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(54) Box nozzle for ladles and the like, with lateral torsion bars
Mit lateralen Torsionsstäbe ausgestatteter Schieberverschluss für metallurgische Gefässe
Fermeture coulissante pour récipients de coulée pourvue de barres de torsion latérales

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Description

The present invention relates to a box nozzle with lateral torsion bars according to the preamble of claim 1. Box nozzles have now been used for several years for discharging ladles, tundishes and the like, if desired. Their use has gradually extended to ever-larger ladles and their reliability has grown in parallel with the improvement in quality of the refractories available on the market.

Box nozzles, of course, consist basically of a pair of refractory plates, one fixed and the other movable, each with an orifice.

Relative movement of these two plates permits regulation of the size of the opening through which the liquid steel leaves the ladle.

Said pair of refractory plates is associated with a first refractory coupling positioned beneath the sliding plate and moving with it, and a second refractory coupling, positioned above the fixed refractory plate, inserted in the thickness of the refractory lining of the ladle plus a third refractory coupling which surrounds it.

These refractory parts are inserted in a support and moving device which generally includes:

- a metal leveling plate, positioned beneath the bottom of the ladle and complete with an appropriate opening for inserting and extracting the second fixed refractory coupling;
- a fixed upper metal plate bolted to the aforesaid leveling plate;
- a fixed lower metal plate, referred as "the cover" for short, which must be dismountable to permit maintenance of the mechanisms and refractory parts of the box nozzle; said "cover" is generally connected to the fixed upper metal plate by means of hinged bolts;
- a sliding metal frame referred to henceforth as "the slide", which moves between the fixed upper metal plate and "the cover";
- guides positioned between "the cover" and "the slide".

The aforesaid metal plates have a large central opening, of course. The two refractory plates with orifices are suitably anchored, the fixed one to the lower face of the fixed upper plate, and the moving one to the upper face of "the slide".

To ensure a good seal for the liquid metal, it is evident, of course, that the sliding contact faces of the fixed and movable refractory plates must be pressed evenly against one another. It is equally evident that the required pressure must be provided by appropriate action between the jaws of connection between the fixed upper metal plate and "the cover". It is necessary to be able to set these means of connection precisely, quickly and safely.

GB 2 158 380 A, utilized for forming the preamble of claim 1, discloses a sliding valve gate in which pivotal side members support torsion bars acting on rocker arms to thrust valve plates into leak-tight contact with one another. Two torsion bars act on each rocker arm.

Bolts and nuts are utilized to draw side members towards one another and to adjust the level of stress in the torsion bars. Due to necessity of using two torsion bars for each rocker arm, the sliding valve gate is cumbersome; moreover, all the torsion bars can only receive the same level of stress, which in some cases could be inconvenient.

According to the Italian Patent Application 12435A/90 dated March 2, 1990, in a box nozzle of the above type, a tilting frame, supported on springs resting on the long sides of "the cover" is inserted between the fixed lower plate, or "cover", and "the slide". In this previous invention the spring assemblies consist of Belleville washers inserted in special housings formed, on the one side, on the lower face of said tilting frame and, on the other, on the upper face of said "cover".

The tilting frame was thus substanised by an elastic bed which allowed the counterposed faces of the fixed and movable refractory plates to rest securely on one another, thus ensuring a good distribution of the pressures over the surfaces in mutual contact.

Furthermore, the arrangement of the spring assemblies around the long sides of "the cover" permitted the springs to be kept as far as possible from the central orifice in the refractory plates and hence from the source of heat generated by the flow of molten metal.

However, the spring assemblies could only partially be moved away from the heat source because the diameter of the assemblies themselves was a large fraction of the width of the box nozzle. Hence the average working temperature of these spring assemblies was still quite high, so they gradually came to lose their elasticity.

Thus, although the box nozzle functioned perfectly, it was necessary to replace the spring assemblies periodically, considerably increasing maintenance costs.

The aim of the present invention is to eliminate the above drawbacks and also to ensure means for protecting the stream of liquid metal so as to prevent contact with the surrounding air.

This object is solved by the features of claim 1.

According to the invention, instead of the spring assemblies, the tilting frame is pushed against the fixed upper metal plate by at least two counterposed pairs of cranks connected to the free ends of torsion bars, while the other ends are fixed to "the cover".

