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Bezeichnung der Erfindung:
Title of invention:
Titre de l'invention : Method of manufacturing xerographic fuser roll having an abhesive surface

Klassifikation / Classification / Classement : G03G 15/20, B05D 1/36, B05D 1/38

ENTSCHEIDUNG / DECISION

vom / of / du 9 October 1987

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /
Titulaire du brevet : Xerox Corporation

Einsprechender / Opponent / Opposant : Hoechst AG.

Stichwort / Headword / Référence Articles 52(1), 56

EPÜ / EPC / CBE "Inventive Step" (Yes)

Kennwort / Keyword / Mot clé :

Leitsatz / Headnote / Sommaire

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Case Number : T 104/85

D E C I S I O N
of the Technical Board of Appeal 3.4.1
of 9 October 1987

Appellant : (Proprietor of the patent)
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Representative :

Decision under appeal : **Decision of Opposition Division of the European Patent Office dated 28 February 1985 revoking European patent No. 0 008 542 pursuant to Article 102(1) EPC.**

Composition of the Board :

Chairman : J. Roscoe

Members : E. Turrini

C. Payraudeau

Summary of Facts and Submissions

I. European patent No. 8 542 was granted on 3 August 1983 in response to European patent application No. 79 301 743.5, filed on 24 August 1979 and claiming priority of 28 August 1978 from an earlier application in the USA.

II. An opposition was filed against the European patent in due time and form by Hoechst Aktiengesellschaft and revocation of the patent requested. US-A-3 942 230 (doc. 1) and DE-A-2 415 986 (doc. 2) were cited to support the allegation of lack of inventive step.

III. By a decision dated 28 February 1985 the Opposition Division revoked the patent. The decision was based on Claims 1 to 10 of the granted patent of which Claims 1 and 8 were independent method and device claims, respectively. Claim 1 read as follows:

1. A method of manufacturing an article (16) having an abhesive outer surface, i.e. one which has release characteristics such that it is highly repellent to sticky or tacky substances, including the steps of:

flame-spraying metal onto a substrate (20, 30, 50) so that it forms a porous layer (28, 42, 52);

applying to the porous layer a solution of a primer in the form of a fluorocarbon polymer;

drying the solution to provide a thin primer layer (24, 38, 54) of the polymer;

applying to the dried primer layer a layer (26, 40, 56) of a powdered resin copolymer of perfluoroalkyl perfluorovinyl ether and tetrafluoroethylene, and

fusing the powder layer until it forms a layer bonded to the primer layer.

IV. The reason for the revocation was that the subject-matter of the claims was lacking inventive step. Fuser rollers for fixing toner images were required to have an abhesive surface and it was acknowledged in the description that such surfaces can be obtained by means of coatings of perfluorinated ethylene polymers. Known fuser rolls with such coatings had an insufficiently long life and it was this problem which the invention was required to overcome. Since, however, the claims were more generally drafted, i.e. not limited to making fuser rolls, the problem was to be seen simply as the production of a surface having abhesive properties comparable with prior art surfaces and having improved wear (or abrasion) resistance. No invention was to be seen in recognition of the problem and the skilled person confronted with it would seek a solution in publications relating to providing surfaces with coatings of materials (such as perfluorinated ethylene) known to have abhesive properties.
US-A-3 942 230 (doc. 1) and DE-A-2 415 986 (doc. 2) were two publications which disclosed the coating of surfaces with the aforesaid polymers.

Doc. 1 disclosed a process differing from that claimed in Claim 1 in not stating that the primer was applied in solution or dried and in not disclosing the use of copolymer of perfluoroalkyl perfluorovinyl ether and tetrafluoroethylene. However, doc. 2, also directed to making an abrasion resistant, long-lasting fluorethylene coated substrate disclosed all the steps of Claim 1 apart

from the flame-spraying. Since both disclosures were concerned with abrasion resistant fluoroethylene polymer coatings it was obvious for the skilled person to combine their teachings by incorporating the feature of doc. 1 which improves the bonding of the coating, i.e. the flame-spraying step, in the method of doc. 2 to arrive at the subject-matter of Claim 1, more especially since it was well known in the art that copolymer of perfluoroalkyl perfluorovinyl ether and tetrafluoroethylene (hereinafter copolymer A) had similar properties to polytetrafluoroethylene itself but had the advantage of a lower melt viscosity.

V. The patentee appealed against the decision on 4 April 1985 and simultaneously paid the appeal fee. The statement of grounds was filed on 1 July 1985 and in it the patentee requested that certain amendments be made to Claims 1 and 8 and 10, that a ruling be given on the patentability of the amended claims and that he be given an opportunity to carry out any concomitant amendments to the description should this ruling be favourable.

