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S. TOUR

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CARTRIDGE FOR BELOW-SURFACE TREATMENT OF MOLTEN METALS

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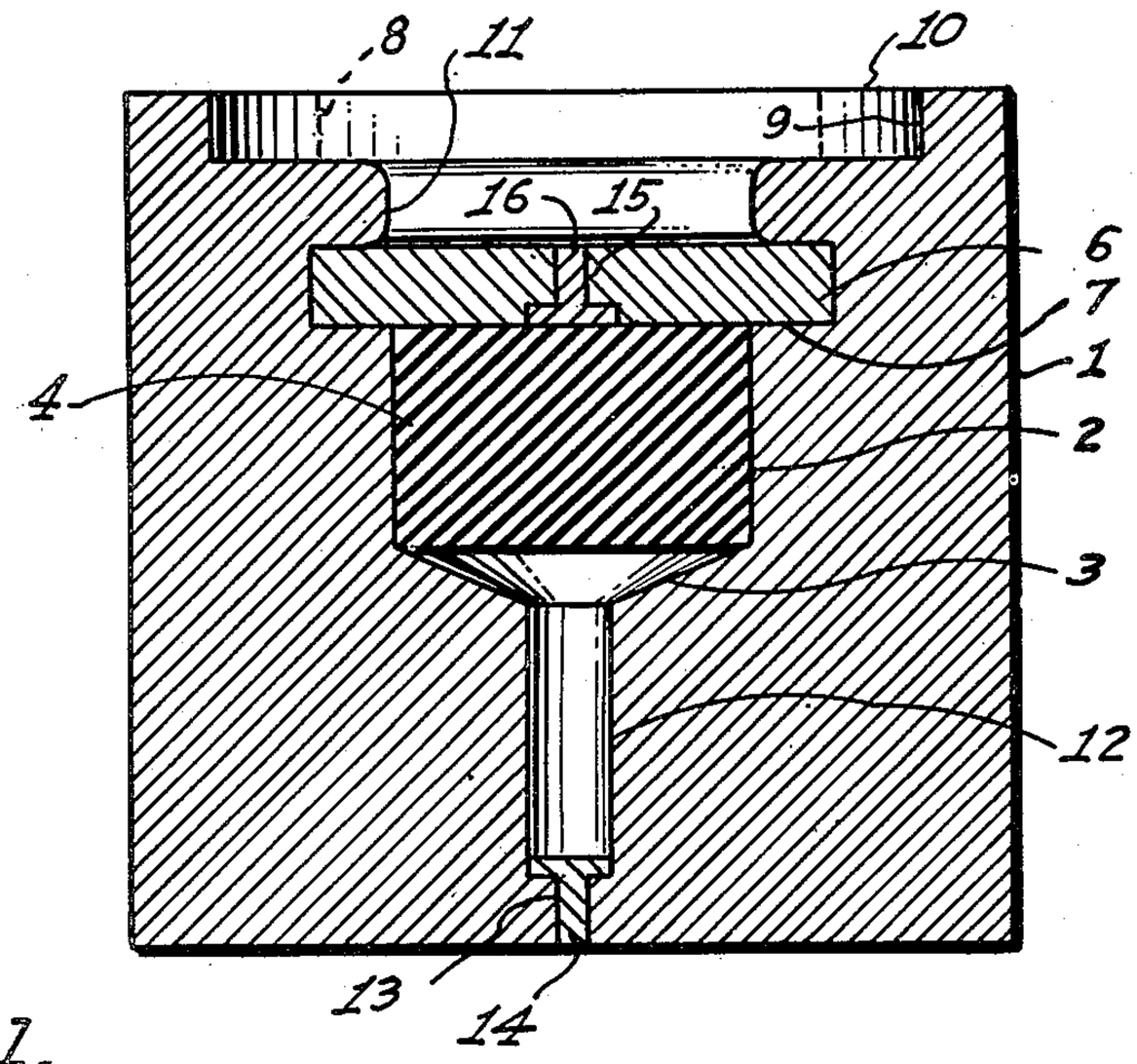

Fig. 1.

