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54 **Slide gate nozzle.**

57 An improved three-plate slide gate, particularly for a tundish, of the type comprising two fixed plates (1,2) rigid with the tundish (3) and provided with a coaxial hole, and, interposed therebetween, a mobile plate (4) provided with a hole and supported by a frame (7) driven in such a manner as to cause said plate to slide longitudinally between a position in which its hole is aligned with those of the two fixed plates and a position of non-alignment, and a plural-

ity of springs (11) acting in the sense of urging the lower fixed plate against the upper fixed plate to provide sealed contact between the corresponding surfaces of the fixed plates and mobile plate substantially for any position of this latter, characterised in that the springs (11) are transversely fixed with respect to the tundish and have their lines of action lying within the longitudinal dimensions of the mobile plate (4) for any position of this latter.

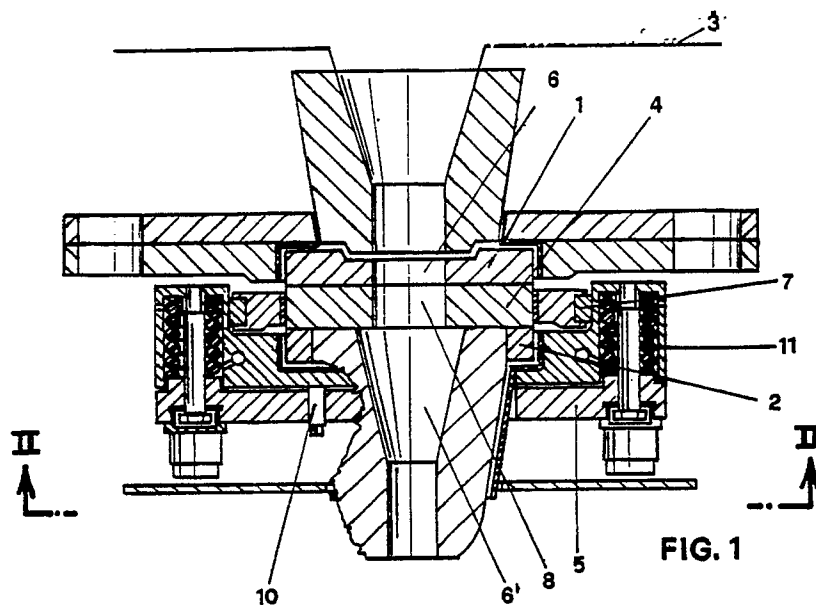


FIG. 1

This invention relates to an improved three-plate slide gate for a tundish.

In casting systems for molten metals, slide gates are known for application to the tundish in order to control the molten metal jet running into the ingot mould. Slide gates comprising three superposed plates are particularly known, in which the two outer plates are fixed and each provided with a hole coaxial to that of the other plate, whereas the intermediate plate, also provided with a hole, is mobile longitudinally between the two fixed plates to enable its hole to be aligned with the holes of these latter and thus establish continuity of passage for the molten metal towards the ingot mould.

A considerable problem of known slide gates derives from the opposing requirements of on the one hand the need for the intermediate plate to be slidable relative to the outer plates, and on the other hand the need for a seals to exist between the plates which is sufficient to prevent air infiltration through the plates and into the steel discharge channel. In this respect, air or rather the oxygen contained in it burns the carbon with which the plates have been treated to increase their mechanical strength and their resistance to chemical attack by the steel, so causing the steel to undergo reoxidation and quality decrease, thus nullifying all attempts to conduct the casting operation out of contact with air.

In the case of three-plate slide gates the drawback is accentuated in that there are two possible entry paths for air drawn in by the venturi effect of the molten metal passing through the discharge channel, these being along the interfaces between the plates.

