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**Datasheet for the decision
of 7 July 2021**

Case Number: T 2265/18 - 3.2.01

Application Number: 13177319.4

Publication Number: 2689983

IPC: B61C7/04, B60L11/02

Language of the proceedings: EN

Title of invention:

Drive system and railway vehicle provided with the drive system

Patent Proprietor:

Hitachi, Ltd.

Opponents:

Siemens Aktiengesellschaft
Bombardier Transportation GmbH

Headword:

Relevant legal provisions:

EPC Art. 56, 122, 123(2)

Keyword:

Re-establishment of rights - sudden illness - all due care
(yes)

Amendments - auxiliary request 4 - intermediate generalisation
(yes)

Admissibility - auxiliary request 5 (yes)

Inventive step - main request (no) - auxiliary request 5 (yes)

Decisions cited:

T 0324/90, T 0525/91, T 0558/02, T 1401/05

Catchword:



Beschwerdekammern
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Case Number: T 2265/18 - 3.2.01

D E C I S I O N
of Technical Board of Appeal 3.2.01
of 7 July 2021

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Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted on 24 July 2018
rejecting the opposition filed against European
patent No. 2689983 pursuant to Article 101(2)
EPC.**

Composition of the Board:

Chairman H. Geuss

Members: W. Marx

S. Fernández de Córdoba

Summary of Facts and Submissions

- I. The appeals of the opponent 2 (appellant I) and the opponent 1 (appellant II) are directed against the decision rejecting the opposition against European patent No. 2 689 983.
- II. The appellants relied, *inter alia*, on the following evidence filed during the opposition procedure:
- E2: DE 20 2009 008 549 A1;
- E5: Power point presentation "Doppelte Power für Amerika"
- E16: Magazine ZEVrail, Sonderheft Tagungsband "Moderne Schienenfahrzeuge", pages 1-7, 96-107.
- III. In its decision the opposition division held, *inter alia*, that starting from the railway vehicle of E2, Fig. 2, the subject-matter of claim 1 as granted involved an inventive step.
- IV. Oral proceedings before the Board took place on 7 July 2021.

The appellants I and II (opponents 2 and 1) requested that the decision under appeal be set aside and that the European patent be revoked. Appellant I also requested re-establishment of rights.

The respondent (patent proprietor) requested that the appeals be dismissed, or in the alternative, that the patent be maintained according to the auxiliary request 4 filed as auxiliary request 3 by letter of 19 December 2019, or one of the auxiliary requests 5 to 7 filed as auxiliary requests 4 to 6 by letter of 23 April 2019.

V. Claim 1 as granted read as follows (feature analysis according to the contested decision):

(F1) A railway vehicle for travelling on a route with an overhead contact line and on a route without an overhead contact line,

(F2) the vehicle being provided with a drive system comprising:

(F3) a first power conversion device (21, 22; 21, 23; 21, 24) that converts AC power to DC power; and

(F4) a second power conversion device (4) that drives an electric motor (5) by using the DC power converted by the first power conversion device as a power supply, wherein:

(F5) the first power conversion device is connected, through a first contactor (12; 14), to a first AC power supply that supplies a single-phase alternating current (F6) and connected, through a second contactor (13), to a second AC power supply (6) that supplies a three-phase alternating current, and

(F7) the first power conversion device performs a power conversion operation according to the AC power supplies connected to the first and second contactors, wherein:

(F8) the drive system is configured, when an AC side of the first power conversion device is switched from the first AC power supply to the second AC power supply, to perform:

(F9) a first step of terminating a switching operation of the first power conversion device to open the first contactor;

(F10) a second step of closing the second contactor to start a switching operation of converting the three-phase alternating current to a direct current by the first power conversion device; and

(F11) a third step of permitting torque output from the electric motor.

Claim 1 according to the auxiliary request 4 was amended by specifying in feature F8 "... to perform in sequential order" (see auxiliary request 5 below) and by adding feature F12, which reads:

(F12) wherein the first and second steps are performed whilst torque output from the motor is prohibited.

Claim 1 according to the auxiliary request 5 comprises the following amendments in features F7', F8', F10', F11' and additional features F12' and F13':

(F7') the first power conversion device performs a power conversion operation according to the AC power supplies connected to the first and second contactors, ~~wherein:~~

a power collector (1) that collects AC power from the first AC power supply; and
a transformer (11) connected to the power collector through a third contactor (15, 16) on a primary side and connected to the first power conversion device through the first contactor and a secondary wire side, the transformer stepping down the AC power from the first AC power supply to supply the AC power to the first power conversion device, wherein:

(F8') the drive system is configured, when an AC side of the first power conversion device is switched from the first AC power supply to the second AC power supply, to perform in sequential order:

...

(F10') a second step of closing the second contactor to start a switching operation of converting the three-phase alternating current to a direct current by the first power conversion device; and

(F11') a third step of permitting torque output from the electric motor; and-

(F12') and an opening operation of the third contactor is carried out in parallel with the first and second steps;

(F13') the third step being carried out on a condition that the second step and the opening of the third contactor are completed.

