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Paper 26
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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ABS GLOBAL, INC. and GENUS PLC,
Petitioner,

v.

XY, LLC,
Patent Owner.

Case IPR2014-01161
Patent 7,195,920 B2

Before GRACE KARAFFA OBERMANN, DONNA M. PRAISS, and MICHELLE R. OSINSKI, *Administrative Patent Judges.*

OBERMANN, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318 and 37 C.F.R. § 42.73

I. INTRODUCTION

This is a final written decision in an *inter partes* review of claims 1 and 3 of U.S. Patent No. 7,195,920 B2 (Ex. 1001, "the '920 patent"). Paper 1, "Pet." We instituted review on the following grounds:

1. Claim 1 as obvious over Johnson[1] and Rens[2];

2. Claim 1 as obvious over Johnson, Rens, and Simons[3];

3. Claims 1 and 3 as obvious over Johnson, Rens, and Touge[4];

4. Claims 1 and 3 as obvious over Johnson, Rens, Simons, and Touge;

5. Claim 1 as obvious over Johnson and Keij[5]; and

6. Claim 1 as obvious over Johnson, Keij, and Simons.

Paper 9, "Dec."

Patent Owner filed a Response (Paper 16, "Resp.") and Petitioner filed a Reply (Paper 19, "Reply"). A final hearing was conducted on October 7, 2015. Paper 25, "Tr." We have jurisdiction under 35 U.S.C. § 6(c). We determine that Petitioner demonstrates by a preponderance of evidence that claims 1 and 3 are unpatentable on the instituted grounds.

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[1] Johnson, US Patent 5,135,759, issued August 4, 1992 (Ex. 1005) ("Johnson").
[2] Rens *et al.*, US Patent 5,985,216, issued November 16, 1999 (Ex. 1006) ("Rens").
[3] Simons, US 5,447,842, issued September 5, 1995 (Ex. 1007) ("Simons").
[4] Touge, *et al.*, US 5,180,065, issued January 19, 1993 (Ex. 1009) ("Touge").
[5] Keij, *et al.*, *High-Speed Photodamage Cell Sorting: An Evaluation of the ZAPPER Prototype, Methods in Cell Biology*, Vol. 42, 371–386, (1994) (Ex. 1008) ("Keij").

A. The '920 Patent

The '920 patent relates to a method of discriminating between sperm cells based on a desired sex characteristic, namely, gender,[6] by separating X from Y chromosome-bearing cells, and, thereby, facilitating sex selection in mammalian offspring produced by artificial insemination. Ex. 1001, 1:12–29, 5:41–42. At the time of the invention, a challenge in the field was the large number of sperm cells required for artificial insemination; up to five hundred million, depending on the species. *Id*. at 1:30–38. The invention addresses "sex-specific and low dose efforts at artificial insemination." *Id*. at 1:16–17. The method of the invention includes a step of discriminating between X and Y chromosome-bearing sperm cells "at a rate of at least about 1200 sorts per second." *Id*. at 20:4–6.

An "object of the invention is to achieve low dose, sorted insemination on levels and with success rates which are comparable to those of the typical unsexed, high dose artificial insemination." *Id*. at 4:65–5:1. Sperm cells are extremely delicate and, by virtue of their shape, are susceptible to damage during sorting, which may cause stresses that negatively affect their performance in the insemination process. *Id*. at 2:45–67, 5:1–9. It was known at the time of the invention that "sperm are time-critical cells" that "lo[]se their effectiveness the longer they remain unused." *Id*. at 2:22–25. Speed, therefore, is "an essential element in achieving high

[6] We follow the convention of using "gender" as synonymous with biological sex. *See, e.g.*, Prelim. Resp. 1 ("The '920 patent relates to selecting the gender of offspring for artificial insemination applications using flow cytometry to identify and collect X-chromosome bearing sperm cells or Y-chromosome bearing sperm cells."); Ex. 1005, 1:15–17 ("Gender of animal offspring is important to livestock producers," for example, "the dairy farmer has little use for most bull calves.").

efficacy and success rates." *Id*. at 2:28–29. The method of the invention includes a step of collecting "viable sperm cells" following the discrimination step. *Id*. at 20:7.

Sperm sorting may be accomplished by providing a source of viable sperm cells, establishing a sheath fluid environment for the cells, discriminating between X and Y sperm cells, and collecting those sorted cells in separate containers. *Id*. at 1:39–2:29, 5:53–6:51. In a technique pioneered by Larry Johnson (the sole named inventor of the Johnson reference applied in each ground set for trial), a flow cytometer is employed to isolate single X or single Y cells in individual droplets that form a sample stream of fluid-sheathed sperm cells. *Id*. at 6:1–30. The sperm cells are treated with a staining agent that differentially dyes X and Y cells. *Id*.

The dyed cells, isolated in individual droplets, are differentially charged, and then differentially deflected as the droplets pass by electrostatic deflection plates. *Id*. at 6:12–51. The different lengths of the X and Y chromosomes cause different levels of staining; sensing the degree of dye present, the flow cytometer deflects X and Y chromosome-bearing cells in different directions, then separately collects the deflected fluid streams. *Id*. at 1:62–2:1, 6:12–51. Critical to our analysis, the deflected fluid streams are distinguished from an undeflected stream of wasted, "unsortable" cells. *Id*. at 6:45–51. Figure 1 of the '920 patent illustrates initial sample sperm cell stream (8), as well as three sperm cell streams that are formed after the deflection step—representing a stream containing X-type sorted cells, a stream containing Y-type sorted cells, and a stream containing "unsortable" cells—which are collected in three separate containers (14). *Id*.; *see* Fig. 1.