In order to obviate or at least reduce this drawback it has been proposed to apply by means of springs a mutual compression force between the two plates which tends to keep them as close together as possible, preventing the formation of gaps and air infiltration through them. This remedy has however proved unsatisfactory because of the practical difficulty of obtaining sufficient adherence between the plates, as they tend to curve under the effect of the springs, to consequently give rise to the formation of said undesirable gaps.

The main object of the invention is to reduce this drawback by providing a three-plate slide gate, particularly for a tundish, in which a substantial seal is provided between the adjacent plates. In addition, in known slide gates it is very difficult for the mobile plate to move relative to the fixed plates under conditions of perfect mutual translation. In this respect, undesirable stresses arise leading to abnormal movements having componentes at an angle to the longitudinal slide plane of the mobile plate.

These abnormal movements, allowed by the yieldability of the springs, again result in gap formation between the plates, with further risk of air infiltration into the casting channel. In particular, so-called steel seepage can occur, due to the molten metal penetrating into the gaps between the plates caused by their non-mating condition, and solidifying to produce small wedges which during subsequent movement increase these gaps so that the phenomenon automatically worsens until unacceptable.

A further object of the invention is to obviate or at least reduce this drawback, at least when the degree of wear between the plates is still small.

A further drawback of known slide gates is that as a result of all these stresses, deformations and expansions to which the plates are subjected, a longitudinal crack often forms on the mobile plate, beginning at the casting hole and extending along the centre axis of the plate.

This crack also becomes a repository for molten steel, which then solidifies and under the effect of the movement of the plate and the thermal stresses to which it is subjected increases the phenomenon until the plate is made unserviceable.

A further object of the invention is to also obviate this drawback.

All these and further objects which will be apparent from the description given hereinafter are attained according to the invention by an improved three-plate slide gate, particularly for a tundish, of the type comprising two fixed plates rigid with the tundish and provided with a coaxial hole, and, interposed therebetween, a mobile plate provided with a hole and supported by a frame driven in such a manner as to cause said plate to slide longitudinally between a position in which its hole is aligned with those of the two fixed plates and a position of non-alignment, and a plurality of springs acting in the sense of urging the lower fixed plate against the upper fixed plate to provide sealed contact between the corresponding surfaces of the fixed plates and mobile plate substantially for any position of this latter, characterised in that the springs are transversely fixed with respect to the tundish and have their lines of action lying within the longitudinal dimensions of the mobile plate for any position of this latter.

The presente invention will be more apparent from the description of a preferred embodiment thereof given hereinafter with reference to the accompanying in which:

Figure 1 is a vertical section on the line I-I of Figure 2 through a slide gate according to the invention; and

Figure 2 is a view from below on the line II-II of Figure 1.

As can be seen from the figures the slide gate

according to the invention is of conventional three-plate type, of which the two outer plates are fixed to the tundish 3 while the intermediate plate 4 is mobile tangentially to these.

Specifically, the upper fixed plate 1 is directly secured to the outer metal container of the tundish 3, whereas the lower fixed plate 2 is secured to a structure 5, itself fixed to said tundish 3.

Both the fixed plates 1,2 are provided with a passage hole 6,6' for the molten metal, the two being equal and coaxial.

The mobile plate 4 is mounted substantially as an exact fit in a perimetral frame 7 secured to the drive and guide members (not shown) for tangentially moving said mobile plate relative to the adjacent fixed plates 1,2.

The mobile plate 4 is also provided with a casting hole 8, the movements of this mobile plate being such that when in one of its two end positions the hole 8 is coaxial to the holes 6,6' of the fixed plate 1,2, whereas when in the other end position the hole of the mobile plate faces portions of the fixed plates not comprising the relative hole.

Between the steel frame 7 of the mobile plate 4 and the mobile plate itself, which is of refractory material with both surfaces carbon treated, there are interposed a plurality of grub screws 9, the purposed of which is to exert on the plate a series of forces of "centripetal" type, in particular at the casting hole 8.

