Jan. 4, 1955 J. M. FISHELL 2,698,749

APPARATUS FOR INTRODUCING SOLID METAL INTO MOLTEN METAL

Filed June 6, 1951 2 Sheets-Sheet 1

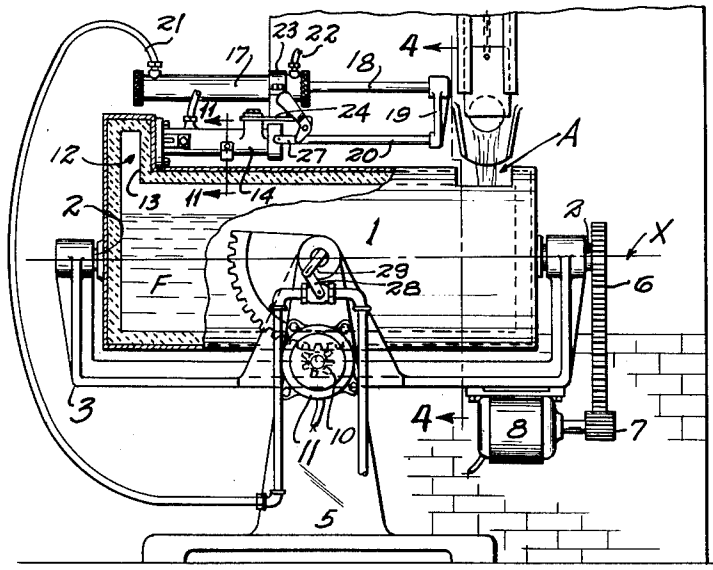


FIG. 1.

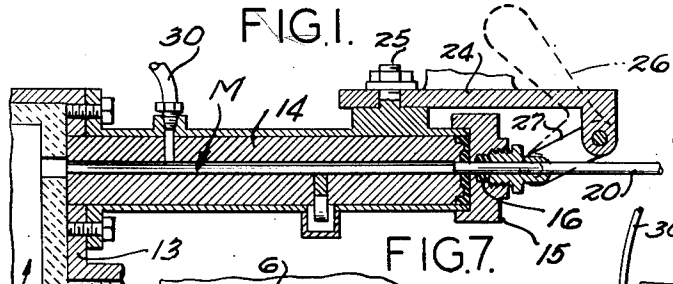


FIG. 7.

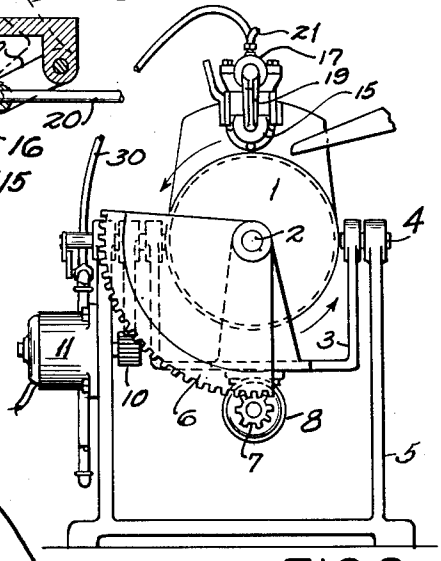


FIG. 2.

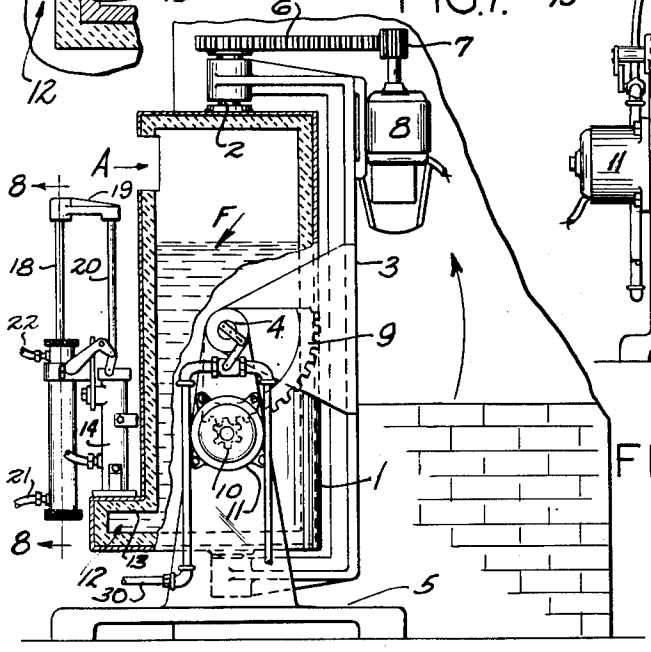


FIG. 6.

