

[54] **COMPOUND BODY NOZZLE FOR A
CONTAINER HOLDING A LIQUID MELT**

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

[58] **Field of Search**..... 222/566, DIG. 1, DIG. 19,
222/DIG. 9

[56] **References Cited**
UNITED STATES PATENTS

3,428,464 2/1969 Pollard..... 222/DIG. 19

3,604,598 7/1969 Kappmeyer et al..... 222/DIG. 1
3,435,992 4/1969 Tisdale et al. 222/DIG. 1

FOREIGN PATENTS OR APPLICATIONS

224,113 11/1924 Great Britain 222/DIG. 1
7,731 1/1916 Great Britain 222/DIG. 1
909,458 10/1962 Great Britain 222/DIG. 1
1,905,995 9/1969 Germany 222/DIG. 1
266,050 2/1927 Great Britain 222/DIG. 1

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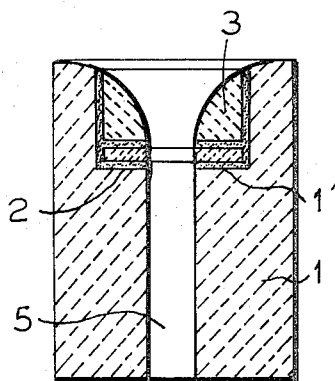
Assistant Examiner—David A. Scherbel

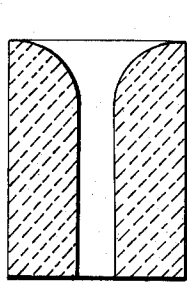
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[57] ABSTRACT

A container for a liquid melt has a nozzle with a flow passage. A refractory ceramic material supports the nozzle and an insert of highly wear resistant refractory material limits the flow passage of the nozzle. The insert comprises a shield body or bodies of oxide ceramic or cermet having a thickness of 5% to 20% of the diameter of the flow passage. The flow passage of the shield body is the same or less than the flow passage of the nozzle.

6 Claims, 6 Drawing Figures





PRIOR ART **FIG. 1**

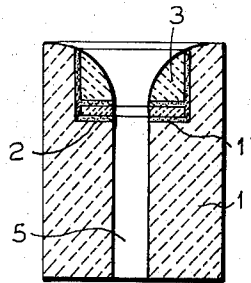


FIG. 2

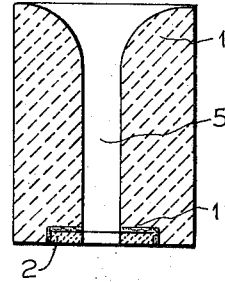


FIG. 3

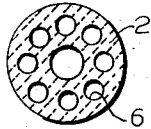


FIG. 5

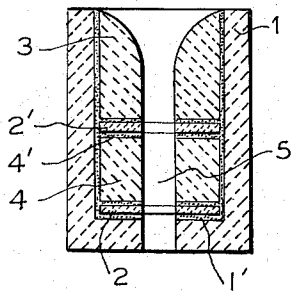


FIG. 4

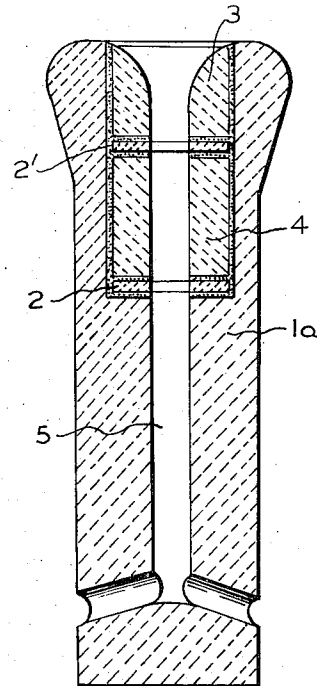


FIG. 6

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COMPOUND BODY NOZZLE FOR A CONTAINER HOLDING A LIQUID MELT

The invention refers to the casting of metals, particularly liquid steel, for example in the bottom pouring of multiple molds, ingot molds or continuous casting and relates to a nozzle formed as a compound body in a container holding the liquid melt.

When continuous casting takes place the molten metal goes from the pouring ladle through an intermediate container (tundish) into the continuous casting mold, that is to say through a refractory ceramic nozzle set on the bottom of the intermediate container. It is important that during the total duration of the casting process the cross section of the flow passage opening of the outlet be kept free, in order to insure a uniform running speed and pouring efficiency.

