

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SIEMENS MOBILITY, INC., GROUND TRANSPORTATION SYSTEMS USA
INC., HUMATICS CORP., and PIPER NETWORKS, INC.
Petitioners,

v.

METROM RAIL, LLC
Patent Owner.

Case No. IPR2023-0460
Patent No. 10,737,709

**PETITION FOR *INTER PARTES* REVIEW
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.1 *et seq.***

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APPENDIX LISTING OF EXHIBITS

Exhibit	Description
1001	U.S. Patent No. 10,737,709
1002	Prosecution History of U.S. Patent No. 10,737,709
1003	Declaration of Michael Braasch, Ph.D.
1004	Curriculum Vita of Michael S. Braasch
1005	Provisional Application No. 62/177,683
1006	German Patent Application Pub. No. DE102008020700A1 (“Meyer-German”) (Attached as Exhibit A to EX1008)
1007	Certified English-Language Translation of German Patent Application Pub. No. DE102008020700A1 (“Meyer”) (Attached as Exhibit B to EX1008)
1008	Declaration of Harry Gigas
1009	U.S. Patent No. 7,148,791 (“Grisham”)
1010	WO International Publication No. 2013/056244 (“Cross”)
1011	U.S. Patent No. 6,133,876
1012	U.S. Patent Publication No. 2011/0006912
1013	U.S. Patent Publication No. 2010/0039978
1014	U.S. Patent Publication No. 2012/0182191
1015	U.S. Patent No. 5,283,589
1016	U.S. Patent No. 6,597,293
1017	U.S. Patent Application Pub. No. 2010/0124898A1
1018	U.S. Patent Application Pub. No. 2011/0084854A1
1019	C. L. Bennett and G. F. Ross, “Time-domain electromagnetics and its applications,” in <i>Proceedings of the IEEE</i> , vol. 66, no. 3, pp. 299-318, March 1978, doi: 10.1109/PROC.1978.10902.
1020	U.S. Patent Application Pub. No. 2012/0296562A1

1021	U.S. Patent Application Pub. No. 2016/0176422A1
1022	Newton’s Telecom Dictionary, 27 th Expanded and Updated Edition
1023	Dictionary of Computer Science Engineering and Technology (2000)
1024	Microsoft Computer Dictionary, 5 th Edition (2002)
1025	Docket as of January 5, 2023 for <i>Metrom Rail, LLC v. Siemens Mobility, Inc., et al.</i> , 1-22-cv-00049 (D. Del.)
1026	First Amended Complaint, <i>Metrom Rail, LLC v. Siemens Mobility, Inc., et al.</i> , 1-22-cv-00049, Dkt. No. 32 (D. Del. Apr. 26, 2022)

I. MANDATORY NOTICES

A. Real Party-In-Interest – §42.8(b)(1)

Petitioners Humatics Corp., Siemens Mobility, Inc., Ground Transportation Systems USA Inc., and Piper Networks, Inc. are the real parties-in-interest. Thales USA, Inc. is also a real party-in-interest.

B. Related Matters – §42.8(b)(2)

1. United States Patent & Trademark Office

U.S. Patent No. 10,737,709 (“the ’709 patent”) claims the benefit of provisional application No. 62/177,683 and U.S. Patent Application No. 15/078,427.

2. District Court Matters

The ’709 patent is at issue in the following pending case: *Metrom Rail, LLC v. Siemens Mobility, Inc., et al.*, 22-cv-00049-RGA (D. Del.).

C. Counsel and Service Information – §42.8(b)(3) and (b)(4)

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¹ For purposes of this IPR, the individual petitioner parties have designated Mr. Rahmeier of Faegre Drinker as lead counsel. Counsel for each petitioner will coordinate and act through the designated lead counsel. With the exception of Petitioner Ground Transportation Systems USA Inc., each individual petitioner’s designation of Mr. Rahmeier as lead counsel is not representation of an attorney-

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Powers of attorney are submitted with this petition. Counsel for Petitioners consent to service of all documents via electronic mail.

Petitioner requests *inter partes* review of claims 1-20 (“Challenged Claims”) of the ’709 patent (EX1001).

II. INTRODUCTION

The ’709 patent relates to a worker protection system comprising a train-mounted unit that communicates with one or more wayside units on or near a train track. The units can provide alerts to nearby workers and/or the operator of the train.

Petitioners, supported by the expert declaration of Michael Braasch, PhD, demonstrate that the challenged claims are unpatentable.

III. CERTIFICATION OF STANDING

The ’709 patent is available for IPR, and Petitioners are not barred or estopped from requesting IPR of its claims. 37 C.F.R. §42.104(a).

IV. UNPATENTABILITY GROUNDS

Petitioners request cancellation of claims 1-20 as follows.

Ground	Reference(s)	Claim(s)	Basis
1	Meyer, Grisham	1-5, 7, 10-16, 19-20	103
2	Cross, Grisham	1-4, 6-12, 17-19	103
3	Meyer, Grisham, Cross	6, 8-9, 17-18	103

The above-identified references are prior art (at least) under post-AIA §102(a)(1) based on the following publication dates, each of which is more than one year before the earliest-alleged priority date (March 23, 2015):

Reference	Publication
Cross	2013-04-18
Meyer	2009-11-05
Grisham	2006-12-06

Other than Grisham, none of these references was cited during prosecution.

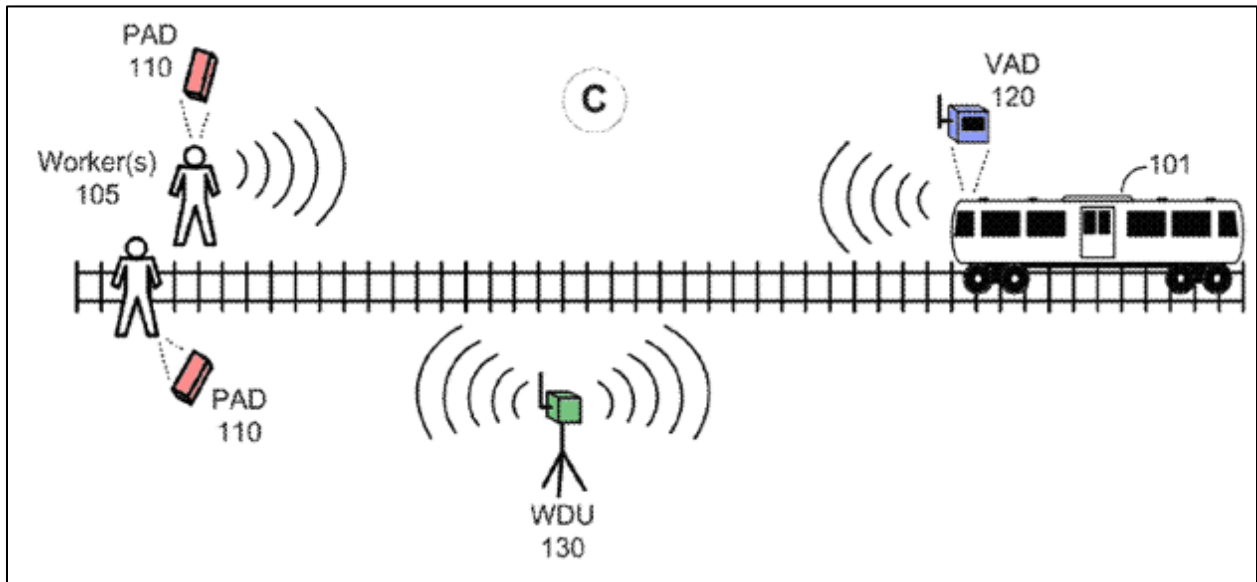
V. THE '709 PATENT

The '709 patent relates to a “worker protection system.” EX1001, Abstract. This system enhances worker safety “in railway work environments.” EX1001, 2:23-28. The system includes “portable alert devices (PADs)” that can be “worn by worker(s)” and which “communicate with one or more companion devices.” EX1001, 2:37-43; EX1003 (“Braasch-Decl.”), ¶¶29-30, 39-46. This communication may result in the “issuing of alerts by the PADs.” EX1001, 2:40-43.

The patent identifies at least two types of “companion devices” with which the PADs communicate. EX1001, 2:44-52; Braasch-Decl., ¶¶29-30. First, the PADs can communicate with “vehicle-mounted companion devices, referred to as vehicle alert devices (VADs).” EX1001, 2:44-47; Braasch-Decl., ¶¶29-30, 35-38. Additionally, the PADs can communicate with “wayside detection units (WDUs)” placed “along or near [a] path of [an] approaching object,” such as a train. EX1001, 2:47-52; Braasch-Decl., ¶¶29-30, 47-49. The VAD and/or WDU can be “configured to trigger alerts under particular conditions,” such as when a train is approaching an area occupied by workers. EX1001, 2:52-65; Braasch-Decl., ¶¶31-49. When an alert

is triggered, the PADs can “issue an indication (e.g., audio, visual, tactile, etc.) to alert the worker wearing it of an approaching object.” EX1001, 3:3-9; Braasch-Decl., ¶¶39-46.

A VAD (blue), a WDU (green), and PADs (red) are shown below:



A. Challenged Claims

Claims 1-20 are reproduced in the Claim Listing. *Infra* §X. The claims are directed to systems including two or more of the “companion devices” discussed in the specification, with each claim requiring that the devices communicate with one another using ultra-wideband (UWB) signals.

Independent claims 1 and 12 (and their dependent claims, 2-11 and 13-19) recite systems comprising a “train-mounted unit” that communicates with a

“wayside unit” using UWB signals, with the two units working “cooperatively” to “provide alerts” to nearby workers. Braasch-Decl., ¶¶52-58.

Independent claim 20 recites a system comprising UWB radios located “along the railroad tracks,” on a “vehicle,” and “associated with one or more workers,” with the vehicle and worker UWB radios configured to generate alerts based on their relative locations. *Id.*

B. Level of Ordinary Skill in the Art

A POSA would have had a background in wireless electronics, including at least a bachelor’s degree in electrical engineering or a related field and would have had at least two years of experience with using such electronics for control systems applications such as collision avoidance systems or positioning systems. Braasch-Decl., ¶¶24-28.

C. Prosecution History

The ’709 patent issued from U.S. Patent Application No. 16/246,940, which was filed on January 14, 2019. EX1002, 12-60; Braasch-Decl., ¶¶50-51. The examiner did not issue any office actions and allowed the challenged claims.

VI. CLAIM INTERPRETATION

Claim limitations are construed according to their ordinary meaning in light of the specification and prosecution history. 37 C.F.R. §42.100(b). Because the prior

art plainly discloses the claim limitations, no express constructions are necessary.

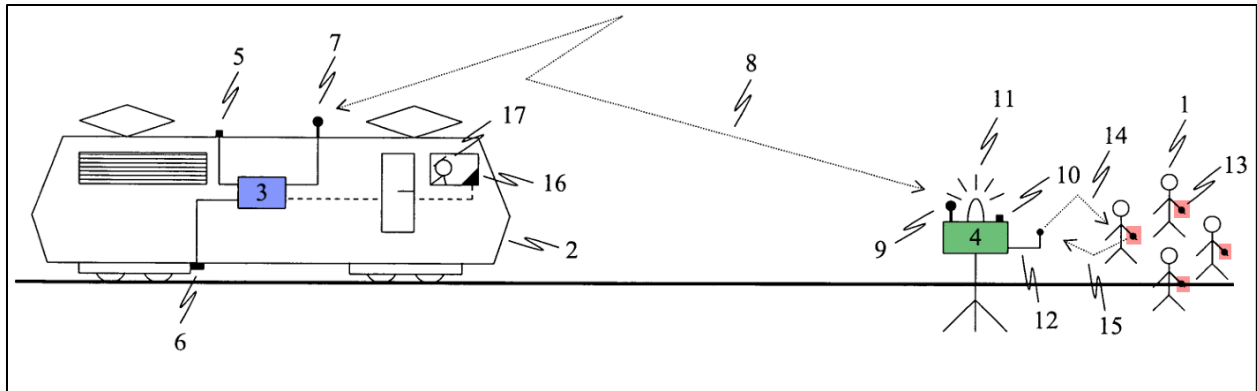
Vivid Techs. Inc. v. Am. Sci. & Eng'g, 200 F3d 795, 803 (Fed. Cir. 1999).

VII. GROUNDS FOR UNPATENTABILITY

A. Ground 1: Claims 1-5, 7, 10-16, and 19-20 Would Have Been Obvious over Meyer in view of Grisham

1. Meyer

Like the '709 patent, Meyer relates to a “railway collision warning system” designed to warn of a “collision risk between [a] rail-bound vehicle” “and [] at least one person.” Meyer, Abstract; Braasch-Decl., ¶¶62-63. The system includes a “stationary unit” “arranged on [a] rail-bound vehicle,” (e.g., a train) and a “mobile unit” “arranged in the proximity of at least one person,” such as “along the track section” of a “railway construction site.” Meyer, ¶¶16-19; Braasch-Decl., ¶¶64-65. The system may further include “mobile or portable transponders” “[a]rranged on or attached to the personnel to be warned.” Meyer, ¶23; Braasch-Decl., ¶¶64-65. The stationary unit (blue), mobile unit (green), and mobile transponders (red) are shown below:



The wayside mobile units detect an approaching train based on wireless communication with the train; the mobile unit then wirelessly transmits a “warning signal” to the worker-worn transponders, which, in turn, generate alerts to the workers. Braasch-Decl., ¶¶66-69. Meyer does not, however, describe what wireless communication technology its devices use to detect the presence of other devices and/or to communicate information between devices.

2. Grisham

Grisham describes a “danger proximity warning system...that utilize[s] ultra wideband (UWB) technology to effectively warn a person when there is a potentially dangerous situation in their vicinity.” Grisham, Abstract; Braasch-Decl., ¶¶70-71. Like Meyer’s system, Grisham’s system includes a first device “coupled to” a “locomotive” and a second device “coupled to” a “second object,” such as a “railroad pole, work vehicle or another locomotive.” Grisham, 19:52-65; Braasch-Decl., ¶¶72-73. The system may further include a device “carried on or by a person.” Grisham, 27:40-44; Braasch-Decl., ¶¶72-73.

