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(71) Applicant: **FOSECO INTERNATIONAL LIMITED**
285 Long Acre
Nechells Birmingham B7 5JR(GB)

(72) Inventor: **Comes, Heinrich**
Bookamp 20
D-4280 Borken, 3-Weseke(DE)
Inventor: **Friede, Klaus Dieter**
Löfflerstrasse 15
D-4223 Vörde 2(DE)
Inventor: **Krampe, Hubert**
Ulmenstrasse 44
D-4421 Reken(DE)
Inventor: **Jünnemann, Michael**
Schönblick 18
D-4504 Georgsmarienhütte(DE)

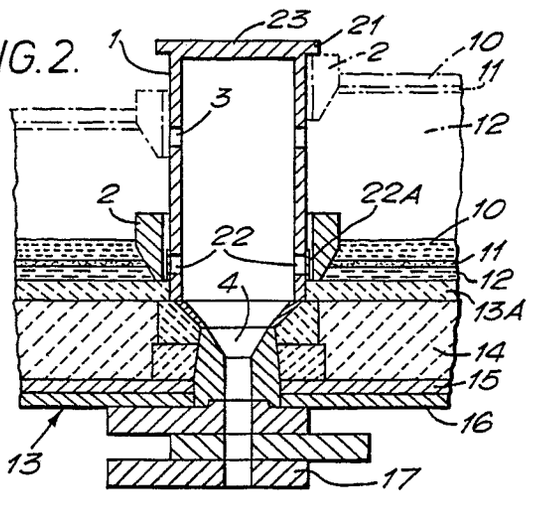
(74) Representative: **Moore, John Hamilton**
Foseco Holding International Limited Group Patents Department 285 Long Acre Nechells Birmingham B7 5JR(GB)

(54) Retaining and/or pouring means for tanks for metal melting baths.

(57) The invention relates to means for retaining contaminations in metal melting baths, e.g. a tundish containing molten metal.

Contaminations, e.g. from slag and other covering layers on the metal surface, can pass through the outlet of the tundish and hence contaminate the cast metal. The invention aims to avoid this problem by providing an annular buoyancy body (2) which surrounds the outlet (4), the body (2) being in the form of a protective ring preventing particles (10, 11) floating on the surface of the metal (12) from entering outlet (4). The body (2) may be constrained to surround a starting tube (1) which surrounds outlet (4) and to float up the starting tube (1) with increasing depth of molten metal (12). Pouring openings (3) in the starting tube (1) are thereby effectively closed by body (2) as the slag-covered surface of the metal (12) rises above the openings (3) and the openings (3) are then exposed to allow molten metal (12) to flow through only after layers (10, 11) of potential contaminations have safely passed.

FIG. 2.



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RETAINING AND/OR POURING MEANS FOR TANKS FOR METAL MELTING BATHS

The invention relates to a means for retaining contaminations contained in a melting bath, i.e. containing molten metal, in a vessel, e.g. a tank, a ladle, a distribution means, a tundish and the like.

The invention particularly relates to a pouring means for tundishes for receiving molten metal (steel) and for passing it on into ingot moulds or into the mould of a continuous casting plant but is not limited thereto. In a continuous casting process into water-cooled moulds, the steel is passed from a ladle into a tundish, which has outlets in the bottom corresponding to the positions of the moulds. For regulating the steel flow to the moulds the tundish is either provided with slide gate nozzles from below or with plugs from above, or, in the case of free-runs, with outlet nozzles only. In accordance with the pouring systems used, the outlet areas are heated before use by means of burners, from below or from above, in order to avoid chilling during the start-up of casting. The first portion of the steel reaching the tundish and distributing there up to the outlets, is coined by low temperatures and contaminations, which result e.g. from refractory particles from the lining, from sand and from the oxidation of the steel during the start-up of the casting.

In case of insufficient heating the following disadvantages occur in particular with sliding gate nozzles and free-runs:

1. Chilling of the steel in the outlet.

2. Addition of contaminations to the first portion of the continuous steel which leads to a devaluation or scrapping of said first portion.

