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D E C I S I O N
of 18 November 1999

Case Number: T 0928/94 - 3.4.1

Application Number: 85112591.4

Publication Number: 0177048

IPC: G07B 17/02

Language of the proceedings: EN

Title of invention:
Apparatus and process employing microprocessor controlled D.C. motor for controlling a load

Patentee:
Pitney Bowes Inc.

Opponent:
Francotyp-Postalia Aktiengesellschaft & Co.

Headword:
-

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

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

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0928/94 - 3.4.1

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 18 November 1999

Appellant I (Opponent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 9 November 1994 concerning maintenance of European patent No. 0 177 048 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 I (opponent) lodged an appeal, received on 5 December 1994, against the interlocutory decision of the Opposition Division, dispatched on 9 November 1994, maintaining European patent No. 0 177 048 (application No. 85 112 591.4) in amended form. The fee for the appeal was paid on 5 December 1994. The statement setting out the grounds of appeal was received on 10 March 1995.

The appellant II (proprietor of the patent) likewise lodged an appeal, received on 9 January 1995, against the interlocutory decision of the Opposition Division. The appeal fee was paid on 9 January 1995. The statement setting out the grounds of appeal was received on 8 March 1995.

The opposition had been filed against the patent as a whole on the basis of Article 100(a) EPC, 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:

(D3) US-A-4 263 537 and

(D4) US-A-4 016 467.

II. Oral proceedings were held on 18 November 1999.

III. The appellant I requested that the decision under appeal be set aside, and that the patent be revoked in its entirety.

IV. The appellant II requested that the decision under appeal be set aside and that the patent be maintained on the basis of the following documents:

Claims: Nos. 1 to 22 as filed at the oral proceedings on 18 November 1999,

Description: pages 2, 3 as filed at the oral proceedings on 18 November 1999, pages 4 to 24 of the patent as granted,

Drawings: sheets 1/23 to 23/23 of the patent as granted.

V. The wording of Claim 1 reads as follows:

"Apparatus for controlling the displacement and velocity of a portion of a load (38, 464, 122), whereby the load portion is moved through a total desired displacement from a first position to a second position substantially in accordance with a trapezoidal-shaped velocity versus time profile, comprising:

a) a d.c. motor (120) including an output shaft (122) for driving the load portion;

b) means (126) for sensing angular displacement of the motor output shaft from a home position thereof;

c) a microprocessor (502) comprising:

i. clock means (506) for generating successive sampling time periods,

ii. means (504, 508) for providing first counts respectively representative of successive desired angular displacements from the home position of the motor output shaft (122) during respective successive sampling time periods to cause the load to be moved in accordance with a predetermined trapezoidal-shaped velocity versus time profile,

iii. means (504, 508) responsive to the sensing means (126) for providing second counts respectively representative of actual angular displacements from the home position of the motor output shaft (122) during respective successive sampling time periods, and

iv. means (504, 508) 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 from the home position of the motor output shaft (122) to substantially match the desired angular displacement from the home position of the motor output shaft (122) during respective successive sampling time periods, whereby the

load portion is moved through said total desired displacement from the first position to the second position substantially in accordance with the predetermined trapezoidal-shaped velocity versus time profile; and

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

The wording of Claim 16 reads as follows:

"A process for controlling the displacement and velocity of a portion of a load, whereby the load portion is moved through a total desired displacement from a first position to a second position substantially in accordance with a trapezoidal-shaped velocity versus time profile, the process comprising:

a) providing a d.c. motor (120) having an output shaft (122) for driving the load portion;

b) providing first counts representative of respective desired angular displacements of the shaft (122) from a home position thereof during respective successive sampling time periods to cause a portion of the load to be moved in accordance with a predetermined trapezoidal-shaped velocity versus time profile, the first counts being specified according to the load portion coupled to the motor;

c) sensing angular displacement of the shaft (122)

from its home position and in response thereto providing second counts representative of respective actual angular displacements from the home position of the shaft (122) during respective successive sampling time periods; and

d) digitally compensating for the difference between the first and second counts during each successive sampling time period and generating and amplifying a pulse width modulated motor control signal for controlling rotation of the shaft (122) to cause the actual angular displacement from the home position of the shaft (122) to substantially match the desired displacement from the home position thereof during respective successive sampling time periods, whereby the load portion is moved through said total desired displacement from the first position to the second position substantially in accordance with the desired trapezoidal-shaped velocity versus time profile."