Because of the elongated form of the torsion bars, they can be positioned on the long sides of "the cover". In other words, they can be positioned as far away as possible from the heat source, so that they retain their elasticity for a long time, thus reducing the amount of maintenance.

The essential characteristics of the invention are summarized and schematized in the claims. However, objects and advantages thereof also emerge from the
following description concerning preferred embodiments shown only by way of example, with particular reference to the accompanying drawings, where:

- Fig. 1 shows a half-sectionized longitudinal view of the box nozzle in the open position, where the orifices of the fixed and movable refractory plates are lined up; the term "longitudinal" indicates the direction parallel to the direction of movement of the sliding refractory plate;
- Fig. 2 is a half cross-section of the box nozzle on II-II in Fig. 1; it should be noted that the sectioned part beneath the III-III plane follows the II-II' line of Fig. 3 below;
- Fig. 3 (upper part) shows a section along III-III of Fig. 2, while Fig. 3 (lower part) gives a view of the box nozzle from the bottom, with certain details in section as per the III-III plane of Fig. 1;
- Fig. 4 shows a view from the bottom of the fixed upper plate;
- Fig. 5 is a section along V-V of Fig. 4;
- Fig. 6 is a section along VI-VI of Fig. 4;
- Fig. 7 (upper half) provides a top view of "the cover", while Fig. 7 (lower half) provides a view thereof from the bottom;
- Fig. 8 is a cross-section of "the cover" on VIII-VIII of Fig. 7;
- Fig. 9 is a partial longitudinal section of "the cover" on the IX-IX plane of Fig. 7;
- Fig. 10 (upper part) provides a view from the bottom of the tilting frame, while Fig. 10 (middle part) provides a top view thereof;
- Fig. 11 is a cross-section of the tilting frame on XI-XI of Fig. 10;
- Fig. 12 is a longitudinal section of the tilting frame on XII-XII of Fig. 10;
- Fig. 13 (upper part) provides a view of the slides from the bottom, while Fig. 13 (middle part) provides a top view thereof;
- Fig. 14 is a cross-section of the slide on the XIV-XIV plane of Fig. 13;
- Fig. 15 is a longitudinal section of the slide on the XV-XV plane of Fig. 13;
- Fig. 16 provides a half-sectionized view of the sliding refractory plate associated with the relevant coupling;
- Fig. 17 provides a half-sectionized view of the refractory coupling alone;
- Fig. 18 is a section on the XVIII-XVIII plane of Fig. 17.

With particular reference to the above figures, reference number 10 indicates the fixed upper metal plate that is attached to the bottom of the ladle by means of screws not indicated in detail. Drilled hinge-pieces 11 and 12 are fixed to the long side of said plate.

Hinged to these via pins are bolts 13 and catches 14.

By means of nuts 15 of bolts 13, fixed upper plate 10 supports a lower metal plate 20, which is also fixed when the box nozzle is in operation but can be detached from the fixed upper plate for nozzle maintenance operations.

Said lower plate 20, known as "the cover", is actually formed of a robust quadrangular frame with two pairs of lugs 21 on the external longitudinal sides, pierced by splined holes 22 on the horizontal plane. Said cover 20 provides also external longitudinal flanges 23 above said lugs 21. The external flanges have notches 24 and 25 to permit the passage of bolts 13 and catches 14.

One splined end 41 of a solid shaft is inserted into each of the splined holes 22, while the other splined end 42 is inserted in the end-bush 43 - also splined - of another shaft 44 which is hollow, coaxial with and placed over said solid shaft 40. These solid and hollow shafts together form the torsion bars.

To the other end of hollow shaft 44 is connected a crank 45, which protrudes through a slot 26, with its free end 46 inside the long sides of the cover 20.

The cover 20 also has an ample rectangular opening 28 for the passage of the sliding coupling 71 and, on its transverse edges, it also has ample passages 129 for the actuating rod 83 of a hydraulic ram 84 which is fixed to the cover 20 by screws and threaded holes 85.

Ends 46 of cranks 45 provide a flexible support for a tilting frame 50 which has specific seats 51. The tilting frame 50 has an ample central opening 52 roughly rectangular in shape, while on the upper face of its long sides there are guide strips 53 for slide 60 which has a circular central opening 61. The sliding refractory plate 70 is mounted on the upper face of slide 60.

