United States Patent [19]

Shapland

[11] **3,780,916**

[45] **Dec. 25, 1973**

[54] **ROTARY GATE FOR BOTTOM POUR VESSEL HAVING REMOVABLE NOZZLES**

[75] Inventor: **James T. Shapland,** Wilkins Twp., Allegheny County, Pa.

[73] Assignee: **United States Steel Corporation,** Pittsburgh, Pa.

[22] Filed: **Dec. 17, 1971**

[21] Appl. No.: **209,034**

[52] **U.S. Cl.** **222/555,** 137/269, 251/206

[51] **Int. Cl.** **B22d 37/00**

[58] **Field of Search** ..... 222/DIG. 7, DIG. 18, 222/555; 292/74; 251/206; 137/269; 138/94, 94.3, 94.5

[56] **References Cited**

UNITED STATES PATENTS

R27,237	11/1971	Shapland	222/DIG. 7
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Primary Examiner—Robert B. Reeves
Assistant Examiner—David A. Scherbel
Attorney—Ralph H. Dougherty

[57] **ABSTRACT**

A rotary gate for a bottom-pour vessel has a plurality of removable and interchangeable refractory inserts, at least one of which has a nozzle opening therethrough. The inserts can be removed or replaced at any time they are not in the active position.

6 Claims, 9 Drawing Figures

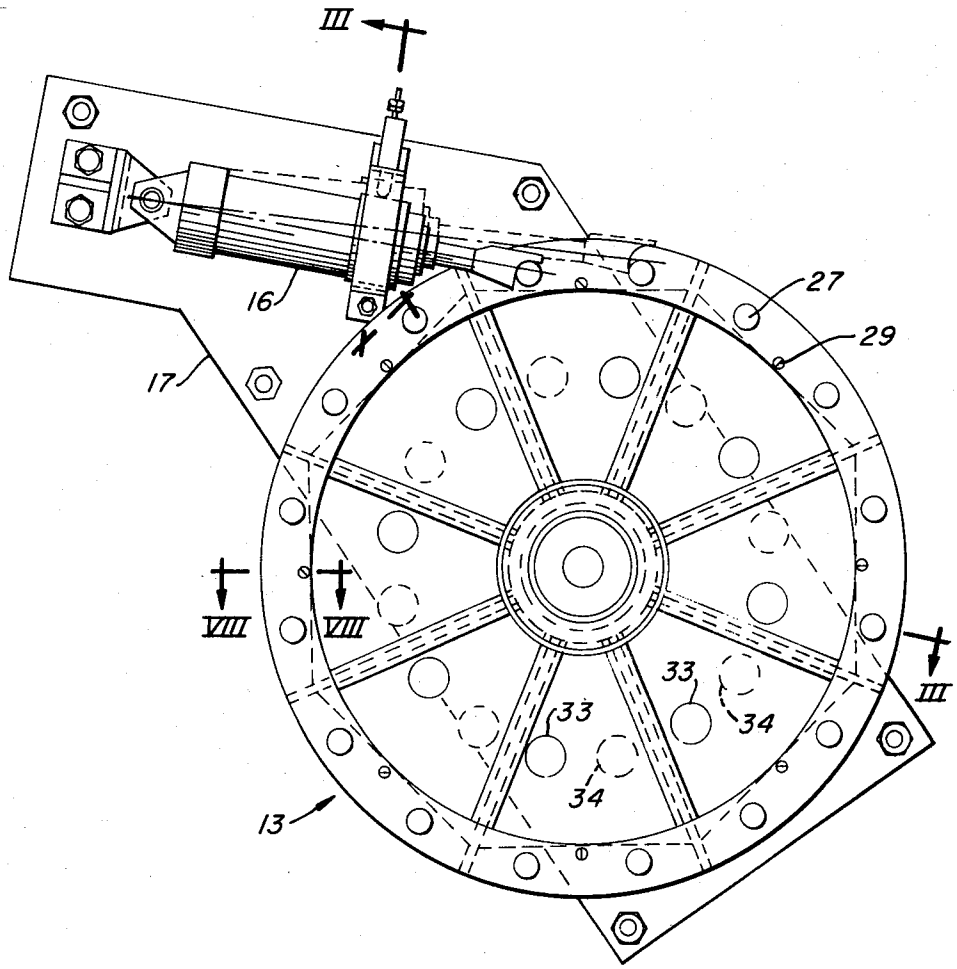


FIG. 1

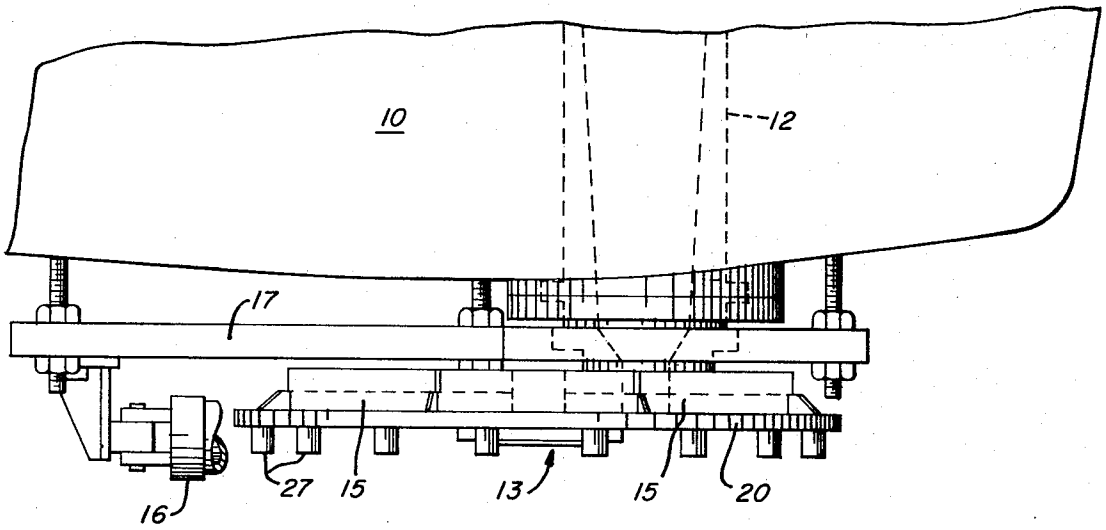


FIG. 2

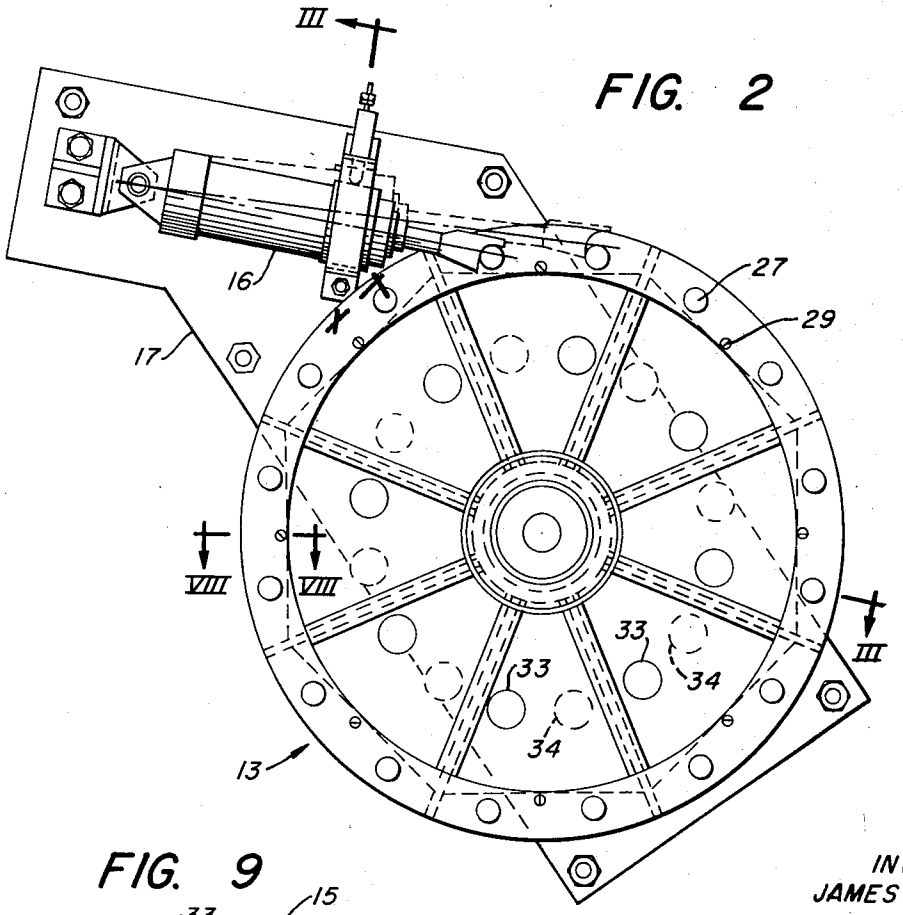
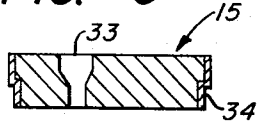


