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Rocher

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[54] **PROTECTIVE ALLOY ADDITION APPARATUS**

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[52] **U.S. Cl.** ..... **266/34 T,** 75/53

[51] **Int. Cl.** **C21c 7/00**

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

[56] **References Cited**

UNITED STATES PATENTS

3,784,177 1/1974 Rocher et al. ..... 266/34 T

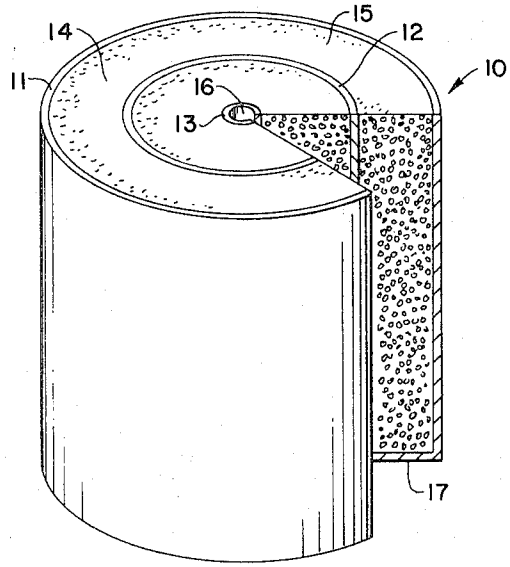
Primary Examiner—Gerald A. Dost

Attorney, Agent, or Firm—Webb, Burden, Robinson & Webb

[57] **ABSTRACT**

A protective alloy addition apparatus is suitable for installation on a refractory lined rod positioned in a pouring ladle. The apparatus comprises a base member adapted for positioning on the rod and an outer sleeve and inner concentric sleeve positioned on the base member so as to form a first chamber between the sleeves and a second chamber radially inward of the inner sleeve. A protecting first addition agent is positioned in the first chamber and an alloy addition agent to be protected is positioned in the second chamber. The addition agent to be protected is also topped and bottomed with the protecting addition agent in the second chamber.

