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D E C I S I O N
of 4 July 2000

Case Number: T 0707/97 - 3.2.2

Application Number: 90850215.6

Publication Number: 0401188

IPC: D21F 7/06

Language of the proceedings: EN

Title of invention:
Control system for a paper or board machine

Patentee:
VALMET CORPORATION

Opponent:
Voith Sulzer Papiermaschinen GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (no)"

Decisions cited:
T 0176/84, T 0195/84

Catchword:
-

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Case Number: T 0707/97 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 4 July 2000

Appellant: (Opponent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 22 May 1997 concerning maintenance of European patent No. 0 401 188 in amended form.**

Composition of the Board:

Chairman: W. D. Weiß
Members: M. G. Noël
J. C. M. De Preter

Summary of Facts and Submissions

I. Upon opposition by the appellant against the grant of European patent No. 0 401 188, the Opposition Division decided by interlocutory decision dated 22 May 1997 to maintain the patent in amended form.

II. The state of the art was represented, principally, by the following documents:

D1: "Automatische Querprofilregelung am Beispiel einer Dickenquerprofilregelung mittels Nipco-Walzen" by P. Ficklscherer, Wochenblatt für Papier-fabrikation 22, 1988, pages 973-982.

D2: DE-A-3 701 554.

III. The appellant lodged an appeal against the first instance's decision on 27 June 1997. In its statement of grounds, filed on 30 September 1997, extension of the patented subject-matter was objected (Article 123(2) EPC) as a result of amendments made to claim 1 as well as lack of novelty and inventive step of the same, in particular vis-à-vis documents D1 and D2. In support of its allegations, new documents were filed.

The respondent (patent proprietor) replied to the appellant's contentions on 9 April 1998 and requested for apportionment of costs due to abuse of procedure if the late filed documents were to be considered by the Board.

IV. In a communication dated 4 May 2000 sent following a summons to oral proceedings, the Board informed the parties that the discussion would turn principally on the inventive step of claim 1 with respect to the

disclosure of document D1 in combination with that of document D2, including the embodiment according to Figure 3.

The respondent, on 31 May 2000, filed amended claims 1 to 9 as an auxiliary request.

V. Oral proceedings were held on 4 July 2000, at the end of which the requests were as follows:

The appellant requests that the decision under appeal be set aside and that the European patent be revoked.

The respondent requests that the appeal be dismissed or that the patent be maintained in amended form in accordance with claims 1 to 10 submitted at the oral proceedings of 4 July 2000 (first auxiliary request) or in accordance with claims 1 to 9 submitted on 31 May 2000 (second auxiliary request).

The former request for apportionment of cost was withdrawn by the respondent.

VI. Claim 1 according to the main request (version as maintained by the Opposition Division) reads as follows:

"Control system for a paper or board machine, by means of which the transverse profile of properties of the web (W) to be produced, in particular its thickness profile, is regulated, said control system comprising a number of actuators (30,31,32) and a corresponding number (N pcs.) of actuator controllers (42), said actuators being fitted in a row in the transverse direction of the web to be effective across the width of the web (W) whose profile is to be regulated, and said control system including a process computer (101) or an equivalent logical component as well as a

feedback branch provided with an arrangement (15,26,27,28;18) for measurement of the web profile to be regulated, characterized in that the various actuators (30,31,32) in the control system are provided with intelligent actuator controllers (42_1·...42_N) which control the mechanical regulation to take place independently in accordance with their own measurement-regulation algorithms, and that the data communications in the control hierarchy between a higher control device (101,40) and the various actuator controllers (42_1...42_N) are arranged along a bus (41) common of the various actuator controllers (42_1...42_N)."

Claim 1 according to the first auxiliary request differs from the main request by deleting the characterizing feature "which control the mechanical regulation to take place independently in accordance with their own measurement-regulation algorithms, and" and by adding at the end of the claim, the following features:

"that each actuator controller (42_1...42_N) is seen upwards in the hierarchy as an independent unit, to which set values are given in digital form along the serial bus (41), whereupon the actuator controllers (42_1...42_N) control the mechanical regulation to take place independently in accordance with their own measurement-regulation algorithms."

