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[54] ROTARY SLIDE CLOSURE FOR LIQUID MELT CONTAINER

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[52] **U.S. Cl.** **222/554**, 222/555, 251/144, 251/304, 251/309

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

[58] **Field of Search**.....222/516, 548, 554, 555; 251/144, 304, 309, 312

[56] **References Cited**

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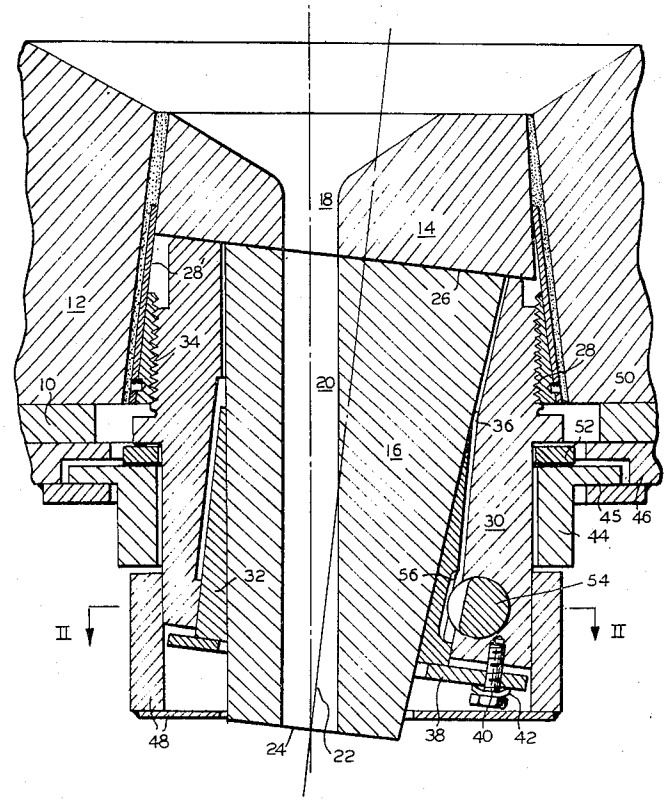
[57] **ABSTRACT**

A rotary slide closure for a liquid melt container has a fixed plate with a through-flow channel at the outlet of the container. A rotary slide plate is mounted in contact with and adjacent the fixed stationary plate also having a through-flow channel. The through-flow channels may be brought into mutual connection or disconnection for throttling the melt. The rotary slide plate has a discharge opening for its through-flow channel that is coaxial in relation to the axis of rotation of the rotary slide plate and the axis of rotation of the slide plate forms an acute angle with the vertical central axes of the through-flow channels.

