

THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 27

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte YUKIHISA TAKEUCHI and TSUTOMU NANATAKI

Appeal No. 1997-0947
Application 08/385,926¹

HEARD: OCTOBER 5, 1999

Before THOMAS, FLEMING, and FRAHM, Administrative Patent Judges.

FRAHM, Administrative Patent Judge.

DECISION ON APPEAL

Appellants have appealed to the Board from the examiner's final rejection of claims 1 to 7, which constitute all of the claims pending in the application.²

¹ Application for patent filed February 9, 1995. Appellants rely upon a foreign priority filing date under 35 U.S.C. § 119 of February 14, 1994.

² Claims 8 to 10 were canceled as per appellants' after final amendment dated August 29, 1996.

BACKGROUND

The subject matter on appeal is directed to the field of piezoelectric-electrostrictive (P/E) film elements which are used for purposes such as microphones, sensors, inkjet printers, etc. (specification, page 1). As indicated in the specification, appellants recognized that prior art P/E devices suffered from the problem that the P/E layer of the P/E unit suffers stress due to firing shrinkage, thereby causing the P/E film element not to exhibit its inherent piezoelectric/electrostrictive characteristics (specification, page 5). Appellants also recognized that when multiple P/E units are placed together on a substrate, the firing of one P/E unit may interfere with other P/E units on the same substrate, resulting in a reduced displacement of the diaphragm portions of the affected P/E units (specification, pages 5 to 6). To overcome this problem, appellants provide a substrate having a window and a convex diaphragm portion formed integrally therein, with a P/E film element consisting of upper and lower electrodes and a P/E layer sandwiched in between, wherein the P/E unit is laminated on the convex diaphragm by a film-forming method (see independent claim 1 on appeal and Figure 3). As stated by appellants in their specification, this arrangement converts stress and strain in the P/E unit with high efficiency and prevents a reduction in displacement amount when more than two P/E units formed on a substrate are actuated simultaneously (specification, page 5). The P/E film element recited by appellants in their claims on appeal effectively achieves the goals of reduced cross-talk between adjacent P/E units, increases diaphragm displacement and operating response, and increases mechanical strength of the diaphragm

(Brief, pages 3 and 11; and specification, page 31, Table 1).

For the reasons set forth in the Brief (pages 5 to 13), and as further discussed, infra, we find that the applied references to Texaco, Hubbard, and Ravinet fail to teach or suggest, individually or in any combination thereof, at least the features discussed above and defined in claims 1 to 7 of a substrate with integral convex diaphragm and a laminated P/E film unit formed on the convex diaphragm.

Representative independent claim 1 is reproduced below:

1. A piezoelectric/electrostrictive film element comprising:

a ceramic substrate having at least one window, and a diaphragm portion formed as an integral part thereof, for closing each of said at least one window, said diaphragm portion having a convex shape and protruding outwards, in a direction away from a corresponding one of said at least one window; and

a film-like piezoelectric/electrostrictive unit including a lower electrode, a piezoelectric/electrostrictive layer and an upper electrode, which are formed in lamination in the order of description on a convex outer surface of said diaphragm portion by a film-forming method, wherein said convex shape of the diaphragm portion is provided in an unbiased state of the piezoelectric/electrostrictive unit.

The following references are relied on by the examiner:

Ravinet et al. (Ravinet)	4,535,205	Aug. 13, 1985
Hubbard	4,635,079	Jan. 6, 1987
Texaco et al. (Texaco)	5,210,455	May 11, 1993

Claims 1 to 7 stand rejected under 35 U.S.C. § 103. As evidence of obviousness, the examiner relies upon Texaco in view of Hubbard.

Claims 1 to 7 stand rejected under 35 U.S.C. § 103. As evidence of obviousness, the examiner relies upon Texaco in view of Ravinet.

Rather than repeat the positions of appellants and the examiner, reference is made to the Brief and the Answer for the respective details thereof.³

OPINION

In reaching our conclusion on the issues raised in this appeal, we have carefully considered appellants' specification and claims, the applied references, and the respective viewpoints of appellants and the examiner. As a consequence of our review of the record before us, we find that Texaco, Hubbard, and Ravinet, fail to teach or suggest the salient features of claims 1 to 7 on appeal of a substrate having a window and a convex diaphragm portion formed integrally therein, with a P/E film element consisting of upper and lower electrodes and a P/E layer sandwiched in between, wherein the P/E unit is laminated on the convex diaphragm by a film-forming method. Accordingly, we will reverse the examiner's decisions rejecting claims 1 to 7 on appeal as being obvious under 35 U.S.C. § 103.

