SLIDING VALVE FOR A CONTAINER OF LIQUID SMELT PROVIDED WITH A LIP

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Sliding Valve for a Container of Liquid Smelt Provided with a Lip

A sliding valve for a container provided with a lip containing a liquid smelt such as a pouring ladle has an orifice plate mounted on the container in the area of the lip. A valve plate has a flow passage and means for moving the valve plate with a sealing effect against the orifice plate. The valve plate is made of refractory material and the flow passage and sealing surface of the valve plate are made of a heat resistant metallic hard material, such as an oxidation stable metal silicide with a high melting point. The flow passage and the sealing surface of the valve plate may be made of a heat resistant powder metallurgical solid solution, such as a solid solution containing zirconium oxide and molybdenum. Up to 40 percent by volume chromium may be added to the metal phase of the powder metallurgical solid solution. The flow passage and the sealing surface of the valve plate have a coating of a heat resistant metallic hard material.

6 Claims, 2 Drawing Figures

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3,567,082 2/1971 Tinnes

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Field of Search

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ABSTRACT

A sliding valve for a container provided with a lip containing a liquid smelt such as a pouring ladle has an orifice plate mounted on the container in the area of the lip. A valve plate has a flow passage and means for moving the valve plate with a sealing effect against the orifice plate. The valve plate is made of refractory material and the flow passage and sealing surface of the valve plate are made of a heat resistant metallic hard material, such as an oxidation stable metal silicide with a high melting point. The flow passage and the sealing surface of the valve plate may be made of a heat resistant powder metallurgical solid solution, such as a solid solution containing zirconium oxide and molybdenum. Up to 40 percent by volume chromium may be added to the metal phase of the powder metallurgical solid solution. The flow passage and the sealing surface of the valve plate may have a coating of a heat resistant metallic hard material.

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SLIDING VALVE FOR A CONTAINER OF LIQUID SMELT PROVIDED WITH A LIP

This is a continuation, of application Ser. No. 57,431 filed July 23, 1970, now abandoned.

The invention concerns a sliding valve for a container provided with a lip, which contains a liquid smelt, as used particularly for pouring ladles in the metallurgical industry, for regulating the quantity discharged and for closing the lip, and pertains to the using of highly heat-resistant material for such sliding valves.

It is a known fact, that the linear movable or rotary displaceable part of a sliding valve which is called a valve plate, which is located for instance below a pouring ladle in a housing and is carried displaceably and sealing against the undersurface of an orifice plate which is firmly set in the bedstone of the bottom of the ladle, is exposed to a high strain due to the thermal, chemical and erosive action of the liquid smelt which rapidly flows through it, although the valve plate like all the other parts of the sliding valve and the ladle which enter in contact with the liquid smelt are made of highly heat resistant material, or are lined with it. Thus especially in a throttled slide position, an erosion in the passage canal of the valve plate can lead to undesired changes of the flow cross section, which not only impairs controllably the constancy of the quantity discharged and its speed, but also in a closed slide position decreases the overlap of the sealing surface and the orifice plate, and therefore creates a danger of breakthrough. A further difficulty is the danger of “freezing” of the liquid smelt in the passage canal of the orifice plate when closing the sliding valve, particularly when the valve plate remains for a long time in a shut-off position, because due to the insufficient heat conductivity of the refractory material of the valve plate, and to the fall of temperature which it causes as compared with the flow passage, the sealing surface of the valve plate is not heated enough and thus is within the zone of the solidification temperature of the liquid smelt.

An object of the invention is to avoid these deficiencies and difficulties and provide a sliding valve which is highly resistant to the thermal, chemical and eroding action of the flowing-through liquid smelt and where a “freezing” of the smelt during the individual pouring phases is not possible.

A further object according to the invention is to provide in a sliding valve the flow passages and the sealing surface of the valve plate of heat resistant metallic hard material, preferably a high-melting, oxidation stable metal silicide or a heat resistant powder metallurgical solid solution, preferably on a basis of zirconium oxide and molybdenum. When using a metallic hard material or a powder metallurgical solid solution as protection against wear and tear for the flow passages and sealing surfaces of the valve plate this gives the latter a high resistance against erosion and mechanical stress and alloys, as compared to the refractory material of the valve plate which has a higher heat conductivity, a directional heat conduction on the valve plate and thus a heating up of the sealing surface during a throttled or opened state, which when using the sliding valve prevents the “freezing” of the liquid smelt above the sealing surface of the valve plate in the area of the orifice plate-flow passage.

A further object of the invention is to use a powder metallurgical solid solution for increasing the oxidation stability of the metal phase wherein up to 40 percent by volume of chromium may be added. As a metallic hard material there may be advantageously used molybdenum-disilicide (MoSi2).

Heat resistant hard materials as well as powder metallurgical solid solutions can be arranged as coating in the area of the flow passage and the sealing surface of the valve plate. As heat resistant coating can be advantageously used in the flow passage of the valve plate a jacket shaped insert which has a flange shaped collar stretching over the sealing surface of the valve plate, which when using a heat resistant cement for the variable extension of the insert and the valve plate is set in the valve plate.