At the time of the invention, according to the ’920 patent specification, “the only quantitative technique used to achieve the separation of X and Y chromosome-bearing sperm has been that involving individual discrimination and separation of the sperm through the techniques of flow cytometry.” *Id*. at 1:62–66. “In the application of a high speed cell sorter to the sorting of sperm cells . . . rates of sorting in the thousand and twelve hundred ranges have already been achieved through a high speed cell sorter.” *Id*. at 7:20–25. Regarding that relatively high rate of sorting, the ’920 patent specifically credits advances “made by the flow cytometers available through Cytomation, Inc. under the MoFlo® trademark.” *Id*. at 7:3–5. The ’920 patent discloses that MoFlo® cell sorters “have increased sorting speeds extraordinarily and have thus made flow cytometry a technique which is likely to make feasible the commercial application of sperm sorting.” *Id*. at 7:6–9.

The ’920 patent also describes variations to the shape and orientation of the collection container, which may decrease stresses on the cells during collection. *Id*. at 10:1–59. The ’920 patent discusses other aspects of stress reduction, relating to selection of the collector fluid and use of a coordinated level of a nutrient to the cells. *Id*. at 10:60–14:10. Four examples purport to “show the performance enhancements possible through differing aspects of the invention.” *Id*. at 15:5–7, 15:16–18:18.

B. The Challenged Claims

Claim 1 of the ’920 patent is reproduced below.

1. A method of sorting cells comprising the steps of:

a. establishing a cell source which supplies viable sperm cells to be sorted;

> b. establishing a sheath fluid to create a sheath fluid environment for said viable sperm cells;
>
> c. sensing a property of said viable sperm cells;
>
> d. discriminating between said viable sperm cells having a desired sex characteristic at a rate of at least about 1200 sorts per second; and
>
> e. collecting said viable sperm cells having the desired sex characteristic comprising the step of cushioning said cells from impact with a collection container.

Claim 3 depends from claim 1, and further narrows the method by requiring that "said step of collecting comprises the step of collecting in an angled collector."

II. DISCUSSION

A. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are interpreted according to their broadest reasonable interpretation in light of the specification of the patent in which they appear. 37 C.F.R. § 100(b); *see In re Cuozzo Speed Techs., LLC*, 793 F.3d 1268, 1278 (Fed. Cir. 2015) ("We conclude that Congress implicitly approved the broadest reasonable interpretation standard in enacting the AIA."). Claim terms are given their ordinary and customary meaning as understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). If an inventor acts as his or her own lexicographer, the definition must be set forth in the specification with reasonable clarity, deliberateness, and precision. *Renishaw PLC v. Marposs Societa' per Azioni*, 158 F.3d 1243, 1249 (Fed. Cir. 1998).

This case turns on the broadest reasonable interpretation of two terms in claim 1: (1) "said viable sperm cells" in step (e); and (2) "discriminating between said viable sperm cells having a desired sex characteristic at a rate of at least about 1200 sorts per second" in step (d). We consider the applied prior art as representative of the level of ordinary skill in the art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). We turn now to resolving the broadest reasonable interpretation of those two claim terms.

i. "said viable sperm cells"

Claim 1 is directed to a method of sorting cells in a series of steps carried out on a supply of "viable sperm cells." In step (a) of claim 1, a supply of viable sperm cells is provided, and the term "said viable sperm cells" in subsequent steps (b) through (e) refers back to those cells.

Step (e) of claim 1 follows discrimination step (d), and specifies "collecting said viable sperm cells . . . comprising the step of cushioning said cells from impact with the collection container." In our decision to institute review, we determined that the term "said viable sperm cells" in step (e) refers back to the cells that were viable in step (a), but conveys "no intent to require that 'said viable sperm cells' must remain viable through the cushioning step." Dec. 8. On that basis, we held that claim 1 is broad enough to embrace a method in which none of the sperm cells, viable in step (a), remain viable through cushioning step (e). *Id*. at 9.

Based on the full trial record, we conclude that such an interpretation, while broad, is not reasonable. A person of ordinary skill in the art at the time of the invention would have understood that claim 1 carries a requirement that some number of cells collected in step (e) must remain viable—that is, capable of fertilizing an egg cell and useful for artificial

insemination. *See* Ex. 1001, 8:59–60 (referring to "the viability of the cells for their intended purpose (here, artificial insemination").[7]

In that regard, a skilled artisan would have recognized that some degree of cell death inevitably occurs during any method of sperm cell sorting and collection. *Id*. at 2:39–67, 4:48–66; Ex. 2012 ¶¶ 28, 31, 33; Ex. 1018, 87:21–88:13 (Patent Owner's witness). At oral argument, Patent Owner retreated from a position, taken in its brief, that claim 1 requires collection of at least about 1200 "viable" sperm cells per second. *Compare* Resp. 30–31 (citing Ex. 2012 ¶ 98), *with* Tr., 34:19–36:22. We agree with Patent Owner that a skilled artisan would have understood that claim 1 cannot reasonably be construed to require collection of at least about 1200 viable sperm cells. *See, e.g.*, Tr., 34:19–36:22 (Patent Owner's counsel, explaining that a skilled artisan would understand that not every cell discriminated must remain viable after collection to meet claim 1).

The entire thrust of the '920 patent specification, however, concerns collecting viable sperm cells that are capable of fertilizing an egg cell and are useful for artificial insemination. *See, e.g.*, Ex. 1001, Abstract, 1:12–38

[7] We have considered Patent Owner's argument that the '920 patent "sets out criteria for determining viability" that involves "statistical analyses with large groups of pregnancies observed and reported against a control" (Tr., 32:13–19), such that the term "viability" in the context of the '920 patent has a special meaning (*id.* at 33:19–34:2) beyond the plain and ordinary meaning of "capable of developing into a living thing" (*see* Merriam-Webster Dictionary, http://www.merriam-webster.com/dictionary/viable). We decline to require that "viable sperm cells" must meet such rigorous criteria, as we are not persuaded that the evidence of record supports such a special meaning for the term "viable." *See In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994) (requiring a special definition for a claim term to be set forth in the specification with "reasonable clarity, deliberateness, and precision").

