United States Patent

Andrzejak et al.

[15] **3,684,267**

[45] **Aug. 15, 1972**

[54] **APPARATUS FOR INTRODUCING GAS TO HOT METAL IN A BOTTOM-POUR VESSEL**

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[22] Filed: **Jan. 12, 1970**

[21] Appl. No.: **2,224**

[52] **U.S. Cl.**.....**266/38,** 266/34 PP, 222/561

[51] **Int. Cl.**.....**C21b 7/14,** B67d 1/08

[58] **Field of Search**.....164/66, 259, 281; 266/34 A, 266/34 T, 34 PP, 38; 222/561; 75/49, 59

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[57] **ABSTRACT**

A sliding gate apparatus for the controlled pouring of hot metal into a continuous casting mold is disclosed. The gate includes a vertical tubular opening for the introduction of gas to the hot metal. A modification includes a permeable refractory block positioned in the opening.

9 Claims, 3 Drawing Figures

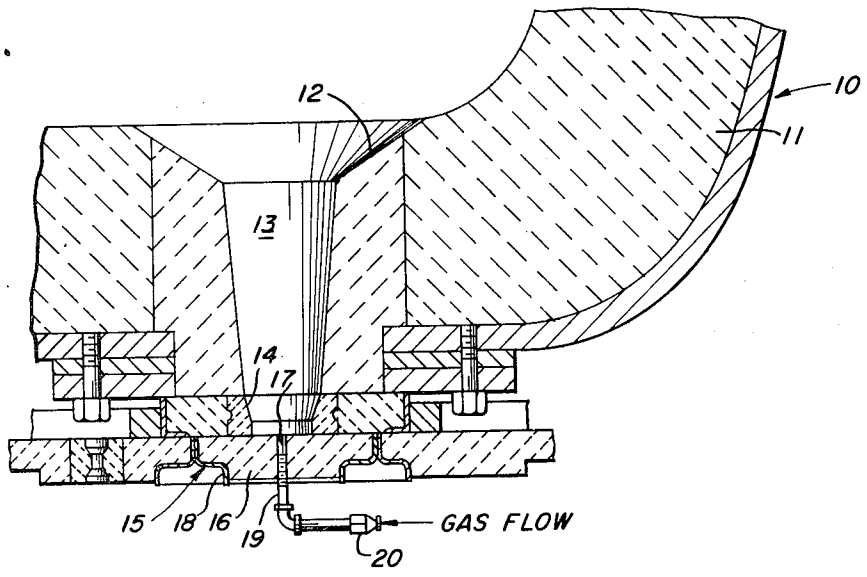


FIG. 1

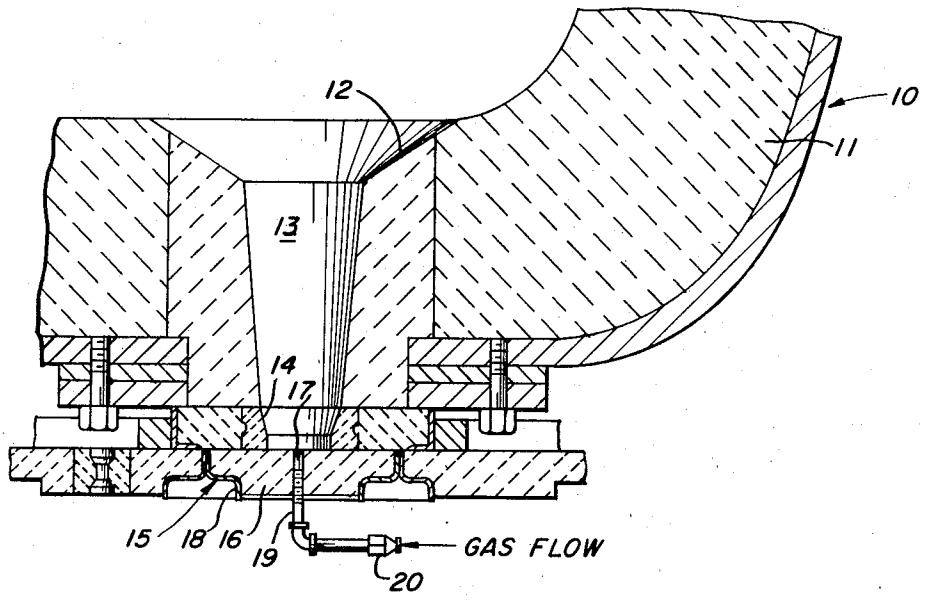


FIG. 2

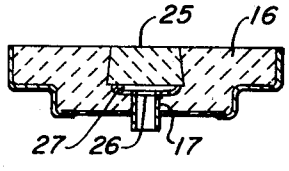
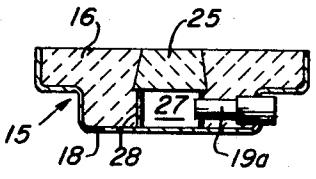


FIG. 3



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APPARATUS FOR INTRODUCING GAS TO HOT METAL IN A BOTTOM-POUR VESSEL

This invention relates to an improved refractory closure apparatus through which gas can be introduced to molten metal in a bottom-pour vessel.

