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PROCESS FOR CASTING METALS INTO ASBESTOS-CONTAINING MOLD COATING

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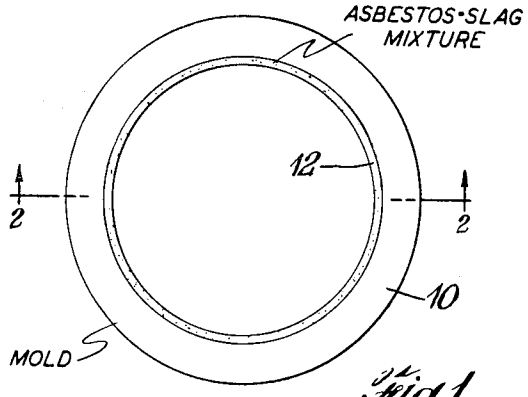


Fig. 1.

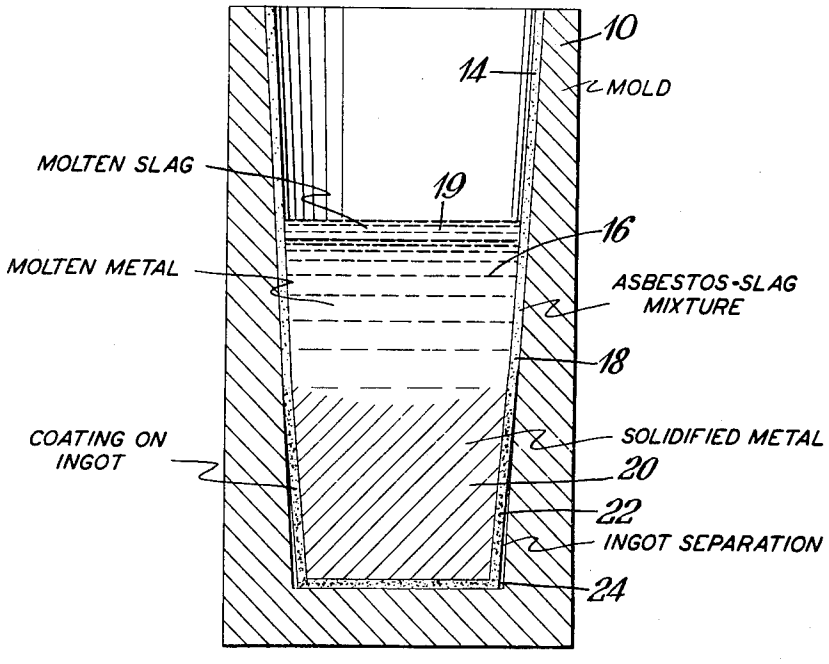


Fig. 2.

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PROCESS FOR CASTING METALS INTO ASBESTOS-CONTAINING MOLD COATING

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This application is a continuation-in-part of my co-pending application Serial No. 192,956, filed May 7, 1962, now abandoned.

The present invention relates generally to a process for casting metals, and more particularly, to a casting process wherein a mold coating is formed on the inner walls of the casting mold.

As used herein, the term "metals" refers to both elemental metals and metal alloys.

It has been known to apply coatings to the surfaces of mold cavities, and a great variety of coating compositions and coating processes have been heretofore proposed. The purpose of a mold coating is generally to produce a smooth surface on the cast article, to prevent deterioration of the surface of the mold cavity, to control the rate at which the heat is lost from the hot metal within the mold, and to prevent sticking of the hot body to the mold. The coatings also serve various other purposes known to those familiar with the casting art. In order to serve the aforementioned purposes, a mold coating should have the ability of being easily applied to the desired mold surface, of firmly adhering thereto until the molten metal begins to solidify, of being non-reactive with the metal being cast, and of resisting spalling and cracking under changing thermal conditions.

One excellent process for casting metals involves casting and solidifying the molten metal in ingot molds lined with fused silicate materials. Ingots properly cast in fused silicate-lined molds have excellent surface finishes. It is difficult, however, to provide such a fused silicate lining in an ingot mold and it is also difficult to maintain the integrity of the lining during the casting and solidification of the metal. A glass-like silicate lining on the inner walls of an ingot mold has little resistance to mechanical or thermal stresses and therefore spalls easily leaving bare, unprotected spots on the mold walls and forming harmful inclusions in the casting.