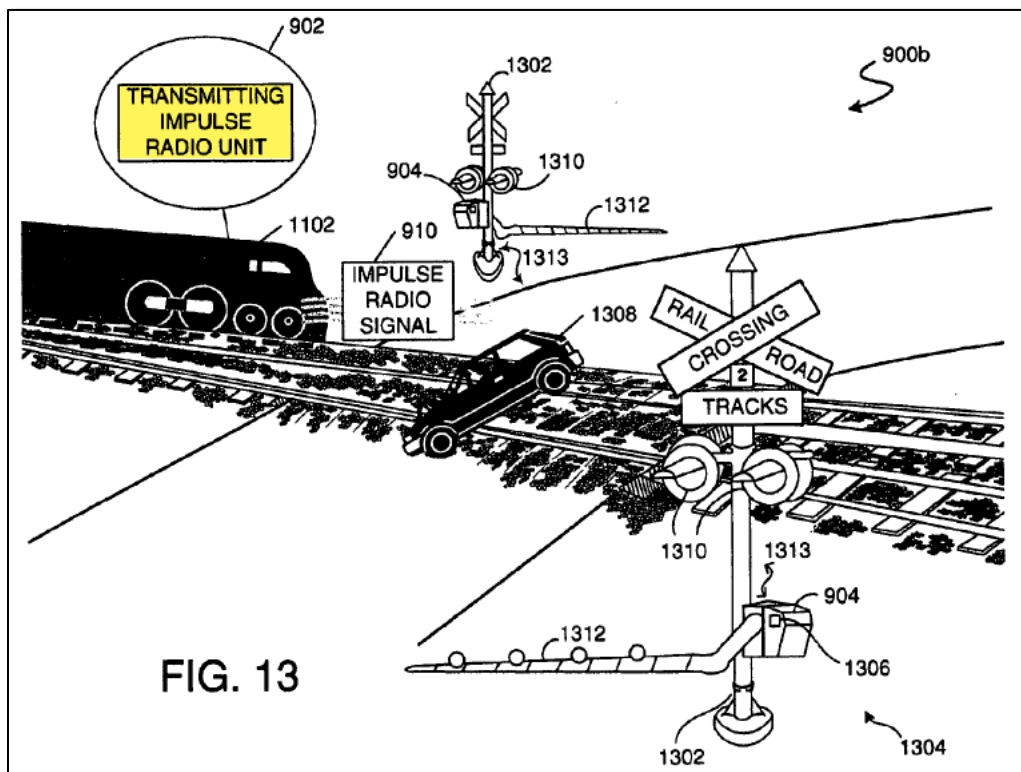
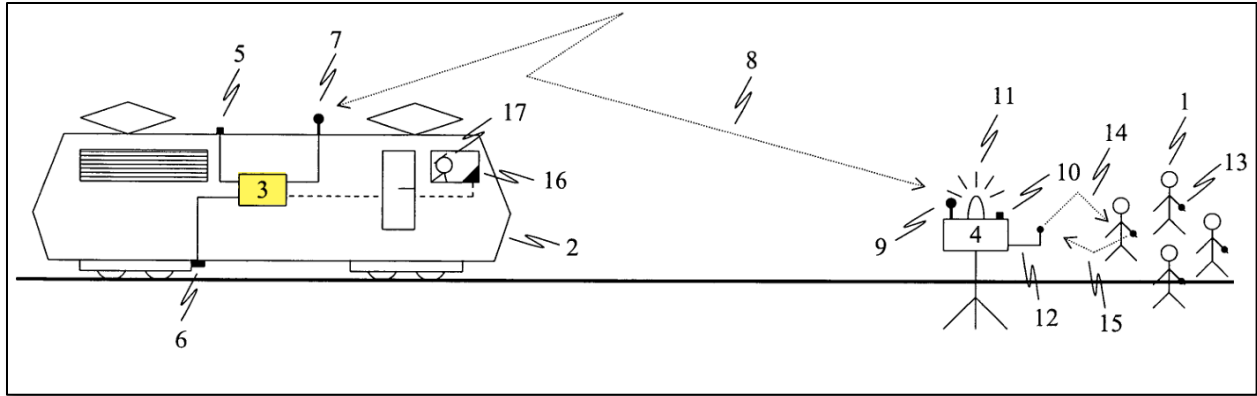
Each of these devices is an “impulse radio unit.” These “[i]mpulse systems” “can measure distances to relatively fine resolution.” Grisham, 15:27-35; Braasch-Decl., ¶¶74-78. In particular, an impulse radio signal contains a “time position measurement” that “can be used to measure propagation delay to determine link distance to a high degree of precision.” Grisham, 15:38-40; Braasch-Decl., ¶¶79-82. Using propagation delay to determine distance in this manner is otherwise known to POSAs as a “time of flight” distance determination. Braasch-Decl., ¶¶79-82.

Grisham describes a worker-protection system in which transmitters/receivers placed at various locations can, based on communication of UWB signals, trigger alerts warning of a collision risk. Braasch-Decl., ¶¶83-87.

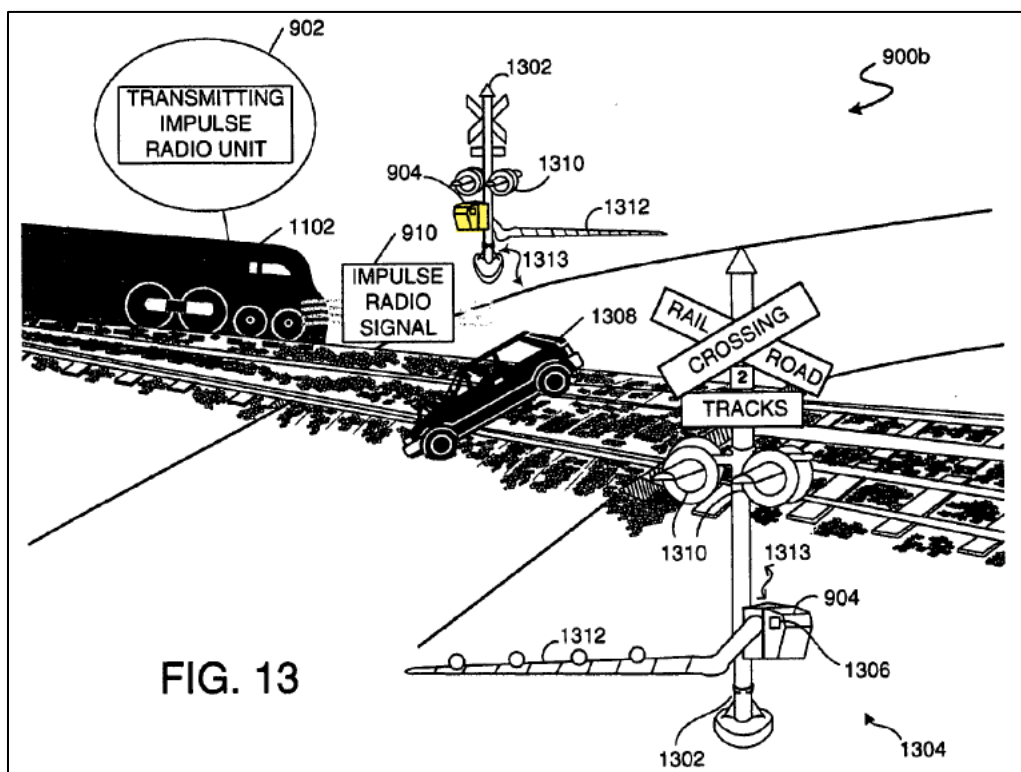
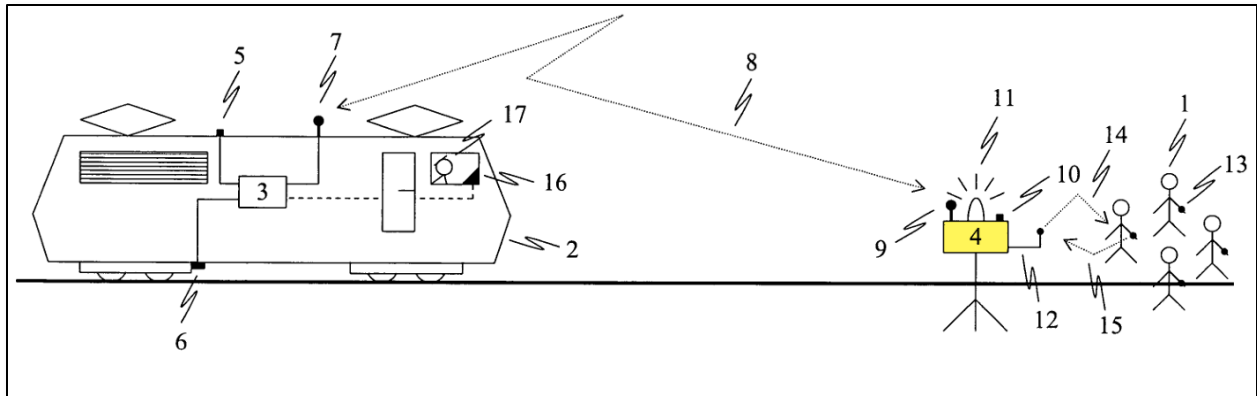
3. Meyer-Grisham Combination

POSAs had reason to use Grisham’s UWB-based devices to perform the transmitting/receiving functions of Meyer’s train-mounted stationary unit, wayside mobile unit, and worker-attached transponders. Braasch-Decl., ¶¶88-105.

Meyer and Grisham’s systems are remarkably similar in configuration and operation. Braasch-Decl., ¶¶89-91. Both systems involve a train-mounted radio-communication device. *Compare* Meyer, ¶36 (stationary unit attached to a train) *with* Grisham, 20:59-63 (impulse radio unit attached to a train). These train-based devices are highlighted in the figures of the respective Meyer and Grisham systems below:

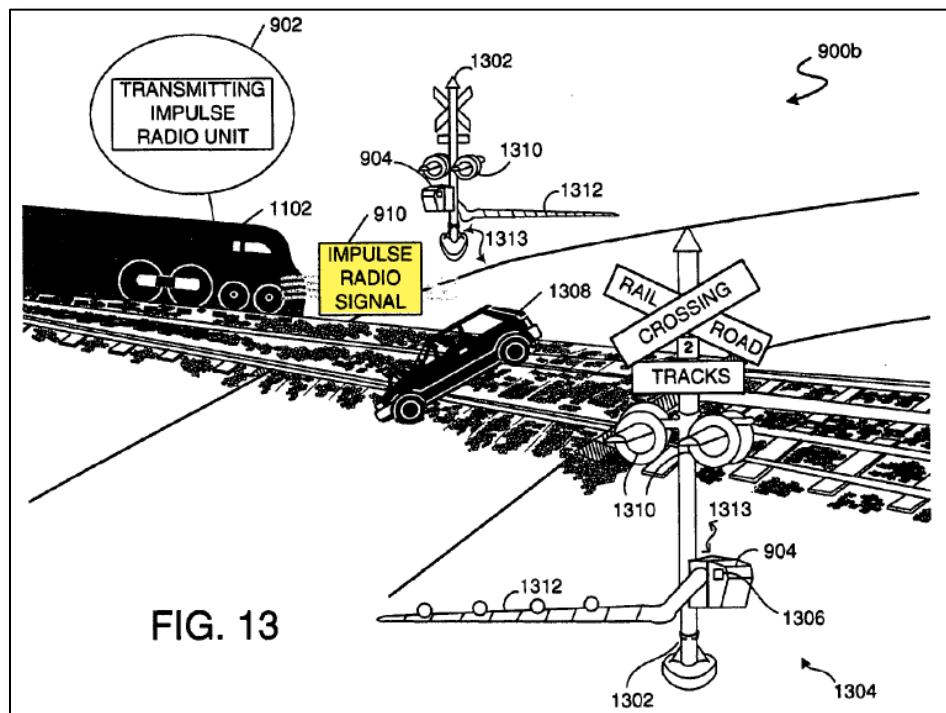
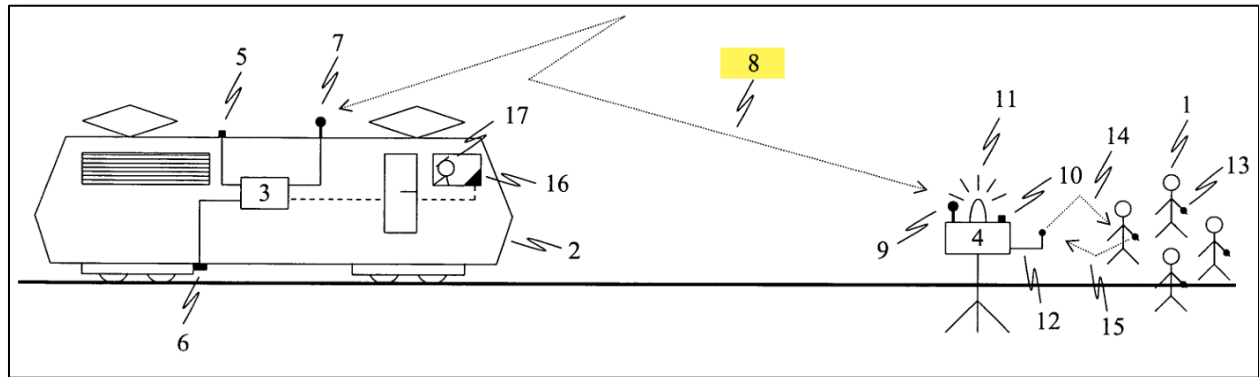


In both systems, this train-based device exchanges signals with other devices, including wayside devices. Compare Meyer, ¶36-37 (mobile unit near workers on track) with Grisham, 21:18-35 (unit attached to railroad pole along track). These devices are highlighted below:



