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Datasheet for the decision of 7 December 2016

Case Number: T 2167/13 - 3.2.03

Application Number: 07121789.7

Publication Number: 1932604

IPC: B22C9/10, B29C67/00

Language of the proceedings: EN

Title of invention:
Disposable thin wall core die, methods of manufacture thereof and articles manufactured therefrom

Applicant:
GENERAL ELECTRIC COMPANY

Headword:

Relevant legal provisions:
EPC Art. 56

Keyword:
implicit disclosure (no)
selection invention (yes)
Inventive step - (yes)

Decisions cited:
T 0653/93

Catchword:
selections of various interrelated parameters cannot be evaluated independently

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Case Number: T 2167/13 - 3.2.03

D E C I S I O N
of Technical Board of Appeal 3.2.03
of 7 December 2016

Appellant: (Applicant)	GENERAL ELECTRIC COMPANY 1 River Road Schenectady, NY 12345 (US)
Representative:	Pöpper, Evamaria General Electric Technology GmbH GE Corporate Intellectual Property Brown Boveri Strasse 7 5400 Baden (CH)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 24 April 2013 refusing European patent application No. 07121789.7 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	G. Ashley
Members:	B. Miller
	M.-B. Tardo-Dino

Summary of Facts and Submissions

I. The appeal lies from the decision of the examining division to refuse European Patent application No. 07 121 789. The applicant (hereinafter: the "appellant") filed an appeal against this decision in due form and time.

II. In its decision the examining division held that the subject-matter of claim 1 filed with the letter of 5 March 2010 lacked an inventive step (Article 52(1) and 56 EPC) in view of the state of the art disclosed in document EP 1 495 820 (D1) when combined with US 2005/023710 (D4) or the common general knowledge of the skilled person.

III. The appellant requested that the contested decision be set aside and a patent be granted on the basis of the set of claims filed on 28 September 2016.

IV. Independent claim 1 reads as follows:

"A method comprising:
injecting into a thin wall disposable core die (100) a slurry having
a viscosity of 1 to 1,000 Pascal-seconds at room temperature when tested at a shear rate of up to 70 seconds^{-1} and
a flow index of less than 0.6,
the injecting being carried out at a hydrostatic pressure of 0.07 to 7 kilograms per centimeter square;
wherein the thin wall disposable core die (100) has an average wall thickness of 0.5 to 10 millimeters;
restoring the thin wall disposable core die to its original position upon removal of the hydrostatic pressure;

curing the slurry to form a cured ceramic core;
removing the thin wall disposable core die (100) from the cured ceramic core; and
firing the cured ceramic core to form a solidified ceramic core (90)."

Dependent claims 2-10 concern preferred embodiments of the method of claim 1.

V. The reasons for the decision under appeal, as far as relevant to the board's decision, may be summarised as follows:

The method of claim 1 of the application is defined inter alia by a certain viscosity and flow index of the ceramic slurry and a certain wall thickness of the core die. Moreover it is stated that the thin wall disposable core die is restored to its original position upon removal of the hydrostatic pressure.
The examining division considered these features to be implicitly disclosed by D1. It was argued by the division that the parameter range concerning the viscosity defined in claim 1 did not meet the selection requirements laid out in the Guidelines, Chapter C, IV, 9.8. The remaining features identified above were considered as being inherent features implicitly met when following the method disclosed in D1.

As a consequence, the examining division concluded that the subject-matter of claim 1 differed from the disclosure in D1 only in that a hydrostatic pressure of 0.07 to 7 kilograms per centimeter square was applied during injection.

Taking into account the general technical knowledge of the skilled person or the teaching of D4, it was

considered to be obvious to perform the injection moulding process proposed by D1 at the hydrostatic pressure indicated in claim 1.

VI. The appellant's arguments may be summarised as follows.

D1 neither explicitly nor implicitly disclosed a method wherein the ceramic slurry for injection had a viscosity of 1 to 1000 Pascal-seconds at room temperature when tested at a shear rate of up to 70 $seconds^{-1}$ and a flow index of less than 0.6, the injecting being carried out at a hydrostatic pressure of 0.07 to 7 kilograms per centimetre square, wherein the thin wall disposable core die has an average wall thickness of 0.5 to 10 millimetres.

