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D E C I S I O N
of 18 December 2003

Case Number: T 0203/02 - 3.2.1

Application Number: 93103868.1

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Language of the proceedings: EN

Title of invention:
Motor and pedal driven bicycle

Patentee:
SANYO ELECTRIC CO., LTD.

Opponent:
SRAM Deutschland GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
"Novelty (yes)"
"Inventive step (no)"

Decisions cited:
-

Catchword:
-



Case Number: T 0203/02 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 18 December 2003

Appellant I: SANYO ELECTRIC CO., LTD.
(Proprietor of the patent) 2-18, Keihan-Hondori
Moriguchi-shi, Osaka (JP)

Representative: Modiano, Guido, Dr.-Ing.
Modiano, Josif, Pisanty & Staub
Baaderstrasse 3
D-80469 München (DE)

Appellant II: SRAM Deutschland GmbH
(Opponent) Postfach 1461
D-97404 Schweinfurt (DE)

Representative: Prechtel, Jörg, Dipl.-Phys. Dr.
Weickmann & Weickmann
Patentanwälte
Postfach 86 08 20
D-81635 München (DE)

Decision under appeal: Interlocutory decision of the Opposition
Division of the European Patent Office posted
28 January 2002 concerning maintenance of
European patent No. 0561268 in amended form.

Composition of the Board:

Chairman: S. Crane
Members: J. Osborne
H. Preglau

Summary of Facts and Submissions

- I. The appeals of both the patent proprietor and the opponent are directed against the interlocutory decision of the Opposition Division dated 28 January 2002 according to which, account being taken of the amendments made by the patent proprietor during the opposition proceedings, European patent No. 0 561 268 and the invention to which it relates were found to meet the requirements of the EPC.
- II. The following prior art played a role during appeal:
- D3: US-A-3 921 741
- D5: US-A-3 533 484
- D12: DE-A-40 00 960
- D14: US-A-3 908 776.
- III. During oral proceedings held 18 December 2003 appellant I/the patent proprietor requested that the decision under appeal be set aside and that the patent be maintained on the basis of the claims filed as first auxiliary request with the letter of 18 November 2003 (main request) or in the alternative on the basis of the first to fourth auxiliary requests submitted at the oral proceedings. Appellant II/the opponent requested that the decision under appeal be set aside and that the patent be revoked.
- IV. The respective claims 1 according to the requests of appellant I/the patent proprietor read as follows:

Main request

"A motor and pedal driven bicycle (P1) comprising a motor wheel driving unit for giving a driving power to a wheel (254), said motor wheel driving unit including a disc-like casing (205, 206) defining a space therein, said casing (205, 206) comprising two portions, a fixed portion (205) secured to a hub spindle (207) of the wheel (254) and a rotatable portion (206) provided on a hub shell (224) mounted on said hub spindle (207) to be rotatable along with said hub shell (224); and a wheel driving motor (251) powered by a battery (220) and a speed reducer coupled to the motor (251) to reduce a revolution speed of said motor (251) and said motor (251) being provided on the inside of the fixed portion of the casing (205), characterized in that said motor (251) extends parallel to and apart from said hub spindle, so that said motor does not enclose said hub spindle, and in that said motor (251) and said speed reducer are both provided at a location lower than said hub spindle (207)."

First auxiliary request

"A motor and pedal driven bicycle (P1; P2) comprising a motor wheel driving unit for giving a driving power to a wheel (104; 254), said motor wheel driving unit including a disc-like casing (105, 106; 205, 206) defining a space therein, said casing (105, 106; 205, 206) comprising two portions, a fixed portion (105; 205) secured to a hub spindle (107; 207) of the wheel (104; 254) and a rotatable portion (106; 206) provided on a hub shell (124; 224) mounted on said hub spindle

(107; 207) to be rotatable along with said hub shell (124; 224); and a wheel driving motor (101; 251) powered by a battery (102; 220) and a speed reducer coupled to the motor (101; 251) to reduce a revolution speed of said motor (101; 251) and said motor (101; 251) being provided on the inside of the fixed portion of the casing (105; 205), characterized in that said motor (101; 251) extends parallel to and apart from said hub spindle, so that said motor does not enclose said hub spindle, and in that a control unit including a control substrate and a control circuit component is provided on said fixed portion (105; 205) of the casing (105, 106; 205, 206)."