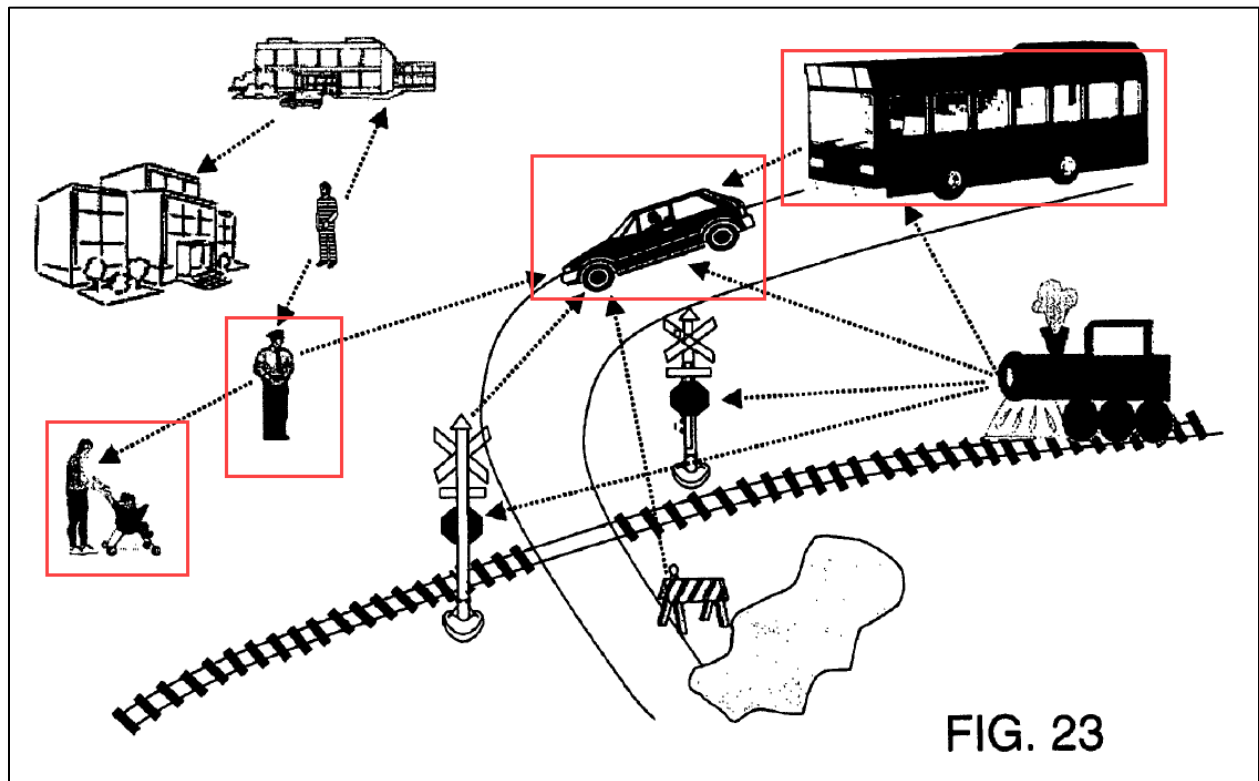
In both systems, these signals are used to determine that a train is approaching an area of the track where another object or person is located. *Compare* Meyer, ¶¶38-39 (determining collision risk based on signals exchanged between stationary unit and mobile unit) *with* Grisham, 21:36-52 (determining dangerous situation based on

signals exchanged between train-mounted unit and wayside unit). These signals are highlighted below:



When these signals indicate a risk of collision, both systems trigger an alert/alarm to the object/individual at risk and/or to the train operator. *Compare* Meyer, ¶¶38-39 (alerts to workers based on “collision risk”) *with* Grisham, 21:36-

These persons/vehicles alerted are highlighted below:



– 11 –

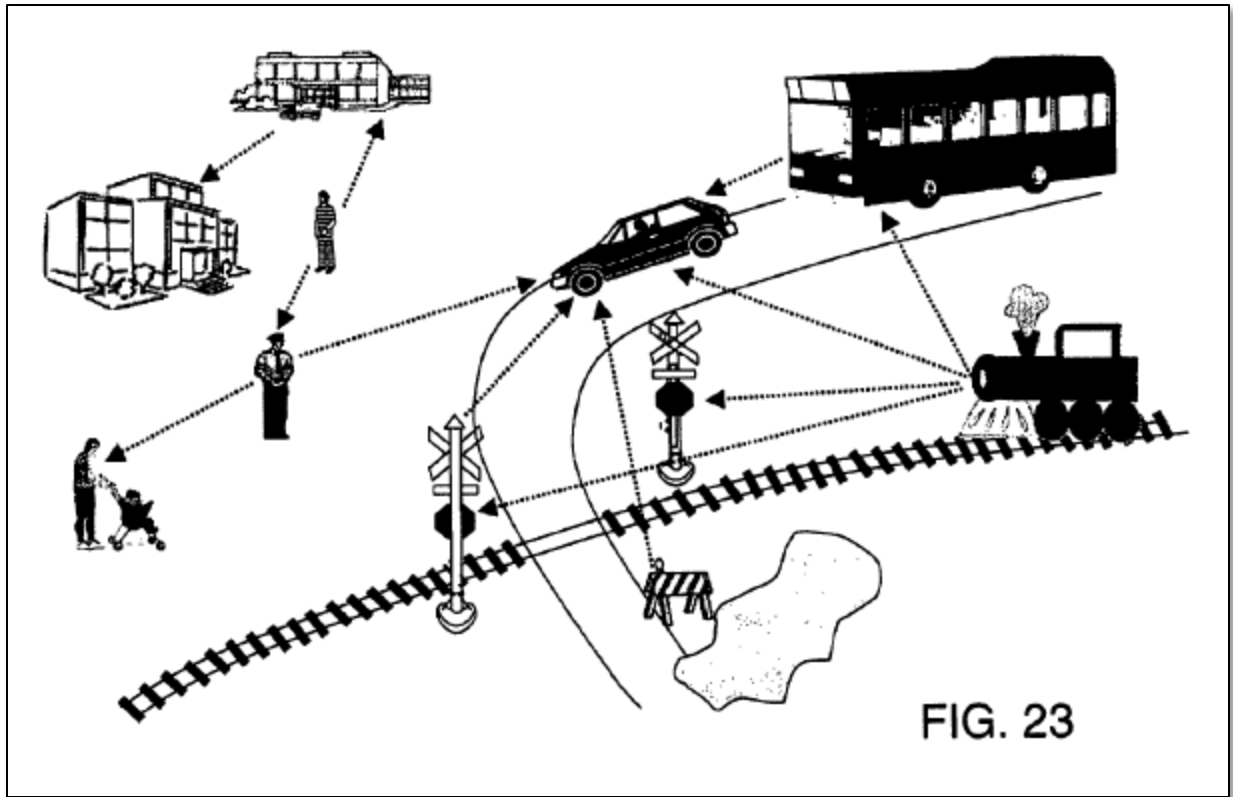
of known elements to obtain predictable results. Braasch-Decl., ¶¶89-91; *see also KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007).

Beyond the systems' similarities, POSAs would have had reason to use Grisham's UWB radios as the wireless communication devices in Meyer's system given the express benefits of UWB taught by Grisham. Grisham, 4:47-53, 5:4-20, 17:34-40; Braasch-Decl., ¶¶92-104. Grisham describes, in detail, how to generate and communicate such signals. Grisham, 6:20-16:67. Grisham teaches that these signals can be used both to communicate information/data and to determine a distance between the sending/receiving devices. Grisham, 17:1-19:38; Braasch-Decl., ¶¶92-96. Grisham highlights that UWB signals are "highly resistant to interference," which is "desirable since impulse radio systems must share the energy spectrum with conventional radio systems and with other impulse radio systems." Grisham, 12:1-8; Braasch-Decl., ¶¶92-96. Additionally, POSAs would have been aware of many benefits of using UWB signals, including resistance to multipath interference, low power use, and ability to transmit through the ground and other obstacles. Braasch-Decl., ¶¶92-96.

For at least these reasons, POSAs had reason to implement Meyer's "railway collision warning system" using Grisham's UWB devices to send/receive information and determine distance between the system's devices. Braasch-Decl., ¶¶92-105.

POSAs would have had a reasonable expectation of success in making this combination, as the stationary and mobile units described in Meyer already “transmit radio signals” containing the train’s “travel information.” Meyer, ¶¶1, 17-18, 20, 37; Braasch-Decl., ¶¶92-105. Utilizing Grisham’s UWB radios to transmit this, and other, information would have been using a known technique (transmission of UWB signals) to improve similar devices (stationary/mobile units sending/receiving radio signals) in the same way (by sending/receiving location-related information). Braasch-Decl., ¶¶92-105; *KSR*, 550 U.S. at 417.

Indeed, Grisham suggests such a combination. Grisham’s Figure 23 illustrates “various types of warnings of potentially dangerous systems that can be conveyed from the danger proximity warning system to persons in accordance with the present invention.” Grisham, 29:34-37; Braasch-Decl., ¶¶92-100.



In the figure, “[e]ach of the vehicles, poles, people, etc. shown have associated with them a UWB-enabled radio.” Grisham, 29:37-39; Braasch-Decl., ¶¶97-101. These UWB radios communicate with one another and, based on those communications, generate warnings, *e.g.*, a warning that a “train [is] approaching a railroad crossing.” Grisham, 29:39-41; Braasch-Decl., ¶¶97-101. Grisham invites POSAs to utilize UWB technology in a variety of scenarios, noting the “many other possible scenarios in which the danger proximity system of the present invention can be used to warn people of dangerous situations.” Grisham, 29:50-52; Braasch-Decl., ¶¶97-101. Grisham also teaches that these scenarios may include a “UWB-enabled

device...carried on or by a person,” such as a “watch, phone, helmet or computing device.” Grisham, 27:40-44.

Implementing Grisham’s UWB radios in Meyer’s system would have yielded predictable benefits, improving the reliability of the worker protection system, *e.g.*, by reducing the likelihood that interference—from other radio signals or from physical objects—would prevent a signal from reaching its intended destination. Braasch-Decl., ¶¶94-99. These benefits would have been particularly advantageous in a railway or subway worker protection system because, as Grisham explains, UWB technology can “transmit and receive impulse radio signals through the ground.” Grisham, 25:51-57; Braasch-Decl., ¶¶94-99.

Using UWB-enabled devices for wireless transmissions in Meyer’s system would have been straightforward, especially in light of Grisham’s teachings about (a) how to send/receive UWB signals and (b) the practical benefits of doing so. Braasch-Decl., ¶¶91-101. The above-described advantages would have been well known and apparent to POSAs because the use of UWB devices was commonplace at the time of the ’709 patent. Braasch-Decl., ¶¶91-101. Thus, POSAs would have been motivated to combine Meyer and Grisham in the manner described herein.

4. Independent Claim 1

a. 1[pre]: “A system for worker protection, the system comprises:”

Meyer discloses “a railway collision warning system to warn of a collision risk between a rail-bound vehicle and at least one person,” including “construction crews.” Meyer, Abstract, ¶15; Braasch-Decl., ¶¶106-107.

b. 1[A]: “a train-mounted unit for use on a train”

Meyer’s warning system “comprises a stationary [] unit” “installed on a rail-bound vehicle.” Meyer, ¶17; Braasch-Decl., ¶¶108-109.

c. 1[B]: “wherein the train-mounted unit comprises: a communication component, comprising one or more antennas, configured to transmit and/or receive wireless signals”

Meyer’s “stationary unit” comprises “a transmission unit or has a connection to such a transmission unit.” Meyer, ¶17; Braasch-Decl., ¶¶110-111. This “transmission unit” (i.e., *communication component*) is used to “transmit corresponding radio signals” (i.e., *wireless signals*). Meyer, ¶17; Braasch-Decl., ¶¶110-111. These signals are “transmitted using the broadcast method such that it can be received in a certain radius.” Meyer, ¶¶17, 36. Additionally, the stationary unit includes a “receiving unit” for receiving a “return message” from a mobile unit. Meyer, ¶27. Meyer-Grisham’s “transmission unit” would have included Grisham’s

transmitting impulse radio, which includes a “transmit antenna” to generate an “emitted signal.” Grisham, 17:25-40; Braasch-Decl., ¶¶88-105, 110-112.

d. 1[C]: “wherein the signals comprise ultra-wideband (UWB) signals”

Grisham’s system “utilize[s] impulse radio technology to effectively warn a person when there is a...locomotive in their vicinity.” Grisham, 2:27-31. An “impulse radio” is “a radio system based on short, low duty-cycle pulse.” Grisham, 5:21-22. The term “impulse radio” is also known as an “ultra-wideband system, or ultra-wideband communication systems.” Grisham, 5:8-13. Thus, “[i]n a preferred embodiment, the emitted signal is wide-band or ultrawide-band.” Grisham, 17:34-35; Braasch-Decl., ¶¶113-115.

As previously discussed (§VII.A.3), POSAs would have been motivated to implement Grisham’s UWB technology in Meyer-Grisham by using UWB-enabled devices to transmit/receive signals between Meyer’s stationary unit, mobile unit, and mobile transponders. Braasch-Decl., ¶¶88-105. Thus, Meyer-Grisham would include a train-mounted unit with a communication component configured to transmit and/or receive UWB signals. Braasch-Decl., ¶¶113-115.

