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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte BRET W. LUDWIG[1]

Appeal 2017-009885
Application 14/110,991
Technology Center 3700

Before KEN B. BARRETT, WILLIAM V. SAINDON, and
JAMES P. CALVE, *Administrative Patent Judges*.

CALVE, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellant appeals under 35 U.S.C. § 134(a) from the Office Action finally rejecting claims 1–4, 6–8, and 10–12. *See* Appeal Br. 1. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

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[1] 3M Innovative Properties Company is identified as the real party in interest. Appeal Br. 2.

CLAIMED SUBJECT MATTER

Claim 1, the sole independent claim, is reproduced with claim 12.

1. A nonwoven abrasive article comprising:
a nonwoven web;
agglomerates comprising formed ceramic abrasive particles bound together by a first flexible binder, the first flexible binder comprising a polyurethane, wherein
a modulus of elasticity of the first flexible binder is less than 28,000 psi, and
a ratio of the formed ceramic abrasive particle size divided by the agglomerate size is 0.0033 to 0.5; and
a second binder binding the agglomerates to the nonwoven fiber web.

12. The nonwoven abrasive article of claim l, wherein the nonwoven abrasive article provides a finer finish on a substrate abraded with the nonwoven abrasive article as compared to a corresponding nonwoven abrasive article with a binder having a modulus of elasticity of greater than 28, 000 psi tested under the same conditions.

Appeal Br. 16, 17 (Claims App.).

REJECTIONS

Claim 12 is rejected under 35 U.S.C. § 112, fourth paragraph, for failing to further limit the subject matter of claim 1.

Claims 1–4, 6–8, 11, and 12 are rejected under 35 U.S.C. § 103(a) as unpatentable over Culler (US 5,942,015, iss. Aug. 24, 1999), Gebhardt (US 2011/0183142 A1, pub. July 28, 2011), and Benner (US 1,953,983, iss. Apr. 10, 1934).

Claim 10 is rejected under 35 U.S.C. § 103(a) as unpatentable over Culler, Gebhardt, Benner, and Carman (US 2003/0205003 A1, pub. Nov. 6, 2003).

ANALYSIS

Claim 12 For Failing To Further Limit Claim 1

The Examiner determines that claim 12 does not limit the structure of the abrasive article recited in claim 1, from which claim 12 depends, because claim 12 recites an intended result of using the abrasive article of claim 1 to provide a finer finish compared to other abrasive articles. Final Act. 2. The Examiner finds claim 12 "merely states that the abrasive article provides a finer finish than one with a binder having a higher modulus of elasticity" and "[t]his does not actually define any materials, configuration or composition of the abrasive article." Ans. 2. As a result, the Examiner determines that "[t]here is no structural difference between the abrasive article defined in claim 1 and the abrasive article defined in claim 12. *Id.* at 3.

Appellant argues that claim 12 requires the nonwoven abrasive article to provide a finer finish than a corresponding article having a binder with a modulus of elasticity of greater than 28,000 psi, and this feature is not required by claim 1. Appeal Br. 8; Reply Br. 2. Appellant also argues that claim 12 recites a structural feature of the abrasive article by characterizing the structure of claim 1 "as capable of providing a finer finish than a comparable abrasive article containing a binder with a modulus of elasticity of greater than 28,000 psi." Reply Br. 2.

The Examiner has the better position. Appellant discloses that using a flexible binder such as a polyurethane binder to make agglomerates out of formed ceramic abrasive particles significantly improves the surface finish of the work piece. Spec. 1:31–33. In fact, flexible bound agglomerates of formed abrasive particles produce a finer finish than abrasive articles made with identical abrasive particles that are not agglomerated. *Id.* at 2:5–8.

Appellant defines a "flexible binder" as a cured material having a modulus of elasticity of less than 28,000 psi. *Id.* at 3:9–13. Flexible binders include polyurethane. *Id.* at 3:13–14. Appellant discloses that, for purposes of defining an agglomerate binder resin as "flexible" or "rigid," a transition occurs when the modulus value decreases to less than 30,000 psi measured by ASTM D882. *Id.* at 25:1–3.