8 Claims, 2 Drawing Figures



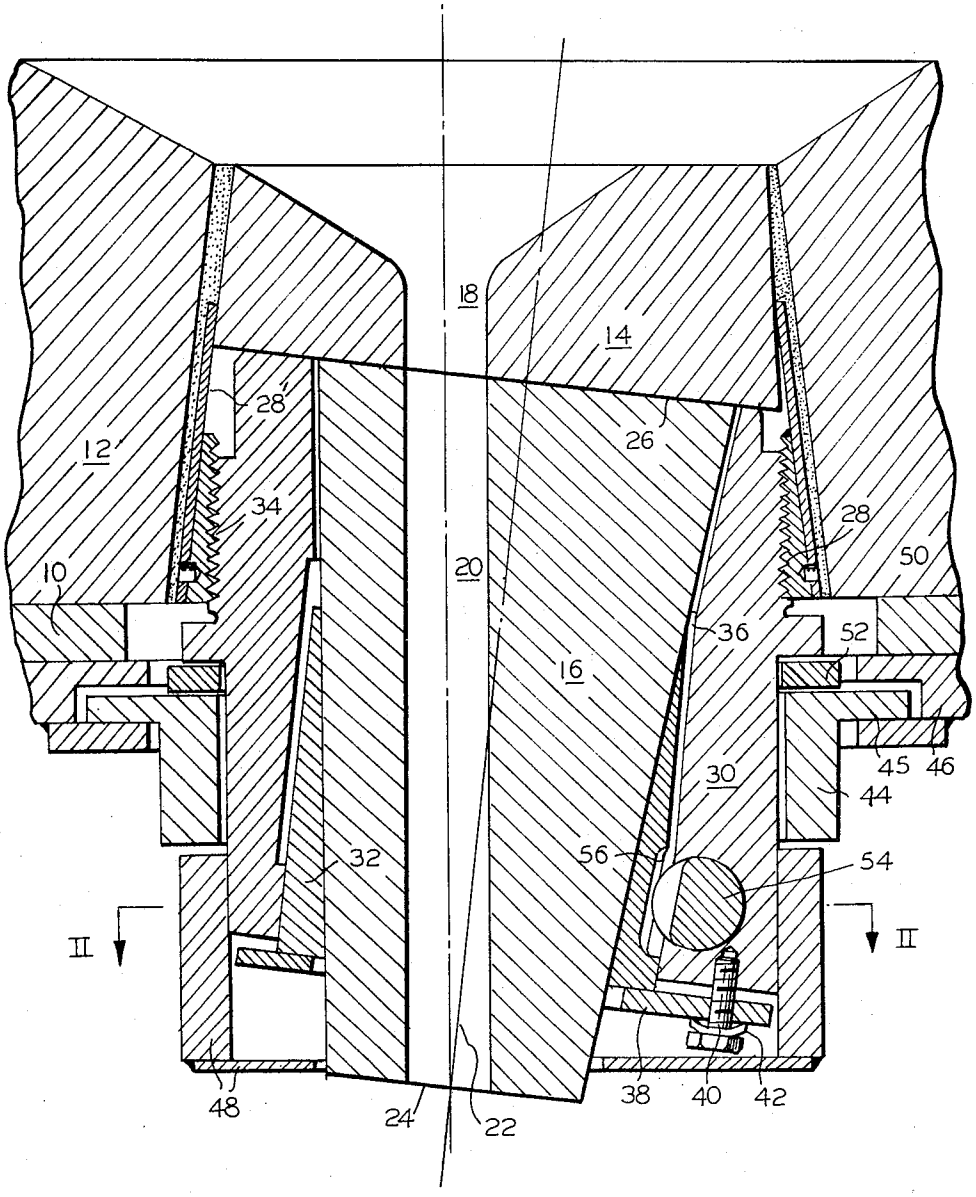


FIG. 1

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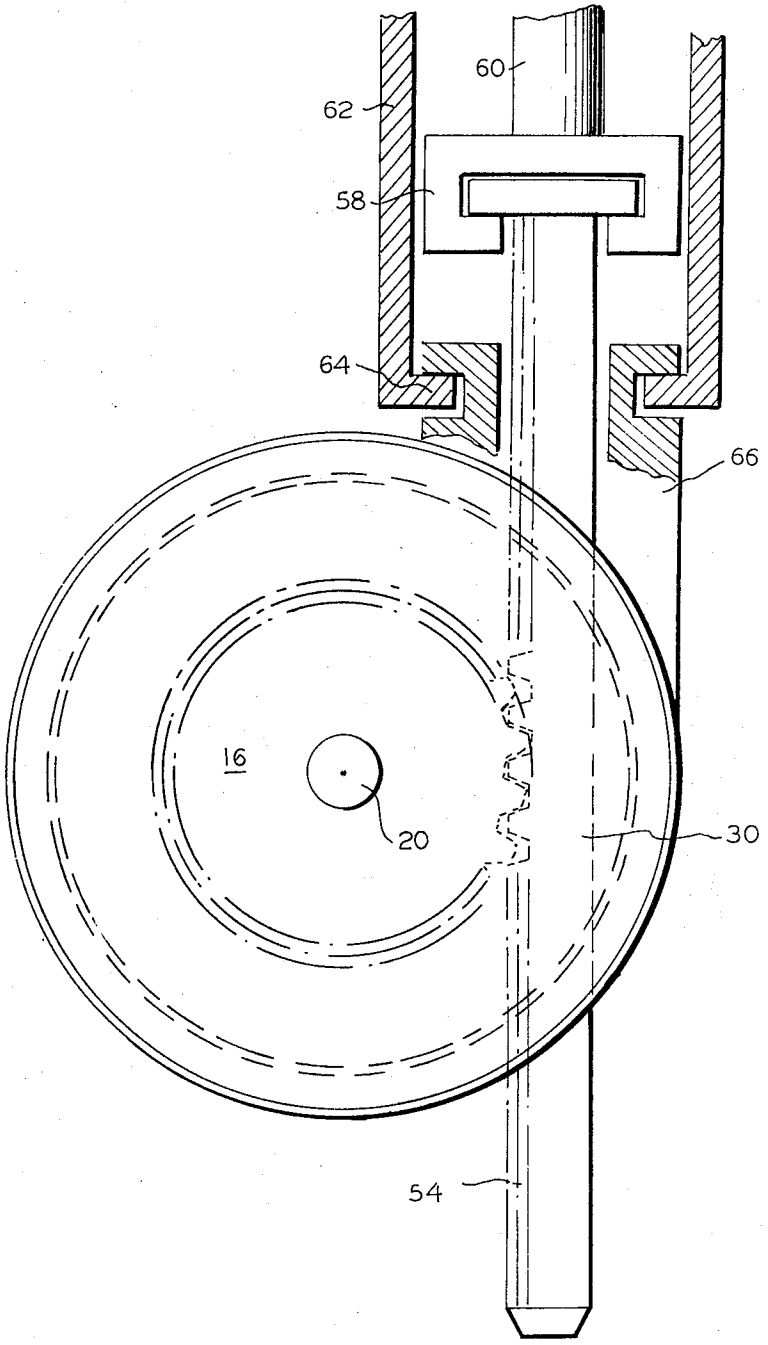

FIG. 2

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ROTARY SLIDE CLOSURE FOR LIQUID MELT CONTAINER

The invention relates to a rotary slide closure on liquid melt containers, consisting of a stationary apertured plate and a rotary slide plate tightly adjacent to the apertured plate on the outside, with at least one through-flow channel in each case.

Owing to the changes that have taken place during recent years in casting pouring technology and in the metallurgical composition of the melts, the refractory material (especially in the case of steel ladles) has been placed under considerable additional requirements. Accordingly, the customary stopper rod closure, which is situated inside the liquid melt during the pouring casting process, is subjected to steadily increasing stresses, which is based to a significant extent on the longer periods during which the stopper rod is situated inside the melt as well as on the higher tapping and pouring casting temperatures. Consequently, the slide closures that are not subjected to such stresses owing to their arrangement outside the liquid metal, are gradually replacing the known stopper rods.

However, the slide closures of the prior art are associated with the problem of lateral displacement of the discharge opening and, therewith, of the position of the outflowing jet, when the slide plate is shifted in the direction of greater or lesser throttling.

For elimination of this disadvantage, a linear slide has already been proposed (OS 1,458,180) wherein the slide plate is guided between two stationary plates. The disadvantage of this structure consists in the requirement of a further stone slab in addition to the apertured and slide plates. Besides, a further pair of sealing and sliding surfaces, representing the wear surfaces, is present. Moreover, the guiding of the slide plate becomes over-rigid and proper clean fitting of all sealing surfaces is practically impossible owing to the manufacturing and assembly inaccuracies in the establishment of the quadruple plane parallelism.

A further known solution of the above-mentioned problem consists in arranging a funnel under the slide plate of a rotary slide, which funnel is connected to the rotary slide plate in a position such that the center axis of its discharge opening coincides with the axis of rotation of the slide plate. There occurs a deficiency in this embodiment: the jet discharged from the slide plate drops on the funnel wall and, consequently, the latter is damaged very rapidly. In addition, since the funnel is relatively cool, the deposition of the cooled metal must be taken into account. Finally, the funnel also constitutes an additional structural component.

