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INTRODUCTION OF MAGNESIUM INTO MOLTEN IRON

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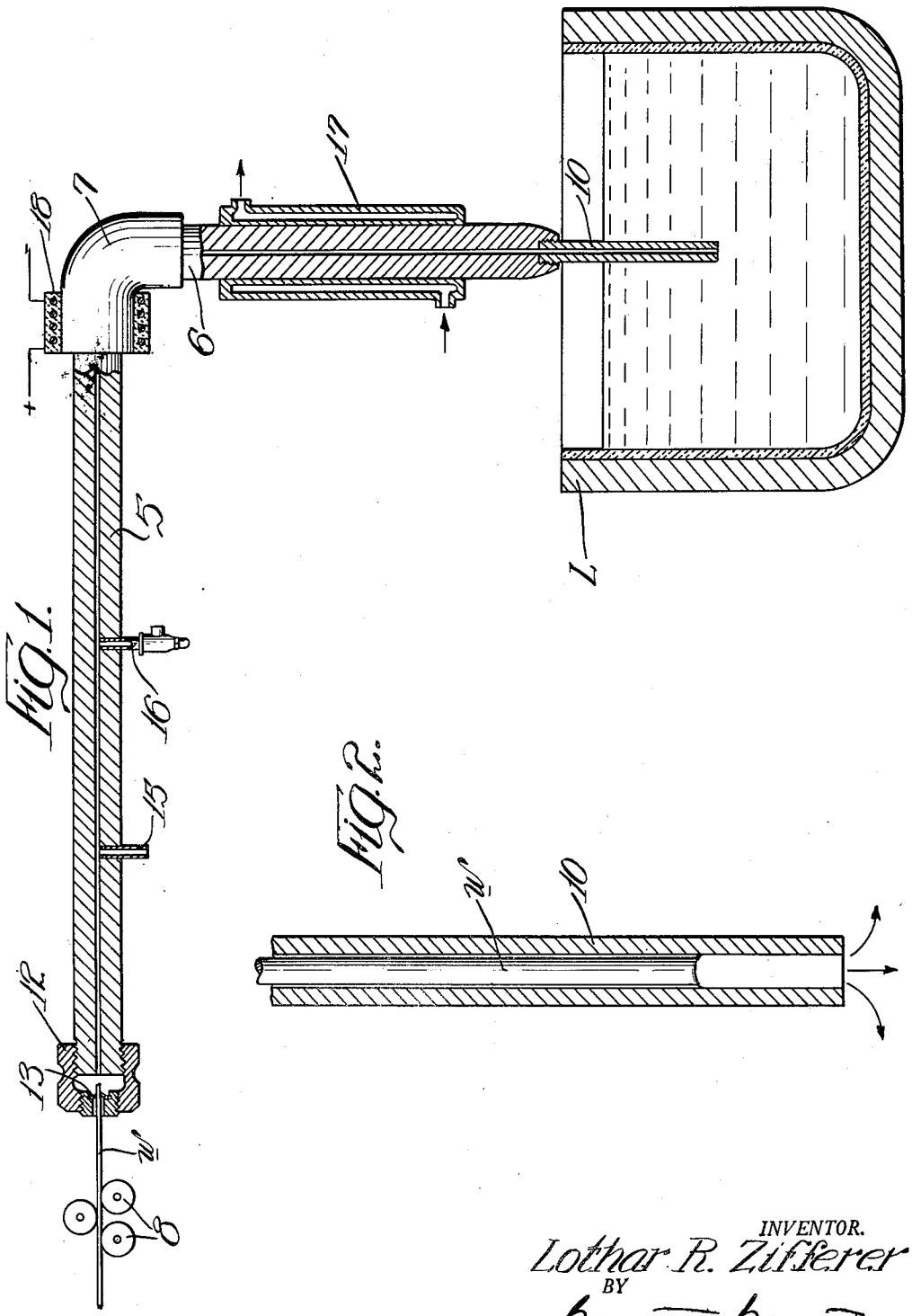


Fig. 1.

Fig. 2.

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INTRODUCTION OF MAGNESIUM INTO MOLTEN IRON

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8 Claims. (Cl. 75—129)

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The invention is applicable to all instances where an inoculating agent is to be introduced to a pool of molten ferrous metal, and irrespective of whether the agent is intended as an alloy component or merely as a fugitive catalyst or a detergent. However, its greatest utility is realized where the temperature of the molten metal to which the inoculating agent is to be added is equal to or above the vaporizing temperature of such agent.

