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(54) **TIGHTENING DEVICE FOR A REFRACTORY PLATE OF SLIDING CLOSURE ON THE SPOUT OF A VESSEL FOR MOLTEN METAL**

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(57) **ABSTRACT**

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A clamping device (2") is provided for a refractory plate (3) of a slide closure at the outlet of a container for metal melt. The plate (3) has two pairs of side faces (10, 11), disposed mirror-symmetrically with respect to its longitudinal center plane (L), at which a clamping element (22", 23", 43) disposed in a slider housing (1) engages with its clamping faces. The side faces (10, 11) disposed at one side of the longitudinal center plane (L) form an obtuse angle ( $\gamma$ ). Three of the clamping elements are developed as binding fittings (22", 23") pivotably supported in the slider housing (1) and the fourth clamping element has a binding jaw (43, 30) displaceable in the direction toward the corresponding side face (10 or 11). Therewith results a simple and optimal bracing of this plate (3) stress-loaded by the high-level heating generated during operation.

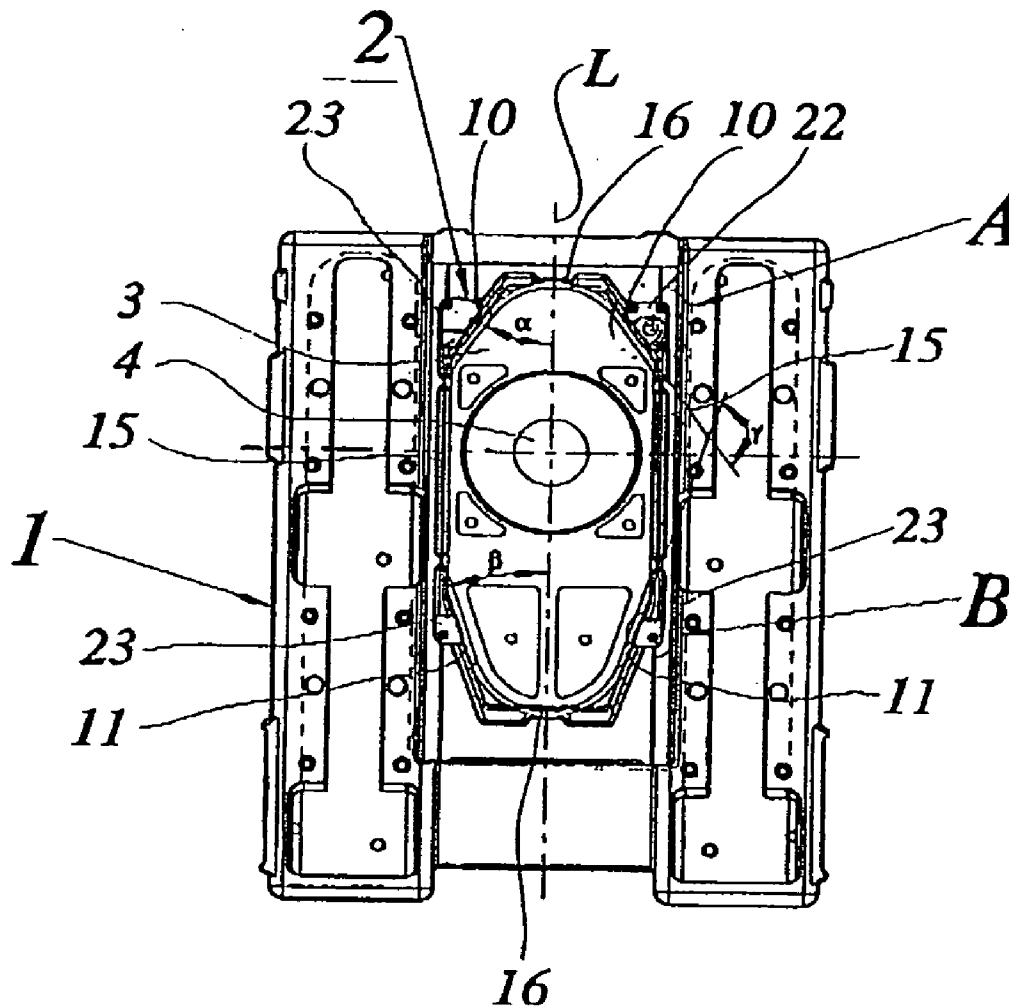
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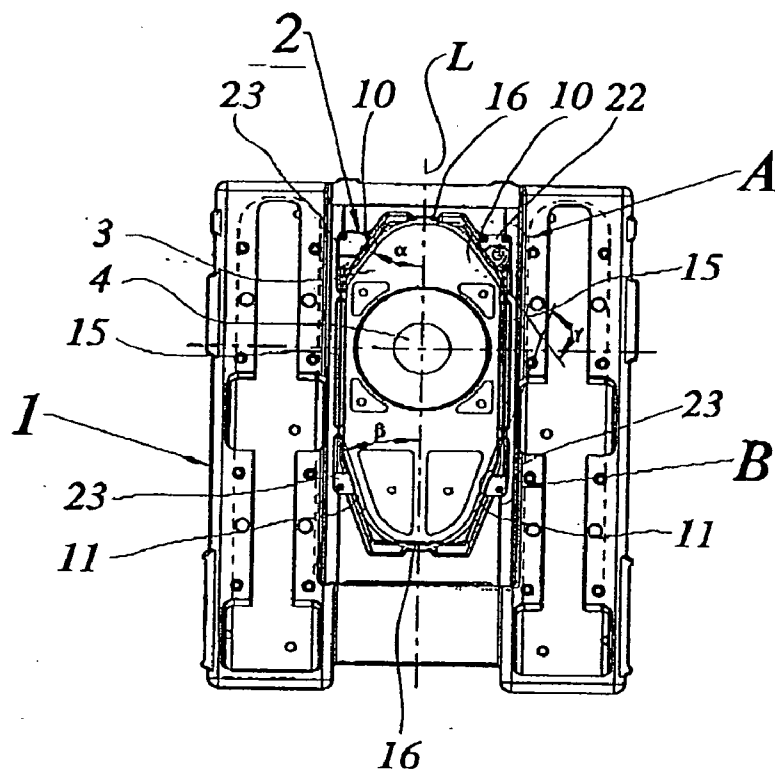
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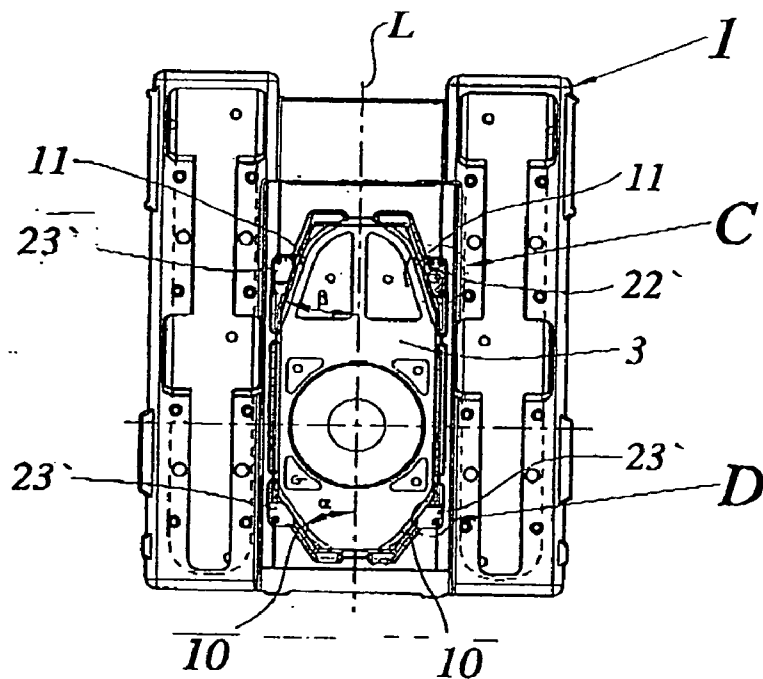
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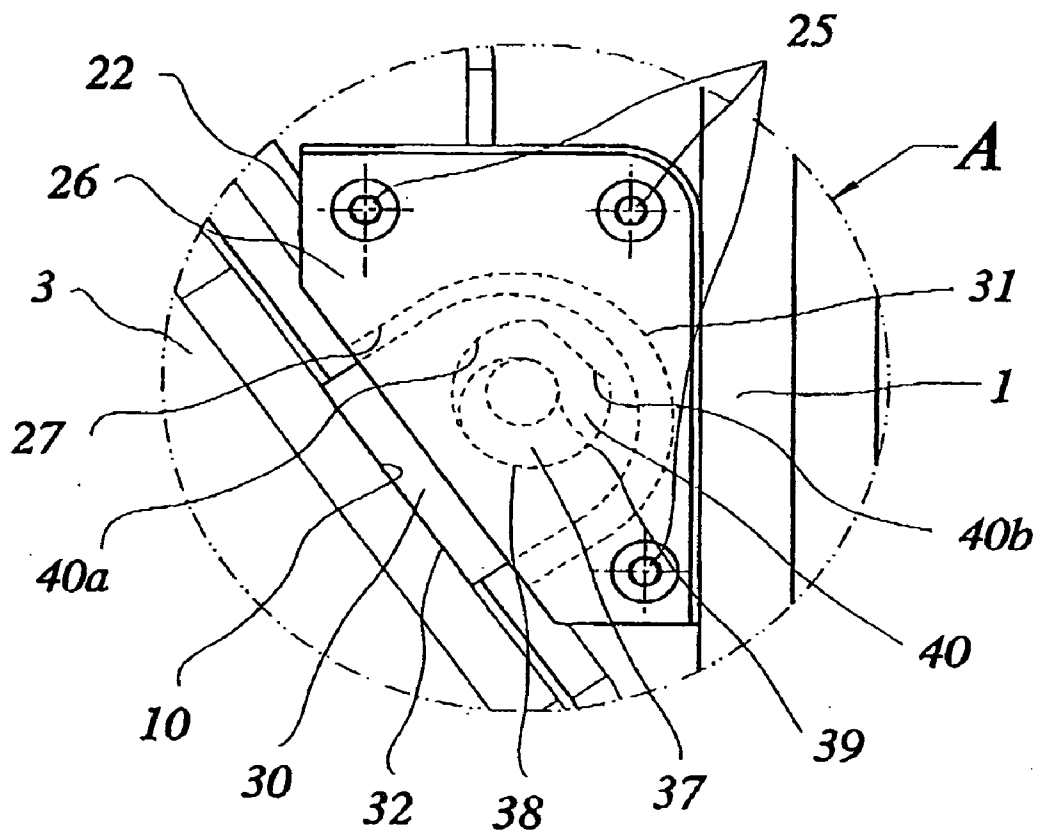
*Fig. 1*



