Dec. 8, 1953 J. K. STONE, JR 2,662,008

DEVICE FOR PROGRESSIVELY RELEASING A REAGENT IN A BATH OF MOLTEN METAL

Filed Aug. 17, 1950

FIG. 1.

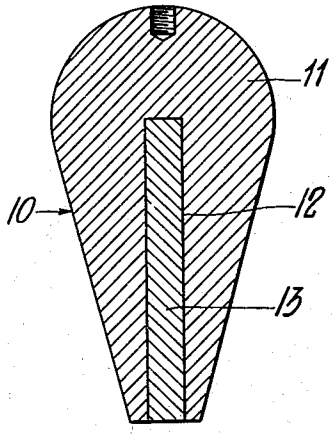


FIG. 2.

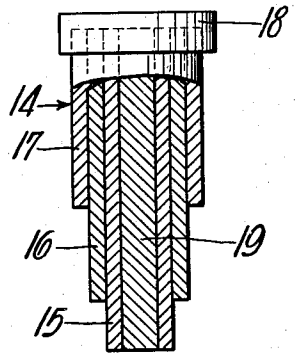
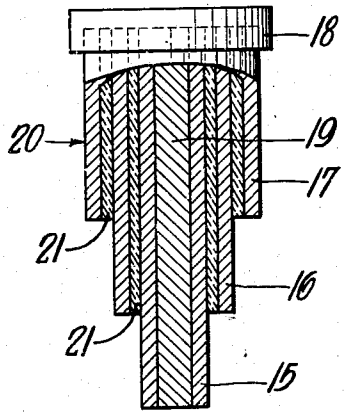


FIG. 3.



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DEVICE FOR PROGRESSIVELY RELEASING A REAGENT IN A BATH OF MOLTEN METAL

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5 Claims. (Cl. 75—93)

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This invention relates to the refining of metal and, in particular, to a device for introducing a deoxidizing, desulphurizing or fluxing element or alloy into a bath of molten metal such as steel.

The principal object of this invention is to provide a device for gradually vaporizing a reagent metal or compound introduced into molten steel, and releasing it at a controllable rate. In this respect the invention differs from the conventional practice in which a mass of a substance introduced into molten metal loosely is allowed to evaporate at an uncontrolled rate by direct contact with the metal.

The range of materials useful in the last stages of the refining of steel is limited by the physical characteristics required of an agent added to the molten metal in a ladle, for example. That is to say, such an agent must have a specific gravity high enough to sink in the metal or be soluble in iron so it can be added to a stream of molten steel. Preferably the agent should ascend slowly from the bottom of the bath as it is dissolved or vaporized. Certain elements such as those of groups II and III of the periodic system, of which magnesium is typical, lack the necessary characteristics and have others which entirely preclude their use for the purpose stated. As a result, such elements float on the surface of the bath and are consumed by oxidation or reaction with the slag. If an attempt is made to add large masses to the bath, the rapid vaporization thereof becomes almost explosive and the vapor escapes rapidly instead of dissolving in the bath or combining with the oxides, sulphides or other impurities.

I have invented a novel device for releasing a metallurgical reagent gradually within a bath of molten metal over a predetermined period of time. In a preferred embodiment, I provide an elongated metal capsule adapted to hold a charge of the reagent, and having walls of such character that, when the device is immersed in a bath of molten metal, the heating of the charge from the bath will progress longitudinally, thereby effecting a gradual vaporization. The capsule may take any one of several forms but in all cases has a wall affording a resistance to lateral heat flow which varies along the length of the capsule, and a cavity for the charge extending inwardly from the end at which the resistance of the wall to heat flow is a minimum.

A complete understanding of the invention may be obtained from the following detailed description and explanation which refer to the accompanying drawings illustrating several different forms of the device. In the drawings,

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Figure 1 is an axial section through a unitary device conical in shape;

Figure 2 is a similar view of modification which is a built-up tubular device; and

Figure 3 is a similar view showing a modification of Figure 2.

Referring in detail to the drawings and, for the present, to Figure 1, the capsule 10 there shown is a frusto-conical mass of steel having a hemisphere 11 at the larger end, a bore 12 extends axially inward from the smaller end and contains a charge 13 of magnesium, for example. When the capsule is dropped in a ladle of molten steel, the portion of the magnesium adjacent the open end of the bore is first vaporized. Additional increments of the length of the charge are vaporized later as the heat of the bath penetrates the thickness of the wall of the capsule. Since this thickness increases progressively from the open end of the bore toward the closed end, the vaporization will occur progressively over a period of time and the vapors released will ascend slowly through the bath in the form of bubbles, affording a good opportunity for the desired reaction to take place.

Figure 2 shows a capsule 14 composed of a plurality of tubes 15, 16 and 17 of successively decreasing length, telescoped snugly together, all the tubes being co-terminous at one end and thus providing a wall which increases in thickness by steps from the small end toward the large end. A cap 18 is fitted on the latter and a charge 19 of reagent is placed in the innermost tube 15. This form of the device operates in substantially the same way as that shown in Figure 1.

Figure 3 shows a slight modification of Figure 2 according to which capsule 20 has thermal insulating sleeves 21 disposed between adjacent tubes 15, 16 and 17 to delay the flow of heat radially through the composite wall of the capsule.

It will be understood that the rate of effusion of vaporized reagent may be controlled by varying the taper of the capsule 10 or the rate of change of wall thickness of capsules 14 and 20. In using any of the forms of the invention, a progressive volatilization of the charge occurs in a direction axially thereof, in contrast to the immediate or wholesale volatilization of the entire mass such as occurs when the reagent is simply dumped into the bath.

For convenience in handling, the capsule in any of the forms disclosed may be mounted on

the end of a long manipulating rod of suitable metal in any convenient manner. The capsule of Figure 1, for example, has a tapped hole at its larger end adapted to receive the end of such rod which is correspondingly threaded. The other forms of capsules may be welded to the end of a metal manipulating rod without threads.

I claim:

1. A device for gradually releasing a reagent in a bath of molten metal comprising an elongated metal capsule having a length several times its diameter and an axial bore of a uniform diameter and a length several times its diameter, said bore extending inwardly from one end of the capsule and terminating short of the other end, the wall of the capsule increasing in thickness from said one end toward the other end, and a charge of reagent in said bore.

2. A device as defined by claim 1 characterized by said capsule tapering toward said one end.

3. A device as defined by claim 1 characterized by the wall of said capsule increasing in thickness by steps at intervals.

4. A device as defined by claim 3 characterized by said capsule being composed of a plurality of telescoped coaxial tubes of increasing length going from the exterior to the interior.

5. A device as defined by claim 4 characterized by a sleeve of thermal insulation between adjacent tubes.

JOSEPH K. STONE, JR.

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