May 6, 1952 H. A. REECE 2,595,292

METHOD OF ADDING ALLOYS TO METALS

Filed Oct. 5, 1949

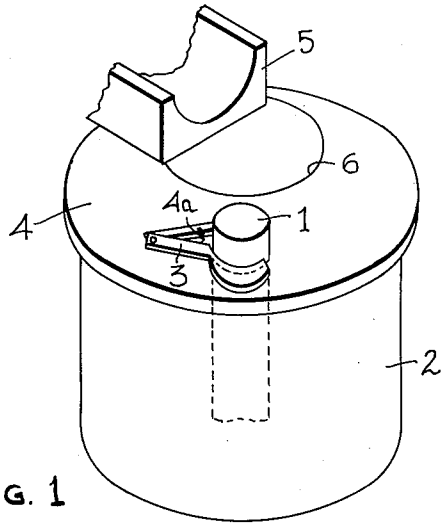


FIG. 1

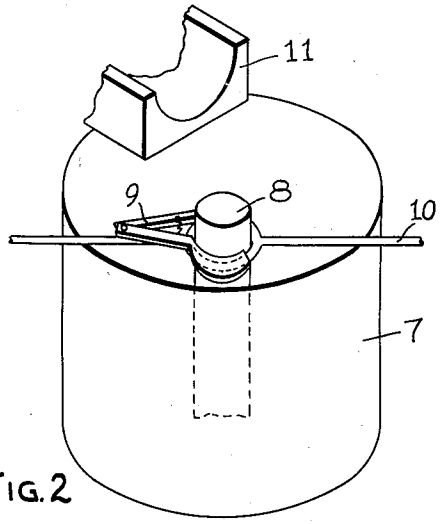


FIG. 2

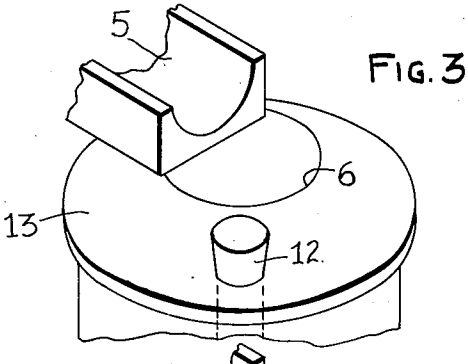


FIG. 3

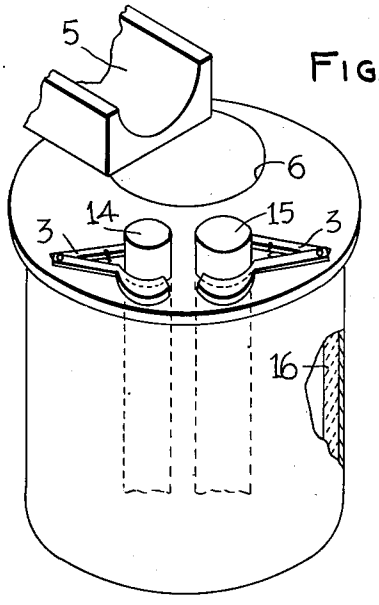


FIG. 4

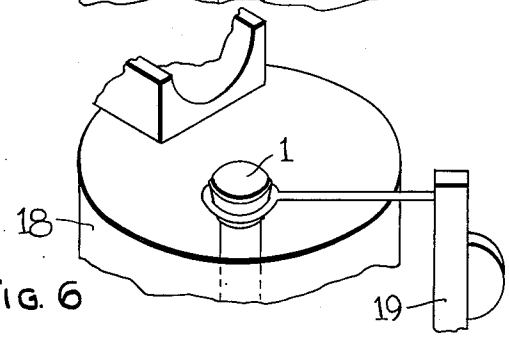


FIG. 6

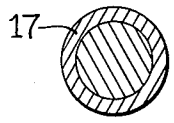


FIG. 5

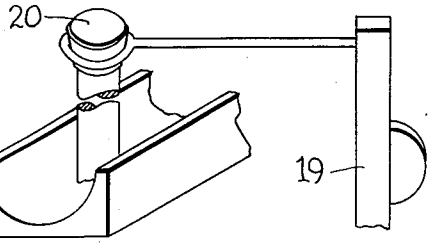


FIG. 7

INVENTOR.
HERBERT A. REECE
BY
William Seler
ATTORNEY

Patented May 6, 1952

2,595,292

UNITED STATES PATENT OFFICE

2,595,292

METHOD OF ADDING ALLOYS TO METALS

Herbert A. Reece, Cleveland Heights, Ohio

Application October 5, 1949, Serial No. 119,659

5 Claims. (Cl. 75—122)

1

This invention relates, as indicated, to methods of adding alloys or alloying constituents to molten metals.