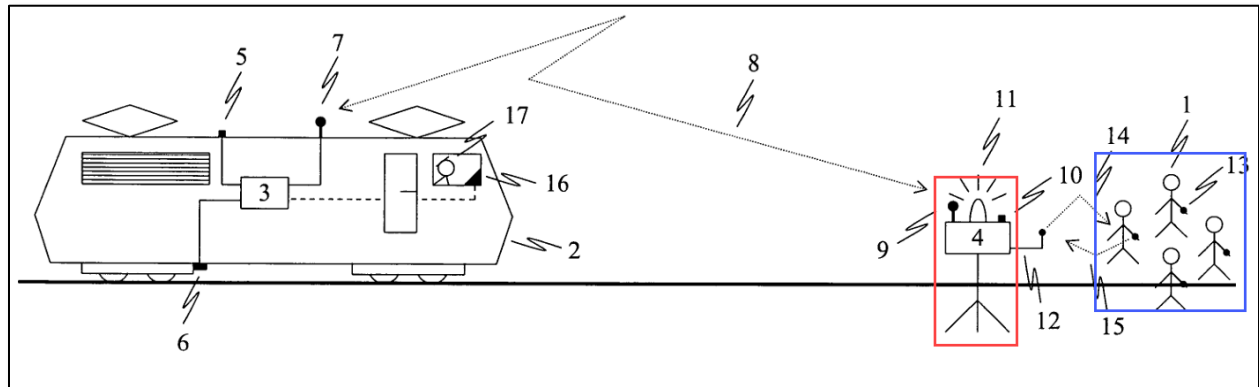
- e. 1[D]: “and one or more circuits configured to process signals and data, and perform one or more applications or functions relating to operations of the train-mounted unit”**

In Meyer’s system, the stationary unit is “connected to the corresponding data bus of the rail-bound vehicle such that the required travel information can be read.” Meyer, ¶17; Braasch-Decl., ¶¶116. Additionally, the stationary unit can be “connected to the [train’s] internal electronics” and can “automatically slow down the [train].” Meyer, ¶45; Braasch-Decl., ¶¶116. The conventional way to process signals and data to perform each of these functions would have been to use a computer with processing capabilities, and POSAs would have understood that such a computer/processor would comprise “*one or more circuits*” for that purpose. Braasch-Decl., ¶¶116-118; *see also* EX1001, 1:63-2:4 (defining “circuit” as “physical electronic components,” *e.g.*, a “processor and memory,” and “software” associated with, executed by, or which configures those components).

- f. 1[E]: “and wherein the train-mounted unit is configured to operate cooperatively with one or more wayside units, configured for placement on or near a track traversed by the train, to provide alerts to one or more workers operating on or near the track, based on communication of the UWB signals with at least one of the one or more wayside units.”**

Meyer’s system includes, in addition to the stationary unit, a “mobile unit.” Meyer, ¶18. As shown in Figure 1, below, the mobile unit (4) (red) can be “set up in

the proximity of [a] track section and [a] construction crew” (blue) working on/near that track. Meyer, ¶35; Braasch-Decl., ¶¶119-120.



The stationary unit and the mobile unit operate cooperatively to provide alerts to the personnel. For example, the “mobile unit” includes a “receiving unit for receiving radio signals transmitted by the stationary unit.” Meyer, ¶18. When a train “approaches the position of the mobile unit 4 or that of the personnel 1 to be warned, the radio signal 8 transmitted by the rail-bound vehicle 2 is received by the mobile unit.” Meyer, ¶39. The mobile unit uses the received signal “to determine a collision risk.” Meyer, ¶39. If there is a collision risk, the mobile unit generates a warning signal for the nearby personnel. *Id*; Braasch-Decl., ¶¶119-121.

In one Meyer embodiment, the mobile unit generates a “warning signal,” (e.g., a “light signal”) that “can be perceived such that the personnel 1 becomes aware that a rail-bound vehicle 2 is approaching their position.” Meyer, ¶¶38-39. In another, the mobile unit “has a near range transmission and receiving unit 12.” Meyer, ¶40, FIG. 2. Nearby personnel are equipped with a “mobile transponder” that can be

“worn on the wrist in the form of a wristwatch.” Meyer, ¶40. When the mobile unit determines a risk of collision based on signals received from the stationary unit, it “transmit[s] a near-range warning signal 14 that can be received by the mobile transponders 13,” which generate an “acoustic, optical, or haptic signal” to alert the workers of the collision risk. Meyer, ¶41; Braasch-Decl., ¶¶119-121.

Moreover, in the Meyer-Grisham combination described herein, Meyer’s stationary unit and mobile unit would include Grisham’s impulse radios, which send/receive UWB signals. Braasch-Decl., ¶¶88-105. Thus, in Meyer-Grisham, the stationary unit and mobile unit would cooperate to provide alerts “*based on the communication of UWB signals.*” Braasch-Decl., ¶¶119-122.

5. Dependent Claims 2-11

a. Claim 2: “The system of claim 1, wherein the train-mounted unit is configured to broadcast alert triggering signals.”

Meyer’s stationary unit “transmits corresponding radio signals...using the broadcast method such that it can be received in a certain radius by the corresponding receiving units.” Meyer, ¶17. The mobile unit then “receive[s] the radio signal” and “extracts from this radio signal 8 the travel information contained therein.” Meyer, ¶39. Based on this information, a “warning signal” is “generated so that the personnel 1 can clear the hazard zone.” Meyer, ¶39. In Meyer-Grisham, the UWB signals transmitted by the stationary unit trigger a “warning signal,” *i.e.*, “*alert*

triggering signals,” and would be transmitted using the “broadcast method” disclosed in Meyer, which was a conventional manner of sending UWB signals. Braasch-Decl., ¶¶123-126.

b. Claim 3: “The system of claim 1, wherein the train-mounted unit is configured to generate data relating to alerts and/or to other devices or objects in a path of the train, based on the communication of the UWB signals with at least one of the one or more wayside units.”

In Meyer-Grisham, the implementation of Grisham’s UWB radios would allow the stationary unit and mobile unit to generate data relating to the distance between the two units. Braasch-Decl., ¶¶127-129. In performing this function, the stationary unit would be “*configured to generate data relating to alerts and/or to other devices or objects in a path of the train, based on the communication of the UWB signals with at least one of the one or more wayside units.*” *Id.*

In particular, a receiving impulse radio unit can “determine the distance that the first object (e.g., first locomotive 1102) is from the second object,” which may be a railroad pole, a work vehicle, etc. Grisham, 20:55-65. To do so, the “time position measurement can be used by the controller 110 to measure the propagation delay and determine the link distance between” the impulse radios. Grisham, 25:16-45; Braasch-Decl., ¶¶127-129.

In Meyer-Grisham, this functionality would be present in both the stationary unit and the mobile unit. Grisham, 25:45-50, 19:62-65; Braasch-Decl., ¶¶88-105.

- c. Claim 4: “The system of claim 1, wherein the train-mounted unit is configured to generate feedback information for outputting to an operator of the train, based on the communication of the UWB signals with at least one of the one or more wayside units.”**

In Meyer-Grisham, the mobile unit transmits “a radio signal to the rail-bound vehicle 2 to notify the latter that the hazard zone is not yet clear of personnel.” Meyer, ¶44. The “stationary unit” can be “connected to a display unit 16 in the operator cab of the vehicle operator 17 to display to the latter that there is an imminent collision risk with personnel.” Meyer, ¶44. The indication that there is an imminent collision risk is feedback information that is output to the operator of the train, as claimed. Braasch-Decl., ¶¶130-131. And, because Meyer-Grisham’s stationary unit and mobile unit send and receive wireless signals using UWB, the generation and display of this risk indication would be based on the communication of UWB signals between units, as claimed. Braasch-Decl., ¶¶88-105, 130-131.

- d. Claim 5: “The system of claim 1, wherein the train-mounted unit is configured to: receive a signal indicating an acknowledgment of a safety alert by a worker of the one or more workers, in response to broadcasted alert triggering signals; and provide an indication of the acknowledgement to an operator of the train.”**

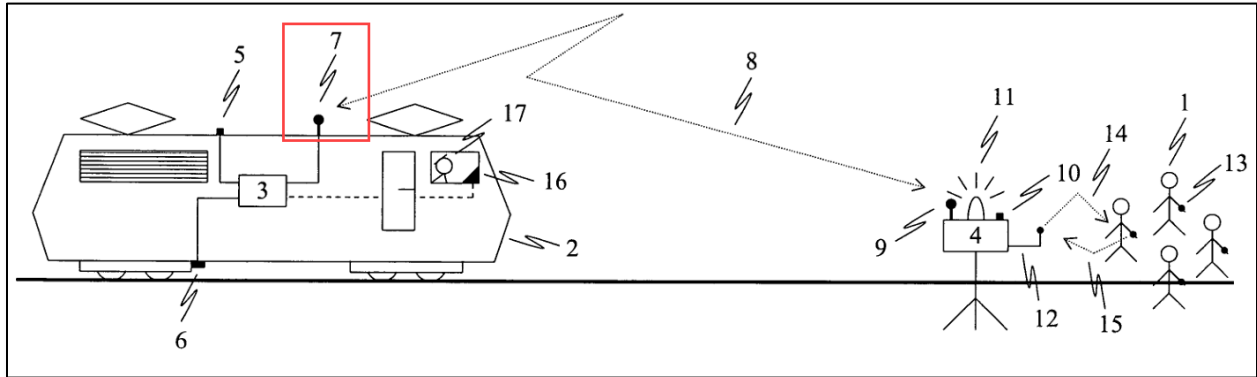
As discussed in connection with Claim 1, Meyer-Grisham’s mobile unit sends a “near-range warning signal” to worker transponders when it determines, based on UWB signals received from the stationary unit, that there is a collision risk. Meyer,

¶41. These worker transponders include an “actuation button that can be pressed when a corresponding warning signal was received by the mobile transponders.” Meyer, ¶42. When the actuation is pressed, a “near-range acknowledgement signal 15 is sent to the mobile unit 4.” Meyer, ¶42. If the mobile unit determines that “the number of acknowledgements is less than the predetermined number of personnel,” the mobile unit can transmit “a radio signal to the rail-bound vehicle 2 to notify the latter that the hazard zone is not yet clear of personnel.” Meyer, ¶¶43-44. The “stationary unit” can be “connected to a display unit 16 in the operator cab of the vehicle operator 17 to display to the latter that there is an imminent collision risk with personnel.” Meyer, ¶44. The stationary unit is therefore configured to receive a signal indicating an acknowledgement of a safety alert in response to a broadcasted alert signal and provide an indication to an operator, as claimed. Braasch-Decl., ¶¶132-134.

- e. Claim 10: “The system of claim 1, wherein the train-mounted unit is arranged into a plurality of separate physical units that comprises at least a broadcast unit comprising at least the communication component, and wherein the broadcast unit is configured for deployment external to the train.”**

Meyer’s stationary unit may comprise multiple physical units, including a broadcast unit and communication component deployed external to the train. Meyer’s stationary unit is connected to a “GNSS sensor (global navigation satellite system) 5,” a “transmission unit 7,” and a “travel detection unit 6.” Meyer, ¶36. The

“transmission unit” “transmit[s] corresponding radio signals” “using the broadcast method.” Meyer, ¶¶17, 36; Braasch-Decl., ¶135. As shown in Fig. 1, below, this transmission unit (7) is deployed external to the train (2), as claimed:



Additionally, to the extent Meyer does not expressly disclose deploying the broadcasting transmission unit external to the train, it would have also been conventional to mount at least the broadcasting antenna external to the train to lessen interference. Braasch-Decl., ¶¶136-137.

- f. **Claim 7:** “The system of claim 1, wherein the train-mounted unit comprises one or more input/output (I/O) components, for receiving input from an operator of the train and/or for providing output to the operator of the train.”
- g. **Claim 11:** “The system of claim 10, wherein the plurality of separate physical units comprises an operator unit comprising at least the one or more I/O components, and wherein the operator unit is configured for use by an operator of the train.”

As discussed in connection with Claim 5, Meyer teaches that the “stationary unit 3 on the rail-bound vehicle 2” can be connected to a “display unit 16 in the

operator cab of the vehicle operator.” Meyer, ¶44, FIG. 2; Braasch-Decl., ¶138. This display provides an output indicating “that there is an imminent collision risk with personnel.” Meyer, ¶44. Moreover, as described in connection with Claim 4, Meyer-Grisham would incorporate Grisham’s “display” associated with its impulse radio units as part of Meyer’s stationary unit. Braasch-Decl., ¶¶139-140. This “display” can be used to output an alert of a potentially dangerous situation and can also receive inputs to “communicate with a person” on a train via another impulse radio unit. Grisham, 25:4-19, 45-50, FIG. 21; Braasch-Decl., ¶¶139-140. The display can also “show[],” *i.e.*, “*output*,” “information about [a] dangerous situation such as the direction, distance and/or speed of the oncoming locomotive.” Grisham, 25:16-19; Braasch-Decl., ¶¶139-140.

