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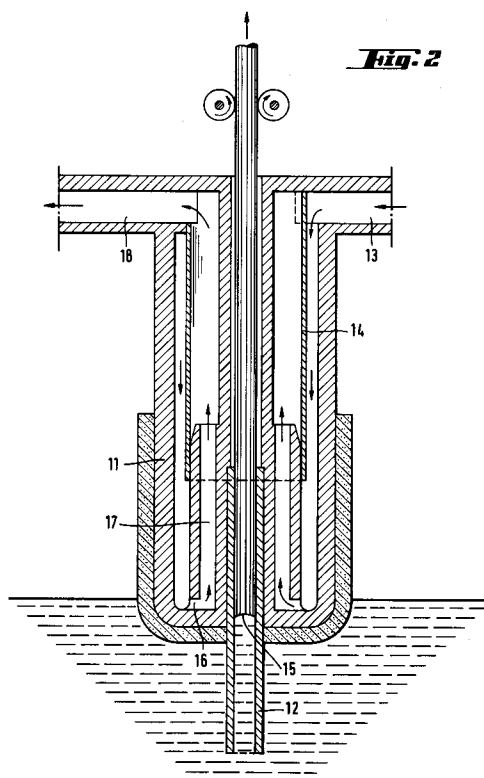
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AT BE CH DE ES FR GB IT LI SE(71) Applicant: **OUTOKUMPU CASTFORM OY**
Riihitontuntie 7 E
SF-Espoo(FI)(72) Inventor: **Koivisto, Markku Hermann**
Sumppukuja 22
SF-28330 Pori(FI)
Inventor: **Pietilä, Seppo Ilmari**
Peräkatu 18
SF-28200 Pori(FI)(74) Representative: **Zipse + Habersack**
Kemnatenstrasse 49
W-8000 München 19(DE)(54) **Apparatus for intensifying cooling in the casting of metal objects.**

(57) The invention relates to an apparatus for intensifying cooling in the casting of metal objects, particularly in vertical continuous casting from bottom to top, when the nozzle (12) of the continuous casting machine is at least at the top surrounded by a cooler (11), which is divided into two parts by a separating member (14) provided therein. According to the invention, the cooler (11) is provided with at least one guide member (16) arranged in the cooler housing and/or connected to the separating member (14) located inside the cooler, which guide member is installed essentially at the height defined by the solidification front (15) located in the nozzle (12) of the continuous casting machine. The guide member is formed for instance of at least one guide channel (16) arranged inside the cooler housing, or of at least one aligning member connected to the separating member.

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The present invention relates to an apparatus for intensifying cooling in the casting of metal objects, particularly in essentially vertical continuous casting carried out from bottom to top.

In continuous vertical bottom casting, known for example from the US patent 3,746,077, the cooling of a metal object is normally carried out by using the cooler of figure 1, where the cooling agent is conducted to the bottom part of the cooler through the top, via the inlet located in the vicinity of the outer wall of the cooler. Inside the cooler there is installed an intermediate pipe so that the cooling agent is directed towards its outlet while rising up in the vicinity of the inner wall of the cooler. In figure 1, the molten metal is conducted to a nozzle 1; in the nozzle, at the height 2, there is formed a solidification front, where the molten metal turns solid. In the cooler 3, the cooling agent is conducted, by means of the intermediate pipe 4, first downwards, through its inlet, to the bottom part of the cooler, and further back up, to the top part of the cooler, to be discharged from the cooler. It is apparent that the heat content discharged from the nozzle 1 is at its highest essentially at the solidification front 2, because metal, in the course of solidification, changes state and thus emits heat according to its temperature in the change of state.

While using the prior art cooler of figure 1 for instance in the casting of wire, where the casting is carried out at essentially high velocities, the increase in the temperature of the cast wire is observed as a function of time. While casting for instance copper wire at the rate of 6 m/min, the surface temperature of the wire may, after cooling, be over 500°C. Such an increase in the wire temperature generally causes the wire to break, which essentially decreases the operation grade. Reasons for the increase in the temperature are for example the thermal expansion of the lower part in the cooler, which creates a gap in the threading between the nozzle and the cooler. Moreover, a high melting heat capacity at high casting velocities brings about an increase in the temperature of the water surface in the cooler, so that an insulating steam bubble is created on the cooling surface of the cooler.