Note:

In accordance with the contested decision (items 17.2 and 18.2), steps F9 and F10 are subdivided in sub-steps as follows:

- 1.1 terminating a switching operation of the first power conversion device
- 1.2 to open the first contactor
- 2.1 closing the second contactor
- 2.2 to start a switching operation of converting the three-phase alternating current to a direct current by the first power conversion device

VI. The appellants' submissions in as far as they are relevant to this decision may be summarised as follows:

Re-establishment of rights (appellant I)

The reason for the belated filing of the statement of grounds of appeal of appellant I was due to the representative of appellant I having suddenly been taken ill the evening the period for filing expired on 3 December 2018. The document for the statement of grounds of appeal had been prepared and was ready for filing on 3 December 2018. Only some minor corrections on this document should have been done by the representative in the afternoon and evening of that

day. Since it was impossible for him to find another person for replacement and to organise filing of the statement of grounds of appeal within the respective time limit, re-establishment in said time limit was requested. The evidence filed by appellant I in this respect should be excluded from dossier inspection.

Interpretation of claim 1 as granted

- According to appellant I, the term "configured to" in feature F8 meant that the drive system was capable of and comprised corresponding appliances (not necessarily a higher-level control unit) for carrying out the steps F9 to F11. Moreover, claim 1 required a sequential order of steps F9, F10 and F11. However, claim 1 did not require that any step was completed as a condition for going on to the next step (see contested decision, section 15.3; also in view of claim 2), so steps could be performed partly in parallel.
- Both appellants agreed on two subsequent sub-steps in feature F10, which were derivable from Figure 3 (S107 and S108) and also reasonable for technical reasons, as a conversion of power required a closed second contactor. However, such interpretation did not apply to the sub-steps of differently worded feature F9, for lack of support in the patent or the corresponding Japanese patent application (see Fig. 3, step S104, paragraphs [0027], [0033]: sub-steps separated by comma or ".", or combined via "and"; or paragraph [0034]: need for preventing electrical connection of the overhead line with the power generator only if there was contact with the overhead line, but turning off the gates did not make the converter inoperative since there were anti-parallel diodes forming a passive rectifier).

Therefore, feature F9 comprised any (including parallel) order of sub-steps. In view of the object of the claimed invention (paragraph [0010]: "*to quickly perform the changeover*"), performing both sub-steps at least simultaneously was obvious, since it took longer to open the conductor 12 as compared to terminating the switching operation of the semiconductor devices of the first power conversion device. Moreover, "to open" introduced a target to be achieved only, which did not limit the scope of the invention. The term "terminating" did not mean that the power conversion device (due to anti-parallel diodes of switching means) was inoperative, or that the likelihood of arcing was reduced, since current could still flow from the overhead contact line to the DC circuit (smoothing capacitor 3) and be rectified during passive rectifier operation, irrespective of feature F10. A control effecting higher DC side voltage was not disclosed in the patent and did not apply to all operating states (e.g. if auxiliary systems drew electrical power from the DC link).

Claim 1 as granted - inventive step

E2 disclosed features F1 to F8 (see Fig. 2 and related description) and also the sequential order of steps F9 to F11 (in the context of paragraphs [0001] to [0006] of the description). It was also known

- to changeover from power supply on an electrified route (overhead contact line) to power supply on a non-electrified route (engine driving a generator),
- to close switch 156 in E2 to supply power from the generator, thereby enabling power conversion of the three-phase AC current to DC current (step F10).

In view of the context disclosed in E2 and what the skilled person would take from E2 (no parallel supply of current from both power sources for safety reasons), it was obvious to arrive at steps F9 and F10 including the respective sub-steps. It only remained to decide on the timing of switching of the power converters. When changing from single-phase to three-phase AC supply as claimed (i.e. from 180° to 120° phase angles), it was clear that the first and second contactors were not closed at the same time (to avoid short-circuit) and that the power converters had to be reconfigured, i.e. steps F9 and F10 were performed sequentially, which then enabled long-term power supply of the electric motor (step F11). Consecutive execution of sub-steps 1.1 ("*terminating a switching operation*") and 2.2 ("*to start a switching operation*") was necessarily required, and it was obvious to execute sub-step 1.1 before sub-step 2.1 ("*closing the second contactor*") in view of the different phase angles of power supply. Moreover, sub-step 2.2 was only possible when three-phase current was supplied which required closure of the second contactor according to sub-step 2.1. At last, for safety reasons, it was obvious to start opening first contactors 151 to 154 (1.2) when current flow from the overhead contact line to the power converter was low, i.e. to terminate switching operation of the first power conversion (1.1) before (to prevent back current, to avoid arcing and damaging the switches, which - in contrast to main switch 205 connected to the overhead line - were normally not foreseen for switching under load). The term "to open" in feature F9 specified a causal relationship between sub-steps 1.1 and 1.2, and included parallel operation if it allowed acceleration of sub-step 1.1. Claim 1 did not define circumstances of the switching operation, e.g. whether there was still contact with the overhead contact line, so it

remained open whether any sequential order had an effect or not. The first power conversion devices shown in the patent document all comprised switchable elements and anti-parallel diodes, so AC to DC conversion (i.e. current flow via diodes) continued if the switching operation of the first power conversion device had been terminated and AC power was still supplied by the overhead contactor line. In contrast, opening the first contactor definitely stopped providing energy to the intermediate circuit. Switching off the gates of a power conversion device was faster than opening a mechanical contactor, and giving priority to one of these sub-steps did not provide advantages with regard to safety and was not inventive. In summary, there was only a limited number of different sequences of performing steps F9 and F10, which were dependent on certain constraints (such as a live overhead line) which were not defined in claim 1.

