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PATENT SPECIFICATION

(11) 1 576 778

(21) Application No. 14579/77 (22) Filed 6 April 1977
(31) Convention Application No. 2615537
(32) Filed 9 April 1976 in
(33) Federal Republic of Germany (DE)
(44) Complete Specification published 15 Oct. 1980
(51) INT CL³ C04B 35/68 B29D 31/00 C04B 35/02
(52) Index at acceptance
B5A 1R158 1R164 1R400 T1P
C1J 14 33 4 9 X

(19)

(54) SLIDING GATE VALVES

(71) We, DIDIER-WERKE A.G. a Company organised under the laws of the Federal Republic of Germany, of Lessingstrasse 16, 62 Wiesbaden, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a process for producing a plate e.g. a sliding or a stationary plate for a sliding closure (sliding gate valve) of the output orifice of a metallurgical vessel, e.g. ladles adapted to contain molten metal, the plate being formed with a sliding surface, a flow orifice, a bearing surface and, engaging thereon around such orifice, a resilient part or boss, the plate being produced by pressing and burning a mixture containing a high proportion of a sintered granular refractory material.

German Offenlegungsschrift 2,197,127 discloses a sliding plate of the kind described which is made of a mixture of refractory sintered magnesia having 55% by weight having a grain size of from 0.5 to 1 mm 32% by weight having a grain size of from 0.2—0.5 mm and 13% by weight having a grain size below 0.2 mm with the addition of a small amount of a conventional adhesive, by mixing, pressing, ceramic firing, drilling the outlet orifice and grinding the sliding surface. Unfortunately, in the case of some particular shapes, required for certain purposes, of sliding plates made of mixtures having a high proportion of a sintered granular refractory substance and either devoid of or containing only a very small percentage of plasticizing substance and with a boiling agent, a breakage rate of something like 90% of the plates occurs in production since the plates tended to crack at the transition between the bearing surface and the boss.

It is therefore an object of the invention to provide a process for producing such plates from mixtures having a high proportion of a sintered granular refractory material and to reduce the incidence of such unwanted cracking.

According to the invention, therefore, a relatively coarse grain mixture is provided at least in the zones of the boss which are likely to crack and on the bearing surface and a relatively fine grain mixture of the refractory material is provided in the remainder of the die, such that:

(a) the relatively course grain mixture contains sintered material of the grain sizes:

1—2 mm	21—29 wt.%
0.5—1mm	18—24 wt.%
0.09—0.5 mm	18—24 wt.%
below 0.09 mm	30—36 wt.%

and

(b) The relatively fine grain mixture has sintered material of the following grain sizes:

1—2 mm	16—22 wt.%
0.5—1 mm	16—22 wt.%
0.09—0.5 mm	20—27 wt.%
below 0.09 mm	35—39 wt.%

and fine grain mixture containing at least 5% by weight more of a grain size below 0.5 mm than the coarse grain mixture;

and a layer of plate or panel made of an elastomeric substance such as rubber or soft plastics is located in the die on the surface associated with the terminal surface of the boss.

It has surprisingly been found that in this process cracking does not occur at the transition between the bearing surface of the plate and the boss. The process also provides a plate having a smooth and easy-to-grind surface.

For optimum results:

(a) The relatively coarse grain mixture contains sintered material having the grain sizes:

1—2 mm	23—27 wt.%
0.5—1 mm	19—22 wt.%
0.09—0.5 mm	20—23 wt.%
below 0.09 mm	30—36 wt.%

and

(b) The relatively fine grain mixture contains sintered material having the grain sizes:

1—2 mm	17—20 wt.%
0.5—1 mm	18—21 wt.%
0.09—0.5 mm	22—27 wt.%
below 0.09 mm	35—39 wt.%

