

[54] METHOD AND APPARATUS FOR LADLE
ADDITIONS

[75] Inventors: George Rocher, Pittsburgh, Pa.;
Pierre Andre Vayda, Burlington,
Ontario, Canada

[73] Assignee: Metallurgical Exoproducts
Corporation, McKees Rocks, Pa.

[22] Filed: July 26, 1972

[21] Appl. No.: 275,184

[52] U.S. Cl. 266/34 T

[51] Int. Cl. C21c 7/04

[58] Field of Search
75/53-58; 266/34 A, 34 T, 34 R

[56] References Cited
UNITED STATES PATENTS

3,322,530 5/1967 Nakamura 75/53

1,876,732 9/1932 Neuhauss 266/34 T
2,915,386 12/1959 Strauss 266/34 T
2,988,444 6/1961 Hurum 266/34 T

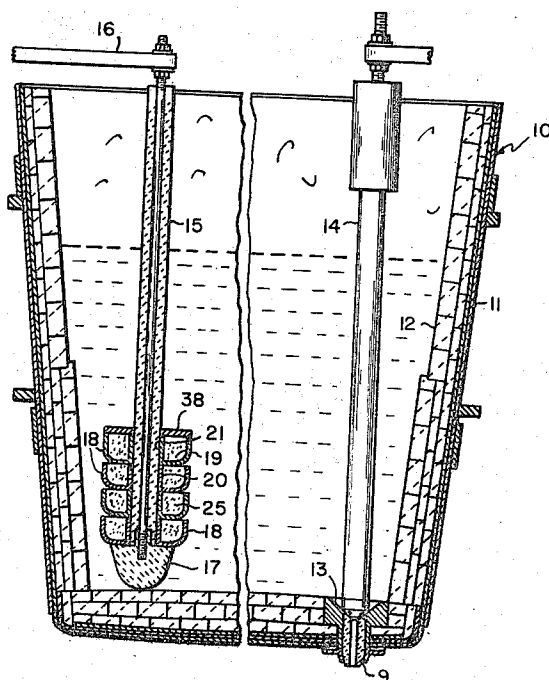
Primary Examiner—Gerald A. Dost

Attorney—John M. Webb

[57] ABSTRACT

A ladle for receiving molten metal is equipped with an elongated, refractory lined rod having an enlarged bottom portion and terminating at the lower end of the ladle. A plurality of stacked container means are positioned about the rod. These container means contain the desired addition agents. The molten metal is then teemed into the ladle and the container means and addition agents are consumed thereby.