The respondent's arguments in its letter dated 24 May 2018 relied only on the invention described in E2 starting with paragraph [0010], which proposed using power from two sources at the same time. In the prior art described before in E2 in relation to Fig. 2, power was supplied alternatively (as explicitly stated in paragraph [0004]): "*wahlweise*"), i.e. either from the overhead line or from the Diesel generator unit.

The late-filed arguments put forward by the respondent during the oral proceedings should not be admitted. Whether the claimed invention concerned an obvious choice among a limited number of possibilities had already been addressed in the statement of grounds of appeal of appellant I (see page 14), not only in the Board's preliminary opinion.

Moreover, the new line of argument that in E2 the upper single-phase supply was used to supply the lower DC/AC converter via the intermediate DC circuit (to provide power to the motor) and, at the same time via closed switch 156, directly the motor in order to start the engine was not convincing. As long as the upper contactors 151, 152 were closed, the current of the secondary winding of the main transformer was flowing across switch 151 and returned across switch 152, so no additional current branching off contactor 152 was possible. The engine 81 in E2 was rather started through motor 91 using DC power (see paragraph [0002], disclosing a mode of operation when no overhead contact line was available). Therefore, even assuming that the engine had to be started in E2, such operation was performed as an intermediate step, still resulting in steps F9 to F11 being disclosed in E2. The second sub-step 1.2 of feature F9 was also fulfilled in the event that only contactors 153, 154 were opened (although contactors 151 to 154 normally were switched simultaneously) and then contactor 156 closed in order to start the engine. The patent itself did not require a re-start of the engine when performing the changeover sequence as claimed, since the engine was already idling (which implied that a clutch was also used to prevent supply of power if not needed). Corresponding step S101 in Fig. 3, however, did not form part of the claimed subject-matter.

Auxiliary request 4 - amendments

Auxiliary request 4 (based on auxiliary request 3 filed on 23 April 2019 and corrected on 19 December 2019) was filed for the first time in appeal proceedings without sufficient excuse for its late filing and should not be admitted into the proceedings.

Moreover, the amendment was neither explicitly nor unambiguously disclosed in paragraphs [0023], [0032]. The amendment resulted in an unallowable intermediate generalisation, since step S101 (see Fig. 3) was not included in claim 1. In addition, permission of torque output according to step S111 in Fig. 3 (see also paragraph [0032]) was performed at the end of the method, not whilst performing steps F9 and F10, and required several conditions to be fulfilled (namely the AND conditions of step S110 for automatic permission). However, in turn this did not mean that a missing notch command (checked either automatically or by the driver) related to zero torque output, as the automatic system possibly required a torque output to hold the vehicle stationary on an inclined route. Finally, the relationship between the claimed torque output and a "notch" (see patent, paragraphs [0023], [0032]) was unclear, since "notch" related to a level of a scale and "notch off" did not necessarily mean a zero torque.

Auxiliary request 5

Auxiliary request 5 was not convergent with previous requests. However, no formal objections were raised. The new structural features of claim 1 were still known from Fig. 2 in E2. Opening the third contactor when changing from power supplied via the overhead contact line to the Diesel engine at a given point in time was self-evident. The problem to be solved by feature F12' was to provide a fast opening of the third contactor. The skilled person would consider the options for opening the third contactor (before the first step, or during the switchover process, or afterwards). It was not inventive to open the third contactor in parallel with the first and second step, provided it was possible for security reasons. This also prohibited

further energy supply from the overhead line and therefore arcing. In this case, there was no advantage of a sequential order of the sub-steps in feature F9. Opening the contactor prior to these steps avoided high current flow through switches 151 - 154 in E2, but would provide a delay. The skilled person always wished to open the main switch as fast as possible to avoid current flow through the primary wire side of the transformer. Performing the opening step during the time span of the first and second steps accelerated the switch-over procedure. Feature F13' related to safety and was within the knowledge of the skilled person.

E16 was filed as a reaction to the auxiliary requests in opposition proceedings. It indicated that switching between AC power supplies during station stops was performed quickly, i.e. E16 showed more than E2, but did not contain an indication regarding a contactor between transformer and power collector or step F13'.

VII. The respondent countered essentially as follows:

Re-establishment of rights

Failure to work within a system which accounts for unforeseen illnesses striking the representative or unavailability of staff did not constitute exercising all due care given the circumstances.

