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# D E C I S I O N
## of 9 February 2004

**Case Number:** T 0664/02 - 3.2.1

**Application Number:** 95200009.9

**Publication Number:** 0664273

**IPC:** B66F 9/24, B60L 11/18

**Language of the proceedings**: EN

**Title of invention:**
An electrically driven lift truck

**Patentee:**
Fiat OM Carrelli Elevatori S.p.A.

**Opponents:**
Honeywell Regalsysteme GmbH
Sichelschmidt GmbH
BT Industries
Clark Material Handling GmbH
Hubtex Maschinenbau GmbH & Co. KG
Inmotion Technologies AB

**Headword:**
-

**Relevant legal provisions:**
EPC Art. 56

**Keyword:**
"Inventive step (no) - main request"
"Inventive step (yes) - auxiliary request"

**Decisions cited:**
-

**Catchword:**
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

**Case Number:** T 0664/02 - 3.2.1

# D E C I S I O N
## of the Technical Board of Appeal 3.2.1
## of 9 February 2004

**Appellant I:** (Opponent)
Sichelschmidt GmbH
Im Hillingschen 32
D-58300 Wetter (DE)

**Representative:**
Dörner, Lothar, Dipl.-Ing.
Stresemannstrasse 15
D-58095 Hagen (DE)

**Appellant II:** (Opponent)
Hubtex Maschinenbau GmbH & Co. KG
Werner-von-Siemens-Str 8
D-36041 Fulda (DE)

**Representative:**
Kluin, Jörg-Eden, Dr. Dipl.-Phys.
Dres. Fitzner, Münch & Kluin
Lintorfer Strasse 10
D-40878 Ratingen (DE)

**Appellant III:** (Opponent)
Clark Material Handling GmbH
Rheinstrasse 19-29
D-45478 Mülheim a.d. Rhur (DE)

**Representative:**
Dr. Stark & Partner
Patentanwälte
Moerser Strasse 140
D-47803 Krefeld (DE)

**Respondent:** (Proprietor of the patent)
Fiat OM Carrelli Elevatori S.p.A.
Via Curiel, 3
I-20089 Rozzano (Milano) (IT)

**Representative:**
Siniscalco, Fabio
Jacobacci & Partners S.p.A.
Via Senato, 8
I-20121 Milano (IT)

**Party as of right:** (Opponent)
Honeywell Regalsysteme GmbH
Honeywellstrasse 2-6
D-63477 Maintal (DE)

**Representative:**
Keil & Schaafhausen
Patentanwälte
Cronstettenstrasse 66
D-60322 Frankfurt am Main (DE)

**Party as of right:** (Opponent)
BT Industries
S-59581 Mjolby (SE)

**Representative:**
Berglund, Erik Wilhelm
Berglunds Patentbyrå AB
Aspebråten
S-590 55 Sturefors (SE)

**Party as of right:** (Opponent)
Inmotion Technologies AB
Solkraftsvägen 13
S-13570 Stockholm (SE)

**Representative:**
Pantzar, Tord
Atlas Copco Tools AB
Patent Department
S-105 23 Stockholm (SE)

**Decision under appeal:**
**Interlocutory decision of the Opposition Division of the European Patent Office posted 24 April 2002 concerning maintenance of European patent No. 0664273 in amended form.**

**Composition of the Board:**

**Chairman:** S. Crane
**Members:** J. Osborne
S. U. Hoffmann

## Summary of Facts and Submissions

I. The opponents' appeals are directed against the decision posted 24 April 2002 according to which the Opposition Division found that, account being taken of the amendments made by the patent proprietor during the opposition proceedings, European patent No. 0 664 273 and the invention to which it relates meet the requirements of the EPC.

II. The following prior art from the opposition proceedings played a role also during the appeal:

D3: *Dr Thomas Pohlmann*, "Wartungsfreier Elektromotor für Gabelstapler", Marktbild Flurförderzeuge 1993/94, 1993, 8-10, 15

D4: GB-A-2 093 217

D9/D19: *W. Leonhard*, "Control of Electrical Devices", Heidelberg: Springer Verlag Berlin, 1985, 204-237

D10: *Peter Vas*, "Vector Control of AC Machines", Oxford: Clarendon Press, 1990, 149

D12: "Drives and Servos Yearbook 1990-1", Newtown: Control Techniques plc, 1990, 113, 114, 141-144

D17: EP-A-0 576 947.

