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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte JAMES A. FEINN, DAVID P. MARKEL, ALBERT NAGAO, PAUL A. RICHARDS, THOMAS R. STRAND, ERIK D. TORNIAINEN, and LAWRENCE H. WHITE

Appeal 2019-001672
Application 13/634,753
Technology Center 2800

Before JULIA HEANEY, MONTÉ T. SQUIRE, and MICHAEL G. McMANUS, *Administrative Patent Judges*.

McMANUS, *Administrative Patent Judge*.

DECISION ON APPEAL

Pursuant to 35 U.S.C. § 134(a), Appellant[1] seeks review of the Examiner's decision to reject claims 1–3, 5–11, and 14–18. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM-IN-PART.

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[1] We use the word "Appellant" to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies the real party in interest as Hewlett-Packard Development Company, L.P. Appeal Br. 1.

CLAIMED SUBJECT MATTER

The present application, entitled "Noncircular Inkjet Nozzle," generally relates to inkjet printing. Spec. ¶ 1. More specifically, it describes a nozzle for an inkjet printer having an aperture through which ink is ejected. *Id.* ¶ 18. The aperture has a shape intended to "reduce velocity differences within the ejected droplet and leverage viscous forces to prevent the droplet from being torn apart." *Id.* The Specification teaches to use "inkjet nozzles which have a smooth profile with one or more protrusions into the center of the nozzle aperture" to achieve such goal. *Id.*

Claim 1 is illustrative of the subject matter on appeal and is reproduced below with certain limitations bolded for emphasis:

1. An inkjet nozzle comprising:

> an aperture having **a first segment defined by a first polynomial equation that forms a first elliptical lobe**, the aperture further having **a second segment defined by a second polynomial equation that forms a second elliptical lobe**, the aperture having protrusions between the two elliptical lobes extending inward to form a throat therebetween, wherein a shape of the aperture is mathematically smooth.

Appeal Br. (Claims App. i) (emphasis added).

REFERENCES

The Examiner relies upon the following prior art:

Name	Reference	Date
Murakami et al. ("Murakami")	US 7,506,962 B2	March 24, 2009
Koizumi et al. ("Koizumi")	US 7,967,413 B2	June 28, 2011

REJECTIONS

The Examiner maintains the following rejections:

1. Claims 1, 2, 5, and 7–10 are rejected under 35 U.S.C. 102(b) (pre-AIA) as being anticipated by Koizumi. Final Act. 2–5.
2. Claims 3, 11, and 14–18 are rejected under 35 U.S.C. 103(a) (pre-AIA) as being unpatentable over Koizumi. *Id.* at 6–11.
3. Claim 6 is rejected under 35 U.S.C. 103(a) (pre-AIA) as being unpatentable over Koizumi and Murakami. *Id.* at 11.

DISCUSSION

Rejection 1. The Examiner rejects claims 1, 2, 5, and 7–10 as anticipated by Koizumi. *Id.* at 2–5. In support of the rejection, the Examiner finds that Koizumi teaches "an aperture having a first segment defined by a first polynomial equation that forms a first elliptical lobe" and "a second segment defined by a second polynomial equation that forms a second elliptical lobe" as required by claim 1. *Id.* at 2–3. The Examiner

finds that Figure 3 of Koizumi, reproduced below, teaches elliptical lobes. *Id.*

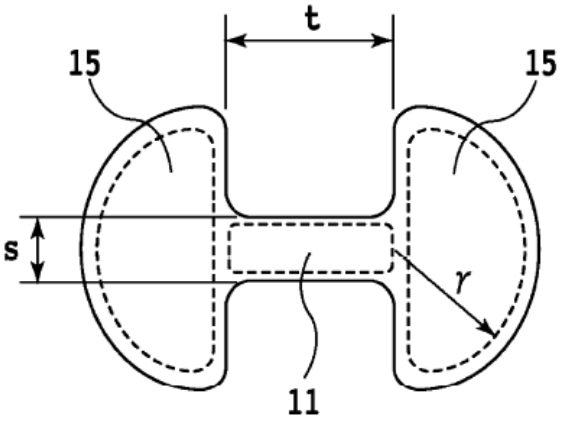


Figure 3 "shows details of the ejection opening 100." Koizumi, 5:45. Koizumi teaches that the figure includes a "pair of roughly semicircular openings 15, or first areas, situated at both ends of the ejection opening 100." *Id.* at 5:48–50.