Yet changes in the nozzle-flow passage cross section during the pouring process could not be prevented until now. These changes occur as follows and are mainly due to the following circumstances:

1. The free cross section of the flow passage can be narrowed by an increase of a crust or the clogging of the flow passage. This phenomenon occurs particularly when pouring steel melt containing additions of aluminum, silicon, manganese or titanium and can be explained by the formation of liquid to pasty mixed crystals through deoxidation, which may adhere to the surface of the flow passage which has been sensitized through deoxidation products such as for instance Al_2O_3 . The determining factor for the extent of such a phenomenon is the concentration of these additions in the melt and their temperature, because in the case of a constant concentration and a decrease of temperature of the melt the degree of saturation can be exceeded, which favors the formation of a crust.

2. The free cross section of the flow passage in the nozzle can be enlarged through corrosion, which for instance can be due to the fact that FeO and/or deoxidation products together with the components of the refractory material of the nozzle form a low melting eutectic mixture.

Both of these phenomenon, the closing as well as the enlargement of the free cross section of the flow passage in the outlet are equally disadvantageous and undesirable, because they may cause considerable disturbance in the pouring process and can also be dangerous. The closing up of the free cross section of the passage may cause a gradual drying up of the metal flow, whereby a wear and tear of the cross section of the passage may produce a break-through of the liquid melt through the wall parts of the nozzle which are most heavily worn by corrosion, and which due to wear and tear cannot continue to withstand hydrodynamic pressure.

In order to prevent a premature wearing action, a known nozzle carries on the upper part of the inlet of the nozzle passage a ring shaped element made of a highly refractory material such as magnesite which is particularly resistant to the flow of the liquid melt, and which compared to the surrounding nozzle material is of a more wear resistant nature. (DPS 638 612).

For the same purpose molds manufactured for continuous casting have been made of combinations of substances of thinly distributed high-melting oxide ceramic and metallic parts, for instance zirconium oxide

and molybdenum and/or tungsten (Austrian patent A 10 478/64).

Yet these measures are only partially satisfactory. In the case of magnesite and to a higher extent with oxide ceramic substance combinations with a metallic phase the high heat conductivity caused by their composition and density are particularly disadvantageous. Therefore, in spite of the existing capacity of resistance of these materials no favorable operating characteristics may be obtained. Due to the great loss of heat there is a lowering of the wall temperature and consequently of the temperature of the contact surface between the flow passage and the molten metal, which causes separations which precipitate on the walls in the form of incrustations. The separations are mainly due to the exceeding of the saturation point for the additives in the melt, particularly deoxidation products, which cause a decrease in the temperature of the melt.

A nozzle for pouring ladles, intermediate containers, etc. made of refractory substances having a wear resistant and a heat insulating part (DGBM. 1 995 110) is also known, whereby the two dissimilar refractory substances through common molding are worked into a homogeneous compound. But even this nozzle manufactured as a compound is not able to resist an increasing enlargement of the free cross section of passage due to corrosion particularly over a prolonged pouring time, for example in the case of continuous casting in sequence, although some progress can be attained with respect to the closing up of the flow passage caused by incrustation by means of an outside insulation of such nozzles. Furthermore such one piece compound nozzles made of refractory materials of diverse qualities, due to the different thermal expansion of the individual compound substances, tend to crack during the burning process, which excludes the usefulness of such nozzles.

An object of this invention is to eliminate the above mentioned difficulties and defects and to provide nozzles used for the passage of molten metal which are improved with regard to their wear resistance as well as the formation of incrustations in the flow passage.

A further object according to the invention is to provide in a compound nozzle of refractory ceramic support material, one or several inserts of refractory oxide ceramic material which are set in order to limit the flow passage, these inserts constituting shield bodies of a thickness of from 5 percent to 20 percent of the diameter of the flow passage, whereby it is of advantage if their flow passage is either of the same size or smaller than the flow passage of the nozzle. A particular advantage of the invention is that due to the higher thermal conductivity of the oxide ceramic material or of the hard material of the insert as compared to the ceramic support material a higher heat dissipation and a higher resistance against corrosion in the area of the insert is obtained. Since with the higher heat dissipation there is necessarily a decrease of the boundary surface temperature in the flow passage of the nozzle in the area of the insert, there is an intended incrustation on the areas of the insert exposed to a contact with the flowing out melt jet, and it is of such kind that the formed incrustations are constantly washed out again in a certain sequence with the effective hydrostatic pressure. With the special installation of one or several such inserts at positions which, depending on the pouring procedure used, are particularly exposed in the area of the flow