Claim 1 according to the second auxiliary request differs from the first auxiliary request by replacing these last features of the first auxiliary request by the following ones:

"that, in the control system, decentralized intelligence is employed, which is just parametered by the higher system in the control hierarchy by giving the set values, that each actuator controller

(42_1...42_N) is seen upwards in the hierarchy as an independent unit, to which the set values are given in digital form along the serial bus (41), whereupon the actuator controllers (42_1...42_N) control the mechanical regulation to take place independently in accordance with their own measurement-regulation algorithms, and that the controlling apparatus placed at a higher level in the control hierarchy is a network server (40), which transfers set values from the automation system to the actuator controllers (42_1...42_N) and status and/or measurement values from the actuator controllers (42_1...42_N) towards the system."

VII. The parties argued as follows:

(i) the appellant:

- The amendments applied to claim 1 according to the main request extend the subject-matter of the patent beyond the content of the application as filed, since they give the impression that the intelligent actuator controllers (i.a.c) are totally independent from the control system. As a matter of fact, the intelligent actuator controllers are supplied with set values transmitted from a control unit placed at a higher level in the hierarchy. Moreover, said amendments give rise to lack of clarity.

- Document D1 discloses a control system for a paper machine having all the features contained in the preamble of claim 1. The actuators are each controlled by a servo-valve which, typically, can be regarded as an intelligent actuator controller functioning as independent control unit and exchanging data with a higher control unit through a common bus (Figure 4). In addition, document D1 discloses (Chapter 5) complex transverse profile

controlling systems (Figures 18 and 20) with the view to decentralize the control levels of the overall control system. Therefore, the subject-matter of claim 1 is not novel and at least not inventive with respect to the disclosure of D1, when rightly interpreted.

- Moreover, the subject-matter of claim 1 does not involve inventive step vis-à-vis the combination of documents D1 and D2, since document D2 discloses (in particular Figure 3) decentralized control systems applicable to industrial and power-plants generally, in which each subunit is seen as an independent actuator controller processing its own setting measurements through an individual microprocessor and exchanging data with a control unit at a higher control level through a common bus. In document D2, the same problem as in the contested patent is addressed and solved in the same way.

- The features incorporated in the claims according to the auxiliary requests fail to add any inventive step to the subject-matter according to the main request since also in document D2 are set values received from a higher level control unit and the subunits are designed to dialog in both directions, through a common serial bus, with the control system placed at the higher control level.

(ii) the respondent:

- The independent control of the mechanical regulation referred to in claim 1 according to the main request is fairly supported by the application as filed. It is not the object of a claim to give all the details of a particular embodiment. However, in order to prevent eventual

objections against Article 84 and 123(2) EPC, a first auxiliary request is submitted, in which it is specified that set values are given to the actuator controllers.

- Document D1 discloses devices for regulating the thickness profile of a web, in particular (cf. Chapter 3 and Figure 5) NipcoMat-rollers ("Stellglieder") having a number of hydrostatic support elements ("Stützquellen") which correspond to the actuators of the present patent and which are controlled by means of a servo-valve. However, only one servo-valve is provided for controlling all actuators. Moreover, a servo-valve is not an intelligent actuator controller in the meaning of the patent in suit.

  Figure 4 shows a profile regulation device operating in the longitudinal direction of the paper web and using two Nipco-rollers and a scanner, all connected via a bus to a remote control unit. Thus, document D1 is concerned with the control of the Nipco-rollers on a upper control level and not with the control at the level of the actuators.

  In Figures 18 and 20, the transverse profile is measured and fed back to the control unit for the calculation of new desired positions, as reported in the background part of the present patent. Again, there is no description of any independent regulation of the individual actuators in accordance with their own measurement-regulation algorithms.

