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D E C I S I O N
of 28 April 1999

Case Number: T 0573/94 - 3.4.1

Application Number: 85112594.8

Publication Number: 0177051

IPC: G07B 17/02

Language of the proceedings: EN

Title of invention:
Printing apparatus comprising microprocessor controlled D.C. motor for controlling print value selection means and process for operating printing apparatus

Patentee:
Pitney Bowes Inc.

Opponent:
Société Secap
Neopost Ltd.

Headword:
-

Relevant legal provisions:
EPC Art. 100(a), 123(2), (3), 54, 56, 102(3)

Keyword:
"Article 56, main request, inventive step - (yes) after amendment"

Decisions cited:
-

Catchword:

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0573/94 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 28 April 1999

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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 3 May 1994 concerning maintenance of European patent No. 0 177 051 in amended form.**

Composition of the Board:

Chairman: G. Davies
Members: G. Assi
M. G. L. Rognoni

Summary of Facts and Submissions

I. The appellant (opponent II) lodged an appeal, received on 4 July 1994, against the interlocutory decision of the Opposition Division, dispatched on 3 May 1994, on the amended form in which the European patent No. 0 177 051 (application No. 85 112 594.8) could be maintained. The fee for the appeal was paid on 4 July 1994. The statement setting out the grounds of appeal was received on 5 September 1994.

Opposition had been filed by opponents I and II against the patent as a whole, on the basis of Article 100(a) EPC, and in particular on the grounds that the subject-matter of the patent was not patentable within the terms of Articles 52(1) and 56 EPC.

The Opposition Division held that the grounds of the opposition did not prejudice the maintenance of the patent in amended form, having regard *inter alia* to the following documents:

(D1) FR-B1-2 407 536 (published on 28 April 1989 and corresponding to FR-A-2 407 536 published on 25 May 1979) and

(L3) US-A-4 259 626.

II. The appellant requested that the decision under appeal be set aside, that the patent be revoked and, as an auxiliary request, that oral proceedings be appointed.

III. The respondent (proprietor of the patent) requested that the decision under appeal be set aside and that

the patent be maintained on the basis of the following documents:

Main request:

claims: 1 to 27 as filed at the oral proceedings on 28 April 1999,
pages 4 to 25 of the patent specification,
pages 2, 3 of the description as filed at the oral proceedings before the Opposition Division on 15 March 1994,

Figure: sheets 1/23 to 23/23 of the patent specification,

Auxiliary request:

claims: 1 to 27 as filed at the oral proceedings on 28 April 1999,

description: pages and Figure sheets according to the main request.

Furthermore, the respondent requested oral proceedings, as an auxiliary request.

IV. The wording of apparatus claim 1 according to the main request reads as follows:

"Printing apparatus comprising: means (460, 464) for changing a value to be printed and means (472, 476, 478) coupled to the changing means for selecting a value to be printed, the value changing means including

a plurality of banks (460) each including a print wheel (464) having a plurality of print elements (465), and the value selection means including means (472) for selecting each bank and means (476, 478) for selecting each print element of a selected bank and means (120, 484, 486) for driving the bank and print element selection means, the driving means including an output shaft (122) and means (448) for selectively coupling the output shaft (122) to the bank and print element selection means to move a portion of the selected selection means through a total desired displacement from a first position to a second position; and control means comprising:

a) a d.c. motor (120) having said output shaft (122) and forming part of said driving means;

b) means (126) for sensing angular displacement of the motor output shaft (122);

c) microcomputer means (500) including a microprocessor (504) comprising:
   i. clock means (506) for generating successive sampling time periods,
   ii. means for providing first counts representing a predetermined displacement-time profile of motion through said total desired displacement and respectively representative of successive desired angular displacements of the motor shaft (122) during respective successive sampling time periods, the counts being specified according to the particular load coupled to the motor,

iii. means (270) responsive to the sensing means (126) for providing second counts respectively representative of actual angular displacements of the motor output shaft (122) during respective successive sampling time periods, and

iv. means for compensating for the difference between the first and second counts during each successive sampling time period and generating a pulse width modulated control signal for controlling the d.c. motor (120), the motor control signal causing the actual angular displacement of the motor output shaft (122) to substantially match the desired angular displacement of the motor output shaft (122) during respective successive sampling time periods; and

d) signal amplifying means (300) for operably coupling the motor control signal to the d.c. motor (120)."