Other methods for casting in fused silicate shells, which avoid the above difficulties, involve preparation and handling of molten silicate materials, requiring special equipment.

It is the object of this invention therefore to provide a method for casting metal ingots which yields ingots with high quality surfaces and which is simple, easy to use, and compatible with ordinary mill operations.

Other aims and advantages of the invention will be apparent from the following description, the drawing, and the appended claims.

According to the present invention, a process is provided for casting metal ingots and other shapes comprising providing on the walls of an ingot mold a lining of asbestos fibers and particulated silicate slag material, casting molten metal into the so-lined mold whereby the heat of the molten metal fuses and fluidizes the particulated silicate slag material and contained asbestos to form a fluid casting shell between the cast metal and the walls of the ingot mold, and solidifying the molten metal in the mold-supported shell of casting slag.

The lining of asbestos fibers and particulated silicate slag material can be provided on the walls of the ingot mold in the following manner although any method of application is within the scope of this invention: first a mixture of asbestos fibers and particulated silicate slag material is prepared in a liquid vehicle, such as water;

next the mold walls are intimately contacted with this mixture; the liquid vehicle is allowed to dry, as by having the mold walls at an elevated temperature whereby the liquid vehicle is driven off by the heat of the mold walls. As the liquid vehicle is driven off, a shell of matted asbestos fibers and slag particles is left inside the mold.

When molten metal is poured into a mold having the above-described asbestos-slag shell, the heat of the metal causes the slag particles therein to melt forming a shell of casting slag around the poured metal body. Additionally the asbestos fibers have their waters of crystallization driven off by the heat of the metal leaving magnesium silicates, in the case of chrysotile asbestos, which form an eutectic or alloy with the silicate slag. The asbestos fibers lose their fibrous nature and become part of the fluid silicate body which completely surrounds and envelops the poured molten body. This fluid body of casting slag thus acts as a fluid mold for the contained metal. The ingot mold is only a support for the fluid shell of casting slag which actually contains and holds the molten metal during its cooling and solidification. The ingot mold also acts as a heat sink.

The fluid casting shell remains molten even after the ingot has partially solidified because the fusion temperature of the cast metal is higher than that of the silicate casting slag.

The solidification and cooling of a poured casting in a fluid casting shell, such as provided by the process of this invention, results in the formation of superior ingots.

Because of the insulating envelope of fluid casting slag between cast metal body and the ingot mold, the cooling of the metal body proceeds at a slower and more uniform rate than if the metal were in contact with the more conductive mold walls.

The envelope of fluid casting slag between the metal body and the ingot walls also ensures the formation of a smooth-walled ingot requiring less conditioning than a conventionally cast ingot. The mold walls are also protected from contact with the hot metal preventing mold wall erosion and thereby increasing mold life. The fluid body of slag between the metal body and the mold walls is free to flow laterally as well as vertically to fill in any voids due to irregularities in the mold wall thereby presenting a smooth surface to the metal body despite mold wall defects.

The asbestos-slag particle-liquid vehicle mixture may be applied to the mold walls by brushing, dipping, spraying, etc. The preferred process for providing the lining involves spraying of the asbestos-slag particle-liquid vehicle mixture. The spraying process permits relatively close control of the thickness of the lining as well as providing for complete coverage of the ingot walls. By applying the asbestos and slag particle mixture in a narrow stream, any sharp corners in the mold can be lined. A uniform lining can be formed quickly by moving the stream over the mold walls rapidly. The spraying process enables an operator to quickly apply a uniform, continuous lining. Generally the mold walls and the mold floor are provided with the coating. In some cases the mold floor may be left bare, or covered with some other material, or may be provided with multiple coatings of the material of this invention. When it is stated herein that the interior surfaces of a mold are coated with the asbestos-slag lining, it is meant that the walls and, if desired, the floor are coated.