(invention relates to minimizing stress on sperm during sorting and collection to achieve a cell population useful for sex-specific artificial insemination), 4:23–31, 8:57–63 (invention relates to sorting viable sperm cells capable of fertilizing an egg cell), 15:41–44, 16:25–30, 17:1–4, 17:62–67 (examples of invention, aimed at impregnating heifers via artificial insemination). Even Petitioner's witness acknowledged that the intended purpose of every sperm sorting method is the collection of viable sperm as a product. Ex. 2014, 55:24–56:3; *see* Tr., 15:19–16:12, 22:20–24:21 (Petitioner's counsel, acknowledging that some cells will die during sorting, but that the terms of claim 1 fairly convey to a skilled artisan a requirement that some cells must remain viable after collection step(e)).

A person of ordinary skill in the art, reading the term "said viable sperm cells" in step (e) of claim 1 in light of the specification, would have understood that the term carries a requirement that some number of collected cells must remain viable, that is, capable of fertilizing an egg and useful in artificial insemination. Ex. 1001, 20:7; *see, e.g., id*. at Abstract, 1:12–38, 4:23–31, 8:47–63, 15:41– 44, 16:25–30, 17:1–4, 17:62–67; *see also* Tr., 24:1–4, 32:1–36:22 (counsel for both parties, agreeing that step (e) requires collection of sperm cells that are useful for artificial insemination). We need not determine the exact number of collected sperm cells that must remain viable in order to meet the "said viable sperm cells" limitation of step (e). Tr. 35:19–23. As explained in more detail below, it is enough, for our purposes, to observe that no reasonable construction of that term excludes the sperm cell population collected by Rens, which was used successfully to impregnate cows in five *in vitro* fertilization experiments. *See* Ex. 1006, 7:46–57 (Example 7).

ii. "discriminating between said viable sperm cells having a desired sex characteristic at a rate of at least about 1200 sorts per second"

Step (d) of claim 1 specifies "discriminating between said viable sperm cells having the desired sex characteristic at a rate of at least about 1200 sorts per second." Ex. 1001, 20:4–6. We must resolve what counts as a sort when calculating the "rate of at least about 1200 sorts per second." *Id*.

In Petitioner's view, the aggregate number of sorted cells (X and Y cells together) is the rate of "sorts per second." Pet. 10–11, 24–25; Reply 1. Patent Owner, by contrast, focuses on the word "desired" in claim 1 to argue that only X (or only Y) cells are counted toward the rate, depending on which type of cell is desired by the person practicing the method. Resp. 15.

We select the broader of those two constructions (Petitioner's view) because it is consistent with how a "sort" is described in the '920 patent specification. Ex. 1001, 6:40. The '920 patent specification discloses that, at the time of the invention, the only quantitative technique for separating X from Y sperm cells involved the flow cytometer developed by Larry Johnson. *Id*. at 1:38–2:8. The specification further discloses that, in Johnson's technique, each act of sorting by the flow cytometer involves an individual droplet that contains an isolated sperm cell (a single X or a single Y cell). *Id*. at 6:12–15. The flow cytometer discriminates individual cells based on the differential dye adsorption of X and Y cells. *Id*. at 1:66–2:1. A cell sensing system detects the relative presence of dye, which stains X and Y cells to a different level, then deflects the X and Y cells into different containers based on their differing fluorescence emission levels. *Id*. at 6:15–48. In that manner, "it is possible to discriminate between X-bearing and Y-bearing sperm by their differing emission levels." *Id*. at 6:27–30. Critical to

our decision, the ’920 patent specification expressly describes a population of “unsortable cells” that are not deflected by the flow cytometer, but instead enter an undeflected “wasted stream” of cells. *Id*. at 6:48–51. The separation process, including the deflection streams that contain the sortable cells, is illustrated in Figure 1 of the ’920 patent.

The closest that the ’920 patent comes to defining a “sort,” for purposes of ascertaining the “sorts per second” rate, is in its description of how the flow cytometer distinguishes sortable cells (which are deflected) from “unsortable” cells (which pass through the system in an undeflected “wasted stream”). *Id*. at 6:48–51, Fig. 1. The flow cytometer “*acts to sort* the cells by causing them to land in one *or more* collectors.” *Id*. at 6:40–41 (emphases added), Fig. 1. A preponderance of evidence supports the broader interpretation advanced by Petitioner: A “sort” occurs whenever an individual sperm cell (whether X- or Y-type) is isolated in a droplet, sensed, and deflected by the flow cytometer. Each act of deflection represents a sort that counts toward the “sorts per second” rate in claim 1.

We are not persuaded by Patent Owner’s counterargument that the term “*desired* sex characteristic” in step (d) narrows claim 1, such that only X (or only Y) cells are counted in the “sorts per second” rate. That would make attaining the rate turn on the subjective desire of the practitioner. A broader and reasonable interpretation is that a “desired sex characteristic” is gender, and each discrete act of sorting a cell based on gender contributes to the “sorts per second” rate of step (d).

The ’920 patent discloses that, at least sometimes, a practitioner will desire both X and Y sorted sperm cells. In that regard, the patent refers to the circumstance in which both types of cells are separately packaged and

used after collection. Ex. 1001, 20:5; *see id*. at 5:41–44 ("[T]he basic goal is that of separating the X-bearing sperm from the Y-bearing sperm. This is done in a manner which isolates the two types of sperm so that each can be separately packaged and dealt with."); *see also id*. at 16:50–17:44 (Example 3, directed to collecting "sperm of each sex"—that is, both X and Y sperm—for use in artificial insemination). If the circumstance of desiring both X and Y sorted cells is not excluded from the scope of claim 1, then the term "cells having a desired sex characteristic" is broad enough to embrace X and Y sorted cells in the aggregate. We select the construction of "sorts per second" that does not exclude that circumstance, which is discussed at length in the specification. *See id*. at 5:41–44, 16:50–17:44.

Patent Owner identifies examples in which artisans have expressed a rate "based on one cell-type" or wherein cells "of each sex" are sorted per second. Resp. 18 (citing Ex. 2014, 2015, 2016). That evidence suggests that, when a sort rate is intended to correspond to the number of X or Y sorted cells alone, the convention is to state so explicitly. *Id*. We are not convinced that the inventors did so with sufficient clarity in claim 1. The broadest reasonable interpretation is that every deflected cell (whether X-type or Y-type) is a sort that counts toward calculation of the "rate of at least about 1200 sorts per second" in step (d). Ex. 1001, 20:6.

