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Datasheet for the decision of 19 November 2009

Case Number: T 0530/07 - 3.2.03

Application Number: 99963070.0

Publication Number: 1141487

IPC: E01C 19/28

Language of the proceedings: EN

Title of invention:
System for predicting compaction performance

Patentee:
CATERPILLAR INC.

Opponent:
BOMAG GmbH

Headword:
-

Relevant legal provisions:
EPC Art. 54, 56

Relevant legal provisions (EPC 1973):
-

Keyword:
"Admissibility of late-filed evidence (yes)"
"Novelty (yes)"
"Inventive step (no)"

Decisions cited:
G 0009/91, T 0641/00, T 0258/03, T 0619/02

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0530/07 - 3.2.03

D E C I S I O N
of the Technical Board of Appeal 3.2.03
of 19 November 2009

Appellant: (Opponent)
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Decision under appeal:
Interlocutory decision of the Opposition Division of the European Patent Office posted 6 February 2007 concerning maintenance of European patent No. 1141487 in amended form.

Composition of the Board:

Chairman: G. Ashley
Members: E. Frank
K. Garnett

Summary of Facts and Submissions

I. The appeal lies from the interlocutory decision of the Opposition Division dated 24 January 2007 and posted on 6 February 2007, to maintain European patent No. 1 141 487 in amended form based on the auxiliary request as filed on 21 December 2006 (Article 102(3) EPC 1973). Grant of the patent had been opposed on the grounds of lack of novelty and inventive step (Article 100(a) EPC).

II. The Appellant (Opponent) filed a notice of Appeal on 27 March 2007, paying the appeal fee on the same day. The statement of grounds of appeal was submitted on 18 June 2007.

III. A communication in compliance with Article 15(1) RPBA was issued together with a summons to attend oral proceedings, and the Appellant subsequently filed, among others, a new document E16 on 19 October 2009. The oral proceedings were duly held on 19 November 2009. At the beginning of the oral proceedings, a fresh ground for opposition pursuant to Article 100(b) EPC was raised by the Appellant.

IV. The Appellant requested that the decision under appeal be set aside and the patent be revoked.

The Respondent (Proprietor) requested that the appeal be dismissed.

V. The wording of claim 1, as maintained by the Opposition Division, reads as follows:

"1. A method for predicting compaction performance, comprising the steps of:

measuring values representative of material density after at least a first and second pass by a compaction machine;

determining a compaction response curve (10,12,14) from said measured values; and

predicting from said response curve (10,12,14) a number of passes by the compaction machine required to reach a desired density for the material; and displaying said number of passes,

said step of determining a compaction response curve (10,12,14) further comprising computing a predicted maximum density and an inflection point defining said curve (10,12,14)."

VI. The following evidence has been considered for the purposes of the present decision:

E4 = "Merkblatt für das Verdichten von Asphalt, Teil 2 Theorie der Verdichtung"; Forschungsgesellschaft für Straßen- und Verkehrswesen, Ausgabe 1993

E16 = "Asphaltstraßentagung 1997, Vorträge der Tagung der Arbeitsgruppe Asphaltstraßen am 5. und 6. Juni 1997 in Weimar"; Forschungsgesellschaft für Strassen - und Verkehrswesen - Köln, Schriftenreihe der

Arbeitsgruppe "Asphaltstrassen", Heft 33;
Kirschbaum Verlag GmbH, Bonn, August 1998.

VII. The parties submitted the following arguments:

VII.1 Admissibility of evidence

(a) E16 was filed late by the Appellant, after the Board had issued the summons to oral proceedings. The Appellant argued that document E16 was in public circulation before the priority date of the patent, since it was produced by the "Forschungsgesellschaft für Strassen- und Verkehrswesen", whose purpose was to inform the road construction industry about new findings at the time. Moreover, E16 had to be considered prima facie more relevant than the prior art on file, since experiments in the lab with the aid of the well-known Marshall method were subsequently confirmed in E16 by a field experiment with road rollers.