Second auxiliary request

"A motor and pedal driven bicycle (P1; P2) comprising a motor wheel driving unit for giving a driving power to a wheel (104; 254), said motor wheel driving unit including a disc-like casing (105, 106; 205, 206) defining a space therein, said casing (105, 106; 205, 206) comprising two portions, a fixed portion (105; 205) secured to a hub spindle (107; 207) of the wheel (104; 254) and a rotatable portion (106; 206) provided on a hub shell (124; 224) mounted on said hub spindle (107; 207) to be rotatable along with said hub shell (124; 224); and a wheel driving motor (101; 251) powered by a battery (102; 220) and a speed reducer coupled to the motor (101; 251) to reduce a revolution speed of said motor (101; 251) and said motor (101; 251) being provided on the inside of the fixed portion of the casing (105; 205), characterized in that said motor (101; 251) extends parallel to and apart from said hub spindle, so that said motor does not enclose

said hub spindle, and in that a control unit including a control substrate and a control circuit component is provided on said fixed portion (105; 205) of the casing (105, 106; 205, 206), the control unit (126; 217) being provided in such a manner that it comes close to the internal surface of the fixed portion (105; 205) of the casing (105, 106; 205, 206) to effectively dissipate heat".

Third auxiliary request

"A motor and pedal driven bicycle (P1; P2) comprising a motor wheel driving unit for giving a driving power to a wheel (104; 254), said motor wheel driving unit including a disc-like casing (105, 106; 205, 206) defining a space therein, said casing (105, 106; 205, 206) comprising two portions, a fixed portion (105; 205) secured to a hub spindle (107; 207) of the wheel (104; 254) and a rotatable portion (106; 206) provided on a hub shell (124; 224) mounted on said hub spindle (107; 207) to be rotatable along with said hub shell (124; 224); and a wheel driving motor (101; 251) powered by a battery (102; 220) and a speed reducer coupled to the motor (101; 251) to reduce a revolution speed of said motor (101; 251) and said motor (101; 251) being provided on the inside of the fixed portion of the casing (105; 205), characterized in that said motor (101; 251) extends parallel to and apart from said hub spindle, so that said motor does not enclose said hub spindle, and in that a control unit including a control substrate and a control circuit component is provided on said fixed portion (105; 205) of the casing (105, 106; 205, 206), the control unit (126; 217) being provided in such a manner that it comes close to the

internal surface of the fixed portion (105; 205) of the casing (105, 106; 205, 206) to effectively dissipate heat, said control substrate being arranged parallel to the fixed portion (105; 205) of the casing (105, 106; 205, 206)."

Fourth auxiliary request

"A motor and pedal driven bicycle (P1) comprising a motor wheel driving unit for giving a driving power to a wheel (254), said motor wheel driving unit including a disc-like casing (205, 206) defining a space therein, said casing (205, 206) comprising two portions, a fixed portion (205) secured to a hub spindle (207) of the wheel (254) and a rotatable portion (206) provided on a hub shell (224) mounted on said hub spindle (207) to be rotatable along with said hub shell (224); and a wheel driving motor (251) powered by a battery (220) and a speed reducer coupled to the motor (251) to reduce a revolution speed of said motor (251) and said motor (251) being provided on the inside of the fixed portion of the casing (205), characterized in that said motor (251) extends parallel to and apart from said hub spindle, so that said motor does not enclose said hub spindle, and in that said motor (251) and said speed reducer are both provided at a location lower than said hub spindle (207), and in that a control unit (217) including a control substrate and a control circuit component is provided on said fixed portion (205) of the casing (205, 206), the control substrate being arranged parallel to the fixed portion (205) of the casing (205, 206)."

