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Datasheet for the decision of 19 September 2013

Case Number: T 0078/12 - 3.5.02

Application Number: 98309243.8

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Title of invention:
Compensation for power transfer systems using rotary transformer

Applicant:
General Electric Company

Headword:

Relevant legal provisions:
EPC Art. 56

Keyword:
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Decisions cited:

Catchword:

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European Patent Office
D-80298 MUNICH
GERMANY
Tel. +49 (0) 89 2399-0
Fax +49 (0) 89 2399-4465

Case Number: T 0078/12 - 3.5.02

D E C I S I O N
of Technical Board of Appeal 3.5.02
of 19 September 2013

Appellant: (Applicant)	General Electric Company 1 River Road Schenectady, NY 12345 (US)
Representative:	Bedford, Grant Richard GPO Europe GE International Inc. The Ark 201 Talgarth Road Hammersmith London W6 8BJ (GB)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 5 August 2011 refusing European patent application No. 98309243.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: G. Flyng
Members: M. Léouffre
P. Mühlens

Summary of Facts and Submissions

I. The applicant appealed against the decision of the examining division, posted on 5 August 2011, on the refusal of the European application No. 98309243.8.

II. The examining division held that claim 1, then on file, did not involve an inventive step (Article 56 EPC) having regard to the combination of following documents:

D1a = EP 0 749 190 A2 and
D3 = CN 1 127 892 A

and common general knowledge.

For the disclosure of D3 reference was and will be made to the text of related US patent D3en = US 5 825 162, which was published after the priority date of the present application and whose content is assumed to be identical to the content of D3. The appellant has not objected this approach.

III. In an annex to a summons to oral proceedings the board expressed the preliminary opinion that the subject-matter of claim 1 of the main (primary) request and of claim 1 of the auxiliary request, both filed with the letter dated 14 December 2011 setting out the grounds of appeal, seemed obvious in the light of the combination of documents D1a and D3.

IV. With a letter of response dated 16 August 2013, the appellant filed a new main (primary) request and a new auxiliary request.

V. Oral proceedings before the board took place as scheduled on 19 September 2013. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of claims 1 to 6 of the main ("primary") request or on the basis of claims 1 to 6 of the auxiliary request, both filed with letter dated 16 August 2013.

VI. Claim 1 of the main request reads as follows:
"Apparatus (100) for transferring power between a first grid (22) and a second grid (24), the first grid operating at a first electrical frequency and the second grid operating at a second electrical frequency different from the first electrical frequency, the system comprising:

a rotary transformer (102) having a first winding and a second winding, the rotary transformer further having a rotatable shaft and a drive motor for rotationally driving the rotatable shaft;

a step-down transformer (30) the rotary transformer (102) being connected to the first grid (22) through the step-down transformer, said step-down transformer (30) being connected to the rotary transformer (102) by a three-phase line (26);

a step-up transformer (32), the rotary transformer (102) being connected through the step-up transformer to the second grid (24);

a shunt compensation circuit (40) connected at a first side to a secondary coil (30S) of the step-down transformer and a first terminal (103(1)) of the rotary transformer (102) at a line segment (26(2)) of the three-phase line (26), and at a second side to ground, wherein the shunt compensation circuit (40) is operable to regulate power in the apparatus (100) by adjusting a reactive current injected in shunt to the apparatus (100) and

a series compensation circuit (50) connected between a primary coil (30P) of the step-down transformer (30) and ground."

Claim 1 of the auxiliary request specifies further: "said step-up transformer (32) being connected by a three-phase line (28) to the second grid (24)".

Claims 2 to 6 of the two requests are identical and are dependent on claim 1.

VII. The appellant essentially argued as follows:

The invention related to a rotary transformer and a series compensation circuit.

The series compensation circuit 50 served "to regulate real power flow in a bandwidth faster than variable frequency transformer 102 can achieve due to inherent inertia of variable frequency transformer 102" (cf. section [0024] of the published application EP 0 917 271 A2. A series compensation circuit in combination with a conventional (non-rotary) transformer as disclosed in D3 would not address the specific problem of bandwidth limitation involved by the use of a rotary transformer.

