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3,390,716

POURING SPOUT AND POURING HEAD FOR THE CONTINUOUS CASTING OF
HIGH MELTING METALS, PARTICULARLY STEEL

Filed Nov. 12, 1965

2 Sheets-Sheet 1

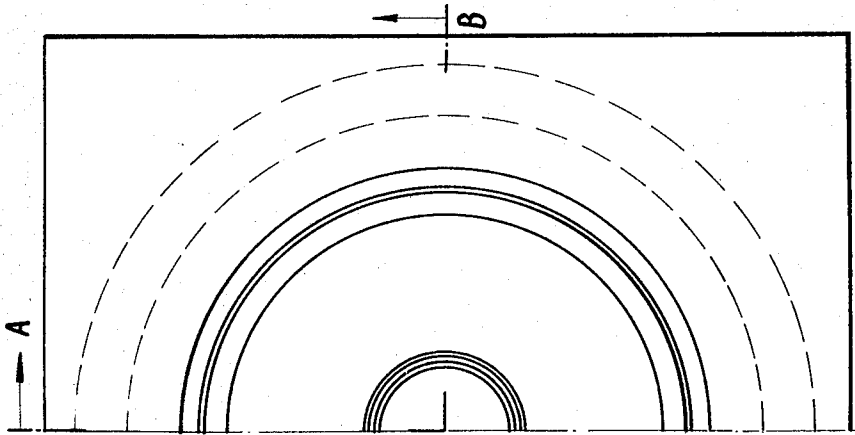


FIG. 1a

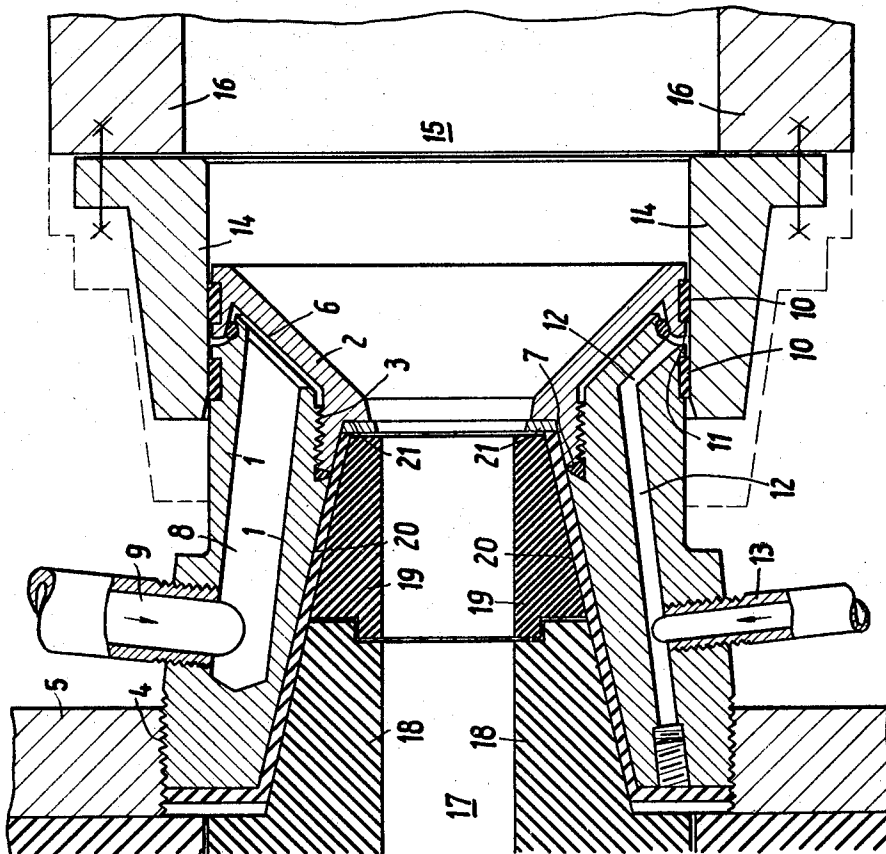


FIG. 1

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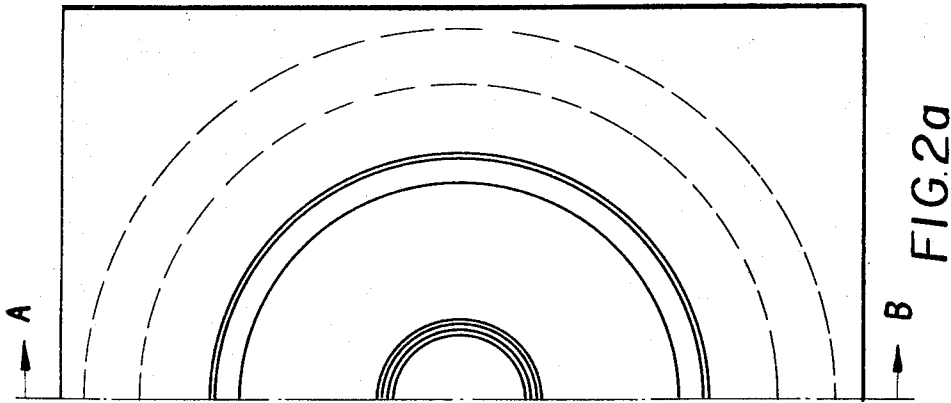


FIG. 2a

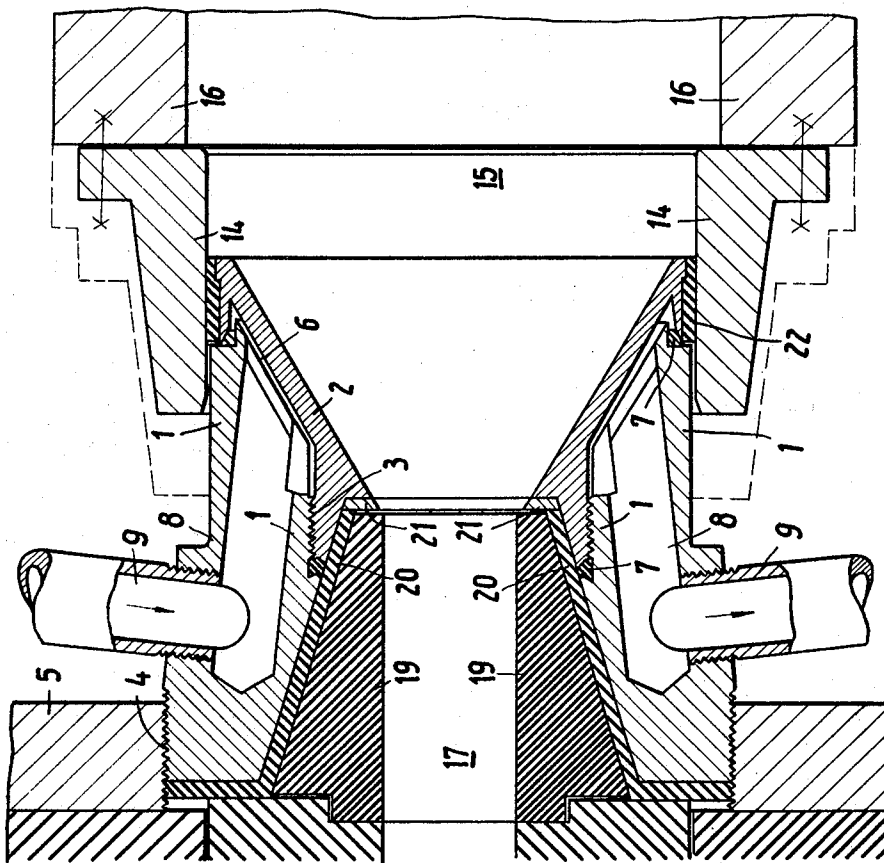


FIG. 2

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3,390,716 POURING SPOUT AND POURING HEAD FOR THE CONTINUOUS CASTING OF HIGH MELTING METALS, PARTICULARLY STEEL

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ABSTRACT OF THE DISCLOSURE

Apparatus for the continuous horizontal casting of high melting metals, comprising an axially reciprocating mold, a stationary pouring spout and pouring head means, a pouring vessel between which said mold and said means are connected to form a closed system, the mold including an extension forming a shoulder with the internal surface of the mold, said pouring spout and pouring head means intruding into said extension, at least one sealing ring peripherally sealing said means with the internal periphery of said extension, said pouring spout being made of a material of high thermal conductivity and means permitting the passage of coolant through the said head and behind the said spout.