3. The contaminations present in the initial steel can partly also lead to a clogging of the dip tubes disposed below the tundish.

In the past there were e.g. dams built in for avoiding these problems, which dams were intended to effect a rise of the contaminations due to the damming up of the initial steel and which were also intended to raise the initial casting temperatures due to the high steel volume by mixing the subsequent hot steel with the initially cold steel. This, however, could not prevent the contaminations floating on the surface from reaching the outlets during the starting phase, thus leading, as already described, to a devaluation of the initial steel strand or to difficulties in the starting procedure of casting. Also, filters proposed for use in the outlet were not able to solve these problems due to blockings or difficulties in chilling.

In the further course of development, starting tubes were used with sliding gate nozzles, independently from the damming and filtering above the outlets, which starting tubes with their cylindrical shape and with a diameter corresponding to the outlet sprue, caused a temporary bulkheading off of the outlet which, though raising the starting temperature, were incapable of preventing the contaminations floating on the surface, when reaching the top of the starting tube or the overflow openings provided in the starting tube, to be the first to enter the outlet.

The present invention is based on the problem of providing means of the initially mentioned kind in a manner as to ensure that the cast strand does not contain contaminations.

This is achieved by means of the features as indicated in the claims.

The gist of the invention is an annular buoyancy body in the form of a protective ring which is either conducted on the starting tube or the plug or, in the case of free-runs, on a suitable means in a manner that it prevents slag from reaching the outlet. The protective ring serves as an inhibit member and projects with its upper part from the surface of the molten bath level to such an extent that no slag particles or the like can pass, across its upper rim, to the inner space of the protective ring. The projection above the bath level can be achieved by selecting the shape of the protective ring and its specific weight in correspondence to the particles floating on the surface of the melting bath or of the melting bath itself, independently from the actual level of the bath.

In the case of use of a starting tube, mobility of the protective ring in upward direction can be restricted by a stopper. This prevents the protective ring from disengaging from the starting tube.

The protective ring can also be fixed at a specific position with respect to the starting tube or its overflow openings. This can counteract the unwanted Vortex-effect, namely, the level in the tundish dropping on the occasion of an exchange of ladles.

According to a preferred embodiment of the invention, the starting tube can also be provided with openings in its lower region too. However, said openings are at first closed by pieces of sheet material so that at first they do not have any function when casting starts up. Under the action of the high temperatures of the melting bath these sheets are eventually melted so that now steel can flow through said openings into the outlet. In the normal melting procedure this actually is not necessary, since the overflow openings in the upper part of the starting tube meet this function. At the end of the sequence, however, these lower openings take over the function that the steel can flow out of the tundish so that only a small residue will

result (so-called button).

The invention is further described by way of example only with reference to the accompanying drawings in which:

Figure 1 shows a vertical section through a pouring means according to the invention in use with a sliding gate nozzle in a tundish;

Figure 2 shows a similar view to Figure 1 with a modified starting tube; and

Figure 3 shows a vertical section through a pouring means according to the invention in use with a plug closure.

In Figures 1 and 2, a tundish 13 is provided with a lining 13A which can be replaced upon wear. Underneath said lining 13 there is a permanent lining 14 and an insulating lining 15. 16 refers to the casing of the tundish itself.

The tundish has an outlet or pouring opening 4 in its base and the entrance to the outlet is surrounded inside the tundish by a starting tube 1. Starting tube 1 has openings 3 towards its upper end.

A protective ring 2 surrounds starting tube 1 and rests on the base of the tundish when the latter is empty. During filling with molten steel, the surface of the molten steel is covered with a slag layer 11 and a covering insulating layer 10 both of which represent a source of contaminating particles for the steel to be poured through outlet 4.

The starting tube of Figure 1 is open-topped whereas in the embodiment shown in Figure 2, starting tube 1 has a lid 23 of greater diameter than tube 1 so that it projects beyond the tube at 21.