The wording of Claim 22 reads as follows:

"A postage meter or mailing machine comprising apparatus in accordance with any one of claims 1 to 15."

Claims 2 to 15 and 17 to 21 are dependent claims.

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

A control system for driving a d.c. motor in accordance with a trapezoidal-shaped velocity versus time profile

was known from document D4 (cf. Figures 3, 4 and 11). The Opposition Division correctly concluded in the decision under appeal (cf. point II.14, last sentence) that the skilled person, starting from D4, would arrive at the apparatus as granted simply by implementing the known analog system in an obvious digital form. In particular, the replacement of the analog system by the claimed digital one was obvious having regard to the knowledge of the person skilled in the art and to document D3 which disclosed a method for digitally controlling the position of a motor shaft. The features which distinguished the present Claim 1 from the granted Claim 1 had to be considered as obvious clarifications and, thus, did not make the claimed subject-matter inventive. The same conclusion applied to Claims 16 and 22 for similar reasons.

VII. The appellant II's arguments may be summarised as follows.

Document D4 would not be the most appropriate springboard towards the present invention. The only points of similarity were the trapezoidal-shaped velocity versus time profile and the use of a predetermined reference profile. However, D4 did not relate to a digital motor control, and did not teach to match angular displacements to predetermined values to enable precise control of displacement as well as velocity during the motion. Thus, the invention went beyond a mere digitall-controlled version of D4 because the circuit known from this document was limited to correcting velocity errors, and was not concerned with displacement errors. Indeed, none of the cited prior art documents considered the problem of accurate

control of both velocity and displacement during the whole motion. As to the digital control system disclosed in D3, it was fundamentally different from the system of the present invention because it was not based on the provision of first "desired" counts and second "actual" counts during successive sampling time periods to control the actual displacement of the shaft.

Reasons for the Decision

1. The appeal is admissible.

2. *Article 123(2), (3) EPC*

The Board is satisfied that the amended claims according to the appellant II's request meet the requirements of Article 123(2), (3) EPC. The appellant I has not raised any objection in this respect.

3. *Novelty*

The claimed subject-matter meets the requirement of novelty. This not being in dispute between the parties, there is no need to give further details.

4. *Inventive step*

4.1 Document D4 discloses a servo drive apparatus for controlling the motion of a load, i.e. the rotating printing drum of a postage meter, from and to a home

position in accordance with a trapezoidal-shaped velocity versus time profile (cf. column 1, lines 43 to 51, Figures 3 to 5 and 11). The apparatus comprises the following features:

- a d.c. motor 32 including an output shaft for driving the load 16,

- means 50 for sensing angular displacement of the motor output shaft,

- motor control means 48, 144, 146, 148,

- amplifying means 142 for applying the motor control signal to the d.c. motor.

According to D4 (cf. Figure 11), an analog circuit is provided for controlling the motor to drive the load at a preselected angular velocity. A first stage 144 generates a ramp signal on line A10 representative of the desired acceleration phase (cf. Figure 4). A second stage 146 produces a constant signal on line A12 for driving the print drum at a preselected constant velocity. A third stage 148 generates a deceleration control signal on line A14. A drum angular displacement sensor 50 is provided at the inputs of the acceleration and deceleration stages. Switches 160, 166, 182 are, moreover, provided to sequentially connect the ramp, constant run, and deceleration control signals to a local motor feedback control circuit 186 during the increasing, constant, and decreasing velocity phases of the drum rotation cycle. In this way, an accurate control of the drum angular velocity is achieved, and the postage meter operates quietly and without

substantial vibration or noise (cf. column 2, lines 59 to 64).

