Oct. 15, 1957 H. KLINGBEIL 2,809,886

PLUNGER FOR THE INTRODUCTION OF SUBSTANCES WITH LOW VAPORIZATION TEMPERATURE INTO LIQUID MELTS

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Fig. 1.

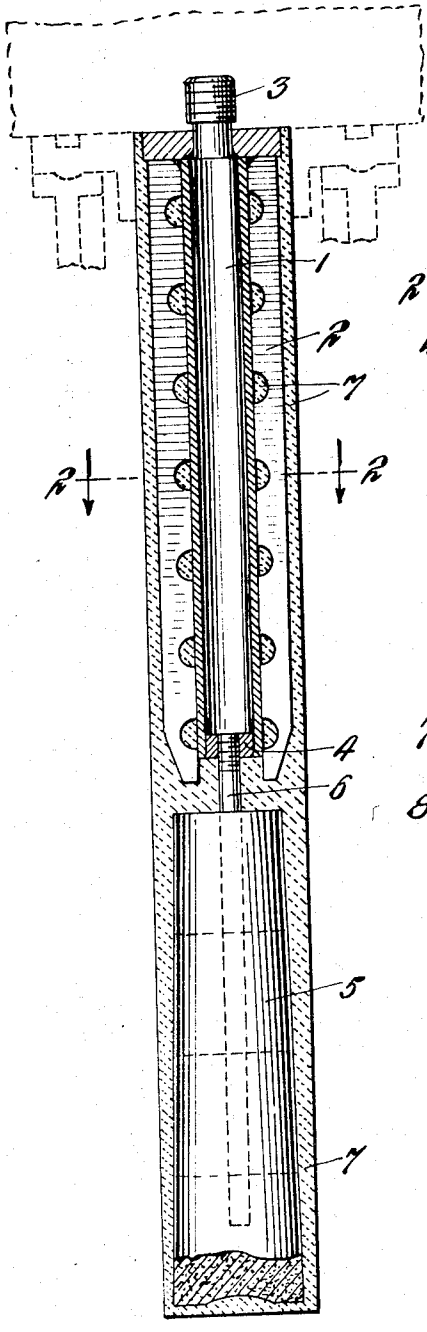


Fig. 2.

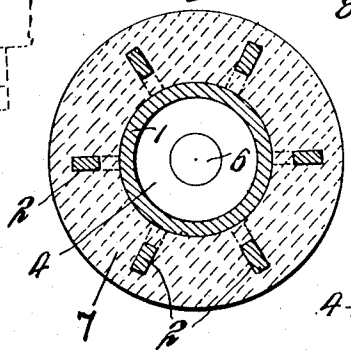


Fig. 3.

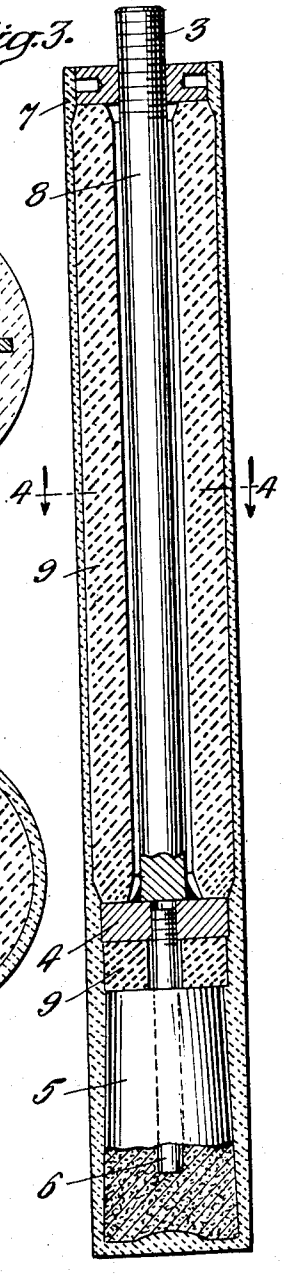
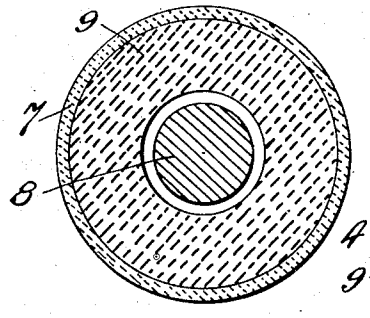


Fig. 4.



