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Aktenzeichen / Case Number / N° du recours : T 364/88 - 3.2.2

Anmeldenummer / Filing No / N° de la demande : 79 103 162.8

Veröffentlichungs-Nr. / Publication No / N° de la publication : 0 014 733

Bezeichnung der Erfindung: Articulated boom-dipper-bucket assembly for a
Title of invention: tunnel boring machine
Titre de l'invention :

Klassifikation / Classification / Classement : E21D 9/10

ENTSCHEIDUNG / DECISION

vom / of / du 20 March 1990

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Zokor International Ltd.

Einsprechender / Opponent / Opposant :

Davy Thornaby Ltd

Stichwort / Headword / Référence :

EPU / EPC / CBE Article 56

Schlagwort / Keyword / Mot clé : "Inventive step - yes"

Leitsatz / Headnote / Sommaire



Case Number : T 364/88 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 20 March 1990

Appellant :
(Opponent)

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Decision under appeal :

Decision of Opposition Division of the European
Patent Office dated 19 April 1988, dispatched on
18 May 1988, rejecting the opposition filed against
European patent No. 0 014 733 pursuant to
Article 102(2) EPC.

Composition of the Board :

Chairman : G. Szabo

Members : H. Seidenschwarz

L. Mancini

Summary of Facts and Submissions

- I. European patent No. 0 014 733 comprising twelve claims was granted on 12 October 1983 in response to European patent application No. 79 103 162.8 filed on 27 August 1979.
- II. Claim 1 as granted reads as follows:

"An articulated boom-bucket assembly forming part of an excavator (30) mounted in the outer cylindrical shield (12) of a tunnel boring machine, the tunnel boring machine having a front circular cutting edge (14), the excavator (30) including a bulkhead (40), an elongate boom (52) and a bucket-scoop (63) the bulkhead (40) of said excavator being mounted on the central axis of the cylindrical shield (12) of said tunnel boring machine, moving means associated with the excavator for moving the bulkhead axially of said cylindrical shield and rotating means for rotating the excavator 360° about an axis coaxial with or parallel to the central axis, characterized by a base (46) mounted on the bulkhead (40) of the excavator and having a front face (48) facing axially toward the front of said machine, said elongate boom (52) having a first inner end (50) pivotally mounted to one side of said base, an elongate dipper member (58) between the boom and the bucket, said dipper member pivotally mounted at a location intermediate the first inner and second outer ends (60,62) thereof to an outer second end (56) of said boom, and said bucket-scoop (63) having an inner edge (65) and an outer cutting edge (64) and being pivotally mounted to the second outer end (62) of said dipper member (58), first reciprocal power means (66) pivotally connected at one end to the other side of said base (46) and pivotally connected at the other end to said boom (52) at a point spaced from said inner end (50) of said boom for moving

said second outer end (56) of said boom about the pivot connection thereof to said base (46) toward and away from said base, second reciprocal power means (72) pivotally connected at one end to said first inner end (50) of said boom (52) and pivotally connected at the second outer end to said first inner end (60) of said dipper member (58) for moving said dipper member about the pivot connection thereof to said boom toward and away from the central axis of the cylindrical body and third reciprocal power means (80) pivotally connected at one end to said first inner end (60) of said dipper member (58) and pivotally connected at the other end to said bucket-scoop (63) and operable to pivot said bucket-scoop about the pivot connection thereof to said dipper member (58) to move said outer cutting edge (64) in a clawing action against material being removed by the tunnel boring machine."

III. An Opposition was filed against the European patent requesting that it be revoked on the grounds of novelty or at least of inventive step.

The following documents were referred to:

- (1) DE-A-2 423 171;
- (2) DE-A-2 805 362;
- (3) GB-A-1 380 405;
- (4) Robert L Priestley Limited: Tunnels and Tunneling; September/October 1977, pages 64/65 (entitled EXHIBIT T1);
- (5) GB-A-852 925; and
- (6) GB-A-991 668.

The documents (4) to (6) were filed after the expiry of the nine month period for filing an opposition.

- IV. After considering the Grounds for Opposition, the Opposition Division rejected the opposition at the conclusion of the oral proceedings held on 19 April 1988. The written statement of reasons for the decision was dispatched on 18 May 1988.
- V. The Appellant (Opponent) lodged an appeal against the decision on 18 July 1988, paying the appropriate fee simultaneously. The Statement of Grounds was received on 12 September 1988.