In Figure 3 is shown a tundish 24 having an outlet 4 in its base that is closed by a plug 6. A protective ring 2 surrounds plug 6 and sits on the floor of the tundish when it is empty or just starting to fill with molten steel 12. The operation of protective ring 2 is very similar to that used with the starting tube 1 of Figures 1 and 2. Indeed, for convenience, since the conditions relating to use of the present invention for the individual pouring means, namely with a sliding gate nozzle 17 or with a plug 6 or as free-run are rather similar, the invention is subsequently described and explained principally in connection with Figures 1 and 2.

Starting tube 1 as shown in Figure 1 has an inner diameter corresponding to the diameter of the outlet and is attached to the tundish base surrounding outlet 4 and fastened and sealed so that during the initial phase steel cannot reach outlet 4 directly and that tube 1 cannot float up. Said tube 1 is open at the top and has slots 3 towards its upper end at a predetermined distance from the tundish base which slots are dimensioned such that the amount of steel that can flow through is larger than that corresponding to the predetermined diameter of the outlet. Around the tube 1 there is provided a protective ring 2, the goemetrical shape and buoyancy of which is such that it floats up due to the buoyancy caused by the steel 12 and assumes a floating position partially submerged in the steel 12 and partly protruding above slag 11 and insulating layer 10. Due to the rise of the steel during the initial casting in the tundish, ring 2 is moved upwardly along starting tube 1, thus preventing an overflow of slag through slots 3. This is shown dotted in Figure 1 where ring 2 is shown closing off opening 3 while the slag and insulating layers 11 and 10 pass opening 3. As protective ring 2 rises further, openings 3 are exposed when beneath the surface of the steel, which latter can then flow through the openings to the outlet in clean, uncontaminated condition.

With the filling of the tundish to the final steel level, ring 2 floats up completely and then is of no further use. The tube 1 inhibits, as long as it remains in place, and even when ladles are exchanged, characterised by a drop in the steel level, the so-called Vortex-effect, i.e. the drawing-in of slag into the outlet. In order to avoid, at the end of the casting sequence, too large a residual amount of steel in the tundish, which is marked by the flow-in level of slots 3, tube 1 is designed in a manner that at the end of the sequence it will leave its position and float up or that it is mechanically forced to do so.

In order to maintain the functions of the total system over a complete sequence, tube 1 may be designed in a manner that floating ring 2 is prevented from floating up further at the upper part of tube 1 during the casting procedure. This embodiment is shown in Figure 2.

As before, in its upper region the starting tube 1 is provided with overflow openings 3, which have a specific height and which are distributed over the circumference of starting tube 1. Overflow openings 3 have a total surface which is adjusted to the inlet opening of outlet 4. At its upper end, tube 1 is provided with a cover 23, which may be integral or a separate lid.

Numeral 21 designates a projection of cover 23 which prevents the floating protective ring from disengaging from starting tube 1 in the upward direction - as shown in dotted form at the right hand side.

In this embodiment in the lower region of starting tube 1 a further opening is shown at 22, though a plurality of such openings can be provided distributed over the circumference of starting tube 1. Said opening 22 is closed by the sheet element 22A so that these openings, at first, cannot perform any function. However, when the sheet 22A melts under the action of the temperature of the molten steel 12, steel can flow through opening 22. Since openings 22 are positioned rather far down the

starting tube it can be achieved that the tundish empties to a very large extent at the end of the sequence. Here there is no risk either that slag 11 or insulating material 10 will reach the casting strand, since with falling bath level protective ring 2 covers said openings 22 in the same manner as openings 3. In comparison to common practice the use of such starting tubes is of advantage since in the processes used so far, starting tube 1 was removed after the actual starting procedure. This gives rise to the danger that through pouring from the tundishes contaminations get into the casting strand.

Thus, the consequence is that when the steel level drops to slot 3 level within a sequence or at the end of a sequence due to an exchange of ladles, floating ring 2 inhibits again the flow of slag and powder into tube 1.