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PLUNGER FOR THE INTRODUCTION OF SUBSTANCES WITH LOW VAPORIZATION TEMPERATURE INTO LIQUID MELTS

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Claims priority, application Germany February 17, 1955

8 Claims. (Cl. 75—93)

The present invention is directed to an improvement in an apparatus and in a method for adding reactive agents to molten metal under pressure and, more particularly, to an improvement in an apparatus and a method for adding to molten metal reactive metallic agents having a vaporization temperature relatively lower than the temperature of the molten metal.

In my U. S. application Serial No. 445,377, filed July 23, 1954 (now U. S. Patent No. 2,776,206, granted January 1, 1957), I described an apparatus comprising a pressure vessel adapted to hold molten metal, e. g., molten cast iron, and having adapted thereto a lid designed to close the pressure vessel in a pressure-tight manner and a plunger fastened to the bottom of said lid adapted to hold addition material and constructed to introduce said addition material below the surface of the molten metal held in the pressure vessel practically simultaneously with closure thereof by said lid so that pressure generated in the closed vessel by vaporization of the addition material in contact with the molten metal is retained in the vessel.

It is an object of the present invention to provide an improved plunger adapted for introducing reactive addition agents into molten metal in accordance with the method and apparatus disclosed in my earlier U. S. application Serial No. 445,377 (now U. S. Patent No. 2,776,206, granted January 1, 1957).

It is a further object of the invention to provide an improved process wherein solid reactive addition agents may be added to molten metal.

Broadly stated, the plunger contemplated in accordance with the present invention comprises a carrier adapted to be detachably connected to the lid of the pressure vessel described in my earlier application Serial No. 445,377 (now U. S. Patent No. 2,776,206, granted January 1, 1957). The free end of the said carrier is adapted to have attached thereto pieces of the addition material, e. g., magnesium, contemplated to be used in treating molten metal held in the pressure vessel, e. g., molten cast iron. The said carrier and the pieces of addition material attached thereto are surrounded or covered by a refractory heat insulating sheath, the wall thickness of which, in the region of the addition material, is great enough to delay melting thereof but not to prevent such melting. The refractory sheath is preferably produced from a plastic refractory material such as a ramming mix which is usual for the lining of cupola furnaces, crucibles, etc. The addition material preferably is first attached ot the carrier and the carrier and the addition material are then covered with the refractory ramming mix which adheres strongly to the assembly after drying.

Embodiments of the invention are shown in the accompanying drawings. Figures 1 and 2 show in section and cross section a plunger comprising a carrier-and-addition-material assembly which is covered by an insulating refractory ramming mix while Figures 3 and 4 show in section and cross section a carrier-and-addition-material assembly in which the carrier has an insulation of ceramic material or graphite and in which the assembly is covered with a refractory ramming mix. In the embodiment depicted by Figures 1 and 2, a tubular carrier body **1** is fitted on the periphery with a plurality of perforated ribs **2**. The carrier is provided with a bolt **3** on one end which is adapted to fasten the carrier to the lid of the pressure vessel. At the other end, the carrier is provided with fastening means **4**, which can be a nut, for attaching to the carrier shaped pieces **5** of the addition material. In the production of cast iron containing spheroidal graphite, the shaped pieces or bodies **5** shown in Figures 1 and 3 would consist of magnesium or a magnesium alloy. The shaped pieces or bodies **5** are provided with a central cast-in carrier rod **6** which may be made of iron or other suitable metal. The rod **6** is adapted to be fixed securely to the carrier **1** by the fastening means **4**.

After attaching the pieces of addition metal **5**, which can be of any shape, to the carrier **1**, the plunger is sheathed with a refractory ramming mix so that the assembly has a cylindrical form. The function of the ribs **2** is to reinforce and secure the ramming mix to the carrier. The wall thickness of the ramming mix is such that in the region of the carrier **1** it protects the carrier from being melted on immersion into molten cast iron. In the region of the shaped pieces of addition metal **5**, the wall thickness of the sheath is, however, not enough to prevent the melting of the shaped pieces of addition material, e. g., magnesium, but only to delay such melting until the plunger assembly has been introduced into the melt and the lid carrying the plunger has been put tightly on to the opening of the pressure vessel.