The Examiner determines that one of skill in the art would have construed "'elliptical' to mean an ellipse and all ellipse-like shapes in light of the specification defining the shape of the apertures to be a fourth order polynomial with geometries including poly-ellipses and poly-circles as disclosed in [paragraph 28]." Final Act. 12.

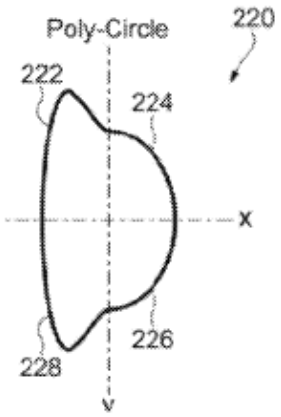
Appellant argues that the rejection of claims 1, 2, and 5 is in error because the openings shown by Figure 3 of Koizumi are semicircular, not elliptical. Appeal Br. 4–9. Appellant similarly argues that the openings taught by Koizumi are not defined by a polynomial equation. *Id.* We consider Appellant's latter argument first.

The Article submitted by Appellant, "Topic 10, Graphing Polynomials," (hereafter "Graphing Polynomials") teaches that "[a] polynomial is a monomial or sum or terms that are all monomials" and that "[p]olynomials can be classified by degree, the highest exponent of any individual term in the polynomial." Graphing Polynomials 1. The Specification teaches that segments of a circle may be defined by an equation of the form $X^2 + Y^2 = R^2$ (where R represents the radius of the circle). Spec. ¶ 31; *see also* Reply Br. 4. Because this equation has multiple terms, it is a polynomial equation. *See* Graphing Polynomials 1. Accordingly, the roughly semicircular portions of the aperture of Koizumi are segments "defined by a first [or second] polynomial equation" as required by claim 1.

In addition to requiring that the segments be defined by polynomial equations, claim 1 further requires that the aperture include first and second "elliptical lobe[s]."

The Examiner determines that "the circle is a special case of the ellipse and derived from the same equation when the constant A is zero, and when the entire equation is squared." Answer 6. Accordingly, the Examiner determines that a semicircular lobe is elliptical for purposes of the claims. *Id.* at 2–3.

Appellant argues that the Examiner's finding is contrary to the Specification which teaches, in reference to poly-circle 220 of Figure 2, that elliptical shapes are defined by equations of the form $(DX^2 + CY^2 + A^2)^2 - 4A^2X^2 = B^4$ while circular shapes are defined by equations of the form $X^2 + Y^2 = R^2$. Reply Br. 3–4. A portion of Figure 2 showing poly-circle 220 is reproduced below.



Element 220 of Figure 2 depicts an exemplary noncircular nozzle aperture geometry. Spec. ¶ 28. Poly-circle 220 is discussed in the Specification as follows:

> The poly-circle shape (220) includes an upper-left quadrant bounded by a first segment (222), an upper-right quadrant bounded by a second segment (224), a lower-right quadrant bounded by a third segment (226) and a lower-left quadrant bounded by a fourth segment (228). The first segment (222) and fourth segment (228) are each defined by a fourth degree polynomial equation of the general form: $(DX^2 + CY^2 + A^2)^2 - 4A^2X^2 = B^4$, both segments being defined using the same set of constants (A, B, C and D). The second segment (224) and third segment (226) are each defined by an equation of the general form: $X^2 + Y^2 = R^2$ (where R is a constant representing the radius of a circle). Poly-circle shape (220) thus is asymmetric about the y-axis, and is symmetric about the x-axis.