As a consequence, the appellant concluded that the subject-matter of claim 1 differed from the disclosure in D1 not only in that a certain hydrostatic pressure was applied during injection, but also by the use of slurry having a viscosity and a flow index as indicated in claim 1 and by the use of a die having a certain wall thickness and elasticity in order to allow restoring of the thin wall disposable core die to its original position upon removal of the hydrostatic pressure.

D1 on its own or in combination with D4 did not provide any hint to use a method as defined in claim 1. Therefore the subject-matter of claim 1 was not obvious.

Reasons for the Decision

1. Article 56 EPC

1.1 D1 discloses in paragraphs [0007] to [0020] an investment casting method, whereby a ceramic slurry comprising a ceramic and a carrier fluid is introduced into a single-piece sacrificial die. Injection moulding is mentioned as an example of a suitable method for introducing the slurry into the die cavity, because the quantity and pressure of the slurry may be precisely controlled as the slurry fills the die cavity. The ceramic slurry is cured to form a ceramic casting core. The sacrificial die is removed by exposing said die to an environment adapted to destroy said die while leaving said ceramic casting core intact. The ceramic casting core is used as part of a mould-core assembly to form said component by performing an investment casting process.

D1 is therefore a relevant document for assessing inventive step.

1.2 As acknowledged by the examining division D1 does not explicitly disclose

(a) using a slurry having
  (i) a viscosity of 1 to 1000 Pascal-seconds at room temperature when tested at a shear rate of up to 70 seconds^{-1} and
  (ii) a flow index of less than 0.6,
(b) the injecting being carried out at a hydrostatic pressure of 0,07 to 7 kilograms per centimetre square,

(c) wherein the thin wall disposable core die has an average wall thickness of 0.5 to 10 millimetres,
(d) restoring the thin wall disposable core die to its original position upon removal of the hydrostatic pressure.

The examining division argued that features a), c) and d) are implicitly disclosed by D1; this is contested by the appellant.

1.3 **Assessment of feature a)**

Paragraph [0015] in column 4 of D1 discloses the introduction of a ceramic slurry into the cavity of the sacrificial die, wherein the slurry contains sufficient liquid phase to provide a viscosity that is usually less than about 10 000 Pascal-seconds.

D1 does not indicate under which conditions (temperature, apparatus, etc.) this slurry viscosity is measured. In the absence of any temperature and measurement conditions (e.g. shear rate or spindle details of the viscosimeter) the actual viscosity values of less than 10 000 Pascal-seconds is difficult to compare with the range defined in present claim 1.

Furthermore, concerning the flow index (a measure of non-Newtonian-ness) no teaching can be found in D1 at all.

The examining division concluded that this feature is disclosed, since the selection of the viscosity range defined in claim 1 does not meet the criteria set out in T279/89.

It might be that a single selection has to fulfil certain criteria in order to establish novelty as laid

down in T279/89. However, the viscosity range is not the only feature distinguishing the subject-matter of claim 1 from the prior art. In case of multiple selections an individual selection cannot be disregarded by the mere fact, that the selection is not purposive. It is established case law, that where claimed subject-matter is defined by various parameters, in the present case not only viscosity but also flow index, hydrostatic pressure and the die wall thickness (see below), the question of novelty cannot be answered by contemplating the ranges of the various parameters separately (see Case Law of the Boards of Appeal, 7th edition, 2013, Chapter I.C.5.2.3, in particularly T653/93).

Hence, the novelty selection criteria are not appropriate in this case for determining the disclosure of the viscosity.

Thus, the board reaches the conclusion that feature a) is not disclosed implicitly by D1.

1.4 **Assessment of feature c)**

The examining division considered the wall thickness of the core die of from 0.5 to 10 millimetres to be implicitly disclosed in Dl owing to the manufacturing process of the die proposed in D1 (stereolithography) and the fact that the die of Dl is sacrificial.

It might be likely that the core die manufactured according to the teaching of D1 has a wall thickness from 0.5 to 10 millimetres in view of the manufacturing process indicated. However, this is not inevitable; it is not impossible that the wall thickness could be different from the claimed range.

Thus, the board reaches the conclusion that feature c) is not disclosed implicitly by D1.

1.5 **Assessment of feature d)**

D1 discloses that the die is filled for example by injection moulding (paragraph [0015]). However, it is not indicated in D1 that the thin wall disposable core die is restored to its original position upon removal of the pressure during the filling process (elastic deformation).

