

[54] METHOD FOR REPAIRING CRACKS IN
INGOT MOLDS, PLATES AND SIMILAR
CAST IRON ELEMENTS FOR USE IN IRON
OR STEEL CASTING

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[58] Field of Search 29/401, 402; 52/514;
164/411

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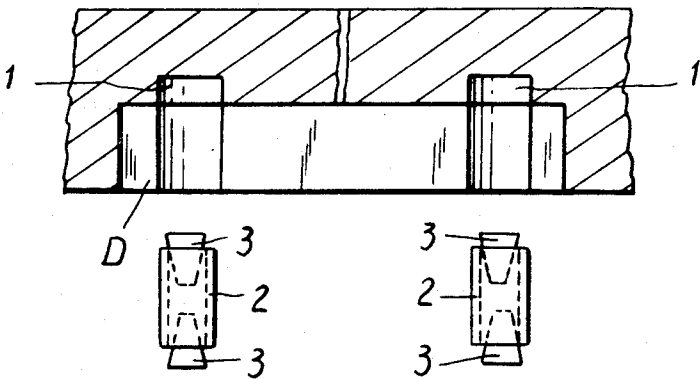
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[57]

ABSTRACT

Straddling the crack a metal plate is placed and fastened to the ingot mold or the like by pins, which are fastened to the ingot mold or the like by welding and by permanent deformation.

4 Claims, 10 Drawing Figures



SHEET 1 OF 3

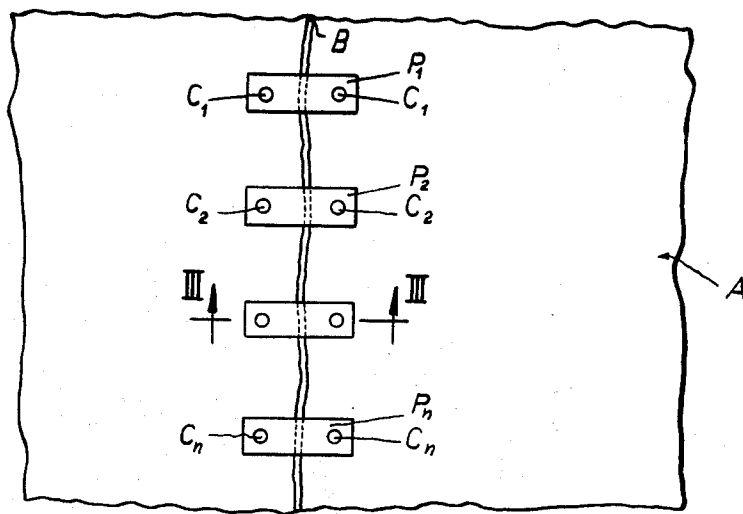


Fig. 1

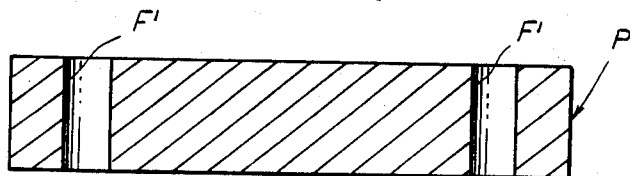


Fig. 2

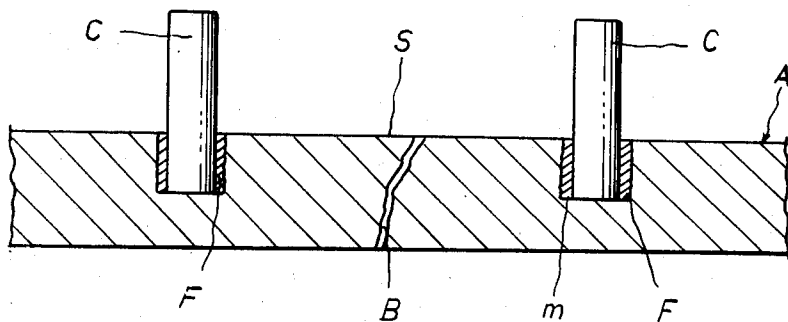
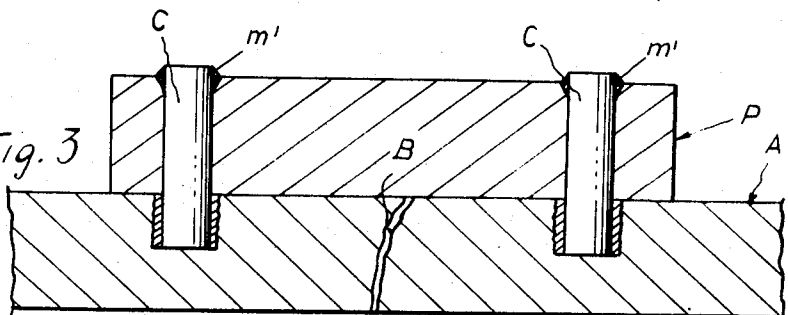


