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D E C I S I O N
of 16 January 2003

Case Number: T 0839/99 - 3.2.5

Application Number: 92904231.5

Publication Number: 0528040

IPC: B29C 45/77

Language of the proceedings: EN

Title of invention:
Method of controlling motor driven injection molding machine

Patentee:
FANUC LTD.

Opponent:
Battenfeld GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0839/99 - 3.2.5

D E C I S I O N
of the Technical Board of Appeal 3.2.5
of 16 January 2003

Appellant: FANUC LTD.
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Representative: Gosdin, Michael, Dr.
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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 8 June 1999 revoking European patent No. 0 528 040 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: W. Moser
Members: P. E. Michel
H. M. Schram

Summary of Facts and Submissions

I. The appellant (patentee) lodged an appeal against the decision of the Opposition Division revoking patent No. 0 528 040.

Opposition had been filed against the patent as a whole based on Article 100(a) EPC (lack of inventive step).

The Opposition Division held that the subject-matter of claim 1 of the patent in suit as granted did not involve an inventive step.

II. The appellant requested that the decision under appeal be set aside and that the patent in suit be maintained as granted.

The respondent (opponent) requested that the appeal be dismissed.

Oral proceedings before the Board of Appeal were held on 16 January 2003.

III. Claim 1 as granted reads as follows:

"1. A method of controlling an electrically operated injection molding machine having a screw (1) axially driven by a servomotor (2) for the control of injection, dwell, and back pressure, and including an injection process, a dwell process, and a metering process,
said dwell process comprising steps of detecting a pressure applied to a resin; finding a difference (∈p) between a dwell pressure (Prj) which has been set and said detected pressure; and

issuing a movement instruction in response to said difference (∈p) to a servo circuit (27) for drivingly controlling said servomotor (2), thereby to perform a feedback control in such a manner that said pressure applied to the resin corresponds to the dwell pressure (Prj) which has been set;
the method being characterised in that said injection process comprises controlling the speed of said servomotor (2) so as to correspond to an injection speed (Vi) which has been set; and said metering process comprises steps of detecting a pressure applied to the resin; finding a difference (∈p) between a back pressure (Pbk) which has been set and said detected pressure; and issuing a movement instruction in response to said difference (∈p) to a servo circuit (27) for drivingly controlling said servomotor (2), thereby to perform a feedback control in such a manner that said back pressure corresponds to said back pressure (Pbk) which has been set."

IV. The following documents have been referred to inter alia in the written and oral proceedings:

D1: JP-A-2-130117, together with an English translation thereof

D2: Fanuc Autoshot Series, AC direct-drive "fully electronic" plastic injection molding machines, ASE-02, 1986. 04, pages 1 to 24

D3: EP-A-0 396 770

D4: EP-A-0 350 872

D5: JP-A- 62-198426 (abstract)

V. In the written and oral proceedings, the appellant argued essentially as follows:

Document D1 does not disclose feedback control during the dwell and metering processes and, indeed, teaches away from the use of feedback control which is regarded as being too slow. The injection moulding machine of document D1 also does not have a separate metering screw and plunger, and thus relates to a fundamentally different type of machine from that of the present invention, in which an axially movable screw is used for control of injection, dwell and back pressure.

The control strategy proposed by document D2 is not compatible with that of document D1, so that these documents cannot be combined. In addition, document D1 refers to the control strategy of document D2 as prior art and discusses the disadvantages thereof, so that the person skilled in the art would not derive a teaching from document D2 to modify document D1.

Neither document D1 nor document D2 suggests the control strategy of the present invention, the essence of which involves control of applied pressure during dwell and metering processes, using screw movement as the controlled parameter of a feedback loop. This is more accurate than motor torque control.

Document D3 only relates to metering and suggests continuously and smoothly varying the receding speed of the screw during the metering process. Document D5 teaches torque control by means of a minor feedback loop during the dwell process. These documents are thus not relevant and should not be admitted into the procedure. They also do not suggest the characterising features of the present invention.

The subject-matter of claim 1 thus involves an inventive step.

VI. In the written and oral proceedings, the respondent argued essentially as follows:

The closest prior art is represented by document D1. This document discloses a closed loop system involving feedback control in which the measured pressure is compared with a set pressure. The term "feedback" includes both continuous and stepwise control.

The object of the invention is, as set out at column 2, lines 23 to 27 of the patent in suit, "to provide a method of controlling an electrically operated injection molding machine in which its injection, dwell, and back pressure are controlled based on positions of the screw". In this connection, it should be noted that the only parameter which can be influenced during an injection moulding cycle is, in fact, the screw position, by means of which the dwell and back pressure are influenced.

The solution to the problem, that is, the use of feedback control is suggested by document D1 itself or alternatively by document D2. It is noted that, in claim 2 at page 2 of document D1, reference is made to an extruding device which undergoes linear motion, so that the teaching of document D1 is not restricted to a device having a separate screw and an axially movable plunger. Document D2 discloses closed loop control of an axially movable screw. The systems of documents D1 and D2 are analogous. The control system of document D1 does not depend on there being a separate screw and axially movable plunger.

Document D3 also discloses feedback control of an axially movable screw.

A combination of documents D2 and D5 also leads to the subject-matter of claim 1, since the disclosure of document D2 would lead the person skilled in the art to apply the technique of document D5 to the metering as well as the dwell process.

The subject-matter of claim 1 thus does not involve an inventive step.

Reasons for the Decision

1. *Late filed documents*

Whilst documents D1 and D2 were referred to in the proceedings before the Opposition Division, documents D3, D4 and D5 have been introduced for the first time in the appeal proceedings, although document D5 was cited in the International Search Report.

