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D E C I S I O N
of 28 April 1998

Case Number: T 0093/95 - 3.3.5

Application Number: 87306483.6

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Title of invention:
Method and apparatus for coating optical waveguide fiber

Patentee:
Corning Glass Works

Opponent:
KABEL RHEYDT Aktiengesellschaft

Headword:
Coating/CORNING GLASS

Relevant legal provisions:
EPC Art. 54, 56

Keyword:
"Interpretation of a drawing in a citation, novelty, inventive step"

Decisions cited:
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Case Number: T 0093/95 - 3.3.5

D E C I S I O N
of the Technical Board of Appeal 3.3.5
of 28 April 1998

Appellant: (Opponent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 28 November 1994 concerning maintenance of European patent No. 0 261 772 in amended form.**

Composition of the Board:

Chairman: R. K. Spangenberg
Members: M. M. Eberhard
R. E. Teschemacher

Summary of Facts and Submissions

I. European Patent No. 0 261 772 based on application No. 87 306 483.6 was granted on the basis of three claims for the Contracting States AT, BE, CH, DE, GB, IT, FR, LI, NL, SE and six claims for Spain.

II. The Appellant (Opponent) filed a notice of opposition requesting revocation of the patent on the grounds of lack of novelty and lack of inventive step. Of the documents cited by the Appellant during the opposition procedure, only the following remained relevant to the present decision:

D3: IOOC-ECOC'85, High-speed bubble-free coating of optical fibres on a short drawing tower, p. 515-518,

D4: Electronics Letters, 1985, Vol. 21, No. 18, p. 786-787.

III. In an interlocutory decision of the Opposition Division posted on 28 November 1994, the patent in an amended form was considered to meet the requirements of the EPC. The decision was based on claims 1 to 3 of the main request filed on 20 July 1993 for the Contracting States AT, BE, CH, DE, GB, IT, FR, LI, NL, SE, and claims 1 to 3 of the main request filed on the same date for Spain. The Opposition Division took the view that D3 and D4, which, like the patent in suit, dealt with the problem of avoiding air-bubble formation in the coating layer, did not point towards the use of carbon dioxide as a coating purge gas. The teaching of D3/D4 would rather have discouraged the skilled person from employing CO_2 as a coating purge gas in view of its relatively high kinematic viscosity.

IV. The Appellant lodged an appeal against this decision. He relied at the appeal stage on a new document, ie a translation in English of JP-A-54-131042 (D6), and submitted that D6 was novelty-destroying. In reply to a communication from the Board, the Respondent filed an experimental report on 25 February 1998. Oral proceedings were held on 28 April 1998. At the oral proceedings, the Respondent submitted two sets of amended claims as a main request. Claims 1 to 3 of the first set, ie for the Contracting States AT, BE, CH, DE, GB, IT, FR, LI, NL, SE, read as follows:

"1. A coating apparatus for the application of a protective organic coating material to a glass optical fiber which comprises a coating die in the path of fiber transport through the apparatus for applying the organic coating material as a uniform liquid layer on the surface of the fiber, the coating die comprising a fiber inlet and a liquid coating reservoir containing a replenishable supply of coating liquid and the coating liquid presenting an entrance surface through which the optical fiber entering the die is transported for immersion therein, the die further comprising an exit orifice positioned downstream of the liquid coating reservoir in the direction of fiber transport through the die for removing excess coating material therefrom prior to exit of the fiber from the die, characterised in that:
the apparatus further comprises fiber conditioning means, positioned upstream of and connected to the fiber inlet of the coating die and adjacent to the entrance surface of the coating material, said means being adapted to treat the surface of the fiber prior to transport into the coating liquid with a flowing atmosphere of a gas effective to displace air from the surface of the fiber and sufficiently soluble in the liquid organic coating material to reduce gas bubbles

entrainment in the coating material applied to the fiber surface, and the fiber conditioning means comprises an annular manifold chamber extending around the path of fiber-transport through the apparatus and provided with at least one inlet port and a plurality of flow directing exhaust ports for the flowing gas, the exhaust ports being distributed around the circumference of the manifold chamber and being adapted to direct the exhaust flow of flowing gas against the surface of an optical fiber being transported through the apparatus."

