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W. T. BOLKCOM ET AL
ADDITIVES FOR MOLTEN METALS

3,079,250

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Fig. 1.

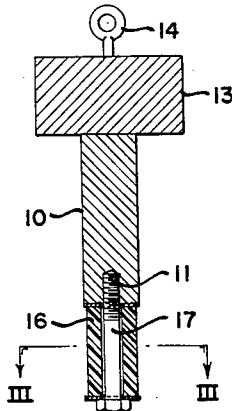


Fig. 2.

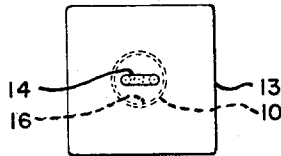


Fig. 3.

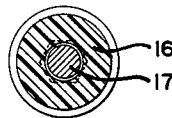


Fig. 4.

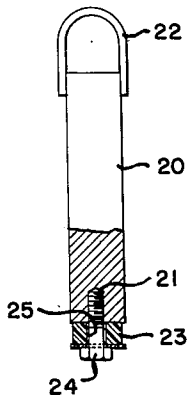


Fig. 5.

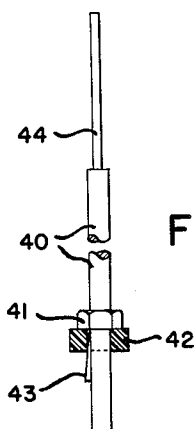
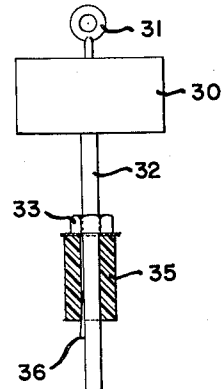


Fig. 6.

INVENTORS

Wilbur T. Bolkcom &
William E. Knapp

By *James Leonard & Paul*
this attorneys

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ADDITIVES FOR MOLTEN METALS

Wilbur T. Bolkcom and William E. Knapp, Allison Park, Pa. (both % American Metallurgical Products Co., P.O. Box 11068, Pittsburgh, Pa.)

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3 Claims. (Cl. 75-53)

This invention relates to additives and means for adding light-weight materials to metallic baths and particularly to means for adding fluorine containing organic compounds such as polytetrafluorethylene. This application is a continuation in part of our copending application Serial No. 632,110 filed January 2, 1957.

We have discovered that the addition of certain organic fluorides containing compounds is advantageous in the treatment of molten metals and particularly in the treatment of molten steel. One of the difficulties, however, in adding such fluorides containing organic compounds is the fact that the material is very light in weight and tends to float so that thorough dissemination of the material in the bath is difficult to obtain.

We have also discovered a means for assuring the dispersion of light weight materials such as fluoride containing organic compounds, e.g., polytetrafluorethylene and the like in the molten bath. In the preferred form of our invention we provide an elongated metallic member capable of extending to a point adjacent the bottom of the molten metal. An annular ring of fluoride containing organic material is attached to one end of the metal member so that when the metal member is lowered into the bath the annular ring of organic material precedes the metal member and is held beneath the surface of the bath by the weight of the metal member. Preferably the annular ring of organic material is attached by means of a bolt threaded into the end of the metal member. The metal member may have attached to the end opposite the annular ring of organic material an enlarged weighted portion which assures an increased load on the organic material to retain it beneath the surface of the molten mass. In the foregoing disclosure we have set out certain objects, purposes and advantages which will be apparent from a consideration of the following description and the accompanying drawings in which

FIGURE 1 is a section through a preferred form of our invention;

FIGURE 2 is a top plan view of the means illustrated in FIGURE 1;

FIGURE 3 is a section on the line 3-3 of FIGURE 1;

FIGURE 4 is a side elevation, partly in section of a second embodiment of the invention;

FIGURE 5 is a side elevation, partly in section of a third embodiment of the invention; and

FIGURE 6 is a side elevation partly in section of a fourth embodiment of the invention.

Referring to the drawings and particularly to FIGURES 1 through 3, we have illustrated an elongated body portion 10 having a threaded opening 11 at one end. An enlarged head portion 13 is attached to the member 11 at the end opposite the threaded opening. The enlarged portion 13 carries an eye bolt 14 by means of which the unit may be raised and lowered. An elongated annular ring of polytetrafluorethylene 16 is attached to the end of the member 10 opposite the enlarged portion 13 by means of a bolt 17 engaging the threaded opening 12.

In use the unit is lowered into a molten bath of metal to be treated so as to carry the annular ring of polytetrafluorethylene to or adjacent the bottom of the molten bath and to retain the unit in that position until the polytetrafluorethylene has been dissolved.

Referring to FIGURE 4, there is illustrated a second

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embodiment made up of an elongated cylinder 20 of steel having a threaded opening 21 in one end and a lifting loop 22 at the opposite end. An annular ring 23 of polytetrafluorethylene is held in position on the threaded end of the cylinder 20 by means of the bolt 24 passing through the cylindrical opening 25 in the ring of polytetrafluorethylene and into the threaded opening 21 in the cylinder of steel.

Referring to FIGURE 5, we have illustrated a third embodiment of this invention in which a head portion 30 of large mass is connected on an eye bolt 31. On the side of the mass 30 opposite the eye bolt there is provided an elongated rod 32 carrying a stop member 33 in the form of a nut intermediate its ends. One or more annular rings 35 of polytetrafluorethylene are slid onto the rod 32 until they contact the stop 33. A wedge 36 is fixed into the end of the lowermost ring 34 of polytetrafluorethylene to lock the ring in place on the rod.