6. Independent Claim 12

a. 12[pre]: “A system for worker protection, the system comprises:”

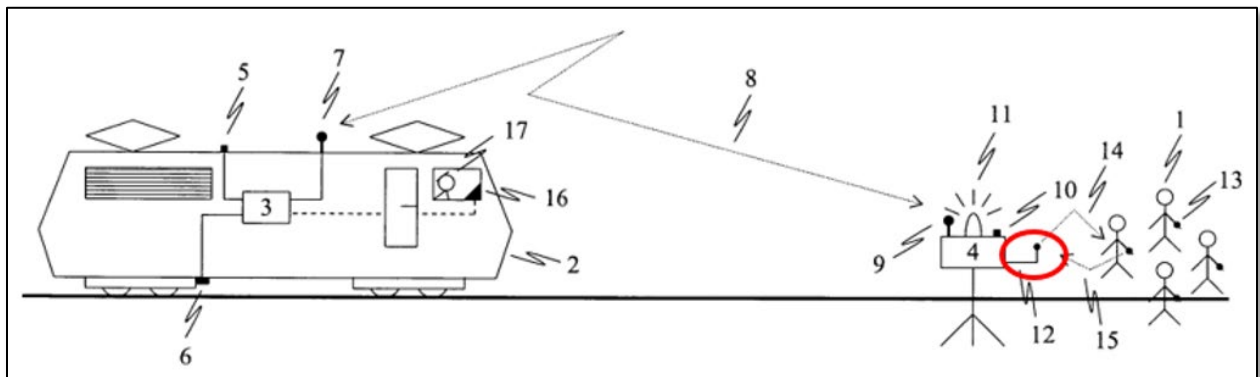
See Claim 1[pre], *supra* §VII.A.4. Braasch-Decl., ¶141.

b. 12[A]: “one or more wayside units configured for placement on or near a track;”

See Claim 1[E], *supra* §VII.A.4, discussing the “wayside units” taught in Meyer-Grisham. Braasch-Decl., ¶142.

c. 12[B]: “wherein each wayside unit comprises: a communication component, comprising one or more antennas, configured to transmit and/or receive wireless signals,”

Meyer’s “mobile unit” “has a corresponding receiving unit 9 to receive the radio signal 8 transmitted by the stationary unit 3 using the transmission unit 7 when the mobile unit 4 is located in the transmission radius of the [train].” Meyer, ¶37. The mobile unit may also include “a near range transmission and receiving unit” that can “transmit a near-range warning signal 14 that can be received by the mobile transponders.” Meyer, ¶¶40-41. Thus, the mobile unit includes a “*communication component*” that is “*configured to transmit and/or receive wireless signals.*” Braasch-Decl., ¶¶ 143-144. The mobile unit also includes an “*antenna*,” as shown below:



Beyond Meyer’s express disclosure, POSAs would have understood that the conventional approach to transmitting and receiving radio signals of the type described in Meyer would involve the use of “*one or more antennas.*” Braasch-Decl., ¶144. Moreover Meyer-Grisham’s mobile unit would include a “transmit

antenna” to generate an “emitted signal” (Grisham, 17:26-36) and a “receive antenna 704 for receiving a propagated impulse radio signal” (Grisham, 17:46-47). Braasch-Decl., ¶145.

d. 12[C]: “wherein the signals comprise ultra-wideband (UWB) signals;”

See Claim 1[C], *supra* §VII.A.4, discussing Grisham’s disclosure of UWB signals and §VII.A.3, discussing the motivation to implement Grisham’s UWB signals in Meyer-Grisham. Braasch-Decl., ¶¶146-147; Grisham 5:8-13, 17:34-35.

e. 12[D]: “and one or more circuits configured to process signals and data, and perform one or more applications or functions relating to operations of the wayside detection unit;”

Meyer’s “mobile unit” receives a radio signal from the stationary unit, extracts “travel information” contained therein, and “compares said information to its own information in order to determine a collision risk.” Meyer, ¶39. If it determines that there is a collision risk, it generates a “warning signal” and/or transmits a “near-range warning signal” to nearby worker “transponders.” Meyer, ¶¶39-41. Thus, Meyer’s mobile unit is “*configured to process signals and data, and perform one or more applications or functions relating to operations of the wayside detection unit.*” Braasch-Decl., ¶¶148, 151. Moreover, POSAs would have understood that the conventional approach to performing the operations described in Meyer would involve the use of “*one or more circuits.*” Braasch-Decl., ¶149. Indeed, this is

consistent with the implementation of Meyer-Grisham, in which the impulse radio units include circuitry to process signals. Grisham, Fig. 7, 17:46-18:35. Braasch-Decl., ¶150.

- f. 12[E]: “and wherein the one or more wayside units are configured to operate cooperatively with any train-mounted unit deployed on a train traversing the track, to provide alerts to one or more workers operating on or near the track, based on communication of the UWB signals between at least one of the one or more wayside units and the train-mounted unit.”**

See Claim 1[E], *supra* §VII.A.4. Braasch-Decl., ¶¶152-153.

7. Dependent Claims 13-19

- a. Claim 13: “The system of claim 12, wherein each wayside unit comprises a power supply for powering components of the wayside unit.”**

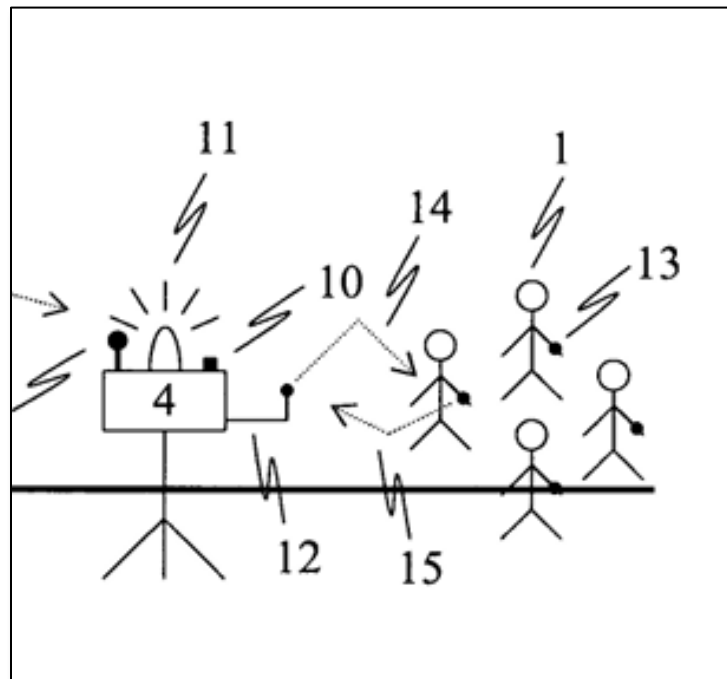
Meyer’s mobile unit “advantageously has an autonomous power supply.”

Meyer, ¶18; Braasch-Decl., ¶154.

- b. Claim 14: “The system of claim 12, wherein each wayside unit comprises a housing for enclosing components of the wayside unit.”**
- c. Claim 15: “The system of claim 12, wherein each wayside unit comprises a support structure for holding and supporting the wayside unit when placed on or near the track.”**

Meyer’s mobile unit may be “portable.” Meyer, ¶18. Thus, it can be “set up in the proximity of the track section and the construction crew such that any light and audio warnings from the mobile unit 4 can be perceived by the personnel 1 to

be warned.” Meyer, ¶35; Braasch-Decl., ¶¶155-156. As depicted below, Meyer’s
wayside unit (4) includes a “*housing*” atop a tripod “*support structure*,” enabling
easy transportation:



Moreover, POSAs would have understood a “*housing*” and “*support structure*” to be conventional design choices to protect the internal electronics of the unit from natural elements (e.g., water, dirt, etc.). Braasch-Decl., ¶¶157-158.

d. Claim 16: “The system of claim 12, wherein at least one wayside unit is configured to broadcast alert related signals, relating to the train when approaching the wayside unit.”

When Meyer's mobile unit determines that there is a collision risk, the mobile unit "transmit[s] a near-range warning signal 14 that can be received by [] mobile transponders" carried or worn by personnel in the vicinity of the mobile unit. Meyer,

¶¶40-41. This near-range warning signal triggers an “acoustic, optical, or haptic signal” “to warn the personnel 1 about an imminent collision with a rail-bound vehicle.” Meyer, ¶41; Braasch-Decl., ¶¶159-160. The mobile unit “*broadcast[s]*” the near-range warning signal, as claimed, because a POSA would have understood “broadcast” in its ordinary sense to be the transmission of a signal to multiple devices simultaneously, as described in Meyer. Braasch-Decl., ¶¶124-126.

Additionally, even if Meyer’s mobile units were found to not disclose “*broadcast[ing]*” this signal, it would have been obvious to do so using the same “broadcast method” used by Meyer’s stationary unit. Braasch-Decl., ¶¶160-162. This technique is the conventional way to ensure that the transmitted signal “can be received in a certain radius by the corresponding receiving units.” Meyer, ¶17; Braasch-Decl., ¶¶160-162. For the same reasons that it would be beneficial to ensure that the signal transmitted from the train’s stationary unit is received by all receiving units in a receiving radius, it would be beneficial to ensure that the signal transmitted from the mobile unit is received by all nearby transponders. Braasch-Decl., ¶¶160-162. Thus, it would have been obvious to POSAs to use the “broadcast method” to send these alert-related signals from the mobile unit to the worker transponders. *Id.*

- e. **Claim 19: “The system of claim 12, wherein at least one wayside unit comprises one or more sensory components, for detecting, monitoring, and/or tracking trains, and wherein the at least one wayside unit configured to determine, based on sensory data obtained from the one or more sensors, when the train is approaching the wayside unit.”**

Grisham discloses a “control box” that “is located at a monitoring location such as next to railroad tracks.” Grisham, 23:12-16. This trackside equipment is “capable of using a sensor 1506 (e.g., electromagnetic sensor, motion detector, percussion sensor) to sense the presence of a third object (e.g., locomotive 1102).” Grisham, 23:14-16. When the sensor detects “a dangerous situation such as the presence of a locomotive,” an impulse radio associated with the sensor can “transmit” a signal that results in the triggering of a warning that the locomotive is approaching. *See* Grisham, 23:25-35.

POSAs would have been motivated to implement this “sensor” in Meyer-Grisham in association with the wayside mobile unit. Braasch-Decl., ¶¶88-105, 163-165. Although the Meyer-Grisham’s mobile unit would use UWB communications to determine that a train is approaching, POSAs would have understood the benefits of having a secondary, fallback method of detecting approaching trains to protect against any risk of malfunction in the train’s UWB equipment. *Id.* Indeed, Grisham discloses the use of UWB transmission and non-UWB “sensor” components in combination, describing an embodiment where a sensor determines that a train is

approaching while an impulse radio unit associated with the sensor transmits signals to trigger alerts to persons of the approaching train. Grisham, 23:4-35. Thus, POSAs would have been motivated to implement a similar sensor in the “mobile unit” of Meyer-Grisham, such that the mobile unit would include “*sensory components, for detecting, monitoring, and/or tracking trains.*” Braasch-Decl., ¶¶88-105, 163-165. POSAs would have had a reasonable expectation of success in implementing this functionality in Meyer-Grisham, as these sensors are conventional equipment and are small, low-powered devices that could be placed anywhere on the track. *Id.*

8. Independent Claim 20

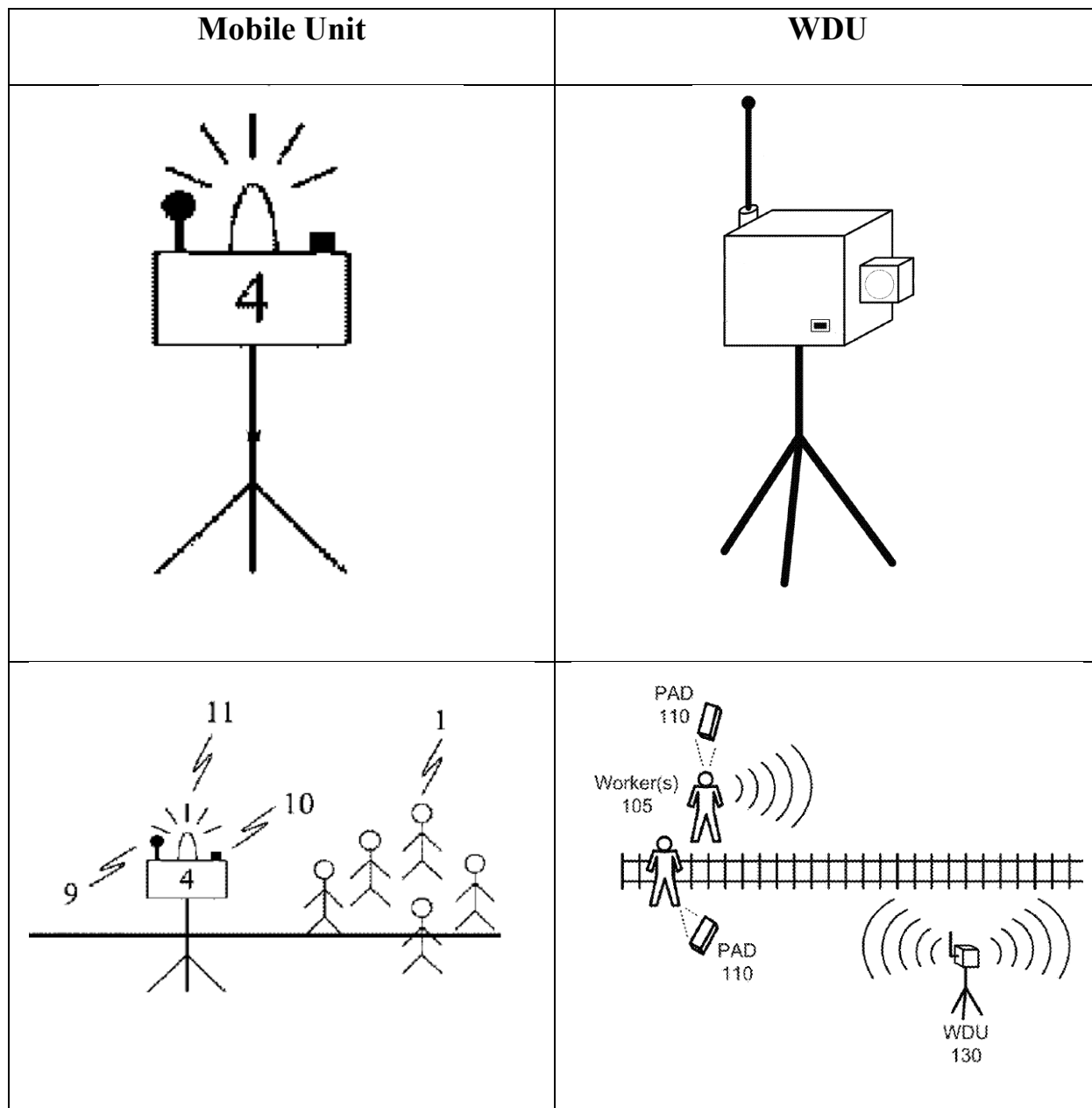
a. 20[pre]: “A system for protecting workers near railroad tracks, comprising:”

See Claim 1[pre], *supra* §VII.A.4. Braasch-Decl., ¶¶166-167.

b. 20[A]: “one or more UWB radios at pre-determined locations along the railroad tracks;”

As discussed in connection with Claim 1[E] and Claim 12[A], Meyer discloses “wayside units” located on/near railroad tracks. Meyer does not expressly disclose that its “mobile unit” is a “*UWB radio.*” However, as discussed herein, POSAs would have been motivated to implement Grisham’s UWB radios as part of the stationary unit, mobile unit, and mobile transponders in Meyer. *See supra*, §VII.A.3. Braasch-Decl., ¶¶88-105, 173.

