United States Patent Office 3,078,531 Patented Feb. 26, 1963

3,078,531

ADDITIVES FOR MOLTEN METALS

Wilbur T. Bolkcom and William E. Knapp, Allison Park, Pa., assignors to American Metallurgical Products Company, Pittsburgh, Pa.

No Drawing. Filed Oct. 5, 1960, Ser. No. 60,551
5 Claims. (Cl. 22—215)

This invention relates to additives for molten metals and particularly to additives and methods for making additions of organic fluorides to molten metals and is a continuation-in-part of our copending application Serial No. 632,005, filed January 2, 1957, now abandoned. 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 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

About three ounces per ton of small pebbles of polytetrafluorethylene were placed in the bottom of an uncoated ingot mold in four-ounce bags. A cover plate was fitted over the ingot mold to restrict the opening into the mold to a 6" diameter opening. Molten steel was teemed into the mold through the hole in the cover plate onto the pebbles of polytetrafluorethylene. Black smoke began to appear almost at once and continued as teeming progressed. When the black smoke appeared to be diminishing, additional pebbles of polytetrafluorethylene were added by throwing them in through the opening in the cover plate until a total of about five ounces per ton had been added. The resulting ingot was compared with a similar ingot poured in the usual fashion. The ingot treated according to the above described process had much less titanate and aluminate inclusion and yielded about 60% to 65% of the ingot as shippable quality as compared with about 45% for the conventional ingot.

Example II

Steel was poured into an uncoated ingot mold in the usual manner. During pouring annular rings of polytetrafluorethylene were added. The rings were added by means of a device such as that illustrated and described in our copending application Serial No. 632,110 filed January 2, 1957, now abandoned. An annular ring of polytetrafluorethylene is mounted on the end of a bar of steel by means of a bolt passing through the central opening of the ring and threadingly engaging the end of the steel bar. An enlarged steel portion is provided on the opposite end of the steel bar to add weight and stability to the unit so that the ring of polytetrafluorethylene may be satisfactorily positioned in the molten metal.

Example III

A Phosphor bronze containing 90% copper and 10% aluminum was treated with approximately 4 ounces of solid polytetrafluorethylene per ton of metal by adding to the mold into which the bronze was poured. In this particular metal the presence of hydrogen normally very seriously affects the flowability of the metal and creates porosity and sponginess of the metal. Such bronze without treatment contained 6 parts per ten thousand of hydrogen, after treatment the same bronze contained only 6 parts per million of hydrogen. The treated bronze was denser and free from porosity as well as being much more flowable 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 in the ingot mold by an active gas contained within the cover plate and the effect of gas escaping through the cover plate around the teemed stream of metal so as to form a protective shield while the metal travels between the ladle and the ingot 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.

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 metals to improve fluidity and reduce inclusions comprising the steps of teeming the molten metal in the usual manner through the atmosphere and free from previous inert gas and fluoride purge into a mold open to the atmosphere and free of inert gas cover through a restricted opening in the mold and adding to the metal during teeming in the mold about ½ oz. to about 8 oz. of solid polytetrafluorethylene per ton of metal.

2. A method of treating steel to improve fluidity and reduce inclusions comprising the steps of teeming the molten metal in the usual manner through the atmosphere and free from previous inert gas and fluoride purge into a mold open to the atmosphere and free of inert gas cover through a restricted opening in the mold and adding to the metal during teeming in the mold about 4 oz. of solid polytetrafluorethylene per ton of metal.

3. A method of treating metals to improve fluidity and reduce inclusions comprising the steps of teeming the molten metal into a mold in the usual manner through the atmosphere and free from previous inert gas and fluoride purge into a mold open to the atmosphere and

adding to the metal during teeming about ½ oz. to about 8 oz. of polytetrafluorethylene per ton of metal.

4. A method of treating metals to improve fluidity and reduce inclusions comprising the steps of teeming the molten metal in the usual manner through the atmosphere into a mold open to the atmosphere and containing about ½ oz. to about 8 oz. of solid polytetrafluorethylene per ton of metal whereby the solid polytetrafluorethylene is fused and gasified and reacts with inclusions in the metal to remove them as the metal is teemed.

5. A method of treating metals to improve fluidity and reduce inclusions comprising the steps of teeming the molten metal in the usual manner through the atmosphere into a mold open to the atmosphere and adding to the molten stream entering the mold about ½ oz. to 8 oz. of solid polytetrafluorethylene per ton of metal.

References Cited in the file of this patent

UNITED STATES PATENTS

963,973	Wright	July 12, 1910
1,998,467	Stroup	Apr. 23, 1935
2,056,234	Stroup	Oct. 6, 1936
2,770,860	Webbere	Nov. 20, 1956

FOREIGN PATENTS

168,831	Austria	Aug. 24, 1951
503,905	Belgium	June 30, 1951
345,047	Great Britain	Mar. 19, 1931
603,213	Great Britain	June 10, 1948
803,493	Great Britain	Oct. 29, 1958