

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

EXOTEC PRODUCT FRANCE SAS,
EXOTEC NORTH AMERICA INC., AND
EXOTEC PRODUCT USA INC.,
Petitioner,
v.

OPEX CORPORATION,
Patent Owner.

IPR2024-00850
Patent 11,472,632 B2

Before BART A. GERSTENBLITH, RICHARD H. MARSCHALL, and
ARTHUR M. PESLAK, *Administrative Patent Judges*.

PESLAK, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Petitioner Exotec Product France SAS, Exotec North America Inc., and Exotec Product USA Inc. (“Petitioner”) filed a Petition for *inter partes* review of claims 1, 3–12, 14, and 23–27 (“the Challenged Claims”) of U.S. Patent No. 11,472,632 B2 (Ex. 1001, “the ’632 patent”). Paper 1 (“Pet.”). Petitioner filed a Declaration of Dr. Stephen Derby in support of the Petition. Ex. 1003.¹ Patent Owner Opex Corporation (“Patent Owner”) filed a Preliminary Response. Paper 7 (“Prelim. Resp.”). Patent Owner filed a Declaration of William E. Singhose, Ph.D. in support of the Preliminary Response. Ex. 2001. On November 1, 2024, we instituted *inter partes* review of the Challenged Claims of the ’632 patent. Paper 11.

After institution, Patent Owner filed a Response to the Petition (Paper 16, “PO Resp.”) supported by a second Declaration of William E. Singhose, Ph.D. Ex. 2007. Petitioner filed a Reply. Paper 25 (“Pet. Reply”). Patent Owner filed a Sur-reply. Paper 27 (“Sur-reply”). An oral hearing was held on August 27, 2025, and the transcript is of record. Paper 38 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of the Challenged Claims of the ’632 patent. For the reasons discussed below, we determine Petitioner establishes by a preponderance of the evidence that all Challenged Claims are unpatentable.

¹ With our authorization, Petitioner substituted Dr. Matthew Spenko for Dr. Derby. Ex. 3001. Dr. Spenko adopted Dr. Derby’s opinions and testimony. Ex. 2006, 10:9–11:12. Patent Owner refers to Dr. Spenko when citing to Exhibit 1003. *See, e.g.*, PO Resp. 21.

II. BACKGROUND

A. Related Matters

Both parties indicate that they are unaware of any related matters. *See* Pet. 97; Paper 6 (Patent Owner’s Mandatory Notices), 1.

B. Real Parties-in-Interest

Petitioner identifies Exotec Product France SAS, Exotec North America Inc., and Exotec Product USA Inc. as the only real parties-in-interest. *See* Pet. 97. Patent Owner identifies itself, OPEX Corporation, as the only real party-in-interest. *See* Paper 6, 1.

C. Overview of the ’632 Patent

The ’632 patent is titled “Material Handling System.” Ex. 1001, code (54). The Abstract of the ’632 patent is reproduced below:

A system may include a vehicle for delivering items and a plurality of racks having a plurality of storage locations. The racks may be arranged to form one or more aisles. The vehicles are configured to drive horizontally along a path that may extend along a path under the racks that is parallel to the aisles. Additionally, the vehicles may be operated to turn while the vehicle is positioned under one of the racks. The vehicles may travel under the racks and cross one or more aisles to reach a particular column in one of the aisles. The vehicle climbs upwardly within the particular column to retrieve an item from a storage location in the column.

Id. at code (57).

Figure 2 of the '632 patent is reproduced below:

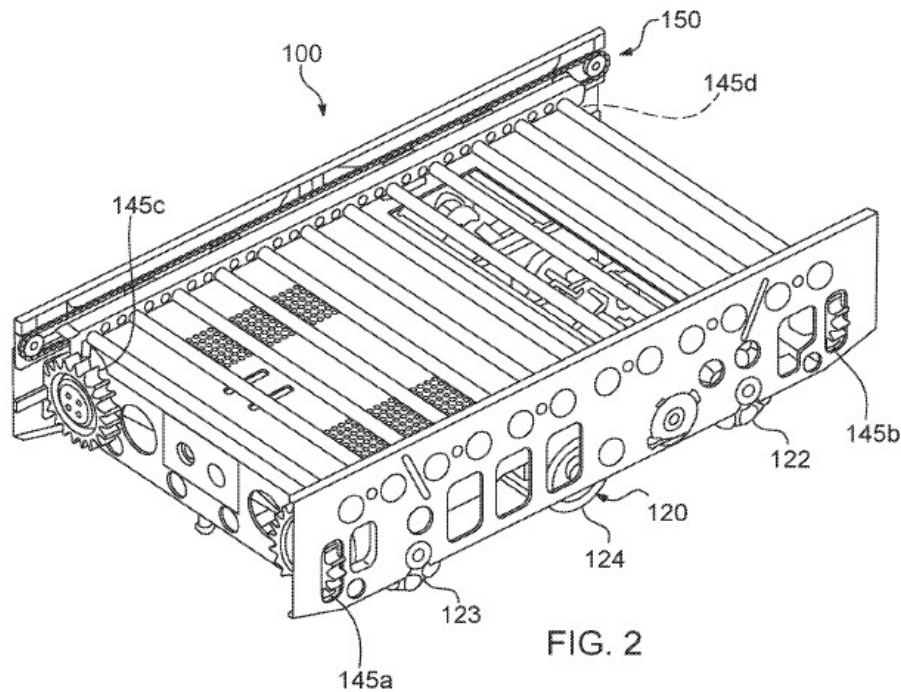


Figure 2 above illustrates details of a vehicle that is part of an automated material handling system. Ex. 1001, 5:42–43, 7:62–63. Vehicle 100 includes horizontal drive assembly 120 formed of rollers 122, 123, and 124, which allow the vehicle “to drive along a track or along an open horizontal surface, such as a floor.” *Id.* at 8:9–23. Vehicle 100 also includes vertical drive mechanism 140 (not numbered in Figure 2) including drive gears 145a–145d. *Id.* at 9:20–32. The vertical drive mechanism allows for vehicle 100 to move vertically within storage racks. *Id.* Vehicle 100 may be semi-autonomous or fully autonomous and include a processor configured to perform steps of a navigation process stored in a memory. *Id.* at 11:37–38, 12:54–58.

Figure 1 of the '632 patent is reproduced below:

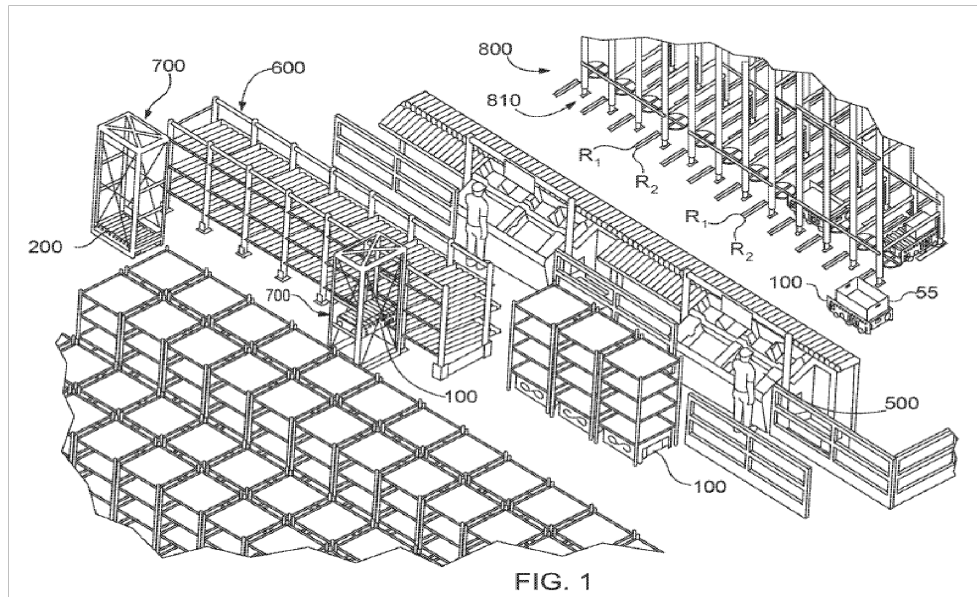


Figure 1 above illustrates a perspective view of a material handling system that includes vehicles 100 sorting and retrieving items associated with racks 600, 700, and 800. Ex. 1001, 5:40–41, 7:10–35.

Figure 7 of the '632 patent is reproduced below:

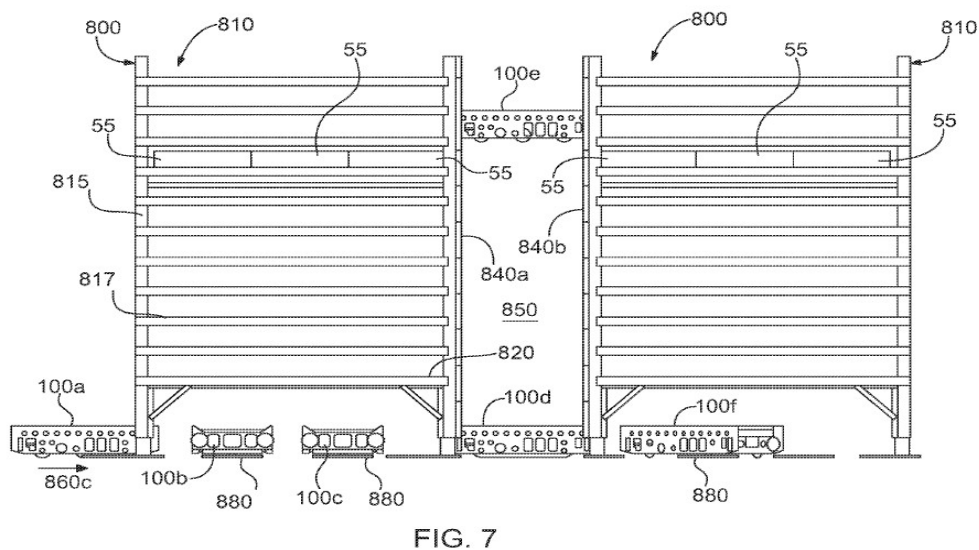


Figure 7 above illustrates a rack system of a material handling system. Ex. 1001, 5:51–52. Storage racks 800 include vertical columns 810 and a

plurality of storage locations 820. *Id.* at 7:41–52. One or more guides 880 function to align vehicles 100 as they travel around, underneath, and within the racks. *See, e.g., id.* at 8:55–57, 9:41–53.

D. The Challenged Claims

Petitioner challenges claims 1, 3–12, 14, and 23–27 of the '632 patent.

Pet. 1. Of those challenged claims, claims 1, 11, and 23 are independent.

Claim 1 is representative and is reproduced below with Petitioner's limitation annotations:

[1.pre] A method for delivering items to storage locations and retrieving items from storage locations, comprising the steps of:

[1.a1] providing a plurality of storage racks spaced apart from one another forming a plurality of aisles,

[1.a2] wherein each storage rack comprises a plurality of columns and each column comprises a plurality of storage locations;

[1.b1] providing a plurality of delivery vehicles
[1.b2] wherein each vehicle comprises a horizontal drive system operable to drive the vehicle along a horizontal surface,
[1.b3] a vertical drive operable to drive the vehicle vertically and [1.b4] a transfer mechanism operable to transfer an item between the vehicle and one of the storage locations;

[1.c] driving a first one of the vehicles to drive the first vehicle to the storage racks;

[1.d1] driving the first vehicle along a first path under a first one of the racks [1.d2] wherein the first rack is adjacent a first one of the aisles and [1.d3] wherein the first path extends in a direction parallel to the first aisle and spaced apart from the first aisle;

[1.e] turning the first vehicle while the first vehicle is under the first rack;

[1.f] driving the vehicle into the first aisle;

[1.g] driving the first vehicle upwardly in the aisle to a first of the storage locations;

[1.h] transferring an item between the first vehicle and the first storage location;

[1.i] driving the first vehicle downwardly in the aisle until the vehicle is on a horizontal surface;

[1.j] driving the first vehicle across the first aisle after the step of driving the first vehicle downwardly; and

[1.k] driving the vehicle out from under the storage racks after the step of driving the first vehicle across the first aisle.

Ex. 1001, 25:2–35.

E. Asserted Ground of Unpatentability

Petitioner asserts the following ground of unpatentability (Pet. 1):

Claim(s) Challenged	35 U.S.C. §²	Reference(s)/Basis
1, 3–12, 14, 23–27	103	Raizer, ³ Hangzhou ⁴

III. ANALYSIS

A. Legal Standards

Petitioner bears the burden of establishing the unpatentability of the challenged claims by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). This burden of persuasion never shifts to

² The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. §§ 102 and 103 effective on March 16, 2013, and those amendments apply to the ’632 patent. Neither party, however, argues that the outcome of this case would differ based on applying the pre-AIA or post-AIA versions of these laws.

³ U.S. Patent Application Publication No. US 2017/0158430 A1 published June 8, 2017, to Raizer (Ex. 1005, “Raizer”).

⁴ CN Patent Publication No. CN 109987366A published July 9, 2019, to Hangzhou (Ex. 1007; English-language translation Ex. 1006, “Hangzhou”).

Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

A claim is unpatentable under § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) when in evidence, objective indicia of non-obviousness (i.e., secondary considerations).⁵ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

The Supreme Court explained in *KSR International Co. v. Teleflex Inc.* that

[o]ften, it will be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.

550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006))

(“[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning

⁵ No evidence of objective indicia of nonobviousness has been presented.

with some rational underpinning to support the legal conclusion of obviousness.” (alteration in original)).

“Whether an ordinarily skilled artisan would have been motivated to modify the teachings of a reference is a question of fact.” *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1327 (Fed. Cir. 2016) (citations omitted).

“[W]here a party argues a skilled artisan would have been motivated to combine references, it must show the artisan ‘would have had a reasonable expectation of success from doing so.’” *Arctic Cat Inc. v. Bombardier Recreational Prods. Inc.*, 876 F.3d 1350, 1360–61 (Fed. Cir. 2017) (quoting *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.*, 676 F.3d 1063, 1068–69 (Fed. Cir. 2012)).

Reasonable expectation of success of the proposed combination is also a question of fact. *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1366 (Fed. Cir. 2016). “The reasonable expectation of success requirement refers to the likelihood of success in combining references to meet the limitations of the claimed invention.” *Id.* at 1367. In evaluating reasonable expectation of success, we must consider the appropriate scope of the “claimed invention.” *Id.* (emphasis omitted).

B. Level of Ordinary Skill in the Art

We consider the asserted grounds of unpatentability in view of the understanding of a person of ordinary skill in the art. In assessing the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (quoting *Custom*

Accessories, Inc. v. Jeffrey-Allan Indus., Inc., 807 F.2d 955, 962 (Fed. Cir. 1986)). “[O]ne or more factors may predominate.” *Id.*

Petitioner proposes the following level of ordinary skill in the art:

A person of ordinary skill in the art (“POSITA”) at the time of the alleged invention of the ’632 Patent would have been a person with a working knowledge of mechanical design and automation. That person would have had a Bachelor of Science degree in an academic discipline emphasizing the design of mechanical, automation, and robotics technologies, in combination with training or at least one to two years of related work experience. Alternatively, that person could have also had a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline. (Ex. 1003, ¶¶42-43). More education can supplement practical experience and *vice versa* (Ex. 1003, ¶¶42-43).

Pet. 5.

Although Patent Owner does not address Petitioner’s assessment of the level of ordinary skill in the art or offer its own assessment in the Patent Owner Response, Dr. Singhose adopts Petitioner’s definition. *See generally* PO Resp.; *see* Ex. 2007 ¶ 78 (adopting Petitioner’s definition). We apply Petitioner’s level of ordinary skill in the art, which we find consistent with the ’632 patent and the asserted prior art. *See also Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art, itself, can reflect appropriate level of ordinary skill in art).

C. Claim Construction

Neither Petitioner nor Patent Owner proposes an express construction of any claim term. *See* Pet. 4; PO Resp. 9. Having considered the record, we determine that it is not necessary to construe any claim term expressly to resolve the issues presented to us. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe

‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

D. Obviousness Based on Raizer and Hangzhou

Petitioner contends that the Challenged Claims would have been obvious over Raizer and Hangzhou. Pet. 6–95. Petitioner supports its contentions with the Declaration of Dr. Derby as adopted by Dr. Spenko. Ex. 1003.

We begin with brief summaries of Raizer and Hangzhou and then address the parties’ respective contentions.

1. Overview of Raizer

Raizer is titled “Automatic Warehouse System.” Ex. 1005, code (54). Raizer’s Abstract is reproduced below:

The invention is an automatic system for picking and placing boxes on shelves in a warehouse. The system comprises a set of autonomous mobile robots; a network of vertical and horizontal rails that are parallel to the vertical support posts and horizontal shelves of the shelving system in the warehouse; and a Real Time Traffic Management (RTTM) server, which is a central processing server configured to communicate with the robots and other processors and servers in the warehouse. The system is characterized in that the robots comprise a set of on-board sensors, a processor, software, and other electronics configured to provide them with three-dimensional navigation and travel capabilities that enable them to navigate and travel autonomously both along the floor and up the vertical rails and along the horizontal rails of the network of rails to reach an exact location on the floor or shelving system of the warehouse.

Id. at code (57).

Figures 5A and 5B of Raizer are reproduced below:

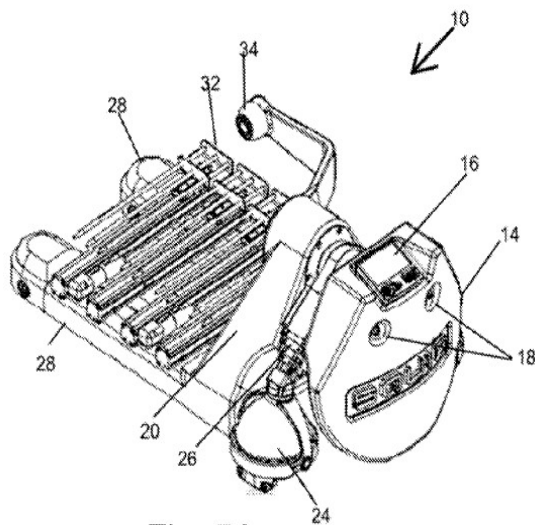


Fig. 5A

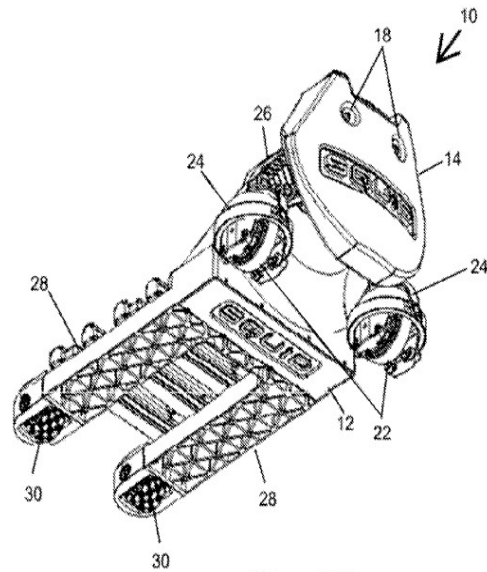


Fig. 5B

Figures 5A and 5B above illustrate top and bottom perspective views of a robot according to Raizer's invention. Ex. 1005 ¶ 65. Robot 10 includes, among other components, a frame formed of beams 28 and 12, rear wheels 30, front wheels 22, drive and steering units 24, arm units 26, micro-pallet lifters 32, and fine positioning sensor 34. *Id.* ¶¶ 103–106.

Raizer further describes the following in connection with its robots:

[A] robot having three-dimensional navigation and travel capabilities that enable it to navigate and travel both along the ground and up vertical rails and along horizontal rails of a network of rails[.]

Robots: A set of autonomous centrally controlled mobile robots that bring desired boxes to and from the picking station. The robots have 3 dimensional travel capabilities enabling them to travel along the ground and up and along the shelves. The robots are pre-loaded with proprietary software which includes the warehouse layout, routes, intersections, and designated areas (this mapping survey is recorded by a "Survey Mode" of the

robot's software). Each robot utilizes dedicated maneuvering algorithms and a proprietary “Fine Positioning” procedure to enable precise, quick and efficient loading.

Id. ¶¶ 48, 84.

Raizer’s Figure 1 is reproduced below:

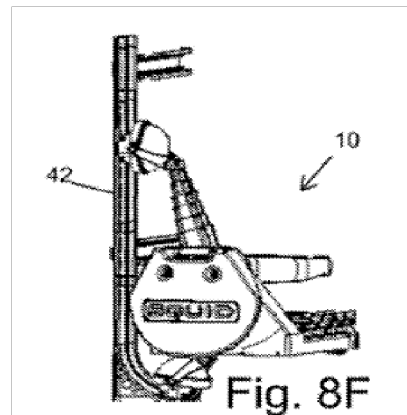
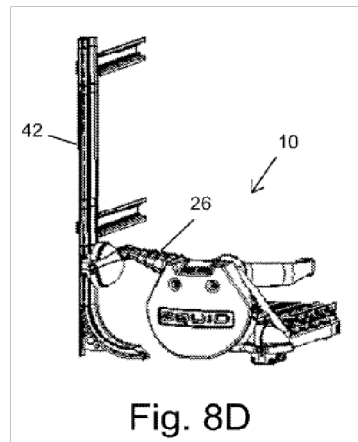
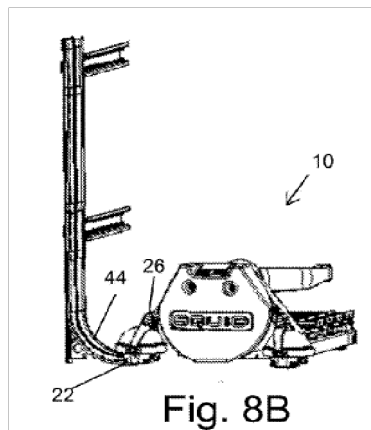


Fig. 1

Figure 1 above shows the floor plan of a typical warehouse, which has been automated according to Raizer’s invention. Ex. 1005 ¶ 58. “The warehouse is divided into three main sections: a Receiving and Dispatch Center (RDC), an Operations Area (OP), and a storage area, which can be divided into zones (for example zone Z01 is shown in FIG. 1.)” *Id.* ¶ 92. Robots can be loaded with boxes for delivering merchandise to shelves (within bays B1, B2, etc.) or retrieve boxes containing items to be shipped from the shelves.