In particular, Meyer’s “mobile unit” is “set up in the proximity of the personnel,” and, therefore, placed in a “*pre-determined location*”—i.e., the location in which personnel are working. Meyer, ¶37; Braasch-Decl., ¶¶169-170. This interpretation of a “*pre-determined location*” is consistent with the ’709 patent, which, like Meyer, teaches that its WDU “may be attached to placement component (e.g., a tripod)” and may be “temporarily placed near the track...at or in advance of each end of a work zone.” EX1001, 3:59-66; Braasch-Decl., ¶¶169-170, 172-173. Meyer’s mobile unit and the patent’s WDU are depicted below:



Alternatively, to the extent a UWB radio at a “*pre-determined location*” must be placed in a fixed location, Grisham discloses such a placement and provides POSAs with reason to implement Meyer-Grisham using a UWB radio at a fixed location. Braasch-Decl., ¶¶171-172. Grisham’s impulse radio unit may be attached

to a “railroad pole” on or near the track. Grisham, 21:15-23. This, too, would be a “*pre-determined location*,” and it would have been obvious to POSAs that Meyer’s “mobile unit” could be attached to a railroad pole or to other similar wayside equipment. Braasch-Decl., ¶¶171-172. Placement of mobile units at fixed locations along the track would have been a beneficial implementation of Meyer-Grisham because certain areas of the track, such as intersections or other high-traffic areas, may present higher risk of collision. Braasch-Decl., ¶¶171-172; *see also* Cross, [049] (describing the placement of wayside devices at intersections).

c. 20[B]: “one or more worker UWB radios associated with one or more workers on or near the railroad tracks;”

Meyer-Grisham also discloses the use of UWB radios associated with one or more workers on or near the railroad tracks. Braasch-Decl., ¶¶174-175. Meyer teaches that it is “particularly advantageous” for its system to include transponders “arranged on or attached to the personnel to be warned.” Meyer, ¶¶23, 35, 41. This is consistent with Grisham’s system, which can include a “UWB-enabled device that is carried on or by a person,” such as a “watch, phone, helmet or computing device.” Grisham, 27:40-44.

Meyer does not expressly disclose that its “mobile transponder” is a “*UWB radio*.” However, as discussed herein, POSAs would have been motivated to implement Grisham’s UWB radios as part of the stationary unit, mobile unit, and

mobile transponders in Meyer’s worker protection system. *See supra*, §VII.A.3; Braasch-Decl., ¶¶88-105, 174-175.

d. 20[C]: “a vehicle UWB radio associated with a vehicle on the railroad track;”

Meyer-Grisham further discloses UWB equipment that is “*associated with a vehicle on the railroad track*,” as discussed in connection with Claims 1[A]. *See supra* §VII.A.4; Braasch-Decl., ¶¶176-177.

Meyer does not expressly disclose that its “stationary unit” is a “*UWB radio*.” However, as discussed herein, POSAs would have been motivated to implement Grisham’s UWB radios as part of the stationary unit, mobile unit, and mobile transponders in Meyer’s worker protection system. *See supra*, §VII.A.3; Braasch-Decl., ¶¶88-105.

e. 20[D]: “wherein: the vehicle UWB radio is in communication with a processor,”

Meyer-Grisham’s stationary unit can be “connected to the internal electronics of the rail-bound vehicle” and can be “equipped to automatically slow down the rail-based vehicle” in response to receiving certain signals from the mobile unit. Meyer, ¶45. Meyer-Grisham’s impulse radios also include a “controller” that is able to “measure the propagation delay and determine the link distance between the receiving impulse radio unit 904 and the transmitting impulse radio unit 902.” *See, e.g.*, Grisham, 24:21-49 (describing controller within receiving impulse radio); *see*

also Grisham, 25:45-50 (teaching that train-based impulse radio unit may contain the “same equipment” as receiving impulse radio). Braasch-Decl., ¶¶88-105, 178. POSAs would have understood that the conventional manner of performing these operations would be to use a “*processor*” in communication with the vehicle unit. Braasch-Decl., ¶¶179-180.

- f. 20[E]: “wherein: the processor determines a position of the vehicle based on time of flight measurements obtained based on communication between the vehicle UWB radio and at least one of the one or more UWB radios that are located at pre-determined locations;”
- g. 20[F]: “the processor determines a location in which the one or more workers are working based on time of flight information obtained based on communication with at least one of the one or more worker UWB radios;”

Meyer’s stationary unit, mobile unit, and mobile transponders all communicate wireless signals. *See supra*, §VII.A.1. While Meyer does not specify the type of wireless communication between these units, POSAs would have been motivated to implement Grisham’s UWB radios as part of Meyer-Grisham as described herein. Braasch-Decl., ¶¶88-105.

Implementing Grisham’s UWB radios in this manner would allow these “[i]mpulse systems” to “measure distances to relatively fine resolution” as compared to other “[n]arrow band systems.” Grisham, 15:27-35. In particular, the impulse radio signals sent and received by Grisham’s UWB radios contain a “time position

measurement” that “can be used to measure propagation delay to determine link distance to a high degree of precision.” Grisham, 15:38-40. Using the propagation delay to determine link distance is the same as using “*time of flight measurements*” to determine this distance. Braasch-Decl., ¶¶181-193.

Grisham highlights that the distance between radios can be used to determine whether an approaching train creates a potentially dangerous situation. Grisham, 20:52-21:14; 22:41-23:3; 24:21-49; 25:16-45. This distance determination can occur in any impulse radio unit in the system, as each component includes the “same equipment.” Grisham, 25:45-50; Braasch-Decl., ¶¶181-193.

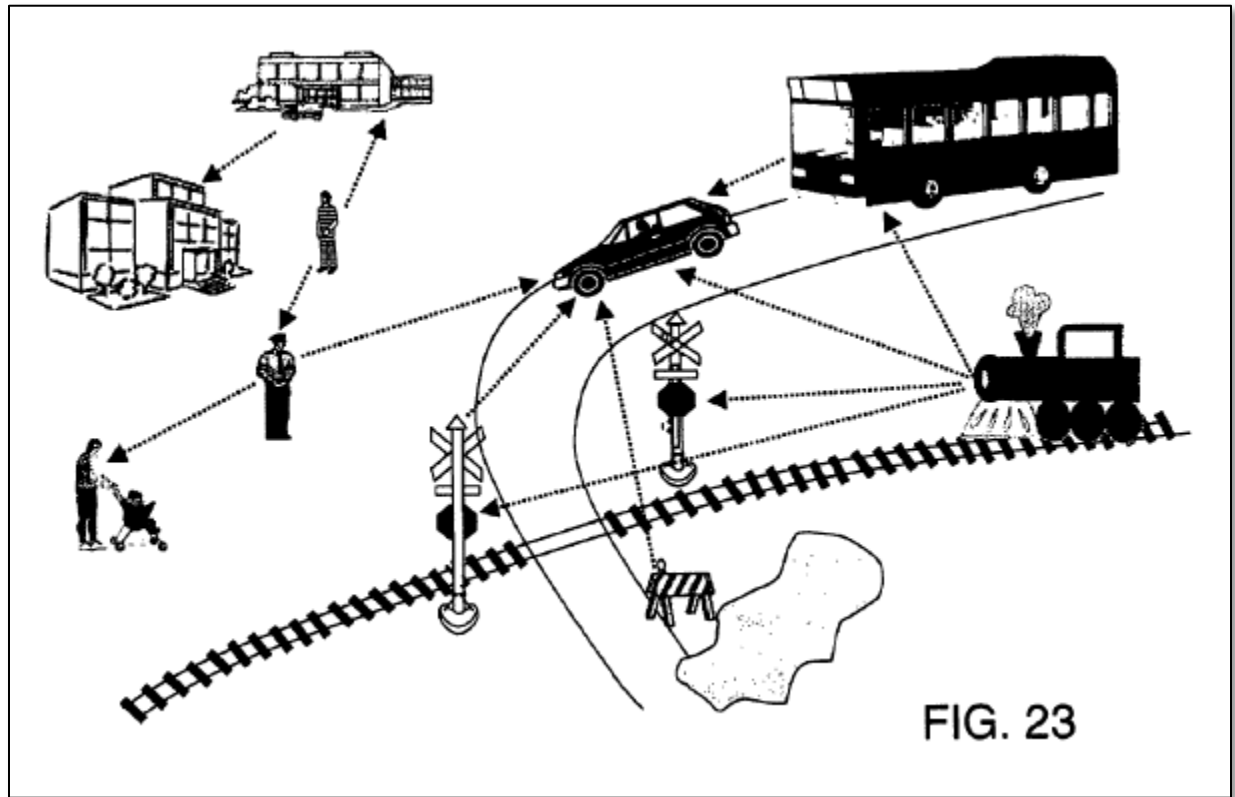
Grisham further highlights the adaptability of these UWB radios to different worker protection contexts by disclosing several different example configurations in which the UWB radios may operate, including one in which the system involves a “UWB-enabled device that is carried on or by a person,” such as a “watch, phone, helmet or computing device.” Grisham, 27:40-44.

In light of these teachings, Meyer-Grisham’s stationary unit would be able to determine the distance between the locomotive and any other impulse radio unit in the system. Braasch-Decl., ¶¶181-193. More specifically, configuring Meyer’s stationary unit to include Grisham’s UWB radios would enable the stationary unit to determine the distance between the stationary unit and the wayside mobile unit, as well as the distance between the stationary unit and the worker-carried mobile

transponders. Braasch-Decl., ¶¶181-193. Enabling the stationary unit to determine its position relative to both the wayside mobile unit and the worker-carried mobile transponders would provide the train operator with multiple sources of information that would be relevant to determining whether there is a risk of a collision and, if so, what steps need to be taken (e.g., braking the train) to avoid such a collision. Braasch-Decl., ¶¶181-193.

For example, there may be some scenarios in which it would be more beneficial for the train operator to know the location of the workers than the distance to the wayside unit, such as when a worker is working on a section of the track that is closer to the approaching train than the wayside unit. Braasch-Decl., ¶193. Conversely, there may be other scenarios in which it would be more beneficial for the train operator to know the distance to the wayside unit than the location of the workers, such as when workers are present on a section of the track that is further from the approaching train than the wayside unit, but in which the workers' equipment, a work vehicle, or some other worker-related obstacle is present near the wayside unit. *Id.* Because a variety of scenarios are likely to arise in a worker-protection environment, POSAs would have had a motivation to configure Meyer-Grisham's stationary unit to determine both the location of the train relative to the wayside, as well as the location of the workers. *Id.* Indeed, Grisham motivates such

a configuration by describing an embodiment in which a train communicates with a number of different objects on or near its tracks (below):



Thus, POSAs would have been motivated by Grisham’s disclosure to implement Meyer’s system to (a) include Grisham’s UWB radios, (b) use these radios to measure the propagation delay (or, time of flight) between the radios, and (c) determine the distance between UWB transceivers—specifically, between the stationary unit and the mobile unit/mobile transponders—according to the techniques described in Grisham. Braasch-Decl., ¶¶181-193.

The ’709 patent does not provide a special definition of “location” or “position.” Therefore, the Meyer-Grisham implementation described above

determines the “*position of the vehicle*” insofar as the distance between the train and a wayside unit constitutes the position of the train relative to that wayside unit. Braasch-Decl., ¶¶194-196. Similarly, Meyer-Grisham determines the “*location*” of the workers insofar as the distance between the train and any worker unit constitutes the location of the worker relative to the train . Braasch-Decl., ¶¶194-196.

However, even if the claim were to require that the system determine an absolute position (*e.g.*, XYZ coordinates) of the train and/or the workers, POSAs would have appreciated that each UWB radio would be capable of doing so. Braasch-Decl., ¶¶194-196. Specifically, because Meyer’s mobile unit includes a GNSS sensor, POSAs would have been able to use the GNSS-based location of the mobile unit as a reference point. Braasch-Decl., ¶¶194-196. POSAs would have understood, based on the disclosure of Grisham, that it would be possible to use this reference point, the UWB-based link distance determination, and a conventional direction-finding antenna to determine an absolute position of any other system component. Braasch-Decl., ¶¶194-196; Grisham, 15:27-56; EX1011, 11:20-12:23.

h. 20[G]: “and the processor generates an alert to an operator of the vehicle based on the determined location of the one or more workers;”

Meyer’s “stationary unit” can be “connected to a display unit 16 in the operator cab of the vehicle operator 17 to display to the latter that there is an imminent collision risk with personnel.” Meyer, ¶44.

As discussed above in connection with Claim 20[F], the stationary unit of Meyer-Grisham would, implementing the disclosure of Grisham, determine a distance between the train-mounted unit and the mobile transponders carried by workers. Braasch-Decl., ¶¶181-196. Thus, if this determination indicates that there is an “imminent collision risk with personnel,” the “display unit” would alert the operator to this risk, as described in Meyer. Braasch-Decl., ¶¶197-198. This operation is further motivated by Grisham, which discloses that its impulse radio units can be “incorporated within or coupled to an after-market display,” which can—in addition to generating an alarm—provide “information about the potentially dangerous situation,” such as the “distance” between the locomotive and a second object. Grisham, 22:24-45; 24:4-25; Braasch-Decl., ¶¶197-198.

