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D E C I S I O N
of 13 July 1994

Case Number: T 0923/91 - 3.2.5

Application Number: 84300056.3

Publication Number: 0115905

IPC: B29C 67/12, B29C 61/06

Language of the proceedings: EN

Title of invention:
Dimensionally heat recoverable article

Patentee:
Raychem Limited

Opponent:
Siemens AG

Headword:
-

Relevant legal norms:
EPC Art. 56

Keyword:
"Inventive step (yes) - after amendment"

Decisions cited:
-

Catchword:
-

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Case Number: T 0923/91 - 3.2.5

D E C I S I O N
of the Technical Board of Appeal 3.2.5
of 13 July 1994

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Decision under appeal: **Interlocutary decision of the Opposition Division of the European Patent Office dated 5 November 1991 concerning maintenance of European patent No. 0 115 905 in amended form.**

Composition of the Board:

Chairman: C. V. Payraudeau
Members: W. D. Weiß
A. Burkhart

Summary of Facts and Submissions

I. Appellant I (Opponent II) and Appellant II (Opponent I) lodged appeals, received on 3 December 1991 and on 12 December 1991, respectively, against the interlocutory decision of the Opposition Division, dispatched on 5 November 1991, on the amended form in which the patent No. 0 115 905 could be maintained. The appeal fees were paid simultaneously. The statements setting out the grounds of appeal were received on 19 February 1994 and 28 February 1994, respectively.

The oppositions had been filed against the patent as a whole and based on Article 100(a) EPC.

The Opposition Division had held that the grounds for opposition mentioned in Article 100(a) EPC did not prejudice the maintenance of the patent as amended according to the documents annexed to its communication, dated 5 November 1990.

III. The Appellants, at the oral proceedings before the Board, held on 13 July 1994, requested that the decision under appeal be set aside and the patent be revoked.

IV. The Respondent requested that the decision under appeal be set aside and the patent be maintained in amended form,

(a) on the basis of Claims 1 to 20, submitted at the oral proceedings of 13 July 1994 together with a correspondingly amended description, as main request, and

(b) on the basis of Claims 1 to 18, submitted at the oral proceedings of 13 July 1994, and a description to be correspondingly amended as a subsidiary request.

V. The Claim 1 according to the main request reads as follows:

"1. A dimensionally heat-recoverable fabric which comprises cross-linked fibres that will recover when heated to a recovery temperature thereof, characterized in that the recoverable fibres have a tensile strength of at least 0.1 MPa at their recovery temperature and have been stretched to an extent that will cause the fabric to recover by at least 60% when heated to the recovery temperature of the recoverable fibres and in that the fabric is woven with heat-stable fibres in one direction and with said heat-recoverable fibres in the other direction or is knitted from dimensionally heat-stable fibres and has warp or weft of said heat-recoverable fibres inserted, so that the fabric will recover in one direction only."

VI. During the oral proceedings before the Board the Appellants based their arguments with respect to lack of inventive step on the following documents:

E3: DE-A-1 665 147,
E5: "Plastics and Rubber: Materials and Applications", August 1980, pages 139 to 144,
E6: GB-A-1 053 651,
E7: US-A-3 058 863,
E8: US-A-3 086 242,
E12: JP-A-5120715 (English translation),
E13: JP-A-4967215 (English translation).

Moreover, the Appellant I, at the oral proceedings, relied on document

E14: US-A-3 597 372 (cited in the description of the patent in suit)

as representing the generally accepted closest state of the art.

The Appellants argued essentially as follows:

Heat-recoverable wrap around sleeves consisting of cross-linked polymeric films which above their respective melting points display an elastomeric behaviour had belonged to the generally known state of the art. The documents E6, E8, and E14 could be cited as typical examples.

A generally known disadvantage of these known sleeves consisted in their tendency to develop quickly propagating cracks, whenever they were subjected to a high stress at locations with acute protrusions or edges.

A skilled person which was confronted with this disadvantage of the known sleeves, would be guided by document E7 to the solution suggested by Claim 1, because this document disclosed the measure to laminate a film with pre-stretched (parallel) fibres to make the film fit for heavy duty packaging (e.g. tools). Document E6 disclosed cross-linked materials which could be stretched up to 800%.