B. Patentability of Claim 1

We instituted trial based on six grounds of obviousness directed to claim 1, each of which applies Johnson in combination with one or more other references. We turn first to the disclosure of Johnson and resolve whether that reference discloses every feature of claim 1 except for the "sorts per second" rate specified in step (d). We then consider whether the

combined teachings of the applied prior art would have suggested modifying Johnson's method to attain "a rate of at least about 1200 sorts per second," by incorporating one of the cell sorting techniques disclosed in Rens or Keij.

We are mindful that a critical question is whether it would have been within the technical grasp of a skilled artisan to employ the modified method of Johnson "at a rate of at least about 1200 sorts per second," while maintaining the ability to collect "viable sperm cells." Ex. 1001, 20:5–9.

i. Johnson

The inventors of the '920 patent repeatedly acknowledge and applaud "the seminal work (no pun intended) by Larry Johnson," citing the same Johnson patent that is applied in the Petition. *Id*. at 6:17–20 (citing "Lawrence Johnson in U.S. Pat. No. 5,135,759"); *see id*. at 2:4–8 (citing and applauding "U.S. Pat. No. 5,135,759") ("The Johnson technique of utilizing flow cytometry to separate X and Y chromosome-bearing sperm has been so significant an advancement that it has for the first time made the commercial separation of such sperm feasible."); *see also id*. at 3:4–5 (lauding "the great advances achieved through the Johnson patent") and 3:22–23 (same).

Johnson discloses a method of "separation, by flow sorting, of intact, viable X and Y chromosome-bearing . . . sperm populations based on relative DNA content" as well as "the subsequent birth of" sex-selected offspring. Ex. 1005, 2:64–3:3. Johnson's method provides a source of viable sperm cells (*id*. at 2:64–67), establishes a sheath fluid to create a sheath fluid environment for those cells (*id*. at 3:44–49; 4:44–50; 6:27–28, 33–35, 38–41; Ex. 1003 ¶¶ 116, 120, 150), senses a property of those cells (Ex. 1005, 2:64–3:13, Ex. 1003 ¶¶ 114, 115, 151), discriminates between those cells based on a desired sex characteristic (for example, gender)

(Ex. 1005, 2:64–3:13, 4:14–18), and collects those cells by cushioning them from impact with a collection container (*id*. at 4:51–58, 6:40–41).

Johnson sorts "intact sperm" cells on a "modified EPICS V flow cytometer/cell sorter." *Id*. at 6:33–35; *see id*. at 2:64–66 (achieving "separation, by flow sorting, of intact, viable X and Y chromosome-bearing rabbit and swine sperm populations"). The cells are "sorted into a test egg yolk extender." *Id*. at 6:40–41. The method collects "viable sperm cells" that are capable of fertilizing an egg cell, as demonstrated by the cells' utility in artificial insemination experiments. *Id*. at 6:65–68; Tables I and II.

A question arises whether Johnson's method includes "cushioning [the] cells from impact with a collection container" as required by claim 1. Ex. 1001, 20:8–9; *see* Ex. 1005, 4:51–58, 6:40–41. On that point, Johnson discloses that "sperm were collected in test egg yolk extender" that was "modified by adjusting the pH and adding a surfactant." Ex. 1005, 4:51–58; *see id*. at 6:40–41 ("[s]perm were sorted into a test egg yolk extender").

Patent Owner argues that Johnson fails to disclose a cushioning element that meets step (e) of claim 1, because the reference "lacks any discussion of altering the geometry of the collection container." Resp. 40–41 ("altering the geometry of the collection container . . . is a required part of the cushioning element" of claim 1). That argument is unpersuasive. Nothing in the claim language limits the cushioning step to altering the container geometry. Ex. 1001, 20:7–9. On the contrary, the plain language of the claim supports Petitioner's view that "[c]laim 1 requires only cushioning 'from impact with a collection container,'" which "can be achieved using liquid in the container." Reply 15 (citing Ex. 1001, 20:8–9).

The ’920 patent specification describes the use of fluid “in the bottom of the container to collect the cells so that they do not hit the bottom of the container.” Ex. 1001, 10:8–10. The ’920 patent further states expressly that an altered container geometry is but one solution for cushioning delicate cells during collection; the specification does not suggest that an altered container geometry is the only solution. *Id*. at 10:17–23 (the ’920 patent, disclosing that a cushioning element “such as” an altered container geometry “may be important” when collecting delicate cells). Patent Owner’s own witness testified that liquid placed in the container prevents cells from hitting the container. Ex. 1018, 96:2–12.

We acknowledge that Johnson does not disclose explicitly that the egg yolk extender cushions the cells during collection. But a preponderance of evidence establishes that a “collection fluid may also serve as a cushioning element” during cell sorting and collection. Ex. 1001, 10:55–56; Ex. 1003 ¶¶ 67, 119, 159, 160. As Petitioner points out, Simons bolsters the proposition that a protein source, such as the egg yolk extender disclosed in Johnson, in fact functions as a medium for “cushioning said cells from impact with a collection container.” Pet. 27–29. Specifically, Simons discloses the importance of maintaining “cell integrity” and that a “protein source can be added to the flow cytometer collection vessel . . . to cushion the fall of the cell into the vessel, enhancing cell stability.” Ex. 1007, 12:34–38, 12:62–65; *see* Pet. 28 (citing evidence that a skilled artisan would have considered the disclosure of Simons in view of Johnson’s disclosure);

Ex. 1003 ¶ 160 (opinion testimony, explaining why a skilled artisan would have considered the combined disclosures of Johnson, Rens, and Simons).[8]

Patent Owner suggests that certain embodiments described in the '920 patent specification, relating to the shape and size of the collection container, should be imported into the cushioning step of claim 1. Resp. 20–22. We reject that suggestion because it is not supported by the broader wording of the claim. Ex. 1001, 20:7–9 (specifying a "step of cushioning said cells from impact with a collection container," without placing any further limitation or condition on the step); *see, e.g., SuperGuide Corp. v. DirecTV Enters., Inc.*, 358 F.3d 870, 875 (Fed. Cir. 2004) ("[A] particular embodiment appearing in the written description may not be read into a claim when the claim language is broader than the embodiment."); *In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993) ("[L]imitations are not to be read into the claims from the specification").