Interpretation of claim 1 as granted

Claim 1 required a drive system configured so as to perform a particular switchover sequence from the first AC power supply to the second AC power supply. The use of ordinal numbers in order to label features F9 to F11 itself imposed a chronological sequence and temporal

order of these steps (granted claim 1 only contained a clarification, not necessarily a limitation). In the context of the wording of claim 1 (consistent with the description) it was clear that the infinitives "to open" and "to start" in features F9 and F10 did not relate to a target or an action, but that these sub-steps were necessitated by feature F8 and related to actual actions to be performed. Since actual actions were required, the English language dictated a sequence of sub-steps because the sub-steps were independent from each other (compare example "closing down a word processor to shut down the PC": closing down the word processor did not shut down the PC). Moreover, the term "terminating" required an ending of sub-step 1.1.

Claim 1 as granted - inventive step

The claimed sequence of steps F9 to F11 provided important advantages for contactor protection. When switching a contactor and current was flowing in the circuit, an electric arc could be generated across the mechanical contactor, thereby damaging or welding it. The measures defined in claim 1 had an effect of decreasing the current flow through the contactors, thereby reducing or eliminating the problem of arcing. Feature F11 prevented a sharp drop in DC voltage of the intermediate circuit. In examples where the converter was provided as pairs of IGBTs and diodes, it was possible to inhibit the electric current flowing into the intermediate circuit via the diodes. Generally, the converter of the invention performed control so that the DC side voltage became higher than the AC side voltage, i.e. no electric current flowed from the AC to the DC side via the diodes of the converter.

Since the switching operation was terminated in step F9 of claim 1, the operation to be started in step F10 was to start the switching operation from a non-operating state. This was different to changing the operation mode from a single-phase AC source to a three-phase AC source, as was the case in E2.

The opposition division considered that the first sub-step 1.1 of feature F9 (terminating a switching operation) was not derivable from E2. The objective technical problem was considered (see item 18.1 of the decision) as providing an appropriate and safe changeover sequence for the railway vehicle of Fig. 2 of the opposed patent, which corresponded generally to the system shown in E2.

As already explained during opposition proceedings (see letter dated 24 May 2018), the basic topology of the drive system shown in Fig. 2 of E2 was in fact quite similar to the topology which the inventors used. However, the inventors identified technical problems when performing a changeover of the power source using such a drive system. The changeover would be accomplished in the shortest possible time when opening contactors 151 - 154 and simultaneously closing contactor 156, while keeping motor and converters operating. A problem with such a change-over sequence was that it was possible for all the contactors to be closed at the same time, so there was a possibility of damage to the generator 91 by the impressing of single-phase AC voltage, or of disturbance to the single-phase grid of the overhead line by the impressing of three-phase AC voltage to the line. In addition, there was a risk of damage to the semiconductors of the converters 141, 142. Assuming the skilled person would foresee these problems, a changeover sequence was possibly adopted in which the contactors 151 - 154 were opened

first, followed by changing the operating mode of the converters 141, 142 and finally closing contactor 156.

However, no indication of switching over power supply or of safe switching was given in E2. The invention disclosed in E2 concerned a different topic (paragraphs [0002], [00010]: reducing costs) and even taugth away from providing steps F9 to F11 (paragraph [0013]: no drop in DC voltage of the intermediate circuit). Thus, it was not a question of an obvious choice or limited selection. Many options were possible, and it was wrong to assume the Diesel engine was always running in E2.

In particular, one would not arrive at the sequence of steps F9 and F10 when starting from the assumption that the engine 81 in E2 had to be started via the DC circuit 11 with power coming from the main transformer. This line of argument was put forward in response to the preliminary opinion of the Board, after having argued in the response to the appellants' appeals (see paragraph bridging pages 5/6) that E2 failed to show features F9 and F10. In this case, contactors 153, 154 in E2 would be opened first while keeping contactors 151, 152 closed in order to provide power from the single-phase power supply to the DC circuit 11. Then, the timing of power conversion device 142 (acting as DC/AC converter) would be reconfigured to provide a difference in phase angle of 120° (other than AC/DC converter 141), also with respect to a third phase supplied via switch 152. Subsequently, contactor 156 was closed to start the engine 81 via the generator 91 acting as motor. E5 provided evidence that the drive system operated like this. Next, the contactors 151, 152 were opened, and only then power conversion device 141 was reconfigured. As a consequence, one would not end up at the subject-matter of claim 1, since the

opening and closing of contactors was the wrong way round. The clutch disclosed in E2 was only necessary if the engine was started via the motor, and you had to get the phases correctly. There was no disclosure of a separate starter-motor or battery to start the engine, or that the engine was idling as in the contested patent (see Fig. 3, which did not require an engine start), which enabled a fast switch-over procedure.

