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[54] **CLAY-GRAPHITE SPOUT**

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[52] **U.S. Cl.** **222/566,** 106/56, 106/69

[51] **Int. Cl.** **B22d 37/00**

[58] **Field of Search** .... 222/566, DIG. 1, 222/DIG. 19; 106/44, 56, 69

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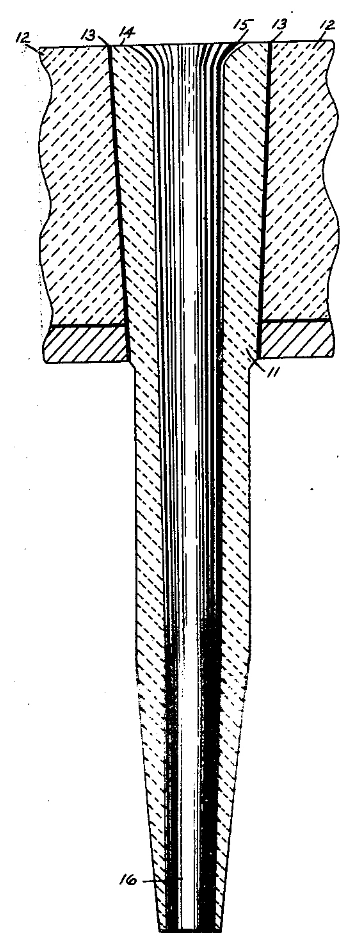
[57] **ABSTRACT**

A pouring spout for pouring molten metal in a continuous casting system, the composition of said pouring spout including, among other substances, graphite, clay, refractory oxides and other refractory materials, wherein the percentages of each substance vary within a specified range according to the purity of metal being poured. The internal configuration of the spout results in a closely controlled and consistent flow of molten metal.

11 Claims, 2 Drawing Figures



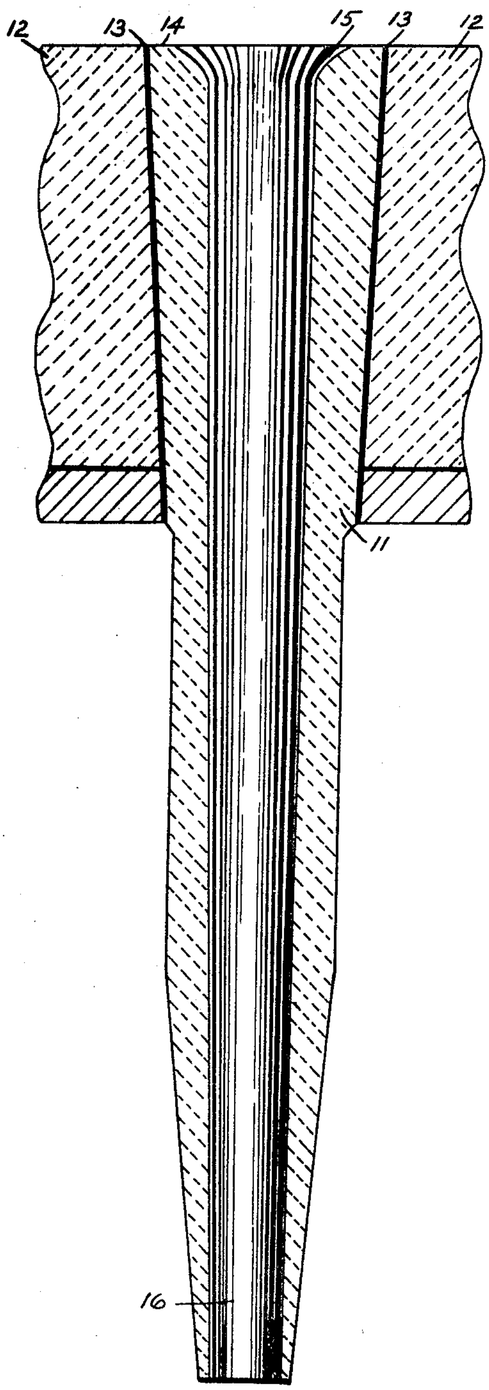


FIG. 1.

