United States Court of Appeals for the Federal Circuit

QUANERGY SYSTEMS, INC.,
Appellant

v.

VELODYNE LIDAR USA, INC., FKA VELODYNE LIDAR, INC.,
Appellee

2020-2070, 2020-2072

Appeals from the United States Patent and Trademark Office, Patent Trial and Appeal Board in Nos. IPR2018-00255, IPR2018-00256.

Decided: February 4, 2022

ERIK BENTON MILCH, Cooley LLP, Reston, VA, argued for appellant. Also represented by JENNIFER VOLK; ELIZABETH SHRIEVES, Washington, DC; PRIYA B. VISWANATH, Palo Alto, CA.

DOUGLAS ETHAN LUMISH, Latham & Watkins LLP, Menlo Park, CA, argued for appellee. Also represented by BRETT MATTHEW SANDFORD; GABRIEL K. BELL, JONATHAN M. STRANG, Washington, DC; ANN MARIE WAHLS, Chicago, IL.

Before NEWMAN, LOURIE, and O'MALLEY, *Circuit Judges*.

O'MALLEY, *Circuit Judge*.

This appeal is about a laser-based system for measuring distances. While useful for a number of purposes, the system is best known for helping autonomous cars sense their surroundings. U.S. Patent No. 7,969,558 ("the '558 patent") claims such a system, and appellee Velodyne Lidar USA, Inc. markets products incorporating such systems. Appellant Quanergy Systems, Inc. also markets products employing laser systems. Unsurprisingly, Quanergy challenged the validity of multiple claims in the '558 patent in two *inter partes* review ("IPR") proceedings before the Patent Trial and Appeal Board ("Board").

Quanergy now appeals the two final written decisions of the Board in those proceedings. In its decisions, the Board held that claims 1–4, 8, 9, 16–19, and 23–25 of the '558 patent are not unpatentable as obvious. *Quanergy Sys., Inc. v. Velodyne Lidar, Inc.* (*Quanergy I*), No. IPR2018-00255, 2019 WL 2237114 (P.T.A.B. May 23, 2019); *Quanergy Sys., Inc. v. Velodyne Lidar, Inc.* (*Quanergy II*), No. IPR2018-00256, 2019 WL 2237137 (P.T.A.B. May 23, 2019). We affirm both decisions.

I. BACKGROUND

A. The '558 Patent

The '558 patent, entitled "High Definition Lidar System," relates to a lidar-based 3-D point cloud measuring system. '558 patent, at [54]; *id.* at col. 3, ll. 3–4. Lidar, or ladar, is an acronym for "Laser Imaging Detection and Ranging." *Id.* at col. 3, ll. 65–66. Think radar—"Radio Detection and Ranging"—but employing light rather than radio waves.

The specification begins by describing the well-known use of a pulse of light to measure distance. *Id.* at col. 1, ll. 11–12. First, a laser emitter pulses, emitting a burst of light. *Id.* at col. 1, ll. 13–14. A system then measures the time it takes for the pulse of light to return to a detector mounted near the laser emitter. *Id.* at col. 1, ll. 15–17. Using that measurement, the system can derive a distance with high accuracy. *Id.* at col. 1, ll. 17–18. The parties refer to this technique of measuring distance as pulsed time-of-flight (or "ToF") lidar.

The specification explains that each distance measurement is a "pixel," and a collection of pixels is called a "point cloud." *Id.* at col. 1, ll. 19–23. Systems may render a point cloud as an image or analyze it for other reasons, including detecting obstacles. *Id.* at col. 1, ll. 22–24. According to the specification, a number of commercial products are capable of rendering a 2-D point cloud. *Id.* at col. 1, ll. 32–34. Most of these devices capture distance measurements using a single laser emitter and detector, as well as a moving mirror. *Id.* at col. 1, ll. 36–39. These devices can also provide for a 3-D point cloud by, *e.g.*, mounting the instrument on a gimbal that "nods" the unit up and down to increase the field of view or using a prism to divide the laser pulse into multiple layers with different vertical angles. *Id.* at col. 1, ll. 47–64.

The specification criticizes these existing 3-D point cloud systems because "the needs for autonomous vehicle navigation place unrealistic demands on" them. *Id.* at col. 2, ll. 35–37. According to the specification, some systems take excellent pictures but are unsuitable for highway use because they take several minutes to collect a single image. *Id.* at col. 2, ll. 37–40. Others suffer from a limited field of view. *See id.* at col. 2, ll. 40–45. The specification explains that "it is necessary to see everywhere around the vehicle, almost a full 360 degrees, in order to safely navigate today's highways," as well as "to have a minimum of delay between the actions happening in the real world and the imaging/reaction to it." *Id.* at col. 2, ll. 45–49. The specification estimates that the update rate of the point cloud—or "refresh rate"—should be at least 5 times per second and specifies that the vertical field of view should extend from above the horizon to as close to the ground in front of the vehicle as possible. *See id.* at col. 2, ll. 53–57.

In this context, the specification discloses its invention of a lidar-based 3-D point cloud measuring system, which rotates a plurality of laser emitters and detectors. *See id.* at col. 3, ll. 3–9. The invention "provides a more compact and rugged unit for gathering 3-D point cloud information." *Id.* at col. 3, ll. 28–30. The preferred embodiment is a lidar system that uses 64 pairs of laser emitters and detectors, has a 360-degree horizontal field of view and a 26.8-degree vertical field of view, and rotates at a rate of up to 200 Hz. *Id.* at col. 3, l. 67–col. 4, l. 7. The system can collect approximately 1 million time-of-flight distance points per second, and it provides the unique combination of a 360-degree field of view, a broad vertical field of view, a high point cloud density, and a high refresh rate. *Id.* at col. 4, ll. 9–13; *id.* at col. 6, ll. 37–41.

Independent claim 1 is illustrative. It recites:

> A lidar-based 3-D point cloud system comprising:
>
> > a support structure;
> >
> > a plurality of laser emitters supported by the support structure;
> >
> > a plurality of avalanche photodiode detectors supported by the support structure; and
> >
> > a rotary component configured to rotate the plurality of laser emitters and the plurality of avalanche photodiode detectors at a speed of at least 200 RPM.

Id. at col. 7, ll. 59–67.

B. The Prior Art

Two prior art references are relevant to this appeal.

1. Mizuno

Japanese Patent Application No. H3-6407 ("Mizuno") describes a device that measures the outer peripheral shape of an object. J.A. 4285. According to Mizuno, conventional devices determined an object's shape by revolving around the object, scanning a light toward it, and using a light detector opposite the light source to measure where the object blocks the light. J.A. 4285–86. Mizuno explains that these conventional devices could not accurately measure the object's outer peripheral shape because they could not measure or detect a recessed portion of the object. J.A. 4286.

To solve this problem, Mizuno teaches the use of a "reflected light-type distance measuring instrument" that is on a rotating member and oriented toward the centerline of the rotating member, where a measured object is placed. J.A. 4286. The instrument emits light toward the centerline and measures the distance to the object by detecting the reflected light. J.A. 4286. In one embodiment of the claimed invention, Mizuno explains that the instrument measures the distance to the location of the reflection "based on the location at which the light is detected." J.A. 4287. Mizuno further teaches that its device can measure surface defects "because the detection position for the reflected light will shift." J.A. 4288.

Quanergy asserts that Mizuno renders the challenged claims of the '558 patent obvious because "Mizuno . . . teaches and renders obvious a pulsed ToF 'lidar' system." Appellant's Reply Br. 16.

2. Berkovic

Berkovic is an article published in 2012, entitled "Optical Methods for Distance and Displacement

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