passage, by means of a directed heat conduction a controlled automatic incrustation which can be destroyed is possible. The control of this constantly renewing formation of a crust as an essential characteristic of the invention can be realized very advantageously when using one or more ring disks which can be inserted into the supporting material of the nozzle as shield bodies, whereby the thickness of each ring disk should vary between 5 percent and 20 percent of the diameter of the flow passage. The cross section of the passage remains constant during the total pouring course when taking into consideration this relationship. With an additional preferably concentric perforation in the ring disk its heat dissipation can be effectively reduced within certain limits if it should be necessary to base it on a relatively higher heat conductivity of the supporting material, and furthermore through this perforation a better connection can be obtained between the ring disk and the supporting material when using a refractory mortar or cement as a mounting material.

In a further application of the invention the flow passage in the supporting material of the nozzle may advantageously have a ridge which acts as a support for the insert, against which the insert is held by a ring element made of the same refractory material as the supporting material whereby the interior opening is shaped as part of the flow passage of the nozzle and on its free end as the inlet profile of the nozzle. This allows a simple and inexpensive manufacturing of nozzles according to the invention, since the setting in of the inserts can be done at the time of manufacturing of the nozzles as well as at the time of installing the nozzle on a container filled with liquid melt. In this latter manner there is the advantage of having the possibility to set up several inserts separated by spacers on the ridge of the supporting material. The spacers may be in the form of collars made of the same material as the supporting material or another refractory material, whereby their flow passages may be of the same size or smaller than the flow passage of the nozzle at the (ridge) in the supporting material, i.e., the same size as the insert openings. This type of assembly and mounting of the nozzle allows the usage of insertable spacing collars of varying length in the manner of an assembly of prefabricated machine parts, that is to say a variable adaptability of the position of the inserts in the area of the flow passage to the technical requirements for melting and casting. This offers a great adaptability of the ceramic material to the metallurgic conditions, for instance the kind of deoxidation, as well as the location of the inserts on endangered places along the flow passage of the nozzle. This constitutes an excellent manner of taking into account that differently deoxidized steel melt may produce different incrustations or corrosion on different places inside of the flow passage of the nozzle.

Refractory materials which according to the invention may be used for manufacturing inserts have proven to be corundum, zircon silicate, zircon oxide or material composed to a greater part of these components. Great capacity of resistance against corrosive and erosive attack, particularly in the case of steel melts, has been shown by inserts of powder metallic hard materials, for example with a basis of molybdenum and zirconium oxide. On the other hand the supporting material of nozzles according to the invention may be very advantageously made of quartz. The utilization of hard materials in such a combination within a nozzle pro-

duces an optimal resistance and does not show any noticeable wear and tear even after pouring several consecutive batches. The supporting material of the nozzle which to a certain extent does show wear and tear plays the role of a carrier of the insert, guide of the pouring jet and heat insulator, whereas the insert mainly provides for a constant flow quantity and pouring speed.

With the above and other objects in view which will become apparent from the detailed description below, some preferred embodiments of the invention are shown in the drawings, in which:

FIG. 1 shows a longitudinal section of a tundish nozzle according to the known art,

FIGS. 2 and 3 each show a longitudinal section of a tundish nozzle with ring disk in accordance with the present invention,

FIG. 4 shows a longitudinal section of a further type of a tundish nozzle with several inserted ring disks,

FIG. 5 shows a plan view of a ring disk and

FIG. 6 shows a longitudinal section of a tundish-immersion type nozzle with several inserted ring disks.

FIG. 1 shows tundish-outlet or nozzle of a known form, and according to the invention as shown in FIGS. 2-4, is shown as a compound body, composed of a main component 1 of a refractory supporting material, for instance quartz with approximately 14 percent Cr_2O_3 , one or more ring disks 2, 2' of hard material, so called cermet with a basis of zirconium oxide and molybdenum, and a holding ring 3 as well as in certain cases one or more spacer collars 4, both made of the same refractory material as the supporting material. The interior flow passage of the holding ring and spacer collar forms one part of the flow-through passage 5 of the nozzle and thus coincides with its inner diameter.