In this statement he cited the following documents for the first time:

- (7) Japanese brochure 44/9 (marked A);
- (8) Japanese brochure 44/11 (marked B);
- (9) Engineering News Record, November 1970, page 12 (marked G);
- (10) Handbook of Heavy Construction, 2nd edition, 1971, pages 31-14 to 31-16 (marked J);
- (11) Contractors & Engineers Magazine: "Unique mining machine excavates water tunnel", reprinted from the August 1968 issue (marked C);
- (12) Engineering News Record, March 6, 1969, pages 27 and 28 (marked F);
- (13) Western Construction: "A new way to drive tunnels"; May 1968 (marked E), and
- (14) US-A-3 404 920.

The Appellant submitted that these documents were most relevant to the decision in demonstrating that the prior art acknowledged in the specification of the patent in suit indeed existed.

- VI. In his letter dated 3 May 1989, the Respondent (Proprietor) contested the Appellant's view in respect of the patentability of the subject-matter of Claim 1.
- VII. Oral proceedings took place on 20 March 1990.
- (i) The Appellant specified his crucial arguments in the two following senses:
1. In view of the feature of dependent Claim 7 and the corresponding embodiments according to the Figures 2 and 3 of the patent in suit, the statement in Claim 1 at column 8, lines 56 to 58 "said elongate boom (52) having a first inner end (50) pivotally mounted to one side of said base..." must be read more broadly than the elongate boom being mounted at its very end. The same consideration would also apply to the first inner end of the dipper member (58) with regard to Claim 9 as granted. It was clear, therefore, that to the extent that Claim 1 as granted covered both the embodiments as illustrated in the patent in suit so also it covered the "structure of D2".

Except for some minor differences, which were mere design features, the known excavator differed from the subject-matter according to Claim 1 as granted only in that it had no means yet associated with the excavator for moving it axially of the outer cylindrical shield of the tunnel boring machine. According to the opening part of the specification of the patent in suit as well as to the documents (7) to (14), especially to document (10), this missing feature was, however, well known in the prior art of tunnel boring machines.

2. Document (10) disclosed all features of the preamble of Claim 1 as granted, whereas the features of the characterising part were known from the document (5) or from the document (6). Especially, Figure 1 of document (6) showed more or less the same as the embodiment shown in Figure 3 of the patent in suit. However, as the features of the characterising portion of Claim 1 were very common in the back hoe art, the subject-matter of Claim 1 did not involve an inventive step.

(ii) The Respondent contested essentially the above arguments:

1. Document (2) concerned a tunnel boring machine, with a multi-lever-linkage (10) provided with a mining tool (11), which multi-lever-linkage was moved by only one working cylinder (28); cf. Claim 1. Because of the linkage of this working cylinder to one of the levers as shown in Figure 1, it would be impossible to raise the cutting edge of the working tool above the middle portion of the tunnel face and to dig from the whole face.

The disclosure of the state of the art in document (2) considered as a whole was so unclear that the person skilled in the art could not build the device according to this document. Therefore, starting from this state of the art, the person skilled in the art could not be led to the subject-matter as granted without an ex post facto analysis.

2. Document (10) would disclose the features of the preamble of Claim 1 as granted, the subject-matter as a whole of said claim, however, would be inventive vis-à-vis this prior art in combination with any feature of the other state of the art not submitted in due time by the Appellant.

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

The Respondent requested that

the appeal be dismissed and that the patent be maintained as granted (main request), or

on the basis of a Claim 1 comprising Claims 1 and 9 as granted together with the Claims 2 to 8 and 10 to 12 as granted (auxiliary request A), or

on the basis of a Claim 1 comprising Claims 1 and 7 as granted together with the Claims 2 to 6 and 8 to 12 as granted (auxiliary request B), or

on the basis of a Claim 1 comprising Claims 1, 7 and 9 as granted together with the Claims 2 to 6, 8 and 10 to 12 as granted (auxiliary request C).

Reasons for the Decision

1. The appeal is admissible.
2. The documents (5) to (14) cited for the first time by the Appellant after the expiry of the nine-month period and during the appeal proceedings have been submitted late

within the meaning of Article 114(2) EPC. Nevertheless, the examination of these documents revealed that the document (10) concerns the prior art within the meaning of Rule 29(1)(a) EPC and the document (5) or (6) shows an articulated boom-bucket assembly comprising features which are relevant for the assessment of the patentability of the subject-matter according to Claim 1 as granted. In the exercise of discretion under Article 114(2) EPC the Board, therefore, decided to regard only the aforementioned documents and to disregard the documents (7) to (9) and (11) to (14) in the appeal.