V. The submissions of appellant I/the patent proprietor can be summarised as follows:

The subject-matter of claim 1 according to the main request is novel with respect to D12 because there is no explicit disclosure in that document of the feature that the motor and speed reducer are provided at a location lower than the hub spindle. Also, the motor is carried by a bracket 10 mounted on the fork and so is not "provided on the inside of the ... casing" as required by claim 1. Moreover, the motor in D12 does not extend parallel to the hub spindle. The subject-matter of the claim also involves an inventive step. The claimed features solve the problem of improving safety by lowering the centre of gravity and reducing vibration levels. It requires several steps when beginning from the prior art according to D12 to arrive at the subject-matter of claim 1, namely to provide the motor on the inside of the fixed portion of the casing, turn the motor through 90°, replace the angle drive by a conventional speed reducer and place both the motor and the speed reducer below the axle. As regards a combination of the teachings of D12 and D5, the latter teaches the use of a series of small motors arranged all around the axle. There is no teaching to select only one motor below the axle. The subject-matter of claim 1 is also not obvious in the light of a combination of D12 and D3. The embodiment of D3, Figure 4 discloses neither that the motor is below the axle nor that it is on the inside of the casing. Moreover, the teaching of D3 is directed towards the provision of clutches between the speed reducer and each of the motor and generator.

Claim 1 according to the first auxiliary request includes the feature that a control unit including a control substrate and a control circuit component is provided on the fixed portion of the casing. This feature is disclosed neither in D12 nor in D14. The latter relates to a different technical field, namely wheelchairs, and merely discloses relays mounted on an angled bracket. The expression "control substrate" in the claim relates to an item such as a printed circuit board which carries electronic components, as can be seen in the patent Figure 10. By comparison there is reference in D14 to wiring.

The subject-matter of claim 1 according to the second auxiliary request additionally contains the feature that the control unit is provided such that it is close to the internal surface of the fixed portion of the casing to effectively dissipate heat. However, in D14 the portion of the bracket which carries the relay is remote from the casing. Heat dissipation is important in view of the closed environment of the casing but this problem is not addressed by D14.

In claim 1 according to the third auxiliary request the control substrate is additionally arranged parallel to the fixed portion of the casing. This is clearly not known from D14, which arrangement would be detrimental as regards heat dissipation.

Claim 1 of the fourth auxiliary request combines the subject-matter of claim 1 of the main request with the features of the control unit having a control substrate and a control circuit component and being provided on the fixed portion of the casing with the substrate

parallel to it. This combination of features which together solve the problem of increased safety cannot be arrived at even by combining three documents, namely D12 with D3 or D5 and D14; this alone is an indication of inventive step. Moreover, there are many possible ways of mounting a printed circuit board. The parallel mounting which is claimed is only one of those and provides the benefits of improvements in both stability and heat dissipation.

VI. Appellant II/the opponent argued essentially that:

The subject-matter of claim 1 according to the main request lacks novelty with respect to the disclosure of D12. In particular, it is clearly stated in D12 column 3, lines 26 to 31 that the motor is provided on the inside of the fixed portion of the casing. As regards the speed reducer, it is within the common knowledge of the skilled person that an angled drive as disclosed in D12 reduces speed and increases torque. The feature of the parallel arrangement of the motor is also known from D12; the motor is three-dimensional and the contested claim does not specify in which dimension the parallelism occurs. The text bridging columns 2 and 3 of D12, which teaches to position the motor and/or batteries to provide a low centre of gravity, in conjunction with the positioning in the preferred embodiment of the batteries below the axle is a teaching to the skilled person to place the motor and speed reducer below the axle.

Even if the subject-matter of claim 1 were found to be novel it would be obvious when starting from the disclosure of D12. That prior art solves the problem of

providing motorised assistance in a bicycle using a wheel which is easily interchangeable with the front wheel in a standard fork. The orientation of the motor in combination with an angled drive resulted from the standard spacing of the arms of the fork. However, the skilled person knows that an angled drive has relatively low efficiency. In order to improve the efficiency it would be obvious for the skilled person to arrange the motor parallel to the axle, thereby avoiding the need for the angled drive. Such an arrangement was already known from D5 in the same technical field.

The subject-matter of claim 1 according to the first auxiliary request is novel but lacks inventive step in the light of the disclosure of D12 and the knowledge of the skilled person. The state of the art at the priority date demanded the use of electronic components for motor regulation and power regeneration and these would be mounted on a printed circuit board (PCB). In view of the aim of D12 to permit easy conversion of a standard bicycle the skilled person would locate the components within the casing and this would be possible only on the fixed portion.

The additional feature of claim 1 according to the second auxiliary request would be normal practice for the skilled person.