7 Claims, 6 Drawing Figures



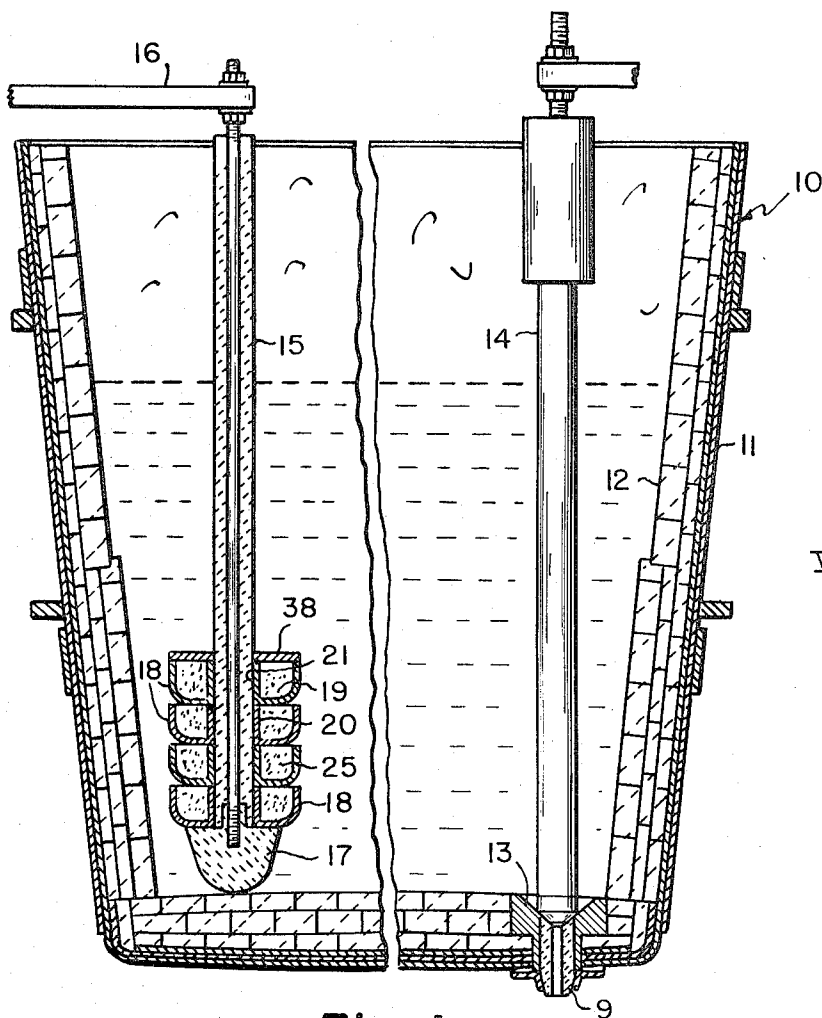


Fig. 1

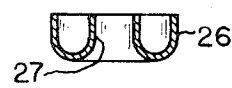


Fig. 4

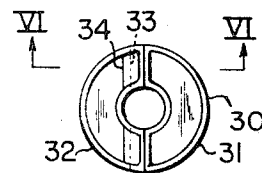


Fig. 5

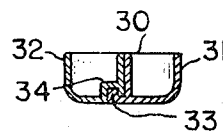


Fig. 6

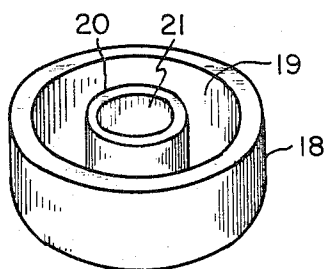


Fig. 2

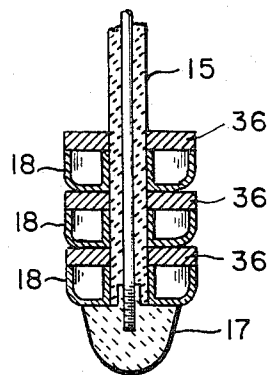


Fig. 3

METHOD AND APPARATUS FOR LADLE ADDITIONS

BACKGROUND OF THE INVENTION

Our invention relates to ladle additions and, more particularly, to ladle additions which have the effect of being made below the molten metal surface.

Despite the many advances in steelmaking and other metal refining processes, the methods of making alloying additions, deoxidizing additions or fluxing additions have remained stagnant. For all practical purposes, the desired additions are made in the traditional manner of dumping them into the tapping stream as the molten metal flows from the furnace or vessel into the ladle. This known procedure has many drawbacks, including low recoveries of addition agents which then increases the difficulty of operating within narrow compositional limits. In certain cases, there simply is not sufficient time to make the necessary additions in the prescribed order. Because of the turbulence and oxygen pickup associated with the tapping stream, highly oxidizable or toxic elements which are highly volatile are difficult to add. And since these additions are normally manually controlled, the time, amount and order of the addition varies from heat to heat. In addition, large ladle additions can drastically effect temperature control. Further, ladle additions cannot contain fines since they do not penetrate the molten metal, and thus do not go into solution.

SUMMARY OF THE INVENTION

By having the addition agent already in the ladle in the desired amount and order, substantially improved recoveries of the addition agent are obtained. In addition, the time, amount and order of the addition agent is no longer a variable and can be easily controlled. Highly oxidizable or toxic elements which are highly volatile can be employed with predictable recovery rates. Fines such as ferro alloy fines can now be utilized with the knowledge that they will go into solution. Fluxes can be employed to assist in removing the various oxide inclusions and with or without such fluxes, the subsurface inclusion frequency in the final product is reduced since there are less oxides formed during the ladle addition.

Our invention is a method and apparatus for making subsurface ladle additions in which container means are stacked within the ladle and are supported by an elongated, refractory lined rod. The container means contains the addition agent and the molten metal is tapped into the ladle after the ladle is so equipped.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a section through a ladle equipped with our device;

FIG. 2 is an isometric of a container;

FIG. 3 is a section showing layers of compacted fluxing agent interposed among the stack of containers;

FIG. 4 is a section showing a modified container shape and a container cover;

FIG. 5 is an elevation showing a two piece, interconnected container; and

FIG. 6 is a section taken along section lines VI—VI of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Our invention finds primary application in the steel industry because the traditional manner of adding the various addition agents to the tapping ladle is still employed. The following descriptions are thusly directed to steelmaking, but it will be recognized that the method and apparatus is similarly applicable to other metal refining processes as well.

