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D E C I S I O N
of 26 April 1995

Case Number: T 0290/94 - 3.3.2

Application Number: 90913503.0

Publication Number: 0491772

IPC: C06C 5/04

Language of the proceedings: EN

Title of invention:
Flexible detonating cord

Applicant:
THE SECRETARY OF STATE FOR DEFENCE IN HER BRITANNIC MAJESTY'S GOVERNMENT OF THE UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND

Opponent:
-

Headword:
Detonating cord/UNITED KINGDOM

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step - main request (no)"
"Auxiliary request - remitted"

Decisions cited:
-

Catchword:
-

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Case Number: T 0290/94 - 3.3.2

D E C I S I O N
of the Technical Board of Appeal 3.3.2
of 26 April 1995

Appellant: THE SECRETARY OF STATE FOR DEFENCE IN HER BRITANNIC MAJESTY'S GOVERNMENT OF THE UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND;
Whitehall
London SW1A 2HB (GB)

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Defence Research Agency
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Decision under appeal: **Decision of the Examining Division of the European Patent Office dated 9 November 1993 refusing European patent application No. 90 913 503.0 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: P. A. M. Lançon
Members: G. J. Wassenaar
R. L. J. Schulte

Summary of Facts and Submissions

I. European patent application No. 90913503.0 was refused by a decision of the Examining Division. The decision was taken on the basis of Claims 1 to 19 filed on 20 September 1991 under PCT.

II. The Examining Division held that the subject-matter of the claims on file did not meet the requirements of Article 56 EPC, because of lack of inventive step over FR-A-2 166 732 (1).

In its decision, the Examining Division considered that the claimed subject-matter was formally new over (1) by virtue of the feature that the cord diameter shall not exceed 2.50 mm. It was argued that if the object is to provide a detonating cord which has high flexibility and can be coiled in a narrow space, then (1) already clearly hints at the possibility of reducing the dimensions of the cord in order to achieve these aims. It was therefore considered obvious to produce a detonating cord according to (1) and having an outer diameter of less than 2.5 mm.

III. The Appellant lodged an appeal against this decision. In the Statement of the Grounds of Appeal, the Appellant submitted a new set of Claims 1 to 10.

He argued essentially that (1) does not require the cord to be particular flexible but is directed to other aims such as high detonation speed and resistance to damage, so that the skilled person seeking a means for producing a highly coilable cord would not regard (1) to be particular relevant. Document (1) would give the reader

no guidance to obtain a highly coilable cord that does not deform on detonation. The aims mentioned in (1) would in fact direct away from applicant's invention.

IV. In a communication of the Board, issued with the summons for oral proceedings, a number of objections were raised against the amended claims and attention was drawn to US-A-3 903 800 (2), which was cited in the international search report under PCT.

V. In reply to this communication, an amended set of claims was filed on 6 April 1995 as main request together with two other sets of claims as auxiliary requests.

Claim 1 of auxiliary request (2) reads as follows:

"1. A detonating cord comprising a core (1) of radially compacted high explosive contained within an inner sheath (2) and an outer sheath (3) which outer sheath coaxially grippingly engages the inner sheath, the hoop strength of the outer sheath being greater than that of the inner sheath characterised in that the outer sheath has an outer diameter of less than 2.50 mm and has a hoop strength which is sufficient to prevent plastic deformation of the outer sheath when the cord is detonated and in that at least one end of the cord has a conical recess (4) containing two layers of explosive (5), lying respectively adjacent to and separated from the core, the layer adjacent to the core (1) being compressed to a lower extent than the layer further from the core so as to magnify the detonation energy available at that end of the cord."

During oral proceedings, which took place on 26 April 1995, a new set of claims was filed as main request.