The object of the present invention is to eliminate some of the drawbacks of the prior art and to achieve a new, improved apparatus, which is more secure in operation, so that the cooling, particularly in continuous vertical upward casting, is made efficient also at essentially high casting velocities. The essential novel features of the invention are apparent from the appended patent claims.

According to the invention, the flow path of the cooling agent, flowing in the cooler of a continuous casting machine in casting from bottom to top, is changed by means of at least one guide member,

particularly at the height defined by the solidification front of the apparatus, so that the cooling, particularly at this height at least, is advantageously intensified. At the same time, this prevents the temperature of the cast object from rising, and consequently the created product from breaking.

The guide member or members of the invention can advantageously be placed in the housing of the cooler, and/or in a separating member defining the flow direction of the cooling agent, which enables the flowing of the cooling agent first from the top part of the cooler down to the bottom, and then further back up. When placing the guide member or members in the cooler housing, these members form channels for guiding the cooling agent to essentially near to the surface to be cooled. Thus the cooling can be intensified, also and essentially as regards the section located above the height defined by the solidification front.

In order to install the guide member of the present invention in the separating member of the cooling agent, the bottom part of the separating member can be provided with the said guide member, for directing the cooling agent in an advantageous fashion towards the surface of the cooler located essentially at the height of the solidification front. For an advantageous aligning of the cooling agent, it is also possible to arrange a groove in the cooler housing, essentially at the height of the solidification front, which groove advantageously expands the cooling surface at this most critical point.

By employing the guide member or members of the invention, the cooling agent is advantageously made to flow past the most critical point as regards vertical continuous casting, so that essentially the total cooling capacity of the cooling agent can be made use of. Thus it is possible to increase casting velocities from the current state without causing an increase in the temperature of the cast product and a consequent danger of breaking.

In the following the invention is explained in more detail with reference to the appended drawings, where

- figure 1 is a schematical side-view illustration of a prior art cooler of a casting machine applying vertical continuous casting from bottom to top,
- figure 2 is a schematical side-view illustration of a preferred embodiment of the invention, where the guide member of the cooling agent is located in the cooler housing,
- figure 3 is a schematical side-view illustration of another preferred embodiment of the invention, where the guide member of the cooling agent is located in the separating member,

figure 4 is a schematical side-view illustration of a third preferred embodiment of the invention, where the guide member of the cooling agent is located in the separating member and in the cooler housing.

Figure 1 was already explained in the description of the prior art.

In figure 2, the cooler 11 is arranged around a nozzle 12, so that at least the top part of the nozzle 12 is cooled. The cooling agent, such as water, is brought into the cooler 11 through the inlet 13 located at the top end of the cooler. In the cooler 11, the cooling agent flows, in the direction of the arrows of figure 2, first downwards in the space between the outer wall of the cooler 11 and the separating member 14 arranged inside the cooler. Thereafter the cooling agent is conducted, according to the invention, to the height of the solidification front 15 in the nozzle 12, to an essentially horizontal guide channel 16 provided in the housing of the cooler 11, so that the cooling agent flows to essentially near to the inner surface of the cooler 11. Consequently the cooling agent meets the inner wall of the cooler 11 essentially at the hottest point, which advantageously improves the efficiency of the cooling. The guide 16 is further connected to another guide channel 17, which is essentially parallel to the vertical inner wall of the cooler 11. In addition to the fact that the guide channels 16 and 17 bring the cooling agent essentially nearer to the hottest point of the cooler housing, the surface of the cooler housing 11 that is in contact with the cooling agent is also essentially expanded at the hottest point. This brings about a further essential improvement in the cooling power of the cooler 11.