Furthermore the shunt compensation circuit of D3 appeared to be connected to the controller 104 and not to the secondary side of the step-down transformer.

Finally D1 and D3 had such different topologies, that a person skilled in the art would not have combined D1 and D3 to arrive at the claimed invention.

Reasons for the Decision

1. *Novelty (Article 54 EPC)*

1.1 Document D1a, which belongs to the same applicant, discloses (cf. figure 4):

an apparatus 200 for transferring power between a first grid 222 and a second grid 224, the first grid operating at a first electrical frequency and the second grid operating at a second electrical frequency different from the first electrical frequency (cf. column 7, lines 31 to 42).

The apparatus comprises:

a rotary transformer (converter) 102 having a first winding RA, RB, RC and a second winding Sa, SB, SC, the rotary transformer further having a rotatable shaft and a drive motor 118 for rotationally driving the rotatable shaft (cf. figure 2 and column 3, line 44 to column 4, line 36);

a step-down transformer 232, the rotary transformer 102 being connected to the first grid through the step down transformer (cf. column 7, lines 43 to 49 and figure 4), said step-down transformer 232 being connected to the rotary transformer 102 by a three phase line (cf. column 7, lines 49 to 51 and figure 2); and

a step-up transformer 238, the rotary transformer 102 being connected through the step-up transformer to the second grid (cf. column 7, line 51 to column 8, line 2).

1.2 The apparatus of D1a comprises further a $10M_{VAR}$ filter which is shown in figure 4 but not mentioned in the description.

1.2.1 The appellant argues that the $10M_{VAR}$ filter is only connected to controller 104. Figure 4 does indeed unambiguously show a galvanic connection between the $10M_{VAR}$ filter and controller 104. But controller 104, which is shown in figure 2 without the filter but in connection with the rotor drive 118 of rotary transformer 102, needs an electrical supply to generate drive for adjusting the angular position of the rotor assembly 110 of rotary transformer 102 (cf. D1a, paragraph bridging columns 4 and 5, and column 8, lines 3 to 12).

1.2.2 In view of the above, the board derives from figure 4 that the solid line which intersects the 15kV line 234 and also the line connecting the $10M_{VAR}$ filter to controller 104 represents a bus that distributes power to the controller and to the $10M_{VAR}$ filter. The $10M_{VAR}$ filter is thus connected not only to the controller but also to both the secondary of the step-down transformer 232 and the rotary transformer 102.

1.2.3 The other side of the $10M_{VAR}$ filter shown in figure 4 is drawn pointing downwards. In the same way, in figures 3A and 3B of the present application, connections to the shunt compensation circuits 40A and 40B, which are said to be connected to ground (cf. section [0028] of the published application), are drawn pointing downwards. D1a and the present application belonging to the same applicant, the board concludes that the other side of the $10M_{VAR}$ filter shown in D1a is likewise connected to ground.

1.2.4 The $10M_{VAR}$ filter constitutes therefore a shunt compensation circuit connected, according to claim 1, at a first side to a secondary coil of the step-down transformer 232 and to a first terminal RA, RB, RC of the rotary transformer 102 at a line segment of the three-phase line 234, and at a second side to ground. The size of the filter: $10M_{VAR}$, which comprises an inductor and a capacitor (cf. figure 4), indicates clearly that it acts as a shunt compensation circuit which is operable to regulate power in the apparatus by adjusting a reactive current injected in shunt to the apparatus.

1.2.5 Finally, in D1a there is a series compensation circuit in the form of a series power capacitor 230 that is connected in series in the three phase line between the primary coil of the step-down transformer 232 and the western power grid 222 (see column 7, lines 43 to 51 and figure 4).

1.3 Claim 1 of the main request differs from D1a in that:

- the series compensation circuit is connected not as in D1a, but between a primary coil of the step-down transformer and ground.

Hence claim 1 of the main request is considered to be novel (Article 54 EPC).