The new main claim reads as follows:

"1. A detonating cord comprising a core (1) of radially compacted high explosive contained within an inner sheath (2) and an outer sheath (3) which outer sheath coaxially grippingly engages the inner sheath, the hoop strength of the outer sheath being greater than that of the inner sheath characterised in that the explosive has a density of between 1.2 and 1.6 g/cm^3, that the outer sheath has an outer diameter of between 1.80 and 2.50 mm and has a hoop strength which is sufficient to prevent plastic deformation of the outer sheath when the cord is detonated, and that the inner sheath has an outer diameter of between 0.65 mm and 1.00 mm."

VI. The Appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of either Claims 1 and 2 filed during oral proceedings as main request or Claims 1 to 6 according to auxiliary request (2) filed with telefax dated 6 April 1995 as auxiliary request.

Reasons for the Decision

1. The appeal is admissible.

2. *Main request*

2.1 Allowability of amendments

Claim 1 of the main request corresponds to a combination of original Claims 1, 3, 12 and 13.

Claim 2 of the main request corresponds to a combination of original Claims 14 to 17.

Thus the amendments do not introduce subject-matter which extends beyond the content of the application as filed so that the amended claims satisfy the requirements of Article 123(2) EPC.

2.2. Novelty

Since none of the prior art documents on file discloses a detonating cord having all the features of Claim 1, the subject-matter of Claim 1 is novel. Novelty was in fact not disputed in the contested decision.

2.3 Inventive step

2.3.1 According to the description of the present application it was an object of the invention to provide a detonating cord which (a) is sufficiently flexible and narrow to allow it to be coiled in a confined space, (b) confines the products resulting from detonation of the cord, and (c) does not expand when detonated, to enable the cord to be completely overwound with successive coils tightly wound on top of each other, enabling a long cord with significant time delay to be coiled into a confined space (page 2, lines 10 to 17).

2.3.2 In agreement with the Examining Division, the closest prior art with respect to Claim 1 is considered to be (1) which discloses a detonating cord comprising a core of radially compacted high explosive contained within an inner sheath and an outer sheath which outer sheath coaxially grippingly engages the inner sheath. The inner sheath consists of lead or a lead alloy and the outer sheath consists of a ductile metal such as stainless steel which mechanical resistance is higher than that of the metal of the inner sheath (Claims 1 and 2).

The diameter of the cord can be reduced practically at will to apply it in miniaturised assemblies containing a multitude of small charges to be detonated at the same time.

The construction of the cord makes it also possible to prevent bursting of the cord when detonating which is especially required in aerospace applications (page 5, lines 17 to 24).

2.3.3 Starting from (1), the technical problem underlying the invention can be seen in providing more precisely defined embodiments of detonating cords according to (1) which satisfy the above mentioned objects (a) to (c).

The example described on pages 5 and 6 of the application, which is in agreement with present Claim 1, shows that a detonating cord fulfilling the above mentioned requirements could actually be made.

Thus the Board is satisfied that the said problem is solved by the products of Claim 1.

2.3.4 It remains therefore to be decided if, for solving the above stated problem, it was obvious to define the conditions as indicated in present Claim 1.

Claim 1 differs from (1) in explicitly requiring the following conditions:

(i) the explosive has a density of between 1.2 and 1.6 g/cm^3,

(ii) the outer sheath has an outer diameter of between 1.80 and 2.50 mm,

(iii) the outer sheath has a hoop strength which is sufficient to prevent plastic deformation of the outer sheath when the cord is detonated, and

(iv) the inner sheath has an outer diameter of between 0.65 and 1.00 mm.

2.3.5 Condition (i) follows directly from fundamental considerations. On the one hand, it was known in the art that a minimum density is required to maintain propagation of the detonation wave in a cord. On the other hand, increasing the density of the explosive would increase the detonation transmission speed which was not an aim related to the problem underlying the claimed invention. It was further known that the density should be lower than the maximum theoretical density of the explosive because otherwise breaks were produced by bending the cord, which would cause a failure of the detonation wave; cf. (2), column 1, lines 25 to 36. During the oral proceedings, the Appellant agreed that the skilled man was aware of the relationship between the density and the detonation properties. Since the theoretical density of an explosive such as HNS, which was used in the example of the present application, is 1.74 a density well below this value should be chosen.