Through the guide channel 17, the heated cooling agent rises in the space between the inner wall of the cooler 11 and the separating member 14, to be discharged from the cooler 11 via the outlet 18. The number of guide channels 16 and 17 in one cooler 11 may vary depending on the use of the apparatus of the invention, so that there are either one or several of them.

In figure 3, around the nozzle 21 there is arranged the cooler 22, where the flowing direction of the cooling agent is indicated with arrows in similar fashion as in figure 2. The cooling agent is fed into the cooler 22 through the inlet 23, and the cooling agent flows, in the space between the outer wall of the cooler 11 and the separating member 24, to the bottom part of the cooler. According to the invention, in the bottom part of the separating member 24, essentially at the height of the solidification front 25 located in the nozzle 21, there is installed at least one guide or aligning member 26 for guiding the cooling agent towards the inner wall of the

cooler, advantageously at the point in the wall which requires most intensive cooling. The heated cooling agent is further conducted, through a flow space formed by the separating member 24 and the inner wall of the cooler, to the outlet 27. By employing the guide member 26 of the invention, a higher flow rate and thus a better cooling capacity is obtained for the cooling agent. Likewise the turbulence of the cooling agent is increased, so that the creation of a steam bed on the cooler surface is advantageously prevented.

In the embodiment of figure 4, the cooler 31 is installed around the top part of the nozzle 32. The cooling agent is fed in through the inlet 33 provided in the top part of the cooler, and the cooling agent flows in the space in between the outer wall of the cooler and the separating member 34 to the bottom part of the cooler 31. In order to direct the cooling agent towards the inner wall of the cooler, in the bottom part of the separating member 34, essentially at the height of the solidification front 35 located in the nozzle 32, there is connected, according to the invention, at least one guide or aligning member 36, which guides the cooling agent to at least one groove 37 formed in the inner wall of the cooler housing in an essentially perpendicular position. Owing to the effect of the guide member 36 and the groove 37, the pressure energy contained in the cooling agent is changed into kinetic energy. Thus the cooling capacity of the cooling agent is improved at the same time as the formation of an insulating steam bed, which would reduce the cooling efficiency, is prevented. The cooling agent heated in the bottom of the cooler, essentially at the hottest point thereof, is discharged from the cooler 31 through the outlet 38 provided in the top part of the cooler.

The above drawings 2 - 4 illustrate preferred embodiments of the invention, each provided with a guide member of a different form, but it is naturally clear that when necessary, these various forms of the guide members can be applied simultaneously in one and the same cooler.

Claims

1. An apparatus for intensifying cooling in the casting of metal objects, particularly in vertical continuous casting from bottom to top, when the nozzle (12, 21, 32) of the continuous casting machine is at least in the top part surrounded by a cooler (11, 22, 31) divided into two parts by a separating member (14, 24, 34) arranged therein, **characterized** in that the cooler (11, 22, 31) is provided by at least one guide member (16, 26, 36) installed in the cooler housing and/or connected to the separating member (14, 24, 34) provided inside the

cooler.

2. The apparatus of claim 1, **characterized** in that the guide member (16, 26, 36) is installed essentially at the height defined by the solidification front (15, 25, 35) located in the nozzle (12, 21, 32). 5
3. The apparatus of claim 1 or 2, **characterized** in that the guide member is formed of at least one guide channel (16, 17) arranged inside the cooler housing. 10
4. The apparatus of claim 1 or 2, **characterized** in that the employed guide member (26) is at least one aligning member connected to the separating member (24). 15
5. The apparatus of claim 1 or 2, **characterized** in that the guide member is formed of at least one aligning member (36) connected to the separating member (34), and of at least one groove (37) formed in the cooler housing. 20