2. *Inventive step (Article 56 EPC)*

2.1 Document D3 discloses an electric power flow controller for controlling electric power flow in a power system (see title and abstract). It refers to a "conventional series compensating technique" in which (like in document D1a) the series compensator 110 is inserted "on the way of the transmission line" (see D3en, column 10, lines 6 to 9 and figure 4). In the subsequent passages D3 explains that this arrangement needs to support a heavy series compensator 11 in a high place with something like an insulator for keeping the series compensator 110 insulated from the ground and between the phases. To solve this shortcoming D3 proposes to locate the series compensator of D3 on the ground potential side (cf. D3en figures 3 and 5 to 8 and column 9, lines 61 to 64). In this arrangement the series compensator 11 is connected between the low-voltage terminal of the winding of the main transformer 12 and the grounded point (see column 10, lines 2 to 5).

In the Board's view, it would be obvious for a person skilled in the art to move the series power capacitor 230 from the position disclosed in D1a (cf. column 7, lines 43 to 46 and figure 4) to the position proposed in D3 in order to achieve the advantages disclosed therein.

2.2 In an attempt to demonstrate that the claimed position of the serial compensation circuit is particularly advantageous in combination with a rotary transformer the appellant referred to section [0024] of the published application: "Series compensation circuit 50 serves to regulate reactive power flow through substation 101, or to regulate real power flow in a bandwidth faster than variable frequency transformer 102 can achieve due to inherent inertia of variable frequency transformer 102. Differing embodiments of series compensation circuit 50 are hereinafter described with respect to Fig. 4A, Fig 4B, and Fig.4C."

2.3 The Board is not convinced by this argument because it is evident that a capacitor bank would be able to regulate reactive power flow just as quickly, regardless of whether it is connected between the power grid and the step-down transformer (as in D1a and figure 4 of D3) or between the step-down transformer and ground (as proposed in figure 3 of D3). In both cases the capacitor bank is serially connected and would introduce a phase shift in the same way to compensate for the reactive power faster than the variable frequency transformer could achieve due to its inherent inertia.

When compensating for the reactive power, the real power is simultaneously regulated (cf. D3en, column 10, lines 16 to 20).

2.4 Furthermore, the fact that the topologies of the circuits of D1a and D3 differ, because D3en does not disclose a rotary transformer, does not play any role when considering lowering the costs of the capacitor 230 of D1a by applying the teaching of D3 to D1a.

2.5 The subject-matter of claim 1 of the main request is therefore considered obvious in the light of the combination of documents D1a and D3.

3. Claim 1 of the auxiliary request specifies further:

"said step-up transformer (32) being connected by a three-phase line (28) to the second grid (24)".

According to D1a, three phase power grids (cf. column 1, lines 43 to 57), which differ in frequency in the range of e.g 59.9 to 60.1 Hz (cf. column 1, lines 18 to 31), are usually interconnected by conventional rectifier and inverter (cf. D1a, figure 1), whereby rectifier and converter are prone to reliability problems especially failure of the switches (cf. D1a, column 2, lines 17 to 19). D1a proposes therefore to replace the rectifier and converter shown in figure 1 by the system shown in figures 2 and 4, which comprises a chain of a step-down transformer, a rotary transformer and a step-up transformer. Hence, it should be concluded that the west and east power grids 222 and 224 shown in figure 4 are implicitly the three phase power grids 22, 24 of figure 1, and that the step-up transformer 238 is connected by a three-phase line to the east power grid 224, in the same way as it is connected to the output of the rotary transformer over a three-phase line SA, SB and SC (cf. figure 2 and column 7, lines 54 and 55).

Thus, the supplementary feature of claim 1 of the auxiliary request is considered to be known from D1a, and the subject-matter of claim 1 as remaining obvious in the light of the combination of D1a and D3 (Article 56 EPC).

Order

For these reasons it is decided that:

The appeal is dismissed

The Registrar: The Chairman:

U. Bultmann G. Flyng

Decision electronically authenticated