

Candidate's Answer Paper
(Examination Paper B - Electricity/Mechanics)

Re: European Patent Application No.
Our Ref:
Title:

Date:

Dear Sirs,

This letter is in reply to the Examining Division's communication of

We enclose:

- (i) New claims 1 - 14 to replace all claims originally filed.
- (ii) Revised pages XXXX of the description and figures YYYY which are in agreement with the new claims as filed. These replace pages AAAA and figures BBBB as originally filed.

The above are submitted in triplicate. A single copy of the amended application documents showing hand annotated amendments corresponding to those above is submitted for the convenience of the Examining Division.

Please return a copy of enclosed Form 1037 to acknowledge that you have received these submissions.

Considering the amendments made, we submit the following:

Concerning Art. 123(2) EPC, new independent claim 1 has a preamble consisting of original claim 1 as filed. No features have been omitted from the original claim 1, so no broadening of subject matter is introduced by this wording.

The characterising portion of new independent claim 1 is disclosed in 95/B(E/M)/e/6, 1st paragraph, 2nd sentence of the description as originally filed. Indeed, the wording of the characterising portion is exactly that of original 95/B(E/M)/e/6, 1st paragraph, 2nd sentence minus the details concerning Figs. 1 - 3 and 5 - 7.

The combination of the preamble and characterising portion is clearly originally disclosed, because the 1st line of the 1st paragraph of the description (95/B(E/M)/e/6) refers to the arrangements of Figs. 8 and 9 as being embodiments of the invention. Therefore, they were originally foreseen as having all the features of original claim 1 as filed, which defined the invention.

Thus applicants believe no subject-matter to have been added by new claim 1.

Concerning Arts. 52(1) and 54(1,2) EPC we observe the following. The available prior art documents are Document I and Document II.

Document I shows neither means for forming a vapour bubble, nor a separate working fluid. Either of these features ensures novelty of amended claim 1 over Document I. Document II does not disclose formation of a vapour bubble in a separate working fluid. It is particularly of note

that all vessels, pipes and ducts of the Document II arrangement are devoted to containing the same fluid. See particularly figure 1 of Document II and elements 49, 50, 47, 46 and 54 of figure 3 of Document II.

Thus the applicants believe appended new claim 1 to be novel over the available prior art.

Concerning Arts. 52(1) and 56, first sentence EPC we observe the following:

Document II is considered to be the nearest available prior art document. This is because, like our invention, the ink jet printing device of Document II relies on the principle that rapid expansion of a vapour bubble can provide a displacement force which can be harnessed to create motion and an ink droplet. See particularly the last sentence of the 4th paragraph of Document II. Document I does not involve creation of a vapour bubble and therefore is considered less relevant than Document II.

New claim 1 adds to the combination of features of its preamble the feature that the vapour bubble is formed in a separate working fluid. The problems which this feature solves could be discussed in several ways. For our purposes we broadly consider one aspect of this problem to be the provision of force generation by rapid vaporisation without requiring an ink with particular properties. See 95/B(E/M)/e/6, last paragraph, lines 1 - 9 of the application as originally filed.

Accepting for the sake of our argument the Examining Division's view that Document II shows the feature of the preamble of new claim 1, the question to be considered is whether the person skilled in the art would be led from the arrangement of Document II to the arrangement of new claim 1 without resort to the inventive skill. We consider that he/she would not be so led.

Document II discloses a "thermoconductive foil" in close contact with its resistor 33 (see figures 1 and 2 of Document II). This foil serves two purposes, i.e. solves two problems, i.e.:

- (i) it "protects the resistor against thermal burnout into the ink", and
- (ii) "makes the resistor insensitive to the chemical properties of the ink used".

Dealing first with (ii), this is an arrangement for protecting the resistor. This can be seen as a problem of the resistor, e.g. that it is chemically damaged by the pH of the ink or that the abrasive nature of the ink removes layers of the resistor physically. Nothing in this problem or solution hints at providing a separate fluid.

