REFRACTORY VALVE PLATES FOR SLIDING GATE VALVES

The present invention relates to sliding gate valves for metallurgical use, particularly for controlling the outlet of a metallurgical vessel, and is particularly concerned with valve plates for such valves, which plates are of the type which have at least one flow opening and a metal band surrounding at least its peripheral surface. Such valve plates are used by inserting them in a metallic frame of the sliding gate valve.

DE-A-2227501 discloses valve plates which are inserted in the mechanism of sliding gate valves without being clamped therein. This has the advantage that these plates, which are subjected to very severe wear and must thus be very frequently replaced, can be inserted and removed from the valve without using a special clamping tool. Furthermore, due to thefact that the plates are only loosely placed in position, additional stress cracks, which are produced, in use, in a plate which is firmly clamped in position due to its own thermal expansion, are avoided. These refractory plates have variations or tolerances in their length or breadth of up to a few millimetres due to the fact that they are fired during manufacture and plates surrounded with a sheet metal shell cannot be machined for reasons of economy. There is thus the danger that when a unit comprising a sliding plate and a discharge sleeve is inserted in the valve mechanism with a few millimetres tolerance a relative movement will occur of the unit with respect to the mechanism when the latter is moved. The sliding plate and the discharge sleeve connected thereto are thus constructed

as a single unit because if the sleeve were inserted separately into the mechanism the sealing mortar which is generally used between the sleeve and the plate is destroyed by the said relative movement of the latter and as a consequence melt would escape and result in a break-out. In the fixed upper plate there is a recess in which an adjacent refractory sleeve engages. The disadvantage of this is that the sleeve wears very rapidly and if the plate is replaced very frequently, reliable relative centering of these two components becomes a major problem and thus despite the difficulty of disassembly the sleeve must also be replaced very frequently.

Against this background it is an object of the invention to provide a refractory valve plate of the type referred to above which can be loosely inserted in the mechanism of a metallurgical valve and which may be produced simply and cheaply and ensures reliable operating characteristics when pouring molten metal.

According to the present invention there is provided a refractory valve plate for a sliding gate valve for controlling the flow of a molten metal, the plate having at least one flow opening and a metal band which surrounds the peripheral surface of the plate and affords an outwardly directed first metallic surface, the plate having a machined or stamped second metallic surface which is cylindrical and substantially coaxial with the flow opening and which, in use, is engaged by a metallic frame of the valve to locate the plate with respect to the frame. Thus a valve plate in accordance with the invention may be inserted into and removed from a metallic frame without difficulty and whilst within the frame is located very precisely with respect

to the frame and thus with respect to, for instance, the flow opening in a discharge sleeve, nozzle or the like upstream of the sliding gate valve, e.g. incorporated in the lining of a metallurgical vessel. Plates in accordance with the invention may be produced very simply since the second surface is metallic and the machining may be simply centered by the flow opening.

In order to achieve the desired machining accuracy, the second surface may be machined by turning and if this surface is stamped this must of course be done with the necessary precision. The machining or stamping is effected to a diameter tolerance of only a few tenths of a millimetre and this results in the location of the valve plate within the frame to within a few tenths of a millimetre.

The height of the second metallic surface is preferably only a few millimetres, e.g. between 3 and 8 millimetres, so that the plate may be easily removed from the metallic frame and does not need to be removed in the manner of a drawer, that is to say uniformly parallel to the machined locating surface.

In one embodiment the plate is of part-circular shape with a refractory nose constituting an extension thereof, the flow opening and the second metallic surface being centrally disposed with respect to the part-circular shape. When pouring, for instance, steel the valve plate is heated in the region of the flow opening up to about 1500^{o}C and the construction referred to above results in a uniform thermal stress distribution in the refractory portion of the plate which leads to an increase in the service life of the plate.

In one embodiment of the invention the plate has a refractory projection, preferably of circular shape and coaxial with the flow opening, extending from one of its flat surfaces, the side surface of which is surrounded by a metal band whose outer surface constitutes the second metallic surface. The metal band surrounding the refractory projection may be integral with the metal band surrounding the peripheral surface of the plate or it may be a shrunk-on band separate from the metal band surround the peripheral surface of the plate.