FIG. 9



INVENTOR
JAMES T. SHAPLAND

By Ralph Dougherty

Attorney

FIG. 3

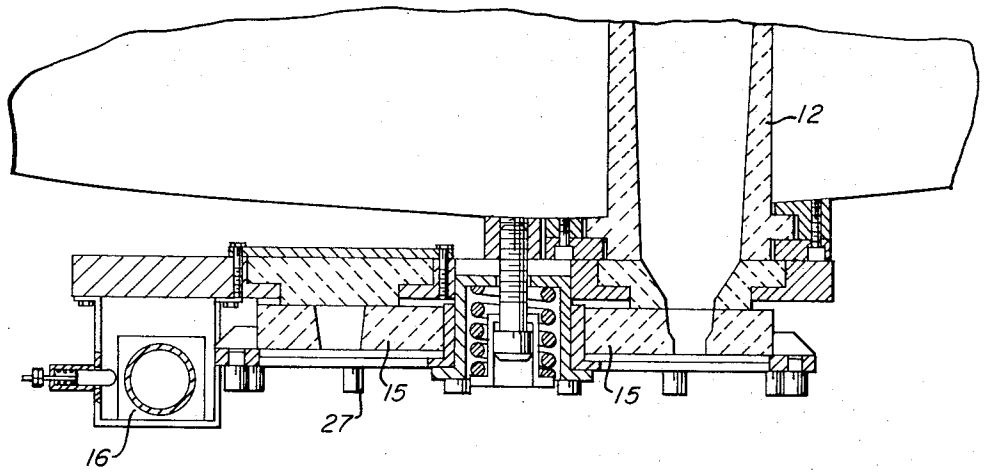


FIG. 6

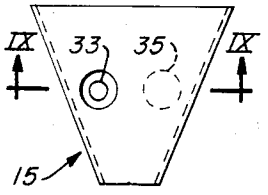


FIG. 4

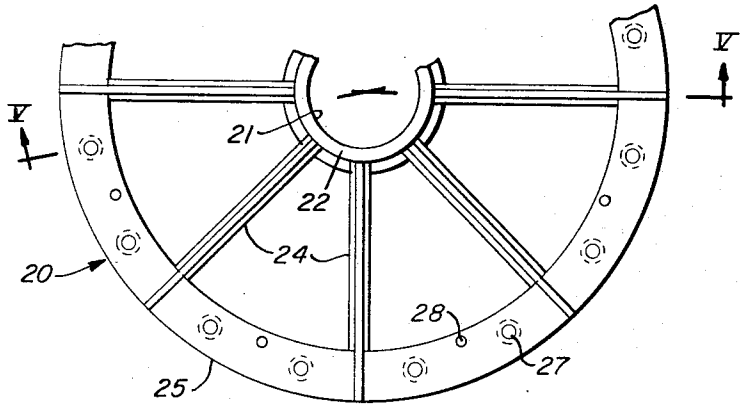


FIG. 7

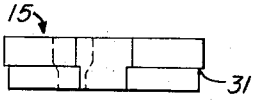


FIG. 8

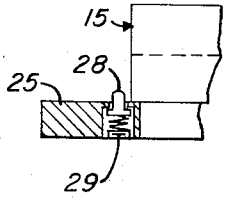
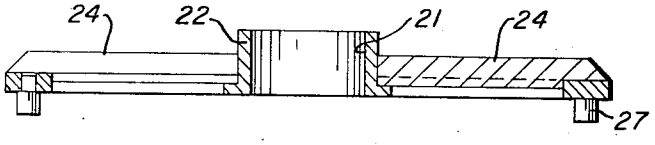