Spec. ¶ 31. Appellant argues that this portion of the Specification indicates that "segments 222, 228 are thus examples of elliptical lobes defined by a polynomial equation" while "segments 224 and 226 are defined by an equation used for defining a circle." Reply Br. 4.

Appellant, however, has not cited (nor have we located) any portion of the Specification that sets forth either a mathematical or textual

description of the term "elliptical." Nor has Appellant shown that the fourth order equation set forth in the Specification (*see, e.g.*, ¶ 29) coincides with the equation for an ellipse in common use. Appellant also has not shown error in the Examiner's determination "that the circle is a special case of the ellipse." *In re Berg*, 320 F.3d 1310, 1315 (Fed. Cir. 2003) (Absent legal error or contrary factual evidence, an examiner's findings may establish a prima facie case of obviousness.). Accordingly, we determine that Appellant has not shown error in the Examiner's finding that Koizumi teaches "a first segment defined by a first polynomial equation that forms a first elliptical lobe" and "a second segment defined by a second polynomial equation that forms a second elliptical lobe."

Appellant additionally argues that the rejection of claim 7 is in error. Appeal Br. 9–11. Claim 7 depends from claim 1 and further requires that "the first polynomial equation that forms the first elliptical lobe is a fourth degree order polynomial equation, and the second polynomial equation that forms the second elliptical lobe is a fourth degree order polynomial equation." *Id.* (Claims App. i).

Appellant argues that the openings taught by Koizumi are not formed using fourth degree polynomial equations. *Id.* at 9.

In the Answer, the Examiner reiterates that "[u]nder the condition where the constant A is zero and D and C are equivalent, the equation can be squared to produce a fourth degree polynomial which results in the same shape as the shorthand equation for a circle of equivalent radius." Answer 7. In its Reply Brief, Appellant merely refers back to its arguments regarding claims 1, 2, and 5. Reply Br. 13. Appellant has not shown specific error in the Examiner's finding.

Appellant additionally argues that the rejection of claims 8–10 is in error. Appeal Br. 11–12. Claim 8 depends from claim 1 and further requires that "the first polynomial equation has a general form of: $(DX^2 + CY^2 + A^2)^2 - 4A^2X^2 = B^4$, where A, B, C and D are constants which define a shape of the first segment." *Id.* (Claims App. ii). Appellant relies upon the same arguments as set forth with regard to claims 1, 2, and 5 and claim 7. *Id.* at 12 ("the semicircular openings 15 of Koizumi are not elliptical lobes defined by a fourth degree polynomial equation."). As we have not found such arguments to be persuasive, we determine that Appellant has not shown error with regard to the rejection of claims 8–10.

Rejection 2. The Examiner rejects claims 3, 11, and 14–18 as obvious over Koizumi. Final Act. 6–11. Appellant argues that the rejection of claims 3, 11, and 16 should be reversed for the same reasons as set forth with regard to claims 1 and 8. Appeal Br. 12. As we have not found such arguments to be persuasive, we determine that Appellant has not shown error with regard to the rejection of claims 3, 11, and 16.

Appellant further argues that the rejection of claims 14, 15, 17, and 18 should be reversed. *Id.* at 13–14. Claim 14 is an independent claim to a "droplet generator" comprising a "first elliptical lobe having a first cross-sectional area, a second elliptical lobe . . . having a second cross-sectional area that is different than the first cross sectional area." *Id.* (Claims App. ii). Appellant argues that the rejection of claim 14 should be reversed for the reasons stated with regard to prior claims and, additionally, because Koizumi does not teach an aperture having lobes with different cross-sectional area.

In the Answer, the Examiner determines that the claim, as drafted, does not clearly define the term "lobe." Answer 9. The Examiner determines that "the entirety of the lobe is not necessarily defined by the equation" and "the cross sectional areas which would be considered as 'a first cross-sectional area' and 'a second cross sectional area' are not defined by the equations nor limited by the same equations." *Id.* As a result, the Examiner determines, "any cross sectional area may be selected even if it does not encompass an entire nozzle area." *Id.* at 9–10.