Nodular iron which is a relatively recent development is produced by introducing magnesium into molten iron. The admixture of one with the other presents hazards of explosion and/or dissipation of the magnesium. The introduction of magnesium through the medium of alloys tends to render the resulting scrap material unsuitable for remelt.

The main objects of this invention, therefore, are to provide an improved process and apparatus for making practical and non-hazardous the introduction of magnesium into molten metal, particularly molten cast iron; to provide an improved process and apparatus for introducing vaporized magnesium into the molten metal; to provide an improved process and apparatus of this kind which employs the pressure of an inert gas to ensure against a back pressure of the vaporized magnesium, and to facilitate the injection of the vaporized magnesium into the molten metal; to provide improved means for controlling and indicating the linear feed of magnesium wire to an injector submerged into the molten metal so as to ensure the injection of the desired amount of magnesium to the molten metal; to provide an improved means for preheating the magnesium wire to better ensure its movement to the submerged injector, and, where necessary, for properly cooling the injector above the point of submergence; and to provide an improved apparatus of this kind which is extremely simple and economical to manufacture, and the use of which secures a highly practical result in the production of nodular cast iron.

In the accompanying drawing:

Figure 1 is a more or less diagrammatic view of an injector apparatus constructed in accordance with this invention, the gas-ejecting end thereof being shown submerged in molten metal; and

Fig. 2 is an enlarged fragmentary view of the submerged end of the injector, the probable changing physical character of the magnesium being indicated thereon.

The illustrated apparatus for carrying out this improved process of infusing vaporized magnesium into molten iron utilizes a guide which

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may comprise a pair of tubular inlet and outlet sections 5 and 6 connected together by an elbow 7 in right angular relation. At the free end of the section 5 which is disposed in a generally horizontal direction is arranged a pair of feeding rollers 8 for pushing a wire of magnesium *w* into and through the two assembled tube sections. The rollers may be manually or mechanically driven. Preferably the rollers are equipped with a suitable governor so as to regulate the rate of feed of the magnesium wire to the facility wherewith it is vaporized when pushed out of a nozzle 10 that is detachably affixed to the end of the vertical tube section 6 for submergence in a body of molten ferrous metal contained within a ladle L. The wire may be marked in some suitable manner to visually indicate the amount thereof that is fed into and through the tube sections.

The end of the tubular section 5, as herein shown, is equipped with a cap 12 wherein is mounted a suitable valve 13 which desirably is similar in construction to the standard gas seal wherein a rod or piston may freely operate. The purpose of such a valve-seal is to permit inward movement of the wire *w* while preventing escape of inert gas from the tubular guide. It is important in this connection that such a gas be confined within the tubular section 6, and means to achieve this end may be specially provided as will presently be noted.

The tubular section 5 is also provided with a gas injection orifice 15 and a stem 16 for mounting a pressure escape or relief valve. These provide for the injection of a suitable inert gas into the tubular sections 5 and 6 to clear them of air and maintain a pressure of such gas in these sections to prevent the vaporized magnesium from backing up into the tubular section 5. During flushing of the tubular guide, the escape valve would, of course, be closed, and this is its normal condition when the flushing has been completed. When flushing has been completed, the valve is set to permit the escape of gas at a pressure slightly greater than the upward pressure emanating from the vaporized magnesium.

The nozzle 10 that is affixed to the discharge end of the section 6 is normally submerged in the molten metal, when magnesium is being introduced into the body thereof. The nozzle is of reduced diameter to minimize the possibility of the nozzle chilling the molten metal at or near the point of submergence. The larger diameter of the tubular section above the nozzle promotes dissipation of heat which is conducted thereto from the molten metal. In the event this mass of metal above the point of submergence is in-

sufficient to properly dissipate the heat, a water-cooled jacket 17 can be arranged thereon, as shown in Fig. 1. Obviously, the tubular section 6 will have to be formed of a material with a melting point well above that of the molten iron. For such purpose, graphite, silicon carbide or ceramic material may advantageously be utilized.