Finally, in a cock-type rotary slide closure (Austrian Pat. No. 165,292), the problem described at the outset is solved in such a manner that a through-flow channel, arranged centrally in a slide plate whose upper portion is in the form of a conical cap, is led through a sharp bend in relation to the jacket surface of the conical cap, upward, toward the stationary apertured plate which is likewise conical or roof-shaped. However, owing to the deflection of the out-flowing melt caused by the sharp bend of the through-flow channel, the refractory material of the slide plate is subjected to considerably increased stresses in the area of the sharp bend of the through-flow channel, which results in a premature wear of the slide closure.

An object of the present invention is to produce a rotary slide closure of the type mentioned which solves the problem of preserving unchanged the position of the outflow opening in spite of the displacement of the slide plate, with simpler means and without the disadvantages indicated above, in such a manner that the axis of rotation of the slide plate forms an acute angle with the vertical perpendicular center axes of the through-flow channels. The proposed solution attains the advantage that, in the case where the slide is fully opened, the outflowing melt may pass in free fall vertically through the through-flow channel and, in the case where the slide is in a throttling position, the melt may pass through the said channel in an almost vertical direction, without the necessity of changing the direction of the melt in this connection. Here, the outlet opening of the slide plate through-flow channel retains its position in every position of the slide. Accordingly, the outflowing pouring casting jet is not displaced in the case of throttling.

Since, according to the invention, the sealing and sliding surface between the apertured and slide plates is situated perpendicularly in relation to the axis of rotation, a position of the sealing and sliding surface deviating from the horizontal results in the vertical position of the opened through-flow channel. This introduces the further advantages: in a throttling position of the closure, the cooperating edges of the through-flow channel openings in the apertured and slide plates (which openings are displaced in relation to each other on throttling) likewise extend obliquely in relation to the direction of flow and, consequently, exert a lesser tendency to bring about turbulence in the flow than a vertical stepped ledge. Moreover, the oblique position of the sealing and sliding surface is favorable insofar as the torque exerted by the slide plate on the fixed apertured plate, whose center axis intersects the axis of rotation at an acute angle, is lesser than in the case of axial-parallel arrangement of the plates, owing to the friction of the sealing and sliding surface.

Besides, the practical assembly of individual parts of a slide closure at the outlet of the container bottom is associated with great difficulties insofar as a uniform fitting of the slide plate on the apertured plate through the entire circumference is concerned. In the case of an oblique sealing and sliding surface, as proposed in the present invention, these difficulties would even be increased. Accordingly, in a preferred embodiment of the invention, the apertured and slide plates consist in a known manner of frustum elements, with the larger end surfaces on the sides of the common sealing and sliding surface, and are held and braced in relation to each other by means of the inner cone surfaces of housing parts (with which they form an assembly unit), the apertured plate being clamped and supported in the housing independently of the pressure of the slide plate. In this connection, the apertured plate is suitably situated on a lower housing portion which is connected detachably to an upper housing portion engaging the outer cone of the apertured plate. Consequently, the static pressure of the melt which rests on the apertured plate is absorbed directly by the slide housing and does not exert a load on the oblique sealing and sliding surface.

In order to prevent solidification of the chilled material on the sealing and sliding surface and the resulting detrimental effect on the operation of the slide closure, it is desirable to arrange this critical zone in the maximum proximity of the melt. Without extending the attachment elements of the slide plate very far inward, a preferred embodiment of the invention takes into account this requirement in such a manner that the slide plate is included in a supporting ring provided with a fitting inner cone and a cylindrical jacket surface, which ring is supported radially in a cylindrical inner bore of the lower housing portion and can be inserted from outside into the inner bore, by means of a face-adjacent tightening disk and tightening screws (that can be screwed into the lower portion of the housing and act on the tightening disk), until the slide plate rests closely tightly on the apertured plate.

If, owing to the special geometrical relationship, in the case of the embodiment possessing oblique sealing and sliding surface, the preferred structure of the slide closure of the invention consists in a pre-assembled component unit, occasion is given for a further proposal to develop the invention. For a rapid and simple mounting of the component on the container, the housing is provided with flange-type peripheral elements that engage, in the manner of a bayonet catch, a suitable fitting socket on the container. In this connection, in order to attain optimal sliding and sealing properties between the apertured and slide plates, the axial position of the peripheral elements may be arranged changeable in relation to the housing by means of intermediate rings. Furthermore, the preferred application of the slide closure of the invention as a pre-assembled unit offers the extraordinary advantage that known filling materials may be introduced from outside into the slide closure when such a closure is assembled. This eliminates the unpleasant operation wherein the perforated brick stone must be filled from inside the ladle. Consequently, the filling (even when consisting of various component materials) may be effected exactly in the desired form and layer arrangement.