The wording of method claim 17 according to the main request reads as follows:

"A process for controlling value selection means in printing apparatus including means (460, 464) for changing a value to be printed and means (472, 476, 478) coupled to the changing means (460, 464) for selecting a value to be printed, wherein the value changing means includes a plurality of banks (460), each of the banks includes a print wheel (464) having a plurality of print elements (465), and wherein the value selection means includes means (472) for

selecting each bank and means (476, 478) for selecting each print element of a selected bank, and means (484, 486) for driving the bank and print element selection means, wherein the driving means includes an output shaft (122), and means (448) for selectively coupling the output shaft (122) to the bank and print element selection means to move a portion of the selected selection means through a total desired displacement from a first position to a second position, the process comprising the steps of:

a) providing the driving means with a d.c. motor (120) having the output shaft (122);

b) selectively coupling the output shaft (122) to one of the selection means;

c) providing amounts representing a predetermined displacement-time profile and representative of respective desired angular displacements of the shaft (122) during respective successive sampling time periods to cause said portion of the selected selection means to be moved in accordance with a desired displacement versus time profile, the amounts being specified according to the particular load coupled to the motor;

d) sensing angular displacement of the shaft (122) and in response thereto providing amounts representative of respective actual angular displacements of the shaft (122) during successive sampling time periods; and

e) digitally compensating for the difference between

said desired and actual angular displacements and generating a motor control signal for controlling rotation of the shaft (122) to cause the actual angular displacement of the shaft (122) to substantially match the desired displacement thereof during respective successive sampling time periods, whereby the portion of the selected selection means is moved substantially in accordance with the desired displacement versus time profile."

Claims 2 to 16 and 18 to 27 are dependent claims.

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

The opposed patent essentially related to a printing apparatus, for instance for a postage meter as acknowledged in the description of the patent, the apparatus comprising a control system for a d.c. motor driving various loads.

Document L3, which was considered as the most pertinent state of the art, disclosed a digital servo control system for a printing apparatus. With regard to claim 1 according to the main request, the features (a) to (d) were known from L3 read in the light of the skilled person's knowledge:

(a) A d.c. motor for driving a printing device was shown in Figures 1, 2 and 18 (reference sign 26).

(b) In Figures 1 and 2, the increment encoder 32 was a position transducer for sensing angular displacement of the motor output shaft.

(c) (i) The control circuit in Figure 2 comprised clock means 40 for generating successive sampling time periods.

(ii) The external source 29 in Figure 2 corresponded to the means for providing first counts. According to column 4, lines 30 to 36, this source might be a digital computer producing a digital command signal indicative of successively commanded positions of the element to be displaced.

(iii) The second counts representing the actual motor positions were produced by the position pulse producer circuit 61 sending position pulses 62 or 63 to the control unit 46 (Figure 2).

(iv) This feature was common to any feedback control system. It corresponded to unit 49 of the control system shown in Figure 2.

(d) Signal amplifying means for driving the motor was disclosed as circuit 59 in Figure 2.

Thus, document L3 disclosed all features of claim 1 except for the mechanical features of the printing apparatus, which were, however, usual for a postage meter.

The fact that the claimed displacement-time profile depended on the load was a condition well-known to the skilled person.

The respondent's submission that the present invention essentially relied on position control whereas L3 showed a velocity control system was unsubstantiated. According to L3, column 1, lines 13 to 17, the control system could be a position control system and, in fact, the position of the motor output shaft was measured throughout the entire displacement range, the essential element for determining this position being the encoder 32 which produced incremental counts corresponding to the second counts according to claim 1.

A d.c. motor control system could, in general, comprise proportional (P), integrating (I) or differentiating (D) feedback controls. In Figure 2 of L3, it was shown that the controller comprised a velocity or D-component (unit 64), an integrating or I-component (unit 51) and a proportional or P-component (path 48, unit 49). Therefore, the patent in suit merely provided a particular case of the system of L3, in which the emphasis was put on the position control (proportional component). Indeed, the control system of the contested patent used values of velocity and acceleration to calculate the desired profile, as shown in Figure 23d, reference signs 904a and 904b.