Id. “The sides of the shelving units that face the aisles between units are called faces (F1, F2, [etc.]).” *Id.* Raizer further describes the following: “the system of the invention is designated as a self-learning system where, for example, algorithm can track the movement of the robots and organize the routes of traffic in and around the warehouse to reduce congestion and prevent ‘traffic jams’ when the robots are busy filling orders.” *Id.* ¶ 98.

Figures 8B, 8D, and 8F of Raizer are reproduced below:



Figures 8B, 8D, and 8F above depict “different stages in the process of the robot of the system of the invention leaving the floor of the warehouse and climbing a vertical rail attached to the shelving.” Ex. 1005 ¶ 70. Robot 10 may engage with rails 42 of a shelving unit at “terminal 44” to climb or descend from the shelves. *Id.* ¶ 111.

Figure 12A of Raizer is reproduced below:

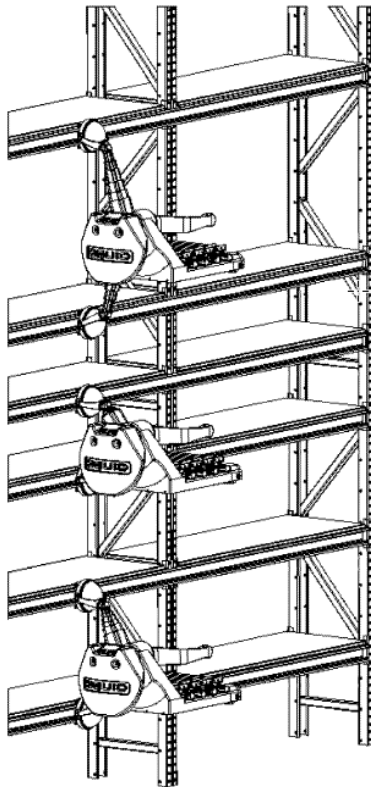


Fig. 12A

Figure 12A “shows how the extension of the arm units allows the robot to adapt itself to travel on shelf systems having variable spacing between shelves.” Ex. 1005 ¶ 74. Raizer explains that “[t]he lengths of the two arm units 26 of . . . robot 10 can be extended or retracted individually allowing the robot to adapt itself on shelf systems having variable spacing systems between shelves as shown in FIG. 12A.” *Id.* ¶ 131.

2. Overview of Hangzhou

Hangzhou is titled “Unmanned Warehouse System and Inbound and Outbound Method Therefor.” Ex. 1006, code (54). Hangzhou summarizes its disclosure in-part as follows:

An unmanned warehousing system using mobile robots and caching apparatuses and an inbound and outbound method utilizing caching apparatuses to improve operation efficiency are provided, wherein an outbound process is completed by picking items placed on a shelf and transporting them to a sorting site, or an inbound process is completed by transporting items from the sorting site to the shelf and storing them on the shelf. The unmanned warehousing system is provided with: at least one shelf, a front surface of which an item can be picked up or placed on; at least one standardized container or a movable bracket for storing scattered items; at least one auto-guided trolley for transporting the standardized container to a specified position; at least one stacking device capable of picking up and storing items on the shelf; and a management terminal for supplying handling instructions to the auto-guided trolley and the stacking device.

Ex. 1006 ¶ 8.

Hangzhou's Figure 1 is reproduced below:

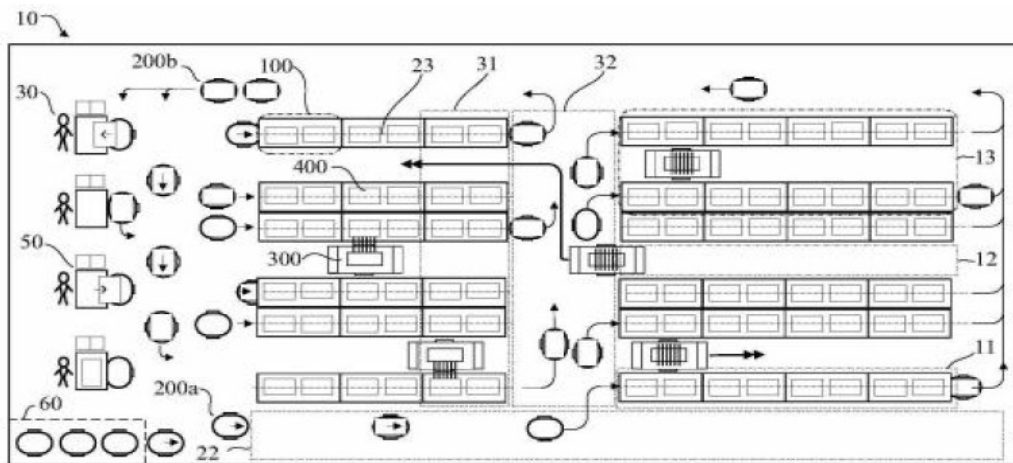


Figure 1 shows a top view of an unmanned warehousing system according to an embodiment of Hangzhou's invention. Ex. 1006 ¶ 11. "The warehousing system 10 includes a dispatch control system not shown in the figure, a plurality of multi-layer shelves 100, a plurality of auto-guided trolleys 200, a

plurality of stacking vehicles 300, optional sorting workstations 50, etc.” *Id.*

¶ 35. Hangzhou further describes the following:

Shelves are placed in rows and columns to improve the plot ratio. In general, a plurality of modular shelves 100 are horizontally connected into a shelf row 11, and a stacking row laneway 12, which is mainly for stacking vehicles 300 to travel and operate and occasionally for auto-guided trolleys 200 and workers to pass through, is provided in front of each shelf row 11. Two shelf rows are usually placed face to face to share a stacking row laneway 12 in the middle thereof. The combination of the stacking row laneway 12 and all the shelf rows 11 facing the row laneway is defined as a shelf-laneway combination 13.

In FIG. 1, the thin lines and solid arrows above or in front of auto-guided trolleys 200 indicate the current paths or directions of the auto-guided trolleys, and the thick lines and solid arrows in front of stacking vehicles 300 indicate the current paths and target positions of the stacking vehicles.

Id. ¶¶ 37, 40.

Hangzhou’s Figure 2 is reproduced below:

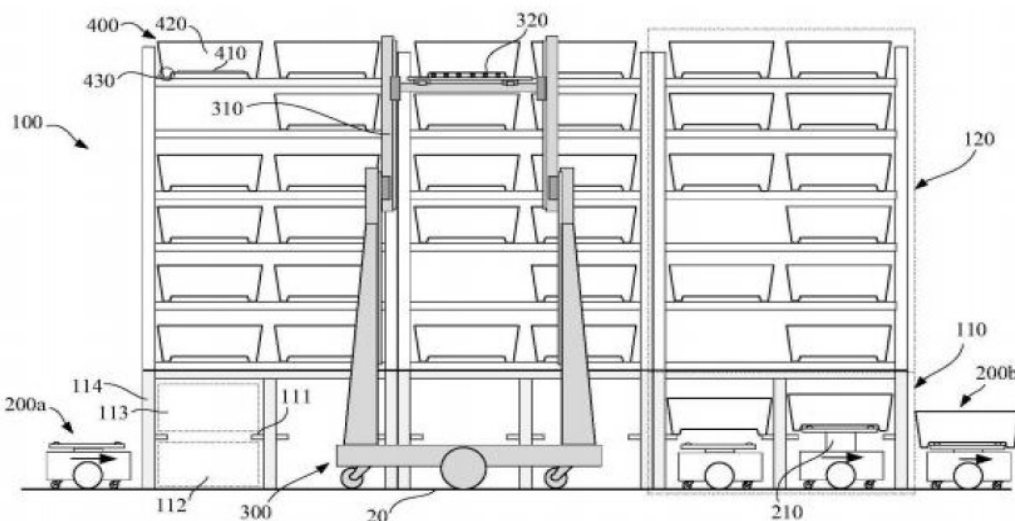


Figure 2 above shows “a side view of the working principle of the unmanned warehousing system” according to the embodiment shown in Figure 1.

Ex. 1006 ¶ 12. Shelves 100 are formed as multi-layer racks 120. *Id.* ¶ 43.

Hangzhou also explains the following:

An auto-guided trolley 200 is a small mobile robot with auto-navigation ability, usually driven by a differential gear train, and equipped with four universal wheels. Such a trolley is characterized by a small size and a low cost. In addition, trolleys are generally designed in symmetrical so that they can turn in place. However, the specific driving form is not limited thereto, and may also be an omnidirectional drive wheel train and others. As shown in FIG. 1, in this embodiment, an auto-guided trolley 200 preferentially travels in column laneways 32 and auto-guided trolley passage spaces 112, never entering stacking row laneways 12 to avoid path conflicts with stacking vehicles 300.

Id. ¶ 48.

Figure 10 of Hangzhou is reproduced below:

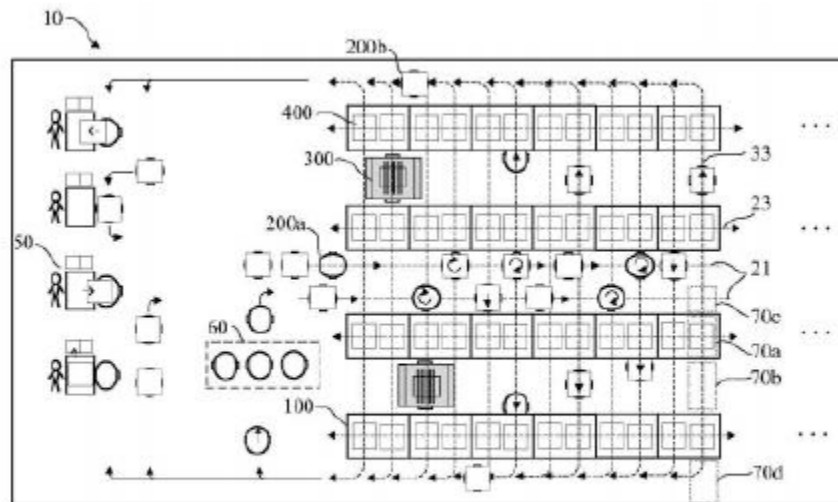


FIG. 10

Figure 10 “is a schematic diagram of the principle of the whole item sorting system and auto-guided trolleys running along the row and column

directions under the shelf in Embodiment 4 of the present invention.”

Ex. 1006 ¶ 71. Hangzhou describes “at the position where the dotted lines intersect, an auto-guided trolley 200 may switch between the row direction and the column direction, including the switch between trolley-special row laneways 21 and column channels 33 and between column channels 33 and row channels 23.” *Id.* ¶ 72. Hangzhou further describes that “[r]oute switching can usually reduce blockage and shorten the turnover time.” *Id.*

3. Analysis of Petitioner’s Challenge

Petitioner provides a limitation-by-limitation analysis of the claims mapping the prior art to the claim limitations. Pet. 9–95. Petitioner also provides contentions concerning motivation to combine and reasonable expectation of success. *Id.* at 6–9.

Patent Owner interposes various arguments directed to motivation to combine and reasonable expectation of success. PO Resp. 23–56.

We start with motivation to combine and reasonable expectation of success and then address Petitioner’s mapping of the prior art to the claim limitations.

a. Motivation to Combine

i. Petitioner’s Contentions

Petitioner contends that an ordinarily skilled artisan “would have been motivated to combine specific teachings of *Hangzhou* with those of *Raizer* to reduce congestion, avoid traffic jams, make more efficient use of space and to allow *Raizer*’s robots to ‘choose among all possible paths.’” Pet. 9 (citing Ex. 1003 ¶¶ 113–114). Petitioner also contends that an ordinarily skilled artisan “would have had a reasonable expectation of success in combining *Raizer* and *Hangzhou*.” *Id.* (citing Ex. 1003 ¶¶ 101, 116).

Petitioner contends that an ordinarily skilled artisan was “aware of the design need for autonomous robot warehouse systems to decrease congestion, avoid autonomous robot collisions, and maximize space utilization.” Pet. 6 (citing Ex. 1003 ¶¶ 46–53, 107). Petitioner further contends that an ordinarily skilled artisan would look to a reference such as *Raizer*, which “discloses autonomous robots configured to travel along the horizontal floor of a warehouse but also along ‘a network of vertical and horizontal rails’ that may be attached to most any type of shelving structure” and “allows for robust increases in available storage space as shelving units grow taller to take advantage of the full height of a warehouse.” *Id.* (citing Ex. 1003 ¶¶ 103–104, 111). According to Petitioner, the result is that “[m]ore autonomous robots would be needed to pick and place packages on these taller shelving units creating a need for new travel ways for the robots to avoid collisions and to reduce congestion.” *Id.* at 6–7 (citing Ex. 1003 ¶¶ 105–106).

Petitioner next contends that an ordinarily skilled artisan “would have understood that combining the *Raizer* autonomous robots, which move both horizontally and vertically, with *Hangzhou*’s teaching of running such robots in passage spaces beneath the shelves, would achieve maximum flexibility in maneuvering the robots along the warehouse floor and eliminating bottlenecks.” Pet. 7 (citing Ex. 1003 ¶¶ 109–110). Petitioner further contends that the combination provides the benefit of eliminating *Hangzhou*’s stacking vehicles due to “the vertical travel flexibility of *Raizer*’s robots . . . because *Raizer*’s robots themselves can pick and place containers on upper shelves.” *Id.* (citing Ex. 1003 ¶ 111).

Petitioner next contends that “several *Hangzhou* embodiments, with expressly interchangeable features, disclose switching or turning travel directions between perpendicularly arranged column and row channels while under shelving units to reduce blockages and shorten robot turnover time” and “[s]uch turning allows the *Raizer* robot to autonomously choose ‘among all possible paths’ to a destination thereby reducing congestion, avoiding traffic jams, and more efficiently using space.” Pet. 7–8 (citing Ex. 1003 ¶¶ 112–115).

Petitioner next contends that an ordinarily skilled artisan would have considered Hangzhou’s Embodiments 1–4 “to be interchangeable or, at a minimum, as describing features that were readily combinable at least in view of shared commonalities and *Hangzhou*’s explicit disclosure that the fourth embodiment is ‘a general form of the previous three embodiments.” Pet. 8 (citing Ex. 1003 ¶ 115; Ex. 1006 ¶ 76).

Petitioner next contends that “[a]llowing the autonomous robots of *Raizer* to travel along the various paths described in *Hangzhou* is additionally obvious because such a combination relies on known solutions to improve similar systems and methods in the same way.” Pet. 8. According to Petitioner, an ordinarily skilled artisan “would have known that implementing under-rack travel and turning routing of *Hangzhou* with *Raizer*’s autonomous robots having three-dimensional navigation and travel capabilities would have led to a predictable result of reducing congestion and preventing traffic jams as taught by both *Raizer* and *Hangzhou*.” *Id.* (citing Ex. 1003 ¶¶ 110, 114).

Petitioner next contends that allowing Raizer’s robots to travel along paths described in Hangzhou would have been obvious because the

“combination relies on known solutions to improve similar systems and methods in the same way.” Pet. 8. According to Petitioner, “implementing the under-rack travel and turning routing of *Hangzhou* with *Raizer*’s autonomous robots having three-dimensional navigation and travel capabilities would have led to a predictable result of reducing congestion and preventing traffic jams as taught by both *Raizer* and *Hangzhou*.” *Id.* (citing Ex. 1003 ¶¶ 110, 114).

Petitioner next contends that “the ’632 Patent is silent as to any particular benefit, unexpected result, or criticality of a choice of a particular routing.” Pet. 9. According to Petitioner, “[g]iven the disclosures of *Raizer* and *Hangzhou* indicating the robots and trolleys can travel throughout a warehouse and can do so in ways to reduce congestion and prevent traffic jams, the choice of routing (turning, under racks, in, across, or parallel to aisles) is an obvious matter of design choice in view of the cited references.” *Id.* (citing Ex. 1003 ¶ 101).

Petitioner next contends that an ordinarily skilled artisan “would have been motivated to combine and would have had a reasonable expectation of success in combining *Raizer* and *Hangzhou*.” Pet. 9 (citing Ex. 1003 ¶¶ 101, 116).

ii. Discussion of Petitioner’s Motivation to Combine Contentions

Before we turn to address Patent Owner’s arguments in response to Petitioner’s contentions on motivation to combine, it is helpful to reiterate the legal principles underlying motivation to combine and our understanding of Petitioner’s evidence and argument.

We start with the premise that “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.” *KSR*, 550 U.S. at 417. In this case, we must determine whether one of ordinary skill in the art would recognize that Hangzhou’s disclosure of driving its auto-guided trolleys 200 under shelves 100 would improve the operation of Raizer’s system in the same way. For us to resolve this question in Petitioner’s favor, Petitioner must provide “some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *Id.* at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). However, bodily incorporation, i.e., “an actual physical substitution of” Hangzhou’s auto-guided trolleys or operating software into Raizer’s system, is not required. *See In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012) (“It is well-established that a determination of obviousness based on teachings from multiple references does not require an actual, physical substitution of elements.”); *In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973) (“Combining the *teachings* of references does not involve an ability to combine their specific structures.”).

The Federal Circuit further explained that

motivation to combine may be found explicitly or implicitly in market forces; design incentives; the ‘interrelated teachings of multiple patents’; ‘any need or problem known in the field of endeavor at the time of invention and addressed by the patent’; and the background knowledge, creativity, and common sense of the person of ordinary skill.

Zup, LLC v. Nash Mfg., Inc., 896 F.3d 1365, 1369 (Fed. Cir. 2018); *see also Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1381 (Fed. Cir. 2023) (explaining that it is sufficient for motivation to combine “that there was a known problem . . . in the art, that Bauman[] . . . helped address that issue,

and that combining the teachings of Kabemoto and Bauman wasn't beyond the skill of an ordinary artisan. Nothing more is required to show a motivation to combine under *KSR*").

Raizer discloses robots that “navigate both along the ground and up and along shelves” and “can be steered by its control system to any location on the floor of the warehouse without the use of a track.” Ex. 1005 ¶¶ 78, 104. Raizer also discloses “organiz[ing] the routes of traffic in and around the warehouse to reduce congestion and prevent ‘traffic jams’ when the robots are busy filling orders.” *Id.* ¶ 98. Raizer does not explicitly disclose driving its robots on the floor under the shelves but discloses vertical space under the lowest shelf and as just discussed, its robots can be steered to “any location on the floor of the warehouse.” Ex. 1005 ¶ 104, Fig. 12A; Pet. Reply 3 (arguing that Raizer’s Figure 12A “show[s] lower shelves of sufficient height for under shelf travel”).

Petitioner’s expert, Dr. Derby, testifies “[i]t was well known to elevate the shelving units above the floor so that robots loaded with containers can travel underneath thereby allowing for more flexible route planning and the elimination of bottlenecks.” Ex. 1003 ¶ 107. In support of the opinion that it was well known to elevate shelving units above the floor, Dr. Derby relies on Exhibit 1008 (“Goren”). Dr. Derby testifies that

Goren describes “further enhance[ing]” capabilities of the systems and robots “by elevating the shelving units above the floor, for example on legs high enough so that a floor robot loaded with a container can travel beneath the shelves.” (Ex. 1008, 6:40–43). Thus, “the floor robots receive the containers from the lift robots in locations in the aisles alongside the shelving units, and then travel beneath the shelves in order to deliver the containers to their destination.” (Ex. 1008, 6:43–47). *Goren* underscored that elevating the shelving units high enough

so that floor robots loaded with containers could pass underneath “allows for flexible route planning and efficient transport by the floor robots, by eliminating bottlenecks that could otherwise occur in the aisles between the shelving units.” (Ex. 1008, 6:41–50).

Ex. 1003 ¶ 49; *see also* Ex. 1008, Figs. 1, 2; Ex. 2006, 80:23–81:6.

Hangzhou discloses “allowing an auto-guided trolley to choose among all possible paths” including “under a shelf” while also “avoid[ing] collisions.” Ex. 1006 ¶¶ 18, 62, 76. Hangzhou also discloses that trolleys 200 travel across the aisles between shelves. *Id.* at Figs. 8–10.

In support of Petitioner’s motivation to combine contentions, Dr. Derby opines that

In view of the explicit teaching in *Raizer* of “organiz[ing] the routes of traffic in and around the warehouse to reduce congestion and prevent ‘traffic jams’ when the robots are busy filling orders” (Ex. 1005, ¶ [0098]), a person of ordinary skill in the art would have turned to *Hangzhou* which expressly discloses “preferentially run[ning]” “an auto-guided trolley” “in auto-guided trolley passage spaces 112,” i.e., under the shelf. (Ex. 1006, ¶ [0048]).