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

FIG. 1 shows a vertical cross section through a rotary slide closure of the invention arranged at the bottom of a liquid melt container, and

FIG. 2 shows a horizontal section through the drive for the rotary actuator of the slide plate along section line II—II of FIG. 1.

The rotary slide closure illustrated in the drawings is arranged on a metal jacket **10** of a liquid melt container, in particular, a casting pouring ladle or an intermediate container (tundish) of a continuous casting apparatus, with a refractory lining **12** of the container being shown in the drawings only in the area of the outlet opening. The slide closure proper consists of a fixed apertured plate **14** and a rotary slide plate **16**, each provided with a through-flow channel **18** and **20**, respectively.

The peculiarity of the slide closure illustrated consists in the position of the through-flow channels **18** and **20** in relation to the axis of rotation of the slide plate, the axis being designated by the numeral **22**. In the manner of a deviation from the hitherto-customary axial-parallel design with the vertical axis of rotation, the exemplified embodiment shows the axis of rotation and the central axis of through-flow channels **18** and **20** as intersecting each other in the plane of an outer opening **24** and extending apart toward the container interior at an acute angle. For simplicity, the line passing through this point of intersection and perpendicular to the plane of the discharge opening **24** shall be called the axis of the discharge opening; furthermore, it is coaxial with the axis of rotation **22**. It can be seen that, on a rotation of slide plate **16** around axis **22**, the opening of through-flow channel **20** situated on the inner side is led in an arc of circle and through-flow channel **18** is opened or closed in this connection, entirely or in part, while mouth opening **24** retains its position so that the discharged jet of the melt does not wander or be displaced.

When axis of rotation **22** is inclined to the vertical, a sealing and sliding surface **26**, situated perpendicularly in relation thereto, is necessarily also inclined to the horizontal.

The apertured and slide plates are pre-assembled in the desired position in a slide housing which is ready for installation. Its essential components are a two-part upper housing portion **28**, a lower housing portion **30** and a supporting ring **32**. Upper housing portion **28** consists of an annular shell provided with inner thread and a conical tubular element **28'** that can be screwed on the conical outer surface of the shell. The two-part structure of the upper housing portion provides the advantage that in the case of exchange of parts possibly merely the tubular element **28'** need be replaced.

Lower housing portion **30** can be screwed into upper housing portion by means of a thread **34**. In cooperation with the conical surfaces of apertured plate **14** and upper housing part **28** or **28'**, that prevent a pushing of the apertured plate inward through the housing, aperture plate **14** can be firmly clamped between housing parts **28** and **30**, after the apertured plate is inserted into upper housing part **28** (**28'**), by turning and screwing-in lower housing part **30** on thread **34**. Accordingly, under the load of the static pressure of the melt, the apertured plate **14** is supported basically directly on the housing.

During assembly, conical slide plate **16** is suspended loosely above in a bore **36** of lower housing portion **30**, which bore is conical in the upper portion and cylindrical in the lower portion with its center axis coinciding with the axis of rotation **22**, before the lower portion **30** is screwed into the upper housing portion **28** until the apertured plate **14** is clamped therewith. The supporting ring **32**, which is conical inside and cylindrical outside, is pushed then from below on the cone of slide plate **16** and tightened by means of a tightening disk **38** and a plurality of tightening screws **40** (only one being shown), distributed through the circumference, screwed into lower housing portion **30** and provided with plate springs **42**. Since supporting ring **32** here engages slide plate **16** and presses it against apertured plate **14**, a certain desired contact pressure on the sealing and sliding surface **26** can be set by means of tightening screws **40**, independently of the external forces acting on apertured plate **14**.