The foregoing abstract is not intended to be a comprehensive discussion of all of the principles, possible modes or applications of the invention disclosed in this document and should not be used to interpret the scope of the claims which appear at the end of this specification.

The present invention relates to a pouring spout and pouring head for the continuous casting of high melting metals, particularly steel.

An earlier hitherto unpublished Ser. No. 483,104 filed August 27, 1965, now U.S. Patent No. 3,344,846, issued October 3, 1967 (German Patent application D 45,324), describes apparatus for the continuous horizontal casting of high melting metals—particularly steel—which is substantially characterized in that the entry end of the water-cooled mold is provided with a likewise water-cooled extension of circular section which oscillates together with the casting mold and which has an internal diameter that is less than the smallest diameter of the internal cross section of the mold. The stationary pouring vessel is extended to form a spout which projects into the mold extension and which seals the casting chamber around its entire periphery.

A hitherto unsolved problem which presents itself in the operation of this apparatus is the limited life of the casting spout which must tightly seal the liquid metal-filled chamber in the casting mold and its extension without interfering with or impeding the required oscillatory motion. It is the general opinion that the pouring spout (casting spout) must be of a material that is a good thermal insulator and kept by a method that can be simply performed at a temperature above the liquidus point of the steel that is to be cast. This is intended to prevent the steel from solidifying on the walls of the spout.

However, this arrangement has hitherto proved open to objection in practice for the following three reasons:

(1) A good heat insulating material is generally more or less brittle and will not withstand the mechanical stresses that are due for instance to friction on the inside wall of the mold and its extension.

(2) The thermal expansion occasioned by the unavoidable temperature rise when casting begins may cause such a pouring spout to become jammed in the water-cooled mold or to fracture and thereby to occasion considerable

damage on the inside wall of the mold and its extension.

(3) It has hitherto proved impossible to keep the entire pouring spout at a temperature above the liquidus point of the steel that is to be cast. This still appears to be impossible to achieve because the spout is surrounded by the water-cooled mold or the likewise water-cooled extension so that its peripheral edge is subject to continuous cooling.

According to the above mentioned proposal it is no longer necessary to avoid deposits of solidified steel from forming inside the spout, provided the forcible removal of such deposits according to the prior proposal does not pull away parts of the spout itself. However, this would in any case cause the interior of the casting to be contaminated and the spout might also be quickly destroyed. Nevertheless, it appears to be advisable to construct the pouring spout of a material that is softer than that of the internal surface (sliding surface), of the mold extension in order to prevent the latter from being damaged.

This excludes the use of a ceramic material unless it is surrounded with a ring of some other material. This would introduce fresh difficulties arising from the differential rates of thermal expansion.

The present invention concerns a pouring spout and a pouring head for the continuous casting of high melting metals, particularly steel, in which a pouring vessel is combined with the mold by a pouring head and the pouring spout to form a closed pouring system. According to the invention the pouring spout which is made of a material of good thermal conductivity is cooled by a coolant introduced through the pouring head—and, if necessary, also withdrawn through the same.

FIGURE 1 is a schematic representation of an arrangement according to the present invention. The mold and its extension are shown in their final position upon completion of its stroke in the casting direction. The opposite end position of the mold extension 14 is indicated in discontinuous lines.

The invention will be hereinafter more particularly described by reference to FIGURES 1 and 2 of the drawings which illustrate two different embodiments of the invention. FIGURE 1 is a longitudinal section of the novel arrangement, the section being taken as indicated on the right hand side of FIGURE 1. FIGURE 2 is a longitudinal section of another embodiment of the novel arrangement.

The pouring head 1 may be made of steel or of some other suitable material of appropriate strength and workability. At its forward end this head carries a pouring spout 2, e.g. of copper which is affixed thereto by thread means 3. The pouring head itself is secured to the wall of the pouring vessel 5 by means of a coarse thread 4, a flange, or a combination of both.

Between the end face of the pouring head 1 and the back of the spout 2 is a cooling cavity 6 which may preferably be between 2 and 6 mm. wide and sealed by sealing rings 7. Cooling water entering through a supply pipe 9 and ducts 8 can flow through this gap and leave through passages on the diametrically opposite side, as shown in FIGURE 2.