Purpose (ii) identified above indicates that the resistor once more has a problem, that being that it may burn out. The fact that the foil is thermoconductive presumably indicates that, even when only vapour exists above the resistor and foil heat is conducted away from the resistor and prevents it cracking or melting. This feature appears to us to lead away from the arrangement of new claim 1 of our invention, which purposefully immerses its corresponding resistive heater in a fluid, in this case the separate working fluid. Considering that (ii) above teaches isolation of the resistive heater, no hint or feature is given toward the arrangement of new claim 1.

Document I foresees a flexible covering plate 3 for the application of a piston-like movement of a piezoelectric crystal 12 to an ink supply passage. As Document I concerns a dry mechanical "push on plate" action, this does not suggest a fluid immersed heating resistor: it suggests a

Thus there is no hint in Document II to seek to solve the problem which we have identified, and no means disclosed or suggested by Document I which would provide the solution which we have used. In particular, the only document concerned with force generation by rapid vaporisation shows no hint to seek a medium in which to generate a vapour bubble other than the ink available.

For the above reasons, we consider the problem and solution involved in new claim 1 to satisfy the requirements of Arts. 52(1) and 56, first sentence EPC.

We would furthermore add that it is beyond the means of the "unimaginative" person skilled in the art to start from the teaching of Document II, recognise the problem which we have solved and put in place a solution as claimed by the totality of features of new claim 1. Thus the arrangement of the invention is not per se obvious to the skilled person.

Briefly, the advantages which we see in the arrangement of new claim 1 are:

- (i) those already identified in the last paragraph of 95/B(E/M)/e/6 of the description as filed, which will not be re-stated here; and
- (ii) the basic design allows either a chamber with spaces (element 23 in (original) figure 8) or without (original figure 9), allowing any tailoring of the amount of force provided due to the available mass of working fluid to be vaporised. Thus different sizes of droplet or densities of ink can easily be accommodated;
- (iii) the membrane 21 and working fluid serve to isolate the thin fibre resistor appreciably, and by much more than envisaged in Document II, from chemical and mechanical attack.
- (iv) as no ink is vaporised in any part of the ink supply passage, there is no risk of ink vapour escaping via outlet (8).

Concerning Art. 84 EPC, clarity and completeness we submit the following. Our problem/solution approach argumentation showed that we have offered a complete solution in new claim 1. Additionally, we wish to point out that the phrase "acting on the ink" at the end of the preamble of new claim 1 adequately describes the link between the separate working fluid and the ink. Thus no expressis verbis mention of the flexible membrane (21) need be included in the claim.

The Examining Division has offered arguments in section 8 of the communication of alleging the "straightforward" nature of the arrangements of figs. 8 and 9 as originally filed.

In addition to our earlier problem/solution analysis, we consider that Guidelines C-IV 9.3 and 9.5 is relevant to the division's observations. It must be established that the skilled person would come upon a combination of documents, not just that a combination could be envisaged which approximates a claimed invention. It is also our contention that neither Document I nor Document II discloses a separate working fluid, so a combination of Documents I and II, even if thought of, would not lead to an arrangement with the features of new claim 1. As our analysis of Document II showed, the 8th paragraph of Document II which the division cites suggests a solution to two problems, neither of which is that which the problem/solution approach indicates is solved by our new claim 1. We respectfully disagree with the view under point 8 of the division's communication therefore

Concerning the dependent claims:

Claims 2 - 4 and claims 5 and 6 are original claims 2 - 4, 6 and 8 as originally filed. The statement on 95/B(E/M)/e/7 is considered to provide a basis for the combination of these features with those of new claim 1. Thus Art. 123(2) is satisfied.