Preferably, the metallic addition material **5** is provided in a conical frustrum shape such that when the pieces of addition material are fastened to the carrier **1** and are then covered with an envelope of refractory ramming mix the wall thickness of the envelope decreases toward the free end of the addition material. By this means, the shape is induced to begin melting at the free end, whereupon it bursts the envelope of refractory ramming mix and then melts progressively along its length. In this manner, the addition material is prevented from coming free of the plunger prematurely, a circumstance which would result in the addition material rising to the surface of the melt at which point intimate alloying of the addition material with the whole melt could no longer be assured. It will be appreciated from Figures 1 and 3 that the bottom end of the shaped bodies of addition material **5** is also covered by the refractory ramming mix. The preferred embodiment of the invention advantageously can be carried into practice by arranging the conical frustrum shape so that it presents its smaller circular surface to the carrier **1**. When this shape is provided with a cylindrical envelope, the wall thickness of the envelope decreases toward the free end of the plunger in the region of the shapes.

The embodiment according to Figures 3 and 4 depicts a ceramic sheath **9** about the central shaft **8**. This ceramic sheath may be made of porcelain, burnt clay, electrode carbon, etc. The sheath of ceramic material **9** such as depicted in Figures 3 and 4 can be used repeatedly and saves the application of large amounts of ramming mix in the region of the carrier rod **8**.

Those skilled in the art will appreciate that plastic refractory ramming mixes used in lining cupola furnaces and the like may be composed of various mixtures of silica and clay. Mixtures incorporating granular magnesite or dolomite may also be employed where a basic material is preferred. Plastic refractory ramming mixes are described in the book "The Cupola and

Its Operation," second edition, 1954, American Foundrymen's Society, for example, at pages 27 to 29.

It is to be observed that the present invention provides an apparatus and a method for introducing a relatively volatile addition agent into molten metal. When introducing the addition agent into the molten metal, the plunger consisting of the carrier with the solid addition material affixed thereto, both being coated with the refractory heat insulating sheath, is attached to the inside surface of the lid of the pressure vessel in the manner hereinbefore described. When the molten metal is ready to be treated with the addition material, the lid is positioned to close the pressure vessel in a pressure-tight manner while immersing at least the free end of the plunger in the molten metal. As hereinbefore described, the heat of the molten metal causes the addition agent to melt, vaporize and burst the ceramic envelope after a short time, thus permitting the pressure vessel to be tightly closed prior to the release of the addition agent, e. g., magnesium. The pressure vessel prevents the escape of the addition material by volatilization and allows the molten metal to absorb the addition material. Preferably, the plunger consists of the carrier and a conical frustrum of addition material attached to the carrier at the smaller circular surface. A cylindrical refractory heat-insulating sheath covers both the addition material and the carrier in the manner described hereinbefore.

Although the present invention has been described in conjunction with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention, as those skilled in the art will readily understand. Such modifications and variations are considered to be within the purview and scope of the invention and appended claims.

I claim:

1. In an apparatus adapted for the treatment of molten metal under pressure and comprising a pressure vessel having a lid adapted to close said vessel in pressure-tight relation, said lid having connected thereto a plunger adapted to hold addition material on the free end thereof and to insert said addition material into molten metal held in said vessel when said lid is in pressure-tight relation to said vessel, the improvement which comprises a plunger having a carrier portion adapted to be detachably connected to the pressure vessel lid and addition material attached to the free end of said carrier, said plunger being coated by a layer of refractory heat insulating material providing a substantially cylindrical form to the coated plunger and said layer having a wall thickness decreasing toward the free end of the plunger in the region of the addition material.

2. In an apparatus adapted for the treatment of molten metal under pressure and comprising a pressure vessel having a lid adapted to close said vessel in pressure-tight relation, said lid having connected thereto a plunger adapted to hold addition material on the free end thereof and to insert said addition material into molten metal held in said vessel when said lid is in pressure-tight relation to said vessel, the improvement which comprises a plunger having a carrier portion adapted to be detachably connected to the pressure vessel lid and a conical frustrum shaped piece of addition material attached at the smaller circular face of said conical frustrum to the free end of said carrier, said plunger being surrounded by a substantially cylindrical layer of refractory heat insulating material having a wall thickness decreasing toward the free end of the plunger in the region of the addition material.