In the continuous casting of steel, molten metal is poured from a ladle into an intermediate pouring vessel such as a tundish or degassing vessel and then into a mold. The intermediate pouring vessel is usually recessed above the nozzle. The metal that first reaches this recess has already lost much of its heat to the lining of the vessel. This rather quiescent metal settles into the recess, loses additional heat to its surroundings and begins to solidify. The molten metal in the vessel above the recess does not contain sufficient superheat to remelt the solidified metal. Opening the blocked recess necessitates the use of an oxygen lance, which is an undesirable practice as it impairs the quality of the metal and usually damages the nozzle and refractories in the immediate vicinity. The present invention provides means to agitate the metal in the recess to prevent it from solidifying.

Inert gases are frequently introduced to molten metal to provide various treatments, such as degassing, stirring, and equalizing the metal temperature throughout the vessel. It is known to insufflate gas into a mass of molten metal through the vessel lining as shown in Spire U.S. Pat. No. 2,811,346, around the nozzle as shown in Griffiths and Orehoski U.S. Pat. No. 3,253,307 and through the stopper rod as shown in Saccomano U.S. Pat. No. 3,214,804. Further, it is known to use sliding gates on bottom-pour vessels, as shown in Shapland U.S. Pat. No. 3,352,465.

It is an object of our invention to provide an improved closure apparatus which includes means for introducing gas through a sliding gate into molten metal within a bottom-pour vessel.

It is a further object to provide a sliding-gate closure equipped with means for agitating hot metal in the recess around the nozzle of a vessel to prevent the metal from solidifying.

In the drawing:

FIG. 1 is a cross-section through the nozzle of a bottom-pour vessel equipped with a sliding gate constructed in accordance with our invention.

FIG. 2 is a cross-section of an alternative sliding gate which employs a permeable refractory block in the gas passageway.

FIG. 3 is a cross-section of another sliding gate which has an alternative location for the gas connection.

Referring now to the drawing,

FIG. 1 shows a portion of a bottom-pour vessel **10** with a refractory lining **11** for receiving molten metal. The bottom wall of the vessel has a well or recess **12** and an outlet opening **13** and carries a nozzle **14** fixed to its underside aligned with the opening. A sliding gate closure member **15** is mounted beneath the nozzle. The gate can be supported and operated in any desired manner; hence we have not shown the supporting and operating mechanism. The gate includes a solid refractory portion **16** having a centrally located vertical opening **17** and is covered on its sides and bottom by a steel jacket **18**. A pipe **19** communicates with opening **17** and is affixed therein. Opening **17** may be threaded to receive the pipe. A source of gas is connected to pipe **19** through a nipple **20**.

When vessel **10** is prepared to receive molten metal, gate **15** is placed into the position shown and gas flow is started through the gate into the nozzle region of the vessel. Molten metal is then poured into the vessel. Gas flow into the nozzle region prevents metal from entering opening **17** and prevents solidification of metal in well **12**, outlet **13** or nozzle **14** by agitating the metal.

The alternative sliding gate configuration of FIG. **2** includes a permeable refractory block **25** centered in the upper portion of gate **15**. Pipe **19** is affixed at its upper end to annular steel shell **26** which forms, with block **25**, a cylindrical chamber **27** for distributing the gas evenly over the base of block **25**. Block **25** is preferably a frustum of a cone, but could be a frustum of a pyramid or other suitable geometric shape. Since refractory **16** is dense and of low permeability, it serves to contain the gas in block **25** and force virtually all of the gas through block **25** into the molten metal.

Figure **3** shows an alternative location for the introduction of gas, that being through the side of the gate rather than through the bottom. Where space is limited between the pouring nozzle and a mold beneath it, this gate offers a decided advantage. In this configuration, cylindrical chamber **27** is formed by tube **28** and extends from the bottom of jacket **18** to the bottom of block **25**. Pipe **19***a* is positioned horizontally in the gate.

The gates of our invention perform in the same manner as a regular closure gate in physically stopping the flow of molten metal, yet perform the additional function of stirring or agitating the molten metal in the nozzle region, thus preventing solidification of the metal in this region prior to the beginning of the pour. The gate of either FIG. **2** or **3** has the additional capability of performing as a regular closure gate regardless of whether the gas flow has begun. If the permeable block becomes plugged or is penetrated by molten metal, the gate can easily be replaced by a fresh gate.

We claim:

1. A slide-through gate for closing the pouring nozzle of a molten-metal containing bottom-pour vessel, said gate comprising a refractory body having an opening, and means connected to said gate and communicating with said opening for introducing gas to the vessel.

2. A gate as defined in claim **1** further comprising a permeable refractory block occupying a portion of said opening.

3. A gate as defined in claim **2** further comprising a chamber beneath said block, said opening being vertical and centered in said gate and means for affixing a pipe in said opening.

4. A gate as defined in claim **2** further comprising a chamber beneath said block, said opening having a horizontal segment with means for affixing a pipe therein.

5. In combination with a bottom-pour vessel for teeming hot metal having a nozzle in the bottom thereof and a slide through gate slidable on said bottom to control flow through said nozzle, the improvement comprising means connected to said gate for introducing gas into said vessel through said gate.

6. A combination as defined in claim **5** characterized by a central vertical opening in said gate, a gas supply, and a tubular connection therebetween.

7. A combination as defined in claim 5 characterized by a permeable refractory block positioned in the upper portion of said gate, a chamber beneath said block, a gas supply, and a tubular connector between said chamber and said gas supply.

8. Apparatus as defined in claim 1 further comprising an impermeable metal jacket covering the bottom and sides of said refractory body.

9. A combination as defined in claim 5 further comprising an impermeable metal jacket covering the bottom and sides of said gate.

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