  The hierarchical decentralized regulation concept referred to at the end of Chapter 5 relates to complex paper-macking installations using e.g. six

Nipco-rollers ("Stellglieder") working in tandem, which have nothing in common with the web profile control system of the present patent. Therefore, the characterising features of claim 1 are not disclosed by document D1.

The skilled person would not turn to document D2 since it discloses an open control system ("Steuerung") for machines generally and not a closed feed-back system ("Regelung") for a papermaking machine with severe speed requirements. In the embodiment according to Figure 2, the subunits have no regulation loop. The circuit only provides for sensing defect signals from the actuators, which are then sent to a central control unit at a higher level for producing an alarm or a stop signal.

In the Figure 3 embodiment, there is no mention of any mechanical regulation either and the subunit is provided with a preprogrammed microprocessor (CPU) but no feed-back loop exists between the microprocessor and the associated actuator in the corresponding subunit. Again, the sensor (this time in the form of a displacement transducer such as a limit-switch) provides for stop signals, not for measuring and control signals. Therefore, even when considering document D2 in its combination with D1, one would not arrive at the subject-matter of claim 1.

- The auxiliary requests particularly specify the exchange of data between the actuator controllers and the network server placed at a higher level in the control hierarchy, in conformity with Figure 2 and claim 3 of the present patent. These features are not disclosed by the prior art documents.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments*

With respect to the version as granted, claim 1 according to the main request was amended by incorporating in the pre-characterising portion the words "in a row in the transverse direction of the web", and, in the characterising portion, the feature: "which control the mechanical regulation to take place independently in accordance with their own measurement-regulation algorithms".

These added features are fairly based on the application as filed. In particular, the feature introduced in the characterising portion is drawn up from the original claim 3 and from the description as originally filed (page 3, lines 24 to 28). Although the intelligent actuator controllers are at first provided with set values from a higher control device, they then operate each as independent positioning devices with their own measurement units (Figure 4) for monitoring their own measurements values and for taking decision on the opportunity of adjusting or not the position of the spindle about the initial setting value, all this independently of the control unit placed at the higher level (page 12, lines 29 to 34).

Therefore, the subject-matter of claim 1 interpreted in the light of the description (Article 69(1) EPC) is clear and does not extend beyond the content of the application as filed. Consequently, the provisions of Article 84 and 123(2) are satisfied.

Claims 1 according to the first and the second auxiliary requests differ from the main request by the deletion of the characterising feature previously incorporated and by the incorporation at the end of the claim of part or of the totality, respectively, of claim 3 as granted. These amendments are also not open to objection.

3. *Closest prior art and novelty of claim 1 (main request)*

3.1 Document D1 represents the closest prior art document. It discloses (cf. Chapter 3 and Figures 4 and 5) a control system for a papermaking machine by means of which the transverse profile of the web to be produced, in particular its thickness profile, is regulated. The adjusting elements ("Stellglieder") are in the form of Nipco-rollers having a resilient jacket which is deformable under the pressure of a plurality of hydrostatic support elements ("Stutzquellen") arranged across the width of the roll, and so defining a plurality of pressure zones hydraulically controlled by means of servo-valve. Therefore, the support elements define actuators in the meaning of the present patent. The control system also implies the presence of a suitable arrangement for downwards control measurements of the web profile, such as the scanner illustrated on Figure 4, and a feed-back branch to take account of these measurements (Figure 18 and 20).

3.2 However, document D1 does not disclose clearly and unambiguously that the actuators as defined above are controlled independently in accordance with their own positioning measurements. During the last ten years, the general understanding of what the term servo-valve encompasses has changed from simple follow-up adjustment devices to complete automatic control systems including a monitoring feed-back or closed-loop. Therefore the exact interpretation of the term

"servo-ventil" within the context of document D1 cannot be clearly and unambiguously assessed. Further, Figure 4 shows that data transfer is carried out by way of a common bus connecting different Nipco-rollers to a remote control unit, that is a transfer on a higher level than the one between the actuators inside the rollers and the corresponding adjusting block. There is also no indication that positioning control is liable to take place at the lower level of the actuators in accordance with their own measurement-regulation algorithms. As a consequence, the disclosure of document D1 neither implies that intelligent actuator controllers are known nor even that they are arranged along a bus common to the various actuator controllers.