The following prior art filed during the appeal proceedings also played a role:

D20: Publicity brochure "Mit neuem Antrieb in die Zukunft: Jungheinrich forscht an neuen Energie- und Antriebstechnologien", Jungheinrich AG.

III. The three appellants and one party as of right (BT Industries) requested that the decision under appeal be set aside and that the patent be revoked. In the oral proceedings held 9 February 2004 the respondent requested that the appeals be dismissed (main request) or in the alternative that the patent be maintained in amended form on the basis of the set of claims 1 to 15 presented as the auxiliary request at the oral proceedings. The remaining parties as of right took no part in the appeal procedure.

IV. Claim 1 according to the respondent's main request reads:

"An electrically driven lift truck (10) including at least one electric motor (16) for providing the tractive power for the drive wheels (12) of the truck and an electric motor (17) for actuating a pump (18) which supplies hydraulic circuits of the truck, and having a dc power supply (19) for supplying the electric motors (16,17), wherein the tractive power motor (16) is an asynchronous motor, characterised in that sensor means (30,59) are provided for obtaining angular position parameters, angular speed parameters and current parameters of the tractive power asynchronous motor (16), and in that an electronic control unit (52) is connected to the sensor means (30,59) and controls the power supplies to the tractive power asynchronous motor (16) in dependence on the

required speed of the motor and on the basis of the data provided by the sensor means (30,59), and in that also the pump actuating electric motor is an asynchronous motor (17) and further sensor means (31,60) are provided for obtaining angular position parameters, angular speed parameters and current parameters of the pump actuating asynchronous motor (17), said further sensor means (31,60) being connected to the control unit (52) which controls the power supplies to the pump actuating asynchronous motor (16) in dependence on the required speed of the motor and on the basis of the data provided by said further sensor means (31,60)."

Claim 1 according to the respondent's auxiliary request reads:

"An electrically driven lift truck (10) including at least one electric motor (16) for providing the tractive power for the drive wheels (12) of the truck and an electric motor (17) for actuating a pump (18) which supplies hydraulic circuits of the truck, and having a dc power supply (19) for supplying the electric motors (16,17), wherein the tractive power motor (16) is an asynchronous motor, characterised in that sensor means (30,59) are provided for obtaining angular position parameters, angular speed parameters and current parameters of the tractive power asynchronous motor (16), and in that an electronic control unit (52) is connected to the sensor means (30,59) and controls the power supplies to the tractive power asynchronous motor (16) in dependence on the required speed of the motor and on the basis of the data provided by the sensor means (30,59), and in that also the pump actuating electric motor is an

asynchronous motor (17) and further sensor means (31,60) are provided for obtaining angular position parameters, angular speed parameters and current parameters of the pump actuating asynchronous motor (17), said further sensor means (31,60) being connected to the control unit (52) which controls the power supplies to the pump actuating asynchronous motor (16) in dependence on the required speed of the motor and on the basis of the data provided by said further sensor means (31,60), wherein the input of the control unit (52) is connected to a series of controls (20,21,22,24) of the lift truck relating to the tractive power and to the hydraulic circuits supplied by the pump (18) and is connected to means (30-33,59,60) including the sensor devices (30,31) which provide feedback data on parameters relating to the operation of the lift truck and a brake unit (61) is provided which acts continuously on the tractive-power motor (16) and is deactivated by the control unit (52) on the basis of commands (21)relating to the traction."

Claims 2 to 15 according to the auxiliary request define features additional to the subject-matter of claim 1.