Referring to FIGURE 6, we have illustrated a fourth embodiment of the invention made up of an elongated rod 40 having a stop 41 fixed thereto spaced from one end. One or more annular rings 42 of polytetrafluorethylene are slid on to the rod 40 until they contact the stop 41. A wedge 43 is fixed into the lowermost ring 42 to lock the ring on the rod. A reduced end portion 44 is provided to serve as a handle for immersing the rod into a molten bath of metal.

The elimination of impurities in the form of inclusions and dissolved materials has long been a problem in the metal industry. For example, the removal of gases such as hydrogen and the fluxing of inclusions causes heavy losses in metal production because of the necessity of removing and discarding large portions of ingots in order to eliminate these undesirable components. We have found that solid polytetrafluorethylene, preferably in amounts between about ½ oz. and 10 oz. per ton, may be used in molten metals for reducing the content of undesirable gases, increasing the fluidity of the molten mass, fluxing and eliminating both high and low melting point inclusions and improving the surface conditions of the resulting solidified metal. The subject of this invention can perhaps be best understood by reference to the following examples:

Example I

Molten steel was tapped into a pair of ladles in conventional manner. About 8 ozs. of polytetrafluorethylene per ton of steel was added in the form of rings in the manner illustrated in FIGURES 1 through 3 to one ladle. The steel was turned into molds in the usual manner. Ingots from each of the two ladles were compared. The ingot treated with polytetrafluorethylene according to this example had much less by way of inclusions of particularly aluminate and titanate than the untreated steel and the yield was approximately 20% greater.

Example II

Steel was poured into uncoated open ingot molds. Annular rings of polytetrafluorethylene supplemented with additions of small pebbles of polytetrafluorethylene, were added to one mold periodically during pouring for a total of about 6 ozs. per ton of steel. Tests of the treated ingot compared with the conventional untreated ingots showed a marked reduction in aluminate and titanate inclusions as well as in hydrogen and the yield was about 60% as compared with 45% for the conventional ingots.

Example III

A 90% copper, 10% aluminum Phosphor bronze was treated by adding about 4 ozs. of solid polytetrafluorethylene per ton of metal in the mold during pouring. Normally this grade of bronze is very deleteriously affected

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by hydrogen. The treated ingot contained only 3 parts per million of hydrogen, while the untreated contained 7 parts per million of hydrogen. The treated bronze was moreover denser and free from porosity as well as being more fluid than the untreated bronze.

We have found that the practice of our invention will reduce the hydrogen and oxygen, increase fluidity, increase yields and provide better surface conditions in steel in both hot and cold conditions. We have also found that the additive of our invention has particular advantage in the magnesium industry in promoting a finer and more consistently controlled grain size.

We believe that the surprising success of our treatment results from two types of effects: (1) Physical effects such as the replacement of oxygen by an active gas and increased fluidity or reduced surface tension so that high melting point inclusions levitate, and (2) Chemical effects such as reaction with and reduction in nitrogen, oxygen and hydrogen in the metal. These effects all appear to be supported by the physical indications and appearance of steel ingots. Successful treatment according to our invention is accompanied by extraordinary amounts of dirt, dross and like refuse coming to the top of the molten ingot, indicating that the polytetrafluorethylene has not simply formed a protective atmosphere but has entered into a chemical reaction with the oxygen, nitrogen and hydrogen carried from the furnace and otherwise forming undesirable inclusions in the steel. This is a highly desirable result, not achieved by merely casting in a protective atmosphere but achieved by the practice of our invention. Upon stripping the ingot will have an extraordinary smooth skin. Comparison of treated and untreated ingots shows a great difference in acid soluble and insoluble titanium, aluminum and zirconium. We accordingly believe that our theory is correct but do not wish to be bound thereby.

We have found that the use of polytetrafluorethylene as described herein will produce improved surfaces on metal ingots thus requiring less conditioning and better yields. We have also found that there is a very marked reduction in inclusions and in the elimination or control of hydrogen and oxygen.

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While we have set out certain preferred practices and materials according to our invention, it will be understood that the invention may be otherwise practiced within the scope of the following claims.

We claim:

1. A method of treating steel to improve fluidity and reduce inclusions comprising the steps of pouring the metal while molten into a receptacle, and adding to the molten metal while pouring about ½ oz. to about 10 oz. of solid polytetrafluorethylene per ton of steel.

2. A method of treating steel to improve fluidity and reduce inclusions comprising the steps of forming an annulus of solid polytetrafluorethylene, fixing the annulus on one end of an elongated metal member having a mass substantially sufficient to overcome the buoyancy of the organic annulus spaced from the annulus a distance such that the annulus may be inserted into the molten bath to any selected depth without the mass reaching the bath and introducing the end of the member containing the annulus into the molten metal bath to the desired depth and repeating said steps until about ½ oz. to about 10 oz. of polytetrafluorethylene per ton of steel has been introduced into the molten metal.

3. The method of treating steel to improve fluidity and reduce inclusions comprising the steps of forming an annulus of solid polytetrafluorethylene, fixing the annulus on one end of an elongated member, applying to said member a force sufficient to overcome the buoyancy of the organic annulus and introducing the end of the member containing the annulus into the molten metal bath to the desired depth under the influence of said force and repeating said steps until about ½ oz. to 10 oz. of polytetrafluorethylene per ton of steel has been introduced into the molten metal.

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