Auxiliary request 4 - amendments

The amendment in claim 1 of auxiliary request 4, filed in response to the contested decision, was based on Fig. 3 (steps S101, S111) and paragraphs [0023], [0032] of the patent. The term "notch off" in paragraph [0023] was well understood, as the notch commanded torque output from the motor. Paragraph [0032] disclosed that a notch input was permitted. The term "torque output" was introduced in isolation already in granted feature F11, which implied a previous prohibition. Therefore, the amendment was only a clarification of feature F11.

Auxiliary request 5

The additional features of claim 1 of the auxiliary request 5 stemming from granted claim 2 combined safety (F13': no erroneous message to the driver) and acceleration aspects (F12': faster sequence), so they solved the problem of providing a quick switch-over procedure while doing it safely. The skilled person would only arrive at the claimed solution with hindsight knowledge of the invention ("could-would").

The line of argument of appellant I starting from E16 should not be admitted. Its late filing had not been adequately explained, and E16 did not add anything to

E2 and was not *prima facie* relevant. As argued in respect of E5 (showing the changeover sequence of E16 in more detail), its apparent mode of operation differed greatly from the present invention, as E5 included two drive systems connected to a common intermediate circuit, which was constantly supplied with electrical power even during changeover. Moreover, E5 only disclosed that the converter 4QS(2) was reconfigured after opening of the contactor S12, 14.

Reasons for the Decision

1. Re-establishment of rights

- 1.1 The statement of grounds of appeal was received on 4 December 2018, one day after expiry of the time limit for filing the statement of grounds of appeal.
- 1.2 The request of the appellant I for re-establishment in the time limit for filing the statement of grounds of appeal was filed and the appeal fee was paid on 12 December 2018, i.e. within the time limit laid down in Rule 136 (1) EPC.
- 1.3 The respondent objects that a system in which no precautionary measures have been implemented with respect to unforeseen illness or unavailability of staff cannot be regarded as exercising all duty of care.

In the present case, the representative of appellant I had suddenly been taken ill the evening of the day the time limit for filing the statement of grounds of appeal expired. In view of the confidential evidence submitted by the appellant I on 12 December 2018, the Board is satisfied that, in spite of all due care

required by the circumstances having been taken by the appellant I and its representative, the appellant I (opponent 2) was unable to observe the time limit for filing its grounds of appeal in this case.

The representative was able to credibly demonstrate that the afternoon and the evening of the day the time limit for filing the statement of grounds of appeal expired was intended for final proofreading of the statement of grounds of appeal which was already prepared in advance.

Therefore, the Board sees such a short-term illness as a reason for granting a request for re-establishment of rights according to Art. 122 EPC.

Further, the Board agrees that such a short-term illness did not allow the representative to be substituted.

The Board's view concurs with the relevant case law cited by the respondent. According to T 558/02 "*sudden illness, over which a person has no control, may excuse that person from having to take measures to ensure that time limits are met*". This decision is cited again in T 1401/05, which also refers to a similar case found in T 525/91 ("*the representative's proven illness was considered to amount to an inevitable event*"). From the facts submitted in this case, the Board cannot see that the representative was required to have recourse to a system of staff substitution in the case of illness (as e.g. in T 324/90 cited by the respondent) to ensure that the requirements of Article 122(1) EPC ("*all due care required by the circumstances*") were met.

1.4 Consequently, the request of the appellant I for re-establishment in the time limit for filing the grounds of appeal under Article 122 EPC is granted and the appeal of appellant I must be considered to have been reasoned in due time.

2. *Claim 1 as granted - inventive step*

2.1 The subject-matter of granted claim 1 lacks an inventive step in view of the disclosure of document E2 (Article 56 EPC).

2.2 Undisputedly, E2 discloses the features F1 to F8 of claim 1. Moreover, it was not contested that in view of feature F8 ("*configured to*") the drive system is capable of and comprises corresponding appliances for carrying out the steps according to features F9 to F11. Therefore, the steps defined in features F9 to F11 provide a limitation to the subject-matter of claim 1. The parties also agreed on steps F9 to F11 being performed in sequential order. The appellant I only argued that claim 1 did not require that any step was completed as a condition for going on to the next step. Moreover, it was not disputed that the wording of feature F10 specified two subsequent sub-steps 2.1 ("*closing the second contactor*") and 2.2 ("*to start a switching operation of converting the three-phase alternating current to a direct current by the first power conversion device*"), since a conversion of power required a closed second contactor.

2.3 The matter of dispute was whether the first step according to feature F9 also defined two sub-steps 1.1 ("*terminating a switching operation of the first power conversion device*") and 1.2 ("*to open the first contactor*") in sequential order.

The description and drawings of the contested patent might not provide a clear and unambiguous support in this respect. However, claim 1 specifies in feature F8 that an AC side of the first power conversion device is switched from the first AC power supply to the second AC power supply, so it is clear that "to open" in sub-step 1.2 (and also "to start" in sub-step 2.1) relates to an actual action to be performed and thus to an independent sub-step. The Board does not follow the appellants' view that the term "to open" introduced a target to be achieved only. Moreover, the Board follows the respondent's view that the English language dictates a sequence of sub-steps because the sub-steps are independent from each other. As admitted by the appellant I in its letter of 29 August 2019 (page 15, first paragraph) and followed by the Board, feature F9 includes (in view of the infinitive form "to open") a causal relationship between sub-steps 1.1 and 1.2, which in the Board's view requires sub-step 1.1 of "*terminating a switching operation*" as a prerequisite (or pre-step, as found by the opposition division) for subsequent sub-step 1.2 "*to open the first contactor*".

