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File Number: T 370/89 - 3.5.2  
Application No.: 81 303 440.2  
Publication No.: 0 046 027  
Title of invention: Heat recoverable articles and processes for producing the  
same  
Classification: H01R 4/70

**D E C I S I O N**  
of 31 January 1991

Applicant:  
Proprietor of the patent: Raychem Limited  
Opponent: kabelmetal electro GmbH

Headword:  
EPC Art. 56, 100(a)  
Keyword: "Inventive step (after amendment, yes)"

**Headnote**



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Boards of Appeal

Chambres de recours

Case Number : T 370/89 - 3.5.2

**D E C I S I O N**  
**of the Technical Board of Appeal 3.5.2**  
**of 31 January 1991**

**Appellant :**  
(Proprietor of the patent)

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**Decision under appeal :**

**Decision of Opposition Division of the European  
Patent Office dated 12 April 1989 revoking  
European patent No. 0 046 027 pursuant to  
Article 102(1) EPC.**

**Composition of the Board :**

**Chairman :** E. Persson  
**Members :** W.P.H. Riewald  
J.A.H. van Voorthuizen

## Summary of Facts and Submissions

- I. European patent No. 0 046 027, incorporating an independent process Claim 1 and an independent product Claim 14 together with appended Claims 2 to 13 and 15 to 20 was granted to the Appellant on 12 November 1986 in response to European patent application No. 81 303 440.2 filed on 27 July 1981 and claiming priorities of two applications in the United Kingdom of 28 July 1980 and 2 April 1981, respectively.
- II. An opposition was filed on 25 July 1987 by the Respondent who cited several prior art documents and requested revocation of the patent on the ground of a lack of inventive step.
- III. The Opposition Division revoked the patent by a written decision dated 12 April 1989 on the ground that the subject-matter of Claim 1 lacked inventive step with regard to the document FR-A-1 154 280.
- IV. On 7 June 1989 the Appellant lodged an appeal.

A statement of grounds of appeal was filed on 18 August 1989 together with amended claims. After further written submissions by the parties including the filing of amended Claims 1 and 14 on 20 February 1990, the Board summoned the parties to oral proceedings as alternatively requested by the Appellant. In a communication accompanying the summons, the Rapporteur indicated that the following documents appeared to be of particular relevance in the present case:

D1: US-A-3 721 749 (corresponding to GB-A-1 334 556 cited in the patent in suit),

- D2: FR-A-1 154 280 (on which the Opposition Division's decision was based),  
D3: DE-A-1 947 057 (cited in the letter of opposition, dated 24 July 1987).

The Appellant was informed that the Board regarded D1 as the closest prior art and that it appeared questionable whether the subject-matter of the independent claims (Claims 1 and 14 filed on 20 February 1990 in main and alternative versions) involved an inventive step when taking into account the teaching of D2.

- V. Oral proceedings were held on 31 January 1991 at the end of which the Appellant (patentee) requested that the decision under appeal be set aside and that the patent be maintained on the basis of Claims 1 to 18 filed in the course of the oral proceedings and the description to be amended accordingly.

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

- VI. The independent Claims 1 and 13 read as follows:

"1. A process for the production of a heat-recoverable boot, udder or end cap for electrical purposes having a thickness of at least 0.1 millimetres which comprises:

- (a) providing a first body of fusion bondable polymeric material having gel content as measured by test method ANSI/ASTM D2765-68 of less than 20% which has been deformed at a temperature below the softening point of the material to produce heat-recoverable polymeric material having a thickness of at least 0.1 millimetres,

- (b) forming a fusion bond between one or more parts of the first body and a further part or parts of the first body or one or more parts of a second body of fusion bondable polymeric material to produce the configuration of at least one seam bonded heat-recoverable boot, udder or end cap, and
- (c) cross-linking the recoverable boot, udder, or end cap and the bond between the deformed first body and the said further part(s) of the first body or the said part(s) of the second body, the cross-linked boot, udder or end cap having one or more openings to the exterior and being recoverable substantially only in the radial sense.

13. A seam bonded heat-recoverable boot, udder or end cap for electrical purposes comprising a first body of a polymeric material which has been deformed at a temperature below the softening point of the material to render the material heat-recoverable, one or more parts of the first body being fusion bonded to a further part or parts of the first body or to one or more parts of a second body of polymeric material with the bonded parts having a gel content as measured by test method ANSI/ASTM D2765-68 of less than 20% and the bond between the first body and the said further parts of the first body or the said parts of the second body being cross-linked, the deformed material having a thickness of at least 0.1 millimetres, and the bonded parts being in such arrangement that the boot, udder or end cap has at least one opening to the exterior and is heat-recoverable substantially only in the radial sense."