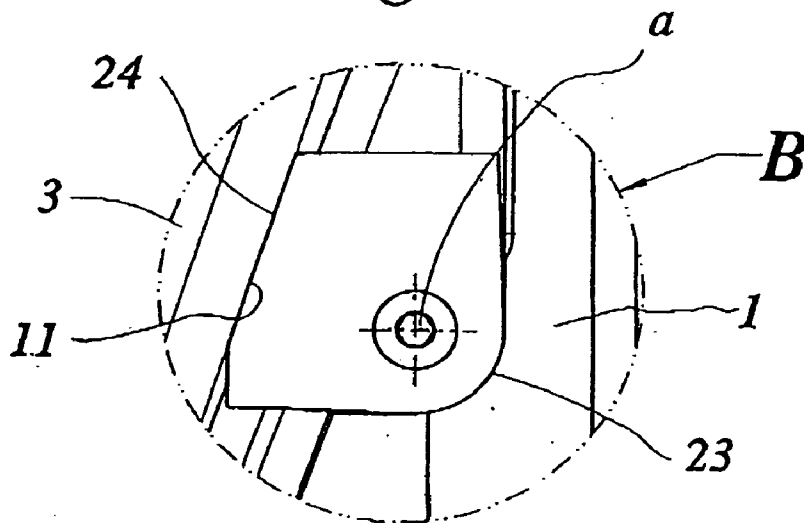
*Fig. 2*



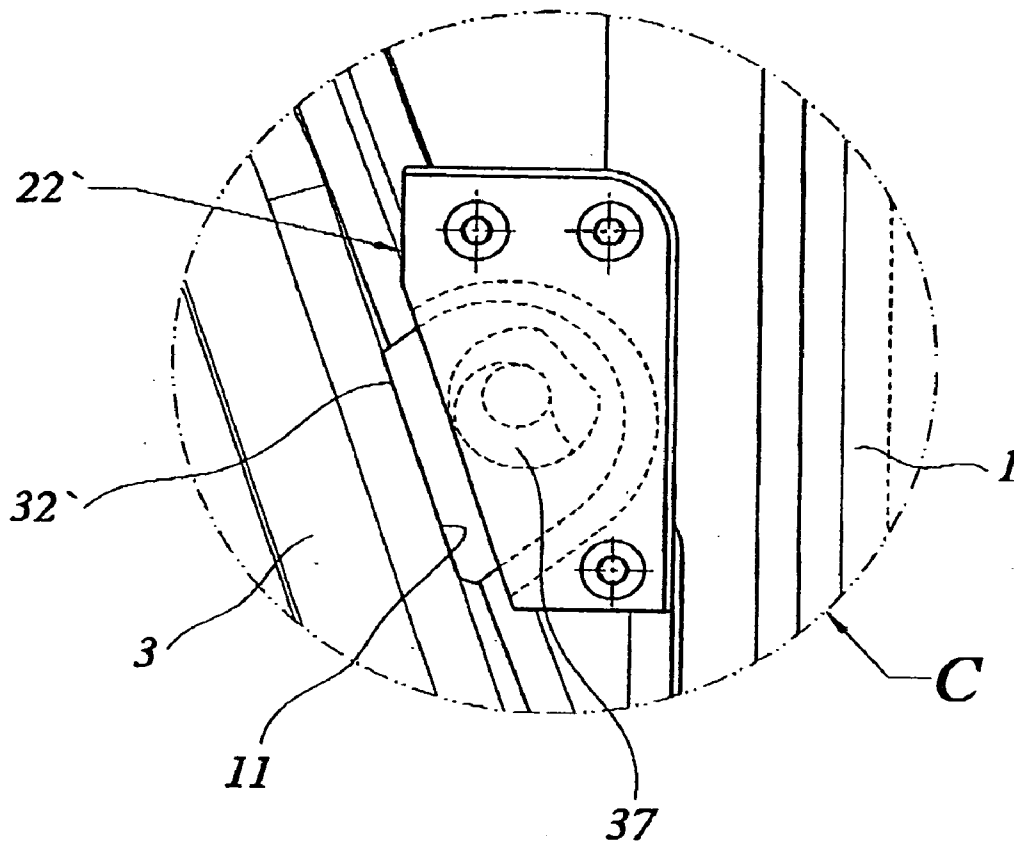
*Fig. 3*



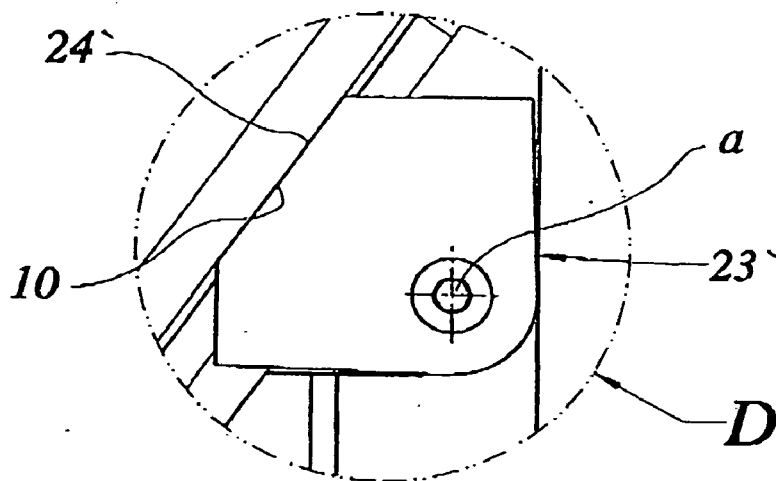
*Fig. 4*



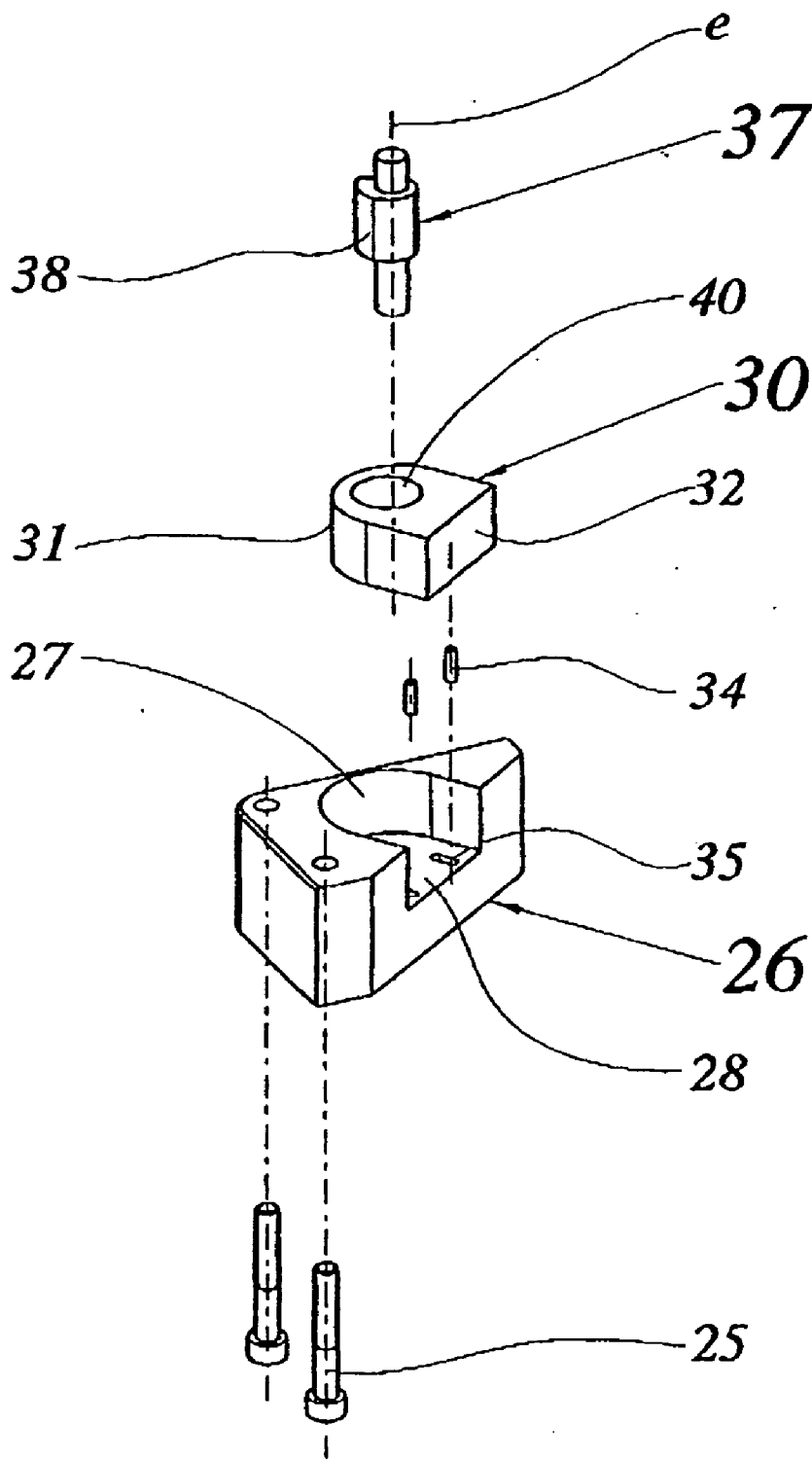
*Fig. 5*



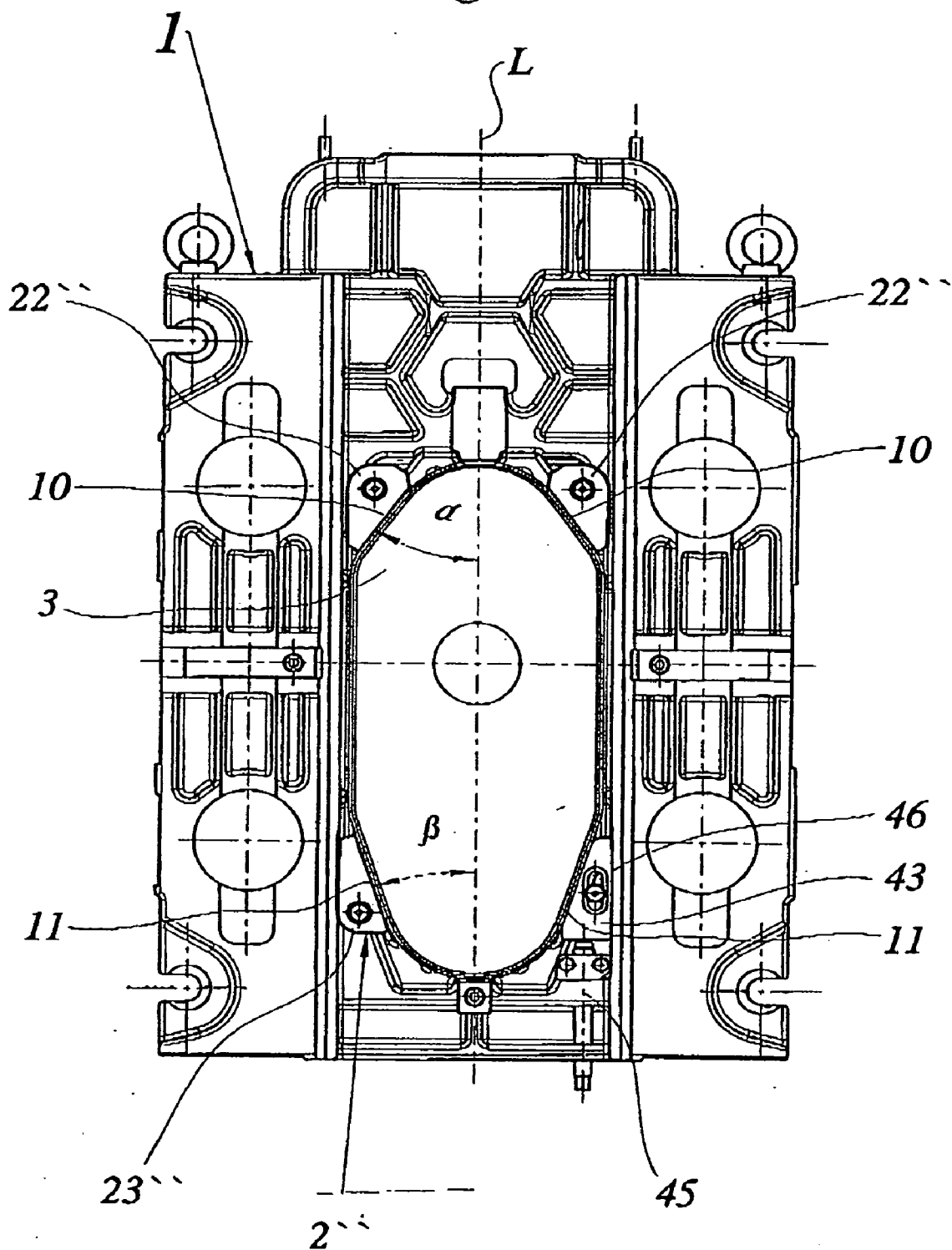
*Fig. 6*



*Fig. 7*



*Fig. 8*



**TIGHTENING DEVICE FOR A REFRACTORY  
PLATE OF SLIDING CLOSURE ON THE SPOUT  
OF A VESSEL FOR MOLTEN METAL**

[0001] The invention relates to a clamping device for a refractory plate of a slide closure at the outlet of a container for metal melt according to the preamble of claim 1 or 7.

[0002] A clamping device of this type is disclosed for example in EP B 0 920 361. At two side faces of a refractory slide closure plate, which are disposed mirror-symmetrically relative to the longitudinal center plane of the plate and form with one another an angle, with their clamping faces engage clamping elements pivotably supported in a slider housing. The plate is fastened in with a further pair of side faces, on which either two movable parts of a frame included in the slider housing or two further clamping elements, which are each braced by means of a bracing device. The use of a braceable frame, which can be set into the slider housing, as well as also the use of further clamping elements, which are actuated by means of a common bracing device, is relatively complicated and requires high technical and assembly expenditures, and, in addition, the clamping device requires a great deal of space.