To the structure 5 supporting the lower fixed plate 2 there are applied a plurality of screws 10 acting on the lower surface of said plate for the purpose of pressing it against the facing upper fixed plate 1 to keep the sandwich formed by the three plates of the slide gate compressed vertically.

To said structure 5 there are also applied a plurality of springs 11 of vertical axis, again for the purpose of transversely compressing the sandwich formed by the three plates to compensate any slack which forms during use.

The springs 11 are disposed about the casting hole 6' at a distance therefrom such that, taking into account the longitudinal dimensions of the mobile plate 4, their line of action falls within the longitudinal dimensions of said mobile plate for any position thereof.

The operation of the slide gate according to the invention is as follows.

When the mobile plate 4 has been mounted on its frame 7, the grub screws 9 are tightened to keep the plate "compacted", for the dual purpose of reducing the risk of crack formation and of slowing the rate of propagation of any which may have formed.

After the mobile plate 4 together with its frame 7 have been mounted in the slide gate between the

two fixed plates 1,2 and its frame has been connected to the relative drive members, the screws 10 are tightened to "compact" the three plates 1,2,4 transversely together to ensure mutual sealing and prevent any not perfectly tangential movements of the mobile plate 4 causing the various plates to separate because of the inevitable yielding of the springs 11.

The purpose of the springs 11 is to take up any slack between the plates 1,2,4, their action extending over all three plates about the casting holes 6,6',8 and therefore helping to provide an effective seal, even in the case of possible plate deformation.

Essentially, the combined effect of the springs 11 and screws 10 ensures an effective seal between the plates for any relative position thereof, this on the one hand preventing carburization of their mutually contacting surfaces and on the other hand preventing the entry of air drawn in from the outside with consequent oxidation of the jet of molten metal.

Claims

1. An improved three-plate slide gate, particularly for a tundish, of the type comprising two fixed plates (1,2) rigid with the tundish (3) and provided with a coaxial hole, and, interposed therebetween, a mobile plate (4) provided with a hole and supported by a frame (7) driven in such a manner as to cause said plate to slide longitudinally between a position in which its hole is aligned with those of the two fixed plates and a position of non-alignment, and a plurality of springs (11) acting in the sense of urging the lower fixed plate against the upper fixed plate to provide sealed contact between the corresponding surfaces of the fixed plates and mobile plate substantially for any position of this latter, characterised in that the springs (11) are transversely fixed with respect to the tundish and have their lines of action lying within the longitudinal dimensions of the mobile plate (4) for any position of this latter.

2. A slide gate as claimed in claim 1, characterised by comprising a plurality of screws (10) with their axis substantially parallel to the axis of said springs (11) and acting against the outer surface of the lower fixed plate (2) to prevent it separating from the upper fixed plate (1), said screws being closer than said springs to the casting hole.

3. A slide gate as claimed in claim 1, characterised in that the frame (7) of the mobile plate (4) comprises a plurality of screws (9) acting on the edge of said plate orthogonally to the screws (10) to compress it in a transverse direction.

4. A slide gate as claimed in claim 1, charac-

terised in that the springs (11) are disposed about the casting hole (6') of the lower fixed plate (2) along a substantially circular line.

5. A slide gate as claimed in claim 2, characterised in that two screws (9) situated on opposite sides of the casting hole (8) are applied to each longitudinal side of the support frame (7) for the mobile gate (4).

6. A slide gate as claimed in claim 3, characterised in that the screws (10) are applied to a support structure (5) for the two fixed plates (1,2) which is itself fixed to the tundish (3).