VII. The Appellant's submissions were essentially based on the argument that D2 (considered by the Opposition Division to be the closest prior art) dealt primarily with heat-

recoverable material in the form of sheets for wrapping and sealing any products - such as aliments, hardware or machine parts - whereas, after amendment, the patent in suit dealt solely with the production of boots, udders or end caps for electrical purposes and that, therefore, D1 had to be regarded as the closer prior art.

Insulation of electrical conductors was disclosed in D2 only in the form of a pre-stretched ribbon wrapped around the metal without welding of the polymer. Heat-sealing of the polymer by welding with subsequent cross-linking by irradiation was admittedly disclosed in D2, however only in connection with thin packaging bags, a technical field that was far removed from the more demanding conductor isolation by boots, udders or end caps.

The Appellant put emphasis on the fact that D2 was an old document (priority of 1955 and published 1958) and was aimed at replacing the rather expensive polyvinylchloride by irradiated polyethylene as a heat-recoverable material for wrapping sheets. D2 did certainly give the information that the irradiation (cross-linking) of the polyethylene may be performed before the deformation step as well as after the deformation step. It should, however, be taken into account that the use of polyethylene in the boots field had been known for a long time, and that the expansion step was always performed only as a "hot-expansion", i.e. above the softening point of the material which means that the material had always to be cross-linked before undergoing the expansion.

Therefore, the patentee regarded himself as the first to see commercial possibilities for cold-stretched and welded and thereafter irradiated articles for the specified heavy-duty purposes requiring the claimed thickness, opening(s) and radial-only recovery.

VIII. The Respondent argued essentially that the process steps of Claim 1 were principally known from D2 in the claimed order:

- (a) stretching of a fusible polymeric article at a temperature below the softening point of the polymer,
- (b) fusion bonding parts of the article with each other in order to form a heat-recoverable article, and
- (c) cross-linking the polymer and therewith the fusion bond.

The skilled person would understand that the use of these process steps was not only possible for the thin sheets of polyethylene as mentioned in the specific example 1 of D2 but equally for sheets of greater thickness as the document itself mentions as possible thicknesses of the irradiated polyethylene ranging from 2.5  $\mu\text{m}$  to 2.5 mm or more.

Therefore, in the Respondent's view, it would have been obvious to apply the teaching of D2 to the production of, for instance, boots for electrical purposes as known from D1.

#### Reasons for the Decision

- 1. The appeal is admissible.
- 2. **Novelty**
  - 2.1 With the now amended claims the present invention relates to heat-recoverable boots, udders or end caps for electrical purposes and processes for producing the same.

With respect to this particular technical field D1 is to be regarded as the closest prior art. This document describes the production of heat-recoverable members or connectors (Figures 1 and 2: reference 10; Figures 5 to 7: reference 22) which can be looked upon as a series of parallel boots (tubular members 11 and 21) connected by longitudinal seams (13 and 20) and providing electrical insulation means for flat multi-conductor cable connections. The wall thickness of the heat-recoverable material in the expanded condition ranges from 3 to 5 mils, i.e. 0.076 to 0.127 mm (see column 3, lines 36 to 39).

The longitudinal seams 13 (Figure 1) can be the result of appropriately bonding a previously extruded or otherwise formed hollow article (column 3, lines 50 to 53). Preferably, however, first and second plies or a single folded up ply are bonded accordingly (column 3, lines 53 to 68). In other words, there is a first body of bondable polymeric material and a bond is formed between one or more parts of the first body and a further part or parts of the first body or one or more parts of a second body of bondable polymeric material to produce the configuration of seam bonded boots.

D1 mentions at column 4, lines 1 to 47 the possibilities for forming heat-recoverable materials: non-cross-linked material may be deformed at temperatures below its softening point (column 4, lines 12 to 24) or cross-linked material may be deformed at temperatures above its crystalline melting point (column 4, lines 25 to 47).

The gel content of a polymeric material is a measure for its degree of cross-linkage. The specification in the independent claims that the gel content is less than 20%, which merely means that the degree of cross-linkage is

low, provides therefore no further effectual limitations in respect of the known polymeric materials used for the production of heat-recoverable articles.

The content of the independent Claims 1 and 13 goes beyond the disclosure of D1 by a closer specification of the production steps, in particular of their order:

- The deformation which is responsible for the heat-recoverability of the final product has already been carried out before the different parts of the material are bonded to the intended form of a boot, udder or end cap.
- The bond is performed as a fusion bond.
- The cross-linking is the last step of the process.

The process according to Claim 1 and the product made by this process according to Claim 13 are, therefore, novel over the prior art disclosed in D1.

2.2 D2 discloses methods for producing heat-recoverable sheets or ribbons and bags, but not boots, udders or end caps for electrical purposes. D2 is therefore not novelty destroying.