Following two communications from the Board, oral proceedings were held on 7 May 1987. At these proceedings, which the respondent (opponent), though duly summoned, did not attend, the appellant (patentee) requested that the decision under appeal be set aside and the patent maintained on the basis of either:

(a) Claims 1 to 10 of the granted patent amended as proposed in the statement of grounds (main request); or

(b) the documents submitted during the oral proceedings (first auxiliary request); or

(c) the documents as in (b) but with the incorporation of the subject-matter of Claim 2 in Claim 1, renumbering of the remaining claims and incorporation of the same amendment (as in Claim 1) in former Claim 8 (now 7).

The respondent had earlier stated that he maintained his request that the appeal be dismissed.

VI. After the Board had deliberated, the Chairman informed those present that the Board still considered the US Defensive Publication T 934 010 (hereafter doc. (4)) to be the closest prior art and that if this publication, a full copy of which was not then at its disposal, only contained, as had hitherto been assumed, disclosure of a fuser roll having the copolymer A in the form of a sheet glued to the roll, the Board would be inclined to consider the main request allowable but could not decide until it had obtained and examined the complete document, to assure itself that that was all which was in fact disclosed. The procedure would, therefore, be continued in writing.

VII. After having examined the document in question, the Board, in a communication pursuant to Article 110 and Rule 58(4) EPC, informed the parties of the amended text in which it intended to maintain the patent.

The Board also stated that it had examined the content of FR-A-2 324 035, published before the priority date claimed, which claimed priority from a US application referred to in the papers of the defensive publication, but found it to contain no new matter of relevance to the issue of inventive step. It had, therefore, decided not to exercise the powers conferred on it by Article 114(1) EPC to introduce the document into the proceedings. No further mention of it is therefore made in this decision.

VIII. Within the time limit set, the appellant communicated his approval of the text and proposed the correction of obvious spelling errors in Claims 1 and 8. No response to the Board's communication was, however, received from the respondent. The Board has noticed further clerical errors in Claims 8 to 10 and proposes their correction by replacement of the first word "An" in each by "A".

IX. The two independent Claims, 1 and 8, of the approved and corrected text, read as follows:

1. A method of manufacturing a xerographic fuser roll (16) having an adherent and abhesive outer surface, i.e. one which has release characteristics such that it is highly repellent to sticky or tacky substances, consisting of a resin copolymer of perfluoroalkyl perfluorovinyl ether and tetrafluoroethylene, characterised in that it includes the steps of:

(a) flame-spraying metal on to a cylindrical substrate (20, 30, 50) so that it forms a porous layer (28, 42, 52) integral therewith;

(b) applying to the porous layer a solution of a primer in the form of a fluorocarbon polymer;

(c) drying the solution to provide a thin primer layer (24, 8, 54) of the polymer;

(d) applying to the dried primer layer a layer (26, 40, 56) of a powdered resin copolymer of perfluoroalkyl perfluorovinyl ether and tetrafluoroethylene, and

(e) fusing the powder layer until it forms a layer bonded to the primer layer.

8. A xerographic fuser roll comprising a cylindrical substrate (20, 30, 50) bearing an outer layer (26, 40, 56) of a copolymer of perfluoroalkyl perfluorovinyl ether and tetrafluoroethylene, having an abhesive surface, i.e. one which has release characteristics such that it is highly repellent to sticky or tacky substances characterised in that the substrate has deposited on it a porous layer (28, 42, 52) of flame sprayed metal; a dried primer layer of a fluorocarbon polymer (24, 38, 54) and finally, the outer layer (26, 40, 56) which consists of a powdered copolymer of perfluoroalkyl perfluorovinyl ether and tetrafluoroethylene fused and bonded to the dried primer layer.

X. The main arguments presented by the appellant were essentially as follows:

The invention was directed to solving the problem of loss of mechanical integrity of the coating of polymer A, applied as described in doc. (4) and specifically to so improve the bond to the substrate as to ensure a fuser roll operating life of more than 750 000 copies. Docs. (1) and (2) could be excluded from consideration in assessing inventive step and would be dismissed by the skilled man without experimentation because neither of them mentioned the problem or the presence of a thermal gradient across the coating in the rolls being considered, or could be said to teach anything about adhesion. In any case, there was no reason to suppose that a bond which was adequate in the applications envisaged there would perform well in the quite different environment experienced by a fuser roll.

