

The opinion in support of the decision being entered today was *not* written for publication and is *not* binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte JAMES MILLER,
KEVIN A. MCCULLOUGH,
E. MIKHAIL SAGAL, and
JEFFREY PANEK

Appeal 2007-0123
Application 10/408,939
Technology Center 1700

Decided: June 11, 2007

Before CHUNG K. PAK, CHARLES F. WARREN, and
LINDA M. GAUDETTE, *Administrative Patent Judges*.

GAUDETTE, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal from the Examiner's final rejection of claims 1-10, the only claims pending in this application. We have jurisdiction over the appeal pursuant to 35 U.S.C. § 6(b).

Appellants' invention relates to a thermoplastic, thermally-conductive composition for use in an article designed to dissipate heat, for example, a

thermal interface to a heat-generating electronic component. Independent claim 1 is illustrative of the invention and is reproduced below:

1. A thermoplastic, thermally-conductive composition, comprising:
 - a) about 20% to about 80% by weight of a thermoplastic elastomer matrix, said matrix forming a network;
 - b) about 25% to about 60% by weight of a first thermally-conductive, filler material having an aspect ratio of about 10:1 or greater;
 - c) about 5 to about 50% by weight of a phase change material, said phase change material being capable of changing from a solid state to a liquid state and from a liquid state to a solid state within a temperature range of about 10°C to about 115°C; and
 - d) about 10% to about 25% by weight of a second thermally-conductive, filler material having an aspect ratio of about 5:1 or less, wherein the composition has a thermal conductivity of greater than 3 W/m°K,

wherein said phase change material is contained within said network formed by said elastomer matrix such that said phase change material in said liquid state is retained in said network thereby preventing said liquid phase change material from flowing out of said network within said composition.

The Examiner relies on the following prior art references to show unpatentability:

MuCullough	US 6,048,919	Apr. 11, 2000
Duvall	US 6,391,442 B1	May 21, 2002

The Examiner made the following rejection:

Claims 1-10 under 35 U.S.C. § 103(a) as unpatentable over Duvall in view of McCullough.

ISSUE

The Examiner contends that it would have been obvious to modify Duvall's composition to include the filler materials disclosed in McCullough. Appellants contend that Duvall fails to disclose an elastomer matrix forming a network in which the phase change material is contained. The issue for us to decide is: Has the Examiner shown that Duvall's composition inherently possesses the claimed structure?

For the reasons discussed below, we answer this question in the affirmative. Accordingly, we affirm the Examiner's rejection of claims 1-10.

RELEVANT FINDINGS OF FACT ("FF")

- 1) Duvall discloses a thermal interface material composed of a thermally conductive filler and a phase change material. (Col. 5, ll. 29-30).
- 2) Duvall indicates that the thermally conductive filler can be a mixture and should be "selected from a variety of materials." (Col. 5, ll. 31-36). Suitable thermally conductive filler include "boron nitride, aluminum oxide, nickel powder, copper flakes, graphite powder, powdered diamond and combinations thereof." (Claim 15). The bulk conductivity of the mixture of thermally conductive fillers should be between 0.5 and 1000 W/m-°K (col. 5, ll. 36-37).
- 3) Duvall states that the particle size distribution and filler loading should be selected to maximize packing, thereby producing the most efficient thermal conductance. (Col. 5, ll. 41-44).