(b) The Respondent did not object to the public availability of E16. However, the document was submitted too late, and not prima facie more relevant than those on file. Therefore, it should not be admitted into the proceedings.

VII.2 Interpretation and technical nature of claim 1

(a) The Appellant argued that, compared to claim 1 as granted, method claim 1 now described the vague calculation of two parameters to define a compaction curve, namely a maximum density and an "inflection point". This curve was not further specified, in

particular not all curves relating to the exponential function according to equation number two of the patent specification were included in the definition of claim 1. However, a non-technical feature in the form of a mathematical formula to compute these two parameters had been added to the subject-matter of the claim. Although present claim 1 was technical as a whole, the mere computation, based on such a formula, was not a technical feature. Since the Opposition Division held that claim 1 as granted was not novel over the known prior art, it followed from T 641/00 (OJ EPO, 2003, 352), that the introduction of a non-technical feature could establish neither novelty nor the presence of an inventive step with regard to this prior art.

(b) The Respondent argued that, the specification of the shape of the response curve in claim 1 was a matter of clarity, and thus no ground for opposition. Moreover, the formula used to compute the two parameters for defining the curve had to be considered in context with the other features of the claim. Since it was used for operating a compaction machine and resulted in an improved compaction efficiency, the formula was embedded in the claimed method. Therefore, the method step of computing a predicted maximum density and an inflection point in order to determine the response curve was technical.

VII.3 Novelty of claim 1

(a) The Appellant argued that, the purpose of document E16's research work, as described on page 49, left hand column, was the calculation of compaction performance

to determine the quality of asphalt compaction. To this end, compaction experiments in the field had been carried out, monitoring the increase of material density as a function of the compaction work by a road roller. The increase in density followed a curve in the form of an exponential function and thus corresponded to the law of growth ("Wachstumsgesetz") generally known from laboratory experiments for compaction work. According to E16 on page 51, second and third column, and page 52, first and second column, the desired material density ("Verdichtungsgrad k") of a compaction process in the field can be determined by this exponential function dependent upon the number of roller-passes ("Walzübergangszahl"), and therefore a prediction of compaction performance of a compaction machine was disclosed by E16.

As was stated in E16 on page 50, third column, headed "5. Versuchsergebnisse", the material densities and thus the desired densities capable of being achieved continuously increased with increasing number of roller-passes. Thus, after each roller-pass the material density had to be measured by means of the described drill core samples in order to notice an increase in density. Since claim 1 did not suggest any sequence of calculations, it did not matter whether the drill core samples were analysed at a later point of time or not. In calculating the number of roller-passes by use of the converted logarithmical formula of the compaction curve in figure 5 of E16, only the starting density "ρ_{A0}", and the densities "$\rho_{A(n)}$" after each pass could be determined by measurements. Thus, the remaining parameters maximum density "$\rho_{A\infty}$" and constant "Walzwiderstand W" were unknown, and had to be derived

from the formula by solving a system of two equations with respect to these two variables, in a similar way to establishing the two unknown parameters of claim 1, namely the predicted maximum density and the constant "inflection point". The constant "Walzwiderstand W" of this formula indeed corresponded to the "inflection point k" of claim 1 of the patent, since the influences on compaction which were derivable from table 1 and 2 on page 49 of E16 were also part of a specific compaction resistance in the form of the "inflection point k". When the equations were solved, the required number of passes for any "Verdichtungsgrad k", ie any desired density, could be readily predicted from the formula and eventually also had to be displayed. Therefore claim 1 lacked novelty over the disclosure of E16.

(b) The Respondent argued that E16 concerned discussions of experiments in the lab and field. According to page 53, headed "8. Schlußfolgerungen", the document only disclosed the confirmation of the theoretical results of the lab by those measured in the field.

E16 firstly did not disclose a prediction of how many passes of the compaction machine in figure 1 of E16 were required to reach a target density, and that the number of passes had to be displayed.