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APPARATUS FOR INTRODUCING SOLID METAL INTO MOLTEN METAL

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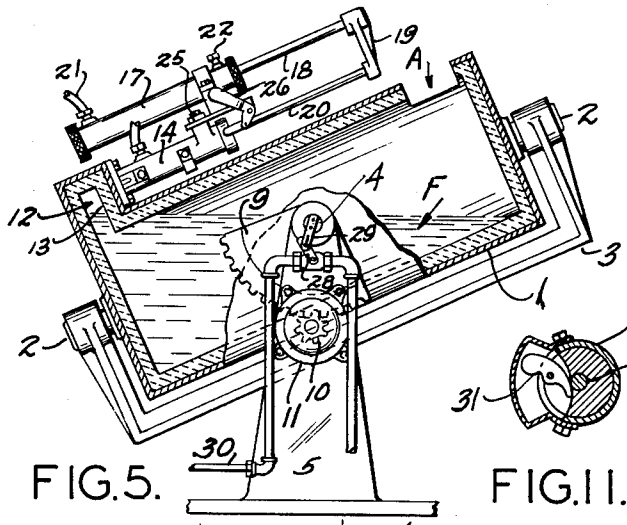


FIG.5.

FIG.11.

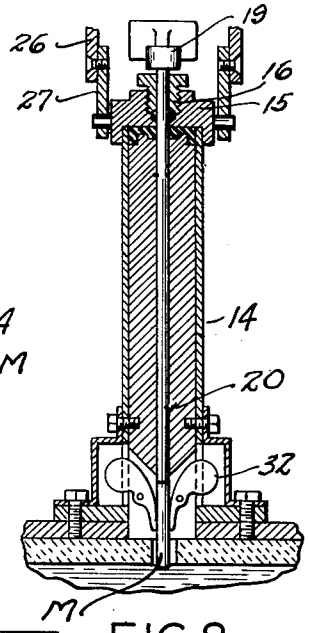


FIG.8.

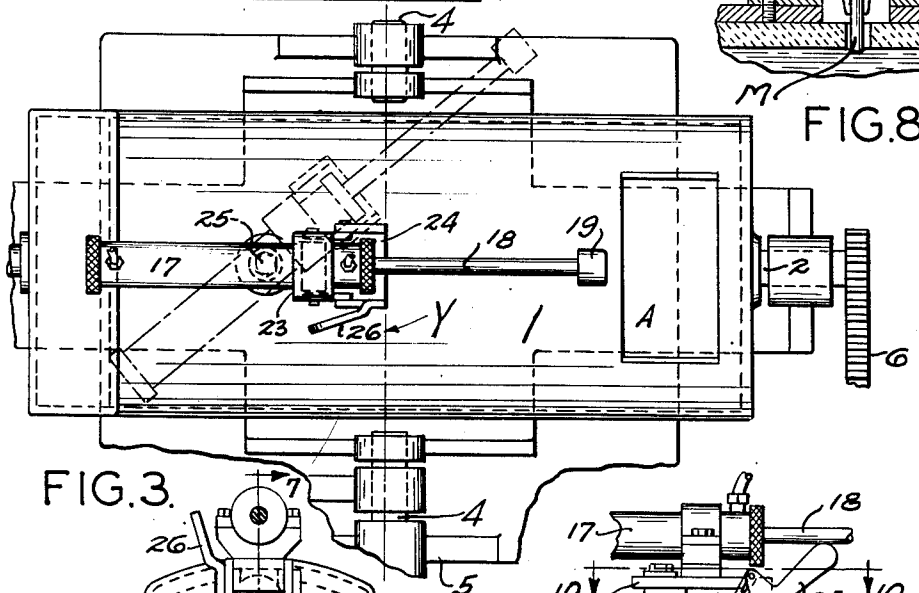


FIG.3.