Quite apart from this, doc. (1) lacked many of the features of Claim 1, whereas doc. (2) was exclusively concerned with improving the resistance to corrosion of fluorocarbon polymer-coated metal surfaces and its essential disclosure was the provision of a corrosion-resistant material comprising comminuted zinc in a layer system lacking a porous flame-sprayed layer.

There was no suggestion in doc. (1) or (2) that certain of its features could be combined with selected features of the other. The Opposition Division and respondent's arguments were therefore based on hindsight. The dramatic improvement in fuser roll life achieved pointed to the fact that the features of the claimed process reacted synergistically to provide a significant technical advance.

XI. The respondent on the other hand contended that despite the limitation of the claims to xerographic fuser rolls the subject-matter of the patent still lay in the technical field of coating with metals and thus that all documents concerned with the provision of abhesive coatings on metal articles were relevant. Since fuser rolls were subject to corrosion attack in use, doc. (2) was particularly relevant. The problem of achieving optimum adhesion applied to all fluoropolymer coatings because of the abhesive nature of such materials. Many solutions to the problem had been proposed since 1946, and it was known from US-A-3 393 086 (doc. (3)) and GB-A-1 191 700 (doc. (5)) to provide an oxidic intermediate layer and to coat this with primer prior to applying a fluoropolymer layer from a dispersion, to give a layer sequence no different from that produced when powder coating, itself known from doc. (2), was used. It

was not true that the achievement of a firmly adherent layer was only mentioned in passing in doc. (1) and it was quite clear that the layers disposed between the outer coating of abhesive copolymer and the metal roll had the sole purpose of ensuring firm adhesion of that coating just as had all intermediate layers used in the coating field. Furthermore, the selection of copolymer A for coating fuser rolls could not be credited to the patentee as it had already been proposed in doc. (4). Doc. (2) was directed like the patent-in-suit to the problem of loss of mechanical integrity of the copolymer coating and when the roll was used in chemical reactors as proposed it would have a considerable thermal gradient across its thickness as does the coating on a fuser roll. It was known from GB-A-1 137 227 (doc. (6)) to provide a fuser roll having the layer sequence electroplated nickel - air-dried fluoropolymer primer - fluoropolymer. The skilled man looking to improve the adherence of a coating of copolymer A would consider these coatings systems and if need be, combine their teachings. This would call for no more than the exercise of his routine skills.

Reasons for the Decision

1. The appeal complies with Article 106 to 108 EPC.

In the notice of appeal the appellant refers to the appealed decision as one issued by the Examining Division to refuse the application, and requests that the application proceed to grant. However, the date of the decision and application number of the patent revoked by it are correctly quoted. Therefore, in the absence of any other decision issued on the quoted date in connection with the application in question, the notice of appeal is

also considered to satisfy the requirement of Rule 64(2) EPC that it should contain a statement identifying the decision which is impugned and the extent to which amendment or cancellation of the decision is requested. The appeal is therefore admissible.

2. The present version of the claims is not objectionable under Article 123(2) or (3) EPC since Claims 1 and 8 differ in substance from the granted claims only in being further restricted to a xerographic fuser roll comprising a cylindrical substrate,as opposed to an article, and a method of making it, a restriction which is supported by the originally filed drawings inter alia, and the appendant claims are unchanged. The modified description also contains no new matter.

3. Following a close study of all the documents to which reference has been made during this appeal, or the foregoing opposition, or in the European search report, and those cited in the patent itself, the Board is satisfied that the method and xerographic fuser claimed in the only independent Claims 1 and 8 respectively are novel. As the respondent (opponent) has never alleged lack of novelty, the Board deems it unnecessary to go into this in great detail here. Of the documents mentioned above only docs. (2) and (4), to be discussed later, make any reference to copolymer A and in neither of them is there any suggestion to apply this copolymer to a substrate bearing a flame-sprayed metal layer.

4. It remains, therefore, to be considered whether the subject-matter of these claims involves an inventive step.

4.1 The Board considers the closest prior art to be the method disclosed in doc. (4). This document relates to a method of making laminated rolls for various applications, including use as fuser rolls for office copying machines, in which, after a layer of adhesive has been applied to the cleaned and optionally acid etched surface of a cylindrical metal, e.g. aluminium, core, a calendered sheet of uncured copolymer of a perfluoroalkyl perfluorovinyl ether and tetrafluoroethylene (copolymer A), and optionally a functionally substituted perfluoroalkyl perfluorovinyl ether, is wrapped around the core and held under pressure by wrapping with heat shrinkable tape while heated for a prolonged period at up to 250°C, after which the tape is removed and the surface preferably ground. The roll is stated to be very useful in applications requiring an elastomer covered roll having excellent resistance to heat and/or chemicals but no reference is made to the abhesive properties as such of the copolymer used and no alternative methods of applying it are proposed.