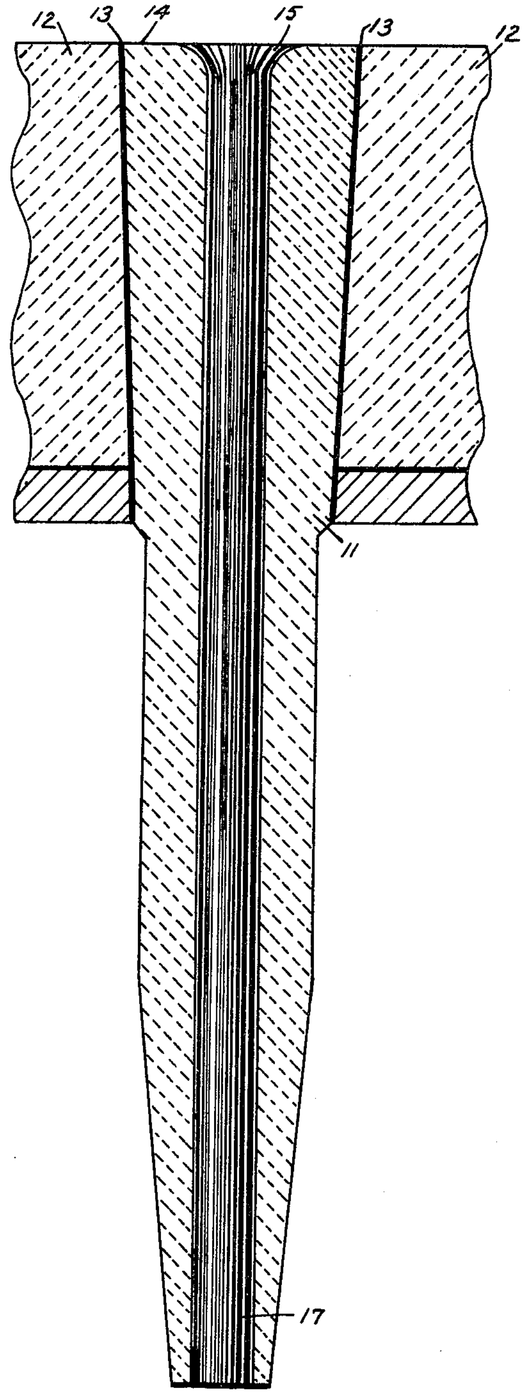


FIG. 2.

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CLAY-GRAPHITE SPOUT

BACKGROUND OF THE INVENTION

In a continuous casting system for casting metal, molten metal is poured from a mechansim comprising a molten metal reservoir or pour pot with a nozzle or spout extending out the bottom at one end. The molten metal is poured into a channel formed by the groove in the periphery of a rotating casting wheel and an endless metal band surrounding a portion of the periphery of and moving with the casting wheel. The pouring pot is spaced away from the casting wheel in an area immediately adjacent to the intersection of the casting wheel and the endless band.

For a good quality bar, it is desirable that the molten metal stream leaving the spout have a consistent pattern with respect to the metal pool in the mold of the continuous casting machine. To have this consistency, it is necessary that close control of the metal stream be maintained, and this is commonly accomplished through a pour spout. In the past, the internal configuration of the pour spout has not given the desired control of the molten metal. Pouring spouts have been fabricated of various materials, including graphite and silicon carbide, which can withstand the elevated temperatures required in a molten metal system, but not to the degree and comparable lengths of time associated with the present invention.

Pour spouts of prior art types, i.e., commercial graphite compositions, have been produced with a square inlet and a substantially straight bore, which was necessary to guide the molten metal to the intersection of the casting wheel and endless band, but prior art spouts have not provided the control exercised by the present invention.

While pouring spouts of this construction have been utilized for a number of years, the life of a typical pouring spout is short, usually between 5 and 8 hours of pouring time. The pouring spout must be preheated to a temperature level approximately equal to the temperature of the molten metal before the casting operation starts, and the molten metal flowing through the pouring spout maintains the temperature of the pouring spout at this high level. The elevated temperatures cause the material of prior art pouring spouts to oxidize and generally deteriorate. Since the molten metal generally does not fill the inside opening of the prior art pouring spouts, deterioration occurs due to oxidation of the graphite at both inside and outside surfaces.

SUMMARY OF THE INVENTION

Briefly described, the present invention comprises a pouring spout for pouring molten metal from a pouring pot into the groove of a casting wheel wherein the pouring spout is constructed of carbon, silica, alumina, silicon carbide, silicon, glaze and various other refractory substances. The pouring spout is constructed with a tapered or straight bore having a rounded inlet.