Johnson discloses all but one feature of claim 1: The missing feature is "discriminating between cells having a desired sex characteristic at a rate of at least about 1200 sorts per second." Ex. 1001, 4–6. When addressing the sort rate, Johnson discloses that "intact X- and Y- bearing sperm fractions were sorted simultaneously from the population of input sperm at a rate of 80-90 sperm of each type per second." Ex. 1005, 4:16–18.

[8] Simons provides background information probative of techniques that were available at the time of the invention for cushioning cells during a sorting operation. *See, e.g.*, Ex. 1007, 20:36–41. We are not persuaded that Simons' focus on blood cells makes it non-analogous art. Resp. 46–49. "When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007).

We next address whether a skilled artisan, informed by the combined disclosures of the applied prior art, would have had the desire and ability, with a reasonable expectation of success, to modify Johnson's method to discriminate between X and Y sperm cells "at a rate of at least about 1200 sorts per second," as specified in step (d) of claim 1. Ex. 1001, 20:4–6. Here again, we train our attention on whether it would have been within the technical reach of a skilled artisan to increase the sort rate to the degree required by step (d), while maintaining an ability to collect "viable sperm cells" as required by step (e). We turn first to the grounds based on Rens, and then discuss those based on Keij.

ii. Rens

Rens is directed to a flow cytometry orienting nozzle that "enable[s] the utilization of high speed cell sorters in order to maximize the number of sorted sperm per unit time." Ex. 1006, 2:39–41. A person of ordinary skill in the art would have been aware of the orienting nozzle disclosed in Rens, and would have recognized its "application for sorting viable male (Y) and female (X) sperm populations in a cell source." *Id*. at Abstract.

Rens describes using the orienting nozzle to achieve high speed sperm sorting with two commercially-available cell sorters: an EPICS® V Series flow cytometer/cell sorter (of the type used to sort sperm cells in Johnson) and a MoFlo® high speed cell sorter (of the type used to sort sperm cells in the '920 patent). Ex. 1003 ¶ 128 (citing Ex. 1005, 6:34–35; Ex. 1006, 5:12–18). We find significant that Rens uses a MoFlo® high speed cell sorter, which the '920 patent specification credits as having "increased sorting speeds extraordinarily" to achieve "rates of sorting in the thousand and twelve hundred ranges." Ex. 1001, 7:3–25.

In Example 7, Rens applies "the MoFlo® high speed cell sorter" to a flow cytometry method developed by Larry Johnson. Ex. 1006, 5:16–20 (Rens, explaining that "the MoFlo® high speed cell sorter . . . was modified for sorting sperm as described in" a 1986 publication of Johnson); *see id.* at 1:17–28 (identifying and discussing that publication). A key dispute in this review is whether, in Example 7, Rens discloses a method of discriminating between X and Y sperm cells "at a rate of at least about 1200 sorts per second." Ex. 1001, 20:4–6.

Example 7 discloses that "up to 25 millionxsperm [sic] (50 million, total X and Y) were required to be sorted between 9am and 4pm." Ex. 1006, 7:52–54 (Example 7). Example 7 discriminates between X and Y cells at a rate of 1984 sorts per second—if one calculates the rate based on the aggregate number of sorted X and sorted Y cells (Petitioner's view). Pet. 10–11, 24–25. Example 7 achieves a sort rate of exactly half that amount, namely, 992 sorts per second—if one calculates the rate based only on the number of X cells sorted, or only on the number of Y cells sorted, but not both (Patent Owner's view). Resp. 29.

For reasons discussed above in our claim construction analysis, we hold that the "sorts per second" rate recited in step (d) corresponds to the aggregate number of X and Y chromosome-bearing sperm cells that are discriminated and deflected during a droplet sorting operation. *See supra*. Example 7 discloses a method that discriminates between X and Y sperm cells at a rate of 1984 sorts per second (based on the 50 million X and Y sperm cells that are sorted over 7 hours). Ex. 1006, 7:46–57; Pet. 10–11, 24. Patent Owner's counterview—that Example 7 discloses a sort rate of exactly half that number, or 992 sorts per second—is unconvincing in view of our

conclusion that the "sorts per second" rate in claim 1 corresponds to the aggregate number of X and Y sperm cells deflected by the flow cytometer.

A skilled artisan would have been looking for ways to increase the sort rate of Johnson's method. At the time of the invention, a person of ordinary skill in the art would have been well aware of the desirability of sorting X and Y sperm at increasingly higher sort rates to facilitate sex-specific artificial insemination. The commercial importance of gender selection in animal offspring was well understood; for example, in "beef cattle and sheep breeds, the male grows at a faster rate than the female and hence is preferred for meat production," while "sexed semen to produce only females would make milk production more efficient." Ex. 1005, 1:15–24. At the time of the invention, a well-established goal in the field was "the utilization of high speed cell sorters in order to maximize the number of sorted sperm per unit time." Ex. 1006, 2:40–43.

The inventors acknowledge that artisans were actively seeking ways to increase the rates of sorting X and Y sperm at the time of the invention, and indicate that "[a]dvances have been particularly made by the flow cytometers available through Cytomation, Inc. under the MoFlo® trademark," which the inventors further characterize as having "increased sorting speeds extraordinarily and have thus made flow cytometry a technique which is likely to make feasible the commercial application of sperm sorting." Ex. 1001, 7:3–9; *see id*. at 2:9–22 (although "still experimental, separation has been significantly enhanced" by using "high speed flow cytometers such as the MoFlo® flow cytometer produced by Cytomation, Inc.," which produce "almost ten-fold advances in speed" of sorting sperm cells). Artisans were aware that "the time critical nature of"

sperm cells in the artificial insemination process "made speed an essential element in achieving high efficacy and success rates." *Id*. at 2:27–29. A desire to achieve higher sort rates would have prompted a skilled artisan to look for ways to modify Johnson's method to increase the rate of sorting.