FIG. 5



INVENTOR
JAMES T. SHAPLAND
By Ralph Dougherty
Attorney

ROTARY GATE FOR BOTTOM POUR VESSEL HAVING REMOVABLE NOZZLES

This invention relates to bottom pour vessels for teeming molten metal such as steel and in particular to improved rotary discharge valves for such vessels.

The discharge of steel from bottom pouring vessels is often controlled by a reciprocable valve or a slide-through gate valve located on the exterior of the vessel beneath the discharge nozzle. Such valves have a horizontally movable closure member capable of sealing tightly against the outlet end of the nozzle when the valve is closed. Both the reciprocating valve and the slide-through valve have certain disadvantages. They require a large amount of space, both in the direction of travel of the valve, as well as in the transverse direction so that they are not suitable for applications involving multiple pouring streams in close proximity. Furthermore, these valves incorporate a large number of springs, sliding members, pivoted members and other critical mechanical components that are distributed over a large area of the bottom shell of the liquid steel vessel so that they are difficult to protect from overheating and damage from liquid steel splashing during teeming.

Lyman U.S. Pat. No. 3,430,644 discloses a teeming apparatus having a rotary discharge valve mounted beneath the vessel for closing a discharge nozzle and an actuator for rotating the valve. This valve comprises a unitary refractory disc having a plurality of teeming openings and a metal tray supporting the disc. However, if any teeming opening should become blocked or badly worn or if it becomes desirable to utilize a teeming opening having a diameter not present in such refractory disc, it is necessary to shut down the teeming operation to replace the disc. This is an expensive and impractical operation.

It is the primary object of my invention to provide a rotary sliding valve apparatus for a bottom pour vessel, which apparatus has a plurality of interchangeable refractory nozzles.

It is a further object to provide means for removal and replacement of nozzles not in the active position whenever desired.

This invention will now be described with reference to the accompanying drawings in which:

FIG. 1 is a front elevational view of a vessel for molten metal having a discharge valve of this invention.

FIG. 2 is a bottom view of the rotary valve of this invention and the mounting plate on which this valve is mounted.

FIG. 3 is a vertical sectional view of the valve of this invention taken along line III—III of FIG. 2.

FIG. 4 is a fragmentary plan view of a tray for containing the refractory closure member of this invention.

FIG. 5 is a vertical sectional view of the tray taken along line V—V of FIG. 4.

FIG. 6 is a plan view of the nozzle of the invention.

FIG. 7 is an end view of the nozzle.

FIG. 8 is a partial vertical sectional view of the tray and nozzle taken along line VIII—VIII of FIG. 2.

FIG. 9 is a sectional view of the nozzle taken along line IX—IX of FIG. 6, but showing the nozzle enclosed in a metal frame.

As shown in FIG. 1, vessel 10 for containing molten steel has a bottom pour discharge nozzle 12. The vessel may be a ladle, tundish, vacuum degassing vessel, or other vessel for teeming molten steel or othpr metal.

Such a vessel conventionally has a refractory lining and a metallic outer shell. The discharge nozzle 12 is opened and closed by a rotary valve apparatus 13 which rotates about its central axis. Rotary valve 13 carries a plurality of teeming nozzles or gates 15, to be described hereinafter, any one of which may be aligned with nozzle 12 by rotation of valve 13 to permit teeming of molten metal from vessel 10.