"2. A method for applying a protective organic coating to a glass optical fiber wherein the glass fiber as drawn from a glass preform is transported through a liquid coating die having a fiber inlet, a fiber outlet, and a liquid reservoir containing an organic coating liquid, the liquid coating die providing a liquid coating on the fiber, wherein the liquid coating is thereafter cured to provide the protective organic coating, and wherein bubble inclusions in the coating are reduced by reducing air entrainment into the coating liquid by the fiber, characterised in that: the step of reducing air entrainment into the coating liquid comprises the step of conditioning the surface of the fiber by passing the fiber through a conditioning chamber positioned adjacent to and connected with the fiber inlet to the liquid reservoir, the chamber comprising a cylindrical channel through which the fiber is downwardly drawn into the reservoir and within which conditioning of the fiber surface is carried out by sweeping the fiber surface with a flowing atmosphere consisting essentially of CO_2."

"3. A method for continuously coating a glass optical fiber by drawing the fiber through a body of a curable liquid coating composition followed by removal of

excess coating liquid from the fiber and curing of the coating liquid to form a solid protective layer thereon, wherein the atmosphere surrounding the optical fiber at the point of entry thereof into the liquid coating composition is modified to reduce air entrainment by the fiber into the coating liquid, characterised in that:
(a) the atmosphere at the point of entry of the fiber into the liquid coating material consists of a flowing atmosphere of a gas having a flow direction towards the surface of the optical fiber entering the coating liquid; and
(b) the flowing atmosphere consists essentially of a carbon dioxide gas which resists entrainment, segregation and bubble formation in the liquid coating as it is applied to the optical fiber."

The preamble of method Claim 1 for Spain is identical to that of method claim 2 for the other Contracting States, and its characterising part reads as follows:
"(a) the step of reducing air entrainment into the coating liquid comprises the step of passing the fibre through a conditioning chamber positioned adjacent to and connected with the fiber inlet to the liquid reservoir, the chamber comprising a cylindrical channel through which the fiber is downwardly drawn into the reservoir, the chamber further comprising a gas inlet into which a purge gas is introduced, said gas being caused to flow upwardly in the cylindrical channel to provide countercurrent gas flow with respect to the downward direction of fiber draw; and (b) the purge gas is carbon dioxide gas."

Apparatus claim 2 for Spain corresponds essentially to apparatus claim 1 for the other Contracting States. Method claim 3 for Spain is identical to method claim 3 for the other designated States.

The Respondent also filed as an auxiliary request two sets of three claims. These claims differ from the claims of the main request only by the introduction of "UV-" before the terms "curable liquid coating composition" in claim 3 of both sets of claims.

V. The Appellant's arguments as regards the claims of the main request can be summarised as follows:

The method according to claim 2 of the first set of claims was not novel over the disclosure of D6. This document taught that contact of the fibre with air was detrimental and had to be avoided. It was evident from this objective that the coater 7 and the conditioning chamber (tube 10) had to be connected to each other, otherwise the desired aim would not be achieved. The gap between the conditioning chamber and the coater in Figure 4 was only a diagrammatic inaccuracy. Furthermore, no gap was necessary to thread up the fibre since this could be achieved by opening a door of the conditioning chamber. The dimensions of the gap and of the coating die outlet chosen in the Respondent's experimental report were not representative for the apparatus of D6.

The method of claim 3 was also not new in respect of D6. As the construction of the conditioning chamber in Figure 2 of the patent in suit corresponded to that shown in Figure 5 of D6, the direction of the gas at the point of entry of the fibre into the liquid was the same in both cases. According to D6 tube 10 could be separated from furnace 3 and, thus, it could have a short length so that the gas approaching the coater was not necessarily directed downwardly. The term "drying" used in D6 meant curing by means of heat and was equivalent to curing in the case of coatings for optical fibres.

Concerning the inventive step of the claimed process, the Appellant argued that the problem of improving the characteristics of the interface between the glass surface of the optical fibre and the organic coating as stated in the patent in suit was dealt with in D6. Thus, D6 concerned the same problem and disclosed the same solution as the patent in suit. Furthemore, the problem of applying a bubble-free coating onto an optical fibre at high draw speeds was already solved by D3/D4. As D3/D4 taught that the said problem was solved by performing a gas purge immediately before coating the fibre, the skilled person would have tried to find out by a series of experiments the most appropriate alternative gas to CCl_2F_2, all the more so since the gases listed in D3 pointed in a specific direction. The comparative tests submitted on 10 October 1994 could not prove an inventive step since CF_4 was randomly selected from the number of Freon gases and the draw speeds were not in agreement with those used in the patent in suit.