Fixed refractory plate 30 is mounted against the lower face 16 of the fixed upper plate 10. Fixed upper refractory coupling 31 rests against said fixed refractory plate 30.

In order to complete the elements illustrated in Fig. 1 there is the metal coupling 80, fixed to the upper face of a heat shield 81, connected to a metal plating 73 which surrounds and protects refractory coupling 71 fixed to sliding plate 70.

Additionally there are the guide strips 62 fixed to the long sides of slide 60, destined to run on guide strips 53 attached to the tilting frame 50. A third pair of strips 63 is fixed to the upper face of the long sides 27 of cover 20 and, together with guide strips 53, ensures heightwise restriction of the movement of slide 60 which is actuated by rod 83 of ram 84.

The third fixed refractory coupling 32, which surrounds coupling 31 and rests against the upper surface of levelling plate 33, welded to the bottom 34 of the ladle, is shown in Fig. 1.

Coupling 32, in turn, is surrounded by the inner refractory lining 35 of the ladle.

Fig. 1 also illustrates the metal plating 36 of fixed plate 30, as well as the metal plating 72 and 73 of sliding
refractory plate 70 and sliding coupling 71.

It should be observed that nuts 15 of bolts 13 are tightened flush to the external flange 23 of cover 20: this eliminates the need for the use of torque spanners, thus simplifying assembly.

It should also be noted that catches 14 do not support flange 23 when nuts 15 are tightened, since their function is to indicate to the operator that nuts 15 have been completely tightened: if this is not the case, it is not possible to tilt the catches to the position illustrated in Fig.1.

Catches 14 also provide a guarantee against accidental opening of bolts 13.

Fig.1 shows magnets 18 inserted in corresponding cavities of catches 14 and which act on the sides of cover 20 preventing the catches from turning outwards.

In Fig.1, and with particular reference also to Fig.16, an annular cavity 87 is visible between the external surface of the sliding refractory coupling 71 and its metal plating 73. Through conduit 86, this annular cavity is pressure fed with an inert gas - e.g. argon - and on its turn it feeds the pressurized inert gas beneath the metal plating 73, through channels 89 obtained via grooves cut on the outer surface of coupling 71; said grooves are covered by plating 73 of coupling 71.

Hence when the inert gas is pressure fed into conduit 86, it enters first into annular cavity 87 and then into channels 89 whence it emerges to create a protective layer about the steel casting which prevents oxidation of the steel by the atmosphere.

Fig.2 shows how cranks 45 support tilting frame 50 on which runs slide 60 through guide strips 53 and 62.

When cranks 45 are not pressed against the bottom of tilting frame 50, at rest, their axis is horizontal; in the case illustrated, the angle (y) represents the elastic deformation imposed on the crank and the two shafts 40 and 44, which corresponds to a very precise force applied to the end of the crank at the bottom of the tilting frame 50.

Of course, the initial position of the cranks will be selected according to the force that these must exert on the bottom of tilting frame 50.

The dimensions of the various parts of the equipment are such that, when, through nuts 15, cover 20 is thrust upwards, sliding refractory plate 70 comes into contact with fixed refractory plate 30 before nuts 15 have attained their end-of-travel position, to which a crank position between the upper surface of flanges 23 of cover 20 and the lower surface of lugs 17, supporting bolts 13, is corresponding.

Lugs 17 are mounted on pins 19 supported by hinge-pieces 11 or 12 protruding from the sides of the fixed upper plate 10. Said hinge-pieces 11 or 12 are fixed to the sides of plate 10 by screws and are not shown in Figs.4-6.

When the opposing faces of the fixed and movable refractory plates 30 and 70 come into contact, the subsequent tightening of nuts 15 creates an elastic torsion in shafts 40 and 44 which form the torsion bars according to the invention, to which the inclined position of angle (y) of crank 45, shown in Fig.2, corresponds.

In said Fig.2 nuts 15 have been tightened until the counterposed faces 17 and 23 rest against one another. As can be seen from Figs.2 and 3, angle (y) can vary within fairly wide limits so as to achieve the desired locking force between cranks 45 and tilting frame 50, between this and slide 60, between slide 60 (through guides 63 and 62) and refractory plate 70 and finally between this and fixed refractory plate 30.