The subject-matter of claim 1, and similarly that of claim 17, according to the main request did not involve an inventive step, because it would have been obvious to the skilled person to apply the d.c. motor control system of L3 to a prior art printing apparatus, thus arriving at the claimed system.

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

The devices according to the documents acknowledged in the introductory part of the patent should be considered as the most relevant state of the art. In such devices, various loads were driven by stepper motors. Contrary to the appellant's allegations, the subject-matter of the independent claims of both requests did not merely differ from these prior art devices by the use of a d.c. motor instead of a stepper motor. Indeed, claim 1 defined a sampling control system which was basically different from known d.c. motor control systems and, in particular, from the system as disclosed in L3. According to this document, the positioning of the motor was mainly carried out by a velocity control system using velocity feedback. The control system was then switched to a position control mode only when the end position was approached (see abstract and column 6, lines 9 to 23). Furthermore, in the claimed control system, for each sampling time period a desired position which had been calculated and stored to form a predetermined profile was compared with the actual position in the same period, any deviation between the position values being used for correction. This had the effect that the actual position of the motor output shaft very closely followed the desired position throughout the whole positioning process. In contrast thereto, the system of L3 (see Figure 2) used during substantially the entire positioning process a velocity feedback based on the comparison of the actual velocity signal generated by the velocity detector circuit 64 with the reference angular velocity as given by control signal 48. As long as these velocities were equal, the control system did not produce any correction signals with the consequence that the system in L3 did not recognise any deviation

in the actual position of the motor. The position signals 62 and 63 were only used to switch from velocity control to position control for the last part of the positioning process (see column 6, lines 17-23).

Reasons for the Decision

1. The appeal is admissible.

2. *Main request*

2.1 Article 123(2),(3) EPC

The claims as amended according to the main request meet the requirements of Article 123(2) and (3) EPC. The appellant has not raised any objection in this respect.

2.2 Novelty

The novelty of the subject-matter of the main request is not in dispute among the parties, nor is it doubted by the Board. There is thus no need for a detailed discussion of this issue.

2.3 Inventive step

2.3.1 Document D1 shows a postage meter, of which the printing apparatus comprises (see Figures 6 to 8 and page 16, line 17, to page 19, line 25):

- means for changing a value to be printed, which

includes:

- a plurality of banks each including a print wheel having a plurality of print elements,

- means for selecting a value to be printed, which includes:

  - means for selecting each bank,

  - means for selecting each print element of a selected bank,

- means for driving the bank and print element selection means, which includes:

  - an output shaft,

  - means for selectively coupling the output shaft to the bank and print element selection means to move a portion of the selected selection means through a total desired displacement from a first position to a second position.

2.3.2 Therefore, the subject-matter of claim 1 differs from the printing apparatus known from D1 by the provision of control means comprising:

- a d.c. motor (see feature (a)), which is operated by a control signal according to feature (d),

- means for sensing angular displacement of the motor shaft (see feature (b)), and

- a microcomputer means (see features (c)(i) to (c)(iv)), which defines a sampling time position feedback control system.

These features solve the problem of accurately positioning the motor output shaft so that, at any time, its position corresponds to a desired predetermined value according to a given displacement-time profile depending on the selected load to be driven.

2.3.3 According to D1, stepper motors (see reference signs 84 and 86 in Figure 6) are provided for driving the value changing means and the value selecting means. Document L3 discloses a digital servo control system including a d.c. motor. In view of this document, it would be obvious to the skilled person to realize that the stepper motor of D1 could be replaced by a d.c. motor, in particular considering that L3, column 1, lines 13 to 17 explicitly refers to the possibility of using the disclosed control system for a printing device (carriage, type wheel). Moreover, the substitution of the specific hardware shown in L3 by a microprocessor would be within the ordinary skill of the expert, who should be defined as an electronics engineer dealing with control systems.