10 Claims, 3 Drawing Figures



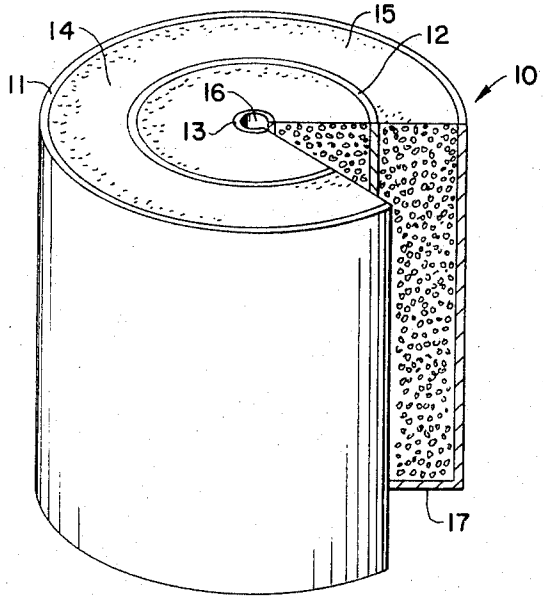


Fig. 1

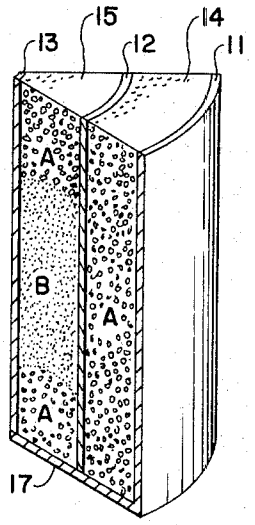


Fig. 1a

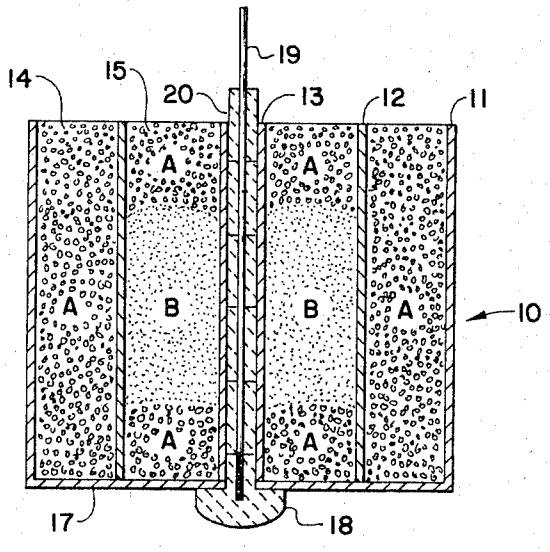


Fig. 2

PROTECTIVE ALLOY ADDITION APPARATUS

FIELD OF THE INVENTION

My invention relates to ladle addition apparatus normally used in the metals industry and, more particularly, to ladle addition apparatus in the steel industry which includes an addition agent to be protected and an encapsulating protecting addition agent.

DESCRIPTION OF THE PRIOR ART

In the manufacture of alloy steels and the like, alloying addition agents are often either readily oxidized, extremely expensive, highly toxic or readily volatilized. Because of any one or a combination of these factors, it is necessary to protect the addition agent so as to insure that it is properly dissolved into the metal bath with a predictable and favorable yield. The yield, normally given in per cent, is the amount of addition agent retained in the metal upon solidification divided by the amount originally added to the molten metal. Of course, the predictability of an alloying addition yield is essential to permit the metal producer to operate within narrow ranges of compositional values to achieve the precise properties and characteristics required in today's market. In copending application Ser. No. 275,184, filed July 26, 1972 and now U.S. Pat. No. 3,784,177, and Ser. No. 358,263, filed May 7, 1973 and now U.S. Pat. No. 3,809,380, of which I am a coinventor, there are disclosed novel apparatus for making ladle additions by positioning certain types of containers on a refractory lined rod in a ladle.

I have now found that I can add to the concepts disclosed in those applications and construct an alloy addition apparatus which will protect an addition agent to maximize yield and give reproducible recovery rates.

SUMMARY OF THE INVENTION

My invention is a ladle addition apparatus which comprises at least two concentric sleeves positioned on a base member adaptable to cooperate with a refractory lined rod in a ladle. The sleeves form an outer chamber and an inner chamber and the protecting addition agent is placed in the outer chamber. The addition agent to be protected is placed in the inner chamber and is topped and bottomed within the inner chamber by the protecting addition agent.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a broken away isometric of my ladle addition apparatus;

FIG. **1***a* is an isometric of the portion of the apparatus broken away in FIG. **1**; and

FIG. **2** is a section through my ladle addition apparatus in place on a refractory lined rod.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

My ladle addition apparatus has general application to the metals industry but has particular application to the steel industry where several of the alloying additions are added to a pouring ladle contemporaneously with the ladle being filled from the steelmaking furnace or vessel. The most common example of an addition agent which must be protected is an addition agent which has a greater affinity for oxygen than for iron and oxidizes readily to form oxides which float into the slag or get entrapped in the solidifying metal as an undesirable inclusion. My apparatus protects such an addition agent by means of a second addition agent which encapsulates the addition agent to be protected and, therefore, sacrificially combines with the oxygen in the immediate area of the addition to render a higher and more predictable yield to the addition agent being protected.

An apparatus to perform such a protective function is illustrated in FIGS. **1**, **1***a* and **2**. The structure, per se, generally designated **10**, includes an outer sleeve member **11** positioned on a base member **17** which base member includes a central opening. A second sleeve member **12** having a diameter substantially less than the diameter of outer sleeve **11** is concentrically positioned radially inward of outer sleeve **11** on base member **17** to form annular chamber **14** between the respective sleeves. A third sleeve **13** having a central opening **16** is positioned on base member **17** about the central opening thereof and accommodates the refractory lined rod **19**, illustrated in FIG. **2**. A chamber **15** is thusly formed radially inward of sleeve **12** and generally between sleeves **12** and **13**. Where the apparatus is constructed at the steelmaker's facility it is possible to eliminate inner sleeve **13** since a chamber could likewise be formed between inner sleeve **12** and the refractory lined rod **19** in the ladle.