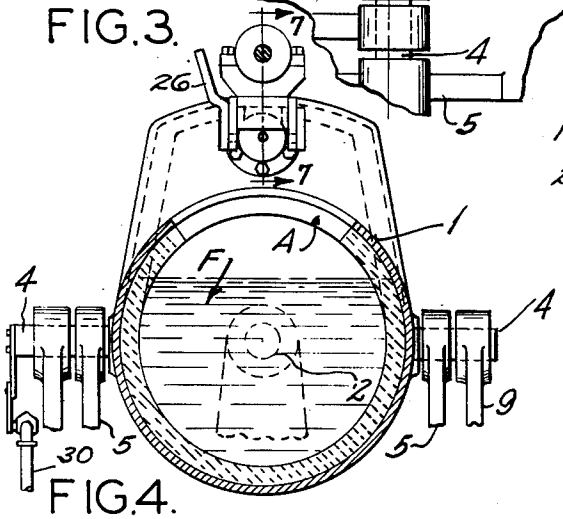


FIG.4.

FIG.9.

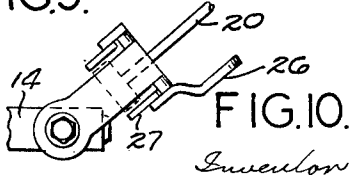


FIG.10.

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APPARATUS FOR INTRODUCING SOLID METAL INTO MOLTEN METAL

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Application June 6, 1951, Serial No. 230,153

10 Claims. (Cl. 266—34)

The invention relates to metallurgy, and more particularly to the treatment of molten metal, for example, a ferrous metal, with a relatively high volatile material, for example, magnesium.

It has been proposed to introduce relatively small quantities of magnesium into a mass of molten iron or steel to obtain a product having improved characteristics over untreated iron or steel. Such introduction of magnesium acts to reduce the sulphur, some of the phosphorus, and, particularly, all of the oxides in the molten iron and there are other beneficial results shown in the grain structure of the iron which are not fully understood. The high volatile nature of magnesium makes its introduction into the molten iron difficult, uncertain and dangerous and the main object of the present invention is to facilitate such introduction with certainty and safety.

This object is attained by the controlled introduction of magnesium in desired or graduated amounts into the molten metal beneath the surface of the same and under conditions which exclude exposure of the volatile metal to air.

Another object is to effect the introduction by means of an apparatus which may be easily "charged" with the volatile material and readily manipulated to introduce the same into the molten metal.

These and other more specific objects of the invention, as will be apparent from the following description, are attained in the manner described by use of the apparatus illustrated and described, reference being had to the accompanying drawings, in which:

Figure 1 is a side elevation, sectioned in part, of an elongated container for molten metal, such as a foundry forehearth or ladle, and associated mechanism for feeding a more volatile metal to molten metal in the container. The container is shown in an initial position with its major axis horizontal and the feeding mechanism is inoperative.

Figure 2 is a right-hand end view of the structure shown in Figure 1.

Figure 3 is a top view of the structure shown in Figures 1 and 2.

Figure 4 is a vertical transverse section taken on the line 4—4 of Figure 1.

Figure 5 is a side elevation of the same structure, sectioned in part, showing the container with its major axis inclined to the horizontal so that the molten metal in the container seals off an entry passage.

Figure 6 is a side elevation, sectioned in part, of the same structure showing the container with its major axis vertical, the feeding mechanism being operable.

Figure 7 is a detail vertical longitudinal section taken on the line 7—7 of Figure 4.

Figure 8 is a similar section taken on the line 8—8 of Figure 6.

Figure 9 is a detail side elevation of some of the parts shown in Figure 1, drawn to an enlarged scale and shifted to a different position.

Figure 10 is a top view of some of the parts shown in Figure 9 and is taken approximately on the line 10—10 of Figure 9.

Figure 11 is a detail vertical section taken on the line 11—11 of Figure 1.