- 2.4 In view of this interpretation of claim 1 as granted, the Board concurs with the appellants that Fig. 2 and the related description in E2 (i.e. paragraphs [0004] to [0009]), which describe the state of the art as the starting point for the invention made according to E2) represent the relevant disclosure in document E2 for assessing inventive step.

The Board does not follow the respondent that no indication of switching over power supply was given in E2, or that E2 even taught away from providing steps F9 to F11. The passages referred to by the respondent in

this respect (E2, paragraph [0010] onwards: "*Wird keine Mehrsystemfähigkeit gefordert ...*") might concern the invention described in E2, but not the prior art discussed before as shown in Fig. 2 of E2.

As explicitly stated in E2 (see paragraph [0004]:

"wahlweise Einspeisung aus dem Fahrleitungsnetz oder einer Dieseldieseleinheit"), the drive system of Fig. 2 is supplied with power either from the overhead line or from a Diesel generator unit, i.e. exclusively from one power source in each operating state. E2 therefore discloses a changeover from a single-phase AC supply (on an electrified route in a first state, which requires closed contactors 151 - 154) to a three-phase AC supply (in a second state, which requires a closed contactor 156), as required by feature F8. Different phase angles of AC power supply (180° versus 120°) in these states of operation require that in E2

- contactor 156 was open in the first operating state of single-phase AC supply and had to be closed when switching to three-phase AC supply and

- the power conversion device has to be reconfigured.

The sub-step 2.1 of closing the second contactor is therefore implicitly derivable from E2 when switching over AC supply as specified in step F8. Moreover, reconfiguration of the first power conversion device (formed by two circuits 141 and 142 in E2, as in the patent) means that single-phase switching operation in the first state had to terminate and a switching operation of converting three-phase AC had to start in the second state. A sequential order of sub-steps 1.1 and 2.2 is therefore also implicitly disclosed in E2. As agreed by the parties, conversion of three-phase AC current (sub-step 2.2) can only start when the second contactor is closed (sub-step 2.1), i.e. the two sub-steps of feature F10 are necessarily performed in sequential order. As regards sub-step 1.1, it is also

implicitly clear to the skilled reader that this sub-step was performed prior to closing the second contactor (sub-step 2.1), to avoid single-phase AC supply to the three-phase generator 91 in Fig. 2 of E2.

In view of the foregoing, the Board concludes that the following sequence of features or sub-steps is already implicitly disclosed in document E2:

- 1.1 terminating a switching operation of the first power conversion device
- 2.1 closing the second contactor
- 2.2 to start a switching operation of converting the three-phase alternating current to a direct current by the first power conversion device

2.5 It has not been contested by the appellants that E2 leaves open whether sub-step 1.2 ("*to open the first contactor*") is performed in sequential order and causal relationship with sub-step 1.1 ("*terminating a switching operation of the first power conversion device*"), according to the Board's understanding of claim 1. Novelty of the subject-matter of claim 1 as granted is therefore not in question.

2.6 The first contactor 151 - 154 shown in Fig. 2 in E2 must be closed in the above mentioned first state of operation (single-phase AC supply). Regarding the second state of operation (three-phase AC supply), E2 teaches ("*wahlweise Einspeisung*") that no power is supplied from the overhead contact line.

The circuitry shown in E2 for supplying single-phase AC voltage from the overhead contact line to the main transformer comprises a main switch 205 on the primary side of the transformer and contactors 151 - 154 on the secondary side. However, E2 is silent on how to switch

the main switch and contactors 151 - 154 (the first contactor as claimed) when changing over from single-phase AC power supply to three-phase AC power supply. In particular, E2 leaves open whether during such changeover the primary side of the main transformer is still connected to the overhead contact line via the main switch remaining closed (case A), or whether voltage supply to the primary side of the main transformer is cut off first by opening the main switch and/or lowering the power collector (case B).

- 2.6.1 In case A, there is a risk of damage to the generator or of disturbance to the single-phase grid of the overhead line if the first contactor remained closed, as admitted by the respondent. Therefore, the Board follows the contested decision (see issue 18.2) that opening the first contactor before closing the second contactor is at least obvious to the skilled person in case A, i.e. the sequence of steps
- 1.2 to open the first contactor
 - 2.1 closing the second contactor
 - 2.2 to start a switching operation of converting the three-phase alternating current to a direct current by the first power conversion device
- would be derived from a person skilled in the art at least obviously from the disclosure of E2 in order to solve the problem of providing an appropriate and safe changeover sequence.
- It remains to be discussed whether the ordering of sub-steps 1.1 and 1.2 (with sub-step 1.1 performed before sub-step 2.1, see above point 2.4) can be considered as involving an inventive step in case A where single-phase AC voltage is still supplied to the main transformer.