Thus it is an object of this invention to provide a pouring spout in a molten metal casting process which is durable and long lasting.

Another object of this invention is to provide a pouring spout which allows a more controlled and consistent stream of molten metal to pass through it.

Another object of this invention is to provide a pouring spout which is less likely to oxidize than prior art pouring spouts.

Still a further object of this invention is to provide a pouring spout which is inexpensive to construct, easy to connect to the pouring pot of a metal casting machine, and which lasts for an extended period of time during the pouring process.

Other objects, features and advantages of the invention will become apparent upon reading the following specification, when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross sectional view of a pouring spout as it extends from a pouring pot of a casting system, showing the spout as having a tapered internal configuration and a rounded inlet.

FIG. 2 is a cross sectional view of a pouring spout similar to FIG. 1, but showing the spout as having a straight internal configuration and a rounded inlet.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring in more detail to FIG. 1, the pouring spout is connected at its upper end, support shank 11, to pouring pot 12. The pouring spout is generally tubular in configuration. Pouring pot 12 defines an opening 13 in its bottom surface, which is inwardly tapered throughout at least a portion of its length. The pouring spout is inserted from inside pouring pot 12 into opening 13, by wedging the pouring spout down through tapered opening 13. The taper of the upper portion of support shank 11 of the pouring spout and of opening 13 of pouring pot 12 is such that the downward movement of the pouring spout is limited and upper surface 14 about the rounded upper opening inlet 15 of tapered bore 16 is seated at a level where it is substantially coincident to, or above the plane of the inner surface of pouring pot 12.

FIG. 2 shows a cross sectional view of a pouring spout similar to FIG. 1, except that bore 17 is straight, instead of tapered as in FIG. 1, 16.

Before molten metal is allowed to flow through the pouring spout, the pouring spout should be preheated to a temperature approximately equal to the temperature of the molten metal to prevent the initial metal flow through the pouring spout from solidifying before it reaches the casting wheel. After the molten metal is allowed to flow through the pouring spout, the preheating function can be terminated since the molten metal will maintain the temperature of the pouring spout.

While the average life span of the prior art graphite pouring spouts is from about 5 to 8 hours of pouring time, a pouring spout of the composition disclosed in this invention will survive pouring times from about 12 to more than 15 hours. The material next to the metal flow must be sufficiently erosion and oxidation resistant in order to maintain its internal shape and structural strength throughout the time of its operation. It has been found through practice that materials that are very hard, and thus resistant to erosion, will clog during operation with solidified metal building up on the spout's internal surface. The severity of the solidified metal deposit and the time for its accumulation depend on the impurity level of the metal being poured and on the propensity for high melting point oxides to form. However, it is presently understood that if the material is soft enough, solidifed metal will not adhere. A primary feature of this invention is that the material is soft enough to prevent metal solidification internally, but not so soft that erosion destoys its internal shape. The material is basically a mixture of graphite, clay, refractory oxides, and other refractory substances. The exact composition can vary according to the chemistry of the molten metal being poured, but the general range of the spout material constitutents are:

CONSTITUENT	WEIGHT PERCENT
Carbon (graphite)	28 to 70
Silica (SiO_2)	0 to 36
Alumina (Al_2O_3)	0 to 22
Silicon Carbide (SiC)	0 to 52
Silicon	0 to 20
Glaze	0 to 20
Other Refractory Substances	0 to 5

Glaze generally has the following composition:

CONSTITUENT	PERCENT RANGE
Feldspar	0 to 3
Borax	0 to 4
Cryolite	0 to 5
Calcium Silicate	0 to 3
Silicon	0 to 10

The above material has the advantageous feature of being oxidation resistant. Therefore, no additional coating on the external surface exposed to the atmosphere is required to protect the material from oxidation. Such coatings for oxidation protection, as used in the prior art practice, have separated from the spout surface and contaminated the molten metal pool by falling into it.