The container 1 is shown as consisting mainly of a cylinder of boiler plate with a refactory lining, there being an opening A in the wall of the container near the top and right hand end of Figure 1 for the introduction and discharge of the molten metal. Trunnions 2, aligned with the longitudinal axis X of container 1, are journaled in a cradle 3 which, in turn, has trunnions 4 aligned with a transverse axis Y and journaled in a stationary frame 5. A quadrant 6 (Figure 2), fixed to a trunnion 2, meshes with a pinion 7 on a reversible motor 8. This motor may be operated to rotate the container 180° about axis X from the metal receiving position (Figure 1) to a metal discharging position (not shown).

A quadrant 9, fixed to a trunnion 4, meshes with a pinion 10 on a reversible motor 11. This motor may be operated to tilt cradle 3 and container 1 about axis Y from the normal position (Figure 1) through the intermediate position (Figure 5) to an upright position (Figure 6).

At the upper left hand end of container 1 (Figure 1) the cylinder is extended to form an entry passage 12 having an apertured wall 13 mounting an elongated introduction chamber 14, the outer end of which mounts a readily removable cap 15 provided with a packing gland 16. Alongside chamber 14 is a cylinder 17 fitted with a piston having a rod 18, the outer end of which carries an arm 19 normally projecting over the axis of chamber 14. A follower 20 is slidable through gland 16, cap 15 and chamber 14 and is operated by the admission of air through conduits 21 and 22 in opposite directions axially of chamber 14. Cylinder 17 is mounted by a strap 23 on a plate 24 pivoted at 25 to chamber 14 and movable about its pivot between the solid and broken line positions shown in Figure 3. A bell crank 26 is pivoted to plate 24 and connected by links 27 to cap 15 which may be removed from chamber 14 and clamped thereto by operation of bell crank 26.

To operate the machine and follow the method disclosed in this application, cap 15 is released from chamber 14 and swung away from the right hand end of the chamber. A magnesium rod M is then inserted in chamber 14, cap 15 is then applied to the chamber and locked in position.

Container 1 and cradle 3 are then rotated on trunnion 4 to the position shown in Figure 5 when the top of molten iron F seals off passage 12 from the remainder of cylinder 1.

At this point, an inert gas is admitted to chamber 14 through a conduit 30 and is discharged and, operating on the "diving bell" principle, expels air from passage 12 and prevents the admission of molten iron into chamber 14. The gas and air in the passage is expelled through the molten iron. This supply of inert gas under pressure is effected automatically by opening control valve 28 by a crank 29 on trunnion 4.

As the container is tilted from the position shown in Figure 5 to the position shown in Figure 6, air is admitted to the upper end of cylinder 17. Rod 18 and follower 20 are moved downwardly to force magnesium rod M from chamber 14 to passage 12 where it is immersed in a molten iron and, as it vaporizes, passes upwardly through the molten iron. A depth of thirty inches of iron gives a head pressure of approximately eight pounds per square inch. At this pressure, a pound of pure magnesium vaporizes into 186 cubic feet of gas. The feed of the magnesium rod into the iron may be so controlled that the evolution of magnesium vapor will be sufficiently dampened in its flow through the molten iron so that no dangerous velocities will be reached. As the magnesium passes through the molten iron, it effects the well-known changes in the characteristics of the iron. When the predetermined amount of magnesium has been fed into the molten iron, motor 11 is reversed and the container is returned to the normal position shown in Figure 1, the supply of inert gas through conduit 30 being cut off as the level of the molten iron falls below passage 12. The container may then be rotated on axis X to discharge the treated molten metal through opening A to a suitable transfer ladle or trough to the casting molds.

Brakes 31 and 32 are actuated by gravity to hold the magnesium rod M against undersirable movement through chamber 14. Brake 31 functions when container 1 is in or near a horizontal position. Brake 32 functions

when container 1 is in or near an upright position. The admission of air through conduit 22 to cylinder 17 to feed follower 20, and rod M, may be controlled to feed the rod as rapidly as desired to effect the proper admixture of the magnesium and molten iron.

It will be understood that any desired alloy of magnesium with other metals in rod or bar form, or in powdered form, may be substituted for the magnesium rod M, but pure magnesium may be used without the danger attendant the introduction of magnesium into molten iron, as previously attempted.