Ex. 1003 ¶ 109.

A person of ordinary skill in the art would have combined these references to provide the system of *Raizer* with reduced congestion and prevention of traffic jams, while also maximizing efficient use of space, such as by running the robots of *Raizer* in passages under the shelves as disclosed in *Hangzhou* in order to “organize the routes of traffic in and around the warehouse to reduce congestion and prevent ‘traffic jams’ when the robots are busy filling in orders” as disclosed in *Raizer*. (Ex. 1005, ¶ [0098]). Moreover, because the autonomous robots of *Raizer* move both horizontally and vertically, the robots are able to move in the aisles as well as under the shelves to allow maximum flexibility in maneuvering the robots along the warehouse floor and eliminating bottlenecks. Notably, *Raizer* discloses a vertical

drive (comprising drive wheels 22, small wheels 36, and drive and steering units 24) operable to move the robot vertically that shares common components with, but is nonetheless distinct from, its horizontal drive system (comprising drive wheels 22, rear wheels 30, and drive and steering units 24).

Id. ¶ 110.

A person of ordinary skill in the art would have been motivated to combine *Hangzhou*'s encouragement to use trolleys moving in column and row channels beneath shelves and across aisles to deliver items to picking stations with the three-dimensional travel capabilities of the robots of *Raizer*, because such routing or route switching serves the well-known design need to increase the number of robot travel ways within a warehouse environment thereby reducing congestion and avoiding traffic jams on the warehouse floor. *Hangzhou* also teaches that route switching between column and row channels “can usually reduce blockage and shorten [robot] turnover time.” (Ex. 1006, ¶ [0072]).

Id. ¶ 112.

Similarly, a person of ordinary skill in the art would have been motivated to combine *Hangzhou*'s driving of the trolleys into and across the aisles with the “three-dimensional navigation and travel capabilities” of *Raizer*, because such aisle crossing routing also serves the well-known design need to increase the number of robot travel ways within a warehouse environment thereby reducing congestion and avoiding traffic jams.

Id. ¶ 113.

A person of ordinary skill in the art would have also been motivated to combine *Hangzhou*'s disclosure of trolleys turning to switch travel directions between perpendicularly arranged column and row channels while under one of the racks with the “three-dimensional navigation and travel capabilities” of the robots of *Raizer*, because such under rack turning reduces congestion and potential for trolley collision. Such turning also allows the *Raizer* robot, which is “completely autonomous and can be steered by its control system to any location on the floor of the warehouse” (Ex. 1005, ¶ [01014]), to “choose among all

possible paths” thereby further reducing congestion, avoiding traffic jams, and maintaining a more efficient use of space. (Ex. 1006, ¶ [0076]).

Id. ¶ 114.

We credit this testimony by Dr. Derby because it explains the technical reasons for Petitioner’s assertion that an ordinarily skilled artisan would have been motivated to modify Raizer with Hangzhou’s teachings of running robots beneath the shelves and is supported by the interrelated teachings of Raizer and Hangzhou cited therein. Based on the disclosures of Raizer and Hangzhou discussed above in light of the background knowledge in the art reflected in Goren, we find that Petitioner presents compelling argument that an ordinarily skilled artisan would have been motivated to combine the teachings of Raizer and Hangzhou because we agree that Hangzhou’s technique of running robots under shelves would improve Raizer’s system in the same way by providing more travel paths for the robots to reduce congestion, prevent traffic jams, and avoid collisions between the autonomous robots.⁶

We now address Patent Owner’s evidence and contentions concerning motivation to combine which we ultimately determine to be unavailing in light of our discussion of Petitioner’s evidence above.

iii. Patent Owner’s Contentions

a) Teaching Away

Patent Owner contends that “Raizer advocates for the benefits of an approach attaching rails to existing shelves to ascend and descend the

⁸ Because of this finding, we do not reach the question of whether this combination is also an obvious design choice.

shelves, flexible containers, and a one-robot system comprising complex robots with arms” while “Hangzhou discloses use of specific shelving patterns, standardized containers, and a two-robot system where robots are specialized to planes of motion and particular tasks—specifically teaching against a one-robot system.” PO Resp. 24–25 (citing Ex. 1005 ¶¶ 115, 132, 133; Ex. 1006 ¶¶ 4–5); *id.* at 25 (“Petitioner completely ignores that Hangzhou actually teaches away from using a robotic arm, such as that utilized in Raizer’s robots.”); *id.* at 40 (“Hangzhou specifically teaches away from a single-type [robot], noting that a single-type robot system is not desirable because “in the solution, the whole shelf is handled, requiring each mobile trolley to be provided with a high load capacity, which greatly increases the device cost.” (citing Ex. 1006 ¶ 4)); *id.* at 41 (arguing that “Raizer’s robots also utilize robotic arms . . . which Hangzhou again teaches away from” (citing Ex. 1003, Fig. 12A; Ex. 1006 ¶ 6)).

Petitioner disputes that Hangzhou teaches away from single-type robot systems. Pet. Reply 11 (citing PO Resp. 15, 24–25, 40–41; Ex. 1009, 6:31–22). Petitioner argues that Hangzhou identifies drawbacks with two specific prior art single-type robot systems, i.e., “Amazon’s Kiva robot system” and a Panasonic system. *Id.* at 12 (citing Ex. 1006 ¶ 4). Petitioner further argues Patent Owner misleadingly omits that “*Hangzhou* also identifies drawbacks specific to three prior art systems that are multi-robot collaboration solutions.” *Id.* (citing Ex. 1006 ¶ 5). According to Petitioner, “Dr. Singhose confirmed that *Hangzhou*’s background simply discusses drawbacks specific to five example systems . . . which are of the single type and multi-type variety and does not criticize single-type robots as a class.” *Id.* (citing Ex. 1009, 63:1–22).

In the Sur-reply, Patent Owner argues that “*Hangzhou* expresses a preference for and teaches towards a multi-robot solution over a single-type solution.” Sur-reply 12 (citing Ex. 1006 ¶ 3).

For the following reasons, we do not agree with Patent Owner that *Hangzhou* teaches away from using single robots with robotic arms such as disclosed in *Raizer*.

“A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1327 (Fed. Cir. 2009) (citation omitted). A reference does not teach away “if it merely expresses a general preference for an alternative invention but does not ‘criticize, discredit, or otherwise discourage’ investigation into the invention claimed.” *Id.* (citation omitted). But even if a reference is not found to teach away, its statements regarding preferences are relevant to a finding regarding whether a skilled artisan would have been motivated to combine that reference with another reference. *See Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1051 n.15 (Fed. Cir. 2016) (en banc).

Hangzhou describes alleged drawbacks with two specific single robot systems. Ex. 1006 ¶ 4. *Hangzhou* asserts that “Amazon’s Kiva robot system” requires a mobile trolley with “a high load capacity, which greatly increases the device cost” and due to shelf height may “easily tip over during movement which restricts the improvement of warehousing capacity.” *Id.* *Hangzhou* also asserts that a Panasonic single robot system generally limits the number of shelves to “three to ensure robot movement stability, which

limits the storage capacity of warehouses together with the high cost of a single mobile robot.” *Id.*

Hangzhou further describes alleged drawbacks with three prior multi-robot systems. Ex. 1006 ¶ 5. Hangzhou asserts that an Amazon multi-robot system “has a long deployment cycle, high costs, and low reliability.” *Id.* Hangzhou also asserts that a Dematic system has a mechanical joint arm that “is limited in the pickup range with a low load capacity and high cost” and a Knapp system “requires the installation of the three-dimensional warehouse, leading to a high deployment cost” and “cannot continue to work in the case of internal failure.” *Id.*

Patent Owner’s declarant, Dr. Singhose, testified that paragraph four of Hangzhou does not criticize all single-type robots. Ex. 1009, 63:15–18. Dr. Singhose also testified that paragraph 5 of Hangzhou does not criticize all multi-type robot systems. *Id.* at 63:19–22.

With respect to Patent Owner’s argument that Hangzhou teaches away from the use of robotic arms, Patent Owner relies on paragraph 6 of Hangzhou. *See* PO Resp. 41. Hangzhou provides that “although the on-site modification is not required, a large number of costly heavy-load mobile trolleys or robotic arms need to be configured.” Ex. 1006 ¶ 6. The only other mention of robotic arms in the existing systems is in connection with the Dematic multi-robot system. *See id.* ¶ 5. There is no mention or criticism of robotic arms in connection with the Amazon Kiva system or the Panasonic system which are both single-robot systems. *Id.* Consequently, the statement in paragraph 6, if, *arguendo*, it can be construed as criticizing robotic arms, it is in connection with multi-robot systems, like Hangzhou, not single robot systems such as Raizer.

Having reviewed the above disclosure of Hangzhou and Dr. Singhose's testimony, we find that Hangzhou does not teach away from single-robot systems with robotic arms such as those disclosed in Raizer. After describing alleged drawbacks to certain specific prior art single-robot *and* multi-robot systems, Hangzhou discloses a system using two robots without robotic arms, i.e., auto-guided trolleys 200 and stacking vehicles 300. Ex. 1006 ¶ 41, Figs. 1, 2. Although Hangzhou's choice of a two-robot system without robotic arms indicates a "preference" for such a system, that fact alone does not support a finding that Hangzhou, when read in its entirety, criticizes a single-robot system or discourages an ordinarily skilled artisan from applying Hangzhou's teaching of driving the robots under its shelves to a single-robot system such as Raizer. *DePuy Spine*, 567 F.3d at 1327.

To the extent that Patent Owner argues that an ordinarily skilled artisan would not have been motivated to combine Raizer and Hangzhou because of the difference in robot types or the use of robotic arms, the argument is unavailing for two reasons. First, Petitioner does not propose modifying Raizer's system to use a multi-robot system but, in fact, argues that Raizer advantageously eliminates the need for Hangzhou's second robot, i.e., the stacking vehicle. *See* Pet. 7 (arguing that "*Raizer's* robots eliminates the need for *Hangzhou's* stacking vehicles because *Raizer's* robots themselves can pick and place containers on upper shelves."). Second, the argument appears to be premised on a bodily incorporation of Hangzhou's multi-robot system into Raizer. *See In re Mouttet*, 686 F.3d at 1332 ("It is well-established that a determination of obviousness based on teachings from multiple references does not require an actual, physical

substitution of elements.”); *see also* Pet. Reply 12 (“the Petition combines the robots of *Raizer* with the robot travel teachings of *Hangzhou* and nothing in *Hangzhou* suggests that those teachings are inapplicable or undesirable in a single robot system”).

Patent Owner further attempts to contrast *Raizer* and *Hangzhou*. According to Patent Owner, “Petitioner . . . describes *Raizer* as ‘plug and play in any warehouse, integrating with an already in-use facility, shelving system and infrastructure resources of a conventional warehouse’ while ‘*Hangzhou* requires ‘a “lower layer” of a “channel support frame” [that] “is used to automatically guide a trolley to pass through . . . and *Hangzhou*, itself, specifies that its application is ‘especially suitable for temporary warehouses.’ PO Resp. 25–26 (citing Pet. 20–21; Ex. 1006 ¶ 9). This contention is unavailing because Patent Owner does not explain why *Raizer*’s disclosure of a system adapted to be “plug and play in any warehouse” could not be used in what *Hangzhou* describes as a “temporary warehouse[.]”

b) Alleged Lack of Detail and Vagueness

Patent Owner contends that Petitioner “fail[s] to provide sufficient evidentiary support regarding a motivation to combine the references.” PO Resp. 23. Patent Owner argues that “Petitioner points to generalized and overarching issues common to warehousing, namely to ‘reduce congestion, avoid traffic jams, [and] make more efficient use of space’ but these issues “are vague, applicable to all automated warehouse systems, and do not actually articulate why a [person of ordinary skill in the art] would look to specifically combine *Raizer* with *Hangzhou*’s ability to go under the racks.” *Id.* at 24 (citing Pet. 9).

This contention is unavailing for the following reasons.

As discussed above, we find that Petitioner presents a compelling reason as to why a person of ordinary skill in the art would have been motivated to combine the teachings of Raizer and Hangzhou. Raizer itself discloses that its algorithm “organize[s] the routes of traffic in and around the warehouse to reduce congestion and prevent ‘traffic jams’ when the robots are busy filling orders.” Ex. 1005 ¶ 98. Hangzhou explicitly discloses driving its robots under the shelves. Ex. 1006, Figs. 1, 2. Petitioner asserts, and Patent Owner does not dispute, that driving the robots under the shelves creates more routes for the robots to travel and, thus, reduces congestion. Ex. 1003 ¶¶ 112–114; Tr. 42:6–8.

Patent Owner next contends that the Petition fails to “detail the system of its proposed combination” and “improperly picks and chooses elements from Raizer and Hangzhou, element by element, to attack the patent.” PO Resp. 29. According to Patent Owner, “[n]umerous material implementation details are left unaddressed, such as whether the robots would travel on rails or if there would be the cache space and channel support frame to guide the delivery robots” and the “navigation system is left unaddressed as well – Raizer discloses a ‘survey mode’ that generates [the] required navigation maps, while Hangzhou does not disclose any such mode.” *Id.* at 30 (citing Ex. 1005 ¶ 84; Ex. 2007 ¶ 89).

This contention is unavailing for the following reasons.

Contrary to Patent Owner’s assertion, the Petition specifically proposes modifying Raizer’s system of “autonomous robots, which move horizontally and vertically on tracks attached to shelves, with *Hangzhou’s* teachings of running such robots in passage spaces beneath the shelves.”

Pet. 7 (citing Ex. 1003 ¶¶ 109–110); Pet. Reply 12 (arguing that Patent Owner “ignores that the Petition combines the robots of *Raizer* with the robot travel teachings of *Hangzhou*”); Tr. 9:15–21. This proposed combination includes Raizer’s Survey Mode that is a “mapping survey” that “includes the warehouse layout, routes, intersections, and designated areas.” See Ex. 1005 ¶ 84. Further, Petitioner contends that Hangzhou “disclose[s] switching or turning travel directions between perpendicularly arranged column and row channels while under shelving units to reduce blockages and shorten robot turnover time.” Pet. 7–8 (citing Ex. 1003 ¶¶ 112, 115); Pet. Reply 3. Petitioner’s proposed combination, thus, involves using Raizer’s existing robot system including its Survey Mode while adding a feature, not expressly described in Raizer, of driving the robots under the shelves, a feature which Petitioner has shown was known in the art. Pet. 7–9; Pet. Reply 3.

In addition to Hangzhou, Dr. Derby cites to Goren as background art showing elevated shelves “so that a floor robot loaded with a container can travel beneath the shelves.” Ex. 1003 ¶ 49 (quoting Ex. 1008, 6:40–43); see also Ex. 1008, 9:3–5 (“The floor robots travel beneath shelves 28 in order to deliver the containers to their destinations.”). Petitioner also argues, and we agree, that Figure 12A of “*Raizer* show[s] lower shelves of sufficient height for under shelf travel.” Pet. Reply 3 (citing Ex. 1005, Fig. 12A).

c) Raizer’s Goals and Principle of Operation

Patent Owner contends that Petitioner’s proposed combination contradicts Raizer’s goals and principles of operation and detracts from Raizer’s inventive principles and objectives. PO Resp. 26, 31, 32, 52. According to Patent Owner, Raizer’s overarching goal is “providing ‘an

automatic warehouse system that can be relatively inexpensive and easily added to existing warehouses operated by businesses’ which is . . . ‘suitable for small and medium sized warehouses.’” *Id.* at 26 (citing Ex. 1005 ¶¶ 15, 16).

We disagree with Patent Owner’s argument that Petitioner’s combination contradicts or detracts from Raizer’s goals and principles of operation.

Raizer states that “*a* purpose of the present invention [is] to provide an automatic warehouse system that is suitable for small and medium sized warehouses” and “*another* purpose of the present invention [is] to provide an automatic warehouse system that can be relatively inexpensively and easily added to existing warehouses operated by businesses.” Ex. 1005 ¶¶ 15, 16 (emphasis added). Raizer also states that “[a]lthough a main idea behind the present invention is to retrofit existing warehouses, *the system can obviously be installed in new structures*, in which case the rails of the invention can be manufactured as an integral feature of the shelving system.” *Id.* ¶ 112 (emphasis added). Given that Raizer discloses several purposes for its invention and specifically contemplates application of its system in a new warehouse, we disagree with Patent Owner that Raizer’s “overarching goal” is to apply its system to existing warehouses.

To the extent that Patent Owner contends that an ordinarily skilled artisan would not have been motivated to combine the teachings of Raizer and Hangzhou due to cost or other business-related issues, such a contention is unavailing. The Federal Circuit explains that because “a given combination would not be made by businessmen for economic reasons does not mean that persons skilled in the art would not make the combination

because of some technological incompatibility. Only the latter fact would be relevant.” *In re Farrenkopf*, 713 F.2d 714, 718 (Fed. Cir. 1983) (citation omitted).

Patent Owner next contends that “Raizer’s robot design is not compatible with Hangzhou’s loading techniques, which enable Hangzhou’s operation under the shelves.” PO Resp. 28. Patent Owner argues that Hangzhou uses “a specialized lower loading rack that constrains the trolley’s movement when carrying a specialized container; as such, Hangzhou teaches that when turning under a storage rack, a trolley should unload its payload, turn 90 degrees, reload the payload, and proceed perpendicularly.” *Id.* (citing Ex. 1006 ¶ 73; Ex. 2007 ¶ 97). Patent Owner also argues that the profile of Raizer’s robot “is incompatible with travel beneath storage racks, as evidenced by Hangzhou’s symmetrical, low-profile trolley design.” *Id.* (citing Ex. 2007 ¶ 95).

This contention is unavailing because Petitioner does not propose utilizing the structure of Hangzhou’s shelving but rather applies Hangzhou’s explicit teaching of driving robots under the shelves to Raizer’s system while leaving undisturbed Raizer’s robot’s ability to engage tracks on the shelving and load or unload containers directly. Further, Patent Owner does not argue that it would be beyond the level of ordinary skill in the art to make appropriate modifications to the dimensions and layout of Raizer’s shelving to enable travel of Raizer’s robots with containers under the shelving. Dr. Singhose, in fact, confirms that an ordinarily skilled artisan would and could determine shelf height and dimensions to allow passage of robots thereunder. Ex. 1008, 49:7–51:10.

Patent Owner next contends that “Raizer’s navigation system is not designed to properly navigate underneath storage racks.” PO Resp. 28 (citing Ex. 2007 ¶ 97). Patent Owner argues that “Raizer’s efficient path finding system is one of its core inventive aspects, as it is designed to operate on low position information to increase efficiency.” *Id.* (citing Ex. 1005 ¶ 80). Patent Owner further argues that “[t]raveling under racks would require much higher positional accuracy than on an open floor, decreasing efficiency and removing a core inventive aspect from Raizer’s robot.” *Id.* (citing Ex. 2007 ¶ 97).

This contention is unavailing for the following reasons.

Raizer discloses that its robots are pre-loaded with software that “includes the warehouse layout, routes, intersections, and designated areas,” “dedicated maneuvering algorithms and a proprietary ‘Fine Positioning’ procedure to enable precise, quick and efficient loading,” and “on-board sensors that are located at various locations on the robot to aid the robot in navigation and to identify obstacles.” Ex. 1005 ¶¶ 84, 103. Raizer describes its system as “self-learning . . . where, for example, algorithm can track the movement of the robots and organize the routes of traffic in and around the warehouse.” *Id.* ¶ 98. Neither Patent Owner nor Dr. Singhose address why the software, self-learning algorithms, and sensors on Raizer’s robots are unable to navigate under storage racks.

Raizer also discloses that its robots comprise two front wheels 22 that “can be independently rotated in any direction by drive and steering units 24” and “can be steered by its control system to any location on the floor of the warehouse without the use of a track, embedded wire or any other arrangement to guide it.” *Id.* ¶ 104.

Paragraph 97 of Dr. Singhose's declaration, cited by Patent Owner in support of this contention (PO Resp. 28), provides that

The collision-and-snagging problem is exacerbated when we consider that the Raizer robot would often be carrying a load. A load would make it more difficult to turn in a confined space. Once again, given the teachings of Hangzhou, a POSITA would know about this problem and expect Raizer's system to fail because it cannot perform the turning operation in the manner taught by Hangzhou. For example, Hangzhou teaches that it is best to unload the robot payload before making a turn while under the storage racks. [EX1006, HANGZHOU ¶ 73.] Only after the turn is completed is the load transferred back onto the robot so that it can proceed on its way. [*Id.*] Raizer simply has no way of turning in this manner.

Ex. 2007 ¶ 97. This testimony by Dr. Singhose does not address why Raizer's Fine Positioning procedure which "enables precise, quick, and efficient loading" of items into storage areas on the shelves would fail if the robot travelled under the same shelves. Further, the testimony ignores the fact that Raizer's robots do not load or unload from under the shelves but, rather from the exterior sides of the shelves. Ex. 1005, Fig. 12A. Further, Dr. Singhose's testimony that Raizer has no way of turning under the shelves is inconsistent with Raizer's disclosure that the front wheels of its robots can turn in any direction. Therefore, his testimony is entitled to little, if any, weight, on this point.