The internal configuration of the pouring spout, i.e., the tapered bore **16** (see FIG. **1**) and the straight bore **17** (see FIG. **2**), along with rounded inlet **15** insures that molten metal completely fills the spout and never allows separation between the molten metal stream and the spout surface such that an air void formation takes place. The presence of air creates relative cold spots on the internal surface of the spout and generally causes the spout temperature to be lower than if the spout passage was full of molten metal. A full spout has molten metal in contact with all its internal surface. Thus, the spout material is at a more uniform and higher temperature than the prior art practice. This thermal condition of the spout tends to minimize the formation of solidifed metal on the internal surface.

Moreover, not only is the thermal condition of the full spout better, but its flow control of the molten metal stream is improved. Since the molten metal stream is always in contract with the internal surface of the spout, it is always confined by the internal surface to a set direction after it leaves the spout. Thus, once casting is started and the spout orientation adjusted so that the molten metal stream has the proper pattern with the molten metal pool in the casting machine, the full spout maintains this configuration throughout its operation. A partially full spout has unstable flow in that the molten metal stream tends to shift its contact with the spout's internal surface from one place to another. Thus, the stream direction changes and does not maintain its optimum orientation with the molten metal pool of the casting machine.

A full spout is more economical to fabricate than a partially full one because a full spout utilizes all its cross sectional area whereas a partially full one does not. Thus, a full spout can be of smaller dimensions and still have sufficient passage area for the molten metal stream to allow the same production rate as a partial full spout of larger dimensions. For example, a pour

spout approximately eighteen inches long, approximately three inches in diameter at the large end and approximately one and one-fourth inches in diameter at the small end has proven more successful than the prior art pour spouts. Successful pour spouts have been constructed in accordance with this invention having a tapered bore with a diameter of approximately one and one-fourth inches at the large end and approximately 13/16 inches at the small end, i.e., the included angle of the taper being 1° or more, and having a straight bore with a 13/16 inch diameter. The radius of the rounded inlet on both the tapered bore and straight bore pour spouts must be equal to or greater than the radius of the uppermost portion of the bore.

Thus, the invention disclosed herein provides an improved pouring spout for casting molten metal, having a longer life which reduces the cost of the casting operation since the frequency of pour spout replacement is lessened, therefore less down time is experienced in the casting machine. Also the internal configuration of the pour spouts of this invention results in better quality cast metal.

EXAMPLE 1

A pouring spout of the following composition was utilized in a continuous casting system: carbon (graphite) — 70%, silica (SiO_2) — 20%, glaze—8%, and traces of refractory substances. The dimensions of this pouring spout, having a tapered bore, were as follows: large end overall diameter — 3 inches, large end of bore diameter — 1¼ inches, small end overall diameter — 1¼ inches, rounded inlet radius — 11/16 inch, small end of bore diameter — 13/16 inch, overall length 17 ¾ inch. The pouring spout was preheated to a temperature equal to the temperature of the molten copper to be poured. Then the molten copper was poured through it into the casting wheel. The pouring spout remained in continuous service for 14 hours and 45 minutes before the casting operation was terminated.

EXAMPLE 2

A pouring spout of the following composition was utilized in a continuous casting system: carbon (graphite) — 50%, silica (SiO_2) — 20%, silicon — 20%, glaze — 8%, and traces of refractory substances. The dimensions of this pouring spout were the same as the dimensions of the pouring spout of Example 1. The pouring spout was preheated to a temperature equal to the temperature of the molten copper to be poured. Then the molten copper was poured through it into the casting wheel. The pouring spout remained in continuous service for 12 hours before the casting operation was terminated.

EXAMLE 3

A pouring spout of the following composition was utilized in a continuous casting system: carbon (graphite) — 40%, silica (SiO_2) — 36%, alumina (Al_2O_3) — 22%, and traces of refractory substances. The dimensions of this pouring spout were the same as the dimensions of the pouring spout of Example 1. The pouring spout was preheated to a temperature equal to the temperature of the molten copper to be poured. Then the molten copper was poured through it into the casting wheel. The pouring spout remained in continuous service for 13 hours and 50 minutes before the casting operation was terminated.

EXAMPLE 4

A pouring spout of the following composition was utilized in a continuous casting system: carbon (graphite) — 37%, silica (SiO_2) — 30%, alumina (Al_2O_3) — 22%, silicon carbide (SiC) — 13%, and traces of refractory substances. The dimensions of the pouring spout, having a straight bore, were as follows: large end overall diameter — 3 inches, bore diameter — 13/16 inch, rounded inlet radius — ½ inch, small end overall diameter — 1¼ inches, overall length — 17 ¾ inches. The pouring spout was preheated to a temperature equal to the temperature of the molten copper to be poured. Then the molten copper was poured through it into the casting wheel. The pouring spout remained in continuous service for 12 hours and 15 minutes before the casting operation was terminated.