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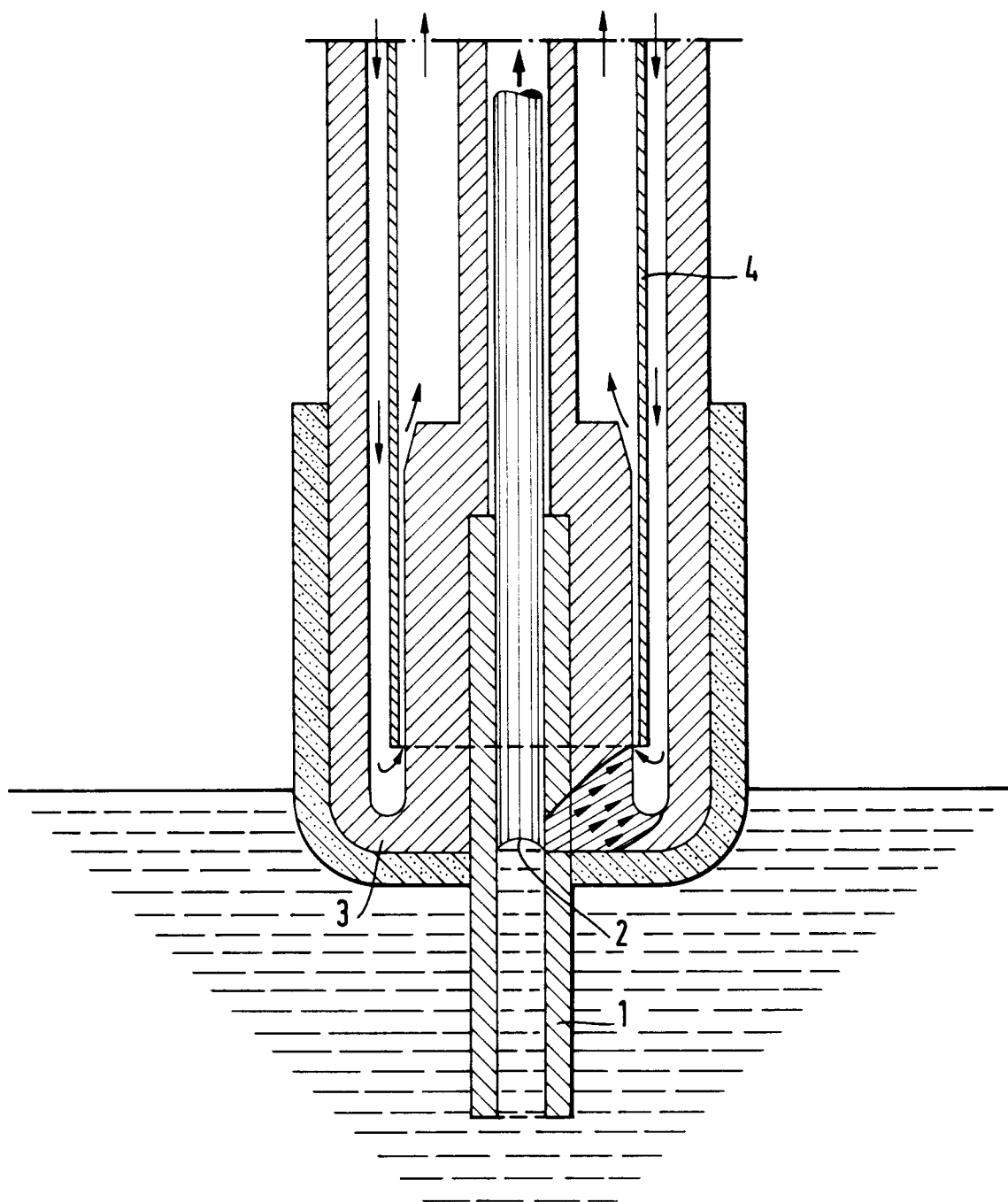
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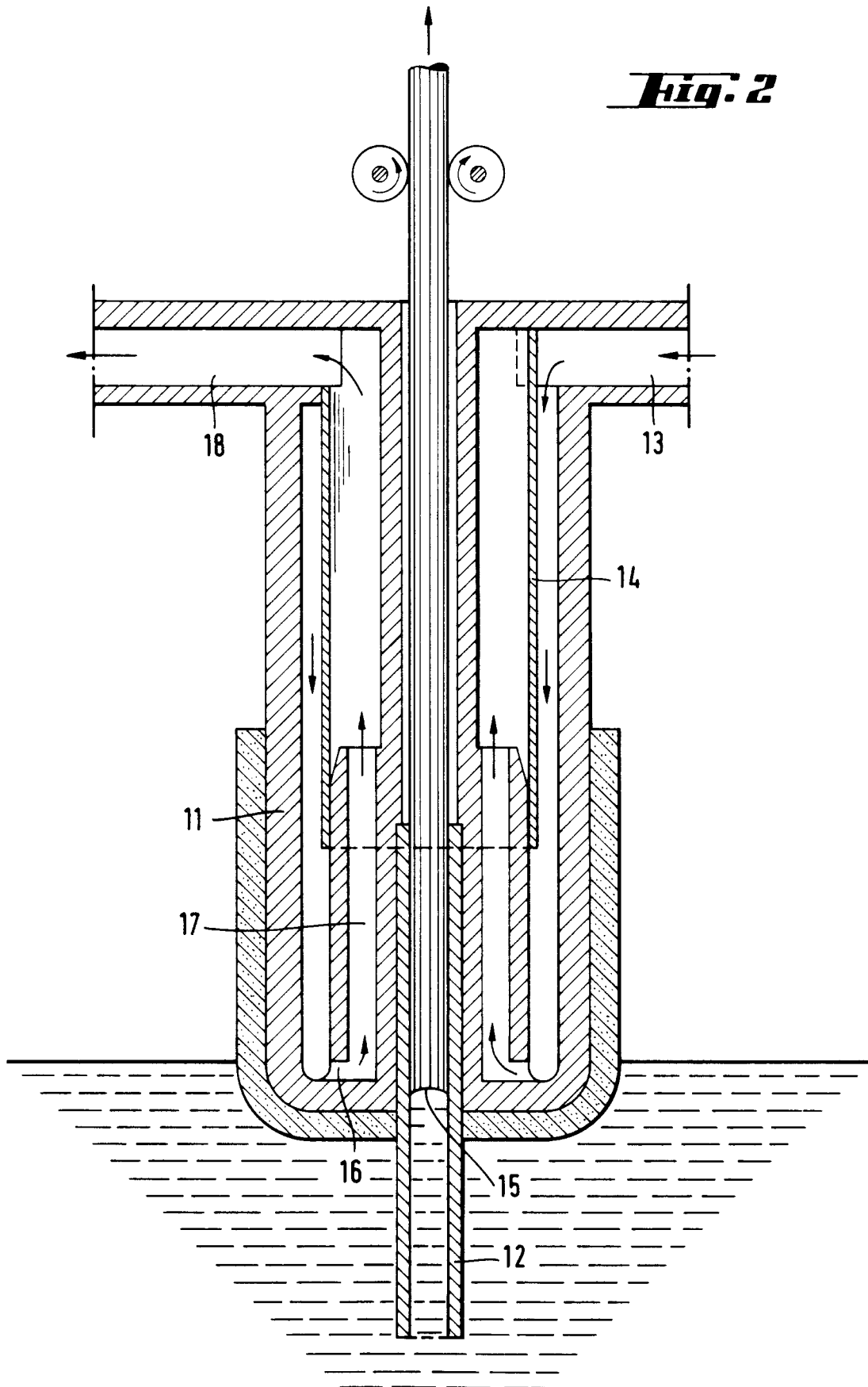
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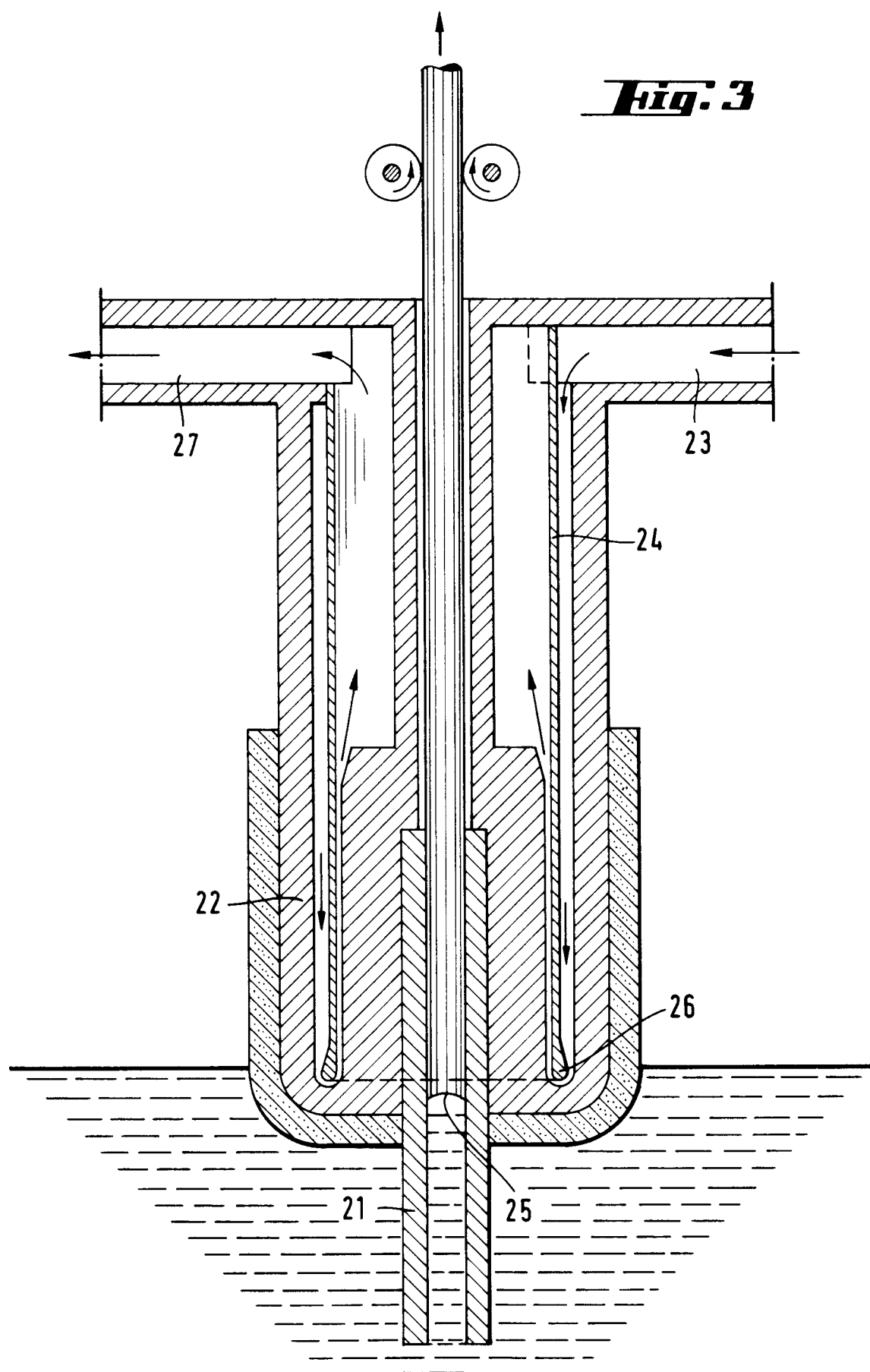