Patent Owner next contends that Raizer "aims to solve specific shortcomings" of prior art systems "includ[ing] 'the requirement of a large capital equipment investment,' 'poor modularity' including required reorganization and required 'downtime.'" PO Resp. 31 (citing Ex. 1005 ¶¶ 5–7). According to Patent Owner, "Petitioner's proposed system comprised of Raizer's robots and Hangzhou's ability to go under the shelves

exacerbates these shortcomings” and an ordinarily skilled artisan “would not have been motivated to look to Hangzhou to modify Raizer.” *Id.* Patent Owner argues that modifying Raizer to allow for travel under shelves “require[s] unacceptable modifications of Raizer” and “large capital investment . . . leads to poor modularity, and requires reorganization and downtime.” *Id.* at 31–32 (citing Ex. 1005 ¶¶ 4–16).

Petitioner responds that Patent Owner “provides no explanation as to why modifying *Raizer* with shelving units with elevated lower shelves leads to poor modularity or runs counter to *Raizer*’s goals of adaptability.” Pet. Reply 9. Petitioner argues that Patent Owner “overlooks clear disclosure in *Raizer* that ‘the system can obviously be installed in new structures’ and is not limited to ‘retrofit existing warehouses.’” *Id.* (citing Ex. 1005 ¶ 112; Ex. 2006, 71:8–21).

In the Sur-reply, Patent Owner argues that it “does not claim that including an additional step of elevating shelving to *Raizer*’s system is physically impossible—rather, it is an additional step that would inflate costs, contrary to the express goals of the reference.” Sur-reply 9 (citing PO Resp. 31–32). Patent Owner further argues that “[t]he question of motivation asks whether running robots under shelves **detracts** from *Raizer*’s primary purpose of retrofitting and would thus dissuade a POSITA from making the modification” and that “*Raizer*’s system is particularly sensitive to expensive or time-consuming modifications because it is designed with retrofitting primarily in mind.” *Id.* (citing Ex. 2007 ¶¶ 107–111).

This contention is unavailing for the following reasons.

First, to the extent that Patent Owner is relying on capital expenditures or other business-related considerations such as “reorganization and

downtime” to argue against the combination of Raizer and Hangzhou, as discussed above, any such contention is unavailing because it does not relate to “technological incompatibility.” *In re Farrenkopf*, 713 F.2d at 718. Second, Patent Owner’s argument that one of ordinary skill in the art would be dissuaded from the proposed combination because of Raizer’s disclosure of retrofitting existing warehouses is undercut by Raizer’s explicit disclosure that its system is applicable to new as well as existing warehouses. Ex. 1005 ¶ 112. Third, Patent Owner’s reference to “poor modularity” resulting from the combination lacks any explanation. *See* PO Resp. 31–32.

Patent Owner next contends that Petitioner’s stated reason for the combination—“that increasing the number of travel paths could hypothetically ease congestion”—“is a non-existent problem.” PO Resp. 32. In support of this contention, Patent Owner argues that “Raizer teaches that its invention already reduces congestion.” *Id.* (citing Ex. 1005 ¶ 98). Similarly, Patent Owner argues that “Raizer avoids collisions by using only one type of robot and spacing them out vertically on shelves, precluding the need to go under the shelves.” *Id.* at 34 (citing Ex. 2007 ¶ 119). According to Patent Owner, “Raizer’s robots travel on the face of the shelves but can be above and below each other on different shelves to avoid colliding” which “effectively adds numerous travel paths in the vertical direction, thereby reducing the need for numerous travel paths on the ground surface.” *Id.* (citing Ex. 1003, Fig. 12A; Ex. 2007 ¶ 119).

This contention is unavailing because the adequacy of an existing system does not preclude and would not discourage a person of ordinary skill in the art from attempting to improve on Raizer by adding more potential travel paths under the shelves. *See DyStar Textilfarben GmbH &*

Co v. C.H. Patrick Co., 464 F.3d 1356, 1368 (Fed. Cir. 2006) (“Because the desire to enhance commercial opportunities by improving a product or process is universal—and even common-sensical—we have held that there exists in these situations a motivation to combine prior art references.”).

Patent Owner further argues that Petitioner “ignores the downsides of creating travel lanes under shelves, and in turn ignores that other significant traffic issues are created by introducing Hangzhou’s travel under the shelves into Raizer.” PO Resp. 33. Patent Owner argues that Hangzhou’s trolleys “avoid congestion and collisions with the stacking vehicles by traveling in the column laneways and in trolley passage space” and “preferably do not enter the stacking row laneway aisles reserved for the stacking vehicles.” *Id.* at 33–34 (citing Ex. 1006 ¶ 48; Ex. 2007 ¶ 68). According to Patent Owner, this allows the system of Hangzhou “to efficiently deliver goods and avoid collisions.” *Id.* at 34 (citing Ex. 1006 ¶¶ 48, 59; Ex. 2007 ¶ 68). Patent Owner similarly argues that “Hangzhou’s stacking robots fill the aisles” and “are configured so they can simultaneously service the shelves on either side of an aisle.” PO Resp. 38 (citing Ex. 1006 ¶¶ 16, 46, Fig. 3).

This contention is unavailing for the following reasons.

First, the Petition specifically contemplates that an ordinarily skilled artisan would have understood that “*Raizer’s* robots eliminate[] the need for *Hangzhou’s* stacking vehicles.” Pet. 7. Consequently, the potential for collisions with stacking vehicles in stacking row laneway aisles, such as in Hangzhou, is not an issue in the proposed combination. Further, contrary to Patent Owner’s assertion, Hangzhou specifically discloses embodiments where trolleys 100 enter the stacking laneways. Ex. 1006, Figs. 8–10.

Patent Owner's next contention relates to certain deposition testimony by Dr. Spenko. PO Resp. 35. Dr. Spenko was asked to illustrate hypothetical routes that a robot might travel under shelves in Raizer's system to retrieve packages. *Id.* at 36 (reproducing Ex. 2005, Raizer Figure 1 annotated by Dr. Spenko). Patent Owner argues that each of the paths identified in orange by Dr. Spenko was "inefficient" because the robot "was required to travel out from under the shelves and out into the aisle . . . to engage the terminals to access the rails so that the robot could travel vertically to ascend the shelves." *Id.* at 37 (citing Ex. 1005 ¶ 111; Ex. 2006, 111:3–112:2; Ex. 2007 ¶ 126). According to Patent Owner, "while the robots in Raizer could avoid collisions with each other by spacing vertically, when using Hangzhou's under the shelf capability, Raizer's robots would be more apt to collide given the increased need to enter the aisle." Patent Owner argues this undercuts "Petitioner's supposed benefits of increased pathways." *Id.* at 38 (citing Ex. 2007 ¶¶ 127–128).

These contentions are unavailing for the following reasons.

Patent Owner's argument that Raizer's robots would be more apt to collide ignores the fact that Raizer's robots already travel in the aisles and that its robots are provided with on-board sensors to "aid the robot in navigation and to identify obstacles" and "form a virtual 'bubble' around the robot as it travels." Ex. 1005 ¶ 103. Nonetheless, even if there is a disadvantage to the proposed combination, the Federal Circuit instructs that "a given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine." *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006); *see also Winner Int'l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 n.8 (Fed. Cir.

2000) (“The fact that the motivating benefit comes at the expense of another benefit . . . should not nullify its use as a basis to modify the disclosure of one reference with the teachings of another.”).

Next, we address various issues raised by Patent Owner in connection with Raizer’s navigation and software. *See* PO Resp. 47–54.

Patent Owner first contends that without access to Raizer’s Survey Mode software, which Raizer describes as proprietary, claim limitations [1.c] and [1.d1] cannot be practiced because “[t]here is no way to drive vehicles under the storage racks without the layout, routes, and intersections provided by the proprietary software.” PO Resp. 47–48. Patent Owner premises this contention on an assumption that explicitly driving a robot under storage racks requires modification of Raizer’s proprietary Survey Mode to establish “the required new routes and intersections.” *Id.* at 49 (“[T]he proposed combination requires that Raizer’s proprietary software be changed so that it can establish the required new routes and intersections.”).

We disagree with Patent Owner that Raizer’s software must be modified in the proposed combination for the following reasons.

Raizer teaches a fulsome system for robot navigation in a warehouse. It discloses that “each robot is pre-loaded with dedicated software which includes the warehouse layout, routes, intersections, and designated areas” and the robots navigate to “fixed specific locations in the warehouse such as terminals (locations at which the robot leaves the floor and climbs a vertical rail of the shelving system).” Ex. 1005 ¶¶ 33, 80. Raizer illustrates how its robots 10 attach to terminals at floor level. *Id.* ¶ 70, Figs. 8B–8E. Because Raizer teaches that its robots are loaded with software including a warehouse

layout and can navigate to terminals where the robot can leave the floor, Raizer contains the information necessary to locate possible routes under the shelving, e.g., the space between terminals on the floor level as shown in Raizer's Figure 12A. Further, Raizer discloses that "[n]avigation, driving, fine positioning procedure . . . is done by processors in every robot. The drivers and controllers in each robot execute dedicated algorithms to fully enable the robot's multi-channel degrees of freedom" and its "algorithm can track the movement of the robots and organize the routes of traffic in and around the warehouse." *Id.* ¶¶ 89, 98; *see also* Pet. 20 (arguing Raizer "deploys 'a self-learning system where, for example, algorithm [sic] can track the movement of the robots and organize the routes of traffic in and around the warehouse'" (citing Ex. 1003 ¶ 159; Ex. 1005 ¶¶ 79, 98)).⁷

Patent Owner next contends that "[m]apping under shelves, however, is very challenging and beyond the skill of a [person of ordinary skill in the art]." PO Resp. 50 (citing Ex. 2007 ¶ 152). According to Patent Owner, "Hangzhou's two-robot system specifically avoids such requirements to map the paths under the shelves because of the channel support frames guiding the trolleys" but Raizer would require "additional mapping of the space below the shelves using sensors that perform 'Survey Mode'" so that its

⁷ To the extent that any modification to Raizer's software were necessary, Dr. Singhose testified that an ordinarily skilled artisan could write code to drive and turn a robot. Ex. 1009, 73:20–22. Likewise, Dr. Spenko testified that when Raizer refers to "the mapping survey is recorded by a survey mode or the robot software . . . there's algorithms out there that can do that, but person of ordinary skill in the art would understand that and say okay, that can be done." Ex. 2006, 64:17–22. We credit this testimony and find that, if any modification were required, such modification would be within the level of ordinary skill in the art.

robots are able to turn and drive under the shelves. *Id.* (citing Ex. 1006 ¶ 59; Ex. 2007 ¶ 151). Patent Owner argues that “[a]ttempting to use Raizer’s robot and its sensors to navigate under shelves would create serious navigation issues due to . . . multipath effects.” *Id.* at 51 (citing Ex. 2007 ¶ 154).

Petitioner responds that Patent Owner does not explain “how such alleged effects only exist when robots travel underneath racks, but not when *Raizer’s* robots travel in aisles between two racks which would presumably create similar effects in *Raizer’s* system even without modification.” Pet. Reply 19. Petitioner contends that Dr. Singhose testified that multipath effects arise “during mapping, not in obstacle detection mode.” *Id.* (citing Ex. 1009, 91:20–92:11). According to Petitioner, “any such multipath effect would not impact the proposed combination in modes other than ‘Survey Mode’ even under Opex’s contrived theory.” *Id.* at 20.

Patent Owner’s contention is unavailing for the following reasons.

First, Patent Owner does not direct us to any disclosure that Raizer’s Survey Mode requires the use of sensors to map the paths under shelves. Raizer discloses “[t]he robots are pre-loaded with proprietary software which includes the warehouse layout, intersections, and designated areas (this mapping survey is recorded by a ‘Survey Mode’ of the robot’s software).” Ex. 1005 ¶ 84; *see also id.* ¶ 33 (“[T]he processor of each robot is pre-loaded with dedicated software which includes the warehouse layout, routes intersections, and designated areas.”). Second, Patent Owner’s arguments concerning multi-path effects are based on using Lidar sensors which rely on laser reflections. PO Resp. 50; Ex. 2009, 2–3. Raizer,

however, does not disclose using Lidar sensors. Ex. 1005 ¶ 103. Thus, Patent Owner’s multi-path arguments are unavailing.

Patent Owner next contends that “Raizer’s robots use ‘anchor point navigation.’” PO Resp. 52. Patent Owner argues that this

allows Raizer’s robots to ‘use *less accurate sensing and motions when travelling on the floor* in order to arrive at the designated destination *as rapidly and efficiently as possible* and employ dedicated algorithms and more precise sensing only when near anchor points, *i.e.*, fixed specific locations in the warehouse such as terminals . . . picking stations, and battery charging stations.

Id. at 52–53 (citing Ex. 1005 ¶ 80; Ex. 2007 ¶ 63). According to Patent Owner, “Raizer’s use of ‘anchor point navigation’ is an essential feature of Raizer’s system” and “is beneficial because ‘[t]his feature provides *significant savings in energy and load on the sensor and navigation system* since the robot has to check exactly where it is only when approaching its destination.” *Id.* at 53 (citing Ex. 1005 ¶ 79–80; Ex. 2007 ¶ 64).

Patent Owner attempts to contrast Hangzhou by arguing that it “requires a much more complex navigation planning system in order to ensure safe and reliable operation.” PO Resp. 53 (citing Ex. 1006 ¶ 59). According to Patent Owner, “Hangzhou’s navigation system needs to evaluate four different path planning methods” and its “algorithm intentionally introduces delays and wait times when the trolleys are travelling on the ground to plan a path to a destination that avoids collisions and proper transfer of items between the trolleys and the stacking vehicles.” *Id.* at 53–54 (citing Ex. 1006 ¶¶ 63, 80; Ex. 2007 ¶ 76). Patent Owner further argues that combining Hangzhou and Raizer in order to run Raizer’s robots beneath shelves would require additional “sensors and navigational system complexity” that “would have required modifications that would

have obviated Raizer’s innovation.” *Id.* at 54 (citing Ex. 1005 ¶ 80; Ex. 2007 ¶ 97).

This contention is unavailing for the following reasons.

First, the Petition does not propose eliminating Raizer’s use of anchor point navigation. Second, the Petition does not propose bodily incorporating Hangzhou and its navigation system into the modified Raizer system.

iv. Finding as to Motivation to Combine

For the reasons explained above and based on a full consideration of Petitioner’s and Patent Owner’s arguments and evidence as to motivation to combine, we find that one of ordinary skill in the art would have been motivated to modify Raizer with the travel-under-shelf teachings of Hangzhou. Specifically, we find that one of ordinary skill in the art would have been motivated to combine Hangzhou’s teaching of running robots under shelves with Raizer’s system to improve Raizer in the same way, by providing more travel paths for the robots to reduce congestion, prevent traffic jams, and avoid collisions between the autonomous robots. Ex. 1003 ¶¶ 109–114; *Intel Corp.*, 61 F.4th at 1381 (Fed. Cir. 2023).

b. Reasonable Expectation of Success

Petitioner contends that an ordinarily skilled artisan “would have been motivated to combine specific teachings of *Hangzhou* with those of *Raizer* to reduce congestion, avoid traffic jams, make more efficient use of space and to allow *Raizer*’s robots to ‘chose among all possible paths.’” Pet. 9 (citing Ex. 1003 ¶¶ 113–114). Petitioner further contends that an ordinarily skilled artisan “would have been motivated to combine and would have had a reasonable expectation of success in combining *Raizer* and *Hangzhou*.” *Id.* (citing Ex. 1003 ¶¶ 101, 116).

Patent Owner first contends that the Petition’s reference to reasonable expectation of success is conclusory and “falls well short of the requirement to *show* a reasonable expectation of success, and not to merely state that there was one.” PO Resp. 43. Patent Owner further contends that “Dr. Spenko only relies on conclusory assessments and not the references’ actual disclosures.” *Id.* With reference to Dr. Spenko’s declaration in support of reasonable expectation of success, Patent Owner argues that he failed to provide examples of the teachings in the prior art or the knowledge of an ordinarily skilled artisan to support a finding of reasonable expectation of success. *Id.* at 44 (citing Ex. 1003 ¶ 101). Patent Owner further argues that “Dr. Spenko does not provide any support for his statement that the routing for Petitioner’s combined system is ‘an obvious matter of design choice.’” *Id.* Patent Owner repeats its arguments discussed above that Raizer’s single-type robots are so different than Hangzhou’s multi-type robots that “Dr. Spenko’s conclusory statement that the choice of routing is ‘an obvious matter of design choice’ is unfounded and overlooks . . . these fundamental differences in the references and their implications.” *Id.* at 44–45.

Petitioner, in turn, argues that “[t]he straightforward nature of the proposed combination is the epitome of reasonableness—*Raizer*’s robots, which *Raizer* discloses as being able to navigate anywhere along the floor of a warehouse, with *Hangzhou*’s teaching of routing such robots under the shelves of the warehouse and across aisles.” Pet. Reply 5–6 (citing Pet. 6–9; Ex. 1003 ¶¶ 110–111; Ex. 2006, 87:16–89:25). Petitioner further points to the contention in the Petition that an ordinarily skilled artisan “would have known that implementing the under-rack travel and turning routing of

Hangzhou with *Raizer*'s autonomous robots having three-dimensional navigation and travel capabilities would have led to a predictable result of reducing congestion and preventing traffic jams as taught by both *Raizer* and *Hangzhou*.” *Id.* at 7 (citing Pet. 8; Ex. 1003 ¶¶ 110, 114). Petitioner contends that with “a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp” then “[i]f this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.” *Id.* (quoting *KSR*, 550 U.S. at 421 (Petitioner’s emphasis omitted)).

“A conclusion of obviousness requires a reasonable expectation of success.” *Intelligent Bio-Sys.*, 821 F.3d at 1365 (citing *KSR*, 550 U.S. at 421. Further, “the ‘predictable result’ discussed in *KSR* refers not only to the expectation that prior art elements are capable of being physically combined, but also that the combination would have worked for its intended purpose.” *DePuy Spine*, 567 F.3d at 1326 (citations omitted). “Obviousness does not require absolute predictability of success . . . all that is required is a reasonable expectation of success.” *In re O’Farrell*, 853 F.2d 894, 903–04 (Fed. Cir. 1988) (citations omitted). In cases where motivation to combine arguments are intertwined with reasonable expectation of success, a finding of motivation to combine also implicates reasonable expectation of success. *See Elekta Ltd. v. ZAP Surgical Sys., Inc.*, 81 F.4th 1368, 1376 (Fed. Cir. 2023). With these principles in mind, we evaluate the parties’ respective contentions.

Petitioner proposes modifying *Raizer* with *Hangzhou*’s teaching of driving robots under the shelves. As discussed above, after analyzing Petitioner’s evidence and argument in light of Patent Owner’s contentions

and evidence, we find that Petitioner has shown that Hangzhou's technique of running robots under shelves would improve Raizer's system in the same way by providing more travel paths for the robots to reduce congestion, prevent traffic jams, and avoid collisions between the autonomous robots. Further, Patent Owner does not dispute that travelling under the shelves adds more traffic routes. Tr. 42:6–8. Consequently, we find that Petitioner also establishes a reasonable expectation of success because the combination applies a known teaching from Hangzhou to Raizer with a predictable result. *KSR*, 550 U.S. at 421.

We now turn to Patent Owner's remaining contentions concerning reasonable expectation of success which we determine are unavailing.

Patent Owner contends that Petitioner has not demonstrated reasonable expectation of success in combining Raizer and Hangzhou because of “the failure to clarify the operation of the proposed system or even attempt to reconcile some of their incompatibilities.” PO Resp. 30–31; *see also id.* at 45 (arguing that Petitioner “failed to provide adequate disclosure of their proposed modified system”). This contention is unavailing for the reasons discussed above in connection with motivation to combine, i.e., Petitioner proposes modifying Raizer with the teachings in Hangzhou of driving the robots under shelves.

Patent Owner next contends that there can be no reasonable expectation of success because the “proposed combination requires the use of proprietary components, such as those of Raizer.” PO Resp. 46. Patent Owner argues that Raizer's proprietary Survey Mode and Fine Positioning software “cannot be combined with technology from a secondary source by a [person of ordinary skill in the art], because a [person of ordinary skill in

the art] would not have access to the proprietary components.” *Id.* at 47. As discussed above for motivation to combine, we do not agree with Patent Owner that any modification of Raizer’s proprietary software is required to incorporate Hangzhou’s teachings of running robots under the shelves. Additionally, as discussed above, modifications, if any, to Raizer’s software would be within the level of ordinary skill in the art. Consequently, this contention is unavailing.

Patent Owner also argues that due to the multipath effects caused by Lidar sensors discussed above, “Dr. Spenko does not appear to have fully considered what is actually involved with Petitioner’s proposed combination of Raizer and Hangzhou, he cannot support a reasonable expectation of success.” PO Resp. 56. As discussed above, we disagree that Raizer is limited to the use of Lidar sensors. Consequently, this contention is unavailing.

We now turn to Petitioner’s mapping of the prior art to the Challenged Claims.⁸

c. Claim 1

[1.pre]: A method for delivering items to storage locations and retrieving items from storage locations, comprising the steps of

Petitioner contends that to the extent the preamble is limiting, Raizer teaches “‘an automatic system for picking and placing boxes on shelves in a warehouse’ comprised of ‘autonomous mobile robots,’ and ‘a network of vertical and horizontal rails’ ‘parallel to’ ‘vertical support posts and horizontal shelves.’” Pet. 9–10 (citing Ex. 1003 ¶ 118; Ex. 1005, Abstract). Petitioner further contends that the robots “navigate and travel autonomously

⁸ We use Petitioner’s limitation annotations for ease of reference.

both along the floor and up the vertical rails and along horizontal rails of [a] network of rails.” *Id.* at 10 (citing Ex. 1003 ¶¶ 119–120; Ex. 1005, Abstract).