In response to the appellants' argument that the term "terminating" did not mean that the power conversion device did not operate in view of passive rectifier operation (via diodes), the respondent argued that the claimed invention (although not specified in claim 1) performed control so that the DC side voltage became higher than the AC side voltage and, thus, no electric current flow from the AC side to the DC side via the diodes of the converter was possible. Such operation is also explicitly suggested in E2 (see paragraph [0009]: "*Hochsetzsteller*", meaning that the power conversion device operates as step-up or boost converter, which requires switching elements, such as IGBTs shown in the patent). Terminating switching operation of the AC/DC converter prior to opening the first contactor in this mode of operation reduces current flow and therefore the risk of damaging the contactor (e.g. by welding the contact points) due to arcing. In view of the well-known problem of arcing when opening contactors while current is still flowing, the Board finds it obvious to perform sub-steps 1.1 and 1.2 sequentially, as specified in feature F9.

2.6.2 Assuming case B, opening the first contactor does not provide a technical effect. The Board agrees therefore with the appellants that in this case the order of sub-steps 1.1 and 1.2 has no advantage and therefore cannot contribute to an inventive step.

2.7 The respondent's line of argument put forward on the assumption that the engine 81 in E2 has to be started via the DC circuit 11 with power coming from the main transformer could not be followed by the Board. According to this line of argument contactors 151, 152 were closed in order to supply single-phase AC current via power converter 11 to the intermediate DC circuit

11, whereas contactors 153, 154 were open and contactor 156 closed in order to start the engine 81 via the three-phase generator 91 acting as motor and supplied with AC power from DC circuit 11 via converter 142. In particular, the Board cannot see how such operation would be obviously derivable from the circuit shown in Fig. 2, since the three-phase motor would be supplied at the same time with 180° single-phase AC voltage provided directly by the main transformer (branching off behind contactor 152) and 120° two-phase AC voltage provided by converter 142 converting the DC voltage. The argument of the respondent that E5 (discussed during the opposition and appeal proceedings) provided evidence that the drive system in E2 operated like this did not convince the Board. Looking at E5 or E16 (showing similar circuitry), a dedicated independent three-phase DC-AC converter is used in the lower path leading to the motor/generator for starting the engine, whereas a further three-phase AC-DC converter (corresponding to power conversion devices 141 and 142 in E2) is still used to supply the intermediate DC circuit with power from two secondary windings of the main transformer. Thus, other than in E2, the arrangement in E5 or E16 allows to adjust the phase angle relationship for supplying the motor-generator accordingly.

Since the new line of argument of the respondent was not followed by the Board, no decision on admission of this late-filed line of argument had to be taken.

2.8 It follows from the above considerations that the subject-matter of claim 1 does not involve an inventive step (Article 56 EPC).

3. *Auxiliary request 4 - amendments*

3.1 Claim 1 of the auxiliary request 4 (filed as auxiliary request 3 by letter of 19 December 2019) is not allowable since it comprises subject-matter which extends beyond the content of the application as filed, contrary to the requirements of Article 123(2) EPC.

3.2 Claim 1 was amended by adding feature F12, according to which torque output from the motor is prohibited when performing the first and second steps. The sole explicit disclosure of prohibiting motor torque output is on page 11, fourth paragraph, of the application as filed (paragraph [0032] of the patent), which refers to step S111 in Fig. 3. It describes that in response to a driver's notch input motor torque output is permitted on condition that the contactors 103 and 104 are open and all auxiliary power supplies (APS) have restarted the switching operation (i.e. the AND-condition in step S110 must be fulfilled). In turn, this means that motor torque output in response to a notch input is prohibited if at least one of the two conditions is not fulfilled. Prohibition of motor torque output is therefore only disclosed in this passage in close connection with a check for further conditions which have not been included in feature F12. Thus, based on this disclosure alone, the amendment according to auxiliary request 4 amounts to an unallowable intermediate generalisation.

Admittedly, permission of torque output from the electric motor was already specified in isolation (without requiring further conditions, such as a notch input) in feature F11 as granted, i.e. in the third step according to claim 1. However, this not imply that torque output from the motor was necessarily prohibited

before when performing the first and second step. It is noted that, if the Board were to follow the respondent's argument in this respect, step F12 was only a clarification (and not a limitation) of feature F11, such amendment would already not be allowable under Rule 80 EPC, as it would not be an attempt to overcome a ground of opposition.

The Board finds that the original disclosure leaves open whether any torque output from the electric motor is prohibited while performing the first and second step. Since steps of the changeover sequence might be executed automatically (see paragraph [0023] of the patent: automatic check for notch command being off), it cannot be excluded that the automatic system is still authorised to output a torque command to the electric motor. It might be suggested from page 9, second paragraph (paragraph [0023] of the patent), that the process moves from step S101 to the first and second steps after having checked (automatically or manually) that a notch command from the driver's cab is off. Moreover, motor torque output in response to a notch input is permitted in step S111, so it might be originally disclosed that torque output from the motor in response to a notch input is prohibited while performing the first and second step. However, omission of this additional requirement again amounts to an unallowable intermediate generalisation.