[0003] The aim of the present invention is providing a space-saving clamping device simple in terms of production and assembly of the type described in the introduction as well as a slide closure comprising the clamping device, which makes possible a simple and rapid fastening in of the plate, and in which optimum compressive stress conditions are ensured for the plate in the braced and heated operating state.

[0004] The aim is attained according to the invention through a clamping device with the characteristics of claim 1 or 7.

[0005] The clamping device according to the invention is simple, cost-effective and permits the space-saving installation of the plate in the slide closure.

[0006] Further preferred embodiments of the clamping device form the subject matter of the dependent claims.

[0007] The invention will be explained in further detail in the following in conjunction with the drawing. Therein depict:

[0008] **FIG. 1** in a first embodiment in top view a slide closure housing with a refractory plate fastened in by means of a clamping device,

[0009] **FIG. 2** in a second embodiment in top view a slide closure housing with a refractory plate fastened in by means of a clamping device,

[0010] **FIG. 3** the detail marked by circle A in **FIG. 1** at an enlarged scale,

[0011] **FIG. 4** the detail marked by circle B in **FIG. 1** at an enlarged scale,

[0012] **FIG. 5** the detail marked by circle C in **FIG. 2** at an enlarged scale,

[0013] **FIG. 6** the detail marked by circle D in **FIG. 2** at an enlarged scale,

[0014] **FIG. 7** an embodiment of a clamping element in perspective exploded view, and

[0015] **FIG. 8** in top view a slide closure housing with a refractory plate fastened in by means of a clamping device in a third embodiment.

[0016] A slide closure at the outlet of a container for metal melt according to **FIG. 1** has a housing **1**, in which by means of a clamping device **2** a refractory plate **3** with a through-flow opening **4** is fastened in. The structure and operational function of the slide closure, which in particular is used for ladles containing steel melts provided in continuous casting machines, is known per se (for example from EP B1 0 277 146) and is therefore not further depicted or described. The plate **3** can optionally be a slider plate of the slide closure, however, a stationary bottom plate of the same could also be fastened in by means of the clamping device **2** according to the invention. The refractory plate **3** is comprised of a heat-resistant ceramic material; it can be developed integrally or be comprised of a basic material and be provided with a refractory insert forming the throughflow opening **4**, through which, under operating conditions with the slide closure open, the steel melt flows.

[0017] Plate **3** has an elongated symmetric shape; the longitudinal center plane of plate **3** is denoted by L in **FIG. 1**. With a plate **3** fastened in in housing **1**, the longitudinal center plane L extends in the actuation direction of the slide closure. Plate **3** has two pairs of side faces **10, 11**, disposed mirror-symmetrically with respect to the longitudinal center plane L, each of which forms an angle  $\alpha$  or  $\beta$ , respectively, with the longitudinal center plane L, and which serve as bracing faces. The two side face pairs **10, 11** are of different length and disposed at a different angle  $\alpha, \beta$  with respect to the longitudinal center plane L, and the shorter side faces **10** form a greater angle  $\alpha$  with the longitudinal center plane L than the longer side faces **11**. Both of the side faces **10, 11** at one side of the longitudinal center plane L form an obtuse angle  $\gamma$ . They are each connected via a side face **15** parallel to the longitudinal center plane L. The side faces **10** or **11**, opposite with respect to the longitudinal center plane L, are each connected with one another across rounded transverse faces **16**.