Patent Owner does not address Petitioner’s contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that Raizer teaches the subject matter of the preamble for the reasons explained by Petitioner. Consequently, we need not reach the question of whether the preamble is limiting.

[1.a.1]: providing a plurality of storage racks spaced apart from one another forming a plurality of aisles

Petitioner provides the following annotated version of Raizer’s Figure 1 in support of its contention that Raizer discloses this limitation (Pet. 11):

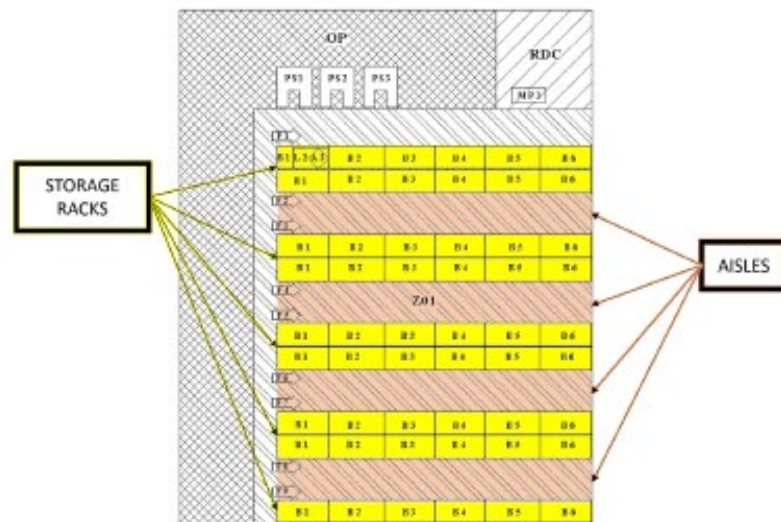


Fig. 1

Figure 1 is a schematic “floor plan of a typical warehouse.” Ex. 1005 ¶ 58. Petitioner annotates the drawing with yellow shading of “storage racks” and orange shading of “aisles” between the storage racks. Pet. 11.

Petitioner contends that Raizer discloses “‘a plurality of shelving units’ (storage racks) where the shelving units consist of ‘horizontal and vertical pieces of angle iron that support the shelves.’” Pet. 10 (citing Ex. 1003 ¶ 122; Ex. 1005 ¶ 92, Fig. 1). Petitioner further contends that Raizer discloses “[v]ertical supports divide shelving units into bays (B1, B2 . . .),’ and ‘sides of the shelving units that face the aisles’ (plurality of aisles) ‘between units are called faces (F1, F2, . . .).” *Id.* (citing Ex. 1003 ¶¶ 122–123; Ex. 1005 ¶ 92).

Patent Owner does not address Petitioner’s contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that Raizer discloses this limitation for the reasons explained by Petitioner.

[1.a.2]: wherein each storage rack comprises a plurality of columns and each column comprises a plurality of storage locations

Petitioner contends that Raizer “has ‘a plurality of shelving units’ (storage racks) where ‘a given row of shelves’ (storage locations) ‘in a bay’ (columns) ‘can hold several boxes arranged in one or more side-by-side stacks each comprising one or more boxes stacked one upon the other.’” Pet. 11 (citing Ex. 1003 ¶¶ 125–126; Ex. 1005 ¶ 92). According to Petitioner, “[t]he ‘exact location of a box in the warehouse is designated by an address’ ‘representing the zone, face, bay, level, and specific location.’” *Id.* (citing Ex. 1003 ¶¶ 125–126; Ex. 1005 ¶ 92).

Patent Owner does not address Petitioner’s contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that Raizer discloses this limitation for the reasons explained by Petitioner.

[1.b.1]: providing a plurality of delivery vehicles

Petitioner contends that Raizer's autonomous mobile robots correspond to the recited "delivery vehicles." Pet. 12 (citing Ex. 1003 ¶ 129; Ex. 1005 ¶ 19). According to Petitioner, Raizer's "robots 'complete [a] mission of removing a box from (or delivering a box to) a specific location on a shelf' in a warehouse." *Id.* (citing Ex. 1003 ¶¶ 129–130; Ex. 1005 ¶¶ 19, 27, 114).

Patent Owner does not address Petitioner's contentions. PO Resp. 23–56.

We reviewed Petitioner's contentions and evidence and find that Raizer discloses this limitation for the reasons explained by Petitioner.

[1.b.2]: wherein each vehicle comprises a horizontal drive system operable to drive the vehicle along a horizontal surface

Petitioner contends that Raizer's robots comprise "two drive and steering units," and each of the units "compris[es] one front wheel and components configured to rotated [sic] the front wheel at least 360 degrees about an axis vertical to the floor in order to steer the robot" and additionally "rotate the front wheel about a horizontal axis in order to cause the robot to move in the direction that the front wheel is pointing." Pet. 12 (citing Ex. 1003 ¶ 132; Ex. 1005 ¶ 25). According to Petitioner, Raizer discloses that the robots navigate along the ground which corresponds to traveling along a horizontal surface. *Id.* (citing Ex. 1003 ¶ 133; Ex. 1005 ¶ 78); *id.* at 14 ("Raizer discloses a horizontal drive system comprising drive wheels 22, rear wheels 30, and drive and steering units 24 operable to drive the vehicle along a horizontal surface.") (citing Ex. 1003 ¶¶ 135–136).

Patent Owner does not address Petitioner's contentions. PO
Resp. 23–56.

We reviewed Petitioner's contentions and evidence and find that
Raizer discloses this limitation for the reasons explained by Petitioner.

[1.b.3]: a vertical drive operable to drive the vehicle vertically

Petitioner contends that in Raizer's process the robots “‘leav[e] the floor of the warehouse and climb[] a vertical rail attached to the shelving,’ where the ‘robot travels vertically with both front wheels in the same vertical rail.’” Pet. 14 (citing Ex. 1003 ¶ 140; Ex. 1005 ¶¶ 114–121, Figs. 8A–8G). Petitioner further contends that right wheel 22 of the robot enters a terminal on the shelf and is locked to vertical rail 42. *Id.* at 15 (citing Ex. 1003 ¶ 141; Ex. 1005 ¶¶ 116–117, Figs. 8C); *id.* at 17 (“[W]hen the drive wheel 22 enters the U shaped channel 46 in rail 42 the small wheels 36 lock the drive wheel on the rail.” (citing Ex. 1003 ¶ 145; Ex. 1005 ¶ 122, Fig. 9B)). Next, Petitioner contends that after the right wheel advances up vertical rail 42, the robot is slightly off the ground and left front wheel 22 moves into terminal 44 and is locked to the rail. *Id.* at 16 (citing Ex. 1003 ¶ 143; Ex. 1005 ¶¶ 119–121, Fig. 8F).

Patent Owner does not address Petitioner's contentions. PO
Resp. 23–56.

We reviewed Petitioner's contentions and evidence and find that
Raizer discloses this limitation for the reasons explained by Petitioner.

[1.b.4]: a transfer mechanism operable to transfer an item between the vehicle and one of the storage locations

Petitioner contends that Raizer discloses a “‘a gripper mechanism attached to the top side of the [robot] frame that is configured to pick and

place boxes,’ and allows ‘the robot to handle different sized boxes.’” Pet. 18 (citing Ex. 1003 ¶ 149; Ex. 1005 ¶¶ 27, 31). Petitioner further contends that the robots “can ‘grab and lift [a] carton’ ‘to place the cartons on the shelves or to pick them up.’” *Id.* (citing Ex. 1003 ¶ 149; Ex. 1005 ¶ 101). Petitioner also contends that Raizer’s Figure 14A shows a robot positioning a box on a shelf with “a gripper mechanism (transfer mechanism) operable to transfer an item between the vehicle and one of the storage racks.” *Id.* at 19 (citing Ex. 1003 ¶¶ 151, 152; Ex. 1005 ¶ 138, Fig. 14A).

Patent Owner does not address Petitioner’s contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that Raizer discloses this limitation for the reasons explained by Petitioner.

[1.c]: driving a first one of the vehicles to drive the first vehicle to the storage racks

Petitioner contends that Raizer’s robots “comprise a set of on-board sensors, a processor, software, and other electronics configured to provide them with three-dimensional navigation and travel capabilities” in order “to navigate and travel autonomously both along the floor and up the vertical rails and along the horizontal rails of the network of rails to reach an exact location on the floor or shelving system.” Pet. 19–20 (citing Ex. 1003 ¶¶ 154–156; Ex. 1005 ¶¶ 22, 34, 83, Abstract).

In connection with its motivation-to-combine arguments, Patent Owner contends that this limitation is not met because Raizer’s proprietary Survey Mode software could not be modified by an ordinarily skilled artisan. PO Resp. 47–48. As discussed above, this contention is unavailing because we do not agree that Raizer’s software requires modification, and

even if it would require modification, any such modification would be within the level of ordinary skill in the art.

We reviewed Petitioner’s contentions and evidence and find that Raizer discloses this limitation for the reasons explained by Petitioner.

[1.d.1]: driving the first vehicle along a first path under a first one of the racks

Petitioner contends that the combination of Raizer and Hangzhou teaches this limitation. Pet. 20–22; Tr. 11:15–12:16.

Petitioner first contends that Raizer’s system is a plug and play system in any warehouse. Pet. 20. Petitioner argues that, if Raizer is determined to not disclose driving a vehicle along a path under one of the racks, Hangzhou “discloses ‘an unmanned warehousing system’ where a ‘lower layer’ of a ‘channel support frame’ ‘is used to automatically guide a trolley to pass through’ such that an ‘auto-guided trolley travels through the lower layer of the support frame to a position below the containers.’” *Id.* at 20–21 (citing Ex. 1003 ¶ 161; Ex. 1006, Abstract). Petitioner contends that auto-guided trolleys 200 travel in “auto-guided trolley passage spaces 112” under Hangzhou’s shelves. *Id.* at 21.

Petitioner provides the following annotated version of Hangzhou’s Figure 2 to illustrate the travel of Hangzhou’s robots (Pet. 21):

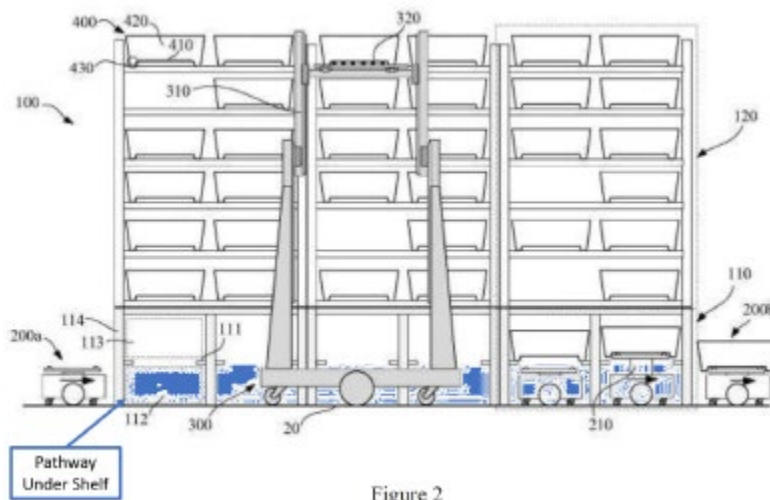


Figure 2

Figure 2 is a front view of a storage rack in Hangzhou's warehouse system. Ex. 1005 ¶ 12. Petitioner annotates Figure 2 by highlighting auto-guided trolleys in blue located within passage space 112 and a text box reading "Pathway Under Shelf" and a blue line pointing to the left passage space 112. Pet. 21.

Petitioner refers to its motivation-to-combine arguments discussed above and contends that an ordinarily skilled artisan "would have been motivated to combine driving of trolleys under a rack of *Hangzhou* with the capabilities of *Raizer's* robots" and the combination of *Raizer* and *Hangzhou* "render[s] obvious driving the first vehicle along a first path under a first rack." Pet. 22 (citing Ex. 1003 ¶¶ 164, 165).

In connection with its motivation-to-combine arguments, Patent Owner contends that this limitation is not met because *Raizer's* proprietary Survey Mode software could not be modified by an ordinarily skilled artisan. PO Resp. 48. As discussed above, this contention is unavailing.

We reviewed Petitioner's contentions and evidence and find that the combination of *Raizer* and *Hangzhou* teaches this limitation for the reasons explained by Petitioner.

[1.d.2]: wherein the first rack is adjacent a first one of the aisles

Petitioner contends that the combination of Raizer and Hangzhou teaches this limitation. Pet. 22–23.

Petitioner first contends that Raizer’s plurality of storage racks are “spaced apart from one another forming a plurality of aisles where a row of racks is adjacent an aisle.” Pet. 22 (citing Ex. 1003 ¶ 167). Petitioner alternatively contends that, if Raizer is determined not to disclose a first rack, Hangzhou discloses “a first rack, under which the vehicle travels, that is adjacent a first aisle.” *Id.* (citing Ex. 1003 ¶¶ 167–168; Ex. 1006 ¶¶ 35–37, Fig. 1). According to Petitioner, an ordinarily skilled artisan “would have been motivated to combine the driving of trolleys along a path under a rack where the path is adjacent an aisle of *Hangzhou* with the capabilities of *Raizer*’s robots” and the combination “renders obvious the first rack is adjacent a first one of the aisles.” *Id.* at 23. (citing Ex. 1003 ¶¶ 169, 170).

Patent Owner does not address Petitioner’s contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of Raizer and Hangzhou teaches this limitation, for both alternatives, for the reasons explained by Petitioner.

[1.d.3]: wherein the first path extends in a direction parallel to the first aisle and spaced apart from the first aisle

Petitioner contends that the combination of Raizer and Hangzhou teaches this limitation. Pet. 23.

Petitioner first contends that “*Raizer* discloses a plurality of storage racks spaced apart from one another forming a plurality of aisles adjacent to

the row of racks under which the robot may travel in a first path spaced apart from and parallel to a first aisle.” Pet. 23–24 (citing Ex. 1003 ¶ 172).

Petitioner next contends, if Raizer does not disclose this limitation, then Hangzhou does. Pet. 24. Petitioner provides the following annotated version of Hangzhou’s Figure 10 (*id.* at 25):

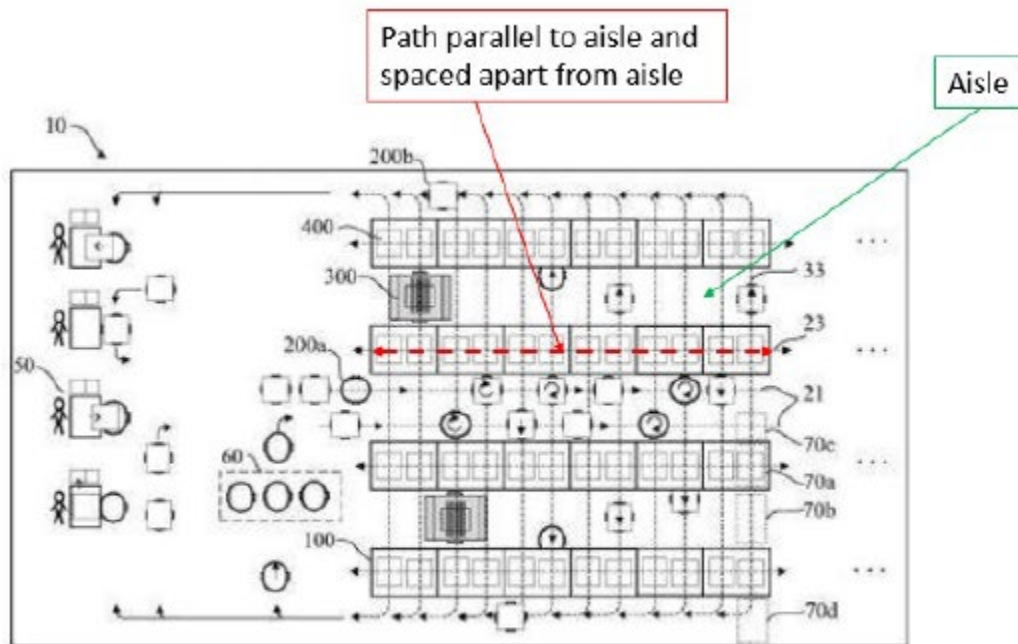


Figure 10

Figure 10 “is a top view of an unmanned warehousing system . . . and a schematic diagram of the principle of an auto-guided trolley performing inbound and outbound operations when it runs along a row channel and a column channel under a shelf.” Ex. 1006 ¶ 19. Petitioner adds a green box with text “Aisle” with a green arrow pointing to an aisle between rows and a red box with text “Path parallel to aisle and spaced apart from aisle” with a red arrow pointing to a dashed red line under a row of shelves. Pet. 25.

Petitioner contends that annotated Figure 10 “discloses that a ‘dotted line displayed on the center line of each shelf row is used to indicate the row

channel 23 for auto-guided trolleys 200 under the shelf, which is a path parallel to the stacking row laneway 12.” Pet. 24 (citing Ex. 1003 ¶ 173; Ex. 1006 ¶ 40). Petitioner further contends that annotated Figure 10 “discloses the first path extends in a direction parallel to the first aisle and spaced apart from the first aisle.” *Id.* (citing Ex. 1003 ¶¶ 174, 176; Ex. 1006, Fig. 10).

Patent Owner does not address Petitioner’s contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find the combination of Raizer and Hangzhou teaches this limitation, for both alternatives, for the reasons explained by Petitioner.

[1.e]: turning the first vehicle while the first vehicle is under the first rack

Petitioner contends that the combination of Raizer and Hangzhou teaches this limitation. Pet. 27 (citing Ex. 1003 ¶ 187).

Petitioner first contends that Raizer’s “vehicles can travel in any direction and to various locations.” Pet. 25 (citing Ex. 1003 ¶¶ 177–180).

Petitioner contends that, if Raizer should be determined not to disclose turning the vehicle while under the first rack, “*Hangzhou* discloses driving the vehicle under the rack and that the ‘trolleys are generally designed’ ‘to turn in place,’ even 90⁰.” Pet. 26 (citing ex. 1003 ¶¶ 182, 184–185; Ex. 1006 ¶¶ 48, 73, Fig. 2). Petitioner further contends that Hangzhou’s “‘auto-guided trolley 200 may switch between the row direction and the column direction,’ and that ‘[s]witching the driving direction does not bring a problem to auto-guided trolleys because auto-guided trolleys 200

can be small enough to turn in the auto-guided trolley passage space 112.”
Id. (citing Ex. 1003 ¶ 183; Ex. 1006 ¶ 72, Fig. 10).

Petitioner argues that it would have been obvious to an ordinarily skilled artisan “that *Raizer*’s robot could turn while under a shelf, given *Raizer*’s disclosure of three-dimensional movement capabilities and ability to turn ‘360 degrees about an axis vertical to the floor.’” Pet. 27 (citing Ex. 1003 ¶ 186). Petitioner further argues that an ordinarily skilled artisan “would have also, or alternatively, been motivated to combine the ability of *Hangzhou*’s trolley to rotate in place 90⁰ under shelves with *Raizer*’s travel capabilities.” *Id.* (citing Ex. 1003 ¶ 186; Ex. 1006 ¶¶ 72, 76).

Patent Owner does not address Petitioner’s contentions. PO
Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find the combination of *Raizer* and *Hangzhou* teaches this limitation for the reasons explained by Petitioner.

[1.f]: driving the vehicle into the first aisle

Petitioner contends that the combination of *Raizer* and *Hangzhou* teaches this limitation. Pet. 27 (citing Ex. 1003 ¶ 187).

Petitioner first contends that *Raizer*’s “vehicles can travel in any direction and to various locations.” Pet. 27–28 (citing Ex. 1003 ¶¶ 183–191).

Petitioner provides the following annotated version of *Hangzhou*’s Figure 10 (Pet. 29):

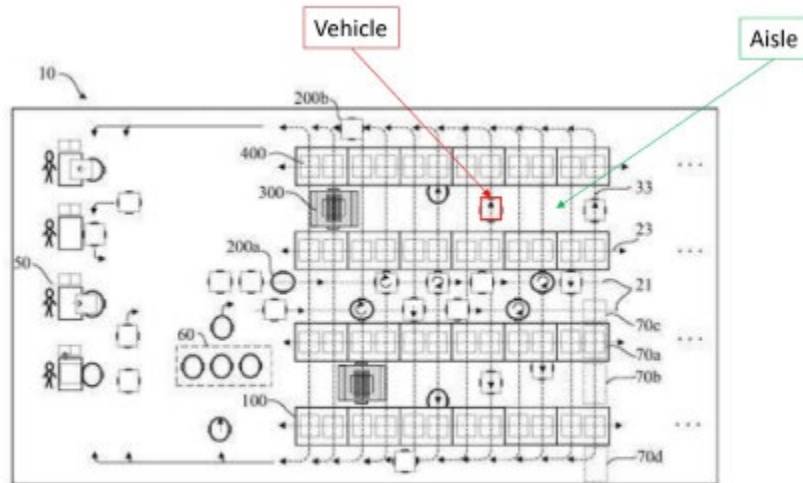


Figure 10

Figure 10 “is a top view of an unmanned warehousing system . . . and a schematic diagram of the principle of an auto-guided trolley performing inbound and outbound operations when it runs along a row channel and a column channel under a shelf.” Ex. 1006 ¶ 19. Petitioner adds a green box with text “Aisle” with a green arrow pointing to an aisle between rows and a red box with text “Vehicle” with a red arrow pointing to a path between shelves. Pet. 29.