Between the two seals 10, which may consist of tightly fitted asbestos strips, one carried by the pouring head 1 and the other inserted into the periphery of the spout 2, is a lubricating gap 11 which can be supplied with a lubricant through ducts 12 and an admission pipe 13. A supply of lubricant may be provided at any desired number of points around the periphery of the pouring head. However, generally, 2 to 4 supply pipes will be sufficient.

The seals 10 should be so tightly fitted that no more lubricant can squeeze from the gap 11, and out between the seals 10 and surface 14 than is necessary for the lubrication of the sliding surface, i.e. the inside surface of the

mold extension marked 14. Otherwise there is a risk that bubbles may be formed in the continuous casting, particularly at the top of the casting chamber 15 inside the mold marked 16 which at its end carries the extension 14.

The entry channel 17 which connects the pouring vessel to the casing chamber 15 is formed by the brick liner 18 in the outlet of the pouring vessel and by the brick liner 19 of the spout, both made of refractory material. Both brick liners are protected from excessive loss of heat to the pouring head by an intervening insulating layer 20 consisting for instance of asbestos. The lining brick 19 in the spout bears against the spout 2 with the intervention of an insulating ring 21.

The purpose of the insulating ring 21 is to reduce the temperature jump between the liner 19 and the pouring spout 2 during casting. It is therefore preferred that it should consist of a material which has a thermal conductivity intermediate between that of the two adjacent parts 2 and 19.

Soft iron is suitable for such a purpose. The thickness of such an insulating ring should be small enough for the pouring spout 2 to be sufficiently cooled to prevent it from being fused by its direct contact with the liquid steel.

The pitch of the lip of the pouring spout in relation to the longitudinal axis of the pouring system, which in FIGURE 1 is shown to be roughly 45°, has the advantage of shortening the length of the pouring channel 17 so that the risk of deposits of frozen metal being formed and possibly occluding the channel is thus avoided.

This advantage is specially exemplified in the embodiment in FIGURE 2 where the lip of the pouring spout makes an angle of 30° with the longitudinal axis of the pouring system. The somewhat lengthened lining brick 19 in the pouring spout here practically directly adjoins the refractory lining brick of the pouring vessel.

Moreover, in the embodiment in FIGURE 2, the supply of a lubricant to the sliding contact surfaces of spout 2 and of extension 14 has been dispensed with. Instead, the pouring spout 2 here carries a sealing ring 22 which preferably consists of a high-grade very dense graphite in view of the very excellent self-lubricating properties of this material. Nevertheless, it will be understood that some alternative material might well be used. Moreover, several sealing rings may be inserted in succession into the periphery of the pouring spout in a manner resembling a group of piston rings.

Apart from the structural simplifications due to the omission of the lubricant supply system provided in FIGURE 1, the present arrangement affords a further considerable advantage if the sealing ring, as shown in FIGURE 2, is arranged to extend to the forward end of the pouring spout. Theoretically this gives the spout a life of unlimited duration since in the case of major wear only the graphite ring need be replaced between casting periods in addition to the refractory liners 18, 19 at the pouring vessel outlet and in the spout. Owing to the strong cooling effect of the spout 2 and of the extension 14 and the high thermal conductivity of the graphite ring the latter is not liable to experience chemical or physical stress and wear by direct contact with the liquid steel.

The pouring head, pouring spout and pouring vessel are extremely simple to assemble. First, the sealing rings 7 are inserted into the pouring head, and, in the embodiment according to FIGURE 2, the sealing ring 22 is pushed on to the pouring spout from the back. The spout 2 can then be screwed into the threads 3 and tightened. The insulating ring 21, the insulating layer 20 and the liner 19 are next inserted into the pouring head and into the pouring spout 2 from the back. The lining brick 18 in the outlet of the pouring vessel is cemented into the associated apertured outlet lining brick with refractory mortar and the entire pouring head together with the spout can then be mounted on the coarse threads at 4 and rotated until the brick liner in the pouring outlet

and the brick liner in the spout are firmly thrust together. The joint between the two may be sealed by the previous application of refractory cement. Finally, in the embodiment according to FIGURE 1 the sealing rings 10 are inserted into their grooves or cemented into them if this should be desired.

The proper functioning of the pouring head and spout essentially depends upon the provision of means which permit the axis of the pouring head to be exactly aligned with the axis of the mold and its extension.