At the outset, we note that the examiner admits that the primary reference to Texaco (see Figure 11 therein) "doesn't show a convex diaphragm" (Answer, page 4 and page 5). The examiner then relies upon either of two secondary references to Hubbard and Ravinet to teach this feature. The examiner notes quartz crystal 28 in Hubbard's Figure 3 as being a convex piezoelectric disk which

³ We note that the amendment submitted with the Brief on August 29, 1996, has been entered and considered as per the October 30, 1996, communication from the examiner.

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"forms a diaphragm" (Answer, page 4) (emphasis added). The examiner further notes that "Ravinet shows (fig. 13) a convex (when undriven) piezoelectric disk (3) which forms a diaphragm (3)" (Answer, page 5) (emphasis added). The motivation for combining either of the secondary references with Texaco is the same, "in order to focus the generated energy" (Answer, page 4 and page 5). We note that the examiner makes no arguments in response to the Brief (see Answer, page 6, section 13, Response to Argument) and relies solely on the statement of the rejection at pages 3 to 5 of the Answer.

Independent claim 1 on appeal clearly calls for two distinct elements: (1) "a ceramic substrate having at least one window, and a diaphragm portion formed as an integral part thereof, . . . , said diaphragm portion having a convex shape;" and (2) a "piezoelectric/electrostrictive unit including a lower electrode, a piezoelectric/electrostrictive layer and an upper electrode, which are formed in lamination in the order of description on a convex outer surface of said diaphragm portion" (claim 1 on appeal) (emphasis added).

Appellants argue that Hubbard and Ravinet have no actual diaphragm since these references have eliminated the diaphragm by forming the piezoelectric layer itself in a convex shape (Brief, pages 7, 8, and 13). We agree.

Hubbard specifically states that a desired advantage of his invention "is that a diaphragm is no longer required, thereby saving a considerable amount of time in manufacturing and expense."

(Hubbard; column 1, lines 58 to 61). Thus, we agree with appellants (Brief, pages 8 and 9) that Hubbard teaches away from Texaco, who employs a flat diaphragm integral with a substrate. First, Hubbard teaches using quartz and not layered electrodes. Second, as recited in Hubbard's claim 1 (see column 3, line 33 to column 4, line 6), the crystal or piezoelectric element 28 is configured in a convex shape, and is not a diaphragm. The examiner relies therefore on the P/E unit 28 of Hubbard as constituting the diaphragm. We find no diaphragm in Hubbard.

Ravinet (Figure 13) teaches a microphone having a convex shaped P/E unit consisting of a piezoelectric plate (3) which is sandwiched between two electrodes (4 and 5). Ravinet fails, however, to teach a convex diaphragm integrally formed in a window of a substrate upon which the P/E unit is formed.

Appellants' claims on appeal call for a layered P/E unit 18 (consisting of lower electrode 12, P/E layer 14, upper electrode 16) being formed by lamination on top of a convex diaphragm (10), wherein the convex diaphragm (10) is integrally formed with a window (6) in a ceramic substrate (6). See appellants' Figure 3. Accordingly, since neither Hubbard nor Ravinet teach a distinct convex diaphragm portion and a layered P/E unit, we will reverse the rejections of claims 1 to 7 under 35 U.S.C. § 103.

The examiner has also failed to cite any persuasive motivation for making the combinations, other than to say that such would have been obvious "in order to focus the generated energy" for

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purposes of ink ejection and recording (Answer, pages 4 and 5). We agree with appellants (Brief, page 10) that there would have been no motivation for one of ordinary skill in the art to make the diaphragms of P/E elements convex in shape in order to focus energy, and that to have done so would have involved the use of hindsight.

In view of the foregoing, the decisions of the examiner rejecting claims 1 to 7 under 35 U.S.C. § 103 are reversed.

REVERSED

JAMES D. THOMAS)	
Administrative Patent Judge)	
)	
)	
)	BOARD OF PATENT
MICHAEL R. FLEMING)	
Administrative Patent Judge)	APPEALS AND
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)	INTERFERENCES
)	
ERIC FRAHM)	
Administrative Patent Judge)	

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