The asbestos employed in this process should be in a finely-divided form, small enough to pass through the spraying device when this method of application is used, and smaller in dimensions than the thickness of the lining so as to form a generally smooth lining. In general, it

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is preferred to use chrysotile asbestos fibers which conform to the materials in Group 7 of the Quebec Asbestos Producers Association classification. This group contains the short fibers and floats. It has been found that asbestos which is only slightly wettable is more satisfactory in the present process than asbestos that has a high degree of wettability. Asbestos prepared by a dry process, such as mechanical chopping or beating, is usually less wettable than asbestos prepared by a wet process, such as chemical treatment of an asbestos slurry. The less wettable forms of asbestos are preferred because they lead to a more porous coating and facilitate vaporization of the liquid vehicle.

The liquid vehicle in which the asbestos and slag particles are suspended is preferably water but may be other liquid vehicles. The liquid vehicle should not be a binder for the mixture for its purpose is to suspend the mixture and make application of the asbestos-slag particle coating possible. The liquid vehicle is then evaporated to leave an intermeshed mass of asbestos fibers and slag particles on the mold walls. As the liquid vehicle is driven off, the shrinking together of the asbestos fibers and slag particles, together with a mechanical binding of the mass to irregularities on the mold wall surface causes a self-supporting mat of asbestos-slag to form in a shell inside the mold. This shell is gas permeable and will allow the escape of evolved gases when molten metal is poured into the mold.

The casting slag employed in the process should be generally inert to the molten metal to be cast, although in some cases special slags may be used to prevent the formation of inclusions in the surface of the cast body or to otherwise favorably treat the metal being cast or aid in the casting process. The casting slags have a melting temperature lower than that of the metal and generally lower than melting temperatures of smelting slags. The casting slags may be made synthetically or may be made by treatment of smelting slags to increase their fluidity and decrease their melting temperature. The compositions of the casting slags include such metallic silicates as the calcium-magnesium-aluminum silicates. The silica content of the casting slag should generally be in the range of about 15 to about 55 percent by weight and preferably in the range 40 to 45 percent silica. Suitable slag compositions for casting ferrous base metals are listed below:

Table 1

Casting slag	Composition, percent by weight	
	Preferred range	Typical
A		
CaO	33.5 to 36.5	34.5
CaF_2	6.25 to 6.75	6.85
SiO_2	42.5 to 45.5	44
MgO	4.25 to 5.75	5
TiO_2	6 to 8	7
FeO	1.5 max	0.5
Al_2O_3	2 max	0.6
ZrO_2	Low	0.4
MnO	Less than 1.5	0.5
Cr_2O_3		0.5
Others	Low	
B		
SiO	41 to 45	42
CaO	36 to 40	38
Na_3AlF_6	17 to 21	20
Others	Low	

The above listed casting slags have melting points of about 1200° C. (A) and about 1100° C. (B) and can be used for casting carbon steel and other ferrous metals, including most stainless steels. When casting ferrous metals which contain reactive metals such as titanium, aluminum, and zirconium, an undesirable amount of the reactive metal is lost by reaction with the silica in the shell of casting slag, with a corresponding increase in the amount of silicon in the cast body. In such cases it is preferable to use a casting slag having less than 15 percent

by weight silica. Titanium oxide and/or aluminum oxide may be substituted for a substantial part of the reduced silica content. The composition of the casting slag could contain oxides of calcium, magnesium, manganese, aluminum, titanium, zirconium, and iron, calcium fluoride and/or sodium-aluminum fluoride and less than 15 percent by weight silica. Suitable compositions of these low silica casting slags are given in Table 2.

Table 2

Casting slag	Composition, percent by weight	
	Preferred range	Typical
C		
CaO	32 to 35	34.
CaF_2	6 to 7.5	6.5.
SiO_2	8 to 10	9.
MgO	4.5 to 6	5.
TiO_2	6 to 7.5	6.5.
Al_2O_3	30 to 32	31.
Na_2O	4.5 to 6	5.
Others	Low	3.
D		
CaO	33.5 to 36.5	
CaF_2	6.25 to 7.75	
SiO_2	13.5 to 15.5	
MgO	4.25 to 5.75	
TiO_2	6 to 8	
Al_2O_3	30 to 33	
Others	Low	
E		
CaO		About 29.
CaF_2		About 6.5.
SiO_2		About 15.
MgO		About 5.
TiO_2		About 12.
Al_2O_3		About 31.
Others		About 1.5.