3. In an apparatus adapted for the treatment of molten metal under pressure and comprising a pressure vessel having a lid adapted to close said vessel in pressure-tight relation, said lid having connected thereto a plunger adapted to hold addition material on the free end thereof and to insert said addition material into molten metal held in said vessel when said lid is in pressure-tight relation to said vessel, the improvement which comprises a plunger having a carrier portion adapted to be detachably connected to the pressure vessel lid and a conical frustrum shaped piece of addition material attached at the smaller circular face of said conical frustrum to the free end of said carrier, said plunger being surrounded by a layer of refractory heat insulating material providing a substantially cylindrical form to the coated plunger and thereby providing decreasing wall thickness of said refractory heat insulating material toward the free end of the plunger in the region of the addition material.

4. In an apparatus adapted for the treatment of molten metal under pressure and comprising a pressure vessel having a lid adapted to close said vessel in pressure-tight relation, said lid having connected thereto a plunger adapted to hold addition material on the free end thereof and to insert said addition material into molten metal held in said vessel when said lid is in pressure-tight relation to said vessel, the improvement which comprises a plunger having a carrier partion adapted to be detachably connected to the pressure vessel lid and a conical frustum shaped piece of addition material selected from the group consisting of magnesium and magnesium alloys attached at the smaller circular face of said conical frustum to the free end of said carrier, said plunger being surrounded by a layer of refractory heat insulating material providing a substantially cylindrical contour thereto and thereby providing decreasing wall thickness of said refractory heat insulating material toward the free end of the plunger.

5. In the process of adding reactive addition agents to molten metal under pressure, the improvement which comprises attaching a conical frustum shaped piece addition material to a carrier to form a plunger having the addition material affixed to one end thereof, said addition material being adapted to melt and vaporize in contact with said molten metal, enclosing said plunger in a heat insulating refractory sheath having decreasing wall thickness toward said end in the region of the addition material, affixing said sheathed plunger to the inside face of a lid of a pressure vessel containing molten metal in such manner that the addition material is positioned at the free end of said sheathed plunger, and immersing at least the free end of said sheathed plunger in molten metal contained in said pressure vessel while simultaneously closing said vessel in a pressure-tight manner to hold therein pressure produced by melting said addition material.

6. In the process of adding reactive addition agents to molten metal under pressure, the improvement which comprises attaching a conical frustum shaped piece of addition material to a carrier to form a plunger having the addition material affixed to one end thereof, said addition material being adapted to melt and vaporize in contact with said molten metal, enclosing said plunger in a substantially cylindricaly heat insulating refractory sheath to provide a decreasing wall thickness toward said end in the region of the addition material, affixing said sheathed plunger to the inside face of a lid of a pressure vessel containing molten metal in such manner that the addition material is positioned at the free end of said sheathed plunger, and immersing at least the free end of said sheathed plunger in molten metal contained in said pressure vessel while simultaneously closing said vessel in a pressure-tight manner to hold therein pressure produced by melting said addition material.

7. In the process of adding reactive addition agents to molten cast iron under pressure, the improvement which comprises attaching a conical frustum shaped piece of addition material to a carrier to form a plunger having the addition material affixed to one end thereof, said addition material being adapted to melt and vaporize in con-

tact with said molten cast iron, enclosing said plunger in a substantially cylindrical heat insulating refractory sheath having a decreasing wall thickness toward said end in the region of the addition material, affixing said sheathed plunger to the inside face of a lid of a pressure vessel containing molten cast iron in such manner that the addition material is positioned at the free end of said sheathed plunger, and imersing at least the free end of said sheathed plunger in molten cast iron contained in said pressure vessel while simultaneously closing said vessel in a pressure-tight manner to hold therein pressure produced by melting said addition material.

8. In the process of adding magnesium to molten cast iron to produce cast iron under pressure containing spheroidal graphite, the improvement which comprises attaching a conical frustum shaped piece of addition material selected from a group consisting of magnesium and magnesium alloys to a carrier to form a plunger having said addition material affixed to one end thereof, enclosing

said plunger in a substantially cylindrical heat insulating refractory sheath to provide a decreasing wall thickness in said sheath toward said end in the region of the addition material, affixing said sheathed plunger to the inside face of a lid of a pressure vessel containing molten cast iron in such manner that the addition material is positioned at the free end of said sheathed plunger, and closing said vessel while immersing at least the free end of said sheathed plunger in molten cast iron contained in the pressure vessel, whereby the release of magnesium is delayed until after the lid has tightly closed said pressure vessel.

References Cited in the file of this patent

UNITED STATES PATENTS

2,158,517	McParlin	May 16, 1939
2,662,008	Stone	Dec. 8, 1953