The claimed apparatus lacked an inventive step in view of D6. The use of a plurality of exhaust ports for the flowing gas did not solve the problem of avoiding bubbles but only improved the stability of the fibre. It was well-known to the skilled person that by using a plurality of exhaust ports instead of one the risk of vibration of the fiber was decreased.

VI. The Respondent put forward inter alia the following arguments:

The method of claim 2 was novel in respect of D6 for several reasons, and in particular because D6 did not disclose the requirement that the conditioning chamber be connected to the reservoir. The drawing in D6 was indeed diagrammatic, however the presence of a gap between the coater 7 and the tube 10 in Figure 4 made physical sense. It allowed the gas introduced into the tube to go out as well as threading of the fibre.

The method of claim 3 was novel over the disclosure of D6, since the CO_2 atmosphere was said in claim 3 to flow towards the surface of the optical fibre entering the coating liquid, whereas D6 contained no information from which the gas flow direction could be clearly and unambiguously derived. In D6 the gas inlet was positioned right at the top of the tube, and as the length of tube 10 was of one meter or more the gas had a flow direction downward by the time it approached the coating die. In Figure 2 of the patent in suit the gas was directed towards the surface of the fibre when the latter was about to enter the liquid, ie 2 or 3 cm above the die. Although no dimension was given in the patent in suit, the terms "point of entry" in claim 3 had to be read in the light of Figure 2 and of the common general knowledge; D3/D4 gave dimensions of several meters for the distance between the drawing furnace and the coating applicator. Therefore, the terms "point of entry" meant "close to" the point where the fibre enters the liquid. Furthermore, the requirement that the atmosphere at the point of entry of the fibre into the liquid consisted essentially of CO_2 was not met by D6 because of the gap between the lower end of the tube 10 and the coater. Because of the said gap D6 did not achieve the reduction in bubble inclusions. The term "consisting essentially" in claim 3 meant that the flowing atmosphere could contain a small quantity of air but the quantity of air was such that reduction of bubble inclusions was achieved. Furthermore, the curing step stated in claim 3 was not disclosed in D6.

As regards inventive step the Respondent submitted that the technical problem to be solved by the invention with respect to D3 was to provide an alternative way to avoid bubble formation to an extent comparable to CCl_2F_2, ie to produce essentially bubble-free coatings. The purpose of D6, as explained on page 4 thereof, was completely different and did not concern the point of entry into the liquid. Therefore, the skilled person would not have turned to D6 to solve the said problem of bubble inclusions. In view of D3/D4 it would not have been obvious to replace CCl_2F_2 by CO_2 since a gas having a "sufficiently low" kinematic viscosity was required in these documents, ie a gas with a kinematic viscosity of about 16% of that of air. The teaching of D3/D4 would not have led the skilled person to try CO_2, whose kinematic viscosity was three times higher. The apparatus also involved an inventive step, since D6 did not suggest using fibre conditioning means connected to the coating die and an annular manifold chamber with a plurality of exhaust ports to solve the problem of avoiding bubble formation.

VII. The Appellant requested that the decision under appeal be set aside and that the patent be revoked. The Respondent requested that the patent be maintained on the basis of the claims according to the main request or the auxiliary request as submitted during the oral proceedings. As a further alternative, if any of the claims were found not to be patentable, he requested that the patent be maintained with the remaining claim or claims.

Reasons for the Decision

1. The appeal is admissible.

Main request

2. Amended claim 1 of the first set of claims is essentially based on a combination of claims 4 and 5 as filed, and the additional feature that the conditioning means is connected to the inlet fibre of the coating die is directly and unambiguously derivable from the original application (see original claim 1, Figure 2 and page 12, line 30, to page 13, line 3). Claims 2 and 3 are identical with granted claims 2 and 3. As regards the set of claims for Spain, claim 1 corresponds to a combination of claims 1 and 2 as filed, claim 3 is identical with granted claim 3 and the above considerations in connection with claim 1 of the first set apply to claim 2. The scope of protection of the granted apparatus claims and of granted claim 1 for Spain has clearly been limited. All claims of the main request therefore meet the requirements of Article 123(2) and (3) EPC.

