United States Patent

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[73] Assignee **United States Steel Corporation**

[54] **SLIDING GATE CLOSURE FOR BOTTOM-POUR VESSEL REMOVABLE AS A UNIT**
7 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **222/504,** 222/505, 222/512, 222/561, 222/567
[51] **Int. Cl.** **B67d 3/00**
[50] **Field of Search** 222/504, 561, 512, 567, 505, 566

[56] **References Cited**

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ABSTRACT: A sliding gate closure which includes a replaceable orifice plate positioned in a fixed relation to a removable mounting plate. Blank gates and nozzle gates are supported on entrance and exit rails depending from the mounting plate, and on levers pivoted to the mounting plate in the space between the ends of the rails opposite the outlet from the vessel. Levers are spring actuated and can be adjusted individually beforehand and the position of adjustment maintained through changes of orifice plate.

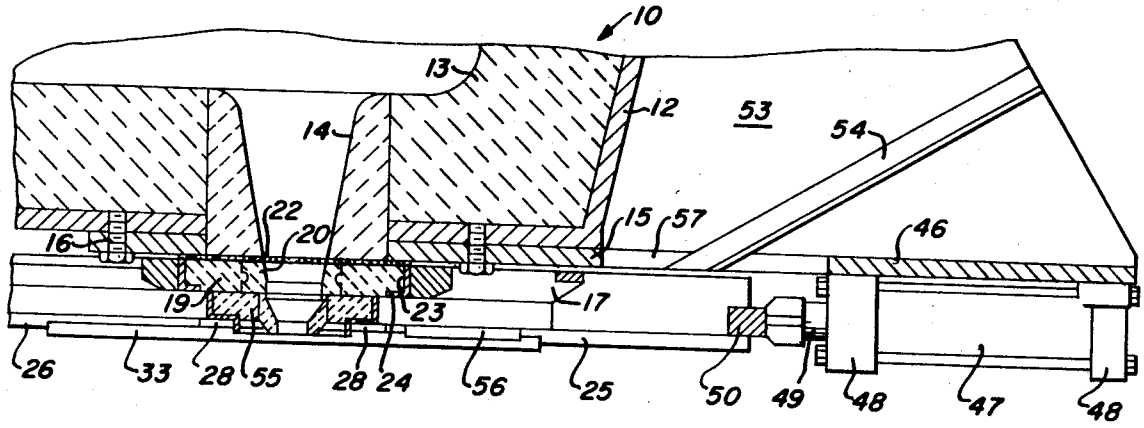

FIG. 1

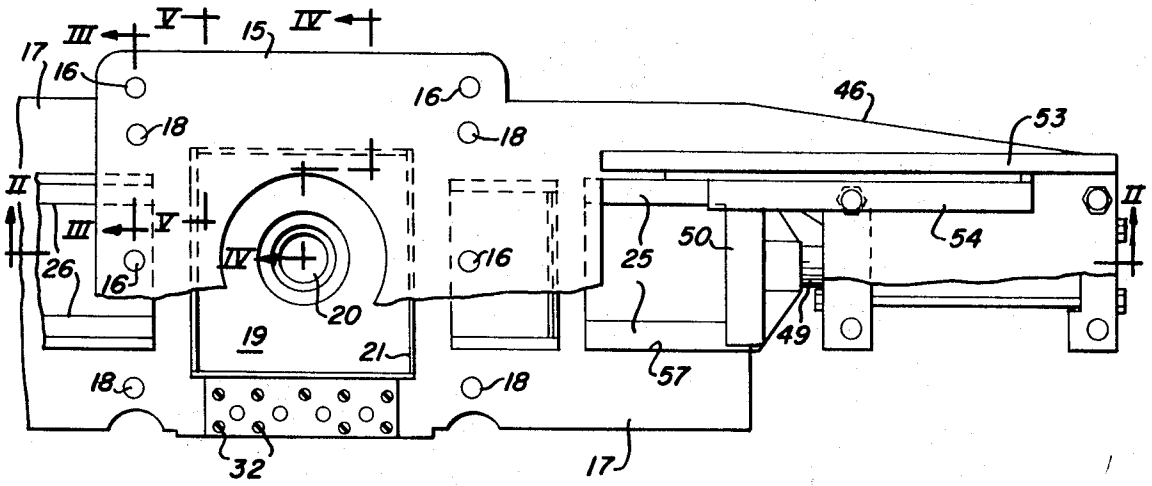

FIG. 2

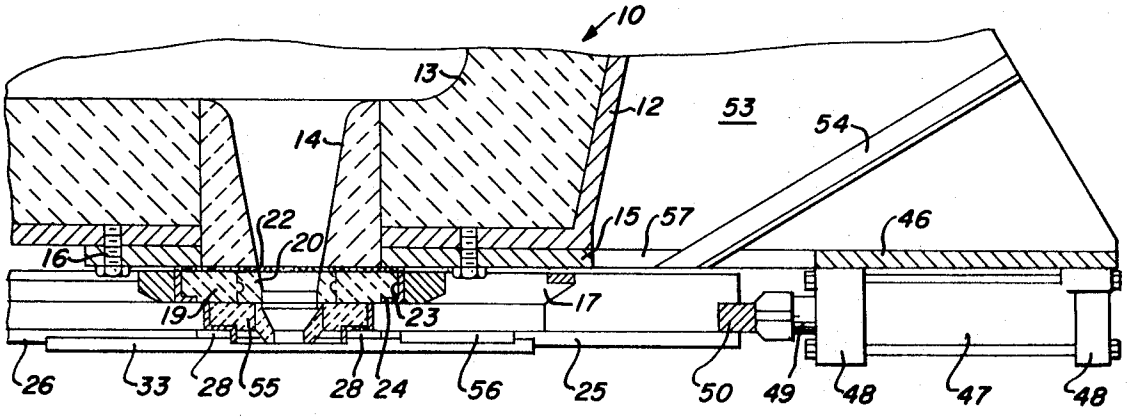

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FIG. 6

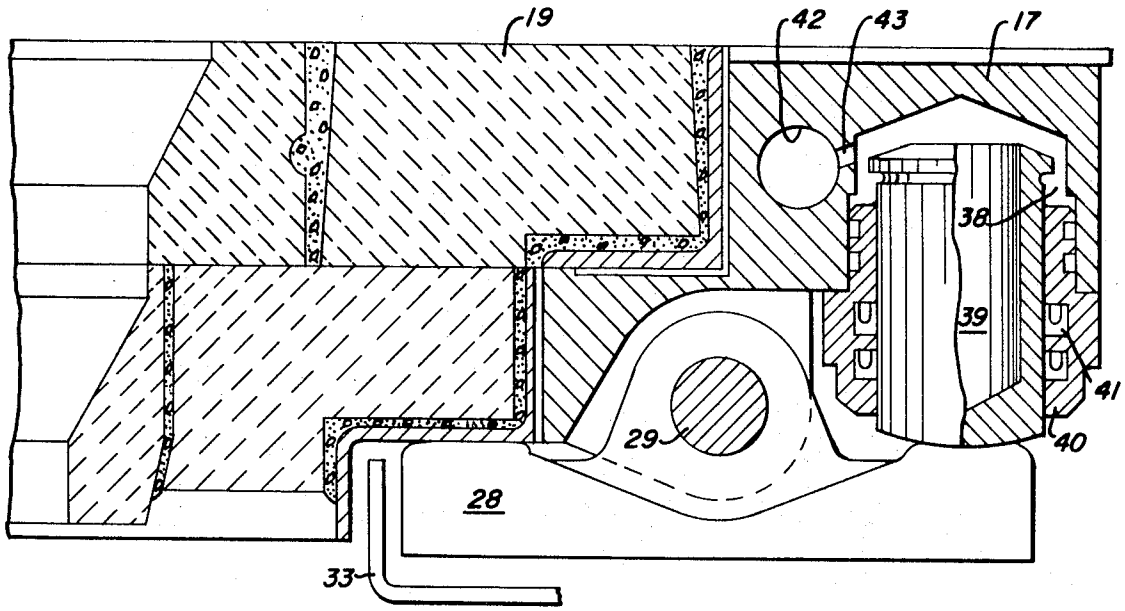


FIG. 3

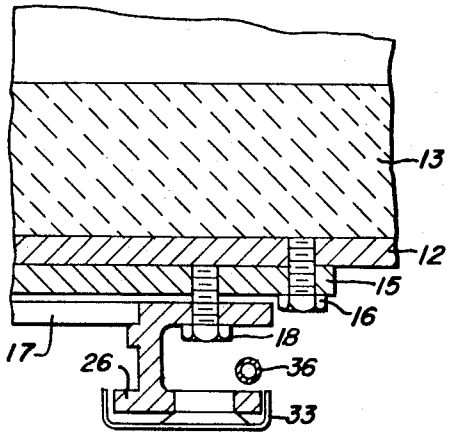


FIG. 4

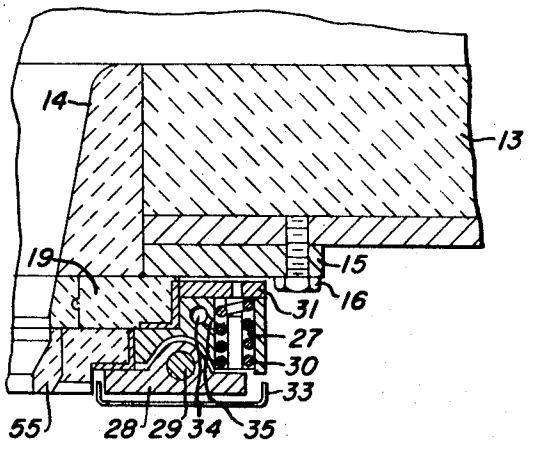
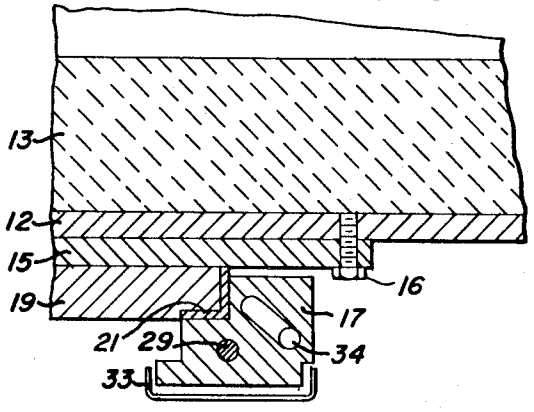