3. Closest state of the art and novelty

- 3.1 According to the findings of the Board, which is in accordance with the opinion of the parties, a mechanical bucket excavator as disclosed by document (10), pages 31-14 to 31-16 and Fig. 31-8 is actually the closest prior art with respect to the subject-matter of Claim 1.

In addition to the features according to the preamble of Claim 1 the known excavator also comprises

- a base mounted on the bulkhead of the excavator and having a front face facing axially toward the front of the tunnel boring machine;
- a boom having an inner end pivotally mounted to one side of said base;
- a bucket-scoop having an inner edge and an outer cutting edge and being pivotally mounted to the outer end of said boom;
- reciprocal power means pivotally connected at one end to the other side of said base and pivotally connected

at the other end to said boom at a point spaced from said inner end of said boom for moving said outer end of said boom about the pivot connection thereof to said boom toward and away from the central axis of the cylindrical shield of said machine, and

- further reciprocal power means pivotally connected at one end to said boom at a point spaced from the inner end of said boom and pivotally connected at the other end by "a lever-linkage" to said bucket-scoop and operable to pivot said bucket-scoop about the pivot connection thereof to said outer end of said boom to move said cutting edge in a clawing action against material being removed by the tunnel boring machine.

3.2 Consequently, the subject-matter of the patent in suit differs from the known excavator in the sense that

- (a) a dipper member between the boom and the bucket-scoop is pivotally mounted at a location intermediate the inner and outer ends thereof to the outer end of said boom;
- (b) the bucket-scoop is pivotally mounted to the outer end of said dipper member;
- (c) reciprocal power means are pivotally connected at one end to the inner end of said boom and pivotally at the outer end to said inner end of said dipper member for moving said dipper member about the pivot connection thereof to said boom toward and away from the central axial of the cylindrical body, and
- (d) the further reciprocal power means are pivotally connected at one end to said inner end of said dipper member and pivotally connected at the other end to

said bucket-scoop and are operable to pivot said bucket-scoop about the pivot connection thereof of said dipper member.

These differences between the closest prior art and the subject-matter of Claim 1 as granted have not been contested by the Appellant. Novelty is therefore no issue in the case.

4. Problem and solution

- 4.1 With the type of excavator as disclosed by document (10), a large breakout force is obtained at the centre of the hole in the material being dug out by the boom-bucket assembly. However, only about half of that breakout force is obtained at the periphery of the hole being dug.

It follows from the discussions of the aforementioned prior art by the parties during the oral proceedings that the technical problem to be solved by the invention was to provide a generally strong uniform breakout force at all positions of the cutting edge of the bucket-scoop across the tunnel face.

- 4.2 According to the teaching of Claim 1 as granted this problem is essentially solved by dividing the boom in two parts and by pivotally connecting the outer part with the bucket-scoop as a dipper member to the inner part (cf. (a) and (b) in Point 3.2) in such a way that an additional reciprocal power means for moving this dipper member can be provided (cf. (c) in Point 3.2) without increasing the overall size of the excavator.

The reciprocal power means for moving the bucket-scoop allow to adjust and keep the cutting edge of the bucket-scoop in that position where the force at the cutting edge

is at its greatest. The movement of the inner part of the divided boom together with the corresponding movement of the dipper member ensure that the cutting edge is moved in said position from the periphery to the centre of the tunnel face in such a manner that a strong and a generally uniform breakout force over the whole tunnel face is maintained. Furthermore, the mounting of the reciprocal power means for moving the dipper member and the bucket-scoop as well as for moving the inner part of the divided boom according to Claim 1 results in a crowded design of this three-part multi-lever system, in which all reaction forces of the reciprocal power means are transmitted on the shortest way to the frame of the tunnel boring machine.

5. Inventive step

5.1 For the examination whether the requirement of inventive step is met by the claimed subject-matter, it is important to consider cantilever systems as they are known from the documents (5) or (6), which systems comprise a boom, a dipper member, a bucket and three reciprocal power means for movement of said three members.

