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D E C I S I O N
of 20 September 2005

Case Number: T 0218/03 - 3.2.03

Application Number: 95919976.1

Publication Number: 0760723

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Language of the proceedings: EN

Title of invention:
Methods of closing the inlet of a green-sand mould after non-gravity casting with a non-ferrous alloy in a mould-string plant

Patentee:
GEORG FISCHER DISA A/S

Opponent:
Heinrich Wagner Sinto Maschinenfabrik GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
"Novelty and inventive step: yes"
"Interpretation of the claims"

Decisions cited:
-

Catchword:
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Case Number: T 0218/03 - 3.2.03

D E C I S I O N
of the Technical Board of Appeal 3.2.03
of 20 September 2005

Appellant: (Proprietor of the patent)
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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 17 December 2002 revoking European patent No. 0760723 pursuant to Article 102(1) EPC.

Composition of the Board:

Chairman: U. Krause
Members: Y. G. A. Jest
K. M. Garnett

Summary of Facts and Submissions

I. The appeal is directed against the decision posted on 17 December 2002 of an opposition division which revoked European Patent No. 0760723. In the decision under appeal, the opposition division held that the subject-matter of independent claim 9 as granted lacked novelty and that the subject-matter of independent claims 1, 12 and 13 of an auxiliary request, but identical to claims 1, 12 and 13 as granted, lacked inventive step.

The proprietor, hereinafter the appellant, lodged the appeal on 14 February 2003 and paid the appeal fee on the same day. With the statement of grounds, which was received on 15 April 2003, the appellant requested the maintenance of the patent as granted or as amended on the basis of a revised set of claims 1 to 6.

The four independent claims 1, 9, 12 and 13 as granted read as follows:

"1. Method of closing the inlet in a mould by means of a movable element after non-gravity casting with a non-ferrous alloy of green-sand moulds in a mould-string plant, characterized in that the element is shaped as a hollow element (14,14') constituting the outermost part of the inlet system (8) adapted to abut against a nozzle (13) of a casting device and said element being securely fixed in the moulding sand of each mould in such a manner that it can resist the closing and sealing force from the nozzle (13) of the casting device, but on exertion of a considerably greater force

is displaced axially inwardly into the mould and bars the inlet of the latter."

"9. Method of closing the inlet in a mould by means of a plate after non-gravity casting with a non-ferrous alloy of green-sand moulds in a mould-string plant, characterized in
a) that the runner (8) of each mould adjacent to the casting inlet comprises a downwardly extending part (8',8''),
b) that the plate (22,22') is placed in oppositely disposed grooves in the mould parts substantially at right angles to the downwardly extending part (8',8'') of the runner (8) with a through-going opening (23,23') lying aligned with said runner, and
c) that the plate (22, 22') after casting of the mould is displaced inwardly into the latter and bars the runner (8)."

"12. Method of closing the inlet of a mould after non-gravity casting with a non-ferrous alloy of green-sand moulds in a mould-string plant, characterized in that the runner (8) in each mould adjacent to the casting inlet has a downwardly extending part(8'''), which is closed from outside by pressing a plug(26) of moulding sand into the runner (8'''), said moulding sand being disposed between said part (8''') of the runner and the outside (24) of the mould."

"13. Method of closing the inlet of a mould after non-gravity casting with a non-ferrous alloy of green-sand moulds in a mould-string plant, the outermost part of the inlet system (8) being adapted to abut against the nozzle (13) of the casting device in each mould is

constituted by a metal tube (27) secured in the mould, said metal tube protruding somewhat from the surface of the mould, and this metal tube (27) being blocked after casting of the mould, characterized in that the part of the metal tube (27) protruding from the mould surface is cooled from the outside causing the metal within this part of the tube to solidify and block the tube."

II. The following documents were inter alia of relevance in the proceedings:

D1: WO-A-9311892

D2: SE-B-0461023 & family member US-A-4589466

D3: DE-A-2441956

D4: GB-A-1410770

D5: US-A-3905419

III. With a communication dated 11 March 2005 the board expressed its views on the correct interpretation of the independent claims and invited the parties to oral proceedings which took place on 20 September 2005.

IV. The appellant requested that the decision be set aside and the patent be maintained as granted or as amended on the basis of the revised set of claims 1 to 6 filed with the letter of 15 April 2003.