V. The arguments presented in support of the requests to revoke the patent can be summarised as follows:

As regards the main request, D3 relates to an electrically driven lift truck having two asynchronous motors with a dc power supply, a tractive power motor and a lift motor. Although it is not explicitly stated, it is normal that the lift motor would drive a pump for supplying hydraulic circuits of the truck. Sensor means

provide feedback of angular position and speed parameters of the motors. Although according to D3 each motor has its own control unit for safety reasons, it is a mere design choice to combine these units if cost considerations outweigh safety considerations. Moreover, according to the description of the preferred embodiment in the present patent the control unit still contains an individual micro-processor for each motor. Although it is not stated in D3 whether the lift motor drives the pump to feed the hydraulic cylinders directly, this is known from D20 which furthermore uses a single control unit for both motors. D9/D19 teaches that precise control of asynchronous motors requires feedback of current parameters in addition to those of angular position and speed and it would be obvious for the skilled person to apply the teaching of this reference work to improve the performance of the lift truck of D3 and thereby arrive at the subject-matter of claim 1 of the main request.

The additional features in claim 1 according to the auxiliary request are unrelated in function to the other features of the claim 1 and are well known in the art. Furthermore, the added features of the control unit connections with feedback are known from D9, D10, D12 and D14 whilst the feature regarding the brake unit is known from D17.

VI. The respondent countered essentially as follows:

The aim achieved by the subject-matter of the patent is to increase the performance of the lift truck and this is achieved by using the same control system for both motors, including feedback of current parameters. In

the preferred embodiment, moreover, the control unit contains two micro-processors which are interlinked in a subservient manner. By contrast, D3 aims to reduce both noise levels and the need for maintenance and there is no mention of improving the performance of the two asynchronous motors by combining and improving the motor controls. Indeed, it is even stated that each motor has its own control for reasons of safety and there is no suggestion that these separate controls should be identical. D9/D19 stresses that the control arrangement of an asynchronous motor should be adapted to its duty and, in particular, that the complex arrangement including feedback of current parameters is not necessary for a motor having a low dynamic performance requirement, such as for driving a pump. It was common in lift trucks at the priority date that the lift pump would be driven merely at two speeds to supply an accumulator and the need for accurate control then would not exist. The subject-matter of claim 1 according to the main request therefore is not rendered obvious by the cited prior art.

The additional features in claim 1 according to the auxiliary request combine to improve the lift truck performance yet further by preventing the truck from moving backwards on an incline by releasing the brake only when the motor has developed sufficient torque to prevent the movement. Such a combination of features is not disclosed in any of the cited prior art.

## Reasons for the Decision

*Main request*

1. The present patent relates to an electrically powered lift truck having a tractive motor for driving the truck and a further motor for driving a pump to supply hydraulic circuits, both motors receiving energy from a dc power source, i.e. a battery. The very nature of the duty of such lift trucks requires accurate response to control input commands, particularly in respect of manoeuvring a load carried by the truck. Accurate response was previously achievable when using dc electric motors but they suffered from problems such as high maintenance requirements resulting from the brush/commutator arrangement.

1.1 It was already known from D3, which was published in 1993, to equip lift trucks with asynchronous motors fed by inverters from a battery to provide power for both driving the truck and manoeuvring the load. It is not explicitly stated in D3 that the motor for manoeuvring the load drives a pump but, as accepted by the respondent, this is implicit for the skilled person. Although the thrust of D3 is that the asynchronous motors offer lower maintenance, improved control is also cited as a benefit which is achieved by the use of asynchronous motors employing feedback control of motor position and, therefore, also speed (see the caption to the upper illustration on page 8). It is furthermore explained that continual development in motor control systems, providing more powerful digital control of motor angular speed and position at lower cost, were rendering the asynchronous motor increasingly

attractive. For safety reasons each motor is provided with its own control system.

1.2 The subject-matter of claim 1 differs from that of D3 in that:

– sensor means are provided for obtaining also current parameters of both the motors;

– the power supply to both motors is also controlled on the basis of data provided by the current sensor means; and

– a single control unit controls both motors.

The provision of current data feedback in the control arrangement has the effect of improving the performance of the lift truck, in particular the control of the motors. However, the feature of a single control unit has no influence on performance and merely has the effect of reducing costs and/or size of the unit. In this regard the Board is not convinced by the respondent's argument that any synergy arises from the use of a single control unit. It is important to recognise that a single control unit is not to be equated with a single micro-processor. Indeed, according to the description of the preferred embodiment in the present patent specification, the control unit houses two dedicated micro-processors, one for each motor and although one micro-processor is subservient to the other, this function would be equally possible with two individual but interconnected control units.