2.3 D3 discloses a heat-recoverable pre-shaped body from which an udder is formed by bending it around the outlet of a branch cable from a main cable (Figures 17 to 19) and fastening it along its seams by suitable means, for instance by fusion bonding (Figure 12).

This document does not affect the novelty of the claimed invention, because it does not disclose any further details about the material used and the process steps, in particular in respect of any contingent cross-linking.

3. Inventive step

3.1 The closest prior art document cited in the present proceedings and concerning the technical field of boots for electrical purposes, (document D1) teaches the skilled person first to bond the non-cross-linked material along seams in order to achieve the desired tubular configuration of the article, then to cross-link the article and to deform the heated material pneumatically in order to achieve heat-recoverability (according to column 7, lines 17 to 29 of the document). That means that the tubular boot articles had first to be formed into the desired heat stable final configuration on an item-by-item basis and that only in an ensuing step the articles were rendered heat-recoverable by deforming (expanding) them into the heat unstable configuration (cf. also patent description, column 1, lines 23 to 45). Furthermore, the skilled person knows that by cross-linking, polymeric material is rendered non-fusible (e.g. D2, page 3, left-hand column, lines 32 to 34). The handy fusion bonding is thus not practicable with cross-linked material. Therefore, application of cross-linking of the polymeric material with the possibility for effecting the deformation at a temperature above the crystalline melting point, according to the teaching of D1, column 4, lines 25 to 47, leads the skilled person to the conclusion that cross-linking and ensuing deformation can only be carried out on the finished article, i.e. when the bonding has been carried out before.

3.2 Such hot deformation of the finished article was regarded by the patentee as being inconvenient because it gave rise to a number of difficulties (patent description, column 1, lines 46 to 54).

The objective problem underlying the present invention is, therefore, to provide a process of producing heat-recoverable boots, udders or end caps which eliminates the need for deformation of the finished article (patent description, column 1, lines 55 to 60).

This problem is solved by the present invention because the necessary heat-recoverability is ensured by the provision, in a first step, of at least one first body which has already been deformed before its further use in the production process of the boot, udder or end cap, and because cross-linking in a last step ensures a sufficient mechanical strength of the finished article.

- 3.3 There is no incentive derivable from D1 that would lead a skilled person to this concept, i.e. to start the production process with deformed and thus already made heat-recoverable material and to end up with cross-linking of the finished article after intermediate fusion bonding steps.

The Board has taken into account that such a production process is known per se from D2, in particular page 3, column 1, last paragraph to column 2, first paragraph. The Board notes, however, that

- D2 deals primarily with the use of pre-stretched and irradiated sheets or ribbons,
- the cited passage on page 3 relates to the production of bags for test purposes the thickness of the sheets (0.025 mm) being considerably lower than the thickness specified in the present patent (>0.1 mm),

- the mention of thicknesses of 0.0025 to 2.5 mm in D2 (page 3, column 1, line 20) appears to be rather arbitrary and does not relate to the production of the said bags for test purposes or to any other more complicated articles than the said sheets or ribbons,
- D2 does not relate to any tubular embodiments which would require that the material is recoverable substantially only in the radial sense.

The Board is, therefore, satisfied that the skilled person would have disregarded D2 when thinking about possible improvements in the manufacture of boots, udders or end caps. This view is supported by the fact that, despite the relative age of D2 (published in 1958), there was apparently no further application of the said order of process steps in the prior art before the present invention was made (priority date in 1980).

It is true that D3 discloses the use of pre-stretched material for forming an udder for electrical purposes by bending a suitably formed sheet around the outlet of a branch cable from a main cable and by bonding the seams. However, since D3 does not disclose details about the material used and, in particular, about any cross-linking, also this document cannot render the present invention obvious.

4. For the reasons set out above the Opposition Division's objection as to lack of inventive step has been overcome by the amendments of the independent Claims 1 and 13. The dependent Claims 2 to 12 and 14 to 18 have been adapted accordingly and specify embodiments of the invention.

The patent can, therefore, be maintained on the basis of Claims 1 to 18 filed in the course of the oral proceedings.

5. It is, however, necessary that the description be amended accordingly. The citation of the claims in the description will have to be adapted. Furthermore, any reference to embodiments no longer covered by the scope of the claims will have to be deleted from the description (p.e. column 3, lines 19 to 26). A careful re-consideration of the whole description appears to be required. The Board makes use of its powers under Article 111(1) EPC to remit the case to the Opposition Division for the further prosecution thus required.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the Opposition Division with the order to maintain the patent in amended form in accordance with the Appellant's request (cf. paragraph V above).

The Registrar:

The Chairman:

M. Kiehl

E. Persson