The protecting addition agent A is positioned in the chamber **14** and the addition agent to be protected B is positioned in chamber **15**. Protecting addition agent A also is placed below and above addition agent B in chamber **15** to further encapsulate the addition agent B to be protected, FIG. **1**a.

The sleeves **11**, **12** and **13** are preferably made of thin sheet metal such as low carbon steel, but they can also be made of a further addition agent such as aluminum which becomes an alloying addition for the steel as well as a further protecting agent for the element to be protected B. The base member **17** is generally a thin metal plate which will support the weight of the sleeves and the various alloying additions employed.

The apparatus **10** is positioned in a ladle on a refractory lined rod **19**, FIG. **2**. Rod **19** normally terminates in an enlarged refractory section **18** and a plurality of refractory sleeves **20** are positioned in end to end relationship about rod **19** to protect it from the molten metal. Rod **19** can be the actual stopper rod employed to teem the ladle or can be a separate rod extending into the ladle and held in place by support means as disclosed in my copending applications referred to hereinabove.

Three heats of alloy steel were manufactured employing my ladle addition apparatus and the yield results compared with yields obtained from standard steelmaking practice. My apparatus was employed using a standard zirconium alloy as the addition agent to be protected and a protecting addition agent of standard ferrosilicon. The ferrosilicon was placed in the outer chamber **14** and the ferrosilicon also was used to top and bottom the zirconium alloy in the inner chamber **15**. The entire assembly **10** was placed on a separate refractory lined rod in the ladle prior to tapping the furnace thereinto. The sleeves were made of thin gauge low carbon sheet steel. The ferrosilicon reacted with the available oxygen in the area of the apparatus **10** and the resultant recovery of the zirconium in the three heats was 50 percent higher than the standard

yield obtained from adding the zirconium alloy in the standard way.

I claim:

1. A ladle addition apparatus suitable for installation on a refractory lined rod positioned in a ladle comprising a base member adapted for positioning on the rod, outer and inner concentric members positioned on the base member and forming a first chamber between the outer and inner members and a second chamber radially inward of the inner member, a protecting first addition agent positioned in the first chamber and a second addition agent to be protected positioned in the second chamber.

2. The apparatus of claim **1** wherein the outer and inner members comprise sleeves.

3. The apparatus of claim **1,** the second addition agent being topped and bottomed by the first addition agent positioned on the base member and atop the second addition agent.

4. The apparatus of claim **2** including a second inner sleeve adapted to cooperate with the rod and to form the second chamber between the inner sleeve and the second inner sleeve.

5. The apparatus of claim **2,** said sleeves being metal.

6. The apparatus of claim **2,** the second addition agent being a zirconium additive and the first addition agent being a ferrosilicon additive.

7. The apparatus of claim **5,** said metal sleeve being one of low carbon steel or aluminum.

8. In combination with a ladle having a refractory lined rod terminating in an enlarged section and extending thereinto, a ladle addition apparatus comprising a base member positioned about the rod on the enlarged section, an outer sleeve positioned on the base member, a concentric inner sleeve positioned on the base member forming a first chamber between said sleeves and a second chamber radially inward of the inner sleeve, a first protecting addition agent positioned in the first chamber, a second addition agent to be protected positioned in the second chamber.

9. The combination of claim **8** wherein an amount of first addition agent is positioned between the second addition agent and the base member and atop the second addition agent in the second chamber.

10. The combination of claim **8** including a second inner sleeve positioned in the base member and about the rod to form the second chamber between the inner sleeve and the second inner sleeve.

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