FIG. 5



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SLIDING GATE CLOSURE FOR BOTTOM-POUR VESSEL REMOVABLE AS A UNIT

This invention relates to an improved slidable gate construction for use as a closure on a bottom pour vessel.

Although our invention is not thus limited, our gate construction is particularly useful as applied to vessels for pouring molten metal, for example a ladle or tundish. Such vessels have an outlet in the bottom wall through which molten metal is poured into a receiving vessel. It is know to equip the pouring vessel with a slidable gate mounted on the underside of the bottom wall for controlling flow of metal through the outlet, one example of which is shown in James T. Shapland U.S. Pat. No. 3,352,465. The vessel carries a hydraulic operating mechanism for positioning the gate. One practice is to use a reciprocable gate which has both a blank area and a nozzle, as shown in FIGS. 1 to 3 of the patent. The gate is slidable back and forth between positions in which the blank area underlies the outlet to close it, or the nozzle is aligned with the outlet to permit pouring. Another and usually preferred practice is to use gates of the "slide-through" type, each of which is either a blank or provides a nozzle, as shown in FIGS. 4 and 5 of the patent. As the operating mechanism shoves each gate into alignment with the outlet, the new gate shoves the preceding gate on past and eventually off the vessel.

In constructions used heretofore, the bottom of the vessel has carried a fixed orifice plate secured to the vessel with a mortar seal, and the gate-mounting and -operating mechanism has been separately secured to the vessel. Replacement of either the orifice plate or the gate-mounting mechanism has been an awkward operation. It has been necessary to readjust completely both the height of the rails which support the gate and the force on the springs which hold the gate against the orifice plate. These operations must be conducted with the parts installed on the vessel.

An object of our invention is to provide an improved gate construction, applicable to either the reciprocating type or the slide-through type, in which the orifice plate and the gate support form a unitary assembly easily installed on a vessel or removed therefrom.

A further object is to provide a gate construction of the foregoing type, the rails and springs of which can be adjusted accurately before installation on a vessel.

A further object is to provide a gate-supporting mechanism which includes independently adjustable multiple levers for supporting the gates to assure a tight seal and compensate for warpage, thereby effectively preventing formation of fins.