3.3 Chapter 5 of document D1 relates to transverse profile regulations involving a number of independent adjusting parameters in the particular case where only one correcting roll is available. In the embodiment of Figure 18, the control system follows an optimisation model but suffers from a number of drawbacks. To overcome these difficulties, document D1 outlines another complex control system illustrated in Figure 20, which, however, appears to be irrelevant to the present case because of the different nature of the problems addressed. In the case of a still more complicated profile regulation using a NipcoMat plant working with six adjusting elements ("Stellglieder") in tandem, the complexity of the system can only be managed by using a hierarchically decentralized control system. However, it is said that a detailed report would go beyond the frame of this article. It results therefrom that document D1 does not disclose nor suggest the essential features upon which the patent solution is based.

3.4 With respect to the disclosure of the closest state of the art (document D1), the subject-matter of claim 1 according to the main request differs by the features contained in its characterising clause. It is, therefore, novel, within the meaning of Article 54(1) EPC.

4. *Inventive step (main request)*

4.1 The distinguishing features mentioned above represent the solution of the problem underlying the present patent of reducing the load of the main control unit and the number of connecting wires. As a matter of fact, due to the great number of control loops between the main control unit and the various actuators controllers, the reaction velocity of the actuators and, hence, of the overall control system is low.

By providing intelligent actuator controllers by which the mechanical operation of the actuators is controlled independently in accordance with their own measurement-regulation algorithms and which are arranged along a common bus for data communication with a higher control unit, the load on this control unit and reaction time of the control system are reduced and fewer connecting cables are required.

4.2 D2 relates to control systems for machine installations in general, comprising a plurality of actuating elements or actuators ("Aktoren") such as electro-motors, electromechanical devices, and so on. The disclosure of this document is applicable to a large variety of electro-mechanical installations, the control of which is generally coordinated and centralized by a remote main control unit usually enclosed in a control cupboard.

Document D2 starts from the fact that the known installations (cf. column 2, lines 24 to 48) suffer substantially from the same drawbacks as those enumerated in the present patent, in particular the presence of a large number of long cables, high costs and manpower required for installation and maintenance, and risks of errors due to the complex wiring between the actuators and the main control unit. Like the present patent, the problem to be solved is, therefore, to reduce and simplify the wiring system in order to unload the main control unit.

4.3 To solve this problem document D2 (column 2, lines 57 to 68 and Figure 1) suggests to group the various actuators together and to provide, in close proximity to each actuator 18, an electronic circuit (subunits 20.1 to 20.n) comprising an individual control unit communicating with the central unit through a data bus 12, and a power- and amplification unit for supplying energy from the central unit to both the individual control unit and the associated actuator through a power bus 16.

Although document D2 generally discloses separate busses for the power supply and the data transfer (column 3, lines 1 to 15), it is, according to an alternative embodiment, also possible to combine these two functions in only one bus (column 7, lines 36 to 38), in the same way as in the present patent according to which the common cable 41 (cf. Figure 3) actually consists of a seven-pole cable, of which four poles are connected to the higher level server and three poles are connected to the power supply (cf. column 7, lines 33 to 38).

Consequently, the results and advantages referred to in document D2 (column 3, lines 20 to 56) are identical to those obtained in the present patent, namely,

essentially:

- a subunit is individually associated with a corresponding actuator: it follows autonomy and independence of each actuator vis-à-vis the remote central unit.

- decentralization of the whole control system, whereby only data which are necessary to the functioning of all actuators are provided by the main control unit placed at a higher control level: it follows simplication and unloading of the main control unit.