These casting slags have approximate melting points of about 1250° C. (C), about 1325° C. (D) and 1300° C. (E). These slags generally have a major portion of lime and alumina in their compositions and a silica content less than about 15 percent by weight. The above noted low silica casting slags are useful in casting titanium and aluminum containing steels, as well as stainless steels in general, and the titanium-aluminum precipitation hardened nickel and cobalt superalloys.

In regard to casting other non-ferrous metals and alloys the casting slag is generally made chemically inert to the metal to be cast and has a lower melting point than the metal so that the casting slag is still fluid after the metal has at least partially solidified. In Table 3 some suitable slag compositions for casting copper and its alloys are shown:

Table 3

Casting slag	Composition, percent by weight	
	Preferred range	Typical
F		
B_2O_3	28 to 30	28.2.
SiO_2	41 to 43	41.1.
Na_2O	27 to 30	29.8.
Others	Low	1.
G		
B_2O_3		About 72.
SiO_2		About 28.

The melting temperatures of these slags are about 540° C. (F) and about 830° C. (G).

The casting slags described in the above tables are for the slag material which goes into the asbestos-slag mix. The composition of the fluid mold casting slag formed when the metal is poured will be slightly different from these compositions because of the incorporation therein of the asbestos.

The casting slag, which may be prepared by conventional means, is first particulated and then mixed with the asbestos fibers in the liquid vehicle. The slag particles size should be small enough to pass through the spraying

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device when that is the manner of application and should not be larger than the desired shell thickness. A slag particle size less than about 20 mesh (Tyler screen series) is generally preferred for most applications.

The particle size distribution should be such as to yield with the asbestos a more or less porous lining. For example, excessive amounts of fine particles are undesirable in that they tend to form a too dense, solid type lining.

The slag particles are mixed with the asbestos fibers and applied to the mold walls in a liquid vehicle as previously indicated. The asbestos preferred is chrysotile asbestos. This asbestos has flexible, soft fibers which are excellent for holding the particulated slag particles in the matted shell form. Upon heating, chrysotile asbestos loses its waters of crystallization at about 900 to 1000° F. and thereupon the magnesium-silicate residue becomes brittle and readily alloyed with the silicate-base slag to form a molten eutectic compound. By the use of this material the slag particles are effectively held in place along the sides of the mold until the molten metal rises to their level and fuses them to form the fluid mold slag. This fibrous support is then itself incorporated into the molten slag. If the casting slag had been applied to the mold walls with a binder instead of being mechanically supported in the asbestos shell, then the contaminants in the binder would enter the molten metal. Additionally if the casting slag had been applied in a molten condition to the mold walls, the resulting glass-like coating could not resist the thermal shock of the pouring metal and would have broken off in chunks to form glass-like inclusions in the metal and leave unprotected patches of exposed mold surface. The asbestos fiber-silicate slag shell of this invention is flexible and is able to withstand the heat of the molten metal until the metal rises to each level of the mold wall whereupon the adjacent portion of the shell becomes fluid. Any splashings of molten metal during teeming will adhere to and pull away only a small portion of the asbestos-slag shell and not stick to the walls as in unprotected ingot molds or pull away large chunks of solid-type mold coatings.

While the asbestos fibers advantageously form the support structure for the silicate slag particles, the fibers do not remain as such in the fluid casting slag where they would impair the fluidity of the casting slag. These fibers enter the fluid slag and lose their fibrous nature. This is important since the fluid mold casting process requires that the fluid casting slag be capable of flowing around the cast body in response to stresses and to fill voids. In general then, while chrysotile asbestos of Group 7 of the Quebec Asbestos Producers Association Screen Test is preferred, other asbestos materials of a fibrous nature which can be absorbed into the casting slag of the particular metal being cast at the casting temperature used to form with the slag particles a fluid mold casting slag is suitable. Additionally, materials other than asbestos may be used to hold the slag particles in place until the molten metal rises to their vicinity are within the scope of this invention, provided no harmful binders are used therein and further provided that the supporting material is capable of being absorbed into the molten slag so as to produce the fluid mold casting slag.