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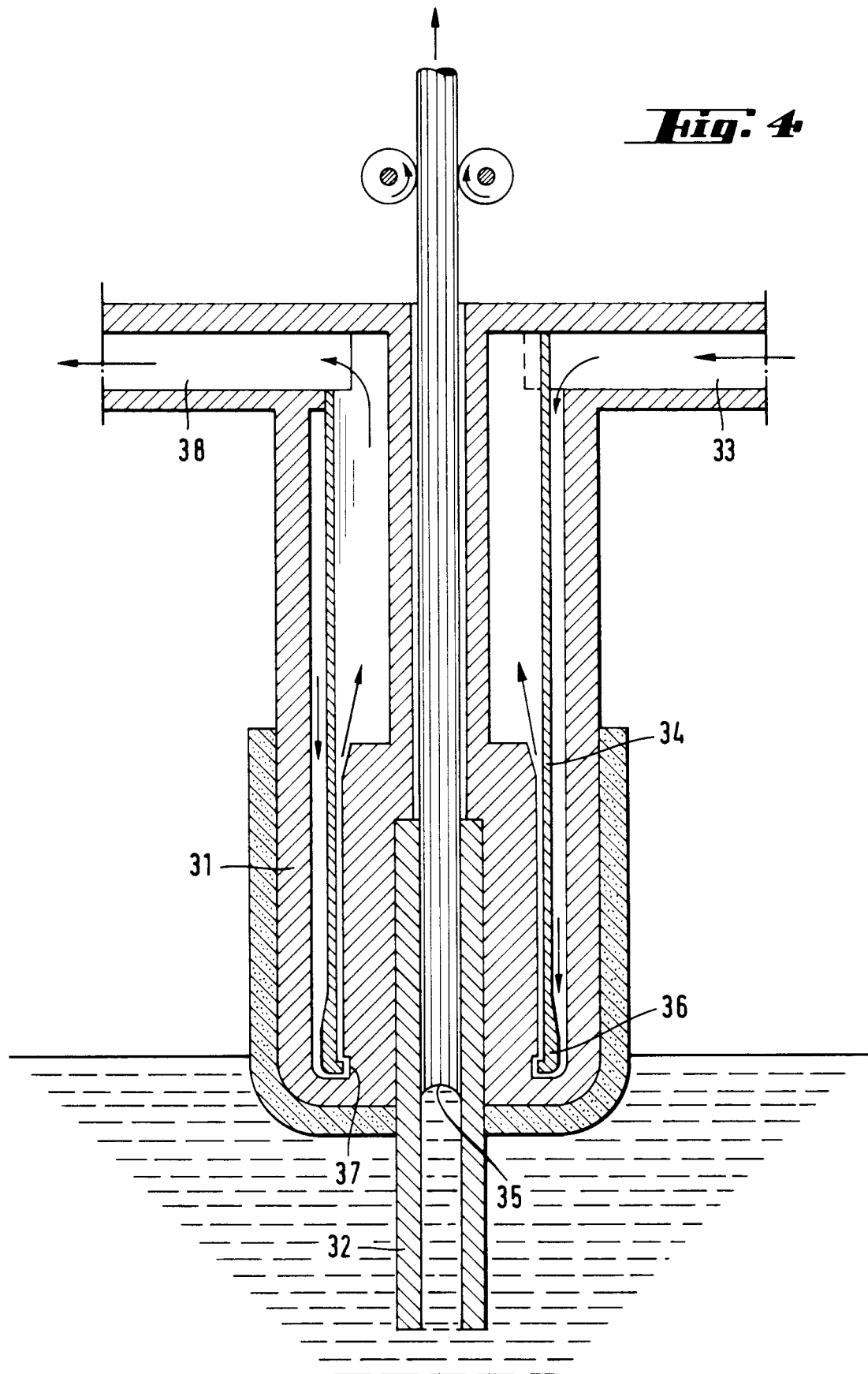
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Fig. 1











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EUROPEAN SEARCH REPORT

Application Number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 91117411.8
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	<u>DE - B - 2 060 451</u> (OUTOKUMPU) * Claims 1,3; column 6, lines 5-26; fig. 2,1 * --	1,2,3	B 22 D 11/22
D,X	<u>US - A - 3 746 077</u> (LOHIKOSK) * Claims 1,2,4; abstract; column 2, lines 35-65; fig. * --	1,2	
A	<u>US - A - 2 553 921</u> (JORDAN) * Fig. 1,2,3; claim; column 2, lines 11-48; abstract * ----	1,2,4	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B 22 D 11/00
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
VIENNA		10-12-1991	SCHÖNWÄLDER
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	