- i. 20[H]: **“and at least one worker UWB radio communicates time of flight information between the at least one worker UWB radio and the vehicle UWB radio to a processor in communication with the at least one worker UWB radio,”**

In Meyer-Grisham, each of the “*UWB radios*” includes a “controller.” Grisham, 20:55-59, 22:44-48; 24:24-28. This controller can be used to “determine the distance that the first object (e.g., locomotive 1102) is from the second object.” *Id.* In particular, the controller can use the received UWB signal to “measure the propagation delay and determine the link distance between the receiving impulse radio unit 904 and the locomotive.” Grisham, 24:44-47. POSAs would have

understood that the conventional manner of performing these signal-processing operations would have involved the use of a processor. Braasch-Decl., ¶¶191-201.

Moreover, POSAs would have been motivated to configure the worker-carried mobile transponders in Meyer-Grisham to receive “time of flight information” and use that information to determine the distance between the worker and an oncoming train. Braasch-Decl., ¶¶202-204. Indeed, Grisham motivates this implementation, teaching that the display associated with an impulse radio is “capable of showing...information about the dangerous situation such as the direction, distance and/or speed of the oncoming locomotive.” Grisham, 22:41-44; 24:21-24; Braasch-Decl., ¶¶202-203. Additionally, although the stationary unit in Meyer-Grisham would have been capable of performing its own determination of this distance, as discussed in connection with Claim 20[F], POSAs would have understood that there may be circumstances in which the operator is unable to take responsive action (e.g., braking the train) to prevent a collision. Braasch-Decl., ¶¶202-203. In such a scenario—or in a scenario in which the stationary unit is malfunctioning—it would be critical for the workers themselves to be aware of the collision risk to enable them to take any necessary steps to reduce or eliminate the risk of harm. Braasch-Decl., ¶¶202-203. By replicating this distance-determination functionality across multiple components in Meyer-Grisham, POSAs would have

made the system more robust and more likely to prevent harmful incidents. Braasch-Decl., ¶¶202-203.

Thus, Meyer-Grisham would have communicated time of flight information to the “*worker UWB radio*” and, more specifically, to a processor in communication with the radio to determine the distance from an oncoming train.

- j. 20[I]: “wherein the processor generates alerts to a worker associated with the at least one worker UWB radio based on one or more of: a determined distance to the vehicle UWB radio, an estimated time of closest approach of the vehicle UWB radio to a location of the at least one worker UWB radio, and an approach speed of the vehicle UWB radio.”

Meyer’s mobile transponders can generate alerts to workers when it is determined that there is a risk of collision. Meyer, ¶41. Additionally, as discussed in connection with Claim 20[H], POSAs would have been motivated to configure the worker-carried mobile transponders to receive time of flight information and to use this information to determine the distance between the worker and an oncoming train. *See supra* §VII.A.3; Braasch-Decl., ¶¶199-204. Specifically, in Meyer-Grisham, these mobile transponders would be UWB radios capable of using the “propagation delay” of a UWB signal received from another UWB radio (e.g., the train-mounted radio) to determine the distance between the two radios. Braasch-Decl., ¶204. If this determination indicated a risk of collision, the mobile transponder

would be able to generate an alert to workers, as disclosed in Meyer. Meyer, ¶¶40-41; Braasch-Decl., ¶204.

Additionally, Grisham motivates configuring the mobile transponders of Meyer-Grisham to use alert-triggering thresholds that are related to the determined distance between the sending/receiving UWB radios. Braasch-Decl., ¶204. For example, Grisham discloses that an alert can be generated by a receiving UWB radio when the distance between radios falls below a “predetermined distance.” *See* Grisham, 2:35-41, Claim 2.

Thus, Meyer-Grisham would have included mobile transponders that themselves generate alerts to workers (as disclosed in Meyer) based on a determination of distance between the mobile transponders and the stationary unit (as disclosed in Grisham). Braasch-Decl., ¶¶204-205.

B. Ground 2: Claims 1-4, 6-12, and 17-19 Would Have Been Obvious over Cross in view of Grisham

1. Overview of Cross²

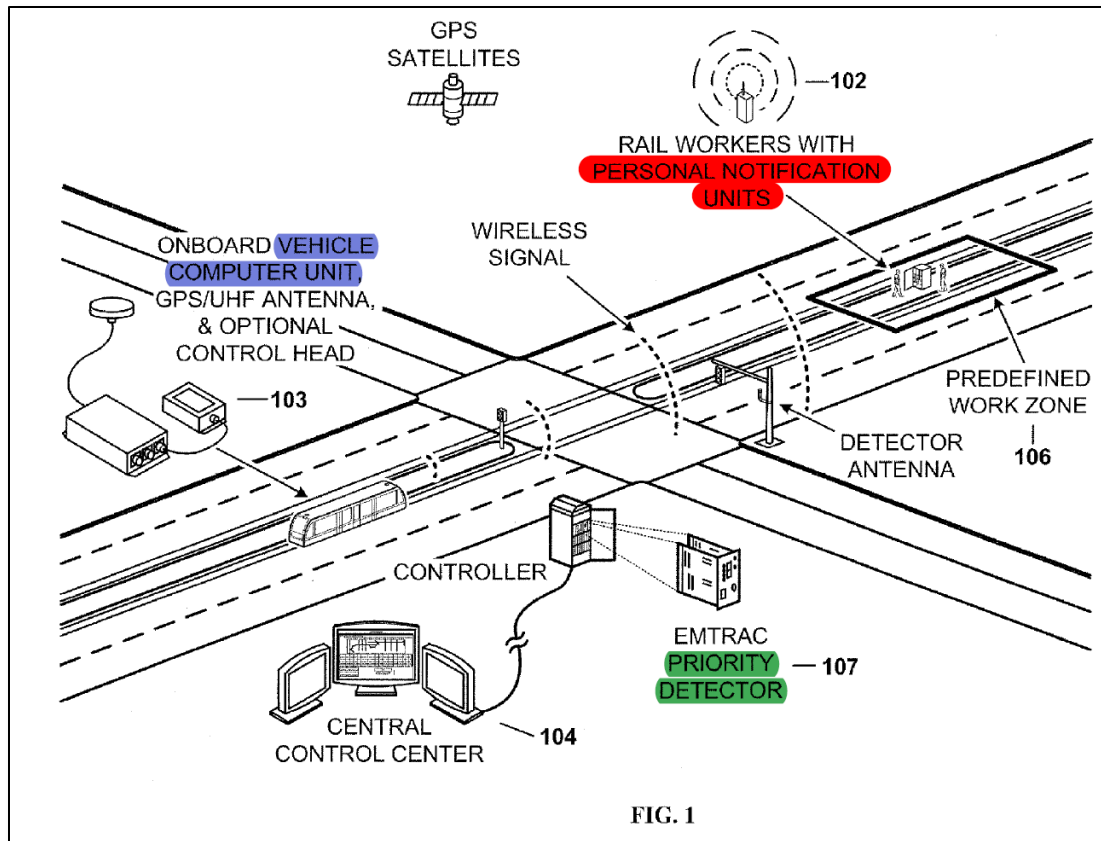
Like the '709 patent, Cross discloses “a safety notification system” in which workers are warned of approaching trains and train-operators are warned of nearby

² Unless otherwise noted, citations in Section VII.B.1 are to Cross.

workers. Cross, Abstract, [001]-Summary³, [026]. Cross’s system relies on three companion devices: (1) “worker equipment” called a “personal notification unit (PNU)”, (2) “mass transit equipment unit” called a “vehicle computer unit (VCU),” and (3) “wayside devices” called “priority detectors.” Cross, [029], [049], FIG. 1 (elements 102, 103, and 107); Braasch-Decl., ¶¶208-210. In Cross, the PNUs are configured to receive “vehicle location information” from a VCU or a wayside device and, based on the received information, “determine whether a warning signal needs to be transmitted” and, if so, “emit a warning sound upon receiving the warning signal.” Cross, [019]; Braasch-Decl., ¶¶211-212.

Figure 1 depicts an exemplary system with all three components:

³ Cross’s “Background” (pp. 1-2) and “Summary of the Invention” (pp. 3-7) each include paragraphs [001]-[005]. To avoid confusion, Petitioners have appended either “Background” or “Summary” to paragraph [001]-[005] citations, e.g., [001]-Background or [001]-Summary.



The PNU is “a simple hardware device” that attaches to a worker using “a clip.” Cross, [044], FIG. 2. The PNU’s computer has “four main functions”: (1) “transmit[ing]...location data of the worker”; (2) “receiv[ing] communications and information” from other devices (e.g., VCUs and priority detectors); (3) “identify[ing] alert mode conditions”; and (4) “transmit[ing] audible, movement or visual warning to a worker.” Cross, [043]. When in “alert mode,” the PNU “send[s] out an alert” to the worker. Cross, [044]; Braasch-Decl. ¶¶214, 217.

The VCU is a permanently-installed or mobile unit that is placed inside a train. Cross, [038]. Like the PNU, the VCU receives information (e.g., alert signals) from

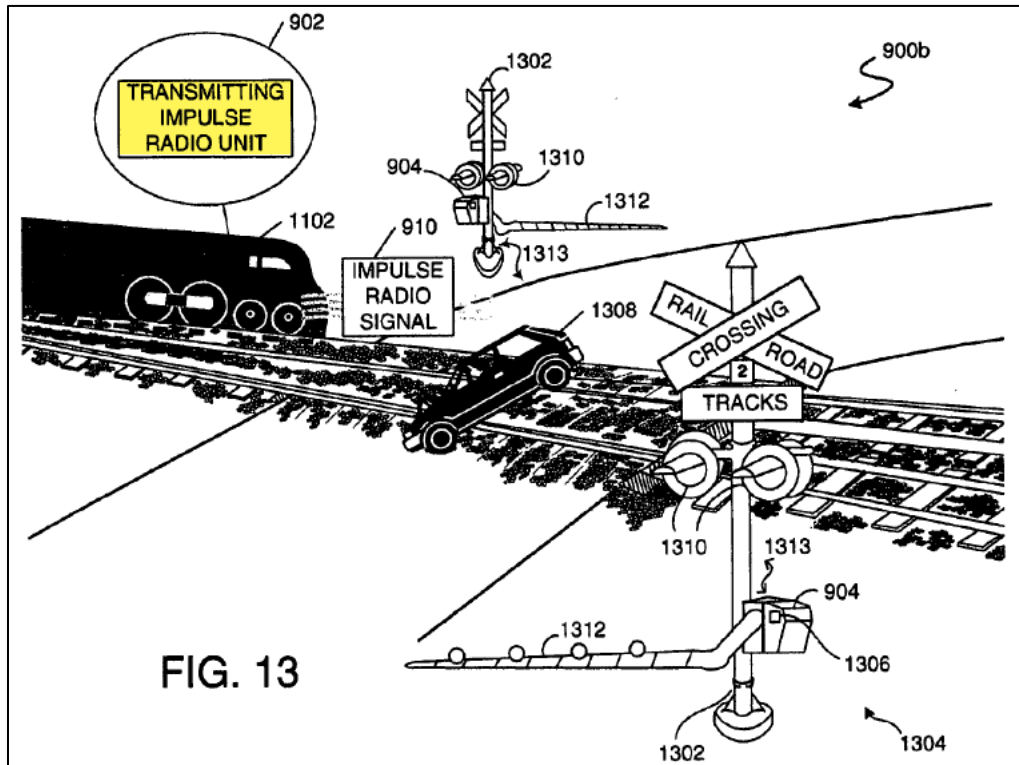
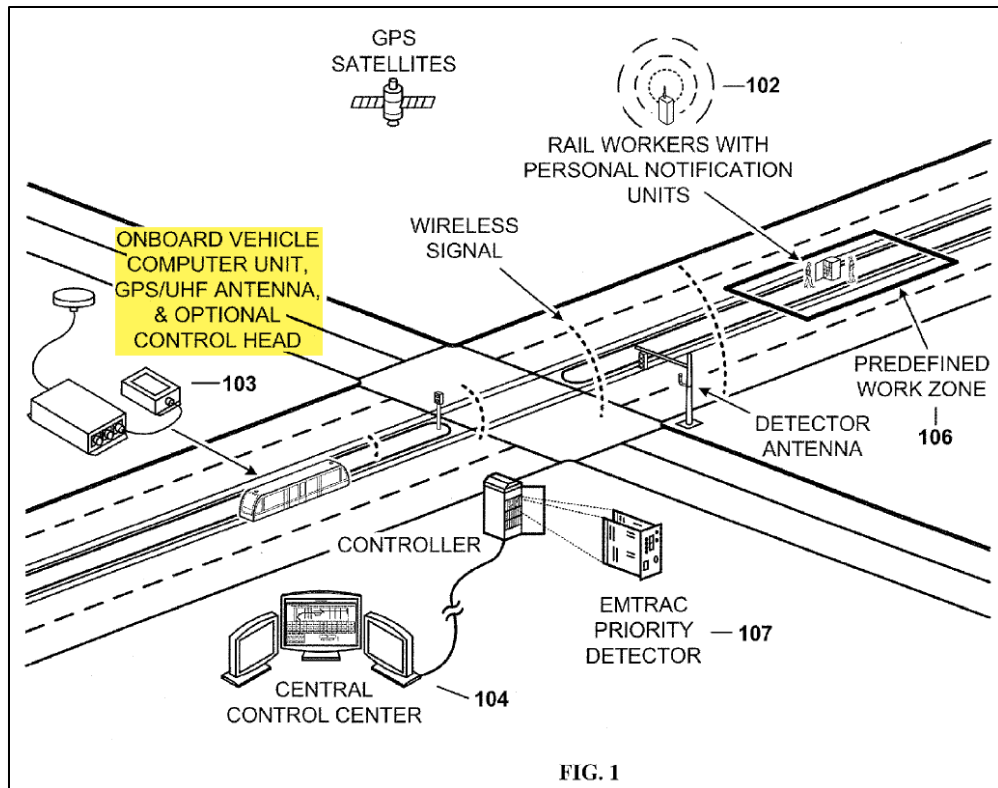
other devices in the system (e.g., PNUs), and also transmits its own “automatic vehicle location (AVL) packets” to those other devices. Cross, [036]-[038]. The VCU also includes “real-time monitoring and display of worker activity and locations on a user interface,” like a “tablet computer.” Cross, [039]; Braasch-Decl., ¶¶215-216.