As regards the parallel mounting of the control substrate and the fixed portion of the casing according to the third auxiliary request, the restricted space available within the casing demands that this arrangement be chosen.

The argument of appellant I/the patent proprietor in respect of the fourth auxiliary request that the need to combine three documents is indicative of inventive step does not apply to a case such as this in which there is a plurality of problems solved. Moreover, wheelchairs commonly use wheels similar to those of bicycles and D14 therefore does not relate to a different technical field.

Reasons for the Decision

Main request

1. D12 relates to a cycle wheel which can be mounted in the front fork of a bicycle in place of the standard wheel. The cycle wheel comprises a disc-like casing having a first, fixed portion secured to a hub spindle 7 and which forms one side of the wheel and a second, rotatable portion which is provided on a hub shell 35, forms the other side of the wheel and carries a tyre. A wheel driving motor 19 powered by batteries 37 is provided on the inside of the fixed portion of the casing (see column 1, lines 44 to 50, particularly line 48). In the embodiment the motor is located above, and with its axis perpendicular to, the hub whilst the batteries are below the hub. The motor is provided with an angle drive having an output shaft which is parallel to the hub. The output shaft of the angle drive carries a toothed wheel 40 which drives a further toothed wheel 41 of the same size and mounted coaxially with the hub of the cycle wheel.

- 1.1 The Board cannot agree with appellant II/the opponent that it is implicit that an angle drive as disclosed in D12 incorporates a speed reducer. Nevertheless, it is implicit for the skilled person faced with the teaching of D12 that the wheel would typically rotate at up to about 150 rpm whilst the motor would typically run at much higher speeds and that it would be necessary to reduce the speed from that of the motor to that of the wheel, thereby also generating sufficient torque to drive the wheel. The feature in claim 1 of a speed reducer is therefore implicitly known from D12.

- 1.2 The Board also disagrees with appellant II/the opponent that there is any ambiguity in the definition in claim 1 as regards the orientation of the motor. In the case of a component such as an electric motor it is normal in the art that the axis of the rotor serves as the basis for defining the orientation of the motor and the present patent provides no basis for any alternative understanding. It follows that D12 does not disclose the feature of claim 1 that the motor is arranged parallel to the hub.

- 1.3 Also the feature in claim 1 regarding the location of the motor and the speed reducer below the hub is not disclosed in D12. The indication in the description that the motor and/or the batteries can be arranged in such a way as to achieve a low centre of gravity cannot be regarded as a disclosure of the motor being below the hub, particularly since in the described embodiment it is the batteries which are below the hub whilst the motor is located above it.

2. It follows from the foregoing that the subject-matter of claim 1 is not anticipated by D12. The following features are novel:

- the motor extends parallel to the hub spindle; and
- the motor and the speed reducer are both provided at a location lower than the hub spindle.

2.1 The two features which differentiate the subject-matter of claim 1 from that of D12 solve separate problems, namely to simplify and improve the efficiency of the drive from the motor to the rotatable portion of the wheel on the one hand and to optimise stability of the bicycle by providing a low centre of gravity on the other hand. The Board does not agree with appellant I/the patent proprietor that these differentiating features can be considered to solve a common problem of improving safety because the arrangement of the motor parallel to the hub, even if it were to result in a reduction of vibrations in the bicycle, has no direct influence on safety. According to consistent case law of the Boards, features which do not mutually influence each other to achieve a technical effect over and above the sum of their individual effects are to be considered individually for assessment of inventive step; the question is whether each group, considered on its own, is derivable from the prior art in an obvious manner.

2.1.1 D12 suggests that the motor can be arranged perpendicular to the hub spindle and provided with an angle drive having an output shaft parallel to the hub in order to minimise the width of the wheel (see

column 5, lines 36 to 41). However, claim 13, which relates to the transmission of power from the motor to the wheel, merely states that the motor is arranged next to ("neben") the wheel axle. The skilled person would have been aware that an angle drive such as shown in the embodiment of D12 both increased cost and reduced efficiency and it would fall within his normal activity to dispense with it by simply arranging the motor parallel to the wheel axle. Indeed, a parallel arrangement of a single motor was already known from D3 in the same technical field, see the embodiment of Figure 4.