The tube is also designed such that the pouring system can be preheated from below, which nowadays is a common measure. When doing so, care must be taken that the waste gases resulting from the burners can escape through slots 3 in the inner body, without problems occurring. The heating of the pouring system thus is more intensive so that the heating period or the energy density of the burner can be reduced. There is no reason either why a common tundish should not be heated from above, as both systems - heating from below and heating from above -can work independently from each other. Due to the large heat reservoir after the heating it is possible to prolong the interruption period between heating and use of the tundish while equally good preheating is maintained.

(By means of Figure 1 there can also be described the conditions as valid for a free-run. The guidance provided for the protective ring 2, according to the invention, can have a cylindrical shape corresponding to the shape of the starting tube 1 as shown in Figure 1, which is also open at the top.)

In cold start free-runs, appropriate temporary closure of the nozzles and different levels of slots 3 in tubes 1 of the individual strands, there can be achieved a timely delayed automatic start of the individual strands. The system can be used for applying, immediately after the heating and before the feeding of the steel to the tundish, the intended covering agents for insulation onto the tundish floor, since floating-up ring 2 around tube 1 prevents the corresponding slag or the still loose covering agent from flowing into the pouring system. This avoids the introduction of oxygen at the steel surface occurring hitherto and simultaneously reduces heat radiation and/or reduction in the steel casting temperature in the tundish during the first few minutes after the start.

In the case of plug-controlled tundishes (Figure 3), floating ring 2 is put around the plug which floats up with the flowing-in steel and which, during casting, inhibits an increased erosion of the plug in the slag or the contaminated steel area. The partly occurring clod formation of the basic covering agents, together with the slag, which influences the plug function, can thus be avoided. By means of a slag agent and/or covering agent applied between plug 6 and ring 2 an oxidation possibly occurring in gap 7 between ring 2 and plug 6 can be avoided. Said agents can be a component of ring 2. The advantage of adding slag formers and/or covering agents without an impediment of the plug is obvious. The covering and/or slag-forming agents, however, can also be applied separately between ring 2 and plug 6. Apart from this, when used together with plug 6, ring 2 effects an appropriate heat balance in the plug tip during the start-up period of casting.

Claims

1. Means for retaining contaminations contained in molten metal in a vessel, the vessel having an outlet through which the molten metal is poured, characterised in that an annular buoyancy body (2) surrounds the outlet (4), the body (2) having the shape of a protective ring preventing particles (10, 11) floating on the surface of the molten metal (12) from entering outlet (4).

2. Means according to Claim 1, characterised in that the design and specific weight of the protective ring (2) are such that its lower edge dips into the molten metal (12) and its main body floats on the molten metal surface.

3. Means according to Claim 1 or 2, characterised in that the specific weight of the material of protective ring (2) is nearer to that of the particles floating on the surface than to that of the molten metal (12).

4. Means according to Claim 1, 2 or 3, characterised in that the protective ring (2) has a cross-section tapering towards the lower end and preferably is of conical exterior shape.

5. Means according to any one of the preceding claims, characterised in that the protective ring (2) is made of refractory material.

6. Means according to any one of the preceding claims, characterised in that protective ring (2) contains inter alia slag-forming and covering agents.

7. Means according to any one of the preceding claims, in which the outlet is of a free-running continuous casting plant, characterised in that the buoyancy body (2) is constrained to float upwardly with increasing depth of molten metal (12).

8. Means according to any one of Claims 1 to

6, in which the pouring means comprises a plug for shutting off the outlet, characterised in that the buoyancy body (2) surrounds the plug (6) in spaced relationship and floats up the plug (6) as the molten metal (12) level increases and returns down the plug (6) to surround the outlet (4) when the metal level falls, thereby protecting the plug against attack from particles (10, 11) floating on the molten metal surface.