4.2 Since the method of doc. (4) and the resulting rolls have all the features of the preambles of Claims 1 and 8 respectively, but none of their characterising features, the claims fulfil the requirements of Rule 29(1) EPC.

4.3 In relation to this prior art, and bearing in mind the improved adhesion of the copolymer to the fuser roll core over extended periods of use, said by the patentee to be achieved by the claimed method and not contested by the respondent, the objective problem to be solved is to be seen as that of devising a method of applying the copolymer to the roll which provides better adhesion and hence substantially improved roll life.

4.4 This problem is said to be overcome by first preparing the surface of the cylindrical substrate by the steps (a) to (c) of Claim 1 and then applying copolymer A to it and fusing the copolymer by the steps (d) and (e) respectively.

4.5 The inadequacy of the adhesion of the copolymer coating of the prior art rolls and the resultant peeling to which the patent-in-suit refers would readily reveal themselves to the skilled man during routine inspection of the rolls after periods of use or as a result of premature failure. Thus, no contribution to inventive step is to be found in recognition of the problem.

4.6 Thus, the question which remains to be answered is whether the prior art would lead the skilled man faced with the problem to replace the known method of applying the copolymer by that claimed in Claim 1.

4.7 Since doc. (4) neither recognises the problem nor suggests any alternative to the method discussed above it alone could not lead the skilled man to the claimed method.

4.8 In looking for a solution to the problem, the skilled man would first be expected to consider refining the prior method by use of different adhesives or by modifying or replacing the steps used in preparing the roll surface to achieve better keying of the adhesive before turning towards radically different ways of applying the copolymer itself, particularly since the method proposed in doc. (4) was presumably itself selected with the awareness that in earlier fuser rolls abhesive fluorocarbon (PTFE) had been applied by the spray coating of enamel (see e.g. doc. (6)). Although it was already known at the priority date from this and other documents to apply such

fluorocarbon polymers, including copolymer A, by various spraying techniques to either fuser rolls or rolls for other applications which would be subjected to heating to at least the same extent, none of the documents available to the Board suggests that these techniques give adhesion superior to that achieved by gluing on a preformed sheet of fluorocarbon polymer.

4.9 As the problem is that of inadequate adhesion of a particular copolymer to a metal surface, the Board, in contrast to the appellant, considers that the skilled man would look for guidance beyond the fuser roll art into other fields of technology where copolymer A, and what he would recognise as similar polymers and copolymers, have to be applied to metal rolls, which in use are subjected to the same or higher temperatures than fuser rolls even though the cyclic change in temperature and pressure to which they are subject might not be the same, particularly since the technique used in doc. (4) was employed to produce rolls for a variety of such applications (see foot of page 10).

4.10 Of the documents relied on by the respondent (opponent), doc. (1) relates to the achievement of enhanced lifetime in composite rolls for use in the manufacture of paper and in other industries at temperatures in the range 205-260°C, i.e. well above the 160°C which the patentee (appellant) says are normally experienced in fuser rolls.

Enhanced lifetime is achieved by flame spraying metal on to a previously grit-blasted cylindrical metal substrate to form a porous layer well bonded to the surface (see column 1, lines 30-50) as in feature (a) of Claim 1, on which layer one of several fluorocarbons (not including copolymer A) is sprayed to provide a prime coat, after

which a thicker top coat is applied and heat applied to fuse it, thus causing it to impregnate the porous layer.

This document, though clearly recognising the need for good bonding of the fluorocarbon to the roll, neither compares the strength or durability of the bonding with that achieved by earlier methods nor does it suggest that the inadequancies of the prior rolls were due to unsatisfactory adherence of the fluorocarbon. It could not, therefore, in the Board's view lead the skilled man to single out the disclosed method from among others for substitution for that employed in doc. (4) in the expectation of improved adhesion of copolymer A. Moreover, there is nothing in document (1) to suggest that the top coat should be applied in a different form than the prime coat (assuming this is to be equatable with the primer layer of Claim 1) or that either coat should be applied as a powder, or indeed that it is of any significance how it is applied.