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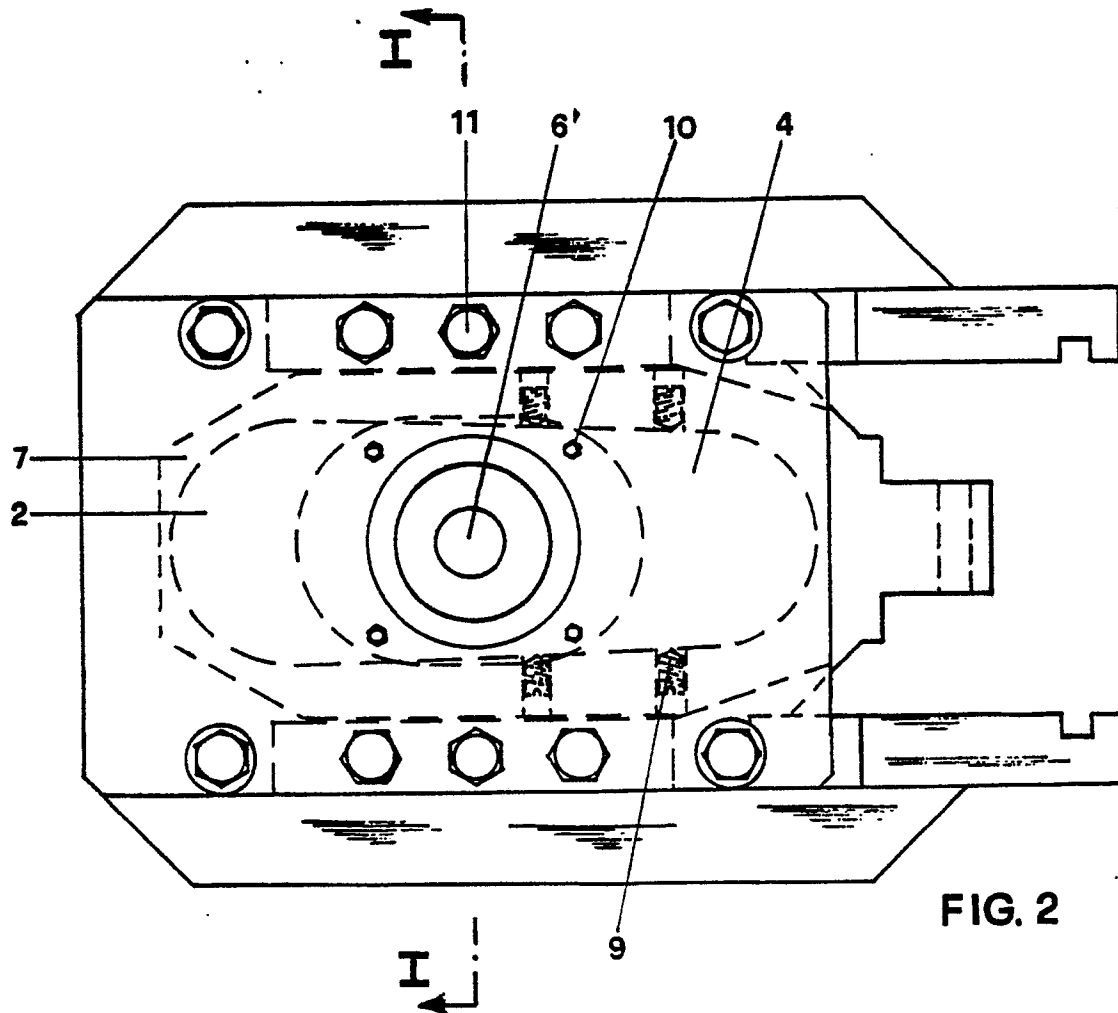
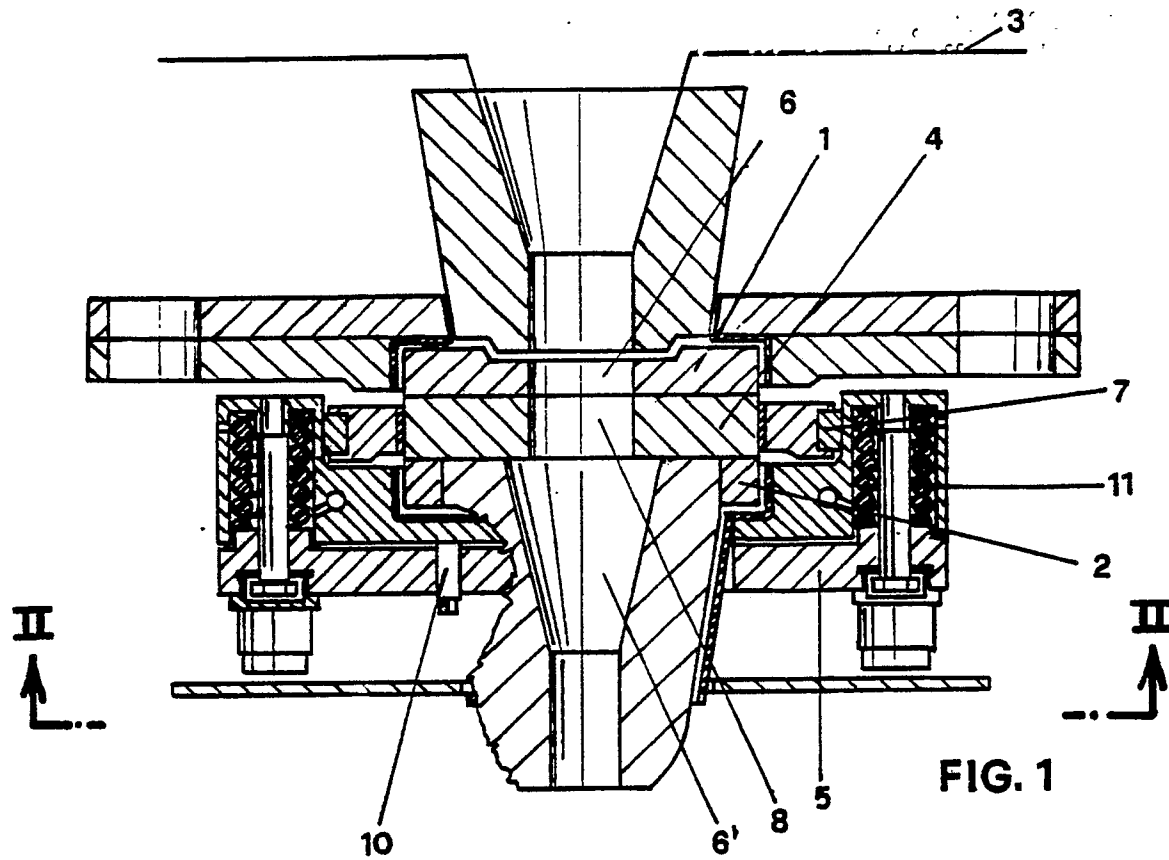
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European Patent
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EUROPEAN SEARCH REPORT

Application Number

EP 89 10 9008

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	DE-A-1 923 045 (UNITED STATES STEEL CORP.) * Page 3, lines 28-33; claim 1; figure 3; page 4, lines 13-18 * ---	1-2	B 22 D 41/40
Y	US-A-3 765 579 (F. CRAMER et al.) * Figure 1; column 2, lines 1-40 * ---	1-2	
A	US-A-4 660 749 (YOKOI et al.) * Figure 2; column 2, lines 23-40 * ---	1	
A	FR-A-2 332 831 (KUROSAKI REFRACTORIES CO., LTD) * Figure 4; page 6, line 25 - page 7, line 12; figures 23,24; page 30, lines 3-14 * ---	1,3	
A	US-A-4 415 103 (E.P. SHAPLAND et al.) * Figure 2; column 5, lines 1-20 * ---	1	
A	DE-A-2 342 876 (USS ENGINEERS AND CONSULTANTS INC.) * Figure 9; page 2, lines 12-22 * -----	4	TECHNICAL FIELDS SEARCHED (Int. Cl.5) B 22 D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 18-05-1990	Examiner DOUGLAS K.P.R.
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