5.1.1 Document (5) concerns a mobile shovel excavator comprising a wheeled chassis upon which is mounted an articulated boom-bucket assembly movable in the horizontal and vertical plane. The angular boom, the dipper member and the bucket-scoop are movable in the vertical plane by reciprocal power means. The reciprocal power means for moving the dipper member are pivotally connected at one end to the longer arm of the angular boom and pivotally connected at the other end to the inner end of the dipper member, which is pivotally mounted at a location intermediate its inner and outer end thereof to the outer end of the longer arm. The reciprocal power means for

moving the bucket-scoop are also pivotally connected at their inner end near to said intermediate location. This mounting of the reciprocal power means permits to press the bucket-scoop down on the ground until the chassis only rests on its two rear wheels as well as on the bucket-scoop and to pull forwards or to push backwards respectively the excavator in soft muddy soil by actuation of the dipper member relative to the angular boom by the reciprocal power means on said longer arm.

The application of this teaching of producing a high force for moving a mobile shovel excavator on its working site to the device according to the document (10) would only result in an additional boom between the existing boom and the base with the reciprocal power means on said additional boom for moving the existing boom in the way of a dipper member and, therefore, in a lengthening of the articulated boom-bucket assembly.

- 5.1.2 Figure I of document (6) shows an excavator having a boom and a dipper member carrying a bucket-scoop and being pivotally mounted on the outer end of the boom. On the boom the reciprocal power means for moving the boom and the dipper member are pivotally connected one behind the other to the boom at the same point. The reciprocal power means for moving the bucket-scoop which is mounted on the dipper member is not connected to the inner end of said dipper member but connected to the bucket-scoop by a lever linkage which allows to convert the excavator from a drag shovel to a face shovel and vice versa. Therefore, the application of this teaching of mounting the reciprocal power means on the boom and dipper member to the mechanical bucket excavator known from document (10) would also lead to an excavator which is unsuitable for a tunnel boring machine because of its dimensions.

5.1.3 Consequently, the aforementioned documents do not give any suggestion how the basic boom-bucket assembly of the known excavator can be modified to arrive at an articulated boom-bucket assembly as granted, whose different members are so adjusted in their disposition with respect to each other, that a strong and generally uniform breakout force is provided at all the positions of the bucket-scoop in a hole to be dug without increasing the overall length and size of the excavator.

5.2 Document (2)

5.2.1 This document concerns a tunnel boring machine, which comprises a multi-lever-linkage mechanism mounted in the outer cylindrical shield of said machine. The mechanism is moved by one reciprocal power cylinder pivotally connected at one end to a first lever mounted on the frame of the machine and pivotally connected at the other end to a second lever at a point spaced from both ends of said lever, near the point where the second lever is pivotally connected to the first lever. At the end of the multi-lever-linkage mechanism can be connected different types of mining tools. The purpose of this known machine is to be economically used independently from the conditions of the soil in the hole to be dug. (cf.: page 4, lines 19 to 23; page 8, lines 1 to 3; Claims 1 and 2; Figure 1.)

No further details with respect to the multi-lever-linkage mechanism and nothing about the force which is provided at all of the working positions of the different mining tools can be derived from the disclosure of document (2).

5.2.2 With regard to the opinion of the Appellant (cf. Point VI(i) above), that the "structure of document (2)" is covered by Claim 1 as granted, the following differences between the known mechanism and the claimed assembly as

specified by the Appellant during the oral proceedings have also to be considered:

- (a) The known tunnel boring machine does not have any means for axial movement of the multi-lever-linkage mechanism.
- (b) The boom of the known multi-lever-linkage mechanism is not pivotally mounted with its inner end to the base.
- (c) The second power means are not connected to the inner ends either of the boom or the dipper member.

Besides the feature (a) which is accepted to be known per se in the prior art of the patent concerned (cf. Point 3.1, as well as the European patent specification, column 2, lines 38 to 40), the features (b) and (c) are not obvious to the person skilled in the art, because the Appellant has not produced any evidence that these features are known in the prior art or that they are mere design features.

Document (2), therefore, also does not give in this respect any hint which could lead the person skilled in the art to the articulated boom-bucket assembly according to Claim 1.

- 5.3 The documents (1) and (3) cited in due time during the opposition proceedings give likewise no hint of the subject-matter of Claim 1. Their teaching could, therefore, neither alone nor in combination with the teachings of the documents discussed in the foregoing paragraphs lead the person skilled in the art to said subject-matter.

5.4 Therefore, the subject-matter of Claim 1 involves an inventive step within the meaning of Article 56 EPC. Hence, the patent can be maintained with the Claims 1 to 12 in the wording as granted.

Order

For these reasons, it is decided that:

The appeal is rejected.

The Registrar:



S. Fabiani

The Chairman:



G. Szabo