In the nozzle shown in FIG. 2 the ring disk 2 is set in the intake side. The ring supporting surface for the ring disk is a ridge 1' which extends radially outwardly from said flow-passage and in all the forms of construction is simultaneously formed or subsequently shaped by cutting into the supporting material of the main body. In order to preserve the proven inlet side profile of such nozzle the holding ring 3 is correspondingly shaped and is set from above onto the inserted ring disk 2 and together with the latter and the supporting material it is strongly joined through an adequate refractory mortar.

FIG. 3 shows a ring disk mortared in at the discharge end of the nozzle.

The utilization of several ring disks 2 and 2', which actually can be made of different materials is shown in the nozzle represented in FIG. 4. Next to the lower ridge 1' which acts as a support surface for the lower ring disk 2, the upper surface 4' of a spacer collar 4, set upon ring disk 2, provides the support surface for an additional ring disk 2' mortared into the supporting material, onto which is added, as shown and explained with regard to the embodiment of FIG. 2, the holding ring 3 which is secured by mortar.

A transferal of the ring disk location according to FIG. 4 onto an immersion nozzle located on a tundish of a continuous casting installation for immersion into the continuous casting mold is shown in FIG. 6. Here as in all the other figures the same parts carry the same reference numbers. The main body of the quartz support material is shown at 1a.

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With a tundish nozzle, according to the invention, made of 100 percent SiO_2 and 14 percent Cr_2O_3 and a 2 mm thick hard material shield composed mainly of molybdenum and zirconium oxide, for instance, steel with the following analysis can be faultlessly poured:

C = 0.07 percent, Si = 0.08 percent

Mn = 0.45 percent, P = 0.030 percent

S = 0.030 percent, Al = 0.033 percent

in a sequence of continuous pouring of several times 12 tons with a constant pouring speed of 1.8 m/mm.

In order to obtain a good durability of the ring disk when mortaring into the supporting material and also in order to determine the degree of its heat conductivity in variable sizes, the ring disk as shown in FIG. 5 may have a number of perforations 6 concentrically arranged around the flow passage, the number and size of the perforations being variable.

It is understood that the invention is not limited to these examples and that it can be used not only for all types of nozzles of containers containing liquid melt, but that particularly by varying the refractory materials used for the supporting material, the holding ring and the spacer collars subject to wear on one hand and the oxide ceramic material or hard material of the ring disks on the other hand, the nozzles can be used for different purposes and the way of pouring melt may be varied.

We claim:

1. A nozzle for use in a container containing a liquid melt, said nozzle comprising
 - a main component formed of a refractory ceramic material, said main component having a flow passage extending therethrough; and
 - at least one insert attached to said main component and having an opening limiting said flow passage, said insert comprising a shield body formed of a highly wear resistant refractory material selected from the group consisting of a ceramic oxide and cermet, said shield body having a thickness of from 5 to 20% of the diameter of said flow passage, said

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shield body comprising a ring-shaped disc set within said main component, said ring-shaped disc having a plurality of perforations therein concentrically arranged around said opening.

2. A nozzle as claimed in claim 1, wherein said highly wear resistant refractory material is further selected from the group consisting of corundum, zircon and silicate, zircon oxide.

3. A nozzle as claimed in claim 1, wherein said main component is quartz.

4. A nozzle for use in a container containing a liquid melt, said nozzle comprising

a main component formed of a refractory ceramic material, said main component having a flow passage extending therethrough; and

at least one insert attached to said main component and having an opening limiting said flow passage, said insert comprising a shield body formed of a highly wear resistant refractory material selected from the group consisting of a ceramic oxide and cermet, said shield body having a thickness of from 5 to 20% of the diameter of said flow passage, said main component having a ridge extending radially outwardly from said flow passage, said shield body positioned on said ridge and further comprising a holding ring retaining said shield body against said ridge, said holding ring having an interior opening forming a portion of said flow passage.

5. A nozzle as claimed in claim 4, wherein said at least one insert comprises a plurality of shield bodies spaced within said main component, and further comprising spacer collars having openings therethrough positioned between adjacent of said shield bodies.

6. A nozzle as claimed in claim 5, wherein said spacer collars are formed of the same material as said main component, and said openings of said spacer collars are the same size as the openings through said shield bodies.

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