3. Concerning novelty, the Appellant had only disputed that the processes according to claims 2 and 3 of the first set were new in respect of the disclosure of D6. As claim 3 in each set of claims is identical, this objection also applies to claim 3 for Spain.

D6 discloses a method for applying a protective plastic coating to a glass optical fibre, wherein the glass fibre as drawn from a preform in a drawing furnace 3 is transported through a plastic material coater 7 having a fibre inlet, a fibre outlet and a reservoir containing the plastic material (see Figs. 4 and 5). The plastic coating on the fibre is then dried in an electric furnace 8. The glass fibre passes through a cylindrical tube 10 (or 51) which is interposed between the drawing furnace and the coater. The said tube is provided with a gas inlet 55 located in its upper part so that the gas atmosphere inside the tube can be controlled. The lower end of the tube is positioned adjacent to the fibre inlet of the coater. The gas atmosphere flowing in tube 10 (or 51) may consist of dry carbon dioxide, which is cited in a list of thirteen individualised gases (see claims 1 and 2; Fig. 4 and 5; complete page 5).

Figure 4 shows a spacing between the lower end of tube 10 and the coater 7. This figure is a schematic representation of the drawing apparatus and is not to scale so that it does not permit any quantitative information to be inferred as regards the extent of the said spacing or gap. However, it clearly illustrates a spacing and the description does not expressely mention that a spacing should be avoided or that the lower end of tube 10 should be connected to the inlet of the coater. The Appellant's arguments that the skilled person would understand from D6 that tube 10 must actually be connected to the fibre inlet of the coater in order to achieve the objective of D6 and that the illustrated gap results from a diagrammatic inaccuracy, are not convincing for the following reasons:

The objective of D6 is to overcome a reduction in the mechanical strength of the fibre resulting from humidity in the atmosphere and from surface scratches caused by dust particles in the air. This is achieved by preventing direct contact of the uncoated optical fibre with the atmosphere in the phase during which the fibre is drawn out from the furnace and then coated with plastic film, in particular by interposing tube 10 as indicated above and passing dried air, a dried gas or a dehydrating gas through said tube (see page 4, lines 1-14; page 6, third paragraph). Although according to D6 direct contact of the uncoated fibre with air should be prevented, D6 also discloses on page 6 that this effect can be achieved even if tube 10 is separated from the electric furnace. Taking into account that a gap between the electric furnace and the upper end of tube 10, ie at a position where the fibre is still at a very high temperature, is compatible with the purpose of D6, the Board sees no reasons why the gap between the lower end of tube 10 and coater 7 as illustrated in Figure 4, ie at a location where the temperature of the fibre is substantially lower, would prevent the desired effect from being achieved. Therefore, the presence of this gap cannot be considered as inconsistent with the objective of D6. Furthermore, as pointed out by the Respondent, this gap makes real technical sense in the alternative illustrated on Figure 4 where the upper end of tube 10 is connected to the drawing furnace. In this case, a small gap should be present between the lower end of tube 10 and coater 7, otherwise the gas introduced into the tube through inlet 55 could not flow out. A spacing between these two elements would also make it possible to thread up the fibre through the coating die. The mere possibility of performing fibre threading in the absence of such a gap, eg through a door in tube 10, as argued by the Appellant, cannot support the allegation that the spacing shown in Figure 4 is merely the result of inaccurate drawing. For these reasons, the Board holds that D6 does not directly and unambiguously imply that the conditioning chamber is inevitably connected to the fibre inlet of the coating die or liquid reservoir. Therefore, the subject-matter of process claim 2 of the first set of claims is new vis-à-vis the disclosure of D6.

4. Turning to the issue of novelty of claim 3, it is stated in item (a) of this claim that "the atmosphere at the point of entry of the fibre into the liquid coating consists of a flowing atmosphere of a gas having a flow direction towards the surface of the optical fibre entering the coating liquid". As pointed out by the Appellant, the patent in suit does not state the dimensions of the conditioning unit 20. However, it refers to the use of a "conventional coating apparatus", in particular a "liquid coating die 12 of conventional design" (see page 3, lines 45-52; page 5, lines 36-40), and discloses a draw speed of 5.5 m/s as well as the values of the gas flow through conditioning unit 20. In view of these indications and of the explanations in the patent in suit about the function of the conditioning unit, it would be clear to the skilled person aware of the general knowledge in this technical field that the dimensions of the conditioning unit 20 in Figure 2 of the patent in suit are very small in comparison to the distance between the drawing furnace and the coating die. Therefore, the Board can accept the Respondent's argument that on its proper construction the term "at the point of entry" stated in claim 2 means "close to" or "near" the point of entry of the fibre into the liquid. This construction is consistent with Figure 2 of the patent in suit.