It has heretofore been more or less standard practice, in adding alloys or alloying constituents to molten metals, to add the alloy or alloying constituent either in the form of a crushed material to the ladle containing the molten metal or to the spout through which the molten metal flows, or in the form of an atomized material by vibrating or rotor machine to the ladle or spout.

The aforesaid methods are characterized by a number of disadvantages or deficiencies, among which the following may be enumerated:

1. They involve crushing of the alloys or alloying ingredients, which is somewhat costly.

2. The crushed or atomized materials may become oxidized in the presence of oxygen, thereby introducing undesirable contaminants into the molten metal.

3. The oxides thus formed contaminate the ladle sides and spout.

4. The spout, in some cases, needs to be mechanized, in order to minimize the danger of oxidation.

5. Light volatile alloys, such, for example, as those of magnesium and calcium, tend to float on the molten metal, become oxidized and form slag coatings which prevent incorporation of the alloys in the molten metal.

I have discovered, as the result of considerable research, that all or many of the aforesaid disadvantages and deficiencies can be obviated or minimized by adding the alloys or alloying constituents to the molten metal in the form of a rod or stick.

The addition of the alloy in such form may be accomplished in various ways, several of which are illustrated more or less diagrammatically in the accompanying drawing, forming a part of this specification.

In Fig. 1, the alloy, in the form of a rod 1, is held in the ladle 2, by means of a clamp 3, which rests on the cover 4 of the ladle. The upper end of the rod extends through a small opening in the cover 4, but the annular opening about the rod is substantially closed or covered by the clamp. The clamp comprises pivotally connected jaws, which are resiliently urged into clamping engagement with the upper end of the rod by means of an extension coil spring 4a. The molten metal, in which the alloy is to be incorporated, flows down the trough or spout 5 and into the ladle through an opening 6 provided in the cover directly below the end of the spout. The flow of

2

molten metal into the ladle is accomplished in such a manner as to avoid impingement of the stream of metal against the rod. As the molten metal rises in the ladle, it melts the rod 1 progressively from the lower end upwardly. The percentage or amount of alloy thus incorporated in the molten metal can be controlled by the thickness of the rod.

By introducing the alloy into the molten metal in the aforesaid form and manner, the alloy is virtually completely protected from oxidation, the formation of slag coverings is largely avoided, uniformity of absorption of the alloy in the molten metal is insured, a uniform dissolution rate is obtained (the alloy dissolving in a ratio directly proportional to the rate at which the ladle is filled), and contact of the alloy with the total amount of metal in the ladle is assured. The method, moreover, is more economical from every standpoint than existing methods, since the alloys can be cast or extruded economically in rod or stick form, and do not require crushing or comminuting in any way. Furthermore, the alloy, being in the form of a solid rod, is less likely to be oxidized, even if exposed, than if in crushed or pulverized form.

If desired, the alloy rod, as shown in Fig. 1, may be immersed in the molten metal in the ladle after the ladle has been filled, with substantially the same results and advantages.

In Fig. 2, the ladle 7 is not provided with a cover, but instead, the alloy rod 8 is clamped at its upper end in a clamp 9, which is supported by a handle 10, which rests on the upper edge of a ladle. The molten metal flows into the ladle from the trough 11, and the rod is melted by such metal as the latter fills the ladle, as in Fig. 1. Due to the absence of a cover on the ladle, the possibilities of oxidation of the alloy rod and of formation of a slag coating are slightly greater than in Fig. 1, but are nevertheless not substantial.

In Fig. 3, the arrangement is similar to that shown in Fig. 1, but in this case, the upper end of the alloy rod 12 has a slight taper and is frictionally supported in an opening in the cover 13 of the ladle, thereby dispensing with the need for rod-supporting clamps.

In Fig. 4, an arrangement similar to that shown in Fig. 1 is employed, but in this case, rods 14 and 15 of different alloys are shown, which rods are simultaneously melted by the rising molten metal. The rods may be of different diameters, thereby controlling the relative proportions of alloying constituents in the final metal. The ladle, in this case, is shown as having a refractory lining

16. As an alternative to this, the weight per linear inch of the respective rods may be varied in proportion to the weight of molten metal poured into the ladle.