Furthermore, for a given angle (y) the locking force can also vary within broad limits because, in the design phase, the diameters and, if necessary, the lengths of shafts 40 and 44 can be varied precisely for this purpose.

Strips 63, which are fixed on flanges 23 of cover 20 when this is still open, can produce an initial deformation of torsion bars 40 and 44, endowing them with a preliminary loading.

After cover 20 is closed, by tightening nuts 15 to the end of their travel (and hence without using torque spanners) a high compression load can be achieved between the faces of the refractory plates 30 and 70, even if the travel of said nuts is relatively limited.

Hence an ample range of easily-achieved settings is made available by modifying the thicknesses of the relevant structural components during the design stage.

Though not described in detail, there are holes in cover 20 for the passage of cooling air, which is fed to various parts of the box nozzle when in use. Figs.4, 5 and 6 provide structural details of fixed upper metal plate 10 which has a rectangular recess 111 on its upper surface to receive the upper metal-clad base of fixed upper refractory plate 30.

The entire fixed upper metal plate 10 is pierced by a circular hole 112, which serves for the passage of the lower end of fixed refractory coupling 31 that can be extracted from below, from the outside of the ladle.

Grooves 113 are on the bottom of recess 111 to facilitate correct positioning of fixed upper refractory plate 30.

The metal plating of the upper face and of the sides of fixed upper refractory plate 30 is also utilized to retain said refractory plate 30 in position in recess 111 by means of cylindrical magnets housed in blind holes 114.

Centring and positioning recesses 115 and 116 for fixed hinge-pieces 11 and 12 are also provided on the long sides of fixed upper metal plate 10. Said hinge-pieces are attached to said metal plate by screws that, for simplicity, are indicated in Fig.2 only by the symmetry axis.

Holes 117 in fixed upper metal plate 10 serve to fix it to ladle-bottom levelling plate 33 via screws. The structural details in Figs.7 and 9 referring to cover 20 have already been described by reference to the preceding Figures.

The structural details of tilting frame 50, shown in
Figs.10 to 12, have also been referred to above.

Referring now to Figs.13 to 15 concerning slide 60, in addition to circular hole 61 crossing the slide 60, the upper face of the latter also has an elongated recess 162 to house sliding refractory plate 70 which, as stated above, is metal clad on the lower face and on sides, allowing therefore the use of cylindrical magnets housed in circular holes 163 on the bottom of recess 162.

One end of slide 60 has means for connecting to actuating rod 83.

Though the invention is based on what has been described and illustrated above, many modifications and variations may be made in its embodiment.

For instance, the locking bolts which hold cover 20 can be replaced by pairs of rotating stirrups, as described in the Italian Patent Application mentioned in the introductory part of this Description.

It should also be noted that where sliding refractory coupling 71 is concerned, instead of the axial channels 89 on its outer surface, it could have radial conduits which emerge in its axial casting hole; and as an alternative, there could be a porous zone that produces the same effect as said radial channels.

However, axial channels 89 are the preferred embodiment, since they do not weaken the structure of the sliding refractory coupling.

Claims

1. Box nozzle for ladles and the like, of the type which includes:

   a) a fixed upper metal plate (10) connected to the bottom of the ladle;
   b) a lower metal plate (20), referred to as "the cover"; supported by the latter by means of bolts (13) and tiltable and detachable from the latter for maintenance of the box nozzle;
   c) a third metal plate (60) which runs between the previous two, through appropriate controls, referred to as "the slide";
   d) a first refractory plate (30) with an orifice, held in a fixed position by the fixed upper metal plate (10);
   e) a second refractory plate (70) with an orifice, held by slide (60) and hence sliding with the latter;
   f) a tilting frame (50) inserted between said slide (60) and said cover (20);
   g) elastic support means, in the form of four torsion bars, positioned between said cover (20) and said tilting frame (50), aligned parallel to the long sides of cover (20); characterized in that each of said torsion bars comprises a solid shaft (40) provided with a first splined end (41), inserted in a splined hole (22) of lower plate (20), and a second free splined end (42) inserted in a corresponding splined end-bush of a hollow shaft (44) extending, around and over said shaft (40), towards said first end (41), the free end of shaft (44) nearest to said end (41) bearing a crank (45), intended to elastically support sliding frame (60) through intermediate frame (50).