2. D9/D19 is an extract from a reference book which teaches the theory behind control of induction motors. Chapter 12.1 relates to a control arrangement which is shown in figure 12.7 and which provides feedback only of angular speed and position but it is stressed that this may not be appropriate for applications requiring a fast response to control input commands. Chapter 12.2, on the other hand, concerns a control arrangement which is shown in figure 12.13 and is suitable for high dynamic performance drives. In this arrangement feedback is provided of stator current in addition to angular position and speed. In view of this teaching, and in particular given the indication in D3 that it was becoming increasingly feasible to employ complex control systems, it would be obvious for the skilled person to adopt the teaching of D9/D19 in order to improve the performance of the lift truck disclosed in D3.

2.1 The respondent refers to the statement in D9/D19, page 206 that there are many applications of asynchronous motors, such as a pump drive, where high speed of response is not required and argues that this teaches away from adopting the more complex control system of figure 12.13. However, the text to which the respondent refers also mentions fan drives and it is clear that it is not a reference to pump drives *per se* but merely an example of an application of a motor having a low dynamic performance requirement. In the technical field of lift trucks, on the other hand and as acknowledged by the respondent, it is well known for the pump to feed hydraulic fluid directly to the circuits responsible for manoeuvring the load and

therefore to have a high dynamic performance requirement.

3. As discussed above, the feature in claim 1 of the single control unit exhibits no functional interrelationship with the remaining features relating to sensing and feedback of current parameters and so these respective features are to be considered separately when judging inventive step. It is the normal activity of the skilled person to optimise all aspects of a control system, not only in respect of safety but also in respect of cost and space requirement, all three of which are mentioned in D3 in the light of the developments to which it refers. The inclusion of individual micro-processors, one for each motor in a common housing, as is done in the preferred embodiment in the present patent, is not inconsistent with the teaching of D3 and would be an obvious result of the skilled person's routine work.

4. On the basis of the foregoing the Board finds that the subject-matter of claim 1 according to the main request lacks an inventive step (Article 56 EPC).

*Auxiliary request*

5. The subject-matter of claim 1 according to this request essentially differs from that of the main request by the addition of the features regarding the supply to the control unit of input command signals from the controls and feedback signals from the sensors, together with the provision of a continuously acting brake on the tractive-power motor which is deactivated by the control unit on the basis of commands relating

to traction. As set out in the patent specification column 7, line 45 to column 8, line 5 these latter additional features have the effect of further improving the performance of the lift truck by automatically preventing movement on a hill when the torque delivered by the motor is insufficient.

5.1 The features relating to the connections to the control unit are well known in the art. However, there has been no evidence provided that the feature of a brake acting continuously except when it is deactivated by the control unit in response to a traction command is known. Moreover, none of the cited prior art gives any suggestion which would encourage the skilled person to adopt the features of present claim 1 in combination. D17 is the only document which has been referred to in respect of the feature relating to a continuously operating brake. This prior art relates to a vehicle having at least two asynchronous traction motors operating in parallel. It is stated in D17 that, for safety reasons, the motors apply a braking torque in the absence of a drive signal so that braking has precedence. However, the teaching of the document relates to the operation of the motors during acceleration and deceleration and is silent about the situation in which the vehicle is stationary without a signal from the control unit. By contrast, the subject-matter of present claim 1 requires a brake unit which acts on the motor, i.e. it is additional to the motor, and which in the absence of a signal from the control unit serves to maintain the vehicle stationary.

5.2 The Board concludes from the foregoing that the subject-matter of claim 1 according to the auxiliary request involves an inventive step. Since claims 2 to 15 contain all features of claim 1 this applies equally to those claims.

## Order

## For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent on the basis of the following documents:

   – claims 1 to 15 according to the auxiliary request submitted at the oral proceedings;

   – description and drawings as granted.

The Registrar: The Chairman:

S. Fabiani S. Crane