In cases where the alloy rod is made of a light, volatile alloy, which is readily oxidizable at high temperatures, the rod, as shown in Fig. 5, may be provided with a protective coating or plating 17 of a metal, such, for example, as chromium or other heat-resistant metal. As an alternative to such coating, the alloy, when cast, may be poured into a tube or pipe of iron or steel or the like, or may be poured into a non-metallic conduit, as for instance, a graphite cylinder, in either of which cases, the alloy will melt and flow downwardly into the ladle metal as the ladle fills. As a further modification of this procedure, the tube or cylinder into which the alloy is poured, may be pierced or slotted to permit the alloy to be fed into the metal progressively as the alloy is melted.

In Fig. 6, an arrangement is shown for gradually feeding the alloy rod 1 in to the ladle 18. For this purpose, a mechanism 19, similar to that employed for actuating the stopper of a conventional bottom tap mechanism, may be employed.

In Fig. 7, a modification of the invention is shown, in which the alloy rod 20 is progressively fed into the stream of molten metal as the latter flows down the trough 21, the rod being progressively melted by the flowing metal. For the purpose of thus progressively feeding the rod 20, a rack and gear mechanism may be employed. Rods of two or more different alloys may be fed in this manner, and the relative proportions of the alloying additions may be controlled as by using rods of different diameters, as shown in Fig. 4, or by feeding one of the rods at a greater rate of speed than the other.

In some cases, where the rod is susceptible of being melted at the molten metal line and thereby breaking off, it is desirable to taper the rod, so that its diameter gradually increases in an upwardly direction. This tends to draw the heat of the molten metal away from the rod at the metal line, thus preventing or minimizing the chances of such burning off of the rod.

Instead of feeding the alloy rod into a ladle or trough, it could be fed into a reaction chamber, such as a forehearth or the crucible of a cupola.

The methods are also adaptable for incorporating two or more alloys into molten metal, by the use of a single rod. For this purpose, one of the alloys may be cast around a solid alloy rod, and in some cases, a third alloy may be cast around the other two. This is of particular value in cases where fixed percentages of alloys are to be added to a molten metal in production work. It may also be valuable where the alloy needed in a molten metal and added in rod form requires a carrier to avoid violent reactions, or, in other cases, where the carrier would speed up the reaction.

The aforesaid methods are applicable to the incorporation of various types of alloys in molten iron and non-ferrous metals. Among such alloys are those of silicon, manganese, molybdenum, magnesium, calcium, titanium, nickel, chromium, vanadium, copper, etc. Graphite, boron, etc. may also be added to molten iron in this manner.

It is to be understood that various changes may be made in the steps and other details of the methods, as described, without departing from the scope of the invention.

Having thus described my invention, I claim:

1. The method of incorporating an alloying ingredient in a molten metal, said method comprising stationarily supporting the alloying ingredient, in the form of a rod or stick, substantially vertically in a ladle, and causing molten metal to flow into the ladle in a stream spaced laterally a substantial distance from said rod so as to avoid impingement of the stream of metal against the rod, whereby the rod is progressively melted from its lower end upwardly as the level of the molten metal rises in the ladle, and the alloying ingredient is uniformly distributed throughout the molten metal.

2. The method, as recited in claim 1, in which the rod is supported at a position adjacent one side of the ladle, and the molten metal is poured into the ladle at a position adjacent the opposite side of the ladle.

3. The method of incorporating a plurality of different alloying ingredients in a molten metal, said method comprising stationarily supporting the alloying ingredients, each in the form of a separate rod or stick spaced from the others, substantially vertically in a ladle, and causing molten metal to flow into the ladle in a stream spaced a substantial distance from said rods so as to avoid impingement of the stream of metal against the rods, whereby the rods are progressively melted from their lower ends upwardly as the level of the molten metal rises in the ladle, and the alloying ingredients are uniformly distributed throughout the molten metal.

4. The method, as recited in claim 3, in which the rods are supported at positions adjacent one side of the ladle, and the molten metal is poured into the ladle at a position adjacent the opposite side of the ladle.

5. The method, as defined in claim 3, in which the different rods are of different diameters, whereby different amounts of the alloying ingredients are incorporated in the molten metal in direct proportion to the diameter of the rods.

HERBERT A. REECE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
543,115	Uehling	July 23, 1895
1,166,167	Woods	Dec. 28, 1915
1,184,523	Field	May 23, 1916
1,298,229	Levy	Mar. 25, 1919
1,467,706	Vos	Oct. 2, 1923
1,596,888	Pacz	Mar. 24, 1926
2,085,802	Hardy	July 6, 1937

FOREIGN PATENTS

Number	Country	Date
2,252	Great Britain	of 1878