The amount of asbestos used in the slag particle mixture can be from about 1 percent and up to 30 percent by weight asbestos with the balance slag particles and liquid vehicle. Generally, from 1 to 5 percent by weight asbestos is used in the dry asbestos-slag particle mix. A small weight percent of asbestos is usually sufficient since its density is low. The small amounts of asbestos residue taken up into the casting clag do not deleteriously change its composition. The actual amounts of asbestos employed in the asbestos slag particle-liquid vehicle mix will vary with the type of asbestos used, its fibrous nature, desired shell size and thickness, and other readily determined factors.

The amount of liquid vehicle, for example water, used depends on the amounts of slag and asbestos in the dry mix, the temperature of the mold walls on which the spraying will be conducted, the type of spraying device employed, and other related shop conditions. Generally about 30 percent or more water is used in the asbestos-slag particle-water mix.

Referring to the drawing an ingot mold **10** is shown schematically in several stages of the casting process. The interior of the mold has already been provided with a shell **12** of asbestos-fibers-silicate slag particles mix by spraying of an asbestos-slag-water mix onto the previously heated mold walls whereby the water evaporated leaving the matted lining shown at **14**. When molten metal **16** was poured into the mold, the heat of the metal fused the silicate slag particles in that portion **18** of the shell adjacent the hot metal to form the fluid mold casting slag. The waters of crystallization of the asbestos were driven off by the heat and the magnesium silicate residue absorbed by the slag. The fluid slag shell, a portion of which is shown in the central area, surrounds the cast metal to form the desired fluid casting mold **18** supported by the walls of the ingot mold **10**. The metal does not come into contact with the mold walls, but rather is contained in the fluid casting slag mold. A layer **19** of casting slag rides on the surface of the molten metal preventing contact of the metal with the atmosphere.

At the bottom of the mold a portion of the cast metal **20** is seen to have solidified and undergone the customary shrinkage. In an earlier stage the fluid mold casting slag would flow to occupy such voids as those **24** formed by the shrinking metal and thereby maintain the optimum insulating and metal cooling conditions of a metal-to-slag-to-mold wall contact, without intervening air spaces. The lower melting point of the casting slag makes this possible. Now however, as shown, the casting slag too has solidified and is seen to have adhered to the ingot rather than the mold walls thereby allowing for easy removal of the cooled ingot.

In the practice of the coating operation, the asbestos and slag particles and the liquid vehicle should be thoroughly mixed together, such as by mechancial stirring, to disperse and disseminate the asbestos and slag particles throughout the liquid. Some species of asbestos which contain no large tightly bound crystalline bundles may be adequately dispersed without the necessity of mechanical beating. This is true also of certain grades of commercial asbestos, much employed in paper and fiber board manufacturre, which has been subjected to a disintegrating treatment in its recovery from the rock in which it was associated in nature. In such cases, the fiber may be merely agitated in a suitable tank with the desired amount of water. Asbestos consisting of large tightly bound fiber bundles may require mechanical beating to achieve good mixture.

The mold should be coated with a shell of sufficient thickness to prevent penetration thereof by the molten metal being cast. Excessively thick shells should be avoided because they result in small ingots and may interfere with the removal of the ingot or casting from the mold. Preferred shell thickness is usually less than about 3/16 inch. The mixture should be applied in relatively thin layers to achieve substantially instantaneous vaporization of the liquid vehicle, but a number of such layers may be applied on top of each other to achieve a final coating or shell of the desired thickness. The thickness of the layer that can be deposited in each pass depends largely on the temperature of the mold walls, i.e., the higher the temperature the greater the thickness that can be deposited in each pass.

The walls of the mold cavity should be at a temperature at least as high as the boiling point of the liquid vehicle employed in the applied mixture.