[0018] The clamping device **2** for detachably securing in the refractory plate **3** comprises four clamping elements **22, 23** disposed in housing **1**, and in each instance one displaceable clamping element **22** and one or two clamping elements **23** supported under articulation are provided for each side face pair **10, 11** of plate **3**. They are disposed in housing **1** oppositely with respect to the longitudinal center plane L.

[0019] In the embodiment depicted in **FIG. 1** the clamping elements **23**, associated with the longer side faces **11** forming a smaller angle  $\beta$  with the longitudinal center plane L, are developed as shown in **FIG. 4** and supported in housing **1** pivotably about an axis a such that when bracing plate **3** they can automatically adapt to the effective angle  $\beta$  of side faces **11** and consequently the contact upon the entire area of their clamping faces **24** is ensured, which causes a uniform pressure distribution of the clamping force onto the plate **3** and is of advantage for the service life (durability) of plate **3**.

[0020] The bracing proper takes place with the clamping element **22**, associated with the shorter side faces **10** forming a greater angle  $\alpha$  with the longitudinal center plane L, whose development is evident in **FIG. 3**. **FIG. 7** also illustrates the

structure of such a clamping element, however, the clamping element shown in FIG. 7 differs minimally from that according to FIG. 3.

[0021] Clamping element 22 includes a base body 26 which, according to FIG. 3, is attached by means of three bolts 25 on housing 1 of the slide closure (in the embodiment example according to FIG. 7 two bolts 25 are provided). The base body 26 is provided with a recess 27 having a U-shaped cross section as well as a bottom face 28 evident in FIG. 7. Into the recess 27 is set a binding jaw 30, which has a peripheral face with a shape corresponding to the recess 27 as well as a clamping face 32. Between the peripheral face 31 and the recess 27 clearance exists. The binding jaw 30 is disposed in recess 27 by means of two pins 34 evident in FIG. 7, which project into longitudinal grooves 35 fabricated in the bottom face 28 of the base body 26, such that it is longitudinally displaceable. For the longitudinal displacement of the binding jaw 30 in the direction toward the side face 10 of plate 3 to be fastened in, a cam 37 is provided, whose rotational axis e (FIG. 7) extends transversely to the displacement direction of the binding jaw 30, and whose eccentric face 38 developed with self-locking gradient cooperates with the inner face of an opening 40 in the binding jaw 30. The termination edge of eccentric face 38 is denoted by 39 in FIG. 3. Apart from the circular portion 40a cooperating with the eccentric face 38, in the embodiment example according to FIG. 3 the opening 40 of the binding jaw 30 has a flat portion 40b in the region facing away from the clamping face 32.

[0022] The rotatable support of cam 37 as well as engaging faces for a tool for its rotational displacement are not evident in the drawing (cam 37 can for example comprise a head developed as a four-cornered shaft). To fasten in plate 3, the cam 37 of clamping element 22 according to FIG. 3 is rotated clockwise and therein the binding jaw 30 is braced with its clamping face 32 with the side face 10 of plate 3. Here also the binding jaw 30 can automatically adapt via pins 34 and longitudinal grooves 35 to the particular effective angle  $\alpha$  of side face 10, such that contact over the entire area is ensured.

[0023] To detach plate 3, the cam 37 of clamping element 22 according to FIG. 3 is rotated counterclockwise. As soon as the termination edge 39, disposed at a maximum distance from the rotational axis e, of the eccentric face 38 has reached the flat portion 40b of opening 40, the binding jaw 30 is displaced away from the side face 10 of plate 3.

[0024] In the same manner the other clamping element 22, opposite with respect to the longitudinal center plane L, is braced or detached, each rotational direction during the positioning of the cam 37 of both clamping elements 22 being opposite.

[0025] The embodiment depicted in FIG. 2 differs from that according to FIG. 1 thereby that the displaceable clamping elements 22' which, for fastening in the plate 3 via cam 37, are associated with the longer faces 11 forming a lesser angle  $\beta$  with the longitudinal center plane L, while the clamping elements 23', pivotably supported in housing 1, are provided for the shorter faces 10 forming a greater angle  $\alpha$  with the longitudinal center plane L.

[0026] FIG. 8 depicts a further variant of a clamping device 2" for fastening in plate 3. This comprises again four

clamping elements, of which three clamp fittings pivotably supported in the slider housing 1 are developed similarly to those according to FIG. 4 or 6. Two of these clamping elements 22" are optionally associated with the two side faces 10 disposed mirror-symmetrically to the longitudinal center plane L and forming the greater angle  $\alpha$ . The third clamping element 23 also developed as a pivotable clamp fitting is provided for bracing of the side faces 11 disposed at the lesser angle  $\beta$ .