In the use of a fairly large magnesium wire, it may be found advantageous to heat the elbow 7 to facilitate the bending of the wire and its feeding into and through the tubular section 6. This may be accomplished by mounting some kind of a heating element 18 on the elbow 7, as indicated in Fig. 1. Such an element may be a conventional electrical resistance heater unit, or an electrical induction or resistor unit. As an alternative, a gas burner may be arranged on the elbow 7.

As indicatel in Fig. 2, the magnesium wire *w*, as it moves through the submerged nozzle 10, is successively converted into a semi-molten state, then a completely molten state, and finally ejected from the end of the nozzle in a vaporous form for infusion into and through the body of molten metal in the ladle L. It is contemplated that a suitable chassis will be provided for raising and lowering the apparatus incident to the operation of filling and emptying the ladle.

I claim:

1. The process of introducing magnesium into a body of molten iron which comprises the steps of submerging in the molten iron one end of a tubular guide, of feeding through the guide and out through the submerged end thereof a magnesium wire to be vaporized by the heat of the molten iron for infusion therewith and of maintaining throughout the length of the guide an inert gas under sufficient pressure during the feeding of the magnesium wire to prevent back flow of vaporized magnesium into the guide.

2. The process of introducing magnesium into a body of molten iron which comprises the steps of submerging in the molten iron one end of a two-direction tubular guide, of feeding through the guide and out through the submerged end thereof a magnesium wire to be vaporized by the heat of the molten iron for infusion therewith, of maintaining throughout the length of the guide an inert gas under sufficient pressure during the feeding of the magnesium wire to prevent back-flow of vaporized magnesium into the guide, and of preheating the wire, while changing its direction of movement through the guide, to facilitate its passage therethrough.

3. A vaporizer for introducing magnesium into molten metal which comprises a guide having angularly-disposed tubular sections, one end of the guide being adapted for submergence in a body of molten metal, means for advancing through the guide a magnesium wire to be vaporized by the heat of the molten metal for infusion therewith, and other means for preheating the wire at the angle between the guide sections to facilitate advance of the wire through the guide.

4. A vaporizer for introducing magnesium into molten iron which comprises a guide having two tubular sections one of which is adapted at its free end to be submerged in the molten iron body, an elbow connecting the tubular sections in angular relation, feed rollers arranged at the entrance of the guide for feeding a magnesium wire through the connected tubular sections, an inert gas orifice and a pressure relief valve located in the first tubular section, and means arranged on the elbow for preheating said wire to facilitate its traversing the angle between the two tubular sections of the guide.

5. A vaporizer for introducing magnesium into molten iron which comprises a plurality of interconnected tubular sections the last of which is adapted at its free end to be submerged in the molten iron body, an elbow connecting two of the tubular sections in angular relation, feed rollers arranged at the end of the first section for feeding a magnesium wire thereinto and through the remaining sections, an inert gas orifice and a pressure relief valve located in the first tubular section, means arranged on the elbow for preheating the wire to facilitate its traversing the angle between the adjacent sections, and heat dissipating means arranged on the last tubular section.

6. A vaporizer for inoculating metal which comprises a tubular guide having an inlet end and a discharge end adapted to be submerged in a body of molten metal to be inoculated, means for feeding a wire of inoculating material through the guide to be vaporized by the heat of the molten metal for infusion therewith, means for maintaining throughout the length of the guide an inert gas under sufficient pressure during the feeding of the inoculating material to prevent backflow of vaporized inoculating material into the guide, and means within the tubular guide medially of its end for preheating the wire to facilitate its advance through the guide.

7. A vaporizer for inoculating metal which comprises a tubular guide having an inlet end and an outlet end provided with a nozzle arranged to be submerged in molten metal, a valve-seal arranged at the inlet end of the guide, means for feeding a wire of inoculating material through the guide to be vaporized by the heat of the molten metal for infusion therewith, means for maintaining throughout the length of the guide an inert gas under sufficient pressure during the feeding of the inoculating wire to prevent back-flow of vaporized inoculating material into the guide, and means within the tubular guide medially of its end for preheating the wire to facilitate its advance through the guide.

8. A vaporizer for introducing magnesium into molten metal which comprises a guide having interconnected tubular sections disposed angularly of each other, one end of the guide being adapted for submergence in a body of molten metal, means for advancing through the guide a magnesium wire to be vaporized by the heat of the molten metal for infusion therewith, and other means for preheating the wire adjacent the point of angular connection between the guide sections to facilitate advance of the wire through the guide past the angular connection point.

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