According to D6, the gas atmosphere can flow in tube 10 through the gas inlet 55 which is positioned in the upper part of tube 10, ie closer to the drawing furnace than to the coater (see Figures 4 and 5; page 5, 2nd and 3rd paragraphs). However, D6 states only the diameter of tube 10 and discloses neither the draw speed of the fibre, nor the gas flow rate nor the length of tube 10. In these circumstances, even if it might be inferred from D6 that the gas has a flow direction towards the surface of the optical fibre near its point of introduction into tube 10 (or 51) from gas inlet 55, it could not be clearly and unambiguously derived from this document that the gas has a flow direction towards the surface of the optical fibre near the point of entry of the fibre into the coating liquid. Therefore, D6 does not prejudice the novelty of the process of claim 3.

5. The Board is satisfied that the subject-matter of the other claims according to this request are also novel in respect of D6, and that the novelty of the subject-matter of all claims is not prejudiced by any of the other cited documents. This not being in dispute, there is no need to give reasons for this finding.

6. Concerning the issue of inventive step of the process according to claim 2 of the first set, the Board considers that D3 represents the closest prior art as this document, contrary to D6, deals with the problem of bubble inclusion in the coating at high drawing speeds.

6.1 D3 discloses a process for applying a protective organic coating to an optical fibre, wherein the fibre is drawn from a preform using a drawing furnace and is transported through a coating applicator filled with a coating liquid such as a commercially available UV-curable acrylate composition, and provided with a die in the bottom. The fibre is cooled before application of the coating by passing through a water-cooled tube filled with a gas having a high heat conductivity such as hydrogen or helium. Coating of the cooled fibre with the UV-curable acrylate composition is performed in a force-feed coating applicator comprising a flexible inlet tube which is completely filled with the coating liquid during operation. The force-feed coating applicator is flushed with a gas of low kinematic viscosity. D3 teaches that the amount of gas entrained into the liquid at high drawing speeds, and thus the amount of bubbles in the cured coating layer, depends on the kinematic viscosity of the gas above the coating liquid. Bubble formation can be avoided completely when the force-feed applicator is flushed with a gas having a sufficiently low kinematic viscosity. A bubble-free coating was obtained at a speed of 700 m/min using a force-feed coating applicator and dichlorodifluoromethane as flushing gas, which gas exhibits a kinematic viscosity of 16% with respect to that of air (see complete page 515; page 516, lines 4-17, Figure 1 and Table 2; page 517, lines 16-17 and Figure 4; page 518, "conclusions").

Starting from this prior art, the technical problem underlying the claimed process can be seen in the provision of an alternative process for producing an essentially bubble-free coating on optical fibres at high drawing speeds.

The process as defined in claim 2 proposes to solve this problem essentially by sweeping the fibre surface with an atmosphere consisting essentially of CO_2 within the cylindrical channel of a conditioning chamber positioned adjacent to and connected with the fibre inlet to the liquid reservoir. In view of examples 32 and 33 of the patent in suit, of the indication on page 8, lines 54-55, that bubble-free coatings can be produced with CO_2 as well as with the Freon gases, and of the additional tests at a higher drawing speed of 12 m/s submitted by the Respondent on 10 October 1994 and on 25 February 1998, it is credible that the said technical problem is solved by the combination of features listed in claim 2. This was not disputed by the Appellant.