The Art. 123(2) EPC basis for the remainder of the dependent claims is summarised in the following table:

Claim	Basis (pages/figs. of description as filed)
7	Figs. 8, 9; 95/B(E/M)/e/6, 2nd paragraph, 2nd line
8	Fig. 8
9	Fig. 9; 95/B(E/M)/e/6, 5th paragraph, lines 3 - 6
10	95/B(E/M)/e/6, 6th paragraph, lines 1 - 3
11	95/B(E/M)/e/6, 6th paragraph, 1st line
12	Figs. 8, 9 particularly element "8"
13	95/B(E/M)/e/7
14	Original claim 9; 95/B(E/M)/e/2, line 1

Very briefly considering the dependent claims, there are considered to specify further advantageous embodiments of the present invention:

Claims 7 - 10 have the advantage of manufacture from simple, regularly shaped components. The embodiment of claim 11 specifies one type of fluid with advantageous properties which can be used.

The embodiments of claims 12 and 13 solve the problems of particular ink delivery orientations.

The applicants request grant of a patent on the basis of the application documents now on file. This request and our enclosed submissions do not imply the abandonment of any of the subject matter of the application as originally filed. We wish to maintain our right to file one or more divisional applications in accordance with Art. 4b(2) Paris Convention and Art. 76 EPC.

Should the Examining Division have further queries or wish further amendment, we request a telephone interview, in order of preference. If the Examining Division should intend to refuse the present application without issue of another communication, we request oral proceedings.

Yours faithfully

Mr

(Authorisation No.).

Enc: Claims 1 - 14
Description
Figures

Note to the Examiner of paper B:

I would contact the client and inform him that extra claims fees on claims 11 - 14 will be payable on grant of the patent (Rule 51(7) and Rule 31(1) EPC).

Claims

1. A printing head comprising at least one ink supply passage (6), the or each ink supply passage (6) having at least one outlet (8), the or each outlet (8) being associated with means (4) for producing a pressure pulse in the ink (13) in the ink supply passage (6) to cause an amount of ink to be displaced towards and ejected out of the respective outlet (8) in the form of a droplet, the or each means for producing a pressure pulse comprising means for forming a vapour bubble (15) acting on the ink in the ink supply passage (6), characterised in that the vapour bubble is formed in a separate working fluid.
2. A printing head as claimed in Claim 1, characterised in that the or each ink supply passage (6) has an inlet (7) connected to an ink reservoir (10).
3. A printing head as claimed in Claim 1 or 2, characterised in that the outlet or outlets (8) is or are arranged along the length of the or each ink supply passage (6).
4. A printing head as claimed in any of Claims 1 to 3, characterised in that the or each ink supply passage is a capillary channel (6).
5. A printing head as claimed in any of claims 1 - 4, characterised in that the or each means for forming a vapour bubble comprises an electrical resistor (4).
6. A printing head as claimed in claim 5, characterised in that the or each resistor (4) consists of a thin fibre metallization layer.
7. A printing head as claimed in any previous claim characterised in that the separate working fluid is contained in a cavity (22) which is bounded by the resistor (4) on one side and which applies force to the ink in the ink supply passage (6) via a flexible membrane (21).
8. A printing head as claimed in claim 7 characterised in that the cavity (22) has side walls (23) whose height determines the height of the cavity in the direction away from said flexible membrane (22).
9. A printing head as claimed in claim 7 characterised in that the cavity (22) consists of rough parts of at least one of the resistor (4) and the flexible membrane (21), the volume of this cavity being sufficient for an adequate volume of working fluid to be contained for proper bubble formation.
10. A printing head as claimed in any of claims 7 - 9 characterised in that the working fluid is introduced between the resistor (4) and membrane (21) during manufacture.
11. A printing head as claimed in any of claims 7 - 10 characterised in that the working fluid

12. A printing head as claimed in any previous claim or claims characterised in that the ink is ejected in a direction substantially perpendicularly to the plane of the flexible membrane (21) as viewed in the rest position.
13. A printing head as claimed in any of claims 1 - 11 or combination thereof, characterised in that the ink is ejected in a direction substantially parallel to the direction of flow of ink in said ink supply passage.
14. A printer comprising a printing head as claimed in any of claims 1 - 13.