UNITED STATES PATENT OFFICE.

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LINING FOR LADLES, CRUCIBLES, &c.

SPECIFICATION forming part of Letters Patent No. 620,310, dated February 28, 1899.

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To all whom it may concern:

Be it known that I, ROBERT A. HADFIELD, a subject of the Queen of Great Britain, residing at Sheffield, county of York, England, have invented an Improvement in Lining for Ladles, Crucibles, &c., of which the following is a specification.

Considerable difficulty is often experienced in the manufacture of manganese steel—by which I mean steel containing between four and thirty per cent. of manganese—by the rapid formation of slag in the ladle or other receptacle containing the molten metal. I have discovered that this slag, which forms in considerable quantity, is due to a reaction between the manganese of the steel and the silicious lining of the ladle or other vessel, a silicate of manganese resulting therefrom of a very thin and fluid character. This reaction occurs because of the large proportion of manganese which the metal contains. It generates quickly and continuously an abundance of slag which is so extremely quick-forming, thin, and liquid, and hence so elusive, that it can hardly be prevented from running along with the molten steel into the molds in which ingots or other castings are made. If this slag so flows into these molds, it thereby becomes a part of the ingots or other castings and constitutes a very objectionable defect therein. Furthermore, in producing manganese steel in ladles and other receptacles with the ordinary silicious lining the liquid manganese steel is continually reducing silicon from the lining at the expense of the manganese in the steel, so much so that a series of analyses of samples taken from time to time during the period consumed by casting a heat of manganese steel from a vessel having a silicious lining show a continual increase in silicon and a corresponding decrease in manganese. Obviously this is most undesirable, as uniformity of product in a single heat is impossible to attain.

In the course of my experiments to obviate the before-mentioned difficulty in the manufacture of articles—such as ingots, castings, or forgings—of manganese steel I have discovered that by the use of a lining of basic composition, as hereinafter described, for the ladles and other vessels employed to contain the molten metal during its production the difficulty is overcome and perfect castings of great uniformity can be obtained.

Though I do not restrict myself to any particular basic material or to any exact proportions of ingredients, I give as an illustration the following: I take a highly-calcined refractory material containing a high percentage of magnesia—say from seventy-five to eighty per cent.—preferably Styrian or Grecian (Isle d'Euboia) magnesia, and I grind it. To about ninety-two parts thereof, by weight, I add about eight parts, by weight, of a binding material, which will give to the mixture greater tenacity than is now usual in basic practice. They should then be very thoroughly mixed.

I preferably use silicate of alumina for the binder, preferably in the form of fat-clay, such as is well known in Sheffield, England, as "pot-clay," there used in the manufacture of crucibles or "pots," and consisting of a mixture of Stourbridge or other fire-clay, china-clay, and a small percentage of coke-dust. This material in small quantities and made of suitable consistency by the addition of water or other convenient medium gives an excellent binding character to the composition without objectionably interfering with its refractory nature, and it prevents almost entirely the formation of slag in a ladle or other vessel lined therewith.

While this hereinbefore-described mixture or lining is practically uninfluenced by the molten manganese steel, it is sufficiently plastic and clinging to adhere to the sides of large or small ladles, which is not true of either magnesia or calcined dolomite alone.

In place of magnesia well-calcined dolomite or even lime, preferably slightly hydraulic lime highly burnt, may be used.

Hydraulic and magnesian lime, especially if very highly fired, are preferable to common lime, because they are much less liable to air-slake.

Whatever base is used care should be taken to prevent its slaking by absorbing water and carbonic acid from the air.

If lime or dolomite rich in lime be used, it should be moistened with petroleum instead of water.

The basic lining which I have above described is better suited to my purpose than

those previously in use and which are of two classes—first, those which consist of magnesia or other base alone are too brittle for my purpose and they do not cling well to the walls of the ladle; second, those which consist of such base bound by means of a carbonaceous bond are objectionable, because the carbon thus present in the ladle-lining is liable to be absorbed by the steel and to alter its composition and properties to an indeterminate and most objectionable degree.

My lining may be applied to molds into which the molten steel is to be poured and is most refractory when so used.

While I have found that such a lining as I have described is particularly useful in the manufacture of manganese steel, it is obvious that its use is not restricted thereto, for it may be applied to ladles or other vessels for holding various kinds of steel—for instance, nickel-steel and chrome-steel.

In carrying out my invention the magnesia or other base need not be extremely pure, and the mixture is moistened only sufficiently for hand-lining, no ramming being necessary, as is practiced with basic linings at the present time.

Having fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. A basic lining for ladles, runners, and molds for casting steel, consisting of magnesia and pot-clay containing coke, substantially as described.

2. A basic lining material for ladles, runners and molds for casting manganese steel, consisting of about ninety-two parts by weight of calcined basic material, and about eight parts by weight of fat-clay, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ROBERT A. HADFIELD.

Witnesses:
GEO. W. WICKERSHAM,
A. W. ANDREWS.