Conditions (ii) and (iv) follow from routine experimentation to realise a cord having the properties mentioned in (1), i.e. that the diameter of the cord can be reduced practically at will and that bursting of the cord when detonated can be prevented (page 5, lines 17 to 24). In the example disclosing a double sheathed cord, the diameter of the cord was 5 mm (Example VII). There is no indication that the diameter should not be reduced to less than half of this value. Moreover (2) discloses that functional detonating cords can be made with an outside diameter of less than 1 mm (0.0395 inch, Example VI). The view of the Appellant that said size relates to the explosive core is not convincing because the expression "outside diameter" would in that case make no sense. But even if the position of the Appellant

were accepted it still would imply that a cord thickness below 2.5 mm would not be extraordinary in the art. Thus no prejudice seems to exists to a cord thickness below 2.5 mm and a core diameter below 1 mm.

Condition (iii) is considered to be equivalent to the property mentioned in (1) that the cord construction prevents bursting of the cord when detonated. A relatively thin stainless steel sheath, hardened by cold drawing, cannot be substantially deformed without bursting.

2.3.6 The arguments of the Appellant in favour of inventive step can be summarised as follows:

(i) Document (1) is concerned with providing a detonation cord which simultaneously exhibit high detonation velocity, a very low scatter of detonation velocity and good mechanical behaviour (page 1, lines 30 to 34). These requirements are contradictory to the objects of the invention, such as high flexibility, relatively low detonation speed and small diameter, because they imply a highly densified and relatively thick explosive core and a relatively inflexible outer sheath of relatively large diameter.

(ii) Scaling down the only example with a double sheathed cord having an outer diameter of 5 mm (Example VII) according to (1) to a final diameter of 2 mm (according to the example of the application) would result in a cord with an outer sheath of only 0.25 mm and does not result in a completely stable detonation cord according to present Claim 1.

(iii) It was not clear to a person skilled in the art that the technical problem referred to above

could be solved at all but if he would try he would have to combine a very specific combination of many variables for which (1) gives no guidance.

2.3.7 Argument (i) is not convincing because the properties and use of the detonating cord given at the end of (1) and referred to under point 2.3.2 above tend to prove that the aim of high detonation speed and good mechanical behaviour need not prevent the construction of a highly flexible, small diameter cord which remains stable when detonated. Furthermore a low detonation speed is not a feature of Claim 1 of the main request.

Argument (ii) is not convincing because the teaching of (1) is not limited to the examples. It is possible that after scaling down Example VII the resulting cord is not completely stable, but said Example was probably not constructed in order to make a completely stable cord. Scaling down Example VII obviously would imply routine measurements and adaptation in order to keep the desired effects mentioned on page 5 of (1).

Argument (iii) is not convincing either. Document (1) gives by indicating the properties and uses on page 5 a clear indication that small diameter, flexible and stable detonation cords could be made. In trying to solve the problem it was obvious to change the thicknesses of the sheaths since a skilled person would immediately regard these to be highly relevant to solve the problem. In acting thus the problem could be solved without the need of taking into account other less obvious variables.

2.3.8 In view of the preceding considerations, the subject-matter of Claim 1 is considered to be the result of routine experimentation and does not involve an inventive step in the sense of Article 56 EPC.

3. *Auxiliary request*

Claim 1 of the auxiliary request contains subject-matter which has not been the subject of any claim on file for consideration by the Examining Division and was thus not at issue in the contested decision. It is even doubtful if its subject-matter was actually considered in drawing the search report. For this reason the Board exercises its power under Article 111(1) EPC, to remit the case to the first instance for further prosecution.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance for further prosecution on the basis of Claims 1 to 4 filed as auxiliary request (2) with telefax dated 6 April 1995.

The Registrar: The Chairman:

P. Martorana P. A. M. Lançon

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