Petitioner contends that, if Raizer is determined not to disclose driving the vehicle into the aisle from under the rack, Hangzhou’s annotated Figure 10 “depicts a vehicle driving into an aisle.” Pet. 28 (citing Ex. 1003 ¶ 192). Petitioner argues that an ordinarily skilled artisan “would have understood the additional pathways illustrated in Figure 10 allow travel under the shelves and across aisles.” *Id.* at 29 (citing Ex. 1003 ¶ 193). Petitioner further argues that it would have been obvious to an ordinarily skilled artisan “that *Raizer’s* robot would have the ability to turn while under a rack and then travel across an aisle as in *Hangzhou*, given *Raizer’s*

disclosure of three-dimensional movement capabilities and ability to turn 360 degrees, as such capability would allow the robot to ‘choose among all possible paths.’ *Id.* (citing Ex. 1003 ¶ 194).

Patent Owner does not address Petitioner’s contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find the combination of Raizer and Hangzhou teaches this limitation for the reasons explained by Petitioner.

[1.g]: driving the first vehicle upwardly in the aisle to a first of the storage locations

Petitioner contends that Raizer discloses this limitation. Pet. 29 (citing Ex. 1003 ¶¶ 196–202).

Petitioner contends that Raizer’s “robot [can] engage a vertical rail, to raise itself off the floor, and to move up and along the network of vertical and horizontal rails.” Pet. 30 (citing Ex. 1003 ¶ 199; Ex. 1005 ¶¶ 56, 78). Petitioner further contends that Raizer’s rails “allow for the vertical and horizontal movement capabilities of the robots along the shelving,” and ‘are mounted on or parallel to the vertical supports and shelves of the warehouse.’” *Id.* (citing Ex. 1003 ¶ 199; Ex. 1005 ¶¶ 56, 78). Petitioner next contends that Raizer’s robots travel vertically on the vertical rails “[i]n order to complete its mission of removing a box from (or delivering a box to) a specific location on a shelf.” *Id.* (citing Ex. 1003 ¶ 197; Ex. 1005 ¶ 114); *see also id.* at 31–32 (reproducing Raizer’s Figures 8B and 8F to illustrate how Raizer’s robots attach to vertical rails to travel upwardly).

Patent Owner does not address Petitioner’s contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find Raizer teaches this limitation for the reasons explained by Petitioner.

[1.h]: transferring an item between the first vehicle and the first storage location

Petitioner contends that Raizer discloses this limitation. Pet. 32 (citing Ex. 1003 ¶¶ 203–207).

Petitioner contends that Raizer’s robots comprise “a gripping mechanism (transfer mechanism).” Pet. 32 (citing Ex. 1003 ¶¶ 148–152, 204–205; Ex. 1005 ¶¶ 27, 31, 101, 103). Petitioner further contends that Raizer’s “robot position[s] a box on a shelf in the storage area” which corresponds to transferring an item between the robot and the shelf in the storage area. *Id.* (citing Ex. 1003 ¶¶ 206, 207; Ex. 1005 ¶ 138, Fig. 14A).

Patent Owner does not address Petitioner’s contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find Raizer teaches this limitation for the reasons explained by Petitioner.

[1.i]: driving the first vehicle downwardly in the aisle until the vehicle is on a horizontal surface

Petitioner contends that Raizer discloses this limitation. Pet. 33 (citing Ex. 2003 ¶¶ 208–211).

Petitioner contends that Raizer’s robots have “‘three-dimensional navigation and travel capabilities’ that enable the robot ‘to navigate and travel autonomously both along the floor and up and down’ . . . ‘the vertical rails and along the horizontal rails of the network of rails to reach an exact

location on the floor or shelving system.” Pet. 33 (citing Ex. 1003 ¶¶ 209–210; Ex. 1005 ¶¶ 56, 78, claims 1, 4, 18).

Patent Owner does not address Petitioner’s contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find Raizer teaches this limitation for the reasons explained by Petitioner.

[1.j] driving the first vehicle across the first aisle after the step of driving the first vehicle downwardly

Petitioner contends that the combination of Raizer and Hangzhou teaches this limitation. Pet. 33 (citing Ex. 1003 ¶¶ 212–217).

Petitioner contends that Raizer discloses driving the vehicle downwardly but “[s]hould *Raizer* be determined to not disclose driving the vehicle across the first aisle after the step of driving the first vehicle downwardly, such a feature would have been obvious to a [person of ordinary skill in the art].” Pet. 34 (citing Ex. 1003 ¶ 215). According to Petitioner, given that Raizer’s robots can autonomously navigate and travel along the floor and up and down rails on the shelves, an ordinarily skilled artisan “would have understood that a robot could also be driven across an aisle after having been driven downwardly to a horizontal surface.” *Id.* (citing Ex. 1003 ¶ 215).

Based on Hangzhou’s disclosure of trolleys traveling with containers, “‘in row and column directions’ underneath the shelving units and across multiple aisles along the column channels,” Petitioner contends it would have been obvious “to incorporate *Hangzhou’s* movement capabilities underneath the shelves and across multiple aisles into *Raizer’s* system to

allow *Raizer's* robots to more efficiently move retrieved items to picking stations.” Pet. 34 (citing Ex. 1003 ¶ 216; Ex. 1006 ¶ 50).

Patent Owner does not address Petitioner’s contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of *Raizer* and *Hangzhou* teaches this limitation for the reasons explained by Petitioner for both alternatives.

[1.k]: driving the vehicle out from under the storage racks after the step of driving the first vehicle across the first aisle

Petitioner contends that the combination of *Raizer* and *Hangzhou* teaches this limitation. Pet. 35 (citing Ex. 1003 ¶¶ 218–223). Petitioner provides the following annotated version of *Hangzhou's* Figure 10 (*id.*):

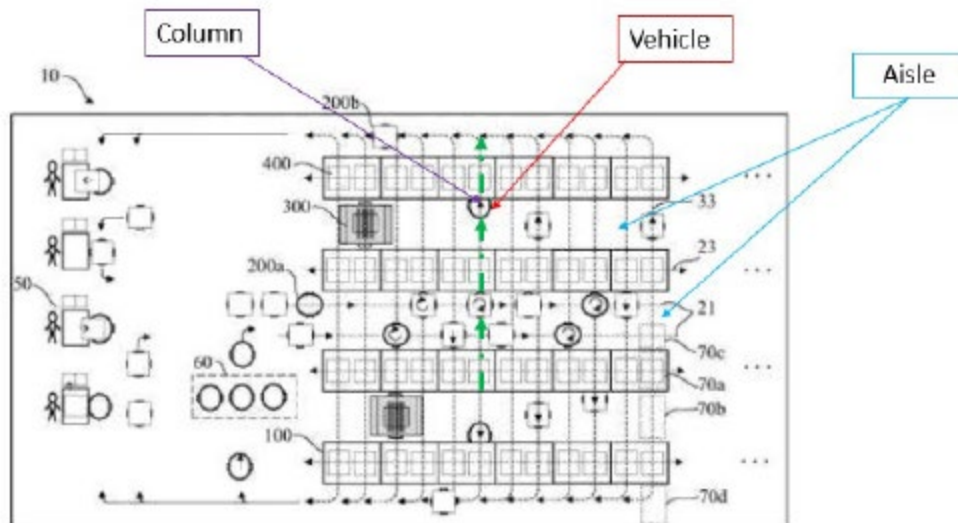


Figure 10

Figure 10 “is a top view of an unmanned warehousing system . . . and a schematic diagram of the principle of an auto-guided trolley performing inbound and outbound operations when it runs along a row channel and a

column channel under a shelf.” Ex. 1006 ¶ 19. Petitioner adds a blue box with text “Aisle” with a blue arrow pointing to an aisle between rows, a red box with text “Vehicle” with a red arrow pointing to a path between shelves, and a purple box with text “Column” and a purple arrow pointing to a path between shelves. Pet. 35.

Petitioner contends, based on Hangzhou’s disclosure of trolleys travelling in row and column directions under shelving units across multiple aisles, that it would have been obvious to an ordinarily skilled artisan “to combine *Hangzhou’s* movement under the shelves and across multiple aisles with *Raizer’s* system to allow *Raizer’s* robots to move more directly to and from picking stations.” Pet. 36 (citing Ex. 1003 ¶ 222; Ex. 1006 ¶ 50). According to Petitioner, the combination of Raizer and Hangzhou “render[s] obvious driving the vehicle out from under the storage racks after the step of driving the first vehicle across the first aisle.” *Id.* (citing Ex. 1003 ¶ 223).

Patent Owner does not address Petitioner’s contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of Raizer and Hangzhou teaches this limitation for the reasons explained by Petitioner.

For all the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 1 would have been obvious over Raizer and Hangzhou.

d. Claim 3

Claim 3 depends from claim 1 and recites [3.pre], [3.a] “wherein a plurality of vertical tracks segments are attached to vertical posts of the first column” and [3.b] “wherein the step of driving the first vehicle into the first

aisle comprises aligning the vertical drive of the first vehicle with the vertical track segments.” Ex. 1001, 25:47–51.

Petitioner contends that the combination of Raizer and Hangzhou teaches [3.pre] and [3.a]. Pet. 36 (citing Ex. 1003 ¶¶ 224–230). Petitioner contends that Raizer’s shelving units “consist [] ‘of horizontal and vertical pieces of angle iron that support the shelves.’” *Id.* (citing Ex. 1003 ¶¶ 225–226; Ex. 1005 ¶ 92, Abstract). Petitioner further contends that Raizer discloses “[a] network of vertical and horizontal rails’ ‘are parallel to the vertical support posts and horizontal shelves’ ‘in [a] warehouse.’” *Id.* (citing Ex. 1003 ¶¶ 226–227; Ex. 1005 ¶ 40); *id.* at 36–37 (reproducing and annotating Raizer’s Figure 8E to illustrate “vertical track segments attached to vertical posts of the first column” (citing Ex. 1003 ¶ 228; Ex. 1005, Fig. 8E)).

Petitioner alternately argues that, if “*Raizer* [is] determined to not disclose vertical track segments attached to multiple vertical post of the first column, such a feature would have been obvious to a [person of ordinary skill in the art] given *Raizer*’s disclosure of attaching vertical rails to the vertical supports of the shelving.” Pet. 37 (citing Ex. 1003 ¶ 229; Ex. 1005 ¶ 78). Petitioner further argues that an ordinarily skilled artisan would “have been motivated to attach vertical rails to multiple service supports of a column to reduce collisions and congestion along the vertical rails of *Raizer*.” *Id.* (citing Ex. 1003 ¶¶ 229–230).

Petitioner contends that Raizer discloses limitation [3.b]. Pet. 38 (citing Ex. 1003 ¶¶ 231–237). Petitioner contends that as Raizer’s “robot approaches an intended terminal, a sensor ‘stops the robot at an exact position relative to the terminal.’” *Id.* (citing Ex. 1003 ¶¶ 234–235;

Ex. 1005 ¶¶ 114–121, Figs. 8A–8G). Petitioner further contends that, after the robot stops, “[t]he electric steering motors in the drive and steering units 24 are activated to turn both front wheels 22 by ninety degrees so that they are exactly facing the ‘U’-shaped channel in the terminal 44” and “drive and steering units 24 are activated to turn both front wheels 22 of the vertical drive of *Raizer’s* robot 10 to align with the terminal 44 and the vertical track segments embodied by vertical rail 42.” *Id.* (citing Ex. 1003 ¶¶ 235–237; Ex. 1005 ¶¶ 115–116, Fig. 8A).

Patent Owner does not address Petitioner’s contentions for claim 3. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of *Raizer* and *Hangzhou* teaches the limitations of claim 3, for both alternatives, for the reasons explained by Petitioner.

For the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 3 would have been obvious over *Raizer* and *Hangzhou*.

e. Claim 4

Claim 4 depends from claim 3 and recites [4.pre], [4.a] “wherein the step of driving the first vehicle into the aisle comprises driving a first portion of the vertical drive through the vertical track segment” and [4.b] “driving a second part of the vertical drive into operative engagement with the vertical track segment.” Ex. 1001, 25:52–56.

Petitioner contends that the combination of *Raizer* and *Hangzhou* renders [4.pre] and [4.a] obvious. Pet. 40 (citing Ex. 1003 ¶¶ 238–247). Petitioner specifically contends that:

Raizer discloses “a synchronized movement tak[ing] place between the driving motor of the right front wheel 22, and electric motors and actuators . . . inside the right arm unit 26 . . . advancing the right wheel into the ‘U’-shaped channel 46 in terminal 44 while the robot 10 remains in position on the floor,” where “right wheel 22 enters the terminal [and] is geometrically locked to the rail.” (Ex. 1005, ¶ [0116]; FIGs. 8A-8G; Ex. 1003, ¶ 243). The “synchronized movement between the driving motor of the right front wheel 22 and right arm 26 continues to extend the right arm unit as right wheel 22 moves further up terminal 44.” (Ex. 1005, ¶ [0117]; FIGs. 8B, 8C, 8E; Ex. 1003 ¶¶ 243-244).

Id.

Petitioner contends that *Raizer* discloses limitation [4.b]. Pet. 42 (citing Ex. 1003 ¶¶ 248–251). Petitioner specifically contends that *Raizer*’s “left front wheel 22 . . . moves into the ‘U’-shaped channel 46 in terminal 44 and is locked into the vertical rail 42, and the second part of the vertical drive becomes operatively engaged with the lower-most vertical track segment.” *Id.* at 42–43 (citing Ex. 1003 ¶¶ 249–250; Ex. 1005 ¶¶ 120–121).

Patent Owner does not address Petitioner’s contentions for claim 4. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of *Raizer* and *Hangzhou* teaches the limitations of claim 4 for the reasons explained by Petitioner.

For the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 4 would have been obvious over *Raizer* and *Hangzhou*.

f. Claim 5

Claim 5 depends from claim 1 and recites [5.pre], [5.a] “wherein the first storage rack is formed of a plurality of vertical posts and,” [5.b] “the

first vehicle has a length and a width and the length is greater than the width and,” and [5.c] “wherein the step of driving the first vehicle along the first path comprises driving the vehicle along a path spaced apart from the vertical posts by a distance greater the half the length of the vehicle.”
Ex. 1001, 25:57–63.

For limitations [5.pre] and [5.a], Petitioner relies on its contentions for limitations [1.pre]–[1.k] and argues that the combination of Raizer and Hangzhou teaches these limitations. Pet. 43 (citing Ex. 1003 ¶¶ 252–253).

Petitioner argues that Raizer discloses limitation [5.b]. Pet. 43 (citing Ex. 1003 ¶¶ 254–256). Petitioner provides the following annotated version of Raizer’s Figure 5D (*id.* at 44):

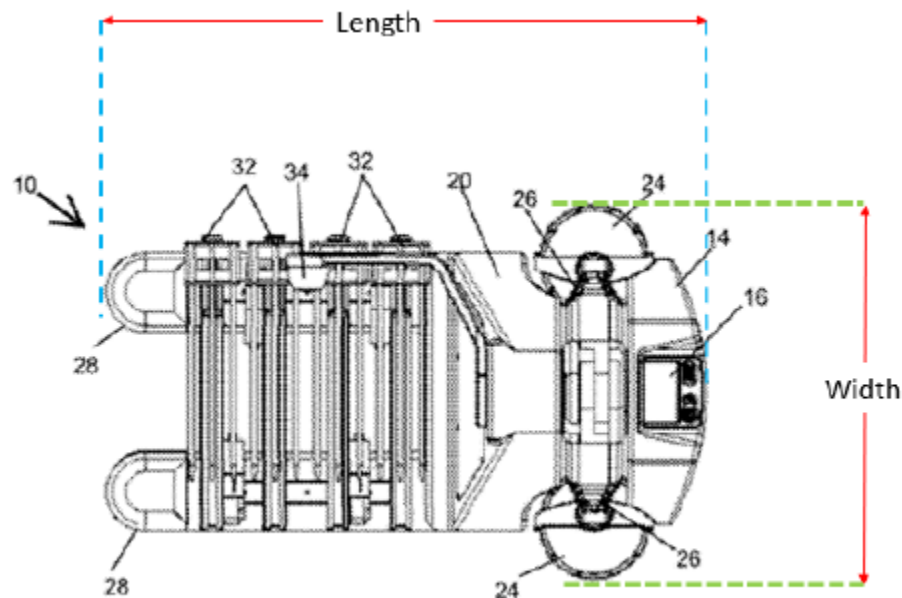


Fig. 5D

Figure 5D is a top view of a robot. Ex. 1005 ¶ 65. Petitioner annotates Figure 5D with a red solid horizontal arrow between broken blue lines at the right and left of the robot with text “Length” and a red solid vertical line

between broken green lines at the top and bottom of the robot with text “Width.” Pet. 44.

Petitioner contends that Figure 5D is a top view of a robot and “[t]he robot (vehicle) has a length and a width, and the length is greater than the width.” *Id.* at 44 (citing Ex. 1003 ¶¶ 255–256; Ex. 1005 ¶ 103, Fig. 5D).

Petitioner contends that the combination of Raizer and Hangzhou teaches limitation [5.c]. Pet. 45 (citing Ex. 1003 ¶¶ 247–264). Relying on its contentions for limitations [1.a], [1.c], and [1.d1], Petitioner contends that “*Raizer* and *Hangzhou* disclose driving the first vehicle along a first path under the storage racks.” *Id.* (citing Ex. 1003 ¶ 257). Petitioner next contends that if *Raizer* is “determined to not disclose driving the vehicle along a path spaced apart from the vertical posts by a distance greater than half the length of the vehicle, a [person of ordinary skill in the art] would have looked to *Hangzhou*.” *Id.* (citing Ex. 1003 ¶ 258).

Petitioner contends that Hangzhou’s “trolleys may ‘switch between trolley-special row laneways 21 and column channels 33 and between column channels 33 and row channels 23” and further that the “trolleys ‘turn[] 90⁰ in place’ and that the ‘diameter of the trolley 200 is less than the short side of the channel support frame 110,’ such that ‘[w]hen the trolley travels to the center of the channel support frame 110, the trolley 200 may turn in place without movement interference.’” Pet. 46 (citing Ex. 1003 ¶¶ 260–261; Ex. 1006 ¶¶ 72–73). In light of this disclosure in Hangzhou, Petitioner contends that an ordinarily skilled artisan would understand “the path would be spaced from the vertical posts by a distance greater than half the length of the vehicle to allow the vehicles to turn without colliding with

support members and to allow the robots of *Raizer* to engage with vertical rails once in the aisle between the shelves.” *Id.* (citing Ex. 1003 ¶¶ 262–264).

Patent Owner contends that Petitioner fails to establish that limitations [5.b] and [5.c] are disclosed by *Raizer* and Hangzhou. PO Resp. 56.

For limitation [5.b], Patent Owner argues that “[t]he only description that *Raizer* provides regarding Figure 5D is that it ‘is a top view[] of a robot of the system of the invention.’” PO Resp. 57 (citing Ex. 1005 ¶¶ 65, 103). Patent Owner further argues that “[w]hile at first blush it appears the length of the robot in the figure is longer than the width, this is insufficient” because *Raizer*’s drawings “do not explicitly indicate a scale.” *Id.* For these reasons, according to Patent Owner, Petitioner cannot rely on the drawings to make conclusions as to geometric dimensions. *Id.*

Petitioner responds that “[Patent Owner] ignores the disclosure in *Raizer* that the ‘main components of robot 10 which are shown in [FIGS. 5A-5D] are mounted on a frame comprised of **two long beam 28 that are rigidly connected together at one end by a shorter beam 12.**” Pet. Reply 26–27 (citing Pet. 5, 43; Ex. 1003 ¶¶ 85, 285; Ex. 1005 ¶ 103).

We agree with Petitioner for the following reasons. *Raizer* explicitly discloses in the description of Figure 5D that the frame is “comprised of two long beams 28 that are rigidly connected together at one end by a shorter beam 12.” Ex. 1005 ¶ 103. The Petition cites to this paragraph of *Raizer* in connection with limitation [5.b]. Pet. 44. Consequently, the Petition does not only rely solely on *Raizer*’s drawings to satisfy limitation [5.b]’s requirement that “the first vehicle has a length and a width and the length is

greater than the width.” Ex. 1001, 25:58–59. We find these disclosures in Raizer sufficient to teach or suggest limitation [5.b] to one of ordinary skill in the art.

For limitation [5.c], Patent Owner argues that “Petitioner’s reliance on *Hangzhou*’s robots’ characteristics is fatal to their argument, as Petitioner’s proposed combination relies on Raizer’s robots, not Hangzhou’s.” PO Resp. 58 (citing Pet. 7). Patent Owner further argues that “Petitioner’s discussion of Hangzhou’s robots’ ability to turn 90⁰ in place because of its symmetrical shape is irrelevant to Raizer’s robots” which “are not symmetrical in shape.” *Id.* (citing Pet. 43–44; Ex. 1003 ¶ 255; Ex. 2005, 89:10–13).

Petitioner responds that the teaching in Hangzhou cited in the Petition “detail[s] the ‘horizontal gap’ disclosed by *Hangzhou* that makes space for the trolleys to travel” and “at minimum renders obvious this limitation, which permits the robots to travel and turn underneath the rack as taught by *Hangzhou*.” Pet. Reply 27.