2.3.4 However, in the Board's judgement, the skilled person wishing to use the control system according to L3 in the printing apparatus known from D1 would not find in the cited prior art any incentive to make all the further modifications which would be necessary to arrive at the claimed apparatus. In particular, the control system shown in Figures 2 and 6 of L3 employs a

velocity feedback control. The actual angular position of the encoder 32 represented by pulses 62 and 63 is compared with the distance signal 38 in the down-counter 86 of the control unit 46 and the resulting first position error signal 91 is used to select one of several reference angular velocity signals stored in a memory 92. As long as the servo control system remains in the velocity control mode, this reference velocity is compared with the actual angular velocity signal produced in circuit 64, thereby providing velocity feedback (see column 6, line 16) via the add-subtract circuit 49. The control unit only switches to a final positioning control when the mode signal 47 is switched from the logic "0" level (velocity control mode) to the logic "1" level (position control mode). Thus, in the servo control system of L3, a control signal is produced which is representative of a reference angular velocity selected for the motor as a function of the displacement from the actual position to the commanded one until said displacement is reduced to a predetermined value and the control system switches to a position control mode for final positioning.

2.3.5 The system of L3 does not include means for providing first counts representing a predetermined displacement-time profile of motion through the total desired displacement, as specified in claim 1, feature (c)(ii). In response to a new-data request and for each commanded position or end point, the command signal generator 29 produces a command signal which consists only of the distance signal 38, representing the total distance of the end point from the start point, and the sense signal 37, which indicates the clockwise or counterclockwise sense of rotation of the motor.

Furthermore, since the known control system is essentially based on a velocity control mode, it cannot show feature (c)(iv) of claim 1.

2.3.6 In claim 1, feature (c)(ii), in particular the fact that first counts are provided "representing a predetermined displacement-time profile of motion through said total desired displacement", defines a more restrictive condition than the mere requirement of providing a value for the total displacement, as disclosed in L3.

Furthermore, the claimed apparatus, according to which at successive time intervals successive actual positions are compared with desired positions and a correction is carried out based on the difference between these positions, relies on a position feedback control, in which time is the independent variable and position is the dependent one. In L3, however, the value of the reference velocity, though updated at predetermined sampling periods, is selected from the memory 92 as a function of the first position error signal 91 (see Figure 6 of L3). Therefore, in the system of L3, position is the independent variable and velocity the dependent one, at least during the main part of the positioning process.

2.3.7 The Board does not share the appellant's view that the circuit in L3 is based on PID-control and that the feedback loop according to claim 1 is merely a particular case of a PID-loop. Indeed, the system shown in Figure 2 of L3 should not be regarded as a PID-loop within the commonly accepted meaning of the term, considering that the elements identified by the

appellant, in particular path 48, unit 49 as well as units 51 and 64, are not comprised within a single closed control loop. Rather, as a function of the value of mode signal 47, the system in L3 selects different control modes.

2.3.8 The remaining prior art documents cited during the examining or opposition procedures do not contain any teaching which would make the claimed subject-matter obvious to the skilled person.

Therefore, the subject-matter of claim 1 is considered to involve an inventive step within the meaning of Article 56 EPC.

2.3.9 Independent claim 17 relates to a process for controlling value selection means in a printing apparatus which essentially comprises the features of claim 1. The process steps, in particular steps (c), (d) and (e), define controlling the position of the output shaft of the motor at each sampling time period as a function of a predetermined displacement in the same way as specified in claim 1. Hence, the subject-matter of this claim equally fulfils the requirements of Article 56 EPC for the same reasons given above.

2.3.10 Claims 2 to 16 and 18 to 27 are dependent on claims 1 and 17 and, therefore, their subject-matters also involve an inventive step.

2.4 The respondent's main request is allowable. In particular, taking into consideration the amendments according to the main request, the patent and the invention to which it relates meet the requirements of

the 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 the first instance with the order to maintain the patent on the basis of the following documents according to the main request:

Claims: 1 to 27 as filed at the oral proceedings on 28 April 1999,
pages 4 to 25 of the patent specification,
pages 2 and 3 of the description as filed at the oral proceedings before the Opposition Division on 15 March 1994,

Figure: sheets 1/23 to 23/23 of the patent specification.

The Registrar: The Chairman:

M. Beer G. Davies