Secondly, no measuring after each pass was disclosed, rather, the drill core samples after the compaction experiments had been finished were analysed: cf. E16, page 50, third column, second and third paragraph. Referring in particular to the roller-passes shown in

figure 1 of E16, the measuring of material densities was not done "on the go" by means of density sensors, such as described in the patent, while the machine is operating, but by the analysis of drill core probes "BK". Thus, a sequence of measuring, computing and displaying according to claim 1 was not derivable from E16.

Thirdly, the Respondent admitted that the formula in figure 5 on page 51 of E16 could be rewritten to correspond to equation number two of the patent, that an initial density and densities relating to a first and second pass had to be analysed (ie measured) from the drill core samples as part of the procedure in E16, and that the maximum density had also to be calculated in E16. However, the Respondent submitted that the parameter "Walzwiderstand W" of E16 was not the same as the "inflection point k" of claim 1 of the patent. As derivable from the specification of the patent, the "inflection point k" was decisive for the behaviour of the respective (compaction) curve, and had the values one, two or four. Thus, it merely involved a mathematical factor, rather than the actual compaction resistance, ie the "Walzwiderstand W" as described by E16. Moreover, no use of E16's formula to compute both a maximum density and an "inflection point" was disclosed by E16. Therefore, for these reasons, claim 1 was novel with respect to E16.

VII.4 Inventive step of claim 1

(a) Starting from E16 as closest prior art, the Appellant reiterated that compaction performance was predicted by the number of passes, which was derivable

from the compaction curve as described by the formula in figure 5 of E16. Prior to determining the number of roller-passes, both unknown parameters must be determined, that is, the maximum density "$\rho_{A\infty}$" and the constant "W"; such a calculation would be easier for the skilled person to carry out than obtaining an analysis of the value "W" in the lab. Therefore, claim 1 was not inventive in the light of E16.

(b) The Respondent did not dispute that the number of passes could be calculated from the formula of E16, and that the skilled person could play with the equation disclosed therein. However, based on E16, he was not given any incentive to compute the parameters maximum density and "inflection point" for the purpose of predicting a number of passes required to reach a desired density. Thus, based on prior art E16, claim 1 was not obvious.

Reasons for the Decision

1. The appeal is admissible.

2. *Fresh ground for opposition*

The fresh ground of insufficiency of disclosure (Article 100(b) EPC) was raised by the Appellant. However, the Respondent did not agree to the introduction of this ground into the proceedings. See G 9/91 (OJ EPO 1993, 408), point 18 of the Reasons. It was therefore not admitted into the proceedings by the Board.

3. *Admissibility of evidence*

The document E16, filed one month before the oral proceedings, describes a field experiment by use of a compaction machine, viz. a road roller, and a comparison is made with compaction experiments in the laboratory. The compaction work in the field apparently also follows an exponential growth curve already known from the lab: cf. E16; page 51, figures 3, 5 and 6. Given that the field experiment of E16 is very closely related to the subject-matter of claim 1, the Board considered E16 prima facie more relevant than in particular the earlier filed document E4, which describes an exponential compaction curve only in context with a Marshall test in the lab: cf. E4; pages 5 and 6, points 2 and 3, and figure 1. The publication of E16 prior to the filing date of the patent was not disputed by the Respondent, and also the Board has no reason to doubt its public availability. Moreover, the Respondent had had sufficient time (about 1 month) to consider the disclosure of E16. The Board thus exercised its discretion under Article 13(3) RPBA to admit the document E16 to the proceedings at that late stage.

4. *Interpretation of the features of claim 1 and their technical nature*

4.1 The Board agrees with the Appellant's view, that the term "inflection point" as referred to in present claim 1 is vague, since it usually defines a point on a curve at which the sign of the curvature, ie its concavity, changes. However, since present claim 1 is based on claims 1 and 3 as granted, this clarity

objection did not arise out of an amendment of claims and is therefore, according to the established case law of the Boards of Appeal, not allowable under Article 102(3) EPC 1973. Thus, the "inflection point" of claim 1 has to be interpreted in the light of the patent as a whole, including the specification. The skilled person would readily recognize from paragraphs [0013],[0014] and [0018] of the patent, that such an "inflection point" had to be understood as a constant "k", which was inherent to a compaction curve, and depended on the material to be compacted. Moreover, since it is generally known in the art that material compaction follows a law of growth in the form of an exponential curve, the skilled person would take such an exponential function as a basis for determining the curve described in claim 1 as well as those of E16: cf. E16; page 50, third column to page 51, first column, bridging paragraph; page 51, first column, first main paragraph, first five lines.