2. Box nozzle according to claim 1, characterized in that said crank (45) passes through the long side (27) of said cover (20) via a slot (26).

3. Box nozzle according to the preceding claims, characterized in that said bolts (13) between fixed upper metal plate (10) and cover (20) are tightened to a flush position which unequivocally establishes the relative position between said plate (10) and said cover (20).

4. Box nozzle according to the preceding claims, characterized in that a sliding refractory coupling (71) is provided, on its outer surface, with an annular groove and axial grooves which, together with outer metal plating (73) of said coupling (71) form an annular cavity (87) acting as a manifold for a pressurized gas, and corresponding axial channels (89) giving onto the lower face of said refractory coupling (71) around the liquid metal discharge line.

5. The use of four torsion bars according to claims 1 and 2 in box nozzles as defined in claim 1, to elastically urge the slide (60) with relevant refractory plate (70) against refractory plate (30) in fixed upper plate (10).

Patentansprüche

1. Schieberverschluß für metallurgische Gefäße (Gießpfannen) und dgl. des Typs, der umfaßt

   a) eine feststehende obere Metallplatte (10), die mit dem Boden (der Unterseite) des metallurgischen Gefäßes (der Gießpfanne) verbunden ist;
   b) eine untere Metallplatte (20), hier als "Abdeckung" bezeichnet, die von der ersteren mittels Bolzen (13) getragen wird und schwenkbar und von der ersteren abnehmbar ist für die Wartung des Schieberverschlusses;
   c) eine dritte Metallplatte (60), die zwischen den obengenannten beiden durch geeignete Kontrollen läuft, hier als "Schieber" bezeichnet;
   d) eine erste feuerfeste Platte (30) mit einem Loch, die durch die feststehende obere Metallplatte (10) in einer festen Position gehalten wird;
   e) eine zweite feuerfeste Platte (70), die ein Loch aufweist und durch den Schieber (60)
festgehalten wird und somit zusammen mit letzterem gleitet;
f) einen Kipprahmen (50), der zwischen den Schlitzen (60) und der Abdeckung (20) eingesetzt ist;
g) eine elastische Träger-Einrichtung in Form von vier Torsionsstäben, die zwischen der Abdeckung (20) und dem Kipprahmen (50) parallel ausgerichtet zu den Längsseiten der Abdeckung (20) angeordnet sind;
dadurch gekennzeichnet, daß jeder der genannten Torsionsstäbe umfaßt eine Vollwelle (40), die mit einem ersten kerbverzahnten (keilförmigen) Ende (41), das in ein kerbverzahntes (keilförmiges) Loch (22) der unteren Platte (20) eingesetzt ist, und mit einem zweiten freien kerbverzahnten (keilförmigen) Ende (42) ausgestaltet ist, das in eine entsprechende kerbverzahnte (keilförmige) Endhülse einer Hohlwelle (44) eingesetzt ist, die sich um die genannte Welle (40) herum und über diese in Richtung auf das erste Ende (41) erstreckt, wobei das freie Ende der Welle (44), der das Ende (41) am nächsten liegt, eine Kurbel (45) trägt, die dazu dient, den Gleitrahmen (60) über den dazwischenliegenden Rahmen (50) elastisch zu unterstützen.

2. Schieberverschluß nach Anspruch 1, dadurch gekennzeichnet, daß die genannte Kurbel (45) durch einen Schlitz (26) die Längsseite (27) der Abdeckung (20) passiert.

3. Schieberverschluß nach den vorhergehenden Ansprüchen, dadurch gekennzeichnet, daß die Bolzen (13) zwischen der feststehenden oberen Metallplatte (10) und der Abdeckung (20) in einer bündigen Position befestigt sind, welche die relative Position zwischen der Platte (10) und der Abdeckung (20) eindeutig festlegt.