According to another feature of the invention, the relatively fine grain mixture contains sintered material having a proportion with a grain size of 0.5 mm which is 8—13 wt.%, preferably 10 wt.% more than does the relatively coarse grain mixture. The mixture preferably contains a bonding agent in the form of a small addition e.g. aqueous sulphite waste liquor, magnesium sulphate dissolved in water, sodium polyphosphate or monoaluminium phosphate. For instance, the mixtures can consist of granular magnesia sinter and a bonding agent or can consist of a granular high-alumina-content sintered material, such as mullite and/or corundum, possibly up to 2 wt.% of refractory fine-grain clay or caustically burned alumina and a bonding agent. Preferably, the grain mixtures are so introduced into the die in two layers that the relatively coarse grain mixture is disposed, at least in the outer region of the boss and in the part immediately adjacent the same, and on the bearing surface, and the relatively fine grain mixture is disposed above the relatively coarse grain mixture, with a substantially plane boundary surface, at least in the region of the sliding surface.

According to another feature of the process according to the invention, to ensure that the passage required subsequently is smooth and wear-resistant, the relatively fine grain mixture is disposed near the bearing surface and without physical interruption in the central region of the boss, such part being adapted to be formed with the flow orifice.

Preferably, to ensure that the resilient part or boss has a flat bottom surface and the moulding releases readily from the die, a steel plate is introduced into the die above the layer or plate of elastomeric material.

Two embodiments of the process according to the invention for producing a sliding plate are shown in the drawings wherein:

Figure 1 shows a construction in which there is a relatively flat boundary surface between a bottom layer having a relatively coarse grain mixture and a top layer having a relatively fine grain mixture, and

Figure 2 shows a construction wherein a top layer having a relatively fine grain mixture so extends into the boss of the sliding plate that the subsequent flow orifice in the plate through the boss is disposed entirely in the refractory material which has the relatively fine grain mixture.

Referring to Figure 1, an elastomeric layer or panel 4 e.g. of rubber or plastics, is first introduced into an appropriately shaped die cavity 3 (consisting of a die, bottom ram and top ram). To ensure that boss 6 of the sliding plate 7 has a smooth bottom end surface, a steel plate 5 of a thickness of preferably of from 2 to 10 mm is placed on the layer or panel 4, whereafter a layer 2 of a relatively coarse grain mixture is introduced into die 3 until at least zones R which are likely to crack and which are disposed at the junction of the boss 6 with the plate 7 have been covered. The relatively coarse layer 2 therefore fills up that region of the die 3 which forms a bearing surface 12 for the plate 7 around the boss 6. A layer 1 of a relatively fine grain size is then so placed above the layer 2 that a substantially plane but preferably rough boundary surface 8 arises between the layers 1 and 2, although there is no appreciable mixing of the two layers 1 and 2. The layer 1 therefore forms the sliding surface 13 of the plate 7. When the pressure used for the pressing operation decreases and when the pressed plate 7 is ejected from the die 3, the presence of the resilient layer or panel ensures that no detrimental stresses arise in the cross-section at risk which is the junction between the boss and the plate and which constitutes the bottom of the boss 6 and that the same does not "stick" in the die 3. The presence of the steel plate 5 in the die provides a plane bottom end surface 9 for the boss 6.

Referring to Figure 2, the relatively fine layer 1 is provided not only near surface 13 but also, without physical interruption, in a substantially cylindrical or slightly truncoconical central portion 10 of the boss 6, the orifice 11 being formed in the portion 10. In one known method of achieving this aim, a tubular jig or template is introduced into the central portion of the die zone forming the boss. The relatively coarse material is introduced in a layer around the template, whereafter the relatively fine material is introduced thereinto and in a layer above the relatively coarse material without appreciable mixing of the two grain sizes, the template being removed from the die before pressing.