It is preferred to have the mold walls at a temperature sufficiently high to substantially instantaneously vaporize

the liquid vehicle. The exact temperature required depends on the rate at which the mixture is deposited on the mold walls, the particular liquid employed in the mixture, the percentage of liquid in the mixture, and the degree of smoothness required in the mold coating. In general, the required temperature increases with increasing deposition rates, increasing percentages of liquid in the mixture, and increasing smoothness requirements. In other words, higher temperatures vaporize more liquid faster and produce smoother coatings, and it is preferred to have the mold wall at a temperature sufficiently high to substantially instantaneously vaporize the liquid vehicle. Of course, there is always a practical upper limit for the temperature beyond which little or no additional benefit is obtained. When water is the liquid vehicle it is preferred to have the mold wall at a temperature from about 250° F. to 800° F. or higher. A mold wall temperature of 600° F. is suitable. Under such conditions, a smooth asbestos-slag shell about 1/16 to 1/8 inch thick may be deposited by spraying in a single pass at a rate of about 5 square feet per minute.

After a shell of the desired thickness has been deposited on the walls of the mold cavity, the molten metal is poured into the shell at a suitable pouring rate. As the molten metal freezes, it contracts and the shell pulls away from the mold wall. In other words, the shell clings to the freezing metal rather than the mold walls, thus preventing the formation of surface defects in the cast article. Since the shell is somewhat flexible, it conforms to the shape of the freezing metal without splitting or buckling.

When both the bottom and sides of the mold cavity are coated with the asbestos-slag shell, it is usually preferred to have slightly greater shell thicknesses at the bottom of the mold to provide for the initial impact of the molten metal. In such cases, a portion of the shell on the bottom of the mold may be removed by the molten metal, but both the asbestos and slag are less dense than the metals cast and float to the top so that no inclusions are formed in the metal.

In an example of the inventive process, a conventional spray gun for liquids with a bottom outlet pressure tank was used to apply various asbestos-water-slag mixtures to the inner walls of a casting mold. The asbestos employed was 7R grade chrysotile (by Quebec Asbestos Producers Association classification). Both wet-process and dry-process asbestos were employed. The asbestos had a slipped-fiber structure, and the individual asbestos fibers were about 30 millimeters in diameter and about 1 to 3 microns long. The asbestos and water were mixed

manually by the use of paddles. The casting slag employed had the following composition by weight:

	Percent
Silica	44
Calcium oxide	35
Magnesium oxide	5
Titania	7
Calcium fluoride	6
Manganese oxide	1
Ferrous oxide	1
Aluminum oxide	1

The melting point of the slag was about 1200° C. and the size of the slag particles was less than 48 mesh, about 85% of the slag particles being 100 mesh by down (both Tyler screen).

The various mixtures were sprayed onto the inner walls of conventional open-end ingot molds (60 inches high) in a single layer to form a shell between about 1/16 and 1/8 inch thick at a deposition rate sufficient to cover about 5 square feet of mold wall per minute. The water in the mixtures vaporized instantaneously as the spray struck the mold wall, and the asbestos and slag adhered firmly to the mold wall, thereby forming a continuous shell reinforced by the mold. After the entire inner surface of the mold had been coated, the molten metal to be cast was poured into the mold at a rate of about 40 inches per minute and a temperature of about 2900° F. The following table gives the percentage of asbestos and slag in the various mixtures, the temperature of the inner mold walls, the mold size, the metal cast, and the amount of asbestos slag mixture deposited on the mold wall.

Table 4

Metal cast	Mold size	Mold temp., ° F.	Mix weight, percent		Lbs. material on mold wall	Asbestos preparation process
			Asbestos	Slag		
X	22" rds.	800–1,000	1.2	30.8	9 slag	Dry.
X	do	800–1,000	1.5	49.3	6–7 slag	Do.
L	do	800–1,000	1.5	49.3	do	Do.
L	do	800–1,000	1.5	49.3	do	Do.

Metals cast

	X	L		X	L
Ni	47	10	Co		Balance.
Cr	22	20	C		0.15 max.
Mo	9		W		15.
Fe	18		Cb		

In each case, the surface of the resulting ingot was substantially free of scabs and other defects and was in condition for further processing.

While various specific embodiments of the present invention have been illustrated and described herein, it is not intended to limit the invention to any of the details herein shown. For example while the process has been generally described in regard to casting ingots in standard cylindrical or tapered ingot molds, the process is equally applicable to the casting of other than ingots, including shapes of various configurations.