A valve actuator 16 (shown partially broken away in FIG. 1) rotates valve 13 to open and close discharge nozzle 12. The actuator is mounted on a mounting plate 17 which is secured to the vessel 10. Valve 13 includes a metal tray 20 (FIG. 4) having a central opening 21 surrounded by an upstanding boss 22. A plurality of T-shaped ribs 24 extend from the boss to a circular flange 25 to form a plurality of compartments in the tray. Flange 25 carries pins 27 extending downwardly therefrom which are engaged by actuating mechanism 16 to rotate the valve 13. Two pins are situated in each segment of flange 25 between adjacent ribs 24. Flange 25 also carries a spring-loaded detent pin 28 in each segment (FIG. 8). The pin has a shoulder which bears upwardly against a seat in flange 25, and is held against the seat by setscrew 29.

Each refractory closure member of insert 15 as best seen in FIGS. 6 and 7 has the general form of an isosceles trapezoid. The insert has a shoulder 31 which allows it to be seated on the flanges of adjacent ribs. Each refractory insert has a teeming opening 33 offset from the center of the insert. Since the teeming opening 33 is in one side of the insert, the insert will also serve as a stopper when the solid half of the insert is beneath the nozzle 12. The insert may be enclosed in a steel frame 34 as shown in FIG. 9 for added strength if desired. Pins 27 are so located with respect to ribs 24 that there is one nozzle-open position and one nozzle-stop position on each insert. The nozzle-stop position is indicated by reference numeral 35 in FIG. 6.

As shown in FIG. 2, the piston rod of hydraulic cylinder 16 is adapted to engage pins 27 for rotation of valve 13. This rotation successively brings nozzles 33 into and out of alignment with discharge nozzle 12. Each stroke of the piston 16 moves the valve 13 one-half the distance between successive nozzles 33. One stroke moves the valve 13 from the nozzle closed position 34 to the nozzle open position 33 on the same refractory gate. The next stroke of the piston moves the valve 13 from the nozzle open position to a nozzle closed position on the next refractory gate. Thus, valve 13 never stops with nozzle 12 above a rib 24. In the embodiment shown, the discharge valve 13 includes eight inserts 15, each containing an offset nozzle 33. 16 pins 27 are mounted on the valve. Thus, 16 strokes of the piston 16 are required to rotate valve 13 through a complete revolution. All movements of the discharge valve 13 are in the same direction. The drive mechanism could be electrical or pneumatic rather than hydraulic, if desired.

The valve could be constructed to bring a different insert under the nozzle on each piston stroke. In this case one half the number of pins 27 are required and the piston rod would have a longer stroke. Each insert would then either have a teeming orifice or be blank for use as a shut off gate.

This invention provides a discharge valve which is particularly suitable for tundishes and degassing vessels. An unlimited number of interchangeable refractor

nozzles may be utilized with this valve. Unlike the single refractory disc shown in the Lyman Patent, any nozzle may be replaced when such nozzle is any position other than the active position under nozzle 12 of the intermediate vessel.

I claim:

1. An apparatus for teeming molten metal including a vessel having a bottom discharge nozzle, a valve on the exterior of said vessel for controlling the discharge of molten metal through said nozzle, said valve being rotatable through 360°, and means for mounting said valve for rotation about its central axis, the improvement comprising:

a plurality of interchangeable refractory inserts in said valve, at least one of said inserts having a teeming opening therein;

said valve having means for supporting said inserts, and means for allowing said inserts to be inserted into and removed from said valve radially and transversely with respect to said central axis; and

means for retaining said inserts in said valve.

2. Apparatus according to claim 1 wherein said means for supporting said inserts comprises a plurality of radial ribs equally spaced about said axis and dividing the valve into a plurality of compartments.

3. Apparatus according to claim 2, wherein said inserts have shoulders adapted for engagement with said ribs.

4. Apparatus according to claim 1, wherein said valve includes a peripheral flange, and a plurality of spring-biased detent pins are housed in said flange, whereby said inserts are retained in said valve when said valve is rotated.

5. Apparatus according to claim 1, wherein at least one of said refractory inserts is enclosed in a metal frame.

6. Apparatus according to claim 1, wherein the teeming opening of at least one insert is in one side of such insert to provide a teeming position and a shut-off position in such insert.

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