While the invention has been described in detail with particular reference to certain preferred embodiments, it will be understood that variations and modifications can be effected within the spirit and scope of the invention as hereinbefore described and defined in the appended claims.

What is claimed is:

1. A pouring spout for use in the continuous casting of molten metal, said spout being constructed of oxidation resistant material having a composition of from about 28 to about 70 percent carbon, from 0 to about 36 percent silica, from 0 to about 22 percent alumina, from 0 to about 52 percent silicon carbide, from about 0 to about 20 percent silicon, from 0 to about 20 percent glaze, and from 0 to about 5 percent other refractory substances.

2. A pouring spout as defined in claim **1**, wherein said spout has a generally tubular configuration with a bore extending from end to end and terminating in openings at each end of the spout, said bore being of a shape such that during pouring, molten metal completely fills the spout and never separates from its internal surface.

3. The pouring spout of claim **2** having a tapered bore with a rounded inlet, wherein the included angle of the bore is at least one degree and the radius of the rounded inlet is at least equal to the radius of the upper portion of the bore.

4. The pouring spout of claim **2** having a straight bore with a rounded inlet, wherein the radius of the rounded inlet is at least equal to the radius of the bore.

5. The pouring spout of claim **2** having an enlarged support shank comprising less than half the length of said spout, and situated at its upper end for insertion into a pouring pot.

6. A pouring spout assembly for pouring high temperature molten metal from a metal pouring pot, said pouring spout assembly comprising an elongated spout of generally tubular configuration having a bore extending from end-to-end and terminating in openings at each end of the spout, and an externally outwardly flared support shank formed at one end of the spout for insertion into a pouring pot such that the spout protrudes from the pouring pot and guides the flow of molten metal away from the pouring pot to a casting machine, said spout having a composition of from about 28 to about 70 percent carbon, from 0 to about 36 percent silica, from 0 to about 22 percent alumina, from 0 to about 52 percent silicon carbide, from 0 to about 20 percent silicon, from 0 to about 20 percent glaze, and from 0 to about 5 percent other refractory substances.

7. The pouring spout assembly of claim **6** having a tapered bore with a rounded inlet, wherein the included angle of the bore is at least one degree and the radius of the rounded inlet is at least equal to the radius of the upper portion of the bore.

8. The pouring spout assembly of claim **6** having a straight bore with a rounded inlet, wherein the radius of the rounded inlet is at least equal to the radius of the bore.

9. In combination, a metal pouring pot for high temperature molten metal and a pouring spout assembly associated therewith, said pouring spout assembly being of a length to guide the molten metal to a region located a substantial distance from said pot, said pouring spout assembly including an elongated spout of oxidation resistant material being of generally tubular configuration, including an enlarged, tapered support shank at the upper end of the pouring spout, which comprises less than half the length of the pouring spout, and combining with a complimentary tapered portion on the pouring pot to give a secure fit between the pouring spout and the pouring pot, a lower portion of said pouring spout assembly being exposed to the atmosphere and comprising over half the total length of the pouring spout assembly, said oxidation resistant materials having a composition of from about 28 to about 70 percent carbon, from 0 to about 36 percent silica, from 0 to about 22 percent alumina, from 0 to about 52 percent silicon carbide, from 0 to about 20 percent silicon, from 0 to about 20 percent glaze, and from 0 to about 5 percent other refractory substances, said pouring spout having a bore extending from end to end and terminating in openings at each end of the said spout, said bore being of a shape such that during pouring, molten metal completely fills the spout and never separates from its internal surface.

10. The combination metal pouring pot and pouring spout assembly of claim **9**, wherein the pouring spout has a tapered bore with a rounded inlet, the included angle of the bore being at least 1° and the radius of the rounded inlet being at least equal to the radius of the upper portion of the bore.

11. The combination metal pouring pot and pouring spout assembly of claim **9**, wherein the pouring spout has a straight bore with a rounded inlet and the radius of the rounded inlet is at least equal to the radius of the bore.

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