In the drawing:

FIG. 1 is a top plan view, with parts broken away, of a slidable gate and operating mechanism therefor in accordance with our invention;

FIG. 2 is a vertical longitudinal section on line II—II of FIG. 1, but showing the mechanism mounted on a pouring vessel;

FIG. 3 is a vertical cross section on line III—III of FIG. 1;

FIG. 4 is a vertical cross section on line IV—IV of FIG. 1;

FIG. 5 is a vertical cross section on line V—V of FIG. 1; and

FIG. 6 is a vertical section similar to FIG. 4, but showing a modification.

FIG. 2 shows a portion of a bottom-pour vessel **10** which has a metal shell **12** and a refractory lining **13**. The bottom wall of vessel **10** has an outlet opening within which a nozzle **14** is mounted. Our gate construction includes a metal submounting plate **15**, which encompasses the lower end of the nozzle and which we attach to the bottom of the vessel with plurality of screws **16**. We removably attach a metal mounting plate **17** to the underside of the submounting plate **15** with a plurality of screws **18**. Plate **17** supports rectangular fixed orifice plate **19**, which has an orifice **20** forming a continuation of the nozzle opening (FIGS. 4 and 5). The orifice plate if formed of a suitable refractory, but has a throwaway metal frame **21**. We interpose a layer of mortar or a refractory gasket **22** between the nozzle **14** and the orifice plate **19** to afford a seal against escape of molten metal via this route. The upper face of the mounting plate **17** has a rectangular opening **23** and upwardly facing shoulders **24** around the perimeter of this opening to

receive and support the orifice plate **19**. Fixed to the mounting plate **17** are a pair of opposed depending entrance rails **25**, exit rails **26**, and two sets of spring housings **27** located at opposite sides of the orifice plate **19** in the space between the ends of the entrance and exit rails. Preferably we weld the rails and spring housings to the plate to form a single integral part.

We pivot respective levers **28** of the first class to the undersides of the spring housings **27** on pins **29** (FIG. 4). Each housing contains a respective compression spring **30**. The lower end of each spring **30** bears downwardly against the outboard end of a different lever **28**. We fasten metal plates **31** over the spring housings **27** at each side of the nozzle plate **19** with screws **32** (FIG. 1). The upper ends of springs **30** bear against plate **31**. We attach heat shields **33** to the underside of rails **25** and **26** underlying levers **28**. The mounting plate **17** has longitudinal passages **34** which communicate with the spring housings **27** through cross passages **35**. We connect air lines **36** to passages **34** and introduce air to the springs via the passages to prevent their overheating.

FIG. 6 shows a modification in which we replace the spring housings with hydraulic cylinders **38**. These cylinders contain vertically movable pistons **39**, the lower ends of which bear against the outboard ends of the respective levers **28**. Cylinder heads **40** and packing rings **41** encircle the pistons and provide a seal. We introduce hydraulic fluid to the cylinders through longitudinal passages **42** and cross passages **43** in the mounting plate **17**. In other respects the modified structure is similar to that already described; hence we have not repeated the description.

The submounting plate **15** has an extension **46**, preferably formed integrally therewith. We attach a double-acting fluid pressure cylinder **47** to the underside of extension **46** with brackets **48**. The cylinder has the usual connections (not shown) for admitting and discharging motivating fluid, and it contains a reciprocable piston and piston rod **49**. The outer end of the piston rod carries a ram **50** horizontally aligned with the space between the entrance rails **25**. We fix a pair of opposed vertical plates **53** to the extension **46** and to the shell **12**. Conventionally plates **53** may be welded to the extension and bolted to the shell, whereby they can be removed from the vessel with the submounting plate **15**. The inner faces of plates **53** carry respective angle irons **54**, which slope downwardly toward the vessel and together form a chute for loading nozzle gates **55** and blank gates **56** onto the entrance rails **25**. The submounting plate **15** has an opening **57** at the lower end of the chute through which the gates drop to the rails.

In assembling the mechanism, we attach the submounting plate **15** to the vessel with screws **16**. The submounting plate already carries cylinder **47**, vertical plates **53** and angle irons **54**. Separately we assemble the mounting plate **17**, levers **28**, pins **29**, springs **30**, plates **31**, and heat shields **33**. We adjust the compressive force of springs **30** to afford the necessary force to hold a gate **55** or **56** firmly against the underside of the orifice plate **19**, but at the same time permit easy movement of the gate relative to the plate. We insert an orifice plate **19** in the opening **23** of the mounting plate, where its frame **21** rests on shoulders **24**, and we apply a layer of mortar or a refractory gasket **22** to the top of the orifice plate. We next attach the assembled mounting plate **17** and orifice plate **19** to the submounting plate **15** with screws **18**. We load nozzle gates **55** and blank gates **56** in the proper sequence onto the entrance rails **25**, and use the cylinder **38** and ram **50** to shove the gates successively into alignment with the nozzle **14** and orifice plate **19**. This last operation is the same as described in connection with FIGS. **4** and **5** of aforementioned Shapland patent; hence we have not repeated the description.

