG. 1 the ramming head 5 is supported by guide rollers 12 and 13 which ride against the closed guide rail 11. As may be seen in FIG. 3, this rail 11 is reinforced by the spoke arms 15 which emanate from the centering member 16. The centering member 16 is engaged in a pivot mount formed by the engaging pin 19, which, in turn, is rigidly connected, via an arm 25, with a stationary upright 26 to fully brace the rail 11.

The ramming head 5, arranged on a separate arm 3, executes a swivel motion on the upright 26 when the vessel 22 is rotated. The forces applied to the ramming head 5 which causes 26 to swivel are absorbed by the reinforcing arms 15.

It will be understood that the description above, of the various embodiments of the slinger apparatus is intended only to illustrate the inventive principle and not to limit the invention to constructional details. It is intended, in particular, that the slinger according to the present invention be utilized to manufacture a wide variety of heat resistant shell linings. If the gap between the internal form wall and the internal wall surface of the vessel has a value of 210 mm. at the upper edge and 260 mm. in the region of the lower edge of the vessel, favorable results may be obtained with slinger apparatus according to the present invention having a rotary impeller with a blade width of approximately 120 mm.

It is practical, further, if the relative speed between the ramming head and the vessel be set between 1.2 and 1.5 meters per second.

The optimum speed of the stream of material slung by the rotary impeller is dependent upon the type of material used. With clay bonded fire clay suitable results may be obtained if this speed is made approximately 60 meters per second. If the machine is operated with magnesium chloride bonded granular curdum, on the other hand, it is best to use a lower speed, typically approximately 40 meters per second.

It is advantageous to adjust the ramming head when the machines put into operation so that the material will be slung substantially parallel to at least one of the wall surfaces forming the gap; that is, the wall surface of the vessel or of the internal form.

This type of slinger apparatus can be used not only to produce heat resistant, and, in particular, high temperature resistant shell linings, but may also be generally used whenever a regularly formed container is to be provided with a bonded inner coating made of material which is suitable for ramming.

It will be understood that the above description of the present invention is susceptible to various modifications, changes, and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

We claim:
1. Apparatus for refractory lining the interior of a vessel, comprising, in combination:
   a. a first support for supporting the vessel;
   b. an applicator head with a rotary impeller means for slinging the material with which the vessel is to be lined;
   c. a second support for supporting the applicator head above said vessel, at least one of said supports being a means for movably supporting the item it supports;
   d. driving means for producing relative motion between said applicator head and the vessel;
   e. guide means having a configuration matching that of the contour of the mouth of the vessel for guiding said applicator head, during the relative movement between the applicator head and the vessel; along a path matching that of the contour of the vessel;
   f. a detachable form arranged in the vessel generating a gap corresponding to the thickness of the shell lining desired;
   g. means at said second support for adjusting the position of said applicator head relative to said vessel, thereby to allow said applicator head to sling material into the gap formed by said detachable form.
2. The apparatus defined in claim 1, wherein said second support includes an upright stand connected to ground and arm means projecting from said stand for holding said applicator head.
3. The apparatus defined in claim 1, wherein said first support means rotatably supports said vessel and said means for producing relative motion between said applicator head and said vessel includes means for rotating said first support means.
4. The apparatus defined in claim 1, wherein said second support means movably supports said applicator head and said means for producing relative motion between said applicator head and said vessel includes means for moving said applicator head along a path matching the contour of the mouth of the vessel.
5. The apparatus defined in claim 1, wherein said guide means includes a guide rail situated in the region of the mouth of the vessel and following a path which matches the contour of the mouth of the vessel, said applicator head includes rail follower means for guiding said applicator head, during the relative movement between said head and the vessel, along the path described by said rail.
6. The apparatus defined in claim 5, wherein said guide means further includes a third support for supporting said guide rail.
7. The apparatus defined in claim 6, wherein said third support includes reinforcing spokes arranged to interconnect a plurality of points along said guide rail.
8. The apparatus defined in claim 1, wherein said means for producing relative motion between said applicator head and said vessel continuously moves said applicator head in one direction around the rim of said vessel.
9. The apparatus defined in claim 8, wherein said means for producing relative motion between said applicator head and said vessel moves said applicator head around the rim of said vessel with speed in the range of 1.2 to 1.5 meters per second.
10. The apparatus defined in claim 1, wherein said applicator head slings the material at a speed in the range of 40 to 60 meters per second.
11. The apparatus defined in claim 1, wherein said rail follower means includes a pair of rotatably mounted guide rollers arranged on opposite sides of said rail and bearing means for rotatably holding said guide rollers in rigid relationship with said applicator head.
12. The apparatus defined in claim 7, wherein each of said reinforcing spokes is connected to hub means for centering said guide rail in the vessel.
13. The apparatus defined in claim 12, further comprising means, engaging said hub means, for supporting said hub.
14. The apparatus defined in claim 13, wherein said means for supporting said hub means includes an upright stand connected to ground, a member, engaging said hub means, and arm means, projecting from said stand, for supporting said member.
15. Apparatus for lining the interior of a vessel, comprising, in combination:
   a. a first support for supporting the vessel;
   b. an applicator head for slinging the material with which the vessel is to be lined and including rail follower means for guiding said applicator head during the relative movement between said head and the vessel;
   c. a second support for supporting the applicator head, at least one of said supports being a means for movably supporting the item it supports;
   d. means for producing relative motion between said applicator head and the vessel;
   e. guide means having a configuration matching that of the contour of the mouth of the vessel for guiding said applicator head, during the relative movement between the applicator head and the vessel; along a path matching that of the contour of the vessel, and including a guide rail situated in the region of the mouth of the vessel, and following a path which matches the contour of the mouth of the vessel, said rail follower means guiding said applicator head.
along the path described by said rail, and further including a third support for supporting said guide rail, said third support including reinforcing spokes arranged to interconnect a plurality of points along said guide rail, each of said reinforcing spokes being connected to hub means for centering said guide rail in the vessel; and means engaging said hub means, for supporting said hub means and including an upright stand connected to ground, a member, engaging said hub means, and arm means, projecting from said stand, for supporting said member.

16. The apparatus defined in claim 15, wherein said member is rotatably connected to said hub means.

17. The apparatus defined in claim 15 wherein said arm means includes means for moving said member in the vertical direction, thereby to engage or loosen the connection between said member and said hub means.

18. The apparatus defined in claim 17, wherein said moving means includes a self-locking worm gear.

19. Apparatus for lining the interior of a vessel, comprising, in combination:
   a. a first support for supporting the vessel;
   b. an applicator head for slinging the material with which the vessel is to be lined and; including rail follower means for guiding said applicator head, during the relative movement between said head and the vessel;
   c. a second support for supporting the applicator head, at least one of said supports being a means for movably supporting the item it supports;
   d. means for producing relative motion between said applicator head and the vessel; and
   e. guide means having a configuration matching that of the contour of the mouth of the vessel for guiding said applicator head, during the relative movement between the applicator head and the vessel, along a path matching that of the contour of the vessel and including a guide rail situated in the region of the mouth of the vessel and following a path which matches the contour of the mouth of the vessel, said rail follower means including a pair of rotatably mounted guide rollers arranged on opposite sides of said rail and bearing means for rotatably holding said guide rollers in rigid relationship with said applicator head for guiding said rail follower means along the path described by said rail.