Test results show that agglomerating ceramic abrasive grains with a *flexible* urethane binder yields a finer finish compared to identically-shaped ceramic abrasive grains agglomerated with a *rigid* binder such as a phenolic binder. *Id.* at 20:19–26. Flexible urethane agglomerates with a modulus of elasticity less than 28,000 psi thus provide finer finishes. *Id.* at 23:9–12.

The Examiner therefore has a sound basis to find that the nonwoven abrasive article recited in claim 1 provides a finer finish on a substrate when compared to a corresponding nonwoven abrasive article having a modulus of elasticity of greater than 28,000 psi. *See* Ans. 2–3. Appellant discloses the finer finish feature as a property of agglomerates recited in claim 1, i.e., by agglomerates formed with a flexible polyurethane binder having a modulus of elasticity less than 28,000 psi. *Id.* at 3:9–14, 20:19–26, 23:9–12, 25:1–3.

It is well-settled that "[a] claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers." 35 U.S.C. § 112, fourth paragraph. Because claim 12 recites a feature that already is present in the structure recited in claim 1, claim 12 does not limit the scope of claim 1 any further. Indeed, Appellant asserts that "the ability to provide a finer finish using a binder with a modulus of elasticity of less than 28,000 psi than a comparable article with a binder having a modulus of elasticity greater than 28,000 is due to the advantageous structural features of the abrasive article recited in claim 1." Reply Br. 2–3.

Appellant also argues that the property recited in claim 12 "does not automatically flow from the express text of claim 1." *Id.* at 2. We are not persuaded by this argument because Appellant does not identify a structure in claim 12 that is not also present in claim 1. *Id.*; Ans. 2.

Instead, Appellant argues that "[c]laim 12 recites a structural feature of the abrasive article of claim 1 because it characterizes the structure of claim 1 as *capable of* providing a finer finish than a comparable abrasive article . . . having a modulus of elasticity of greater than 28,000 psi." Appeal Br. 2 (emphasis added). This argument supports the Examiner's finding that claim 12 merely recites features that already are present in the article of claim 1, which has a modulus of elasticity less than 28,000 psi. Ans. 2–3 (the result of having such a modulus does not further limit claim 12). The Examiner's finding is supported by the Specification's disclosure that binders with such a modulus provide finer finishes as discussed above.

Thus, we sustain the rejection of claim 12 under 35 U.S.C. § 112, fourth paragraph.

Claims 1–4, 6–8, 11, and 12
Unpatentable over Culler, Gebhardt, and Benner

Appellant argues claims 1–4, 6–8, 11, and 12 as a group. Appeal Br. 9–14. We select claim 1 as representative, with claims 2–4, 6–8, 11, and 12 standing or falling with claim 1. 37 C.F.R. § 41.37(c)(1)(iv).

The Examiner finds that Culler teaches a nonwoven abrasive article as recited in claim 1, including agglomerates of particles bound together by a flexible polyurethane binder, but lacks the claimed modulus of elasticity and ratio. Final Act. 3–4. The Examiner finds that Gephardt teaches the claimed ratio, and Benner teaches a flexible abrasive agglomerate and binder with a modulus of elasticity of about 10,000 psi. *Id.*

Appellant raises two principal arguments. First, Appellant argues that Benner mentions a modulus of elasticity of 10,000 psi for a rubber-bonded *agglomerate* but fails to teach a modulus of elasticity for the *binder*. Appeal Br. 9. Appellant argues that the modulus of elasticity of Benner's rubber binder cannot be extrapolated from the agglomerate's modulus of elasticity because Benner attributes the properties of the agglomerate to the degree of adhesion between the binder and abrasive particles. *Id.* at 9–10. Appellant argues that Benner describes the agglomerate's low modulus of elasticity as resulting from the ease with which abrasive particles detach from the rubber binder (i.e., the strength of the bond between the binder and the abrasive particles) and never suggests the modulus of elasticity of the binder can be a result-effective variable. *Id.* at 10–11; Reply Br. 3–4.