Moreover, the skilled person had known from the documents E12 and E13 that cross-linking increased the recovery force of a fabric. Document E13 disclosed a recoverability of the fabric of at least 40% and document E12 a unidirectional shrinkable tube to secure a plurality of wires.

VII. The Respondent argued essentially as follows:

A person who was active in the field of repairing cables was confronted with the problem to quickly but durably protect, under sometimes adverse circumstances, elongated articles comprising large changes in their cross-sections against detrimental environmental influences. The solution proposed by the patent in suit consisted in an article made from an unidirectionally recoverable fabric which had such a high recoverability and shrinking force that it could be simply slipped over the largest cross-section of the article to be protected and during shrinking would reliably and without rupture adapt itself to the complicated contours of the article to be protected.

Document E7, neither by itself nor in combination with document E14, could lead a skilled person to the invention in an obvious manner, because it aimed at providing a biaxially shrinking article made from a non cross-linked polymer, the shrinking power of which was far short of that demanded by the patent in suit.

Document E6 was directed to moulded articles. This was quite a different technique and no skilled person would consider its teaching for the manufacture of fibres which are highly oriented and not easy to cross-link.

Document E3 concerned shrinking insulation tapes of cross-linked polymeric fibres which need only a small recoverability. The same applied to the braided sleeve disclosed in the documents E12 and E13 the intended application of which did not require a rugged encapsulation of an article with largely varying cross-sections.

Reasons for the Decision

1. The appeals are admissible.

2. *Amendments*

The claims as granted were based on the original claims.

Claim 1 according to the main request is based on Claims 1 and 3 together with page 3, lines 19 to 37, of the granted patent corresponding to page 6, line 17, to page 7, line 10 of the description as originally filed. Dependent Claims 2 to 18 according to the main request are based on dependent claims as granted.

The amendments to the description constitute mere adaptations to the admissibly amended claims.

The amended documents according to the main request are, therefore not objectionable under Article 123 EPC.

3. *Novelty*

None of the documents cited by the appellants discloses, in combination, all the features of Claim 1 according to the main request. The subject-matter of this Claim 1 is, therefore, considered to be novel. Since this fact is undisputed it does not need further detailed reasoning.

4. *Closest state of the art*

There exists in practice a plurality of uses, which require to mechanically protect and to simultaneously protect from environment elongated substrates, e.g. pipes, conduits, cables splices and the like. For these purposes a rugged and permanent encapsulation is needed.

Document E14, which is cited in the description of the patent in suit, is the most detailed of the documents E6, E8 and E14 representing the closest prior art and was also used by the Appellants as the starting point of their main chain of arguments.

Document E14 discloses an article which comprises a dimensionally heat-recoverable cross-linked film that will recover when heated to a recovery temperature thereof. The cross-linked film has a tensile strength of more than 0.1 MPa (see col. 10, lines 38 to 43; col. 15, lines 11 to 16) at its recovery temperature and has been stretched to an extent that will cause the film to recover by more than 60% (see Examples VI, X, and XII) when heated to the recovery temperature of the recoverable film. When produced in form of a radially expanded tubing, the film will recover in radial direction only.

5. *Technical problem and solution*

Tubing made from this known heat-recoverable film is used to encapsulate cabled wires and wire harnesses (see col. 4, lines 54 to 71).

A severe problem arises in a particular application when a tubing made from this known heat-recoverable film is used to encapsulate voluminous elongated cable splices or similar types of connections, i.e. elongated articles comprising large changes in their cross-sections. Since the cable, after repair, is often buried in the earth or must withstand similarly adverse environmental conditions for a long time, the covering of the splicing must provide for a reliable mechanical protection. Due to these large and abrupt cross-sectional changes of the substrate to be encapsulated, the material of the heat-recoverable tubing is subjected to largely varying

stresses and strains. In these extreme types of application, the tubing may tend to break and to exhibit a quick crack propagation starting from the initial point of rupture, when it is mechanically affected in the areas which are most subjected to the influence of its inherent recovery force. Moreover, the production of these known heat-recoverable articles requires a sequence of delicate treatment steps of the film article after its extrusion. Nevertheless, a purely unidirectional heat-recovery is extremely difficult to achieve with these known articles, but they mostly exhibit a considerable tendency to recover also in the other direction.