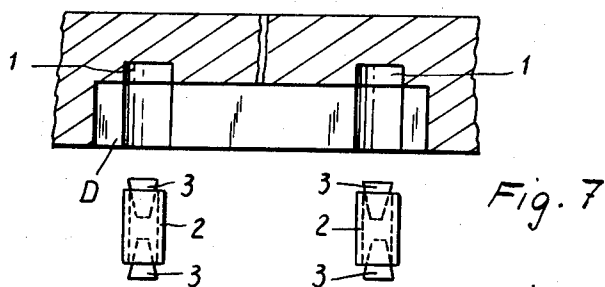
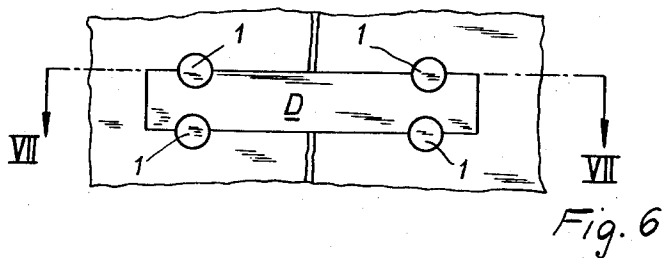
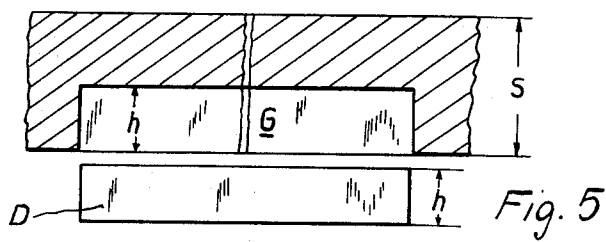
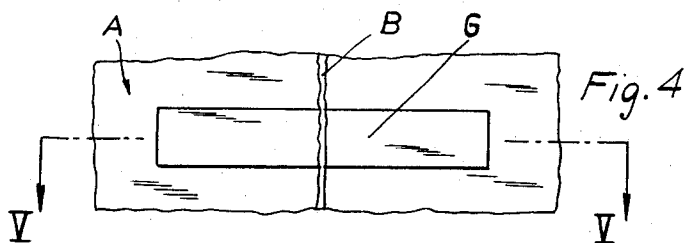
Fig. 3



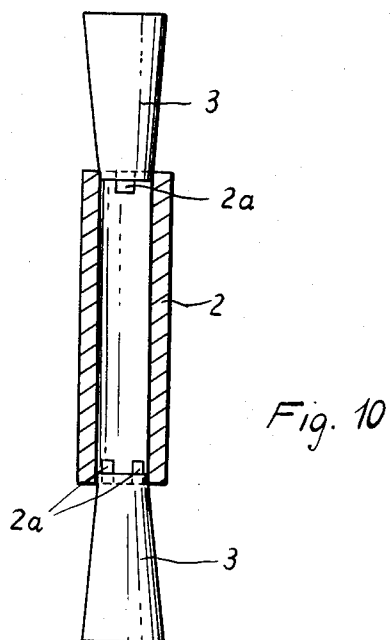
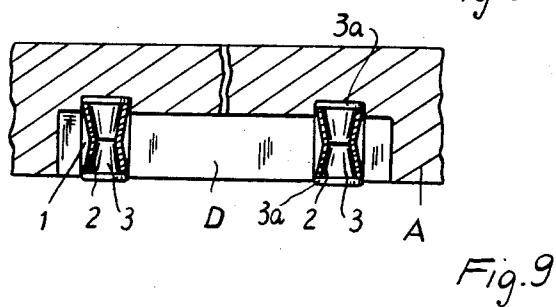
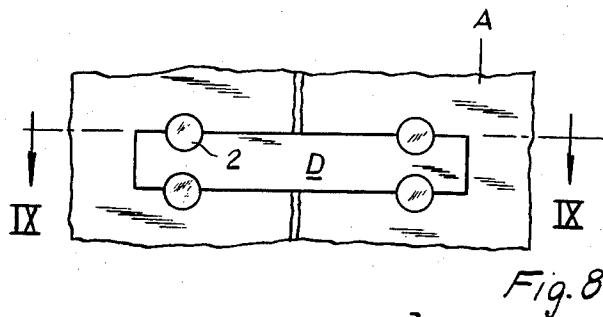
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METHOD FOR REPAIRING CRACKS IN INGOT MOLDS, PLATES AND SIMILAR CAST IRON ELEMENTS FOR USE IN IRON OR STEEL CASTING

This invention relates to a method for repairing cracks or ruptures in ingot molds, plates and similar cast iron elements to be used as steel or iron casting elements and hereinafter generally referred to as casting members.