- 4) Duvall describes the phase change material as “a mixture of two or more compatible components or materials that undergoes a reversible solid-liquid phase change at the operating temperature of the heating device.” (Col. 5, ll. 47-50). Duvall notes that typical operating temperature is 50°C to 100°C. (Col. 5, ll. 56-57).
- 5) The first component of Duvall’s phase change material is a polymer component, which may be a single or multi-component elastomer consisting of one or more of silicone, acrylic, natural or synthetic rubber, or other appropriate elastomeric materials. (Col. 5, l. 66-col. 6, l. 4).
- 6) Duvall’s polymer component “provides the phase change material with body (viscosity) to prevent the melting point component and filler from flowing out from between the heat sink and the microprocessor heat source. It thus acts as a viscosity controller.” (Col. 6, ll. 28-32).
- 7) The second component of Duvall’s phase change material is a melting point component which is said to influence the melting point of the phase change material in order to achieve a melting point at around the operating temperature. (Col. 6, ll. 12-16).
- 8) The viscosity of the melting point component drops as the polymer component dissolves in it allowing the material to flow and wet adjacent surfaces of a heat sink and microprocessor heat source. (Col. 6, ll. 38-44).
- 9) In a preferred embodiment, Duvall’s thermal interface material comprises 10-80% polymer, 10-80% thermally conductive

- filler, and 10-80% melting point component. (Col. 6, l. 61-col. 7, l. 1).
- 10) McCullough discloses a thermally conductive composite material that is easily moldable or castable. (Col. 1, ll. 6-8).
- 11) McCullough discloses using a first thermally conductive filler having a relatively high aspect ratio of at least 10:1 and a second thermally conductive filler having a relatively low aspect ratio of 5:1 or less, in amounts of 25 to 60 vol. % and 10 to 25 vol. %, respectively. (Col. 2, ll. 25-30).
- 12) According to McCullough, the low aspect ratio filler fills the voids between the high aspect ratio filler. As a result, the number of interfaces and base matrix thickness between filler members is reduced, thereby providing a thermally composite material having improved thermal conductivity and performance. (Col. 2, ll. 36-42).
- 13) McCullough “preserves the advantages of prior art thermally conductive plastic compositions” (col. 2, ll. 9-10), which include “a polymer base matrix loaded with a granular material, such as boron nitride” (col. 1, ll. 38-39), and exemplifies the same (see, e.g., Fig. 1, col. 3, ll. 1-3 and col. 3, l. 38 – col. 4, l. 6).
- 14) McCullough discloses an example in which the high aspect ratio filler is carbon flakes with an independent thermal conductivity of 800 W/m-°K and the low aspect ratio filler is boron nitride granules with an independent thermal conductivity of 400 W/m-°K (col. 5, l. 65 –col. 6, l. 5).

- 15) McCullough discloses the material for the high aspect ratio filler and the low aspect ratio filler can also be aluminum, alumina, copper, magnesium, brass and carbon flakes. (Col. 5, ll. 23-50).
- 16) The Specification discloses that “[i]n preparing the compositions of this invention, the filler and phase change materials are intimately mixed with the non-conductive thermoplastic elastomer matrix.” (Specification [0026]).
- 17) The Specification teaches that “[t]he thermoplastic elastomer matrix of the thermally-conductive composition (interface) is important, because it provides a network for containing the liquid phase change material and prevents it from flowing out of the interface.” (Specification [0025]).

ANALYSIS AND CONCLUSIONS

The Examiner found that Duvall discloses the invention as claimed with the exception of an explicit disclosure of the use of a blend of high and low aspect ratio thermally conductive fillers. (Answer 4). In particular, the Examiner found that Duvall’s “polymer” and “melting point component” meet the limitations of the claimed “thermoplastic elastomer matrix” and “phase change material,” respectively.¹ The Examiner relies on McCullough for a disclosure of a thermally conductive composition comprising 25-60% by volume of fillers having a high aspect ratio of at least 10:1 and 10-25% by volume of fillers having a low aspect ratio of 5:1 or less. (Answer 4). The Examiner’s position is that it would have been

¹ Duvall refers to the polymer and melting point component collectively as “the phase change material.”

obvious to one of ordinary skill in the art at the time of the invention to have used McCullough's blend of fillers in the thermal interface material of Duvall. According to the Examiner, the motivation for this combination is Duvall's desire to use fillers that maximize packing to produce the most efficient thermal conductivity and McCullough's teaching that the disclosed blend of fillers provides superior thermal conductivity due to the decrease in the number of interfaces and base matrix thickness between filler members. (Answer 4).