Although Benner does not disclose a modulus of elasticity of a binder per se, Benner teaches that the rubber binder makes the abrasive article soft, flexible, and compressive (i.e., pliable). Benner, 2:84–91, 2:117–121. The binder also provides qualities of softness and cushioning. *Id.* at 4:34–35. The Examiner correctly finds that Benner teaches that the abrasive article is soft, flexible, and compressive to cushion loose grains that are embedded therein and prevent scratching of a lacquer finish due to the qualities of the rubber binder. Benner, 2:120–126; Ans. 3 (citing *id.*).

"The modulus of elasticity of a material is a measure of its stiffness." Definition of modulus of elasticity by Collins English Dictionary at http://www.collinsdictionary.com/us/dictionary/english/modulus-of-elasticity (viewed Oct. 31, 2018). "By definition, a stiffer material has a higher modulus of elasticity." *Id.* The abrasive article has a low modulus of elasticity because the rubber binder deforms easily and elastically under stress indicating that the binder itself also has a low modulus of elasticity.

Benner supports this finding by teaching that the modulus of elasticity of the abrasive article indicates its greater compressibility and cushioning, i.e., its lack of stiffness. Benner, 4:22–32; Ans. 3. The Examiner reasonably finds that the greater compressibility, softness, and pliability of the abrasive article are attributable to the properties of the rubber binder rather than to the abrasive grains embedded therein so the 10,000 psi modulus of elasticity of the abrasive article is a reasonable indication of the modulus of elasticity of the rubber binder. Final Act. 4; Ans. 3. Specifically, it is reasonable that a person of ordinary skill in the art would understand that the softness, etc., of the material is derived from the soft rubber binder, not the hard abrasive grains. The Examiner also reasonably concludes that Benner teaches the advantages of a flexible binder with a low modulus of elasticity as a way to improve the finish of a work piece so that a skilled artisan would have been motivated to experiment with the modulus of elasticity of a binder to render obvious the claimed modulus of elasticity. Ans. 3–4; Final Act. 5.

In response, Appellant argues that "just because a binder is pliable (e.g., easily bent) or soft (e.g., not hard or firm) does not indicate it is elastically deformable." Appeal Br. 11. This argument is not persuasive because, as indicated by the definition of "modulus of elasticity" above, a skilled artisan would understand that the softness, compressibility, and pliability of a material indicate its modulus of elasticity. A material that deforms more easily under stress (is more pliable) has a lower modulus of elasticity. *See* Ans. 4 (softness or pliability indicate elastic deformability).

Appellant also argues that Benner attributes the properties of the agglomerate to the degree of adhesion between the binder and the abrasive particles (friability) so it is "entirely possible that the binder can have a higher modulus of elasticity than the agglomerate mixture." Reply Br. 4.

This argument is not persuasive because Benner discloses that this "friability" allows abrasive grains to loosen from the rubber binder when the abrasive article is *rotated and pressed* against a soft material such as lacquer. Benner, 2:92–120. Appellant has not explained how the ability of individual abrasive grains to separate from rubber binder when the abrasive article is rotated and pressed against a lacquer surface lowers the modulus of elasticity of the abrasive composition below that of the rubber binder by itself. This is especially true when Benner teaches "the abrasive article is soft and flexible and compressive" (*id.* at 2:121–122) to provide "softness or cushioning" *in addition to friability* (*id.* at 4:34–35). The Examiner reasonably finds that these properties are attributable to the rubber binder rather than the abrasive grains, such that the modulus of elasticity of the abrasive article indicates a low modulus of elasticity of the rubber binder within the claimed range of less than 28,000 psi. Ans. 3–4; *In re Peterson*, 315 F.3d, 1325, 1329 (Fed. Cir. 2003) (holding that a prima facie case of obviousness exists when the claimed range overlaps ranges in the prior art). Even if the modulus of elasticity of the rubber binder is higher than the 10,000 psi modulus of elasticity of the abrasive-rubber article, as Appellant argues, there is no basis to conclude that it is greater than 28,000 psi, which would be comparable to the modulus of a rigid resin according to the Specification. Spec. 25:1–3.

The Examiner's findings are supported by a preponderance of the evidence, and the Examiner's obviousness determination is supported by a rational underpinning based on the express teachings of Benner that a binder with a low modulus of elasticity (soft, flexible, compressive) improves the finish and reduces scratches. Benner, 2:117–130. This teaching provides motivation for a skilled artisan to experiment with the binder's modulus of elasticity modulus to render obvious the claimed range.