4.1.1 The subject-matter of Claim 1 differs from the apparatus known from D4 in that the control system operates digitally, and in that a microprocessor according to feature (c) is provided.

The features (i) to (iv) defining the microprocessor solve the problem of accurately positioning the motor output shaft so that, at any time, its position corresponds to a desired predetermined value from the home position in accordance with a given trapezoidal-shaped velocity versus time profile.

4.2 Document D3 (cf. Figure 1) discloses a digital servo drive system including a d.c. motor 1. The feedback control is proportional-derivative. A microprocessor 7 receives via an input line 10 a signal representative of the required angular displacement and direction of rotation, and records the actual angular position of the motor output shaft by counting the pulses generated by a position sensor 2. A control switch 9 drives the motor in response to signals generated by the microprocessor 7 and a comparison circuit 8. The circuit 8 compares a proportional-derivative regulation signal, which is generated by a differentiating member 6 and is a function of the instantaneous speed and position of the motor shaft (cf. column 4, lines 40 to 47), and a control signal, which is produced by a generator 11 and represents a desired curve of movement of the motor shaft (cf. column 4, lines 33 to 39). The operation of the system can be inferred from Figure 5. A control signal reversing the polarity of the motor

current is generated when half of the required angular path has been covered. In this way, the motor is switched from acceleration (cf. range (c)) to braking (cf. range (d)). After the lower angular speed (e) has been reached, the braking phase is switched off and short current pulses are applied alternately in the forward and reverse direction to hold the motor at that speed. When a distance (f) from the desired position has been reached, a final control is switched on as described in Figure 4 (cf. also Figure 8) until the final position is achieved within a setting tolerance (g).

Therefore, the system known from D3 is not a system of the kind as defined in Claim 1, in which during each successive sampling time period the control signal is based on the difference between the actual and the desired angular displacements from a home position. Moreover, D3 does not disclose a trapezoidal-shaped velocity versus time profile.

4.3 In the Board's judgement, the skilled person wishing to use a digital control in the apparatus known from D4 would not have any reason at all to combine the teachings of D4 and D3, because the systems according to these documents operate in a fundamentally different way. Moreover, the control according to Claim 1 should not be regarded as equivalent to the velocity control as disclosed in documents D3 or D4. Indeed, the fact that, during each sampling time period, the actual angular value from the home position is compared with the desired value ensures that, during the entire positioning process, both the output angular position and the angular velocity are precisely controlled. This

cannot be achieved by the systems known from D3 or D4 , nor can it be considered as forming part of the skilled person's knowledge. For instance, in the apparatus disclosed in Figure 3 of D4, an end run sensor 60 and a home position sensor 64 are required because the circuit of Figure 4 does not provide this spatial information.

4.4 The remaining prior art documents cited during the opposition procedure do not come closer to the apparatus of Claim 1.

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

4.5 Independent Claim 16 relates to a process for controlling the displacement and velocity of a portion of a load. The claimed steps essentially correspond to the features of Claim 1.

Hence, the subject-matter of Claim 16 equally fulfils the requirement of Article 56 EPC for the same reasons given above.

The same conclusion equally applies to Claim 22.

4.6 Claims 2 to 15 and 17 to 21 are dependent and, therefore, their subject-matters also involve an inventive step.

5. The appellant II's request is allowable. Taking into consideration the amendments made by the appellant II, 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:

Claims: Nos. 1 to 22 as filed at the oral proceedings on 18 November 1999,

Description: pages 2, 3 as filed at the oral proceedings on 18 November 1999,
pages 4 to 24 of the patent as granted,

Drawings: sheets 1/23 to 23/23 of the patent as granted.

The Registrar: The Chairman:

M. Beer G. Davies