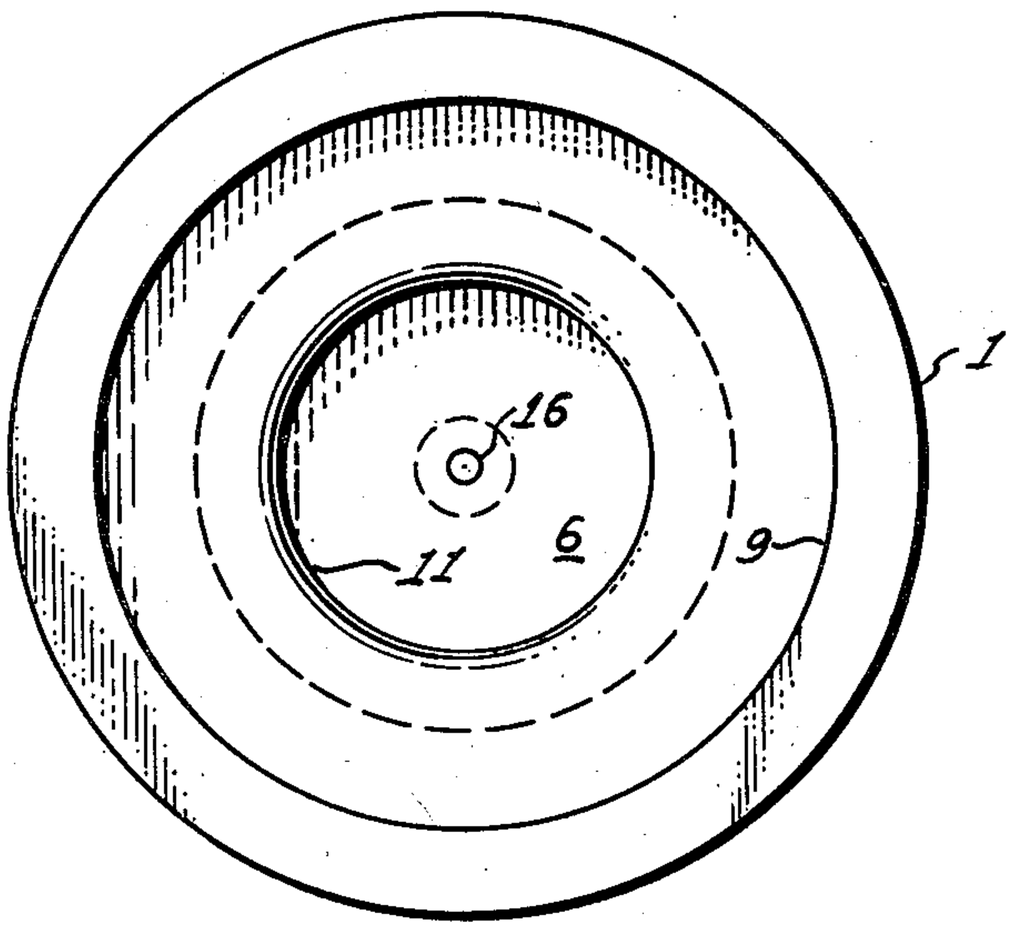

Fig. 2.

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CARTRIDGE FOR BELOW-SURFACE TREATMENT OF MOLTEN METALS

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6 Claims. (Cl. 75—93)

1

This invention relates to new and useful improvements in the below-surface treatment of molten metals. This application is a continuation-in-part of my prior application, Serial No. 765,751, filed August 2, 1947 now Patent No. 2,550,735, issued May 1, 1951.