The equations one and two described in paragraphs [0013] and [0014] of the specification are based on exponential functions to calculate a compaction density. The compaction density "γ_n" of the disputed patent depends on the number of passes "n" of the compaction machine, the starting density "γ_0", and on the constants, predicted maximum density "γ_{max}" and "inflection point k" (cf. in particular equation number two of paragraph [0014]).

4.2 In order to carry out the method of claim 1, the parties agreed that usually, prior to starting compaction, an initial density "γ_0" of the material has to be measured (see paragraph [0021] of the patent).

Moreover, according to claim 1, at least two material densities, ie "$\gamma_{n=1}$" and "$\gamma_{n=2}$", are measured after each pass, ie n=1 and n=2, by a compaction machine. A system of two equations with respect to two unknown variables, the predicted maximum density "γ_{max}" and the inflection point "k", can now be solved, to determine a compaction response curve of claim 1 from the (three) measured values. After "γ_{max}" and "k" have been computed, a specified desired compaction density "γ_{spec}" is inserted into the equation, and the equation is finally solved for the number of passes "n", at which this desired density "γ_{spec}" will be reached (see paragraphs [0017] and [0018] of the patent). The number of passes is then displayed, thereby predicting the compaction performance of the compaction machine.

4.3 As regards the character of the subject-matter of claim 1, it is well established case law of the Boards of Appeal that it is legitimate to have a mixture of technical and non-technical features in a claim, ie the measuring and displaying as well as the computing of values based on a mathematical formula as claimed in claim 1 defines a patentable invention within the meaning of Article 52(2) and (3) EPC. This was acknowledged by the Appellant, and indeed has not been raised as a ground for opposition. In the view of the Board, whether the method step of computing two parameters by use of an equation is a technical feature giving rise to a patentable invention lies within the framework of the examination as to inventive step (cf. points 6.3 and 6.4 below). See CLBA 5th edition 2006, I.D.8.1.1, in particular T 641/00 *(supra)*, points 4 to 6 of the Reasons, and T 258/03 (OJ EPO, 2004, 575).

5. *Novelty of claim 1*
(Article 100(a) EPC, see Article 54 EPC)

5.1 Document E16 describes a comparison of compaction experiments in the laboratory and field: cf. E16; page 50, third column, headed "5.Versuchsergebnisse", to page 52; see in particular figures 3,4 and 6. Moreover, based on this comparison, the inference is drawn in E16 that, owing to the close relationship between the compaction results of lab and field, a prognosis of the required number of roller-passes ("erforderliche Walzübergangszahl") to achieve optimal compaction results may be based on compaction properties determined for the material to be rolled by a laboratory test beforehand: cf. E16; page 52, third column, second last and last paragraph of chapter "5. Versuchsergebnisse", and page 53, last paragraph of chapter "8. Schlußfolgerungen".

However, according to the field experiment in E16, for each of the compaction variants using the bituminous mixture "AB 0/11 S" ("Mischgutsorte"), the required number of passes "n(k)" ("Walzübergangszahlen") of the road roller required reach a specific desired density "k = 94% to 100%" ("Verdichtungsgrad k") is calculated, and the results are shown in figure 6: cf. page 51, third column to page 52, third column, first paragraph, and figure 6 (of the chapter "5. Versuchsergebnisse"). These calculations are based on in situ drill-core samples of the field experiment, obtained after the material has been rolled by the road roller, ie by a compaction machine.

Since the subject-matter of claim 1 addresses any compaction by a compaction machine, experimental compaction in the field is also encompassed by claim 1. A method for predicting the compaction performance, based on a prediction of the number of passes required to reach a desired density for the material analysed in situ is thus, contrary to the Respondent's view, described by E16.