In an alternative embodiment, the plate is flat on both sides and has one or two flow openings formed in it and has an annular groove formed in it coaxial with the or each flow opening. In this event a shrunk-on ring, whose outer surface constitutes the second metallic surface, may be received in the or each annular groove. Alternatively, a U-shaped ring, the inner surface of one of whose limbs constitutes the second metallic surface, may be received in the or each annular groove. If there are two flow openings in the plate the annular grooves are preferably provided on opposite sides of the plate.

In a further alternative a metal ring, whose inner or outer surface constitutes the second metallic surface, is welded to the plate. In a still further alternative the plate is of circular shape, the metal band surrounding the peripheral surface of which having a peripheral portion which is machined and constitutes the second metallic surface and a peripheral portion which is not machined and constitutes the first metallic surface.

The flow opening or one of the flow openings may be sealed by a porous flushing plug.

The invention also embraces a sliding gate valve including one or more plates of the type referred to above and in this event the valve will include at least one metallic frame affording a recess which receives the valve plate with a lateral clearance between it and the first metallic surface, each metallic frame having locating means engaging the second metallic surface of the plate and locating it with respect to the frame and thus with respect also to the fixed flow opening which, in use, is upstream of the valve.

Further features and details of the invention will be apparent from the following description of certain specific embodiments which is given by way of example with reference to the accompanying drawings, in which:-

Figure 1 is a schematic longitudinal sectional view of a sliding gate valve with valve plates in accordance with the invention;

Figure 2 is a plan view of the slider unit of the sliding gate valve of Figure 1;

Figures 3 to 6 are longitudinal sectional views of different modified constructions of valve plates in accordance with the invention; and

Figure 7 is a longitudinal sectional view of a modified construction of valve plate with a round exterior shape.

Referring firstly to Figure 1, only the components of importance to the invention are shown in the illustrated sliding gate valve 10. It comprises a housing 12 with a metallic frame 14 and a refractory valve plate 20 received therein. Secured to the housing 12 is a frame 13 which receives a slider unit

15 with a metallic frame 17 and guides it so that it is movable in the frame 13 by means of an actuator 16 which is not shown in detail. A refractory valve plate 22 is inserted in the frame 17 and a refractory sleeve 18 clamped in position to the slider unit 15. In use, the valve 10 is secured to the outlet 19 of a

metallurgical vessel which is not shown and contains a metal melt. The vessel can, for instance, be a steel pouring ladle or an intermediate distributor and has a refractory discharge sleeve 11 which is partially illustrated, between which and the upper valve plate 20 connected to it there is a layer of mortar which constitutes a seal. Between the sleeve 18 and the lower valve plate 22 there is a similar layer of mortar. The sliding gate valve 10 is shown in the open position and can be throttled or closed in a known manner by linear movement of the slider unit 15. The valve plates 20,22 have contacting refractory slide surfaces which are pressed against one another, also in a known manner.

The valve plates 20 and 22, which are of identical construction, each comprise a respective sheet metal shell 21,23 mortared into which is a refractory plate. The latter has a round refractory projection 20'22' which is centrally disposed with respect to the flow opening 24 in it and is connected at its end face to the respective sleeve 11,18. In accordance with the invention, the valve plates 20 and 22 each have a sheet metal projection which constitutes part of the metal shell 21,23, respectively and surrounds the refractory projection 20',22' and has a machined cylindrical outer surface 21',23' which enables the plate to be precisely centered with respect to the flow opening in the discharge sleeve 11. The metallic frames 14 and 17 have a recess 14',17' which correspond to the associated metallic projection and is somewhat deeper than the height of the associated cylindrical surface 21',23'.