4. Schieberverschluß nach den vorhergehenden Ansprüchen, dadurch gekennzeichnet, daß eine feuerverfeste Gleitkupplung (71) auf ihrer äußeren Oberfläche mit einer ringförmigen Nut und axialen Nuten versehen ist, die gemeinsam zusammen mit einer äußeren Metallplattierung (73) der genannten Kupplung (71) einen ringförmigen Hohlraum (87) bilden, der als Verteiler für ein unter Druck stehendes Gas dient, und die entsprechende axiale Kanäle (89) aufweist, die auf der unteren Oberfläche der feuerverfsten Kupplung (71) um das flüssige Metall herum eine Austragsleibung bilden.

5. Verwendung der vier Torsionsstäbe nach den Ansprüchen 1 und 2 in Schieberverschlüssen, wie sie in Anspruch 1 definiert sind, zum elastischen Anpressen des Schiebers (60) zusammen mit der relevanten feuerverfesten Platte (70) an die feuerverfeste Platte (30) in der feststehenden oberen Platte (10).

Revendications

1. Busette à tiroir pour poches de coulée ou analogue, du type qui comprend :
a) une plaque métallique supérieure fixe (10), raccordée au fond de la poche de coulée ;
b) une plaque métallique inférieure (20), appelée "le couvercle", qui est supportée par la plaque métallique supérieure à l'aide de boulons (13), qui peut être inclinée par rapport à elle et en être démontée, pour l'entretien de la busette à tiroir ;
c) une troisième plaque métallique (60) qui s'étend entre les deux précédentes, au travers de moyens de commande appropriés, et qui est appelée "le coulisseau" ;
d) une première plaque réfractaire (30) comportant un orifice, qui est maintenue en position fixe par la plaque métallique supérieure fixe (10) ;
e) une deuxième plaque réfractaire (70) comportant un orifice, qui est maintenue par le coulisseau (60) et donc coulissee par rapport à la première plaque réfractaire (30) ;
f) une structure d'inclinaison (50) insérée entre ledit coulisseau (60) et ledit couvercle (20) ;
g) des moyens de support élastique, se présentant sous la forme de quatre barres de torsion, qui sont positionnés entre ledit couvercle (20) et ladite structure d'inclinaison (50), et qui sont alignés aux côtés longitudinaux du coulisseau (20) de façon à en être parallèles ;
caractérisée en ce que chacune desdites barres de torsion comprend un arbre plein (40) muni d'une première extrémité cannelée (41), insérée dans un premier trou cannelé (22) de la plaque inférieure (20), et d'une deuxième extrémité cannelée (42), insérée dans un manchon d'extrémité cannelé correspondant, aménagé dans un arbre creux (44) qui s'étend autour dudit arbre (40) et par dessus ce dernier, en direction de ladite première extrémité (41), l'extrémité libre de l'arbre (44) qui est la plus proche de ladite extrémité (41) supportant une biellette (45), destinée à supporter la structure coulisante (60) de manière élastique par l'intermédiaire de la structure intermédiaire (50).

2. Busette à tiroir selon la revendication 1, caractérisée en ce que ladite biellette (45) passe au travers du côté longitudinal (27) dudit couvercle (20) par une fente (26).
3. Busette à tiroir selon les revendications précédentes, caractérisée en ce que lesdits boulons (13) entre la plaque métallique supérieure fixe (10) et le couvercle (20) sont serrés jusqu'à une position d'affleurement qui établit sans équivoque la position relative entre ladite plaque (10) et ledit couvercle (20).

4. Busette à tiroir selon les revendications précédentes, caractérisée en ce qu'un manchon d'accouplement réfractaire coulissant (71) est muni, sur sa surface extérieure, d'une gorge annulaire et de gorges axiales qui, avec le plaquage métallique extérieur (73) dudit manchon d'accouplement (71), forment une cavité annulaire (87) jouant le rôle de collecteur d'un gaz sous pression, et de canaux axiaux correspondant (89) qui donnent sur la face inférieure dudit manchon d'accouplement réfractaire (71), autour de la conduite de décharge du métal liquide.

5. Utilisation de quatre barres de torsions selon les revendications 1 et 2 dans des busettes à tiroir selon la revendication 1, pour pousser de manière élastique le coulisseau (60), et la plaque réfractaire (70) qui lui est associée, contre la plaque réfractaire (30) se trouvant dans la plaque supérieure fixe (10).