2.1.2 As regards the feature that the motor and the speed reducer are both provided at a location lower than the hub spindle, although D12 does suggest that the motor and/or batteries be located on the fixed portion of the wheel in such a way that it results in a low centre of gravity, the only explicit disclosure is in the embodiment, in which the two batteries are below the hub but the motor and speed reducer are above it. According to column 5, lines 18 to 21 the arrangement of the batteries below the hub achieves a low centre of gravity. As can be seen from Figure 2, the batteries are each of comparable size to the motor and there is apparently no space available to arrange both batteries and the motor below the hub. However, it is suggested in D12 as a further possible feature that electrical energy be recovered for instance when descending hills (column 5, lines 50 to 56). This would enable a reduction in the capacity and therefore space requirement of the batteries and the skilled person then would be free to follow the teaching of D12 itself and to use any space which became available beneath the

hub to locate also the motor there. The corresponding location of the speed reducer would follow automatically. Similar considerations would apply if, in the manner known *per se* from D3 and D5 and adopted in the embodiments of the claimed invention, batteries were located outside the casing.

- 2.2 It follows from the above that the subject-matter of claim 1 of the present main request (which corresponds in essence to claim 1 as maintained in the Opposition Division) does not involve an inventive step (Article 56 EPC).

First, second and third auxiliary requests

3. It is not disputed that the subject-matter of claim 1 according to these requests is novel. The closest prior art is that disclosed in D12 and the subject-matter of claim 1 according to the first auxiliary request differs therefrom by the features that:

- the motor extends parallel to and apart from the hub spindle; and
- a control unit including a control substrate and a control circuit component is provided on the fixed portion of the casing.

The respective claims 1 according to the second and third auxiliary requests additionally contain the following differentiating features:

- the control unit is provided such that it comes close to the internal surface of the fixed portion

of the casing to effectively dissipate heat (second and third auxiliary requests); and

- the substrate is arranged parallel to the fixed portion of the casing (third auxiliary request).

3.1 The feature relating to the parallel arrangement of the motor solves the problem set out in 2.1.1 above whilst each of the other additional features relates to the provision and arrangement of a control unit. As already mentioned under 2.1 above, such juxtaposed features are to be considered separately when judging inventive step. The arrangement of the motor parallel to the wheel axle is obvious for the reasons already discussed.

3.2 Appellant I/the patent proprietor has not denied that it was known in the art at the priority date of the present patent to employ electronic circuitry for controlling electric traction motors but argues that the invention according to the claims of the auxiliary requests resides in the arrangement of the control unit in the casing. The only detail contained in D12 of any control system for the motor is a switch mounted on the handlebars of the bicycle and cables connecting the switch with the batteries and the motor and it would be necessary for the skilled person wishing to put the disclosure of D12 into effect using known control technology to supplement that disclosure. It is the aim of D12 that the cycle wheel be interchangeable with a standard one and the only practical solution available to the skilled person would be to provide the control circuitry within the casing of the wheel. The remaining subject-matter of the auxiliary requests relating to the control unit is a juxtaposition of conventional

solutions which would readily have occurred to the skilled person faced with the problem of providing a satisfactory mounting for the electronic control unit in the casing of D12. For example, the arrangement of the substrate both close and parallel to the casing is an obvious solution in view of the necessity for it to be mounted where space is available and in a manner which is not susceptible to vibrations. Any beneficial influence on heat dissipation resulting from this arrangement would be merely a bonus effect and is not determinative as regards the presence of an inventive step. It is therefore the Board's view that the additional features relating to the provision and arrangement of a control unit are merely a result of the normal activity of the skilled person when putting into effect the teaching of D12.

- 3.3 The subject-matter of each claim 1 according to the first to third auxiliary requests therefore also does not involve an inventive step.

Fourth auxiliary request

4. The subject-matter of claim 1 according to this request comprises yet another juxtaposition of features relating to the arrangement of the motor and the control unit, all of which have been considered as part of the higher order requests. In particular, the subject-matter consists of the subject-matter of claim 1 according to the main request together with two of the three features relating to the control unit which were added in the third auxiliary request and which already have been found to be obvious for the skilled person.

4.1 The subject-matter of claim 1 also according to this request therefore does not involve an inventive step.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is revoked.

The Registrar:

The Chairman:

S. Fabiani

S. Crane