The examining division argued that in case a deformation takes place in the method proposed by D1, then this deformation has to be elastic, otherwise the mould would be useless. In particular it was reasoned that during the filling process an elastic deformation takes place when following the teaching of D1.

However, D1 is completely silent in this respect. It could also be that the filling conditions used in D1 (filling pressure and quantity) and the wall material of the core die (its elastic modulus) and thickness thereof are adjusted to such an extent that the mould does not deform during the filling process. If for example a low pressure is used and the die is rigid enough, then no discernible deformation would occur.

In the absence of any specific indication of these parameters, it cannot be concluded with certainty that the die deforms elastically in the method proposed by D1.

1.6 In summary, the board reaches the conclusion that the subject-matter of claim 1 differs from D1 in that the method comprises the steps of

(a) using a slurry having

(i) a viscosity of 1 to 1000 Pascal-seconds at room temperature when tested at a shear rate of up to 70 seconds^{-1} and

(ii) a flow index of less than 0.6,

(b) the injecting being carried out at a hydrostatic pressure of 0,07 to 7 kilograms per centimetre square,

(c) wherein the thin wall disposable core die has an average wall thickness of 0.5 to 10 millimetres and

(d) restoring the thin wall disposable core die to its original position upon removal of the hydrostatic pressure.

1.7 As mentioned in column 1, lines 47 to 51 of the application as published, it is desirable to improve the core die design so that core dies can be produced that are lighter in weight than metal core dies. This is achieved by core dies having thin walls that take advantage of low viscosity slurries (and hence lower operating pressures). Furthermore, it is stated in col. 8, lines 9-15 of the application as published that permanent deformation of the wall upon the application of the hydrostatic pressure is avoided.

1.8 Given that D1 discloses a core die made from polymers which is relatively light compared to a metal die, and a slurry having a viscosity below 10000 Pascal-seconds, the objective technical problem to be solved is considered as improving the method of D1.

1.9 The features identified above (viscosity, hydrostatic pressure, wall thickness and the ability of restoration

of the die upon removal of the hydrostatic pressure) are not independent from each other. In fact, the choice of an appropriate wall material and thickness thereof as well as the choice of an appropriate hydrostatic pressure and slurry viscosity/flow index influences the ability of the core die to restore to its original position.

The choice of the corresponding viscosity/flow index of the ceramic slurry, the choice of the hydrostatic pressure and the choice of a die material having an elastic modulus to allow restoration of the core die to its original position is neither known from nor hinted at by D1, in particular the selection of the individual parameters according to claim 1 of the present application cannot be regarded as an arbitrary modification within the more general teaching of D1.

1.10 Concerning the choice of the hydrostatic pressure the examining division referred to D4. D4 deals with a injection molding process and proposes in example 7 to use a hydrostatic pressure of 0.4 MPa (4,08 kg/cm^2). However, the ceramic material used in example 7 of D4 comprises binder materials having a melting point well above room temperature. Therefore the slurry proposed by D4 cannot have the viscosity and flow index of the ceramic slurry of claim 1.

Since the hydrostatic pressure is usually dependent on the viscosity of the slurry, a skilled person would not simply select a value of the hydrostatic pressure out of context from one document and apply the same pressure in a different environment in an another manner.

No hint can be found in D1 or D4 as to why the skilled person would use the hydrostatic pressure proposed in D4 in example 7 for injection molding of a molten wax slurry when following the method of D1 which involves the use of a ceramic slurry in a carrier fluid.

1.11 Further, no hint can be found in either D1 or D4 to adjust the remaining parameters, such as the viscosity, the flow index and the wall material (elastic modulus) in order to achieve an elastic deformation of the die resulting in the method step of restoring the thin wall disposable core die to its original position upon removal of the hydrostatic pressure defined in claim 1.

1.12 The subject-matter of claim 1 (and dependent claims 2 to 10) is therefore considered to be non-obvious when starting from D1 as the closest prior art and to meet the requirements of Article 56 EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant a patent in the following version:

Description:

Pages 5 to 7, 11	as originally filed
Pages 2,4	filed on 12 August 2009
Pages 9,10	filed on 05 March 2010
Pages 1, 2a, 8	filed on 28 September 2016
Pages 3, 3a	filed on 5 October 2016

Claims:

1 to 10	filed on 28 September 2016

Drawings, Sheets

1/5 to 5/5	as originally filed

The Registrar: The Chairman:

C. Spira G. Ashley

Decision electronically authenticated