While the process of this invention has been described herein in regard to casting ingots in permanent type molds, the use of the term molds herein applies also to the use of molds for foundry casting in general, pressure casting, blow mold casting, lost wax casting, etc., both in permanent and temporary molds, and in general to what-

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ever metal casting operation in which fluid mold casting is operable.

What is claimed is:

1. Process for casting metals in a fluid slag casting mold comprising providing on the interior surfaces of a casting mold a coating of asbestos fibers and particulated casting slag material, pouring molten metal into the so-coated mold whereby the heat of the molten metal fuses the particulated casting slag material and contained asbestos to form a shell of fluid casting slag between the cast body and the walls of the mold, and solidifying the metal body in the mold-supported shell of casting slag.

2. Process for casting metals in a fluid slag casting mold comprising applying to the interior surfaces of a casting mold a coating mixture comprising asbestos fibers and particulated casting slag material in a liquid vehicle, volatilizing the liquid vehicle to leave a coating of intermeshed asbestos fibers and particulated casting slag material, pouring molten metal into the so-coated mold whereby the heat of the molten metal fuses the particulated casting slag material and contained asbestos forming a shell of fluid casting slag between the cast body and the walls of the mold, and solidifying the metal body in the mold-supported shell of casting slag.

3. Process for casting metals in a fluid slag casting mold comprising preparing a coating mixture of asbestos fibers and particulated casting slag material in a liquid vehicle, providing a casting mold whose interior surfaces are at a temperature above the volatilization temperature of the liquid vehicle, spraying the coating mixture onto the interior surfaces of the mold whereby the liquid vehicle is volatilized leaving a coating of intermeshed asbestos fibers and particulated casting slag material, pouring molten metal into the so-coated mold whereby the heat of the molten metal fuses the particulated casting slag material and contained asbestos forming a shell of fluid casting slag between the cast body and the walls of the mold, and solidifying the metal body in the mold-supported shell of casting slag.

4. Process in accordance with claim 3 in which the liquid vehicle is water and the mold walls are at a temperature before coating of at least 212° F.

5. Process for casting metals in a fluid slag casting mold comprising preparing a coating mixture of chrysotile magnesium-silicate asbestos fibers and particulated silicate-base casting slag in a liquid vehicle, providing a casting mold with at least its interior surfaces at a temperature above the volatilization temperature of the liquid vehicle, spraying the coating mixture onto the interior surfaces of the mold whereby the liquid vehicle is volatilized leaving a coating of intermeshed asbestos fibers and particulated casting slag material, pouring molten metal into the so-coated mold whereby the heat of the molten metal fuses the particulated casting slag and contained asbestos forming a shell of fluid silicate-base casting slag between the cast body and the walls of the mold, and solidifying the metal body in the mold-supported shell of casting slag.

6. Process in accordance with claim 5 in which the liquid vehicle is water and the mold walls are at a temperature before coating of at least 212° F.

7. Process for casting metals in a fluid slag casting mold comprising preparing a coating mixture from about 1 to 30 percent by weight asbestos fibers and the balance particulated silicate-base casting slag and a liquid vehicle, providing a casting mold with at least its interior surfaces at a temperature above the volatilization temperature of the liquid vehicle, spraying the coating mixture onto the vertical interior surfaces of the mold whereby the liquid vehicle is volatilized leaving a coating of intermeshed asbestos fibers and particulated casting slag material, pouring molten metal into the so-coated mold whereby the heat of the molten metal fuses the particulated casting slag and contained asbestos forming a shell of fluid silicate-base casting slag between the cast body and the walls of the mold, and solidifying the metal body in the mold-supported shell of casting slag.

8. Process in accordance with claim 7 in which the liquid vehicle is water and the mold walls are at a temperature before coating of at least 212° F.

9. Process in accordance with claim 7 in which the coating of asbestos fibers and particulated slag material on the walls of the mold is from 1/16 to 3/16 inch thick.

10. Process in accordance with claim 7 in which the liquid vehicle is water and the mold walls are at a temperature before coating of at least 212° F.