The second argument presented by Appellant is that Gebhardt is directed to abrasive grain agglomerates that are bonded together via an *inorganic* binder and Gebhardt criticizes and disparages *organic* binders, such as the claimed polyurethanes, as having weak bonds. Appeal Br. 12; Reply Br. 5. As a result, Appellant argues that a skilled artisan would not combine the claimed organic polyurethane binder with the ratio of abrasive grain size to agglomerate size disclosed in Gebhardt because Gebhardt teaches away from organic binders such as polyurethanes. Appeal Br. 13.

This argument is not persuasive primarily because it amounts to an individual attack on the references where the Examiner relies on Culler to teach a polyurethane first binder as claimed and Gebhardt to teach a ratio of individual grain size to agglomerate size that overlaps the claimed range and thereby renders it obvious. Final Act. 3–4. The Examiner also relies on the teaching of Gebhardt that this range of ratios improves fracture resistance of the agglomerates to provide a rational basis for providing the agglomerates of Culler with such a size ratio that is within the claimed size ratio to provide similar improvements in Culler. *Id.* at 4 (citing Gebhardt ¶¶ 36, 37); *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007) ("if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill").

We find no teaching in Gebhardt that the benefits of the particle size to agglomerate size ratio taught therein are limited to agglomerates formed with inorganic binders nor does Appellant present arguments to that effect.

Instead, Gebhardt teaches that organic and inorganic binders have different advantages and disadvantages. Gebhardt ¶¶ 7–11.

Gebhardt teaches that abrasive grain agglomerates are easy to produce by mixing single grains with a binding agent to form an agglomerate that is heat treated. *Id.* ¶ 8. Organic binders have the advantage that they can be heat treated at relatively low temperatures (between 200º C and 300º C) but the bond is less strong. *Id.* ¶¶ 9, 11. Inorganic binders form very strong bonds but they require relatively high temperatures (above 500º C), which are unsuitable for temperature-sensitive abrasive grains. *Id.* ¶¶ 9, 10.

Gebhardt teaches to use inorganic geopolymers of aluminum silicate material that form strong, stable agglomerates at temperatures below 450º C but still retain firmness comparable to known inorganic binders. *Id.* ¶¶ 15, 17, 25. Gebhardt teaches how to form agglomerates of varying sizes from abrasive particles of different sizes that exhibit a high degree of fracture resistance. *Id.* ¶¶ 26, 27, 29, 36, 37. The Examiner reasonably applies the general teachings of size ratios that improve fracture resistance to Culler for similar benefits with Culler's agglomerates.

We are not persuaded by Appellant's arguments that Gebhardt's teaching of the relative merits of organic and inorganic binders would have dissuaded a skilled artisan from using Gebhardt's particle to agglomerate size ratio in Culler to improve the fracture resistance of Culler similarly. This is particularly true where the prior art discussed in Culler uses an organic binder to form agglomerates with abrasive grain sizes of .05 µm to 10 µm and agglomerate sizes of 10 µm to 150 µm. *Id.* ¶ 7 (discussing DE 10 2005 007 661 A1). These particle and agglomerate sizes yield ratios of 0.005 (.05 µm ÷ 10 µm) to 0.00033 (.05 µm ÷ 150 µm) and 1.0 (.10 µm ÷ 10 µm) to 0.0667 (.10 µm ÷ 150 µm) that are comparable to those of Gebhardt and which overlap and render prima facie obvious the claimed ratio range.

For all the foregoing reasons, we sustain the rejection of claims 1–4, 6–8, 11, and 12.

Claim 10
Unpatentable over Culler, Gebhardt, Benner, and Carman

Appellant argues that Carman fails to remedy the deficiencies of Culler, Gebhardt, and Benner as to claim 1 from which claim 10 depends. Appeal Br. 14. Because we sustain the rejection of claim 1 as unpatentable over Culler, Gebhardt, and Benner, there are no deficiencies for Carman to remedy. Therefore, we sustain the rejection of claim 10.

DECISION

We affirm the rejections of claims 1–4, 6–8, and 10–12.

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).

AFFIRMED