The technical problem on which the subject-matter of the patent is based, therefore, consists in providing for a better encapsulation means for the said substrates which is nevertheless easy to apply even under adverse conditions.

This problem is solved by a fabric comprising the combination of features of Claim 1 according to the main request.

The fabric defined in Claim 1 according to the main request is particularly adapted to the requirements of the particular use described above and to guarantee that the said cross-sectionally varying elongated substrate (cable splicing) is firmly compressed and is reliably protected against rough mechanical impact. The high degree of recovery of the fibres in the one direction result in a such dense package of the non-recoverable fibres in the other direction and hence in an impenetrable armour shield.

6. *Inventive step*

6.1. The Appellants have primarily relied on document E7 and asserted that the mere desire to reduce the said tendency to crack propagation of the tubings disclosed in document E14 would guide the skilled person to the claimed subject-matter.

Document E7 discloses a heat-recoverable composite with biaxial shrinkage properties (col. 4, lines 55 to 58) comprising a fabric which, even when woven or knitted, is exclusively made of heat-recoverable fibres laminated to a polymeric film which is stretched and therefore also heat-recoverable (col. 5, lines 3 to 14). The fibres of the fabric are not cross-linked. The recoverability of the composite, which is produced for packaging purposes, is the not separable result of the combined recoverabilities of the fabric and the film and is in either direction much lower than 60% (see col. 6, the table).

Consequently, even if a person skilled in the art would replace the unidirectionally recoverable film material disclosed in document E14 by a composite disclosed in document E7, in order to reduce the tendency to rupture propagation, he would not arrive at a fabric according to Claim 1.

6.2. Moreover, the Appellants have relied on the documents E3, E5, E12, and E13 all concerning various kinds of heat-recoverable fabrics.

It is not disputed that none of the fabrics disclosed in these documents comprises the combination of features of Claim 1 according to the main request (point 3. above).

Document E5 gives a general survey on the state of the art in 1980 of heat-shrinkable polypropylene fibres and fabric made therefrom. Shrinkage rates of "between 30% and 60%" are mentioned (page 142, right column, fourth paragraph) for the fibres which are woven in either warp or weft direction together with a low-shrink float yarn to produce a woven loop pile fabric. The contraction of the high-shrink yarn pulls the float yarn into loops. The contraction of the fabric originating therefrom will depend on the particular weaving characteristics used, but must be considerably lower than the shrinkage rate of the single fibre.

Document E12 discloses a braided tube for holding a wire harness together and permitting single wires to be led out of the harness at suitable positions. This known tube may be braided such that it comprises cross-linked heat-recoverable fibres only in the weft (Figure 1) to be shrinkable in the radial direction only. Document E13 discloses a tube woven from heat-shrinkable fibres for the same application. Here a shrinkage rate of 40% is mentioned (page 5, penultimate paragraph). There is no reason why the shrinkage rate should be chosen higher for the same use in document E12. On the contrary both documents call for throughholes to be maintained between the fibres of the tube in its shrunk state to enable branch wires to be led off (document E12) or entrapped gas bubbles so escape (document E13).

Document E3 discloses a heat-recoverable insulating tape which may be woven and comprises heat-recoverable fibres in the warp and heat-stable fibres in the weft. No shrinkage rate is mentioned. Since, however, the tape is conformed by wrapping to the form of the substrate to be covered, only a small recoverability rate is needed to warrant a tight and firm fit. Therefore, there is no

reason why the shrinkage rate of this known fabric should exceed the value of 40% disclosed in E13. It should preferably be even lower.

Consequently, none of these documents discloses in particular **a fabric** which is heat-recoverable by at least 60% in one direction only nor points to an aspect which would make such a fabric appear to be desirable.

6.3 In summary, the Board reaches the conclusion that the subject-matter of Claim 1 according to the main request involves an inventive step.

Since the respective dependent Claims 2 to 20 as well as the description adapted thereto do not give rise to any objection on the basis of the EPC either, the main request is allowable.

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 with the order to maintain the patent in amended form on the basis of the main request of the Respondent.

The Registrar: The Chairman:

A. Townend C. Payraudeau