The Examiner's determination, however, is not consistent with the Specification. In the context of Figure 3, the Specification teaches that "[t]he noncircular aperture (302) has two elliptical lobes (325-1, 325-2)." Spec. ¶ 39. Figure 3 is reproduced below.

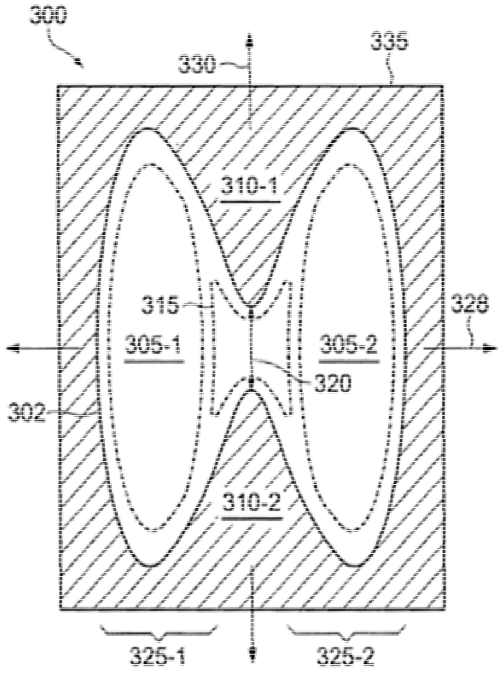


Fig. 3

The Specification teaches that "Fig. 3 is an illustrative diagram showing a poly-ellipse nozzle (300)." *Id.* ¶ 36. Similarly, in the context of Figure 3A, the Specification teaches that "each equation defines a segment of the aperture perimeter corresponding to one of a pair of opposed aperture lobes (425-1, 425-2)." *Id.* ¶ 45. The Specification further teaches as follows:

> it is to be understood that the first and second equations may define segments which do not correspond to lobes of the aperture. For example, the first equation may be employed to define a segment of the aperture perimeter that is on one side of the major axis, and the second equation may be employed to define a segment of the aperture perimeter that is on the other side of the major axis. Similarly, the first equation may be employed to define segments corresponding to one or more quadrants of the aperture perimeter, and the second equation may be employed to define the remaining quadrants of the aperture perimeter.

Id. ¶ 49. The Specification additionally teaches that "[t]he noncircular aperture (302) has two elliptical lobes (325-1, 325-2). Between the elliptical lobes (325), two protrusions (310-1, 310-2) extend toward the center of the nozzle (300) and create a constricted throat (320)." *Id.* ¶ 39.

Taking the foregoing as a whole, in conjunction with the claim language, it is apparent that a segment may correspond to only a portion of a lobe while a lobe is the portion of the aperture on either side of the protrusions.

In view of our construction of the term "lobe," we do not agree with the Examiner's finding that Koizumi teaches lobes with differing cross sectional areas, which is unsupported by a preponderance of the evidence. Accordingly, Appellant has shown error in the rejection of claim 14. As

claims 15, 17, and 18 depend from claim 14 and are rejected, in part, on the same basis (Final Act. 8–10), the rejection of these claims is shown to be in error.

CONCLUSION

The Examiner's rejections of claims 1–3, 5–11, and 16 are affirmed. The Examiner's rejection of claims 14, 15, 17, and 18 is reversed.

In summary:

Claims Rejected	35 U.S.C. §	Reference(s)/Basis	Affirmed	Reversed
1, 2, 5, 7–10	102(b) (pre-AIA)	Koizumi	1, 2, 5, 7–10	
3, 11, 14–18	103(a) (pre-AIA)	Koizumi	3, 11, 16	14, 15, 17, 18
6	103(a) (pre-AIA)	Koizumi, Murakami	6	
Overall Outcome			1–3, 5–11, 16	14, 15, 17, 18

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

AFFIRMED-IN-PART