The boundary surface 8 between the layers 2 and 1 is rough, to ensure satisfactory keying, and extends in the central region of the boss 6 either substantially parallel to or conically to the subsequent orifice 11. Consequently, except for the central region of the terminal surface 9 of the boss 6, the relatively coarse layer 2 is associated with the bearing surface 12, the wall surface 12′ of the boss and the outer part 9 of the boss 6. This ensures that the orifice 11 will be smooth and wear-resistant. There is also no cracking in the zones R at risk where the relatively coarse layer 2 is present, this being assisted by the presence of the resilient layer 4.

WHAT WE CLAIM IS:—

1. A process for producing a plate for a sliding gate valve for the outlet orifice of metallurgical vessels, e.g. ladles adapted to contain liquid melts, the plate being formed with a sliding surface, a flow orifice, a bearing surface and, a boss protruding therefrom around the said orifice, the plate being produced by pressing in a die and burning a sintered granular refractory material, characterised in that a relatively coarse grain mixture of refractory material is provided in the die at least in the zones of the boss which are likely to crack and at the bearing surface and a relatively fine grain mixture of refractory material is provided in the remainder of the die, the relatively coarse grain mixture have the following composition 21 to 29% by weight having a grain size of 1 to 2 mm, 18 to 24% by weight having a grain size of 0.5 to 1 mm, 18 to 24% by weight having a grain size of 0.09 to 0.5 mm, 30 to 36% by weight having a grain size of less than 0.09 mm, the relatively fine grain mixture having the following composition 16 to 22% by weight having a grain size of 1 to 2 mm, 16 to 22% by weight having a grain size of 0.5 to 1 mm, 20 to 27% by weight having a grain size of 0.09 to 0.5 mm, and 35 to 39% by weight having a grain size of less than 0.09 mm, the fine grain mixture containing at least 5% by weight more of grain size below 0.5 mm than the course grain mixture; and a layer or plate or panel of an elastomeric substance is located in the die on the surface associated with the terminal surface of the boss.

2. A process as claimed in Claim 1 in which the relatively fine grain mixture contains 8 to 13% by weight and preferably 10% by weight more sintered material of a grain size of less than 0.5 mm than does the relatively coarse grain mixture.

3. A process as claimed in Claim 1 or Claim 2 characterised in that the sintered granular refractory material consists of granular magnesia sinter and a bonding agent.

4. A process as claimed in Claim 1 or 2, characterised in that the sintered granular refractory material consists of a granular high-alumina-content sintered material, such as mullite and/or corundum, a bonding agent and optionally up to 2 wt.% of refractory fine-grain clay or caustically burned alumina.

5. A process as claimed in any one of Claims 1 to 4 in which in the die the relatively coarse grain mixture is disposed, at least in the outer region of the boss and in the part immediately adjacent the same, and on the bearing surface, and the relatively fine grain mixture is disposed above the relatively coarse grain mixture, with its upper surface which will be the sliding surface of the plate having a substantially plane surface.

6. A process as claimed in any one of Claims 1 to 5 in which in the die the relatively fine grain mixture affords the sliding surface and extends without physical interruption down through the central region of the boss whereby the flow orifice can be formed in the said fine grained material.

7. A process as claimed in any one of the preceding Claims in which a steel plate is introduced into the die above the layer or plate of elastomeric material.

8. A process as claimed in Claim 1 substantially as specifically described herein with reference to the accompanying drawings.

9. A plate whenever made by a method as claimed in any one of the preceding Claims.

KILBURN & STRODE,
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Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1980
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1576778 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG.1

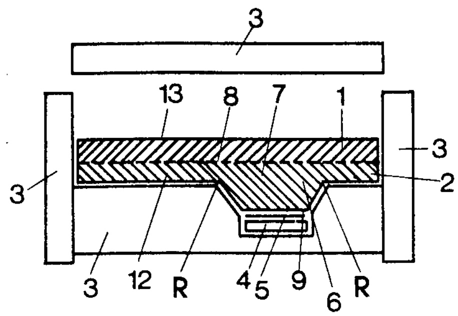

FIG.2