11. Process for casting metals in a fluid slag casting mold comprising preparing a coating mixture from about 1 to 5 percent asbestos fibers and the balance particulated silicate-base casting slag, suspending said mixture in a liquid vehicle, providing a casting mold with at least its interior surfaces at a temperature above the volatilization temperature of the liquid vehicle, spraying the coating mixture onto the vertical interior surfaces of the mold whereby the liquid vehicle is volatilized leaving a coating of intermeshed asbestos fibers and particulated casting slag material, pouring molten metal into the so-coated mold whereby the heat of the molten metal fuses the particulated casting slag and contained asbestos forming a shell of fluid silicate-base casting slag between the cast body and the walls of the mold, and solidifying the metal body in the mold-supported shell of casting slag.

12. Process for casting metals in a fluid slag casting mold comprising preparing a coating mixture of magnesium-silicate asbestos fibers and a particulated silicate base casting slag inert to the metal being cast and having a melting temperature lower than the melting temperature of the metal, suspending said coating mixture in a liquid vehicle, providing a casting mold with at least its interior surfaces at a temperature above the volatilization temperature of the liquid vehicle, spraying the coating mixture onto the interior surfaces of the mold whereby the liquid vehicle is volatilized leaving a coating of intermeshed asbestos fibers and particulated casting slag material, pouring molten metal into the so-coated mold whereby the heat of the molten metal fuses the particulated slag and contained asbestos forming a shell of fluid silicate-base casting slag between the cast body and the walls of the mold, and solidifying the metal body in the mold-supported shell of casting slag.

13. Process for casting ferrous metals in a fluid slag casting mold comprising preparing a coating mixture containing of from about 1 to about 5 percent by weight of magnesium-silicate asbestos fibers and the balance a particulated casting slag containing from about 40 to about 45 percent by weight silica and having a melting temperature lower than the melting temperature of the metal to be cast, suspending said coating mixture in water, providing a casting mold with at least its interior surfaces at a temperature above 212° F., spraying the coating mixture onto the interior surfaces of the mold whereby the water is volatilized leaving a coating of intermeshed asbestos fibers and particulated casting slag material, pouring molten metal into the so-coated mold whereby the heat of the molten metal fuses the particulated casting slag and contained asbestos forming a shell of fluid silicate-base casting slag between the cast body and the walls of the mold, and solidifying the metal body in the mold-supported shell of casting slag.

14. Process for casting alloys in a fluid slag casting mold, said alloys containing elements reactive with silicon oxide, comprising preparing a coating mixture containing from about 1 to about 5 percent by weight magnesium-silicate asbestos and a particulated casting slag containing a major proportion of lime and alumina and less than about 15 percent by weight silica, said casting slag being substantially inert to the alloy being cast and having a melting temperature less than that of the alloy, suspending said coating mixture in water, providing a casting mold with at least its interior surfaces at a tem-

perature above 212° F., spraying the coating mixture onto the interior surfaces of the mold whereby the water is volatilized leaving a coating of intermeshed asbestos fibers and particulated casting slag material, pouring molten metal into the so-coated mold whereby the heat of the molten metal fuses the particulated casting slag and contained asbestos forming a shell of fluid casting slag between the cast body and the walls of the mold, and solidifying the metal body in the mold-supported shell of casting slag.

15. Process for casting copper-containing metals comprising preparing a coating mixture containing from about 1 to about 5 percent by weight magnesium-silicate asbestos fibers and the balance a particulated casting slag containing silica and boric oxide, said casting slag being substantially inert to the alloy being cast and having a melting temperature less than the melting temperature of the alloy, suspending said coating mixture in water, providing a casting mold with at least its interior surfaces at a temperature above 212° F., spraying the coating mixture onto the interior surfaces of the mold whereby

the water is volatilized leaving a coating of intermeshed asbestos fibers and particulated casting slag material, pouring molten metal into the so-coated mold whereby the heat of the molten metal fuses the particulated casting slag and contained asbestos forming a shell of fluid casting slag between the cast body and the walls of the mold, and solidifying the metal body in the mold-supported shell of casting slag.

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