Outwardly cylindrical lower housing portion **30** carries a ring **44** with peripheral segments **45** that engage, in the manner of a bayonet catch, a fitting **46** attached to the container jacket **10** and provided with insertion openings corresponding to peripheral segments **45**. Ring **44** is held on lower housing portion **30** traversed by a rack **54** between a cover plate **48** and a flange **50**, the axial position of the slide housing being adjustable in relation to the opening in the container bottom by means of intermediate rings **52** between flange **50** and ring **44**. Accordingly, if during the passage of time the conical opening in refractory lining **12**, wherein upper housing portion **28**, that is likewise conical, is sealed with mortar is enlarged through repeated removal and reinsertion of the slide, it suffices to insert additional intermediate rings **52** or a single stronger ring **52** in order to obtain again the desired conditions.

The rotary motion of slide plate **16** is actuated by means of a rack **54** which is supported in lower housing portion **30** and meshes with the external teeth **56** of supporting ring **32**. During the rotary motion, supporting ring **32** and slide plate **16** are guided radially in the cylindrical portion of bore **36**. Since the rack **54** also belongs to the slide housing unit, it is provided as shown in FIG. **2** that its rear end be connected to a piston rod **60** of a hydraulic actuation cylinder **62** by means of a rapidly disengageable coupling **58**, which cylinder may be connected to an extension **66** on the lower housing portion **30**, likewise by means of a readily disengageable coupling **64**.

I claim:

1. A rotary slide closure for liquid melt containers comprising a stationary plate having a through-flow channel having a central axis, a rotary slide plate mounted in contact with and adjacent said stationary plate also having a through-flow channel having a central axis, means for bringing said through-flow channels into mutual connection, said rotary slide plate having a discharge opening for its through-flow channel, said discharge opening is coaxial in relation to the axis of rotation of said rotary slide plate, the axis of rotation (**22**) of said slide plate (**16**) forming an acute angle with said central axes of said through-flow channels (**18,20**).

2. A rotary slide closure as set forth in claim **1** wherein said slide plate (**16**) has a sealing and sliding surface (**26**) cooperating with said stationary plate located perpendicular to its axis of rotation (**22**).

3. A rotary slide closure as set forth in claim **2** wherein a housing having inner cone portions (**28, 30, 32**), is provided and said stationary and rotary slide plates (**14,16**) comprise frustum-shaped elements with the larger end surfaces at the sides of said sealing and sliding surface (**26**), and said plates are held and braced in relation to each other by means of said inner cone portions of said housing, with which they form an assembly unit, said stationary plate (**14**) being clamped and supported in said housing independently of said slide plate (**16**).

4. A rotary slide closure as set forth in claim **3** wherein said stationary plate (**14**) rests on the lower housing portion (**30**) that is connected in a detachable manner to the upper housing portion (**28**) engaging the external cone of said stationary plate.

5. A rotary slide closure as set forth in claim **3** wherein said housing portion (**30**) has flange-type peripheral segments (**44,45**) that engage a fitting socket **46** arranged on a container (**10**).

6. A rotary slide closure as set forth in claim **5** wherein the axial position of said peripheral segments (**44,45**) in relation to said housing portion (**30**) is variable by means of intermediate rings (**52**).

7. A rotary slide closure as set forth in claim **1** wherein a supporting ring (**32**) supports said rotary slide plate (**16**), said ring having a fitting inner cone and a cylindrical surface, said lower housing portion (**30**) having a cylindrical inner bore (**36**) in which said ring is supported radially whereby said ring may be inserted from outside into said inner bore (**36**), a tightening disk (**38**) cooperating with said ring and tightening screws (**40**) screwed into said lower housing portion (**30**) acting on said tightening disk to urge said slide plate **16** tightly against said stationary plate (**14**).

8. A rotary slide closure as set forth in claim **1** wherein said means for bringing said through-flow channels into mutual connection comprise an actuation cylinder (**60, 62**) serving as the rotary drive of said slide plate (**16**), a rack (**54**) supported in the lower portion of said housing portion (**30**) actuated by said cylinder and a supporting ring (**32**) for said slide plate having external teeth (**56**) cooperating with said rack.

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