Furthermore, the pouring vessel must be so constructed that the wall which supports the pouring head cannot significantly change its position even if in the course of casting major temperature fluctuations occur. Any minor deviations due to such a cause may be compensated by attaching the extension to the mold in such a way that the extension can slidably move on the end face of the mold a few millimetres in any direction normal to the axis of the casting system.

The pouring spout, e.g., of copper, may be hard-chromed, i.e., chromium plated or otherwise formed with a hard chromium surface.

What I claim is:

1. Apparatus for the continuous casting of high melting metals comprising: a pouring vessel having a pouring head provided with a horizontal pouring spout composed of a material having good thermal conductivity; a horizontal continuous casting mold having an internal peripheral surface, said vessel being connected to said mold through said pouring head and spout to form a closed system in which spout is surrounded by said mold internal peripheral surface; cavity means defined on at least one of said pouring head and pouring spout, constructed and arranged to contain a cooling fluid for conducting heat from said pouring spout; means for providing coolant to said cavity; at least one sealing ring circumferentially extending on an external surface of the pouring spout, within said mold; said mold and said pouring spout being axially relatively movable horizontally, said sealing ring being in lubricated, circumferential sliding contact with said mold internal peripheral surface.

2. Apparatus according to claim 1 further having at least one inlet conduit and at least one outlet conduit communicating with said cavity for supplying and withdrawing cooling fluid.

3. Apparatus according to claim 1 further including another sealing ring circumferentially extending on an external surface of the pouring head, within said mold, said other sealing ring being axially spaced from said at least one sealing ring, and being in lubricated, circumferential sliding contact with said mold internal peripheral surface; conduit means in at least one of said pouring head and pouring spout, said conduit means being communicated to a supply of lubricant and having at least one outlet located axially between said other sealing ring and said at least one sealing ring, for supplying lubricant for said lubricated, circumferential sliding contact.

4. Apparatus for the continuous casting of high melting metals, comprising a pouring vessel, a pouring head and pouring spout means and a continuous casting mold, said vessel being connected to said mold through said pouring head and pouring spout means to form a closed system, the said pouring spout being made of a material of good thermal conductivity and cavity means being provided at the back of the said spout for a coolant for the said spout; means for providing coolant to said cavity; said mold and said pouring head and pouring spout means being relatively axially reciprocable and comprising means for supplying lubricant to the relatively sliding surfaces; at least one lubricant channel in said pouring head and pouring spout means having access to the said relatively sliding surfaces and comprising at least two sealing rings firmly peripherally carried by said means for ensuring a uniform but limited supply of lubricant to the said sliding surfaces.

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5. Apparatus according to claim 4, in which said rings are of asbestos.

6. Apparatus according to claim 4 constructed so that the relative sliding action is between the inner periphery of the mold and the said rings.

7. Apparatus according to claim 1 wherein said at least one sealing ring is composed of self-lubricating material of good thermal conductivity, thereby providing said lubricated, circumferential sliding contact by itself.

8. Apparatus according to claim 4 in which said ring is of a high-grade dense graphite.

9. Apparatus according to claim 4 in which said ring extends to the forward edge of the said pouring spout.

10. Apparatus according to claim 1 further comprising: a refractory brick lining extending from said vessel interiorly of said pouring head toward said pouring spout; a ring composed of material having a thermal conductivity intermediate that of said refractory brick lining and said pouring spout interposed axially between said refractory brick lining and said pouring spout whereby said refractory brick lining bears against the ring and the ring bears against the pouring spout.

11. Apparatus according to claim 1, said pouring spout terminating in an internal lip flaring at 15-60 degrees with the longitudinal axis of the pouring spout.

12. Apparatus for the continuous horizontal casting of high melting metals, comprising a horizontal axially reciprocating continuous casting mold, a stationary pouring spout and pouring head means, a pouring vessel between which said mold and said means are connected to form

a closed system, the mold including an extension forming a shoulder with the internal surface of the mold, said pouring spout and pouring head means intruding into said extension, at least one sealing ring peripherally sealing said means with the internal periphery of said extension, said pouring spout being made of a material of high thermal conductivity and passage means in said head for the passage of coolant through the said head and behind the said spout means for providing coolant to said passage means.

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