As seen in Figure 2, the plate 22 inserted in the

metallic frame 17 of the slider unit 15 has a part-circular outer shape 26 with a refractory nose 22'' which is of reducing breadth away from the flow opening 24 and which permits the sliding plate 22 to provide a sufficiently long closing path S, that is to say a sufficiently large area of refractory material which is at least temporarily in registry with the flow opening in the fixed valve plate 21 as the valve is moved between the open and closed positions.

The valve plate 22 is secured against rotation with respect to the frame 17 by means of abutments 25 on the frame 17. The metallic frame 14 and the valve plate 20 are advantageously of the same construction as the plate 22 and the frame 17. However the refractory nose 20'' of the plate 20 extends in the opposite direction, as seen in Figure 1.

The refractory valve plate 30 shown in Figure 3 is of generally similar shape to the plate 22. This plate 30 and also the further plates 40,50 and 60 shown in Figures 4 to 6 may be used in a sliding gate valve as the lower plate and/or as the upper plate but, for the sake of simplicity, they are shown only as sliding plates. The plate 30 is again inserted into a frame 17 with a lateral or peripheral clearance and has a round, refractory projection 30' central to the flow opening 24 and a refractory nose 30''. The plate has a shrunk-on metal ring 31 around its periphery and a further shrunk-on ring 32 around the projection 30', which is applied whilst warm and has an outer, machined cylindrical surface 33 which is centered in the bore 35 in the frame 17. It would also be possible for the refractory projection 30' to be machined on its exterior surface and for the shrunk-on ring 32 to have

relatively precise external dimensions in order to achieve the necessary accuracy of the external diameter of the surface 33.

The refractory plate 40 shown in Figure 4 is a plate of the type which is known per se and is ground on both sides and is again inserted in a frame 17 with a lateral clearance and has a first outer metal band 41 around its outer periphery, two flow openings 24 and 45 and an annular groove or recess 47,47' respectively extending around the flow openings. Each flow opening is thus partially within a boss which is defined by the associated annular groove but does not project beyond the associated sliding surface of the plate. The outer surface of each boss, i.e. the inner surface of each annular groove, is sheathed with a respective shrunk-on metallic ring 42,46. The latter has a machined outer cylindrical surface 43 which enables the plate 40 to be centered with respect to the bore 44 in the frame 17 which extends into the annular groove 47. The annular groove 47' is identical to the groove 47 but arranged on the opposite side of the plate. This two-hole plate 40 has the advantage that when the flow opening 24 is worn the plate is turned over and the flow opening 45 can be used. The flow opening and annular groove which are not in use can be mortared up with refractory material which can be easily broken away. The external shape of the plate 40 can be in the nature of a pair of spectacles with two round plate portions connected together by a bridge.

The refractory plate 50 shown in Figure 5 is also ground on both sides and has an outer shrunk-on ring 51 in a manner similar to the plate 40 and is provided with an annular groove 57 centrally disposed with

respect to the flow opening 24. A U-shaped ring 52 is embedded in the groove 57. The inner surface 53 of the outer limb of the U-shape is machined and enables the plate to be centered with respect to the frame 17 by means of an annular projection 54 extending upwardly around the opening in the frame, the outer centering surface 55 of which engages and locates the machined surface 53. The plate 50 could also have a second flow opening and a second annular groove in a manner similar to the plate of Figure 4.

The refractory valve plate 60 shown in Figure 6 differs from the plate 20 of Figure 1 only in that it is flat on both sides and a metal ring 62 central with respect to the flow opening 24 is welded to the sheet metal shell 61. The ring 62 has an inner cylindrical surface 63 which is machined and which is engaged by the outer surface 65 of an annular projection on the frame 17 in order to locate the plate correctly.

In a further modification of the invention shown in Figure 7, a valve plate 70 has a circular peripheral surface and a flow opening 74 central thereto. The peripheral surface of the valve plate 70 is surrounded and held together by a metal band 72 constituted by a shrunk-on ring 82 with a machined outer surface 83 which extends around the outer periphery of the plate but does not extend over the entire height of the plate. The plate 70 can thus be removed more easily from the metallic frame 17 since it is only centered in it over a height of a few millimetres. Due to the round external shape of the plate in Figure 7 there is a shorter closure path by comparison with the plate 22 of Figure 2, provided that the external diameters are the same. In compensation, that valve can be so

arranged that when pouring in the throttled state the sliding plate 70 is moved to the side opposed to the closure direction and the wear of the plate is thus distributed more evenly.