4.11 Doc. (2) relates to a method of producing a corrosion-resistant perfluorocarbon polymer coated metal substrate for piping, reaction vessels, pipe flanges and other uses requiring an inert finish that has a good corrosion resistance. In this method a corrosion-retardant finish of a thermally stable binder of alkyl polysilicate containing dispersed finely divided particles of zinc is first applied, followed by a primer layer of PTFE or a specific perfluorocarbon copolymer blended with an adhesion promoter and a corrosion protection agent. Finally, a perfluorocarbon polymer, which may be copolymer A, is applied. This document is primarily concerned with the problem of corrosion by chemicals to which perfluorocarbon polymer coated elements are subject even when the proper perfluorocarbon primer is used, and with the flaking that

occurs when it is sought to apply thick (5-6 mils) layers in a single coat from latices or dispersions of the polymer. Application of the polymer as a powder coating is said to allow application of a thick durable coating. No comparison is, however, made between the adherence achievable by the method and that obtained by glueing a preformed band of polymer A to the substrate.

For this reason, the Board cannot see why the skilled man should be induced by this document to substitute the method it disclosed for that described in doc. (4). Even if he were to adopt its teaching he would not arrive at the method of Claim 1, since the document does not propose the use of a flame-sprayed porous metal layer either as a substitute for or in association with the alkyl polysilicate/zinc finish.

4.12 Docs. (3) and (5) both relate to methods of overcoming the lack of adhesion of coatings of polymeric release agents such as PTFE applied to the metal working surfaces of cooking and baking utensils. Doc. (3) indicates that the prior use of an underlayer of sprayed-on aluminium particles has proved unsatisfactory and proposes instead to use closely spaced particles of stainless steel. In one embodiment the particles are applied by flame-spraying to provide a rough finish, to which is applied first fluorocarbon primer to assure maximum adhesion and then a coating of an aqueous polymer suspension which is subsequently fused by baking. Thus, while this document holds out promise of excellent adherence of abhesive polymers to a metal substrate for use under severe conditions, adoption of its teaching to the provision of copolymer A on a fuser roll would not lead to the method of Claim 1 since it is not proposed applying the outer layer as a powder. Doc. (5) and US-A-3 837 895 propose the

use of an undercoating formed by firing a ceramic or glass frit to improve bonding of a PTFE coating and thus lead away from the claimed use of flame-sprayed metal for this purpose.

4.13 The doc. (6) discloses preliminary coating of a copper or copper-alloy tube from which a fuser roll is to be made with a strongly adherent layer of cupric oxide or electroplated nickel to prevent formation of non-adherent cupric oxide particles. On this layer fluoropolymer is spray coated over a Teflon primer coating. The process is said to improve the adherence of Teflon to copper. It also, however, leads the skilled man away from the use of a flame-sprayed metal coating and is not suggestive of the use of polymer A.

4.14 The only other document discussed in the appeal proceedings was the book Technology of Powder Coating, Portcullis Press 1976, pages 165-6 which refers to the use of powder coating with fluorinated HC polymers, and mentions coating with fluorinated ethylene propylene by a fluidised bed technique. Though it stresses the importance of surface preparation to ensure void-free coating, the only proposal it contains for assuring the maximum adhesion is the application of a special primer beneath the main coating.

4.15 The remaining documents studied come less close to the subject-matter of Claim 1. None of them advocates applying fluorocarbon polymer in powder form to a substrate or mentions copolymer A as such.

4.16 In view of what has been said above, it is considered that these documents, whether considered individually or together by the skilled man, would not have led him, if

faced with inadequate adhesion of copolymer A in the fuser roll of doc. (4) to single out and combine the individual features disclosed in them in different contexts in such a way as to arrive at the method of Claim 1.

4.17 The Board, therefore, concludes that this method involves an inventive step (Article 56 EPC). Claim 1, and hence also the Claims 2 to 7 which are appendant to it, is therefore allowable.

4.18 Claim 8 is directed to a xerographic fuser roll formed by the method of Claim 1 and the respondent has advanced no separate arguments against it. The Board is satisfied on the basis of the foregoing reasoning that the subject-matter of this claim also involves an inventive step and that the claim and Claims 9 and 10, which are appendant to it, are therefore also 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 European patent on the basis of the following documents:

- Claims 1 to 10 as on the sheets attached to the notification of the Board of Appeal in accordance with Rule 58(4) EPC, with the word "adhesive" in Claim 1, line 2 and Claim 8, line 4, corrected to "abhesive"; and the first word of Claims 8 to 10 corrected to "A".

- title and description as in the manuscript - amended copy of the published patent attached to the aforesaid notification;

- drawings as the published patent.

The Registrar: The Chairman:

F. Klein J. Roscoe