6.2 The teaching of D4 as to how bubble inclusions can be avoided at high drawing speeds is very similar to that of D3, and CCl_2F_2 is given as an example of gases having a kinematic viscosity sufficiently high to eliminate completely bubble inclusions (see D4: page 787, 2nd paragraph and "conclusions"). D3 further discloses the kinematic viscosity of some other gases which were also used in the experiments, namely air, helium, argon and xenon (see page 516, Table 2); however results as regards bubble formation are given only for CCl_2F_2. In view of D3/D4, the skilled person faced with the problem of providing an alternative way of producing an essentially bubble-free coating would have contemplated replacing CCl_2F_2 by another gas having a **similar** kinematic viscosity. However, carbon dioxide exhibits a kinematic viscosity which is not similar to that of CCl_2F_2 but more than three times higher (about 55% of the kinematic viscosity of air instead of 16% for CCl_2F_2). In these circumstances, the skilled person could not have expected that an essentially bubble-free coating might be obtained with CO_2 and, therefore, would not have been encouraged to try this gas in order to solve the said problem.

6.3 D6, which is analysed in detail in point 3 above, does not deal with the problem of producing essentially bubble-free coatings at high drawing speeds. The drawing speeds are not mentioned in D6 and cannot be inferred therefrom. Drawing speeds far below those of D3/D4, ie drawing speeds at which the problem of bubble inclusions is not critical, might have been used in D6. The objective of D6 is to overcome a reduction in the mechanical strength of the fibre. Although the presence of bubbles in a coating may negatively affect the mechanical properties of an optical fibre in addition to its optical properties, the purpose envisaged in D6 is clearly to avoid reduction in the mechanical strength resulting from humidity in the atmosphere and from surface scratches caused by dust particles in the air, ie from technical reasons unrelated to air bubble inclusions. Therefore, the teaching of D6 would be of no assistance to the skilled person seeking an alternative way of producing essentially bubble-free coatings at high drawing speeds. Although CO_2 is cited in a list of gases at page 5, D6 contains no information from which the skilled person could have inferred that it might lead to results similar to CCl_2F_2 as regards bubble formation. Therefore, the teaching of D6 would not have encouraged the skilled person to replace CCl_2F_2 by CO_2 in the process of D3/D4. For these reasons, the process of claim 2 is considered to involve an inventive step with respect to D3, D4 and D6.

7. Turning to the issue of inventive step according to the process of claim 3, which is identical in both sets of claims, D3 is also regarded as the closest prior art. The Respondent has argued at the oral proceedings that the subject-matter of claim 3 was equivalent to that of claim 2 of the first set of claims, and that the technical problem solved by the process according to claim 3 was also an alternative way of producing an essentially bubble-free coating at high drawing speeds. The Board cannot accept these arguments for the following reasons:

7.1 Claim 3 does not recite the feature of claim 2 that the fibre surface is conditioned within a cylindrical channel of a conditioning chamber positioned adjacent to and connected with the fibre inlet to the liquid reservoir. Furthermore, as argued by the Respondent, the terms "at the point of entry" into the liquid used in item (a) of claim 3 means in fact "near" or "close to" the point of entry of the fibre into the liquid (see point 4 above). As the presence of a conditioning chamber is not required, let alone a conditioning chamber connected to the inlet of the liquid reservoir, and as the Respondent had expressly confirmed at the oral proceedings that the term "consisting essentially of CO_2" used in the context of claim 3 covers a flowing atmosphere containing air, the amount of air being only limited by the requirement that air entrainment be **reduced**, the subject-matter of claim 3 encompasses the case where the flowing atmosphere near the point of entry of the fibre into the liquid may contain small amounts of air entrained from the surrounding atmosphere. The additional statement in claim 3 that the atmosphere surrounding the optical fibre at the point of entry thereof into the liquid is modified to **reduce** air entrainment by the fibre into said liquid also does not exclude air entrainment but only requires a reduction thereof which can be very small. It clearly follows from the preceding that the combination of features recited in claim 3 is not equivalent to the requirement in claim 2 that a conditioning chamber is adjacent to and connected with the fibre inlet to the liquid reservoir.

In view of the experimental report submitted by the Respondent on 25 February 1998, the question arises whether the problem of producing an essentially bubble-free coating at high drawing speeds is actually solved by the process according to claim 3. From the said experimental report, it can be inferred that already with a relatively small separation between the conditioning chamber and the coating die, an essentially bubble-free coating could not be achieved at high draw speeds, whereas a flowing atmosphere of CO_2 introduced into a conditioning chamber connected to the inlet of the coating die led to a bubble-free coating at the same drawing speed and flow rate of CO_2. In view of these results, and taking into account that claim 3 (i) does not require the presence of a conditioning chamber, let alone of a conditioning chamber connected to the inlet of the coating die, (ii) allows the presence of some air in the flowing atmosphere near the point of entry of the fibre into the liquid and (iii) does not state the degree of reduction of air entrainment, it is not credible that essentially bubble-free coatings can actually be achieved by the process defined in claim 3 and, thus, that the claimed process actually solves the said problem.