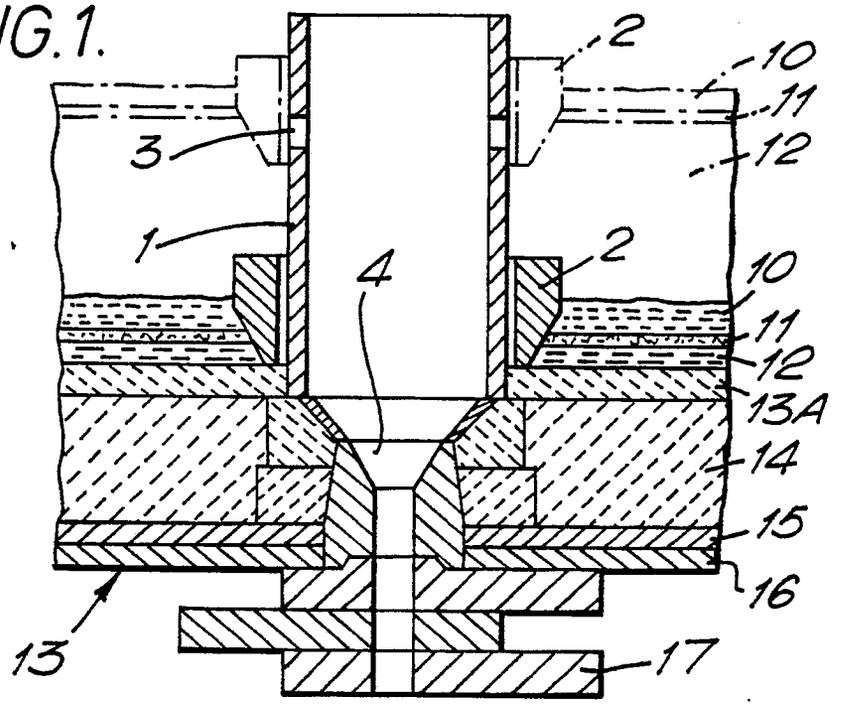
9. Means according to any one of Claims 1 to 6, in which the pouring means comprises a starting tube attached to the outlet, the starting tube having overflow openings for the molten metal, the overflow openings being distributed circumferentially in the upper region of the starting tube so that the molten metal can pour through the outlet only after reaching the overflow openings, characterised in that the buoyancy body (2) surrounds the starting tube (1) in spaced relationship and floats up the starting tube (1) with rising level of molten metal (12) thereby preventing particles (10, 11) floating on the surface of the molten metal from entering overflow openings (3).

10. Means according to Claim 9, characterised in that the starting tube (1) is closed at its top (23) or can be covered by means of a cover lid.

11. Means according to Claim 10, characterised in that the diameter of the lid (23) is greater than that of the starting tube (1), the projecting part (21) of the lid thus preventing further upwards movement of the protective ring (2) when it reaches the top.

12. Means according to any one of Claims 9 to 11, characterised in that the lower region of starting tube (1) is provided with openings (22) which are closed by means of meltable pieces of sheets (22A).

FIG.1.