In the conventional purification of molten metals such as degasification, elimination of stable oxides, desulfurization and dephosphorization, various additive metals are used, including the alkali and alkaline earth metals, with melting points, boiling points and specific gravities as shown in the following table:

Table

	M. P.	B. P.	Sp. Gr.
	° C.	° C.	
Barium	850	1,140	3.5
Calcium	810	1,240	1.54
Lithium	186	1,609±5	.534
Magnesium	651	1,110	1.74
Potassium	62.3	760	.86
Sodium	97.5	880	.971
Strontium	752	1,150	2.6

The difficulty in introducing purifying additives of lower specific gravity and with boiling points lower than the temperature of the molten metal to be treated, has been of long standing and up to now efficient ways of adding these additives have not been found.

One of the difficulties resides in the fact that the additive material being lighter (at the bath temperature) than the molten metal to be treated, will remain on the surface of the bath and therefore will not reach the bulk of the material to be treated.

Attempts have been made to remedy this by securing the additive to the end of a rod and plunging it into the molten metal, thus pushing it underneath the surface thereof. This is extremely hazardous, particularly when the additive is one of high reactivity.

Alternatively, cored solid pieces of metal basically of the composition of the molten metal bath, and in which the cores are composed of the additive, have been used. In this case, the composite is selected sufficiently heavy to initially sink below the surface of the metal bath in the hope that it will there release the treating agent. This desideratum is not achieved. If the cored piece is open to the outside, such as an open ended tube, the major portion of the charge will have to be released by the time the piece has sunk an appreciable depth. If the cored piece is substantially closed, such as a tube with crimped or plugged ends, in which case dissolution of the body of the piece by the molten metal bath is relied upon for release of the charge, such release is effected substantially at the surface of the bath, since as the body of the composite is dissolved away by the molten metal bath, the ratio of core cavity to body of the composite reaches a point at which sinking takes place no longer. As more of the body is dissolved away, the composite rises towards the surface of the molten metal bath and by the time that sufficient of the body has been dissolved away to expose the additive, the cartridge will have risen to substantially the bath surface.

2

One object of the instant invention comprises, inter alia, an improved cartridge capable of discharging or exposing an additive at an effective treating level below the surface of a molten metal bath.

The invention will be fully understood from the following description read in conjunction with the drawings in which:

Fig. 1 is a vertical section through an embodiment of my invention; and

Fig. 2 is a top view of the construction shown in Fig. 1.

Referring to the drawings 1 represents the body of the treating cartridge, which may be of any desired form. The preferred form is substantially cylindrical. A centrally located core cavity 2 of circular cross-section is provided. The conical base 3 of the core cavity may constitute as much as 10% of the volume of the cavity 2. Cavity 2 is filled with a quantity of the alkali or alkaline earth metal to be used as treating agent. This is preferably introduced in the form of a solid plug 4, filling or substantially filling the cavity 2 while leaving the conical base 3 empty to allow for the higher coefficient of expansion of the additive metal.

After this addition a pressure-retaining metal disc 6 is placed in the position shown on seat 7, at which time the metal of which the upper part of the cartridge is composed, is in the form shown in dotted outline 8 (Fig. 1), following which a suitable tool, such as a punch of an outside diameter equal to that of the recess 9, is forced into the top 10 of the cartridge, thereby forming from the sides of the recess the sealing ring 11 of displaced metal bearing on disc 6.

The conical base 3 terminates in tubular duct 12, which in turn connects with orifice 13. Duct 12 and orifice 13 together form an aperture extending between cavity 2 and the outside of the cartridge 1. Orifice 13 is closed by a plug 14 of fusible material, preferably metal, having a melting point above the melting point of the additive metal and preferably below the boiling point of the same. The fusible plug is adapted to release the additive metal as soon as the cartridge arrives at a temperature predetermined by the

material of which the plug is composed, before the mass density of the cartridge as a whole has undergone any marked reduction due to the dissolving away of its exterior or due to its reaching a temperature approximately that of the liquid metal to be treated, and before the boiling of the additive metal can create an internal pressure which may burst the cartridge with explosive violence.