The appellant argued that the method defined in each of independent claims 1, 9, 12 and 13 was not only new but involved also an inventive step when compared to the

available prior art. These arguments can be summarised as follows:

(a) Claim 1

The closest prior art D1 (embodiment of Figures 12 to 16) does not disclose a hollow element which, when moved axially inwards, can close or bar the inlet of the mould. Such an element enables the capture of sand particles in a runner portion distant from the inlet so as to avoid ingress back into the pump or reservoir after closing of the mould inlet. None of the remaining cited documents shows such a hollow, axially moveable element either.

(b) Claim 9

The claimed method differs from D1 (in the embodiment of Figure 7 but amended as suggested in the last sentence of page 10) by features a) and b), i.e. by a downwardly extending part of the runner, by the provision of a closing plate having a through-going opening and by the placing of the closing plate in grooves substantially at right angles to the downwardly extending part of the runner. These distinguishing features solve the technical problem in the sense that they define a suitable closure mechanism in the field of non-gravity casting with a non-ferrous alloy of green-sand moulds in a mould-string plant and contribute to the avoidance any ingress of sand into the mould or back to the feeding pump or to the reservoir of melted alloy. Prior art D4, which shows a shutter in form of a plate with a through-going hole, would not be considered by the skilled person facing the problem of sand ingress since D4 concerns a completely different type of moulding, that is, a

conventional die moulding, in which the mould is not made of sand. But even if a combination D1 and D4 was contemplated, the resulting method would still lack the essential feature of the downwardly extending part of the runner (feature a)).

On the other hand, if D5 (Figures 4,5) were to be considered as the closest prior art, there is nothing there to suggest the provision of a downwardly extending part of the runner (feature a)) in order to prevent sand particles, which might be detached from the mould when moving the closing plate, from flowing back to the reservoir. On the contrary, D5 would suggest the provision of metal parts for the guidance of the closure plate (see embodiment of Figures 2 and 3), which would meet the problem of sand ingress by a different solution, involving the introduction of metal parts in the sand mould.

(c) Claim 12

No cited document discloses the concept of making a sand plug from a part of the mould as a closure means for the mould. The embodiment of Figure 7 of D1 refers to a strip or a plate moved into the runner to close the inlet of the mould and the small amount of sand which might be pushed into the runner is not intended to and cannot act as a closure plug. The problem of sand ingress is solved in the method of claim 12 by the provision of the downwardly extending part of the runner into which the plug is pressed.

(d) Claim 13

The embodiment of Figures 9 to 11 of D1 relates to a method in which the moulds are slid along the chill plate so that sand particles may again flow either into the mould or back to the pump or reservoir. This method would need extensive changes if the inlet of the mould was in the form of a metal tube protruding out of the mould.

Furthermore D2 cannot be considered as the closest prior art since it does not refer to a method of closing the inlet of green-sand moulds in a mould-string plant and does not appear to be suitable to be simply adapted to this type of mould plant.

V. The opponent, hereinafter respondent, requested that the appeal be dismissed and the patent be revoked for lack of inventive step of its subject-matter.

The respondent presented its arguments as follows:

(a) Claim 1

The method of claim 1 differs from the closest prior art D1 (embodiment of Figures 12 to 16) only by the axial movement of the hollow element, which movement alone could however not suffice to define properly the closing operation of the inlet of the mould. Essential features (especially those relating to the "seating surface" cooperating with the hollow element in the closing process, as described in the description of the patent, column 5, lines 29 to 38) are indeed missing from the definition of this technical solution.

Therefore the distinguishing feature cannot solve the problem and should thus not be considered when assessing patentability. For these reasons the method of claim 1 does not involve an inventive step.

(b) Claim 9

The method of claim 9 differs from D1 (embodiment of Figure 7 but amended as suggested in the last sentence of page 10) only by features a) and b), i.e. by a downwardly extending part of the runner and by the provision of a through-going opening in the closing plate, which is guided in opposite grooves of the mould. Feature b), which is known per se from D5, by itself solves the technical problem in the sense that the guidance of the plate in pre-formed grooves prevents any degradation of the mould due to the movement of the plate and thus any ingress of sand into the mould or back into the feeding pump or the reservoir of melted alloy. Feature a) has no influence on the problem of sand ingress and does not contribute to the solution of the problem, and should therefore be disregarded when assessing inventive step. The method of claim 9 is thus obviously derivable from the combination of documents D1 and D5.