2
10
11
3
12
1
2
4
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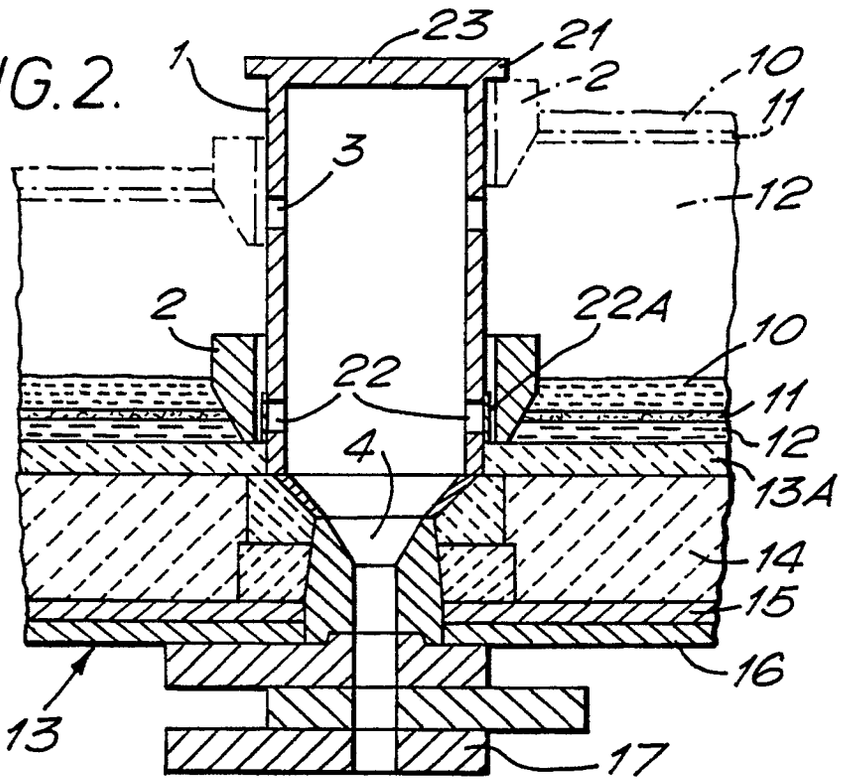
11
12
13A
14
15
16
13
17

FIG.2.


23
21
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12
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22A
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13A
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13
17

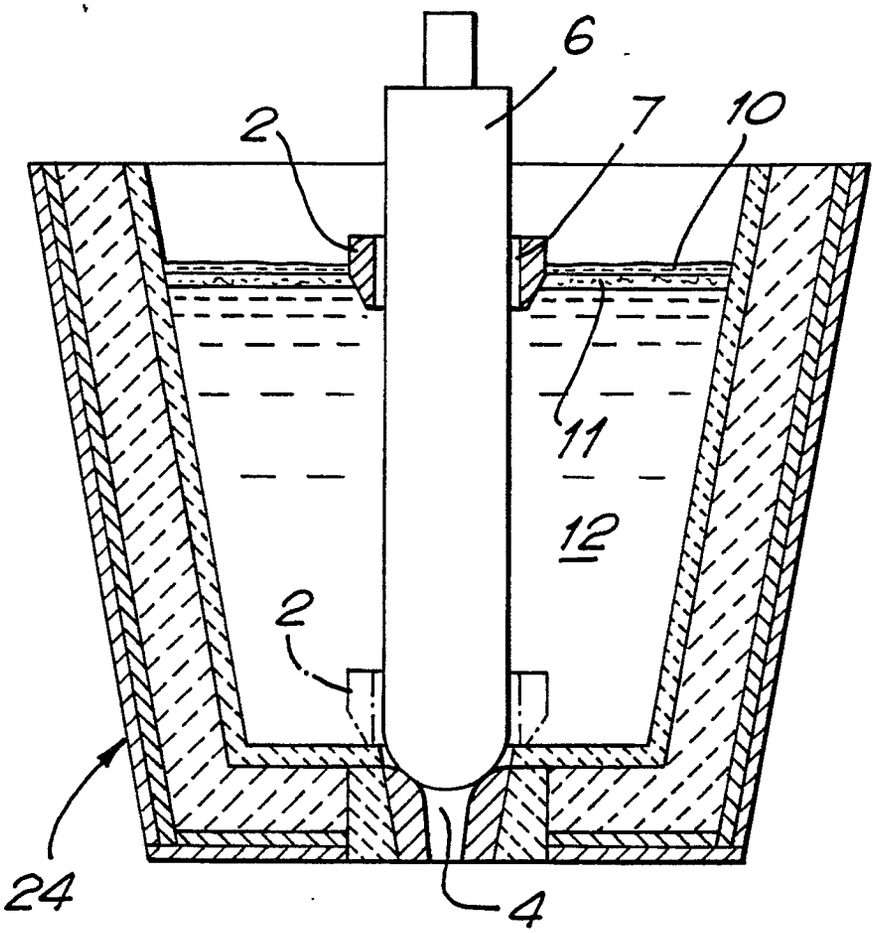

FIG.3.