[0027] The other opposite side face 11 forms the contact face for a clamping element 43 in the form of a binding jaw supported under articulation in housing 1 and displaceable in housing 1 by means of a bracing means (for example a bracing bolt 45) in housing 1. For the articulated support a longitudinal groove 46 is provided, in which a bolt 47, fixed to the housing, is centered approximately free of tolerance. The clamping elements 22", 23", 43 consequently automatically adapt during the bracing of plate 3 to the particular effective angle  $\alpha$  or  $\beta$  of the corresponding side faces 10 or 11, and consequently ensure the contact over the entire area, which yields a uniform pressure distribution of the clamping force. The durability of plate 3 is thereby maximized.

[0028] It is understood that clamping element or binding jaw 43, operationally connected to the bracing means 45, can be disposed at another site, i.e. can be associated with another side face 10 or 11 than that shown in FIG. 8.

[0029] Instead of the above described binding jaw 43, it would also be entirely possible to utilize, at this site the clamping element 22 (or the clamping element 22' according to FIGS. 2 and 5) known from FIGS. 1 and 3 with the binding jaw disposed in the base body, fixed to the housing, displaceable by means of a rotationally displaceable cam. Both solutions are especially simple due to the disposition of a single bracing means.

1. Clamping device for a refractory plate (3) of a slide closure at the outlet of a container for metal melt, the plate (3) comprising two pairs of side faces (10, 11), disposed mirror-symmetrically with respect to its longitudinal center plane (L), at which engage clamping elements (22", 23", 43) disposed in a slider housing (1) with their clamping faces, the side faces (10, 11) disposed at one side of the longitudinal center plane (L) forming an obtuse angle  $\gamma$ , characterized in that three of the clamping elements are developed as binding fittings (22", 23") pivotably supported in the slider housing (1), and the fourth clamping element comprises a binding jaw (43; 30) displaceable in the direction of the corresponding side face (10 or 11).

2. Clamping device as claimed in claim 1, characterized in that the binding jaw (43) is supported under articulation in the slider housing (1) and is displaceably guided by a bracing means (45) against the side face (10 or 11).

3. Clamping device as claimed in claim 1, characterized in that the binding jaw (30) is disposed displaceably in a base body (26) fixed to the housing, and for the displacement of the binding jaw (30) a rotationally displaceable cam (37) is provided, whose rotational axis (e) runs transversely to the displacement direction of the binding jaw (30).

4. Clamping device as claimed in claim 3, characterized in that the binding jaw (30) is disposed longitudinally displaceably in a recess (27) of the clamping element base body (26) and includes an opening (40) for the displacement



disposed transversely with respect to the displacement direction, at whose inner face the rotationally displaceable cam (37) engages.

5. Clamping device as claimed in claim 4, characterized in that the clamping jaw (30) is disposed with clearance in the recess (27) and is guided slidably via two pins (34) projecting into two longitudinal grooves (35) in a bottom face (28) of the recess (27).

6. Clamping device as claimed in claim 4, characterized in that the inner face of the opening (40) includes a circular portion (40a) cooperating with the eccentric face (38) of the cam (37) and, in a region facing away from a binding jaw clamping face (32), a flat portion (40b), and through the cooperation of an edge (39), terminating the eccentric face (38), with the flat portion (40b) the binding jaw (30) can be displaced away from the side face (10 or 11) of the plate (3).

7. Clamping device for a refractory plate (3) of a slide closure at the outlet of a container for metal melt, the plate (3) being provided with at least two side faces (10 or 11), disposed mirror-symmetrically with respect to its longitudinal center plane (L) and forming an angle ( $\alpha$  or  $\beta$ ), at which

clamping elements (22, 23; 22', 23') disposed in a slider housing (1), engage with their clamping faces (24, 32; 24', 32'), characterized in that a clamping element (22; 22') comprises a base body (26) fixed to the housing and a binding jaw (30) displaceable in the base body (26) in the direction toward the corresponding side face (10 or 11), and for the displacement of the binding jaw (30) a rotationally displaceable cam (37) is provided, whose rotational axis (e) runs transversely to the displacement direction of the binding jaw (30).

8. Clamping device as claimed in claim 5, characterized in that the inner face of the opening (40) includes a circular portion (40a) cooperating with the eccentric face (38) of the cam (37) and, in a region facing away from a binding jaw clamping face (32), a flat portion (40b), and through the cooperation of an edge (39), terminating the eccentric face (38), with the flat portion (40b) the binding jaw (30) can be displaced away from the side face (10 or 11) of the plate (3).

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