Appellants contend that the Examiner's rejection is improper because Duvall's composition fails to meet the claim 1 limitation requiring that the phase change material be contained within a network formed by the elastomer matrix. (Br. 6). According to Appellants, the thermoplastic elastomer matrix of the present invention "creates an array of small encapsulating pockets that contain the phase change material." (Br. 6). Appellants contend that Duvall's polymer material cannot encapsulate the melting point component because the melting point component and polymer both melt at the operating temperature range of the heat source. (Br. 6). Thus, Duvall's melting point component is dissolved in the polymer, not contained within a network formed by the polymer matrix as required by claim 1. (Br. 6). Appellants reference, for example, Duvall's disclosure that "[t]he melting point component melts at around the operating temperature and **dissolves the polymer component in the melting point component.**" (Br. 5, (quoting Duvall, col. 6, ll. 38-47)).

During prosecution, claims are given their broadest reasonable construction in light of the Specification from the standpoint of one of

ordinary skill in the art. *See In re American Academy of Science Tech Center*, 367 F.3d 1359, 1364, 70 USPQ2d 1827, 1830 (Fed. Cir. 2004). We are in agreement with the Examiner's conclusion that the language of claim 1, when given its broadest reasonable construction, reads on all phase change materials present in a network, regardless of whether they are dissolved. (*See Answer 5*). Appellants have not identified any language in the Specification or claims, or produced other evidentiary support for their contention that the claim language requires encapsulation of the phase change material in the thermoplastic elastomer matrix. Rather, the Specification's broad disclosure that the materials are "intimately mixed" (FF 15) suggests that the claim phrase "wherein said phase change material is contained within said network formed by said elastomer matrix" encompasses dissolving the elastomer in the phase change material in the same manner taught by Duvall.

In any event, the Examiner's finding that Duvall uses the same materials for the polymer and melting point component as Appellants use for the thermoplastic elastomer matrix and phase change material, provides a reasonable basis on which to conclude that Duvall's composition and the claimed composition possess substantially the same structure. The kinds and amounts of materials used in the composition of Duvall are the same kinds and amounts of materials used by Appellants, i.e., the weight percentages of elastomer, thermally conductive filler (total), and phase change material of Duvall overlap or encompass those of appealed claim 1 (*see FF 1, 2, 5, 7 & 9*). The Examiner's position is further supported by McCullough's disclosure that polymer based matrices (or networks) are known in the art (FF 13). We also concur in the Examiner's conclusion that one of ordinary

skill in the art would have been motivated to use a combination of high and low aspect thermally conductive filler materials in Duvall's composition given McCullough's specific disclosure of using this combination and Duvall's teaching of using a combination of thermally conductive filler materials, which include the same high and low aspect thermally conductive materials used by McCullough (*compare FF 2 with FF 14 and 15*).

Therefore, the burden was properly shifted to Appellants to prove that the composition of Duvall, as modified in view of McCullough, does not necessarily or inherently meet the limitations of claim 1. *See In re Best*, 562 F.2d 1252, 1255, 195 USPQ 430, 433-34 (CCPA 1977). Appellants' argument that Duvall dissolves the polymer in the phase change material is not sufficient to meet this burden. Moreover, Appellants have not presented persuasive arguments or evidence to refute the Examiner's explanation of why one of ordinary skill in the art would have possessed the knowledge and motivation to combine the teachings of McCullough with Duvall. *See In re Kahn*, 441 F.3d 977, 988, 78 USPQ2d 1329, 1337 (Fed. Cir. 2006).

Accordingly, the rejection of claims 1-10 under 35 U.S.C. § 103(a) as unpatentable over Duvall in view of McCullough is affirmed.

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No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv) (2006).

AFFIRMED

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