The standard ladle 10 having a metal casing 11, a refractory lining 12, a bottom aperture 13 and a stopper rod 14 terminating in a stopper nozzle 9 is employed, FIG. 1.

A second refractory lined rod 15 is disposed downwardly into the ladle 10 from a standard goose neck support 16 which can be connected to the ladle itself or connected independent of the ladle. The refractory lined rod 15 extends to the lower portion of the ladle 10 and terminates in an enlarged, refractory section 17 to accommodate the various containers described hereinafter. The rod 15 normally will rest on the ladle bottom to minimize vibration.

A plurality of containers 18 are positioned on the rod 15 with the lowermost container 18 resting on the enlarged section of the stopper rod. These containers 18 are generally torus shaped and include an annular trough 19 which is open at the top surface and extends substantially downward to accommodate a substantial volume of addition agent 25, FIG. 2. The central portion 20 of the container 18 includes a central opening 21 which extends through the container and which slides over the rod 15.

The bottom surface of the container 18 is shaped to substantially conform with the shape of the upper surface of the container 18 so that when the containers are placed in stacked relationship on the rod 15, the bottom surface of a first container 18 shuts off the opening formed by the trough 19 of a lower adjacent container.

The shape of the container can vary and will be dictated by the particular application involved. The container 18 of FIGS. 1 and 3 is rounded only along the outer perimeter to maximize the volume of the trough 19, whereas the container 26 is more symmetrically formed with the central portion 27 also rounded to assist in the closing off of adjacent containers in the stacked condition, FIG. 4. The containers may also include a cover 38 which is illustrated only for the top container 18 in FIG. 1. This cover 38 then permits movement and shipment of the containers with the addition agent and the covers need not be removed when the containers are stacked on the rod.

The container 30 can also be in two hemispherical parts 31 and 32, one of which contains a tongue section 33 and the other which contains a mating groove section 34 so that the two parts 31 and 32 can be loaded with addition agent independently and then positioned about the rod 15 in assembled relationship, FIGS. 5 and 6.

The container is normally made of a mild steel which will readily melt as the molten steel is teemed into the ladle. The container may also be made of an addition agent, for example, an aluminum container.

The addition agent can be an alloy, a deoxidizer or a fluxing agent and the addition agent is merely placed in the containers 18 and then stacked in the desired order of addition along the support rod 15.

It is also possible to use layers of an addition agent interposed among the containers 18 which form the stack, FIG. 3. For example, where the container is aluminum or contains aluminum for the manufacture of killed steel, it may be desirable to interpose layers of compacted fluxing material 36 between the containers 18 so as to promote the elimination of the alumina or other oxides produced, FIG. 3.

A number of alloy additions can be made and the order of the particular addition can be easily controlled by the positioning of the particular addition in the row of containers which form the stack. For example, a highly oxidizable addition, such as boron, can be positioned in the top portion of the stack with the manganese and/or silicon additions being placed in the lower portion of the stack to protect the boron when it goes into solution.

In addition, toxic elements, such as lead and selenium, which are also highly volatile, may also be added with a far greater degree of predictability as to rate of recovery and with less fuming. Since there is far less turbulence in the area of the addition, less oxides will form and, therefore, not only will there be better recoveries of the addition agents, but there will be less sub-surface inclusions in the final product. For the same reason, fines such as ferro manganese fines or ferro silicon fines can be employed in the containers and they will go into solution rather than blowing off or staying on the top slag and never getting into solution.

We claim:

1. A ladle for making additions to molten metal including a refractory lined apertured ladle, means to open and close the aperture of said ladle; a refractory lined rod extending within the ladle and terminating in an enlarged section at the lower end of said ladle; a plurality of stacked container means positioned about said rod on said enlarged section; and an addition agent positioned in at least certain of said container means.

2. The ladle of claim 1, said container means being torus shaped and annularly troughed so that in the stacked position, the bottom of a first container means shuts off the opening defined by the trough of a lower adjacent container means.

3. The ladle of claim 1, said container means made of a metal having a melting point similar to the molten metal intended for said ladle.

4. The ladle of claim 1, said container means made of an addition agent different from said addition agent positioned in said container means.

5. The ladle of claim 1, wherein layers of an addition agent different from said addition agent being retained in said container means being alternately interposed between adjacent container means.

6. The ladle of claim 1, said container means including a first section and a second section, said sections being independent and having connecting means so as to interconnect in forming the container means.

7. The ladle of claim 1 including a cover positioned on each container means.

* * * * *

35

40

45

50

55

60

65