4.4 Document D2 describes two embodiments according to Figure 2 and Figure 3, respectively.

In Figure 2 each individual subunit 20' comprises an actuator 18 (electro-motor) controlled by a logic control circuit 30 and a power amplifier 28 supplied by a power bus 16. A sensor 32 detects misfunctions of the electro-motor and transmits corresponding data signals to the central unit 10 via the control logic 30 and the data bus 12 (column 4, lines 1 to 8 and column 5, lines 58 to 63). Further, the control logic via the bus, receives data from the central unit such as set values for the speed of the motor, and, conversely, transmits to the central unit informations about values measured by the sensor such as the actual speed of the motor. Therefore, like the present patent, a data exchange takes place in both directions between the actuators and the remote control unit, but the actuators are not controlled by the logic control circuit. The presence of a line for connecting the sensor back to the control logic does not lead to another conclusion. The circuit of Figure 2 discloses an open-loop control system in which the logic control circuit 30 only serves as a transmission relay for

values sensed by the sensor and thereafter sent to the main control unit.

4.5 The subunit 20 of Figures 3 of document D2 contains the complete subunit displayed in Figure 2 and, in addition, a microprocessor (CPU) 34 and a memory 36 so as to program with sophisticated algorithms the functioning of the actuators within subunits 20'. The embodiment of Figure 3 serves to increase both the autonomy and the independence of the individual control units vis-à-vis the main control unit 10 (column 4, lines 12 to 25 and column 6, lines 22 to 37), and to directly evaluate in subunit 20' the values measured by the displacement transducer 38. Therefore, this embodiment has different operating modes of the actuators, either in response to parameters preprogrammed in the associated microcomputer or in response to positioning signals continuously measured by the corresponding displacement transducers, such as angle encoders ("Winkelcodierern"). This latter operating mode actually corresponds to the functioning of a closed-loop control system by way of the feed-back line incorporating the displacement transducer 38. Consequently, each individual control subunit 20 operates independently in accordance with its own measurement-regulation algorithms and can be regarded as an intelligent actuator controller in the sense of the patent in suit. Therefore, data exchange with the main control unit through the bus 12 is restricted to information concerning all actuators (column 6, lines 42 to 46), which demonstrates for individual control, at a lower lever, of the actuators and decentralization of the decision taking.

In consequence, document D2 discloses in particular through Figure 3 all the characterising features of claim 1, the subject-matter of which only differs therefrom in that the known general solution is applied

to the regulation of the transverse profile of a paper web on a paper machine. However, starting from document D1 in which a control system for a similar application has already been dealt with, document D2 addresses the same specific problems and discloses a principle solution similar to that in the present invention, while using a different terminology.

In the Board's view, the skilled person will necessarily turn to document D2 which relates to neighbouring and broader general fields where the same problems arise (T 176/84, OJ EPO 1986, 50 and T 195/84, OJ EPO 1986, 121). Moreover, document D2 clearly identifies the basic idea of decentralized intelligence (column 3, lines 35 to 43 and column 7, lines 12 to 22) which represents the essential feature upon which the present patent is based (cf. column 3, lines 10 to 13), a concept already put forward with general terms in document D1 for carrying out web profile regulations in the case of complicated paper machine plants. This is regarded as a clear incitement to combine the teachings of document D2 with those of document D1 and, therefore, to arrive without undue burden to the subject-matter of claim 1.

4.6 It results therefrom that the subject-matter of claim 1 according to the main request lacks an inventive step within the meaning of Article 56 EPC.

5. *Auxiliary requests*

The two auxiliary requests comprise partly or in totality the subject-matter of claim 3 as granted, according to which, essentially, decentralized intelligence consists in transferring set values to each actuator controller, along a serial bus, from a network server placed at a higher level in the control

hierarchy and, conversely, measurement values from the actuator controllers towards the network server.

According to the above detailed analysis (cf. points 4.2 to 4.5), all these features are disclosed in document D2, including the additional disclosure of a serial bus in the form of optical fibres (column 7, lines 41 to 47). The additional features of the auxiliary requests fail to add an inventive step to the subject-matter of the previous claim 1. Therefore, the auxiliary requests are also not allowable either.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is revoked.

The Registrar:

V. Commare

The Chairman:

W. D. Weiß