The orifice plate **19** is an item which requires frequent replacement. In our construction this plate occupies a fixed position with respect to the mounting plate **17**. Consequently there is no need to readjust the compressive force of springs **30** every time we replace the orifice plate. To remove an orifice plate, it is necessary only to remove the four screws **18** which attach the mounting plate **17** to the submounting plate

15. The thickness of the mortar layer or gasket 22 may vary each time, but this variation does not affect the relative position of the orifice plate and mounting plate. However, the springs 30 are individually adjustable to compensate for warpage.

We have shown the present invention applied to a slide-through type of gate, as shown in FIGS. 4 and 5 of the aforementioned patent. Nevertheless it is apparent the same principles may apply to a reciprocating gate as shown in FIGS. 1, 2 and 3 of the patent.

We claim:

1. The combination, with a bottom-pour vessel which has a nozzle in its bottom wall, of a closure mechanism for said nozzle, said mechanism comprising:

a submounting plate fixed to the underside of said vessel and having an opening beneath said nozzle;

a mounting plate removably fixed to the underside of said submounting plate and having an opening beneath said nozzle and horizontally spaced upwardly facing shoulders at the perimeter of the last-named opening;

an orifice plate received in said last-named opening and removably resting on said shoulders in a fixed relation to said mounting plate;

sealing means overlying said orifice plate;

said orifice plate bearing directly against said shoulders and bearing through said sealing means against said submounting plate;

gate-supporting means carried by said mounting plate on its underside;

a gate slidably supported on said gate-supporting means; and

means carried by said vessel for slidably positioning said gate in relation to said orifice plate and nozzle;

said orifice plate being removable from said last-named opening from above when said mounting plate is removed from said submounting plate without disturbing the position of said gate-supporting means relative to said mounting plate.

2. A closure mechanism for a nozzle in the bottom wall of a vessel, said mechanism being formed as a unitary assembly and comprising:

a submounting plate adapted to be fixed to the underside of the vessel and having an opening adapted to be positioned beneath the nozzle;

a mounting plate removably fixed to the underside of said submounting plate and having an opening beneath said first-named opening and horizontally spaced upwardly facing shoulders at the perimeter of said last-named opening;

an orifice plate received in said last-named opening and removably resting on said shoulders in a fixed relation to said mounting plate;

sealing means overlying said orifice plate;

said orifice plate bearing directly against said shoulders and bearing through said sealing means against said submounting plate; and

means carried by said mounting plate on its underside for supporting gates enabling them to be slidably positioned in relation to said orifice plate;

said orifice plate being removable from said last-named opening from above on removal of said mounting plate from said submounting plate without disturbing the position of said gate-supporting means relative to said mounting plate.

3. A combination as defined in claim 1 in which said submounting plate includes an extension lying outside the bottom of said vessel, and the means for slidably positioning said gate includes a fluid-pressure cylinder and ram operated thereby horizontally aligned with said gate.

4. A combination as defined in claim 1 in which said gate-supporting means includes an opposed pair of entrance rails depending from said mounting plate, an opposed pair of exit rails depending from said mounting plate and being aligned with and spaced from said entrance rails, a plurality of opposed pairs of levers of the first class pivoted to the underside of said mounting plate in the space between the ends of said entrance rails and said exit rails, and spring means urging the outboard ends of said levers downwardly, said spring means being adjustable individually before said mounting plate is installed on said vessel and permitting the position of adjustment to be maintained despite variations in the position of said orifice plate relative to said nozzle.

5. A combination as defined in claim 4 in which said submounting plate includes an extension lying outside the bottom of said vessel, and comprising in addition a chute supported above said extension for loading gates on said entrance rails.

6. A combination as defined in claim 4 comprising in addition means in said mounting plate for introducing air to said spring means to cool the latter.

7. A combination as defined in claim 2 in which said orifice plate if formed of refractory and a throwaway metal frame surrounding said refractory.

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