(c) Claim 12

The patent cites in its description prior art D1 (the embodiment of Figure 7) and explains that a small amount of sand being pushed into the runner is disadvantageous for the moulding operation. The claimed method teaches the closure of the mould inlet merely by pressing out a sand plug from the mould structure. Such a method is even worse than D1 when addressing the problem of sand ingress since the plug shape cannot be controlled or, at the very least, there is no indication in the patent of how to shape such a plug. The claimed method therefore does not solve the

technical problem and thus does not involve an inventive step.

(d) Claim 13

The skilled person knows from D1 that the mould inlet may be closed either by mechanical means (Figures 4-7, 12-16) or by cooling/freezing means (Figures 9-11). Starting from D2, in which a protruding inlet tube is mechanically squeezed to stop the flow of melt metal into the mould, the skilled person would envisage as an equivalent alternative solution the closure of the inlet tube by applying a cold source on the inlet tube to freeze the metal in that section, as suggested by D1.

Reasons for the Decision

1. The appeal is admissible.

2. *Preliminary comments*

In the impugned decision the "structural" features of the method-claims were disregarded by the opposition division when comparing the invention with the cited prior art as being not suitable for defining method-steps.

The opposition division also disregarded some further features in the independent claims because they were not able to achieve or contribute to the achievement of one of both objects of the invention, i.e. a suitable closure of the runner and prevention of ingress of sand particles into the runner during the closing process.

This interpretation or assessment of the scope of the claims is not shared by the board.

In opposition proceedings the analysis of the set of claims as granted should take into account the general teaching of the patent, especially in a case where the wording of some claims is not wholly clear. In the present case, the features of the claims presented as "constructional" features are undoubtedly to be construed as method steps, by reading a constructional feature of the mould as meaning a method step consisting of "providing" such a constructional element. If the claims were not construed in this way, it would mean that a possible lack of clarity, which had not been met in the examination phase of the application, could lead to a formal and artificial lack of patentability of the claimed subject-matter without consideration of the intended and generally understood meaning of the claims.

The further disregard of certain further features by the opposition division, on the basis that they did not contribute to the solution of the defined technical problem, is not supported by the facts and evidence, as will become apparent from the following detailed discussion.

3. *The invention*

The invention deals with methods of closing the inlet in a green-sand mould of a mould-string plant by means of a movable element after non-gravity casting with a non-ferrous alloy. In this type of moulding process, green-sand moulds are presented stepwise, one after the

other, in matching relation to a supply nozzle of melt alloy. Once one mould is filled and its inlet is closed, the metal located upstream from the closure means is usually sucked back to the reservoir before the next mould is presented to the nozzle to be filled in turn. When closing the inlet of the mould after filling, some sand particles may be dislodged from the mould by the displacement of the closure means. Before it solidifies, this sand may migrate downstream from the closure means towards the mould cavity and affect the quality of the moulded piece, while the sand upstream of the closure means may migrate back to the pump or to the reservoir, and thus affect the quality of the filling material for the next mould.
Each of the four independent claims provides a solution to this problem of sand migration caused by the closing step, while providing suitable closure means.

In claim 1 the solution consists in the provision of a hollow element which serves as an inlet and which can be displaced axially inward into the mould to close the inlet. Any dislodged sand in the runner will be remote from the inlet so that such sand will remain in the vicinity of the closing area defined by the axial end of the hollow element and by a cooperating seat surface in the runner.

Claim 9 teaches the use of a closure plate with a through-going opening, which is guided by suitable grooves and moved at right angles into a downwardly extending part of the runner. Sand dislodgment is reduced by the provision of grooves and sand particles will stay in the vicinity of the closure plate, thus in

the downwardly extending part of the runner, and will not migrate back to the pump or into the mould cavity.

Claim 12 also uses a downwardly extending part of the runner but the plate of claim 9 is replaced by a sand plug pressed out of the mould material. Of course, sand may be torn away by this method but it will again stay in the downwardly extending part of the runner.