7.2 In these circumstances, the technical problem in connection with claim 3 cannot be seen in the provision of an alternative process for producing an essentially bubble-free coating but only in the provision of a process for coating an optical fibre, which makes it possible to reduce bubble inclusions in the coating at high drawing speeds. The Board is satisfied that the latter problem is solved by the process as defined in claim 3.

7.3 The claimed solution differs from the process according to D3 in that the flowing atmosphere near the point of entry of the fibre into the liquid is directed towards the surface of the optical fibre and consists essentially of CO_2. As indicated above, it was known from D3/D4 that the amount of gas entrained into the liquid depends on the kinematic viscosity of the gas above the liquid, and that complete elimination of the bubbles is achieved at high drawing speeds by replacing the air above the liquid meniscus by a flowing atmosphere of gases having a sufficiently low kinematic viscosity, for example by CCl_2F_2 whose kinematic viscosity is about 16% of that of air. The kinematic viscosity of some gases which were used in the experiments is reported in Table 2 of D3, in particular those of Ar, Xe, and CCl_2F_2 which are respectively 83%, 26% and 16% of the kinematic viscosity of air. The kinematic viscosity of helium, although far higher than that of air, is also mentioned in Table 2 apparently because it was used in the cooling device in view of its high heat conductivity. The skilled person whose aim was not to eliminate completely bubble inclusions in the coating but only to **reduce** bubble inclusions resulting from air entrainment would, in view of D3/D4, have considered replacing air by gases which exhibit a lower kinematic viscosity and do not react with the organic coating liquid. As the kinematic viscosity of CO_2 is about 55% of that of air, he would have expected some reduction of air entrainmnent with this gas, and would thus have recognised that this measure would have solved the technical problem under consideration. As regards the direction of the flowing atmosphere near the point of entry of the fibre into the coating liquid, D3 discloses on page 516 only the inlet of the force-feed coating applicator with gas flushing without indicating the direction of the flowing gas. However, as the atmosphere above the point of entry of the fibre into the liquid, ie near the inlet of the flexible tube shown on Figure 1, consists of the flowing gas which is flushed in the force-feed applicator, there are essentially three alternatives for the gas flow direction with respect to the fibre. It can be either parallel to the fibre, towards the fibre or diverging from the fibre. Choosing the most appropriate of these three alternatives lies within the competence of the skilled person. Therefore, the process according to claim 3 does not involve an inventive step and claim 3 does not meet the requirements set out in Articles 52(1) and 56 EPC.

8. Concerning the apparatus according to claim 1 of the first set, the Appellant has argued that D6 represented the closest prior art. This was not contested by the Respondent. In view of the fact that D3 contains only a very succinct description of the apparatus used for coating the optical fibre, the Board accepts this approach although D6 does not deal with the problem of avoiding bubble inclusions.

8.1 D6 has been analysed in detail in point 3 above. As already indicated above (see point 6.3), D6 neither mentions the drawing speed of the fibre nor deals with the problem of bubble inclusions in the coating. It results from the experimental report of 25 February 1998 that a coating apparatus as described in D6 does not lead at high drawing speeds (12 m/s) to essentially bubble-free coatings contrary to the claimed apparatus at identical drawing speeds and flow rate of gas. The Appellant's arguments that the apparatus used in this experimental report is not representative of the apparatus shown in Figure 4 of D6 because the dimension of the gap and the diameter of the exit orifice of the coater were not similar contrary to what is shown in Figure 4, cannot be accepted. In the Board's judgment, as Figure 4 is a diagrammatic drawing not to scale, no conclusion can be drawn as regards the dimensions of the gap and exit orifice or their proportions. Furthermore, the diameter of the die exit orifice (9 mil, ie 229 μm) used in the experimental report is in agreement with the film thickness mentioned in D6 at page 3, lines 15-16. It is also credible that with a gap of 2.5 inches (ie 6.3 cm) fibre threading through the apparatus was already impractical. In these circumstances, the Board has no reason to consider the apparatus used in the experimental report as not being representative of the apparatus according to D6. Furthermore, the Appellant has himself provided no evidence showing that the apparatus according to D6 would allow the production of essentially bubble-free coating at high drawing speeds.