Inasmuch as there may be conditions within the charge to be treated which will operate against the uniform heating of the cartridge or which, if the cartridge lands on the bottom with the orifice 13 downwardly, might cause the cartridge to be propelled back to the surface of the melt by rocket effect, I find it advisable to provide a second fusible plug located substantially opposite the first, and for this purpose I preferably form within the disc 6 the aperture 15, which is also closed by a fusible plug 16 of fusible material, preferably of metal, having a melting point above the melting point of the additive metal charge and preferably below the boiling point of the same.

In actual practice in treating iron or steel the cartridge and disc will be formed of steel; if the additive metal is an alkali metal, the fusible plugs 14 and 16 may be formed of aluminum, and if the additive metal is an alkaline earth metal, the fusible plugs 14 and 16 may be formed of copper. In actual practice when treating a charge of molten copper, the cartridge and disc will be formed of copper; if the additive metal is an alkali metal the fusible plugs 14 and 16 may be formed of aluminum, and if the additive metal is an alkaline earth metal, the fusible plugs 14 and 16 may be formed of a brass having a melting point above that of the alkaline earth metal and below that of copper.

In either case the additive metal will release itself uniformly and harmlessly at a point adjacent the bottom of the charge, so that its full chemical effect is realized.

In order to assure that the treating cartridge and contents will have a specific gravity substantially in excess of that of the material of the liquid metal to be treated, and will therefore sink to the bottom before discharging its contents, the percentage volume of its core cavity, meaning thereby both the space occupied by the plug of additive metal together with the expansion space, should be less than substantially

$$\frac{d_s - d_e}{d_e} \times 100$$

in which d_s is the specific gravity of the metal of said cartridge when solid and d_e the specific gravity of the metal of said cartridge at its freezing point when molten.

The foregoing specific description is for purposes of illustration and not of limitation and it is therefore my intention that the invention be limited only by the appended claims or their equivalents wherein I have endeavored to claim broadly all inherent novelty.

I claim:

1. A cartridge for the treatment of a molten metal with a relatively small amount of an additive metal selected from the group consisting of the alkali and alkaline earth metals, consisting of a metal container defining and completely enveloping a cavity, a charge of said additive metal within said cavity, the weight of the container and charge exceeding the weight of a corresponding volume in liquid state of the metal of which the container is composed, the wall of said container defining an aperture extending between said cavity and the outside of said container, and at least one plug of fusible material of relatively small size in comparison with the size of said metal container blocking said aperture, the size of said plug being so limited that its fusion and removal will not reduce the weight of the cartridge below the weight of a corresponding volume in liquid state of the metal of which the container is composed said plug having a melting point above that of said additive metal and below that of the metal of which said container is composed and below the boiling point of said additive metal.

2. A cartridge according to claim 1 in which said container is composed of iron, said additive metal is an alkali metal and said plug of fusible material is aluminum.

3. A cartridge according to claim 1 in which said container is composed of iron, said additive metal is an alkaline earth metal and said plug of fusible material is copper.

4. A cartridge according to claim 1 in which said container is composed of copper, said additive metal is an alkali metal and said plug of fusible material is aluminum.

5. A cartridge according to claim 1 in which said container is composed of copper, said additive metal is an alkaline earth metal and said plug of fusible material is brass.

6. A cartridge for the treatment of a molten metal with a relatively small amount of an additive metal selected from the group consisting of the alkali and alkaline earth metals, consisting of a metal container defining and completely enveloping a cavity, a charge of said additive metal within said cavity, the weight of the container and charge exceeding the weight of a corresponding volume in liquid state of the metal of which the container is composed, the wall of said container defining a first aperture extending from said cavity to the outer surface of said container, a second aperture substantially opposite said first aperture extending from said cavity to the outer surface of said container, and a plug of fusible material of relatively small size in comparison with the size of said metal container blocking each said aperture, the size of said plugs being so limited that their fusion and removal will not reduce the weight of the cartridge below the weight of a corresponding volume in liquid state of the metal of which the container is composed said plug having a melting point above that of said additive metal and below that of the metal of which said container is composed and below the boiling point of said additive metal.

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