5.2 Irrespective whether the drill core samples ("BK") in figure 1 of E16 were analysed at a later point of time, E16 nevertheless implicitly discloses measuring values of material density each time the road roller has passed over the field of compaction ("Walzfeld"). Otherwise it could not have been stated in E16 that, with an increasing number of passes, the material densities, and thus also the desired densities, continuously increased and tended towards a limit: cf. E16, page 50, third column, first main paragraph and forth main paragraph ("...kontinuierlich ansteigen..."). This was not disputed by the Respondent.

Furthermore, contrary to the Respondent's view, claim 1 neither suggests any sequence of measuring and computing, nor describes any particular means of measurement, such as density sensors fitted to the compaction machine. Thus, the Board agrees with the argument of the Appellant that the method step of measuring values representative of material density after at least a first and second pass by a compaction machine is disclosed by E16.

5.3 As regards the formula used to define the compaction curve and to calculate the number of passes required to

reach a desired density, the Respondent conceded that the equation indicated as "physikalisch" in figure 5 on page 51 of E16 could be rewritten in the form of equation number two of the patent: cf. patent; column 3, paragraph [0014], at line 23. It follows from a comparison of the equations of E16 and the patent, respectively, that the number of roller-passes "n" ("Walzübergangszahl") corresponds to the number of passes "n" in the patent, the starting density "ρ_{A0}" ("Anfangsraumdichte") to the initial density "γ_0", the arbitrary density "$\rho_{A(n)}$" ("beliebige Raumdichte") to the density "γ_n", and the maximal reachable density "$\rho_{A\infty}$" ("maximal erreichbare Raumdichte") to the predicted maximum density "γ_{max}".

Furthermore, referring to the described values one, two or four of the embodiment in column 3 at lines 38 and 39 of the patent, the skilled person would not derive any teaching from the patent specification, let alone from the subject-matter of claim 1, as to how compaction influences the "inflection point" differently from the compaction resistance "W" ("Walzwiderstand") described by E16. The influences on the compaction resistance are derivable from tables 1 and 2 on page 49 of E16. Since these influences, as argued by the Appellant, must also impact on the factor "inflection point k", the latter is also considered to imply a specific compaction resistance. Thus, in the Board's view, the compaction resistance "W" of E16's equation corresponds to the "inflection point k" of equation number two of the patent.

5.4 As to the determination of the compaction response curve in E16, the parties agreed that a starting

density "ρ_{A0}" ("Anfangsraumdichte") is established, and densities "$\rho_{A(n=1)}$" and "$\rho_{A(n=1)}$" ("Raumdichten") are measured after each pass n=1 and n=2 by analysing the respective drill core samples. Referring again to the formula "physikalisch" in figure 5 of E16, two more variables, namely the maximal reachable density "$\rho_{A\infty}$" and the compaction resistance "W" need to be determined to define the compaction curve described by the formula. A system of two equations, i.e. for the values n=1 and n=2, can now be solved with respect to the two unknown quantities: maximal reachable density "$\rho_{A\infty}$" and compaction resistance "W". The parties agreed that the maximal reachable density "$\rho_{A\infty}$" has to be determined by solving an equation based on the formula in figure 5 of E16. However, as argued by the Respondent, E16 does not disclose that the parameter defining the compaction resistance "W" must necessarily be solved from a system of two equations with respect to this variable. In the view of the Board, the compaction resistance "W" could likewise be determined by the skilled person by means of, for example, the generally known Marshall test apparatus. Therefore, the choice of a method step to compute the compaction resistance "W" (corresponding to the inflection point "k" of claim 1) by use of the formula in figure 5 of E16, thereby solving a system of two equations in particular with respect to the variable compaction resistance "W", is not disclosed by E16.