The solution provided in claim 13 is based on the provision of a metallic tubular inlet protruding from the surface of the mould and by the provision of cooling means which can freeze the metal in the protruding part of said tube so as to close the inlet. Here no sand particles can enter the runner.

4. *Closest prior art*

4.1 Document D1 describes several methods of closing the inlet of a mould after non-gravity casting with a non-ferrous alloy of green-sand moulds in a mould-string plant. After a mould has been filled it is indexed forward, thus out of register with the filling nozzle, whereby a closure means, for example a shutter core (see page 5, last paragraph) closes the inlet automatically.

4.1.1 A first embodiment of the closure means, hereinafter "D1-F7", is illustrated by Figure 7 and is made of a metal strip fed from a coil, which is inserted into the mould and cut: see page 8, third paragraph. This embodiment may be varied, according to the last sentence on page 10, by replacing the metal strip by discrete blade-like closures (thus plates) which are

inserted into successive mould inlets by suitable means. According to Figure 7, the plates would be pushed into the substantially horizontally extending runner at an oblique angle (approximately 45° in the drawing).

4.1.2 The alternative proposed in Figures 12 to 16, hereinafter "D1-F12", is based on a shutter core located in the mould and having an inlet passage in alignment with the inlet for the filling of the mould, such that the shutter core can be moved transversely to close the inlet after filling.

4.1.3 Prior art D1 also describes a non-mechanical closure means, illustrated in Figures 9 to 11, hereinafter "D1-F9". When the mould is filled it is translated (arrow A in Figure 10) so as to bring the inlet 37 of the runner 35 in front of the chill plate 40, such that in this position the melt alloy at the inlet of the runner will be frozen and create a plug.

4.2 Prior art document D5 also addresses the technical field of non-gravity casting in a mould-string plant in which the inlet 16 of a green-sand mould 8 is closed after filling of the mould. The moulds 8 are bottom-filled and comprise a closure plate 14 having a through-bore 23 and supported in a bottom wall of the mould, see especially Figures 2 to 5. This plate is in register with the inlet 16 for the filling operation and slidable transversely out of register with the inlet into the closed position of the mould. In the embodiment of Figure 2 the slidable plate 14 does not contact the compacted sand of the mould but is located in a recess 13 of bottom plate 12. This multi-layered construction of the bottom wall and closure plate

obviously avoids any dislodging of the sand construction of the mould. In the embodiment of Figures 4 and 5, which is directed to an automated moulding device, it appears from the description in column 4, lines 57 to 61 of D5 that the closure plate may either be located in a bottom plate or provided in direct sliding contact with the sand mould. If it is in direct contact, sand will be torn away in the closing step and will ingress into the casting nozzle 6.

4.3 Prior art D2 relates to a moulding process using gas permeable sand moulds such as moulds of shell type, each mould being provided with an inlet tube which cannot be reused. The method of prior art D2 is therefore obviously not suitable for moulding operations in a mould-string plant and cannot define the closest prior art.

The remaining cited documents D3 and D4 are less relevant since they concern conventional die casting processes with metal moulds, in which the problem of sand migration can per definition not occur.

5. *Claim 1*

The method disclosed by the embodiment D1-F12 uses a shutter core 57 presenting a substantial transverse thickness and an axial through-hole 60. It is highly questionable whether this shutter core can come within the description of a "hollow element", given its respective dimensions. But even if claim 1 did not differ from this known prior in this respect, it would still be distinguished by the fact that the hollow element is displaceable **axially inwardly** into the mould

for barring the inlet of the latter, since the shutter core 57 of D1 is slid along a direction transverse to the "axis" of its through-hole 60. During this transverse displacement sand may contaminate the melt metal in the nozzle.

There is no incentive in any cited prior art which could or would prompt the skilled person to adapt the gate-type shutter of D1 such as to close the mould by displacing it axially inwards into the runner.
The method of claim 1 is therefore new and involves an inventive step.

6. *Claim 9*

6.1 Closest state of the art: "D1-F7"

6.1.1 It follows from item 4.1.1 above that the method of claim 9 differs from "D1-F7" by the following features:
a) providing a downwardly extending part in the runner for each mould and adjacent to the casting inlet,
b) providing a through-going opening in the plate, placing the plate in oppositely disposed grooves in the mould parts substantially at right angles to the downwardly extending part of the runner with the through-going opening lying aligned with said runner during casting, before displacing the plate after casting of the mould.