With the above and other objects in view which will become apparent from the detailed description below, a preferred form of the invention is shown in the drawing in which:

FIG. 1 shows the lower part of a pouring ladle with a sliding valve in a partial view in a longitudinal cross section and
FIG. 2 is a top view of the valve plate along section line II—II of FIG. 1.

The metal jacket 1 of a pouring ladle has a refractory lining 2 which covers the outer wall and the floor. On a perforated area of the bottom of the ladle provided for the outflow of the liquid smelt of metal jacket 1 and refractory lining 2 there is the hearth bottom 3 which is rectangular on the outside with a funnel-saped culver 3' and an opening which widens conically downwardly, wherein an inlet jacket 4 which also is made of refractory material is set with refractory mortar. Onto inlet jacket 4 is connected downwardly an orifice plate 5 which is anchored to the jacket face and to the bottom of the ladle with a refractory mortar, having flow passage 5' as part of the sliding valve which generally is indicated as 6.

The sliding valve is essentially composed of a cast iron housing plate 7 (not shown) screwed onto the metal jacket 1 in the area of the bottom of the ladle with a removable frame shaped lid 7', which with 6 expansion bolts (not shown) over spring elements 8 through nuts 9 can be set under pressure against the housing plate, as well as a cast iron, frame shaped lining 10 with lip 10', into which is embedded a valve plate 11 of refractory material with a flow out jacket 12 connected downwardly to it which is also of refractory material. The lining body 10 which carries the valve plate, slides on the guideways 13 set on the lid and can be displaced in a linear direction through a hydraulic drive set on 14.

A jacket shaped insert 11' made of heat resistant molybdenum-disilicide (MoSi2) with a flange shaped collar is embedded into the valve plate by means of a refractory elastic cement and is flush with the surface of the valve plate, i.e. the surface of said insert 11 is a part of the sliding surface of the valve plate 11 which through the prestressed spring elements 8 exerts a sealing action against the undersurface of orifice plate 5. The insert 11' made of molybdenum-disilicide with a heat resistance of more than 2,000°C and a heat conductivity of around 0.1 cal/cm²/s/°C at 20°C increases the service life of the valve plate considerably, so that several ladle pourings can be made with the sliding valve. The heat resistant material for the inlet jacket 4, orifice plate 5, valve plate 11 and outlet jacket 12 is highly aluminaferrous material on a basis of Mullit-Koruntuclay with around 80% Al₂O₃, with a porosity of approximately 20
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percent, a hot bending rigidity of 180 to 200 kb/cm² at 1400°C as well as a heat conductivity of 2.0 to 2.1 kcal/m/h/°C at 1000° to 1200°C. The different heat extensions of the hard metallic insert 11' of MoSi₂ and the valve plate which has a high aluminiferous content are greatly absorbed by the heat resistant elastic cement indicated at 11", which is an alumina mortar granulated below 0.1 mm with an aluminum monophosphate binding. Above this the spring elements 8 are in a position to absorb the material expansion which acts perpendicular to the axis of movement of the valve plate. The flange shaped collar of the insert forms, with its surface adjacent the orifice plate when the valve plate slides a tight surface, that is to say, the flange is proportioned in such a way that even in a closed valve position (the maximum movement of the valve plate in the direction of the arrow) it forms a sufficiently tight surface underneath the flow through opening in the orifice plate 5.

Insert 11' can also be pressed from zirconic oxide and molybdenum into a dry powdered metal body. Up to 40 percent by volume chromium may be added to the metal phase of the powder metallurgical solid solution.

We claim:
1. A sliding valve for use in a container containing a liquid melt such as a pouring ladle, said container having an orifice plate with an orifice extending therethrough mounted thereon;
said sliding valve comprising a valve plate having an orifice extending therethrough, said sliding valve having an upper surface with a recess therein;
an insert having a tubular portion and a flange at one end thereof, said insert being rigidly imbedded in said sliding plate with said tubular portion covering the surface of said sliding plate orifice and said flange positioned in said recess, the upper surfaces of said flange and said sliding plate being flush;
said insert having an orifice therethrough;
means for urging said flush upper surfaces into sealing contact with the under surface of said orifice plate;
means for selectively moving said sliding plate from a first position wherein said orifice of said orifice plate and said orifice of said sliding plate are in alignment to a second position wherein said orifice of said orifice plate is sealingly blocked by said upper surface of said flange;
said insert being formed of a heat resistant metallic hard material, and the upper surface of said insert being larger than the area swept by the insert orifice as the slide plate is moved from said first to said second position, whereby heat is transferred from the smelt passing through the insert orifice to the upper surface thereof to prevent freezing.

2. Sliding valve according to claim 1 wherein said flow passage and said sealing surface of the valve plate are made of a heat resistant powder metallurgical solid solution.

3. Sliding valve according to claim 2 wherein said solid solution contains zirconium oxide and molybdenum.

4. Sliding valve according to claim 2, wherein up to 40% by volume chromium is added to the metal phase of said powder metallurgical solid solution.

5. Sliding valve according to claim 1, wherein said metallic hard material is molybdenum disilicide (MoSi₂).

6. Sliding valve as set forth in claim 1 wherein said heat resistant material is an oxidation stable metal silicide with a high melting point.

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