Documents D3, D4 and D5 were filed by the respondent almost two years before the oral proceedings before the Board in response to the statement of grounds filed by the appellant, which laid emphasis on the argument that document D1 employs open loop as opposed to feedback control. These documents were accordingly cited in order to demonstrate that feedback control of resin pressure in injection moulding is known. It is accordingly considered appropriate to allow the introduction of these documents into the proceedings.

2. *Construction of claim 1 of the patent in suit*

2.1 The term "feedback control" requires a comparison of the measured pressure with a set value, the deviation from the set pressure being fed back to the controller. In the event that the measured pressure is more or less

than the set value, the axially movable extruding device (the screw in the method of the patent in suit and a plunger in the arrangement of document D1) is moved backward or forward so as to decrease or increase the pressure until the set value is obtained. This is discussed in the patent in suit at column 3, line 35 to column 4, line 34 in respect of the dwell process and at column 4, lines 39 to 46 in respect of the metering process.

2.2 The term "movement instruction" is construed as relating to an instruction causing axial movement of the extruding device in order to attain a desired position. The controlled parameter is thus the axial movement of the extruding device. This is distinguished from torque control of the motor and does not require restriction of the motor output torque (see patent in suit, column 13, lines 40 to 48).

3. *Inventive step*

3.1 In the judgement of the Board, and as accepted by both parties, the closest prior art is represented by document D1, which is cited in the description of the patent in suit at column 2, lines 32 to 39. Reference will be made hereinafter to the complete translation of this document filed by the respondent on 23 December 2002.

This document discloses control of an injection moulding machine having a screw which is not axially movable and a plunger during the metering, injection and dwell phases, although the discussion of the prior art at page 3, line 10 does refer to the fact that the extruding device in injection moulding machines may be a screw. Whilst claim 1 of the patent in suit specifies the use of an axially movable screw, axial movement of

the plunger (9) in the machine of document D1 has a corresponding effect to axial movement of the screw, so that this distinction is not seen as being significant.

At page 4 of document D1, the disadvantages of three known types of back pressure control during the metering step are discussed.

Firstly, an open loop control system in which the torque current value of the motor is set to a predetermined value. This is said to suffer from the disadvantage that the screw mechanism which transmits the torque of the motor to the extruding device involves frictional forces which result in unacceptable errors.

Secondly, a closed loop control system in which the torque current value of the motor is set to a predetermined value. Thirdly, a closed loop control system in which the rotational speed of the motor is set to a predetermined value. Both the closed loop systems are said to suffer from the disadvantage that an excessive amount of time is required to attain the set pressure value.

For these reasons, the invention forming the subject of document D1 avoids the control of motor torque to avoid errors caused by friction and also avoids the use of a closed loop or feedback system for the sake of speed.

Document D1 proposes to measure the pressure acting on the plunger (19) by means of a load cell (18) and to compare the measured pressure with a set value which is provided from the back pressure setting device (81) during the metering stage and from the dwell pressure setting device (63) during the dwell stage. An arithmetic circuit (62) is programmed with an empirically obtained function relating the position of

the plunger with resin pressure. The circuit is thus able to calculate the necessary moving amount of the plunger in view of a deviation of the measured resin pressure from the set value of pressure. The plunger is then moved through the calculated distance, as a result of which the desired resin pressure is achieved.

Such a procedure, however, does not constitute feedback control in the usual meaning of the term, since the error is not fed back to the controller, thus achieving the object of the invention of document D1, which is to quickly and accurately change the actual pressure to the set value.

The only examples of feedback control in document D1 are discussed at page 12, lines 10 to 14, where reference is made to feedback control of screw rotation during plasticising of the resin, and at page 14, lines 2 to 7, in connection with control of the injection speed.

There is thus no suggestion of feedback control of the plunger position in order to obtain a desired resin pressure during the dwell and metering processes, and claim 1 of the patent in suit is distinguished over the disclosure of document D1 by the adoption of feedback control.

3.2 Document D2 describes an electrically operated injection moulding machine having a screw axially driven by a servomotor, which includes a closed loop pressure controller during the dwell phase, as disclosed at pages 7 and 19. The document is, however, silent as regards the form of control during metering. As stated at page 14, the controller controls the torque of the electric motor. This document thus relates to the second type of pressure control discussed in the introduction of document D1 and said

to suffer from the disadvantage of only being capable of achieving the set pressure value slowly. The person skilled in the art would thus not use the teaching of document D2 to modify the system of document D1, since this would involve reintroducing a disadvantage which document D1 sets out to avoid.

3.3 Document D3 discloses a back pressure control method involving control of the axial speed of the screw and thus suggests a possibility for pressure control in the metering phase. Document D4 is concerned with a suitable location for a load detecting member for detecting the back pressure acting on the screw of an injection moulding machine. Document D5 relates to dwell control utilising a feedback loop to control motor torque. These documents thus also fail to suggest feedback control of the axial position of the screw during dwell and metering.

3.4 It was suggested on behalf of the respondent that a combination of documents D2 and D5 leads to the subject-matter of claim 1 of the patent in suit. However, both of these documents are concerned with torque control and thus a combination of these documents does not lead to the adoption of a method of control for either dwell or metering including the issuing of a movement instruction, this term being construed as in paragraph 2.2 above.

3.5 The subject-matter of claim 1 thus involves an inventive step. Claim 2 is appendant to claim 1 and is directed to a preferred embodiment of the method of claim 1. The subject-matter of claim 2 thus also involves an inventive step.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is maintained as granted.

The Registrar: The Chairman:

M. Dainese W. Moser