As described in paragraph 3 above, these distinguishing features solve the problem of providing a suitable closure means and avoiding sand ingress.

6.1.2 Prior art document D5 discloses, as discussed in paragraph 4.2 above, a closure means made of a plate having a through-going opening and being slidable in a direction perpendicular to the runner to close the inlet.

It can be accepted that the person skilled in the art could use such a closure means in the method disclosed in "D1-F7" without needing an inventive activity.

However there is no suggestion whatsoever in the cited prior art that such a closure plate should be located in a downwardly extending part of the runner, so that at least this feature would not be derivable from the combination "D1-F7" and D5. Contrary to the argument of the respondent, the board accepts that this part of the runner allows the "capture" of sand particles in the vicinity of the closure plate, thus remote from and "below" the inlet opening of the mould.

6.2 Closest state of the art: D5

From the aforementioned analysis of document D5 it follows that the method of claim 9 differs from D5 at least by feature a), i.e. by the provision of the downwardly extending part of the runner. This difference is not considered as obviously derivable for the skilled person for the same reasons as those indicated above in paragraph 6.1.2.

6.3 The method of claim 9 is thus new and involves an inventive step.

7. *Claim 12*

The embodiment "D1-F7" can be considered as the closest prior art. Due to the method itself the closure strip or plate will push a certain amount of sand into the runner, although not in a compact form and thus not able to form a sand plug. In fact, the general concept of closing the runner with a sand plug formed by pressing out a part of the mould structure into the runner is not known in the cited prior art.

The method of claim 12 is therefore new and inventive.

The respondent raised the question whether the method of claim 12 could solve the problem, in particular whether sand ingress can effectively be avoided, in the light of the fact that the claim and the description give no indication of how to ensure that the sand pushed into the inlet will stay in a compact, plug-like form.

This issue does not fall under the discussion of inventive step but would in substance form a new opposition ground, i.e. lack of disclosure under Article 83 EPC, which ground could be introduced into the proceedings at the appeal stage only with the patentee's explicit agreement, which was not given. In any case the board considers that the method of claim 12 is wholly understandable and that the skilled person would be able to pre-form the mould and the pushing tool so as to ensure the formation of a sand plug, as for instance by reducing the thickness of the plug wall (see recess 24 in Figure 7 of the patent).

8. *Claim 13*

The closest prior art is disclosed in "D1-F9", in which the inlet of the vertical runner is cooled from the outside by bottom contact with the chill plate 40, causing a part of the metal within the runner to solidify and act as a plug (see pages 7 and 8 of D1). The differences of the claimed method and "D1-F9" lie substantially in the fact that:

the outermost part of the inlet system is constituted by a metal tube secured in the mould having a part protruding somewhat from the surface of the mould, which protruding part is cooled down to close the tube.

It is known from document D2 to mechanically squeeze the protruding part of a mould inlet tube so as to close the inlet after filling of the mould. Although the moulding method of D2 may be applied to sand moulds (see D2-US, column 4, lines 30-41) it is not suitable to be directly used in a mould-string plant.

In fact, the person skilled in the art would not have contemplated providing the sand moulds of "D1-F9" with a metal tube protruding out of the mould as shown in D2 because the whole casting process of "D1-F9" would then have to be altered. This need for change is mainly based on the fact that the moulds are stepwise moved on a support plate in register with the injecting nozzle and then translated so as to place the inlet of the runner in front of the chill plate to freeze the melt metal at the entrance portion. The provision of a metal tube protruding from the bottom wall of the sand mould

would of course hinder the translational movement of the moulds and would thus require the complete redesign of the casting process of "D1-F9", especially the automated movement of the moulds, of the nozzle and of the chill plate.

For these reasons the board believes that the skilled person would not have combined "D1-F9" with D2 and arrived in an obvious and straightforward manner at the claimed method.

Prior art D3 would not help either since it concerns a conventional die moulding process.

The method of independent claim 13 thus meets the requirements of novelty and inventive step when compared to the available prior art.

9. Since the main request of the appellant may be granted the issue relating to the auxiliary request does not need to be addressed.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the opposition division with the order to maintain the patent as granted.

The Registrar: The Chairman:

A. Counillon U. Krause