4. *Auxiliary request 5*

- 4.1 The Board sees not reason not to admit auxiliary request 5 (filed as auxiliary request 4 by letter of 23 April 2019) into the appeal proceedings. The appellants' merely objected to auxiliary request 5

being non-convergent with previous auxiliary requests without giving further reasons or substantiation.

Moreover, the Board cannot see an issue in this respect or any other reason for non-admitting the current auxiliary request 5 either, since it

- had already been filed as auxiliary request 2 (together with auxiliary request 1 as in appeal proceedings) with the patentee's opposition reply based on a combination of granted claims, and
- was filed as auxiliary request 4 on 23 April 2019 again in appeal proceedings (*note: numbering of the auxiliary requests changed in view of new auxiliary request 3 filed on 26 April 2021, which was withdrawn during oral proceedings*).

Thus, current auxiliary request 5 was filed at the earliest possible point in time and known to the parties as an expectable fallback position. Moreover, auxiliary requests 1 to 3 filed on 23 April 2019 (auxiliary request 3 corrected on 19 December 2019) addressed the issue of claim interpretation raised by the appellants in order to clarify the claimed subject-matter, not necessarily providing a limitation, as was provided with auxiliary request 5.

4.2 Claim 1 of the auxiliary request 5 is a combination of granted claims 1 and 2 and allowable under Article 84 and Article 123(2) EPC. No formal objections have been raised in this respect.

4.3 The subject-matter of claim 1 of auxiliary request 5 involves an inventive step (Article 56 EPC) over E2.

4.3.1 The Board concurs with the appellants that the structural features added in amended feature F7' (power

collector, transformer, third contactor) are known from Fig 2 of E2. However, E2 is silent with regard to the point in time the third contactor is opened which establishes an electrical connection to the overhead contact line. Therefore, features F12' and F13' are not known from E2, which was not in dispute.

- 4.3.2 Both features F12' and F13' relate to the point in time the third contactor is opened and thus solve the common problem of providing a quick switch-over procedure while doing it safely.
- 4.3.3 When changing from power supplied via the overhead contact line to power supplied via the engine on a non-electrified route, it is well known that the power collector (pantograph) is lowered and (as supported by the wikipedia extract E17 filed in appeal proceedings) that the third contactor connecting the power collector and the primary winding of the main transformer is opened before lowering the pantograph to avoid arcing. Thus, opening of the third contactor is completed when running on a non-electrified route. Moreover, as set out further above, in this mode of operation the second step is completed and the third step ("*of permitting torque output from the electric motor*") is carried out, as required by step F13'. Thus, additional step F13' cannot add anything inventive to claim 1.
- 4.3.4 However, the Board was not convinced that the timing of opening the third contactor as specified in new feature F12', i.e. in parallel with the first and second steps, was obvious in view of E2. As discussed in respect of feature F13', the main switch or third contactor is normally opened while the power collector is still connected to the overhead contact line (otherwise, this step would not make sense). Opening the third contactor

in parallel with the first or second step might lead to interference of transient effects such as high overvoltage when switching off inductive loads, leaving open which part of the circuitry (the first/second contactor, or the third contactor, or the power conversion device) is affected. Since safety should not be compromised in view of the problem formulated above, there is no prompting that the skilled person would arrive at performing a step of opening the third contactor in parallel with the first and second steps.

4.3.5 The Board therefore follows the respondent that the skilled person starting from E2 as the closest prior art would only arrive at the claimed solution with hindsight knowledge of the invention.

4.4 As regards late-filed document E16, the Board follows the respondent that E16 does not add anything to E2. Therefore, with same reasoning, the skilled person would not arrive in an obvious manner starting from E16 and/or taking into account the teaching of E16 at the subject-matter of claim 1 of auxiliary request 5.

E16 might concern a quick changeover procedure. However, as admitted by the appellants, the changeover sequence is performed during a station stop, i.e. where the overhead contact line is still available. Moreover, during a first phase E16 teaches to supply power from the overhead contact line (i.e. the main switch shown in E16 is still closed) via a first power conversion device to the intermediate circuit in order to start a second engine via a second power conversion device supplying power to an electric generator driving the engine. During a second phase, the main transformer is completely separated from the power conversion devices. E16 only shows opening of switches on the secondary

side of the main transformer, but remains silent on the status or operation of the main switch, as does E2.

- 4.5 In view of the foregoing, the issue of admission of late-filed document E16 into the appeal proceedings can be left open.

Order

For these reasons it is decided that:

- The decision under appeal is set aside.
- The case is remitted to the opposition division with the order to maintain the patent on the basis of the claims of the auxiliary request 5 filed as auxiliary request 4 with the letter of 23 April 2019 and a description to be adapted thereto.

The Registrar:

The Chairman:



D. Magliano

H. Geuss

Decision electronically authenticated