The round external shape of the plate 70 also has the advantage that, after use, it may be turned in the frame through 90° and its substantially unworn surface brought into use. The plate 70 can be secured against rotation by simple lateral clamping.

The plates described may be centered in the frame with sufficient operational reliability if, for example, the outer cylindrical surface of the plate has a diameter tolerance of minus 0.1 to minus 0.3 millimetres, whilst the corresponding bore tolerance of the frame is from plus 0.1 to plus 0.2 millimetres.

In connection primarily with sliding plates a flushing plug can in principle be provided instead of the flow opening or one of the flow openings and in the case of a two-part plate one part can be provided without an opening.

CLAIMS

1. A refractory valve plate for a sliding gate valve for controlling the flow of a molten metal, the plate having at least one flow opening and a metal band which surrounds the peripheral surface of the plate and affords an outwardly directed first metallic surface, the plate having a machined or stamped second metallic surface which is cylindrical and substantially coaxial with the flow opening and which, in use, is engaged by a metallic frame of the valve to locate the plate with respect to the frame.

2. A plate as claimed in claim 1 whose second metallic surface is machined by turning.

3. A plate as claimed in claim 1 or 2, whose second metallic surface has a height of between 3 and 8 millimetres.

4. A plate as claimed in claim 1 which is of part-circular shape with a refractory nose constituting an extension thereof, the flow opening and the second metallic surface being centrally disposed with respect to the part-circular shape.

5. A plate as claimed in any one of claims 1 to 4 in which the plate has a refractory projection extending from one of its flat surfaces, the side surface of which is surrounded by a metal band whose outer surface constitutes the machined surface.

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6. A plate as claimed in claim 5 in which the refractory projection is of circular shape and coaxial with the flow opening.

7. A plate as claimed in claim 5 or claim 6 in which the metal band surrounding the refractory projection is integral with the metal band surrounding the peripheral surface of the plate.

8. A valve as claimed in claim 5 or claim 6 in which the metal band surrounding the refractory projection is a shrunk-on band separate from the metal band surrounding the peripheral surface of the plate.

9. A valve as claimed in any one of claims 1 to 4 which is flat on both sides and has one or two flow openings formed in it and has an annular groove formed in it coaxial with the or each flow opening, a shrunk-on ring, whose outer surface constitutes the second metallic surface, being received in the or each annular groove.

10. A plate as claimed in any one of claims 1 to 4 which is flat on both sides and has one or two flow openings formed in it and has an annular groove formed in it coaxial with the or each flow opening, a U-shaped ring, the inner surface of one of whose limbs constitutes the second metallic surface, being received in the or each annular groove.

11. A plate as claimed in claim 9 or claim 10 in which there are two flow openings and the annular grooves are provided on opposite sides of the plate.

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12. A plate as claimed in any one of claims 1 to 4 in which welded to the metal shell surrounding the peripheral surface of the plate is a metal ring whose inner or outer surface constitutes the second metallic surface.

13. A plate as claimed in any one of the preceding claims in which the flow opening or one of the flow openings is sealed by a porous flushing plug.

14. A plate as claimed in any one of claims 1 to 3, which is of circular shape, the metal band surrounding the peripheral surface of which having a peripheral portion which is machined and constitutes the second metallic surface and a peripheral portion which is not machined and constitutes the first metallic surface.

15. A sliding gate valve including at least one metallic frame affording a recess which receives a valve plate as claimed in any one of the preceding claims with lateral clearance between it and the first metallic surface, each metallic frame having locating means engaging the second metallic surface of the plate and locating it with respect to the frame.

16. A refractory plate for a sliding gate valve substantially as specifically herein described with reference to Figures 1 and 2 or any one of Figures 3 to 7 of the accompanying drawings.

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