Preferably, chamber 14 includes a refractory lining to insulate the magnesium rod from the head of the adjacent container 1. The gas supplied through conduit 30 also serves as a coolant for the magnesium as well as bearing the pressure of the molten iron.

Substantial variations in the method and structure disclosed and even the elements of some of the mechanisms disclosed may be made without departing from the spirit of the invention and the exclusive use of those modifications coming within the scope of the claims is contemplated.

What is claimed is:

1. In combination, a container for molten metal having an opening in its side near one end for receiving and discharging metal, structure mounting said container for oscillation about a horizontal axis extending through its ends, structure mounting said container for tilting about an axis extending horizontally transversely of said first-mentioned axis, an introduction chamber extending alongside said container and movable with it about said transversely extending axis, there being a passage for inserting metal from said chamber into the lower portion of said container when the latter tilted about said transversely extending axis from its normal position.

2. In combination, a container for molten metal, an introduction chamber normally above the container, structure mounting the container and chamber for tilting about a horizontal axis, there being a passageway between the container and chamber at the lower portion of the same when tilted to one extreme on said axis, means for feeding a rod of metal through the chamber into said passageway, a seal for closing the lower portion of the interior of the chamber from the atmosphere while the feeding means is operating, and means for introducing gas under pressure into said chamber lower portion.

3. In combination, a container for molten metal, an introduction chamber normally above the container, structure mounting the container and chamber for tilting about a horizontal axis, there being a passageway between the container and chamber at the lower portion of the same when tilted to one position on said axis, means for feeding a rod of metal through the chamber into said passageway, a seal for closing the lower portion of the interior of the chamber from the atmosphere while the feeding means is operating, a conduit for gas under pressure leading to said chamber lower portion, a valve controlling said conduit, and a connection between said valve and the container for automatically opening said valve as the container and chamber are tilted past a predetermined angle from the horizontal and automatically closing said valve as the container is returned towards a horizontal position.

4. In combination, a container for molten metal, comprising a main compartment and an upward extension from the normal upper portion of one end of said extension having a wall normal to and merging with an adjacent side of the main compartment, a chamber extending outwardly of the container and opening at one end into said extension, a follower movable through the other end of said chamber, structure surrounding said follower and sealing the adjacent end of said chamber from the atmosphere, and means exteriorly of said container for moving said follower through said chamber into said extension.

5. In combination, a container for molten metal, an elongated introduction chamber alongside said receptacle, a passage between an end of said chamber and an end of said container, a follower slidable in said chamber and including an extension passing through the other end of said chamber, a seal surrounding said extension and closing the interior of said chamber from the atmosphere, a device exteriorly of said chamber engageable with said extension and providing controlled movement of said follower along said chamber towards said passage, and means for moving said container and chamber into a position with said passage above the level of the major portion of the interior of said container and to another position with said passage adjacent the bottom of the major portion of the interior of said container.

6. Structure as described in claim 5 which includes means for supplying gas under pressure to the introduction chamber in front of the follower.

7. In combination, a container for molten metal, an elongated introduction chamber alongside said receptacle, a passage between an end of said chamber and a portion of said container, a follower slidable in said chamber and including an extension through the other end of said chamber, elements in said chamber for positioning an elongated metal rod to be thrust by said follower lengthwise into said passage, elements for yieldingly engaging such a rod to restrain its movement, and means for actuating said follower to exert thrust on said rod sufficient to overcome said elements.

8. Structure as described in claim 7 which includes means for supplying gas under pressure to the portion of the chamber receiving the metal rod.

9. In combination, a container for molten metal, an introduction chamber, a passage therefrom to said container, a follower movable through said chamber towards said passage, a device exteriorly of said chamber for moving said follower, and means for supplying gas under pressure to said chamber in front of said follower.

10. In combination, a container for molten metal, structure mounting said container for tilting about a horizontal axis to two positions, a relatively small chamber exteriorly of said container and movable therewith and positioned wholly above the level of said axis when the container is in one of said positions but having a part below said level when said container is tilted to the other of said positions, elements forming a passage between said chamber part and the lower portion of the container when the same are tilted to the latter-mentioned position, means for feeding a rod of metal in said chamber and into said passage, and means for sealing the interior of said chamber from the atmosphere while said feeding means is operating.

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