It is well known that ingot molds, particularly large ingot molds, undergo such thermal shocks as to produce, even after relatively short periods of time, flaws, damages or cracks rendering the ingot mold unusable.

Such ingot molds, plates and the like are highly expensive members, whereby it is always profitable to repair the same as far as possible. The methods as used at present for repairing such members have shown to be comparatively costly because of involving long and complicated operations.

Moreover, not always the evident requirement is met for providing reliable repairs, or capable of withstanding the high thermal shocks they are subjected to.

It is the main object of the present invention to provide a method for repairing cracks in ingot molds and the like, requiring a considerably less time than that taken by hitherto known methods and providing an unexceptionable result.

The above object is accomplished by a method consisting of straddling at least one metal plate, such as a cast iron or steel plate, over the crack, flow or damage in the ingot mold or the like, and attaching this plate to the ingot mold or the like through pins, which are welded or fastened by permanent deformation in holes in the ingot mold or the like on opposite sides of the crack or damage.

For the purpose of this description and following claims, the term "pin" as used herein is meant for metal elongated bodies of any section, hollow or solid, and comprising one or more parts. For example, such a term encompasses actual pins, cut down tubes and composite elements comprising a cut down tube and wedge-like metal bodies (such as frusto-conical bodies insertable in the opposite ends of the cut down tube).

The invention will be better understood from the following detailed description of some exemplary embodiments thereof, reference being had to the accompanying drawings in which:

FIG. 1 is a front view showing a crack in an ingot mold as repaired by the method according to the invention;

FIG. 2 is a cross-section of the ingot mold and means used for repairing it at an intermediate stage of the method;

FIG. 3 is a sectional view taken on line III—III of FIG. 1;

FIG. 4 is a view showing a portion of an ingot mold wall, in which wall there is a crack and wherein, in accordance with a modified embodiment of the method of the invention, a seat or recess is formed;

FIG. 5 is a sectional view taken on line V—V of FIG. 4 and, separately, a side view showing a plate to be introduced into the recess;

FIG. 6 is a view corresponding to that in FIG. 4, but after introducing the plate and drilling dead holes;

FIG. 7 is a sectional view taken on line VII—VII of FIG. 6 and, separately, a side view showing composite pins for connecting the plate to the ingot mold;

FIG. 8 is a front view showing the same portion of the ingot mold upon repair completion;

FIG. 9 is a sectional view taken on line IX—IX of FIG. 8; and

FIG. 10 is an enlarged view showing a composite pin comprising a cut down tube and two frusto-conical elements inserted therein.

Referring to FIGS. 1—3, an ingot mold portion is designated at A and a crack thereof to be repaired is designated at B.

According to the invention, two sets of dead holes are drilled on the external face of the ingot mold, these holes being arranged according to almost parallel rows at the edges of the crack, one row of holes on one side and the other row of holes on the other side of the crack.

The repair method according to the invention is divided into several steps. Once the dead holes F have been drilled outside the ingot mold, a steel pin C (FIG. 2) is introduced into each of such holes.

Holes F may be either circular, or square or rectangular in cross-section (where required by particular repairs); in any case it would be convenient that the cross size of the pins should be somewhat less than that of holes F wherein they are accommodated, since the effectiveness of the subsequent operation for fastening the pins to the ingot mold by welding will require to fill up the spacing between the hole and pin by means of metal m.

Such is the length of pins C that, once inserted in the holes, the pins project from the outer surface S of the ingot mold.

Upon insertion in the holes, the pins are fastened to the ingot mold by conventional material welding.

Having thus fastened the pins, steel plates $P_1, P_2 \dots P_n$ are provided, preferably of an elongated shape (such as rectangular plates), the length of which is larger than the spacing between two holes at the same level on opposite sides of the crack, which holes will be referred to as corresponding holes.

Plate P (FIGS. 2 and 3) is then drilled, so that each pair of holes F' will have just the same center distance of pins C which are fastened in the corresponding holes of the ingot mold.