In the Sur-reply, Patent Owner argues that “*Hangzhou*’s trolleys’ ability to turn in place without hitting vertical posts is a consequence of their symmetrical layout.” Sur-reply 26–27 (citing Ex. 1006 ¶ 48). Patent Owner next argues that “Petitioner does not account for *Raizer*’s robots’ profile in their proposed system.” *Id.* at 27 (citing Pet. Reply 27). Patent Owner next argues that “even if *Raizer*’s robot was run along a travel path disclosed in *Hangzhou*, the limitation would not necessarily be met, because [Petitioner] itself argues that *Raizer* is longer than it is wide.” *Id.* (citing Pet. Reply 26–27). According to Patent Owner, “Petitioner fails to show this limitation

would have been obvious because it provides no additional details regarding the width of the travel pathways relative to the robot's dimensions.” *Id.*

We agree with Petitioner.

First, we credit Dr. Derby's testimony on this limitation for the reasons explained below. Ex. 1003 ¶¶ 259–263. Dr. Derby points to Hangzhou's teaching that the “diameter of the trolley 200 . . . [is] less than the short side of the channel support frame 110” so that “trolley 200 may turn in place without movement interference.” Ex. 1003 ¶ 261 (citing Ex. 1006 ¶ 73). Dr. Derby then applies this teaching of Hangzhou to Raizer's unsymmetrical robots and in particular to the long side of Raizer's robots. Dr. Derby testifies that “a person of ordinary skill in the art would have understood that the trolleys [sic] path would be spaced apart from the vertical posts by a distance greater than half the length of the vehicle in order to allow the trolleys to turn without colliding with the support members.” Ex. 1003 ¶ 262. We credit Dr. Derby's testimony because it explains how Hangzhou's teaching of trolleys traveling under shelves would have been applied to Raizer so that Raizer's robots would not collide with support members.

Second, we disagree with Patent Owner's arguments. Patent Owner's argument that the reason Hangzhou's trolleys have the ability to turn in place is due to the symmetrical shape of the trolleys is unsupported attorney argument. In any event, we disagree with Patent Owner's premise because the ability to turn in place flows from the relative dimensions of Hangzhou's trolleys 200 and channel support frame 110. Additionally, Patent Owner does not argue that it would be beyond the level of ordinary skill in the art to

determine the proper spacing of vertical posts so that a vehicle could turn in place regardless of whether the vehicle is symmetrical or not.

We reviewed Petitioner’s contentions and evidence, in light of Patent Owner’s contentions, and find that the combination of Raizer and Hangzhou teaches the limitations of claim 5 for the reasons discussed above.

For the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 5 would have been obvious over Raizer and Hangzhou.

g. Claim 6

Claim 6 depends from claim 1 and recites [6.pre], [6.a] “the step of driving the first vehicle to a workstation to present an item to an operator after the step of driving the first vehicle out from under the storage racks.” Ex. 1001, 25:64–67.

Petitioner contends that Raizer and Hangzhou render claim 6 obvious. Pet. 46 (citing Ex. 1003 ¶¶ 265–273).

Referring to its contentions for limitation [1.d.1], Petitioner contends that “*Raizer and Hangzhou* render obvious driving the vehicle out from under the storage racks.” Pet. 46 (citing Ex. 1003 ¶ 266). Petitioner next contends that Raizer discloses an operations area in its warehouse “where ‘[h]uman workers man the picking stations’ ‘to receive boxes containing items’ ‘the robots have retrieved from the storage area.’” *Id.* at 47 (citing Ex. 1003 ¶¶ 267–268; Ex. 1005 ¶¶ 92, 96). Alternately, Petitioner contends that, if Raizer should be determined not to disclose driving the first vehicle to a workstation, Hangzhou “discloses trolleys performing actions like positioning, lifting, dropping, and carrying to transfer standardized containers 400 between caches spaces 113 and sorting workstations 50

where workers remove the items.” *Id.* (citing Ex. 1003 ¶ 272; Ex. 1006 ¶¶ 36, 47). According to Petitioner, an ordinarily skilled artisan “would have understood that a vehicle could be driven to a workstation to present an item to an operator after having been driven out from under the storage racks.” *Id.* (citing Ex. 1003 ¶¶ 269–272).

Patent Owner does not address Petitioner’s contentions for claim 6. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of Raizer and Hangzhou teaches the limitations of claim 6, for both alternatives, for the reasons explained by Petitioner.

For the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 6 would have been obvious over Raizer and Hangzhou.

h. Claim 7

Claim 7 depends from claim 1 and recites [7.pre], [7.a], “wherein the step of driving the first vehicle across the aisles comprises driving the first vehicle under a second of the storage racks.” Ex. 1001, 26:1–3.

Petitioner contends that Raizer and Hangzhou render claim 7 obvious. Pet. 47 (citing Ex. 1003 ¶¶ 274–277).

Petitioner first contends that an ordinarily skilled artisan would have understood that “a robot could be driven across an aisle and underneath storage racks to minimize congestion and optimize the number of pathways traveled by the robots to allow more robots to maneuver along the warehouse floor.” Pet. 48 (citing Ex. 1003 ¶ 278). Alternately, Petitioner contends that, if Raizer is determined to not disclose driving the vehicle across the first aisle, Hangzhou’s trolleys “can ‘switch between trolley-

special laneways 21 and column channels 33 and between column channels 33 and row channels 23” and “can move underneath the shelving units in a path parallel to the row channels 23 (aisles), and then turn to travel from underneath the shelving unit and across row laneways 21 (aisles) along the column channels 33.” *Id.* (citing Ex. 1003 ¶¶ 280–282; Ex. 1006 ¶¶ 63, 72, Fig. 10). According to Petitioner, an ordinarily skilled artisan “would have been motivated to combine driving trolleys into an aisle and under a second storage rack of *Hangzhou* with the travel capabilities of *Raizer*.” *Id.* at 49 (citing Ex. 1003 ¶ 283).

Patent Owner does not address Petitioner’s contentions for claim 7. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of *Raizer* and *Hangzhou* teaches the limitations of claim 7 for the reasons explained by Petitioner.

For the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 7 would have been obvious over *Raizer* and *Hangzhou*.

i. Claim 8

Claim 8 depends from claim 1 and recites [8.pre], [8.a], “wherein the step of turning comprises rotating the first vehicle about a vertical axis that extends through the first vehicle.” Ex. 1001, 26:4–6.

Petitioner contends that *Raizer* and *Hangzhou* render claim 8 obvious. Pet. 49 (citing Ex. 1003 ¶¶ 285–290).

Petitioner contends that *Raizer*’s robots

compris[e] “two drive and steering units,[”] []where “each unit compris[es] one front wheel and components configured to rotated [sic] the front wheel at least 360 degrees *about a vertical*

axis^[1] to the floor in order to steer the robot” and “to rotate the front wheel about a horizontal axis in order to cause the robot to move in the direction that the front wheel is pointing . . . *Raizer* discloses that “[t]he front wheels 22 of robot 10 can be independently rotated 360 degrees about *an axis vertical to the floor* by their respective drive and steering units 24.

Id. at 49–50 (citing Ex. 1003 ¶¶ 286–287; Ex. 1005 ¶¶ 56, 107).

Petitioner alternately argues that, if *Raizer* does not disclose rotating the vehicle about a vertical axis, an ordinarily skilled artisan would have turned to Hangzhou and would have been motivated to combine the teachings of *Raizer* and Hangzhou. Pet. 50 (relying on its contentions for limitation [1.e]) (citing Ex. 1003 ¶ 288).

Patent Owner argues that “Petitioner points to the robots of *Raizer* and, as a backup, the disclosures of Hangzhou.” PO Resp. 59 (citing Pet. 51). According to Patent Owner, “it is improper for Petitioner to rely on the characteristics of Hangzhou’s robots after explicitly pointing to *Raizer*’s robots for the[] proposed combination.” *Id.* (citing Pet. 7).

Patent Owner’s contention is unavailing because Petitioner relies on *Raizer* for claim 8 and refers to Hangzhou in the alternative in combination with *Raizer*. Pet. 49–50. Further, Patent Owner does not dispute Petitioner’s contentions or evidence based on either *Raizer* or Hangzhou. *See* PO Resp. 59.

We reviewed Petitioner’s contentions and evidence, in light of Patent Owner’s contentions, and find that the combination of *Raizer* and Hangzhou teaches the limitations of claim 8 for the reasons explained by Petitioner.

For the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 8 would have been obvious over *Raizer* and Hangzhou.

j. Claim 9

Claim 9 depends from claim 8 and recites [9.pre], [9.a], “wherein the vertical axis extends through the first path.” Ex. 1001, 26:7–8.

Relying on its contentions for limitations [1.c] and [8.a], Petitioner contends that Raizer and Hangzhou render claim 9 obvious. Pet. 50 (citing Ex. 1003 ¶¶ 291–297). Similar to claim 8, Petitioner argues alternately that Hangzhou teaches the limitations of claim 9 and that it would have been obvious to combine these teachings with those of Raizer. *Id.* at 51 (citing Ex. 1003 ¶¶ 294–295; Ex. 1006 ¶ 73, Figs. 1, 10).

Patent Owner interposes the same contentions for claim 9 as for claim 8. PO Resp. 59.

We reviewed Petitioner’s contentions and evidence, in light of Patent Owner’s contentions, and find that the combination of Raizer and Hangzhou teaches the limitations of claim 9 for the reasons explained by Petitioner. Additionally, Patent Owner’s arguments are unavailing for the same reasons discussed above in the context of claim 8.

For the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 9 would have been obvious over Raizer and Hangzhou.

k. Claim 10

Claim 10 depends from claim 1 and recites [10.pre], [10.a] “comprising the step of driving a second of the vehicles under the first rack⁹ along a second path parallel to the first path so that the second vehicle passes

⁹ Petitioner argues that “[t]he ’632 patent describes a ‘rack’ ‘includ[ing] a plurality of columns’ ‘populated within [sic] a number of containers or totes.’” Pet. 52 (citing Ex. 1001, 18:22–26; Ex. 1003 ¶ 302).

the first vehicle as the first vehicle travels along the first path.” Ex. 1001, 26:9–13.

Petitioner contends that Raizer and Hangzhou render claim 10 obvious. Pet. 51 (citing Ex. 1003 ¶¶ 298–308).

Petitioner contends that if it is determined that Raizer does not disclose the limitations of claim 10, an ordinarily skilled artisan would have turned to Hangzhou. Pet. 52 (citing Ex. 1003 ¶ 301). Petitioner provides the following annotated version of Hangzhou’s Figure 1 (*id.* at 53):

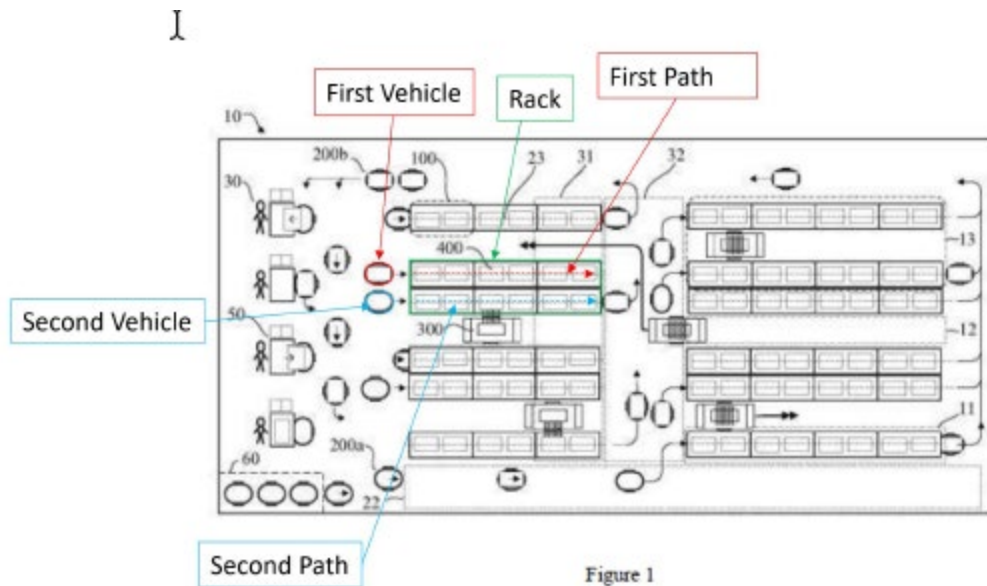


Figure 1 “is a top view of an unmanned warehousing system.” Ex. 1006 ¶ 11. Petitioner annotates this drawing with green rectangle with text “Rack” and an arrow pointing to element 400, a first red rectangle with text “First Vehicle” with an arrow pointing to trolley 200, a second red rectangle with text “First Path” with an arrow pointing to a redline on the top of element 400, a first blue rectangle with text “Second Vehicle” with an arrow pointing to a second trolley 200, and a second blue rectangle with text

“Second Path” with an arrow pointing to a blueline on the bottom of element 400. Pet. 53.

Petitioner argues that annotated Figure 1 shows “a first vehicle and a second vehicle travelling under a rack and parallel to each other such that one of the vehicles could pass the other.” Pet. 52 (citing Ex. 1003 ¶¶ 304–305; Ex. 1006, Fig. 1).

Patent Owner does not address Petitioner’s contentions for claim 10. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of Raizer and Hangzhou teaches the limitations of claim 10 for the reasons explained by Petitioner.

For the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 10 would have been obvious over Raizer and Hangzhou.

l. Independent Claim 11

For limitations [11.pre], [11.a1], [11.b1], [11.b2], [11.b3], [11.c1], [11.c3], [11.c4], and [11.f], Petitioner relies on its contentions for substantially similar limitations of independent claim 1. Pet. 54–57, 61.

Patent Owner does not dispute these contentions. PO Resp. 23–56. We reviewed Petitioner’s contentions and evidence and find that the combination of Raizer and Hangzhou teaches limitations [11.pre], [11.a1], [11.b1], [11.b2], [11.b3], [11.c1], [11.c3], [11.c4], [11.c5], and [11.f] for the reasons explained by Petitioner.

We now address the remaining limitations of claim 11.

[11.a.2]: wherein the first storage rack is longitudinally elongated

Petitioner contends that Raizer discloses this limitation. Pet. 54 (citing Ex. 1003 ¶¶ 317–319). Petitioner provides the following annotated version of Raizer’s Figure 1 to illustrate longitudinally elongated storage racks (*id.* at 55):

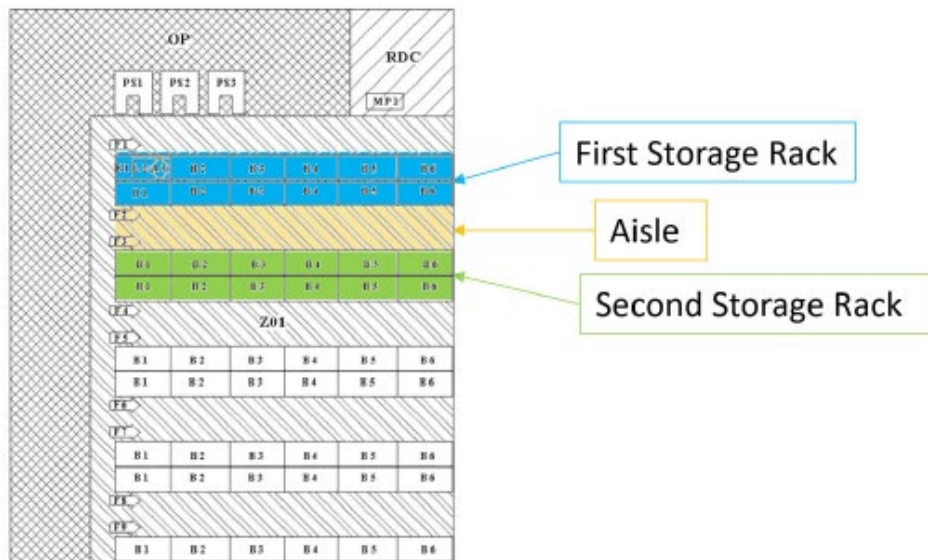


Figure 1 is a schematic “floor plan of a typical warehouse.” Ex. 1005 ¶ 58. Petitioner annotates this drawing with a blue rectangle with text “First Storage Rack” with a blue arrow pointing to a first storage rack shaded blue, a yellow rectangle with text “Aisle” and a yellow arrow pointing to a space between two storage racks shaded yellow, and a green rectangle with text “Second Storage Rack” with a green arrow pointing to a second storage rack shaded green. Pet. 55.

Patent Owner does not dispute these contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that Raizer teaches this limitation for the reasons explained by Petitioner.

[11.c.2]: wherein each vehicle has a length and a width

Petitioner contends that Raizer discloses this limitation. Pet. 56 (citing Ex. 1003 ¶¶ 333–335). Referring to Raizer’s Figure 5D, Petitioner contends that Raizer’s robot has a length and a width. *Id.* (citing Ex. 1003 ¶ 335; Ex. 1005 ¶ 103, Fig. 5D).

Patent Owner does not dispute these contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that Raizer teaches this limitation for the reasons explained by Petitioner.

[11.c.5]: and a transfer mechanism operable to transfer an item between the vehicle and one of the storage locations

Relying on its contentions for limitation [1.b.4], Petitioner contends that Raizer discloses this limitation. Pet. 57 (citing Ex. 1003 ¶¶ 353–357).

In its contentions concerning motivation to combine/reasonable expectation of success, Patent Owner argues that “[t]his limitation cannot be practiced without [Raizer’s] **proprietary ‘FinePositioning’ procedure** to enable precise, quick and efficient loading.” PO Resp. 48. As discussed above in our motivation-to-combine analysis, Patent Owner’s arguments concerning Raizer’s proprietary software are unavailing.

We reviewed Petitioner’s contentions and evidence, in light of Patent Owner’s contention, and find that Raizer teaches this limitation for the reasons explained by Petitioner.

[11.d]: a track positioned in the aisle wherein the vertical drive is configured to cooperate with the track to drive the vehicle vertically upward

Petitioner contends that Raizer discloses this limitation. Pet. 57 (citing Ex. 1003 ¶¶ 358–365). Petitioner specifically contends that Raizer

teaches that its robots connect or disconnect from “[a] curved piece of rail called a terminal 44 [that] is attached to the bottoms of the vertical rails where they reach the ground.” *Id.* (citing Ex. 1003 ¶ 361; Ex. 1005 ¶ 111). According to Petitioner, an ordinarily skilled artisan “would have understood that terminal 44 and vertical rails 42 represent a track positioned in an aisle extending upward and attaching to vertical support posts of the shelving units.” *Id.* at 57–58 (citing Ex. 1003 ¶ 361). Petitioner next repeats its contentions, discussed above in connection with limitation [1.g], concerning the movements of Raizer’s robots along its vertical rails. *Id.* at 58–60.

Patent Owner does not dispute these contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that Raizer teaches this limitation for the reasons explained by Petitioner.

[11.e]: a first horizontal path that extends under the first rack in a direction parallel to the aisle

Petitioner contends that the combination of Raizer and Hangzhou teaches this limitation. Pet. 60 (citing Ex. 1003 ¶¶ 366–373).

Referring to the annotated version of Hangzhou’s Figure 1 reproduced above in connection with claim 10, Petitioner contends that Hangzhou “discloses ‘auto-guided trolleys 100’ travel ‘under the shelf,’ as indicated by the dotted line, and that the path is ‘parallel to the stacking row laneway 12’ or aisle.” Pet. 61 (citing Ex. 1003 ¶¶ 368–371; Ex. 1006 ¶¶ 40, 44–45, 48, Abstract, Fig. 1). According to Petitioner, an ordinarily skilled artisan “would have been motivated to combine the teachings of *Hangzhou* with those of *Raizer* to allow for increased travel paths for robots to reduce

congestion, avoid traffic jams, and increase efficient use of space.” *Id.* (citing Ex. 1003 ¶ 72).

Patent Owner does not dispute these contentions except to the extent that Patent Owner may have intended to incorporate its arguments against limitation [1.c], which contains similar recitations, in the context of motivation to combine and reasonable expectation of success. PO Resp. 47–48. As discussed above for claim 1, we find that Patent Owner’s argument in connection with limitation [1.c] is unavailing.

We reviewed Petitioner’s contentions and evidence and find that the combination of Raizer and Hangzhou teaches this limitation for the reasons explained by Petitioner.

[11.g]: wherein the horizontal drive is configured to turn the vehicle under the first rack by rotating the vehicle about a vertical axis that extends through the vehicle

Petitioner contends that the combination of Raizer and Hangzhou teaches this limitation. Pet. 62 (citing Ex. 1003 ¶¶ 382–392).

Petitioner repeats its contentions discussed above for limitation [1.b.2] concerning the ability of Raizer’s robots to turn about a vertical axis. Pet. 62 (citing Ex. 1005 ¶¶ 383–385). Petitioner also repeats its contentions from limitation [1.e] concerning the teachings of Hangzhou that its auto-guided trolleys can rotate about a vertical axis. *Id.* (citing Ex. 1003 ¶¶ 387–390).

Patent Owner does not dispute these contentions except to the extent that it may have intended to incorporate its arguments against claims 8 and 9, which contain similar recitations. PO Resp. 59. As discussed above for claims 8 and 9, we find Patent Owner’s argument is unavailing.

We reviewed Petitioner’s contentions and evidence and find that the combination of Raizer and Hangzhou teaches this limitation for the reasons explained by Petitioner.