Both Johnson and Rens concern discriminating between X and Y cells for use in sex-specific artificial insemination. Both describe the EPICS® V series of flow cytometers as useful for that purpose. Ex. 1005, 6:34–35; Ex. 1006, 5:12–18). Rens recognizes that, by adapting a "MoFlo® high speed system . . . with a complete flow cell system common to the EPICS system," the device "was then able to receive the elliptical nozzle" of Rens' invention. Ex. 1006, 5:28–35. Rens explicitly discloses applying the MoFlo® high speed sorter to the flow cytometry technique developed by Larry Johnson. *Id*. at 5:16–20.

Petitioner establishes by a preponderance of evidence that it would have been obvious to modify Johnson's method in view of the disclosure of Rens to attain the "sorts per second" rate of step (d), while maintaining the ability to collect "viable sperm cells" as required by step (e) of claim 1. Ex. 1001, 20:4–9. Rens discriminates between X and Y sperm cells at a rate of 1984 sorts per second and uses the sorted cells in "experiments (from 1 to 5 cows)" that "were successfully carried out 5 times." Ex. 1006, 7:55–57 (Example 7). Rens discloses that the MoFlo® sorter, employed in Example 7, enables a sort rate that "would not have been possible without the nozzle of the invention." *Id*. at 5:16–18.

No reasonable construction of "said viable sperm cells" in step (e) of claim 1 excludes the population of cells collected by Rens in Example 7, where that population was used to impregnate "from 1 to 5 cows" in each of

five *in vitro* fertilization experiments. *Id*. at 7:55–57; *see id*. at 7:35–44 (explaining that Rens' experiments involved "in vitro fertilization"). Rens shows that at least some of the collected cells were capable of developing into a living thing by fertilizing an egg cell, and were useful in artificial insemination. *Cf.* Tr., 33:19–34:5 (Patent Owner's counsel, insisting at oral argument that, notwithstanding so many pregnant cows, a question remains whether Rens collected viable sperm cells in Example 7).

Patent Owner argues that Example 7 contains "no disclosure about whether any of the recipient cows were successfully fertilized." Resp. (citing Ex. 2012 ¶ 98). That argument is at odds with explicit statements in Rens, indicating that the *in vitro* fertilization experiments of Example 7 "were *successfully* carried out 5 times." Ex. 1006, 7:56–57 (emphasis added); *see id*. at 5:45–48 ("The last two experiments (Examples 6 & 7) applied the nozzle of the invention to the high efficacy sorting of X and Y sperm *for fertilization which would otherwise not have been possible*.") (emphasis added); *see also id*. at 7:48–49 (Example 7) ("Sorted X and Y (primarily X) sperm were used for artificial insemination of dairy cows.").

A preponderance of evidence shows that a skilled artisan would have had the desire and ability to carry out the method of claim 1 with a reasonable expectation of success. Claim 1 is unpatentable as obvious over Johnson, Rens, and Simons.

iii. Keij

In the alternative, we determine that the subject matter of claim 1 would have been obvious over the combined disclosures of Johnson, Keij, and Simons. As explained above, Johnson discloses all but one feature of claim 1. The reference does not disclose a method of "discriminating

between cells having a desired sex characteristic at a rate of at least about 1200 sorts per second." *See supra*. Petitioner shows by a preponderance of evidence, however, that a skilled artisan would have been led to modify Johnson's method to include the photodamage sorting technique disclosed in Keij and, thereby, achieve the "1200 sorts per second" rate of step (d), while maintaining the ability to collect "viable sperm cells" as specified in step (e). Ex. 1001, claim 1.

Keij discloses a photodamage cell sorter "as a high-speed alternative to droplet sorters." Ex. 1008, Title, 372. In Keij, a first laser detects cells, and a second laser exposes undesired cells "to a lethal pulse of laser light." *Id*. at 372. Photodamage sorters achieve high sort rates in part because they "are not limited in sort rate by the droplet frequency" of a conventional droplet sorter. *Id*.; *see* Ex. 1001, 6:1–11 (explaining mechanism by which a flow cytometer isolates individual sperm cells in droplets). Keij discloses a ZAPPER photodamage sorter that selectively kills or damages unwanted cells with a zap laser beam, leaving desired cells viable; no cells are deflected—both viable and zapped (non-viable) cells are collected in the same container. Ex. 1008, 372 (describing a photosensitizer having "the ability to kill cells after only a brief exposure to a high-power laser flash"); *see id*. at 373 (describing how a cell population "could be rapidly processed by the ZAPPER to a desired level of purity"); *id*. at 374 (describing "beams of the . . . zap laser"); *id*. at 375–377 and Fig. 1 (depicting the ZAPPER and describing how it works); Tr. 6:9–23 (Petitioner's counsel, explaining why each cell killed by the ZAPPER represents a sort).

Whereas a droplet sorter is limited by droplet frequency, "[s]ort rates in a photodamage sorter are limited by coincident arrival of cells during the

laser beam transit time, the electronics processing time, and the sort execution time." *Id*. at 377. Keij posits that photodamage sorters could achieve "a theoretical sort rate of 5,000,000/sec." *Id*. Keij reports that "practical processing rates of 100,000 cells/sec were achieved" using a ZAPPER. *Id*.; *see id*. at 373 (Keij, reporting that "we have completed the design and construction" of a ZAPPER device, "which was designed to operate at sort rates of 100,000 cells/sec").

Keij applies the ZAPPER not to the sorting of sperm cells, but rather, to the sorting of *Escherichia coli* (*E. coli*) cells. *Id*. at 373, 376. Keij identifies other applications, including "the purging of leukemic cells from bone marrow grafts, the isolation of hybrid cells obtained through fusion procedures, and the isolation of hybridoma class switches and mutant cells." *Id*. at 373. Significantly, Keij suggests applying the ZAPPER "when large numbers of sorted cells are required." *Id*. In that context, Keij expressly states: "Sorting of X or Y chromosome bearing sperm cells for insemination is an interesting possibility," citing the work of Larry Johnson. *Id*. (internal citation omitted).[9] We must resolve whether that "interesting possibility" would have been within the technical grasp of a person of ordinary skill in the art at the time of the invention. *Id*.