When all of the required plates $P_1, P_2 \dots P_n$ have been prepared, these plates (FIG. 1) are positioned on the respective pairs of pins $C_1-C_1, C_2-C_2 \dots C_n-C_n$ which, as above mentioned, project from the ingot mold surface S by a distance just greater than the thickness of the respective plates P, thus capable of firmly retaining said plates when welded thereto. Also for the effectiveness of this welding operation, said holes F' should be somewhat larger than pins C in order to allow for metal welding m' in the gap.

It is still to be noted that plates P are also shaped in accordance with the pattern for the surface of the ingot mold or the like, where such plates are laid.

Of course, instead of connecting the pins to the plates by holes, the pins could be connected to the ends of said plates by welding.

It is apparent that such a repair, owing to the monolithic connections between ingot mold and pins/plates, is efficient and durable, in addition to achieve the main

advantages of operational and economical profit, as above mentioned.

Referring to FIGS. 4-10, reference character A still designates the ingot mold and reference character B the crack formed thereon and desired to be repaired.

According to the modified embodiment shown in such figures, firstly a bore or recess G is provided outside the cracked wall. This bore (FIGS. 4 and 5) is rectangular in cross-section and its height h is about half the thickness s of the ingot mold wall, bore which can be electrically provided, by a suitable cutting electrode, or by a milling machine. At the next step, a correspondingly shaped plate D having about the same size as the bore, is introduced into the bore G, and then holes 1 (FIG. 6) are drilled (at least one hole to the major side of the plate and on each side of crack B), the axes of which are substantially positioned between the side wall of the bore and the side wall of the plate facing the preceding wall; so that said holes would half involve the wall and half involve the plate, at least to the depth of bore G. Thus, said holes continue for some distance, obviously involving only the ingot mold.

Said holes, still at an empty condition, are shown in a sectional view in FIG. 7, the engaging means to be accommodated therein being correspondingly shown at readiness for introduction therinto. Each of said means comprise (FIG. 10) a cut down tube 2, the outer diameter of which is somewhat less than that of the respective hole 1 and the ends of which are also provided with notches 2a. As shown in FIG. 10, from both ends of said cut down tube, two frusto-conical bodies 3 are not forcibly threaded therinto, but stopped at some depth in the cut down tube as shown in FIG. 7.

Next, these composite pins 2, 3 are placed in the holes and by a percussion tool, such as a pneumatic hammer, projecting from the cut down tube, to cause it to almost completely penetrate therein. At the same time, also the other body 3 will penetrate therein from the bottom, so that upon mutual contact through the minor bases thereof, said cut down tube 2 is deformed as shown in FIG. 9. Also because of providing slits on the cut down tubes, as beating continues, heads 3a (FIG. 9) will be formed for holding the several elements firmly joined to one another.

In a modified embodiment, instead of the above described composite pins 2, 3, for the same purpose there could be used cut down rods which, brought to red

heat, are inserted in the holes and riveted so as to produce upper end bosses (similar to the above mentioned heads 3a).

In a further modified embodiment, the pins could comprise a slotted cut down tube according to one or more diameters at one end thereof, in which there is inserted only one spreader body similar to that shown at 3, but provided with an extension of a uniform cross-section and introduced into said end of the cut down tube. The composite pin is inserted in the hole so that the spreader body is positioned against the hole bottom. The length of the cut down tube is such that it exits out of the hole. On this projecting portion of the body the percussion tool is caused to beat, thus providing for spreading the slotted end of the cut down tube and deforming (riveting) the other end of the cut down tube, whereby a steady restraint is obtained.

I claim:

1. A method for repairing cracks in casting molds comprising the steps of:

forming a recess in the wall of said casting mold, said recess being rectangular in cross-section and extending perpendicularly across a crack in said wall, the depth of said recess being greater than the width of said recess but less than the thickness of said wall;

positioning a plate within said recess, said plate mating with said recess to substantially fill said recess; providing at least two holes in the plate and wall assembly, at least one hole being provided on each side of said crack, said holes being positioned adjacent a side of said plate and centered on the junction of said plate with said wall and extending to a depth below the bottom of said recess;

installing pins in said holes; and fastening said pins in said holes.

2. The method as claimed in claim 1, wherein said holes are positioned adjacent both sides of said plate.

3. The method as claimed in claim 1, wherein said pins are fastened by welding them to said plate and said wall.

4. The method as claimed in claim 1, wherein said pins comprise a tube and at least one spreader body, and are fastened in said holes by driving said spreader body into said tube.

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