Therefore, starting from D6 the technical problem is seen in the provision of a coating apparatus which permits producing essentially bubble-free coatings on optical fibres at high drawing speeds. This problem is solved by the apparatus as defined in claim 1. The claimed solution differs from the apparatus according to D6 at least in that (a) the fibre conditioning means is connected to the fibre inlet of the coating die and (b) the fibre conditioning means comprises an annular manifold chamber provided with a plurality of flow directing exhaust ports distributed around the circumference of said chamber. In view of the comparative examples in the said experimental report, the Board is satisfied that the said problem has actually been solved by the claimed apparatus.

8.2 The Appellant's argument that the use of a plurality of exhaust ports does not solve the problem of avoiding bubble inclusion but only improves the stability of the fibre is not convincing. In view of the statement on page 5, lines 47-51, of the patent in suit, there is no doubt that the features recited in (b) above also contribute to the solution of the stated problem, since they make it possible "to efficiently sweep entrained air" from the surface of the moving fibre.

D6 itself does not contain any information which could suggest to the skilled person how to modify the apparatus disclosed therein in order to avoid bubble inclusions in the coating at high drawing speeds. The Appellant did not rely on other documents at the appeal stage to substantiate that the claimed apparatus lacked an inventive step. The Board also did not find any indication in the remaining pre-published documents which could have hinted at the claimed solution. In particular, it is noted that neither D3 nor D4 gives more than the vaguest of information as to what constructional features were provided in the apparatus for introducing the flushing gas into the force-feed coating applicator. Furthermore, the apparatus of D3 was designed for the use of a flushing gas having a low kinematic viscosity whereas the constructional features of the claimed apparatus are chosen having regard to the fact that the gas must be sufficiently soluble in the liquid organic coating as pointed out by the Respondent. In these circumstances, the subject-matter of the apparatus claim 1 is considered to involve an inventive step.

9. The considerations set out in points 8 and 6 above, concerning the inventive step of the subject-matter of claims 1 and 2 of the first set of claims, apply mutatis mutandis to the subject-matter of claims 2 and 1 for Spain respectively. In respect of claim 1 for Spain the Board observes that, although the claimed proposal for solving the technical problem set out in point 6.1 above is somewhat different from that according to claim 2 of the first set, it comprises the relevant technical features concerning the position of the conditioning chamber and its connection with the coater, as well as the use of CO_2 as purge gas, so that the Board is satisfied that the said problem is also solved. It follows that claims 1 and 2 of both sets meet the requirements of patentablity set out in Article 52(1), whereas claim 3 in each set does not fulfil the requirement of inventive step. For the latter reason, the main request cannot be allowed.

Claims 1 to 3 according to the auxiliary request

10. The claims according to this request differ from the claims of the main request only in that the respective claims 3 indicate that the curable coating composition is a **UV**-curable coating composition. This feature has been incorporated into these claims in order to establish novelty of the process of said claims over D6, should the Board decide that their novelty is prejudiced by that document. However, as a UV-curable acrylate coating composition is used in D3 the reasons indicated above in points 7 to 7.3 in connection with the issue of inventive step of the process according to claim 3 of the main request apply likewise to the process according to this auxiliary request. Therefore, the auxiliary request for all designated Contracting States cannot be allowed either.

Further auxiliary requests

11. As stated in point 9 above, claims 1 and 2 for the Contracting States AT, BE, CH, DE, GB, IT, FR, LI, NL, SE, and claims 1 and 2 for Spain, all according to the main request meet the patentability requirements set out in Article 52(1) EPC. Therefore, the request based on claims 1 and 2 of both sets, claim 3 being deleted in both sets, 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 department of first instance with the order to maintain the patent with the following claims and a description to be adapted:

   Claims 1 and 2 according to the main request submitted during the oral proceedings, in both sets for Spain as well as for the other designated Contracting States, claim 3 being deleted in both sets.

The Registrar:

S. Hue

The Chairman:

R. Spangenberg

Te 9.6.

H. Fb.