A person of ordinary skill in the art would have considered Johnson in conjunction with Keij, given the goals and techniques described in each

[9] Patent Owner argues that Keij is non-analogous art because it does not disclose a method of sorting sperm cells. Resp. 46–49. Keij, however, discloses a method of cell sorting, and expressly suggests applying that method to the work of Larry Johnson to sort sperm cells. Ex. 1008, 373. We are not persuaded that Keij is "too remote to be treated as prior art." *In re Clay*, 966 F.2d 656, 658 (Fed. Cir. 1992) (quotation omitted).

disclosure, and would have been prompted to convert Johnson's flow cytometer to a photodamage sorter. Ex. 1003 ¶ 172. Petitioner advances testimony that a skilled artisan would have had a reasonable expectation of success in making that modification. *Id*. Keij states that "[m]ost existing and commercially available dual-beam flow sorters can be converted to photodamage sorters with minor modifications." Ex. 1008, 373.

Patent Owner acknowledges that Keij employs a method of "photodamage cell selection, which resembles a method that uses a dye laser." Resp. 36. Patent Owner points out, however, that Keij sorts cells that are sturdier and more robust than sperm cells, and argues that photodamage sorting would not have been suitable for fragile sperm. *Id*. at 33–35. In particular, Patent Owner contends that "certain cells" would not survive the damaging effects of light leakage and accidental (or incidental) irradiation in Keij's photodamage method. *Id*. at 37 (citing Ex. 2014, 148:20–149:7). That argument, however, appears to be based on speculation "about what might require some further investigation or optimization to be commercially acceptable" in terms of sperm survivability. Reply 22 (citing Ex. 1018, 255:8–256:18).

Patent Owner argues that several other factors would negatively impact the viability or sort rate when processing sperm with a photodamage sorter: (1) the high pressures employed by Keij; (2) a lack of means to repair damage in sperm cells that could occur from incidental light exposure; (3) an absence of any means to orient the sperm correctly; and (4) the length of sperm cells, which exceeds those of the cells sorted by Keij. Resp. 38 (citing Ex. 2012 ¶¶ 105–106, 110–111, 120). We are not persuaded that Patent Owner identifies any factor that would have dissuaded a skilled

artisan from following Keij's express suggestion to modify Johnson's flow cytometer to include a photodamage sorter, or from applying that modified device to the "[s]orting of X or Y chromosome bearing sperm cells for insemination." Ex. 1008, 373 (Keij's express disclosure).

The second and fourth asserted factors are based on opinion testimony presented without citation to any objective record evidence. Ex. 2012 ¶¶ 111, 120; *see* Resp. 38 (relying exclusively on that testimony). One's expertise, even draped with a skilled-artisan veil, does not entitle a naked opinion to much weight. *See Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 776 F.2d 281, 294 (Fed. Cir. 1985) ("Lack of factual support for expert opinion going to factual determinations . . . may render the testimony of little probative value in a validity determination.").

The third asserted factor, that Keij fails to describe an "instrument to detect orientation of sperm and to correctly orient the sperm" is not determinative (Resp. 38), because Johnson plainly does. Ex. 1005, 3:27–37, 4:5–7; *see* Ex. 2012 ¶ 80 (Patent Owner's own witness, acknowledging that Johnson discloses the orientation feature). The combined teachings of the applied references would have suggested that feature to a skilled artisan.

That leaves the first asserted factor; that sperm cells could not have survived the high flow rates and pressures employed by Keij. Resp. 38 (citing Ex. 2012 ¶¶ 105–106 (proposing that the high flow rates employed by Keij would produce pressures and sheath velocities that "exceed those that can be used for [] sperm cell sorting")). We agree with Patent Owner that a critical question is whether sperm cells would have survived passage through the nozzle tip of Keij's device at the relatively high flow rates disclosed in the reference. *Id.*; *see* Ex. 1008, 376 (Keij, explaining that

certain other cells were "tested for their ability to survive passage through the nozzle tip at increased sheath fluid velocities").

Petitioner directs us to persuasive evidence that sperm cells would survive, intact and viable, using the low-end flow rates reported in Keij. Keij tested yeast cells at a flow rate of 25,000 cells per second, which corresponds to a 10 m/s sheath flow velocity. Reply 18 (citing Ex. 1008, 376–377, 382). Patent Owner's own witness agreed that sperm cells survive as viable at that sheath velocity, or even double that velocity (or 20 m/s). *Id*. (citing Ex. 1018, 211:15–212:23; 217:23–218:5). Patent Owner's contrary evidence appears to be directed "only to the extreme high speeds" reported in Keij, and does not speak to whether sperm cells would survive sorting at the lower range of flow rates disclosed in Keij. Ex. 1018, 220:8–24 (testimony of Patent Owner's witness); Reply 18; Ex. 2012 ¶ 106; *see* Ex. 2012 ¶ 105 (referring to Keij's use of "high pressures of up to 70+ psi").

Patent Owner's own witness also "admitted that Keij discloses pressures and sheath flow velocities that could 'easily' be made to work without killing sperm cells." Reply 17 (citing Ex. 1018, 220:20–24); *see* Ex. 1018, 218:8–220:8 (Patent Owner's witness, agreeing that sperm cells survive sort rates of 25,000 cells per second). That evidence is consistent with information provided by Petitioner's witness, who testified that a skilled artisan would have reasonably expected success in applying Keij's photodamage sorter to sperm cells. Ex. 1018, 218:8–220:8; Ex. 1003 ¶¶ 144, 172; *see* Ex. 1008, 382 (describing test in which cells "were sorted at a rate of 25,000 cells/sec"). A preponderance of evidence supports a finding that sperm cells would survive the photodamage sorting process, intact and viable, if a practitioner selected the lower-end flow rates disclosed in Keij.