[11.h.1]: wherein the storage rack comprises a plurality of vertical posts

Petitioner contends that Raizer discloses this limitation. Pet. 63 (citing Ex. 1003 ¶¶ 393–394). Petitioner specifically contends that Raizer “discloses a ‘plurality of shelving units’ with ‘a network of vertical and horizontal rails’ that are ‘parallel to’ ‘vertical support posts and horizontal shelves.’” *Id.* (citing Ex. 1003 ¶¶ 393–394).

Patent Owner does not dispute these contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that Raizer teaches this limitation for the reasons explained by Petitioner.

[11.h.2]: the first and second horizontal paths are each spaced apart from the vertical posts a distance greater the one half the length of the vehicles

Petitioner contends that the combination of Raizer and Hangzhou teaches this limitation. Pet. 63 (citing Ex. 1003 ¶¶ 395–402). Petitioner repeats its contentions for limitation [5.c]. *Id.* at 63–64.

Patent Owner does not dispute these contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of Raizer and Hangzhou teaches this limitation for the reasons explained by Petitioner.

[11.i]: wherein the first horizontal path under the first rack is spaced apart from the second horizontal path a distance greater than the width of the vehicles

Petitioner contends that the combination of Raizer and Hangzhou teaches this limitation. Pet. 64 (citing Ex. 1003 ¶¶ 403–412).

Referring to the annotated version of Hangzhou’s Figure 1 reproduced above in connection with claim 10, Petitioner contends that Hangzhou “discloses that a ‘dotted line displayed on the center line of each shelf row is used to indicate the row channel 23 for auto-guided trolleys 200 under the shelf, which is a path parallel to the stacking row laneway 12’” and further depicts “at least two robots entering shelf columns simultaneously and traveling along parallel paths.” Pet. 66 (citing Ex. 1003 ¶ 406; Ex. 1006 ¶ 40, Fig. 1). According to Petitioner, given Hangzhou’s disclosures of multiple trolleys moving beneath shelves and rotating in place, an ordinarily skilled artisan “would have understood that the first and second horizontal paths would be spaced apart a distance greater than the width of the vehicles to avoid collisions between two vehicles traveling beneath the shelves.” *Id.* (citing Ex. 1003 ¶¶ 410–411).

Patent Owner does not dispute these contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of Raizer and Hangzhou teaches this limitation for the reasons explained by Petitioner.

For all the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 11 would have been obvious over Raizer and Hangzhou.

m. Claim 12

Claim 12 depends from claim 11 and recites [12.pre], [12.a] “wherein the vertical drive comprises a plurality of rotatable elements that each rotate about a horizontal axis and” [12.b] “wherein the horizontal drive comprises a plurality of rotatable elements that each rotate about a horizontal axis transverse the axes of rotation of the vertical drive elements.” Ex. 1001, 26:53–58.

For limitations [12.pre] and [12.a], Petitioner contends that the combination of Raizer and Hangzhou teaches these limitations. Pet. 67 (citing Ex. 1003 ¶¶ 413–419).

Petitioner contends that Raizer’s robots comprise two drive and steering units wherein the units “rotate the front wheel about a horizontal axis in order to cause the robot to move in the direction that the front wheel is pointing.” Pet. 67 (citing Ex. 1003 ¶¶ 414–417; Ex. 1005 ¶ 56). Petitioner provides the following annotated version of Raizer’s Figure 8A (*id.* at 68):

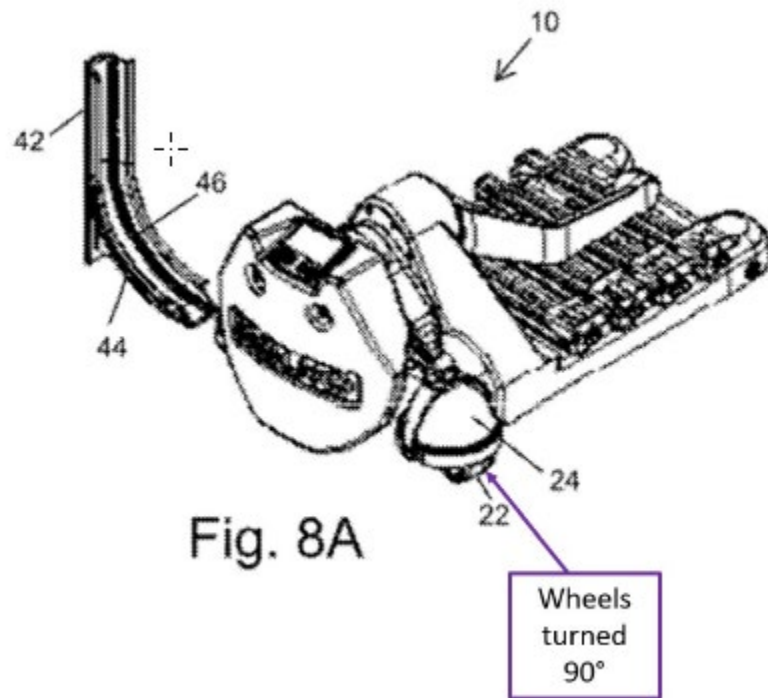


Figure 8A shows a “stage[] in the process of the robot . . . leaving the floor of the warehouse and climbing [a] vertical rail attached to the shelving.” Ex. 1005 ¶ 70. Petitioner annotates this drawing with a purple box with text “Wheels Turned 90⁰ and a purple arrow pointing to wheel 22. Pet. 68.

Petitioner contends that this drawing illustrates Raizer “discloses ‘[t]he electric steering motors in the drive and steering units 24 are activated to *turn both front wheels 22 by ninety degrees* so that they are exactly facing the ‘U’-shaped channel 46 in terminal 44.’” Pet. 68 (citing Ex. 1003 ¶ 418; Ex. 1005 ¶¶ 114–121, Figs. 8A–8G). According to Petitioner, Raizer thus “discloses the vertical drive comprises wheels 22 . . . that each rotate about a horizontal axis.” *Id.* (citing Ex. 1003 ¶ 419).

Petitioner next contends that Raizer discloses limitation [12.b]. Pet. 69 (citing Ex. 1003 ¶¶ 420–424). Petitioner specifically contends that Raizer’s “rear wheels, which form part of the horizontal drive, which rotate

along a horizontal axis that is transverse the horizontal axes about which wheels 22 of the vertical drive system rotate.” *Id.* (citing Ex. 1003 ¶¶ 423–424). Petitioner illustrates this contention with the following annotated version of Raizer’s Figure 6C (*id.* at 70):

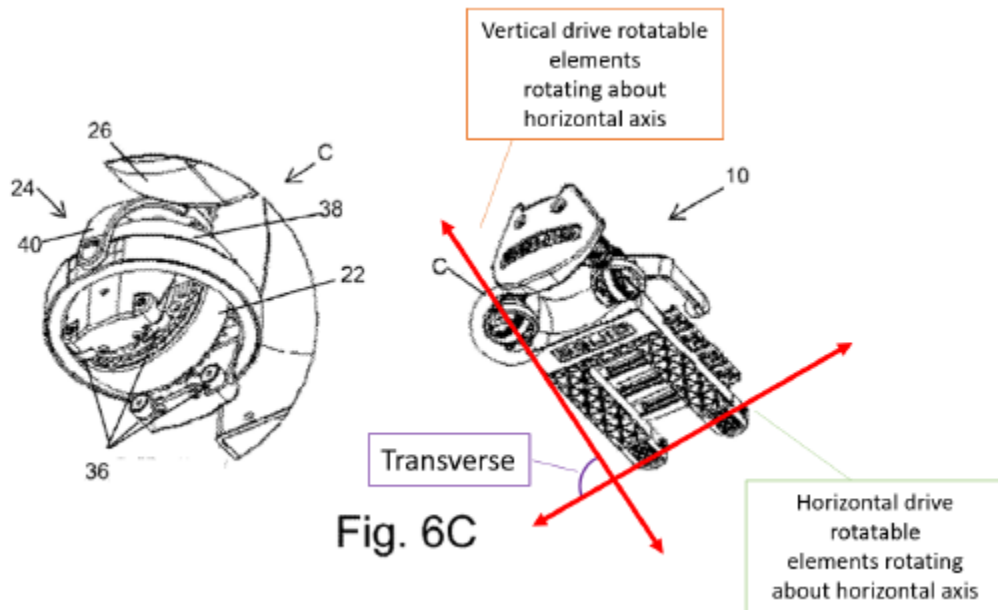


Figure 6C is a “schematic view of the robot . . . enlarged view[] showing a front wheel and steering assembly.” Ex. 1005 ¶ 67. Petitioner annotates this figure with a purple box with text “Transverse” pointing to the intersection of two perpendicular red arrows superimposed on the bottom of the robot, a green box with text “Horizontal drive rotatable elements rotating about horizontal axis” with a green line pointing to one of the red arrows, and an orange box with text “Vertical drive rotatable elements rotating about horizontal axis” with an orange line pointing to the second red arrow. Pet. 70.

Petitioner contends that “[w]hen front wheels 22 are rotated and positioned to engage the vertical rails and raising the robot, rotatable elements of the horizontal drive . . . rotate about a horizontal axis that is

transverse to the horizontal axes about which the wheels 22 . . . are rotating.”
Pet. 70 (citing Ex. 1003 ¶ 424).

Patent Owner does not address Petitioner’s contentions for claim 12.
PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of Raizer and Hangzhou teaches the limitations of claim 12 for the reasons explained by Petitioner.

For the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 12 would have been obvious over Raizer and Hangzhou.

n. Claim 14

Claim 14 depends from claim 11 and recites [14.pre], [14.a] “wherein the track comprises drive elements configured to cooperate with the vertical drive so that rotating the vertical drive about a horizontal axis operates to drive the vehicle upwardly along the track.” Ex. 1001, 27:3–6.

Petitioner contends that the combination of Raizer and Hangzhou teaches the limitations of claim 14. Pet. 70 (citing Ex. 1003 ¶¶ 425–434).

Petitioner first refers to its contentions for claim 11 and repeats its contentions concerning Raizer’s disclosure relevant to the limitations of claim 14. Pet. 70–72. According to Petitioner, the “U”-shaped rails of Raizer “have drive elements configured to cooperate with the wheels 22 of the vertical drive, which allow the robot to climb vertically while locked into the rail (by wheels 36) so that rotating wheels 22 of the vertical drive about a horizontal axis drives the robot vertically upward along the rail.” *Id.* at 72 (citing Ex. 1003 ¶ 434).

Patent Owner does not address Petitioner's contentions for claim 14.
PO Resp. 23–56.

We reviewed Petitioner's contentions and evidence and find that the combination of Raizer and Hangzhou teaches the limitations of claim 14 for the reasons explained by Petitioner.

For the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 14 would have been obvious over Raizer and Hangzhou.

o. Independent Claim 23

For limitations [23.pre], [23.a1], [23.a2], [23.b1], [23.b2], [23.b3], [23.b4], [23.c1], [23.d], and [23.f], Petitioner references its contentions for substantially similar limitations of independent claim 1. Pet. 73–91.

Patent Owner does not dispute these contentions. PO Resp. 23–56.

We reviewed Petitioner's contentions and evidence and find that the combination of Raizer and Hangzhou teaches limitations [23.pre], [23.a1], [23.a2], [23.b1], [23.b2], [23.b3], [23.b4], [23.c1], [23.d], and [23.f] for the reasons explained by Petitioner.

We now address the remaining limitations.

[23.c2]: wherein the step of driving the first vehicle includes driving the first vehicle into a first of the columns in a first of the aisles

Petitioner contends that the combination of Raizer and Hangzhou teaches this limitation. Pet. 83 (citing Ex. 1003 ¶¶ 481–487).

Petitioner contends that Hangzhou's "trolley can move underneath the shelving units in a path parallel to the row channels 23 (aisles), then turn to travel from underneath the shelving unit and across row laneways 21 (aisles)

along the column channels 33.” Pet. 82–84 (citing Ex. 1003 ¶ 483). Petitioner argues that Hangzhou’s Figure 10 “depicts driving a first vehicle into a first of the columns in a first of the aisles.” *Id.* at 84 (citing Ex. 1003 ¶¶ 483, 487; Ex. 1006, Fig. 10). Petitioner further argues that Figure 10 “provides additional pathways that may be traveled along the warehouse floor” and an ordinarily skilled artisan “would have understood that the additional pathways shown in Figure 10 allow for travel under the shelves and across aisles.” *Id.* at 84–85 (citing Ex. 1003 ¶ 484). According to Petitioner, it would have been obvious “to combine *Hangzhou*’s movement capabilities under racks and across multiple aisles with *Raizer*’s system to allow *Raizer*’s robots to move more directly to and from picking stations while also reducing congestion and making more efficient use of space.” *Id.* at 85 (citing Ex. 1003 ¶¶ 483, 485–486).

Patent Owner does not dispute these contentions except to the extent Patent Owner may have intended to incorporate its arguments against limitations [1.c] and [1.d.1], which contains similar recitations, in the context of motivation to combine and reasonable expectation of success. PO Resp. 47–48. As discussed above for claim 1, we find that Patent Owner’s argument in connection with limitations [1.c] and [1.d.1] is unavailing. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of *Raizer* and *Hangzhou* teaches this limitation for the reasons explained by Petitioner.

[23.e]: transferring an item from the first storage location to the first vehicle

Relying on its contentions for limitation [1.h], Petitioner contends that Raizer discloses this limitation. Pet. 88 (citing Ex. 1003 ¶¶ 496–500).

In its contentions concerning motivation to combine/reasonable expectation of success, Patent Owner argues that “[t]his limitation cannot be practiced without [Raizer’s] **proprietary ‘FinePositioning’ procedure** to enable precise, quick and efficient loading.” PO Resp. 48. As discussed above in our motivation-to-combine analysis, Patent Owner’s arguments concerning Raizer’s proprietary software are unavailing.

We reviewed Petitioner’s contentions and evidence, in light of Patent Owner’s contention, and find that Raizer teaches this limitation for the reasons explained by Petitioner.

[23.g]: driving the vehicle out of the first aisle via a path that extends under at least one of the storage racks

Petitioner contends that the combination of Raizer and Hangzhou teaches this limitation. Pet. 90 (citing Ex. 1003 ¶¶ 505–512).

Petitioner contends that Hangzhou discloses “a trolley . . . that had driven into a column, and then proceeds along a path that extends under another storage rack.” Pet. 90 (citing Ex. 1003 ¶ 510; Ex. 1006, Fig. 10). According to Petitioner, it would have been obvious to an ordinarily skilled artisan “to combine *Hangzhou*’s movement capabilities underneath the shelves and across multiple aisles with *Raizer*’s system to allow *Raizer*’s robots to move more directly to and from picking stations while also reducing congestion and more efficiently using warehouse space.” *Id.* at 91 (citing Ex. 1003 ¶ 511).

Patent Owner does not dispute these contentions except to the extent Patent Owner may have intended to incorporate its arguments against limitations [1.c] and [1.d.1], which contains similar recitations, in the context of motivation to combine and reasonable expectation of success. PO Resp. 47–48. As discussed above for claim 1, we find that Patent Owner’s argument in connection with limitations [1.c] and [1.d.1] is unavailing. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of Raizer and Hangzhou teaches this limitation for the reasons explained by Petitioner.

For all the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 23 would have been obvious over Raizer and Hangzhou.

p. Claim 24

For claim 24, which depends from claim 23, Petitioner relies on various of its contentions for claims 1, 10, and 23. Pet. 92 (citing Ex. 1003 ¶¶ 513–521).

Patent Owner does not dispute these contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of Raizer and Hangzhou teaches the limitations of claim 24 for the reasons explained by Petitioner.

For all the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 24 would have been obvious over Raizer and Hangzhou.

q. Claim 25

For claim 25, which depends from claim 24, Petitioner relies on various of its contentions for claims 10 and 24. Pet. 92 (citing Ex. 1003 ¶¶ 522–528).

Patent Owner does not dispute these contentions. PO Resp. 23–56.

We reviewed Petitioner’s contentions and evidence and find that the combination of Raizer and Hangzhou teaches the limitations of claim 25 for the reasons explained by Petitioner.

For all the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 25 would have been obvious over Raizer and Hangzhou.

r. Claim 26

Claim 26 depends from claim 23 and recites [26.pre], [26.a] “comprising the step of turning the vehicle while the vehicle is under one of the racks” and [26.b] “wherein the step of turning comprises turning the vehicle to align the vehicle with a path perpendicular to the first aisle.” Ex. 1001, 28:54–57.

For limitations [26.pre] and [26.a], Petitioner relies on various of its contentions for claims 1 and 23. Pet. 92 (citing Ex. 1003 ¶¶ 529–541).

For limitation [26.b], Petitioner contends that the combination of Raizer and Hangzhou teaches this limitation. Pet. 92 (citing Ex. 1003 ¶ 542). Petitioner provides the following annotated version of Hangzhou’s Figure 10 (*id.* at 94):

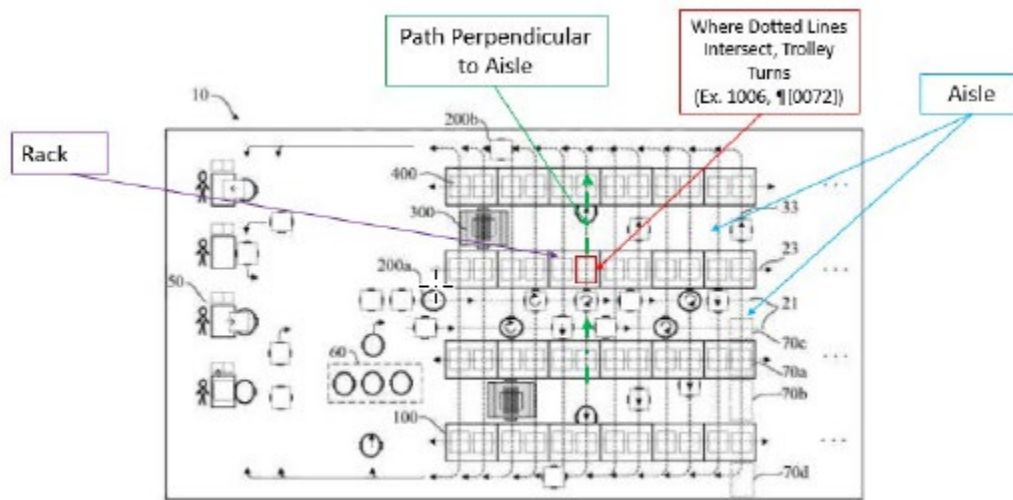


Figure 10

Figure 10 “is a top view of an unmanned warehousing system . . . and a schematic diagram of the principle of an auto-guided trolley performing inbound and outbound operations when it runs along a row channel and a column channel under a shelf.” Ex. 1006 ¶ 19. Petitioner adds a blue box with text “Aisle” with a blue arrow pointing to an aisle between rows, a red box with text “Where Dotted Lines Intersect, Trolley Turns (Ex. 1006 ¶ [0072])” with a red arrow pointing to a location where trolleys can turn, a green box with text “Path Perpendicular to Aisle” and a green arrow pointing to the path, and a purple box with text “Rack” and a purple arrow pointing to a rack. Pet. 94.

Petitioner contends that annotated Figure 10 illustrates “that an ‘auto-guided trolley 200 carrying standardized containers 400 switches between the row and column directions along the traveling direction by’ ‘*turning 90⁰ in place*’” and “teaches turning the trolley to align the trolley with a path perpendicular to the aisle.” Pet. 94 (citing Ex. 1003 ¶ 546; Ex. 1006 ¶ 73).

Patent Owner does not dispute these contentions except to the extent that it may have intended to incorporate its arguments against claims 8 and 9, which contain similar recitations. PO Resp. 59. As discussed above for claims 8 and 9, we find Patent Owner's argument is unavailing.

We reviewed Petitioner's contentions and evidence and find that the combination of Raizer and Hangzhou teaches the limitations of claim 26 for the reasons explained by Petitioner.

For all the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 26 would have been obvious over Raizer and Hangzhou.

s. Claim 27

For claim 27, which depends from claim 26, Petitioner relies on various of its contentions for claims 8 and 26. Pet. 95 (citing Ex. 1003 ¶¶ 548–552).

Patent Owner does not dispute these contentions. PO Resp. 23–56.

We reviewed Petitioner's contentions and evidence and find that the combination of Raizer and Hangzhou teaches the limitations of claim 27 for the reasons explained by Petitioner.

For all the foregoing reasons, we determine that Petitioner establishes by a preponderance of the evidence that claim 27 would have been obvious over Raizer and Hangzhou.

IV. CONCLUSION¹⁰

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1, 3–12, 14, 23– 27	103	Raizer, Hangzhou	1, 3–12, 14, 23–27	

¹⁰ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1, 3–12, 14, and 23–27 of the '632 patent have been shown by a preponderance of the evidence to be unpatentable; and

FURTHER ORDERED that any party seeking judicial review must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2024-00850
Patent 11,472,632 B2

FOR PETITIONER:

John Haynes
Brian Ellsworth
Dana Zottola
Christopher Douglas
ALSTON & BIRD LLP
john.haynes@alston.com
brian.ellsworth@alston.com
dana.zottola@alston.com
christopher.doughlas@alston.com

FOR PATENT OWNER:

Yung-Hoon Ha
Theodoros Konstantakopoulous
Goutam Patnaik
DESMARAIS LLP
yha@desmaraisllp.com
tkonstantakopoulous@desmaraisllp.com
gpatnaik@desmaraisllp.com