5.5 Moreover, E16 teaches that the arbitrary density "$\rho_{A(n)}$" is defined as a function of the desired extent of compaction ("Verdichtungsgrad k"), such that for any extent of compaction, the required compaction performance, ie the number of roller-passes "n", can be

calculated: cf. E16; page 51, first column, third main paragraph ("Zweckmäßigerweise ...") to page 52, right column, first paragraph; the equation "erforderliche Walzarbeit n(k,T)" in figure 5; and figure 6. After the variables of the compaction curve described by the formula "physikalisch" in figure 5 of E16 have been determined, the formula is further developed into the logarithmic equation "erforderliche Walzarbeit n(k,T)" in figure 5 of E16 and the number of passes are calculated. It is reiterated that, therefore, the method step of predicting the number of passes by the compaction machine required to reach a desired density is disclosed by E16.

5.6 Finally, as argued by the Appellant it is implicit that the calculated number of passes has to be displayed by means of display means of some description. For example, in E16, the number of passes is displayed in the form of a graph: cf. figure 6.

5.7 To conclude, the subject-matter of claim 1 differs from the disclosure of E16 only in that the step of determining a compaction response curve further comprises computing, ie calculating, not only a predicted maximum density, but also an inflection point. Novelty over the remaining prior art was not disputed by the Appellant and is also acknowledged by the Board.

Thus, the subject-matter of claim 1 meets the requirements of Article 54 EPC.

6. *Inventive step of claim 1*
(Article 100(a) EPC, see Article 56 EPC)

6.1 The disclosure of E16 (see point 4 above) is considered as providing a suitable starting point for the assessment of inventive step. As pointed out above with respect to the novelty of claim 1, the subject-matter of claim 1 differs from the disclosure of E16 in that the step of determining a compaction response curve further comprises computing an inflection point defining the curve.

6.2 In the light of E16, the problem to be solved can be seen as the provision of a different means for determining of the parameter inflection point, in order to define the compaction response curve following a known mathematical equation.

6.3 Following the well established case law, the presence of an inventive step can only be established on the basis of technical "aspects" (or "contributions") of both

(i) the distinguishing features (ie in the present case tangible features of the implementation of the mathematical equation and its parameters) and

(ii) the effects achieved by the claimed invention over the nearest prior art.

See CLBA 5th edition 2006, I.D.8.1.1.2, in particular T 641/00 (*supra)*, points 5 and 6 of the Reasons and T 619/02 (OJ 2007,***), point 4.2 of the Reasons.

6.4 Firstly, regarding (i), the claimed subject-matter is distinguished from E16 by the manner by which the

compaction curve is derived. To this end, the mathematical formula defining the compaction response curve of claim 1 is not claimed as such, but rather the measured density values, themselves having a technical character, are inserted into the formula, which is then used for calculating the number of passes the compaction machine has to make. Thus, the use of this formula in a technical context as opposed to a formula per se, including the calculation of both the predicted maximum density and the inflection point, is considered to be technical by the Board.

Secondly, concerning (ii), the effect of the distinguishing feature is to provide an alternative way of determining the number of passes the compaction machine makes, this being a technical effect.

Therefore, the distinguishing feature of the subject-matter of claim 1 with respect to the closest prior art E16 contributes to the solution of a technical problem, and thus to the presence of an inventive step.

6.5 However, starting from E16 the skilled person would consider generally known test methods such as the Marshall test for determining the compaction resistance "W". On the other hand, the skilled person would also realise that the three measured densities disclosed in E16, ie the starting density "ρ_{A0}", and the densities after a first and second pass "$\rho_{A(n=1)}$" and "$\rho_{A(n=2)}$", are sufficient to solve a system of two equations for determining the compaction resistance "W".

6.6 Since both ways in E16 of determining the compaction resistance "W", which corresponds to the inflection

point ("k") of claim 1, are commonly known alternatives, the choice of one of these, ie the calculation of an inflection point as claimed in claim 1, is an obvious choice for the skilled person, irrespective whether the calculation is easier than analysing by means of tests methods, as argued by the Appellant, or not.

Therefore, the subject-matter of claim 1 does not involve an inventive step.

7. *Conclusion*

In summary, the independent method claim 1 is not allowable because the ground of opposition under Article 100(a) EPC (Article 56 EPC) relied on by the Appellant prejudices the maintenance of the patent.

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

A. Counillon G. Ashley