Petitioner shows by a preponderance of evidence that it would have been obvious to modify Johnson's method to utilize Keij's photodamage sorting technique on sperm cells at those lower-end flow rates. First, Keij on its face discloses the application of photodamage sorting to sperm cells as "an interesting possibility." Ex. 1008, 373. Keij also states that flow cytometers could "be converted to photodamage sorters with minor modifications." *Id*. In addition, Keij directly points the skilled artisan toward applying the ZAPPER to the work of Larry Johnson. *Id*. A skilled artisan would have recognized that sperm cells are delicate, and that knowledge would have prompted the artisan to select from the lower range of flow rates disclosed in Keij. *KSR*, 550 U.S. at 421 (a skilled artisan has ordinary creativity and is not an automaton).

Keij does not teach away from that path. *See* Resp. 53 (arguing that Keij teaches away by disclosing a technique suitable for "sturdy" cells, not sperm cells, which "are known to be delicate"). A reference teaches away from a claimed invention if it "criticizes, discredits, or otherwise discourages" modifying the reference to arrive at the claimed invention. *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004). Keij, by contrast, characterizes as "an interesting possibility" the application of photodamage sorting to sperm cells with a direct reference to the work of Larry Johnson. Ex. 1008, 373. We will not "read into a reference a teaching away from a process where no such language exists." *DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1364 (Fed. Cir. 2006).

The weight of evidence persuades us that it would have been a routine matter to convert Johnson's flow cytometer to a photodamage sorter, and it would have required no more than an exercise of ordinary skill in the art to

successfully apply that modified apparatus to the collection of viable sperm cells, by employing "a rate of 25,000 cells/sec" as disclosed in Keij. Ex. 1008, Ex. 1008, 376–378 (bridging sentence). The modified method would discriminate between X and Y chromosome-bearing sperm cells at a rate of "at least about 1200 cells per second," under either parties' construction, and the collected cells would survive as "viable" as required by claim 1. Ex. 1001, claim 1; Reply 18–19 (bridging paragraph, and citations to record therein); *see* Ex. 1008, 382 (Keij, discussing test in which cells "were sorted at a rate of 25,000 cells/sec"). Petitioner meets its burden of showing by a preponderance of evidence that the subject matter of claim 1 would have been obvious over Johnson, Keij, and Simons.

C. Patentability of Claim 3

Claim 3 depends from claim 1, and narrows the method by requiring that "said step of collecting comprises the step of collecting in an angled collector." Ex. 1001, 20:17–19. Petitioner challenges claim 3 as unpatentable over Johnson, Rens, Simons, and Touge.[10]

Touge depicts placing containers at an angle for collection of sorted sperm cells. Ex. 1009, 1:44–49, Fig. 6; *see In re Aslanian*, 590 F.2d 911, 914 (CCPA 1979) ("[A] drawing in a utility patent can be cited against the claims of a utility patent application even though the feature shown in the drawing was. . . unexplained in the specification," and such drawings are

[10] This review also includes an obviousness ground directed to claim 3 based on Johnson, Rens, and Touge. As explained above, Simons provides background about techniques known at the time of the invention for cushioning cells during a sorting operation, and bolsters Petitioner's position that Johnson's egg yolk extender cushions cells from impact with a collection container as required by step (e) of claim 1. *See supra*.

evaluated on the basis of what they reasonably disclose and suggest to one skilled in the art) (citations omitted). Patent Owner's own witness testified that the use of angled containers for cell cushioning was well known in the art, observing that "every flow cytometer out there has angled tubes." Ex. 1018, 131:2–9; *see id*. at 28:19–31:8 (testifying that, in the years before the time of the invention, every collection container had "some slight angle to it. I don't remember any that would be directly vertical.").

Petitioner establishes by a preponderance of evidence that it would have been obvious at the time of the invention to collect sorted sperm cells in an angled container as specified in claim 3. Claim 3 is unpatentable as obvious over Johnson, Rens, Simons, and Touge.

D. Secondary Considerations

Patent Owner advances evidence of secondary considerations, which we consider in determining whether the subject matter of the challenged claims would have been obvious at the time of the invention. Resp. 55–60.

Patent Owner alleges commercial success of the invention, but fails to establish any success attributable to the invention of the '920 patent. *Id*. at 57–58. Patent Owner alleges commercial success based on industry articles, which refer to other patents controlled by Patent Owner, but are not shown to refer to the '920 patent. Resp. 57 (citing Ex. 2017, Ex. 2018); Reply 24; Ex. 2012 ¶¶ 128–129; Ex. 1018, 220:24–221:18. One of those other patents is Johnson, which the '920 patent identifies as "so significant an advancement that it has for the first time made the commercial separation of such sperm feasible." Reply 24 (quoting Ex. 1001, 2:1–8); Ex. 2012 ¶¶ 128–129; Ex. 1018, 220:24–221:18. Where "the feature that creates the

commercial success was known in the prior art, the success is not pertinent." *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1311–12 (Fed. Cir. 2006).

Patent Owner advances other evidence, relating to a long felt need for higher sperm cell sort rates, but that evidence suffers from the same defect. Resp. 55–57. As Petitioner points out, Patent Owner "similarly fails to show that the ability to sort faster is attributable to the subject matter claimed in the '920 patent, as opposed to what was known in the prior art." Reply 25. We are not persuaded that the asserted evidence of secondary considerations is pertinent to the invention claimed in the '920 patent.

In the alternative, the evidence of secondary considerations advanced by Patent Owner does not outweigh the strong showing of obviousness made out by Petitioner. *See Sud-Chemie, Inc. v. Multisorb Techs., Inc.*, 554 F.3d 1001, 1009 (Fed. Cir. 2009) (evidence of "secondary considerations will not necessarily overcome a strong prima facie showing of obviousness"). Accordingly, Patent Owner's evidence of secondary considerations does not support a conclusion of nonobviousness of the challenged claims.

III. CONCLUSION

It is

ORDERED that claims 1 and 3 of the '920 patent are *unpatentable*; and

FURTHER ORDERED that, because this is a final decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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