The wayside priority detectors are devices located at various points along the train’s route; they operate as intermediaries that receive wireless signals from and forward wireless signals to other devices in the system (e.g., PNUs, VCUs). Cross, [048]; Braasch-Decl., ¶218.

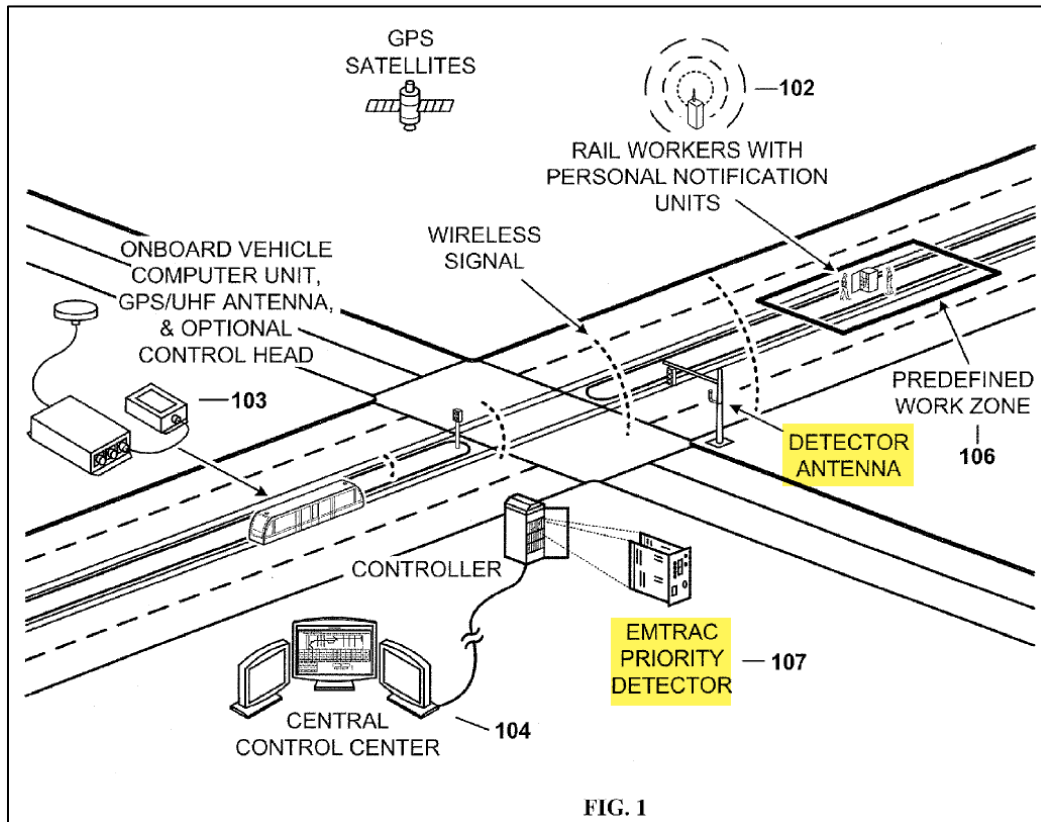
2. Cross-Grisham

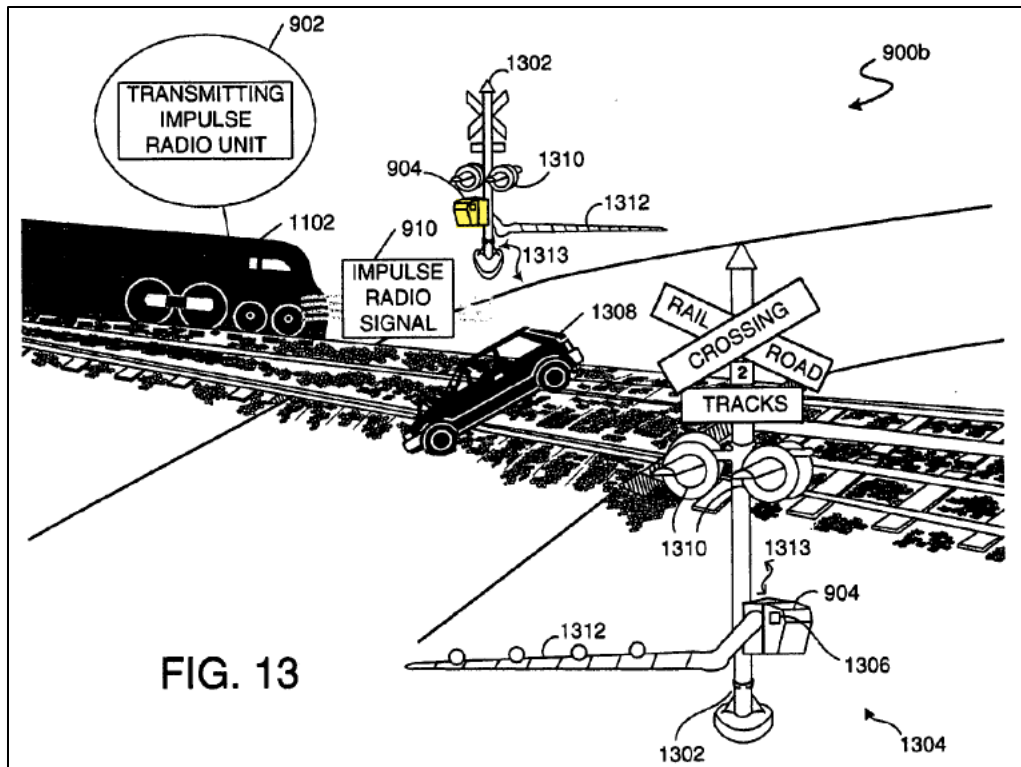
POSAs would have had reason to use Grisham’s UWB-based devices to provide the wireless communication functionality of the VCU, PNU, and priority detectors in Cross’s worker protection system. Braasch-Decl., ¶¶219-237.

The systems disclosed in Cross and Grisham are configured and operate in similar manners. Both systems involve a radio communication device attached to a train. *Compare* Cross, [029], [035] *with* Grisham, 20:59-63. These train-based devices are highlighted below:

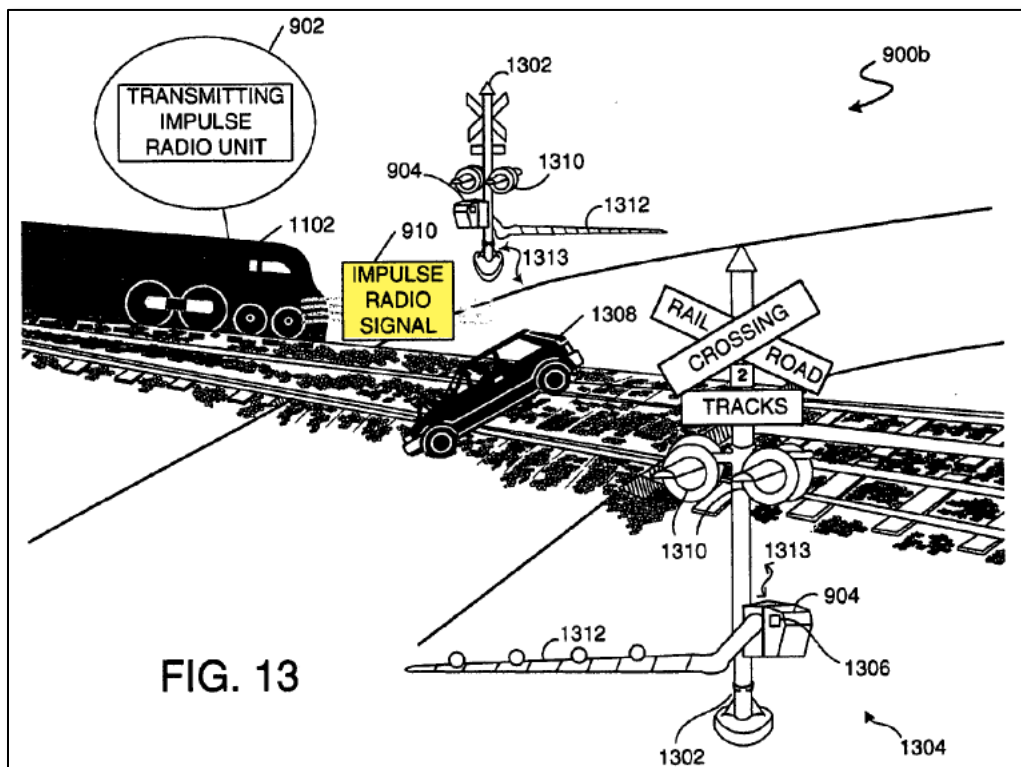
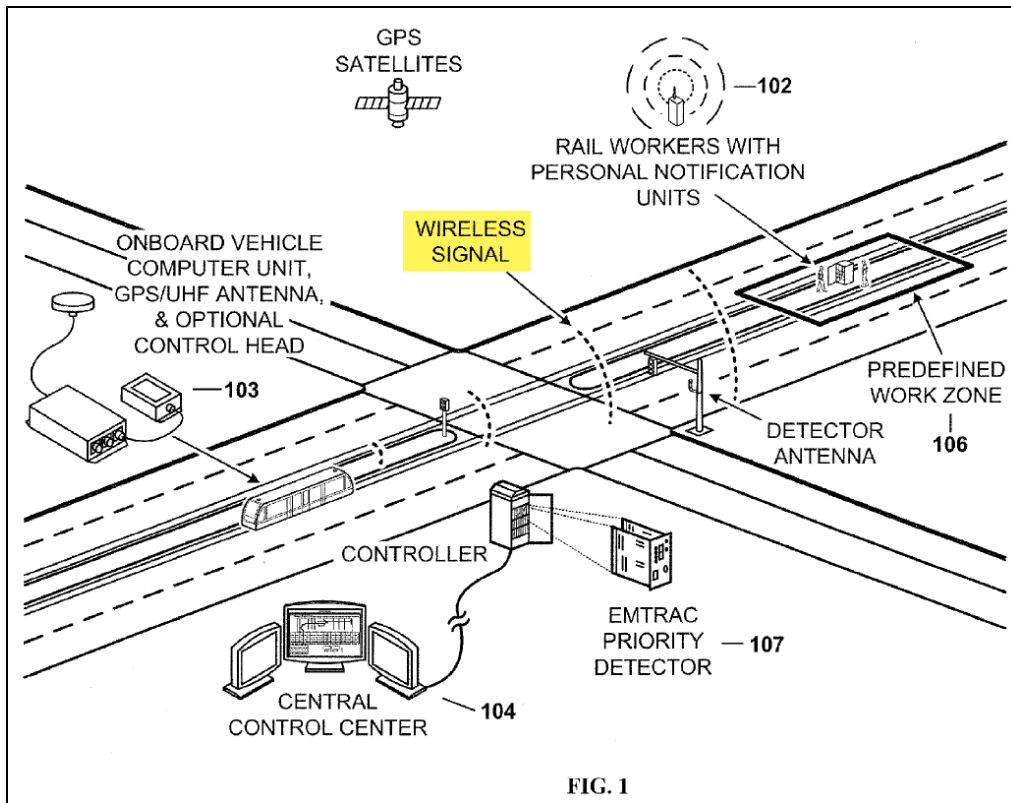


In both systems, this train-based device sends and receives signals to/from other devices, including devices that are placed on or near the track on which the train is traveling. *Compare* Cross, [034], [041] *with* Grisham, 21:18-35. These devices are highlighted in the figures below:

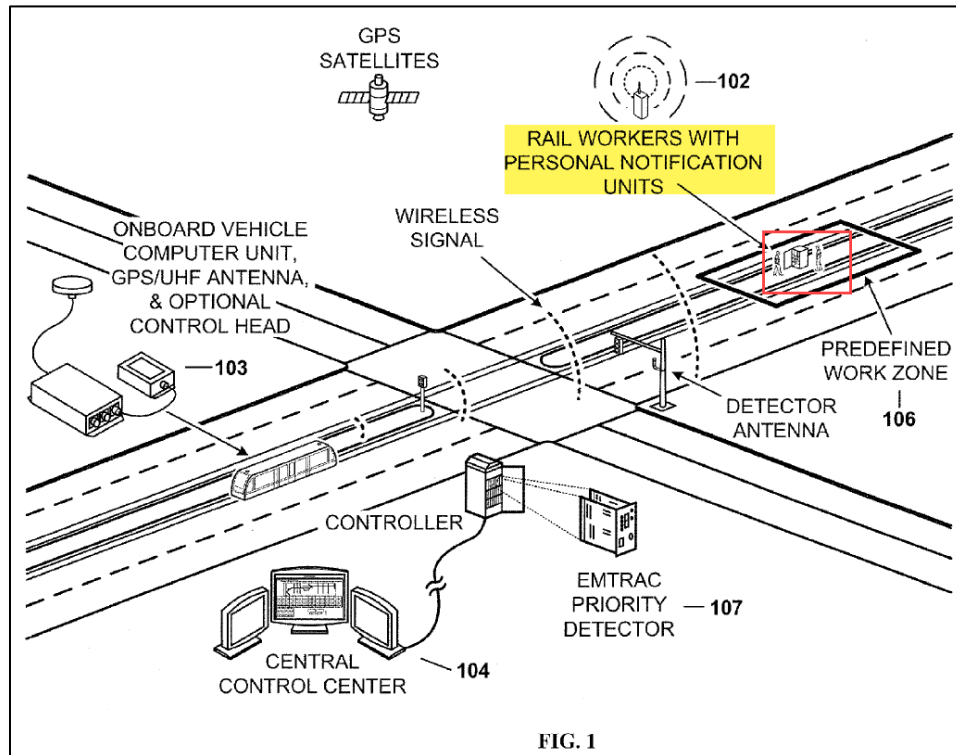


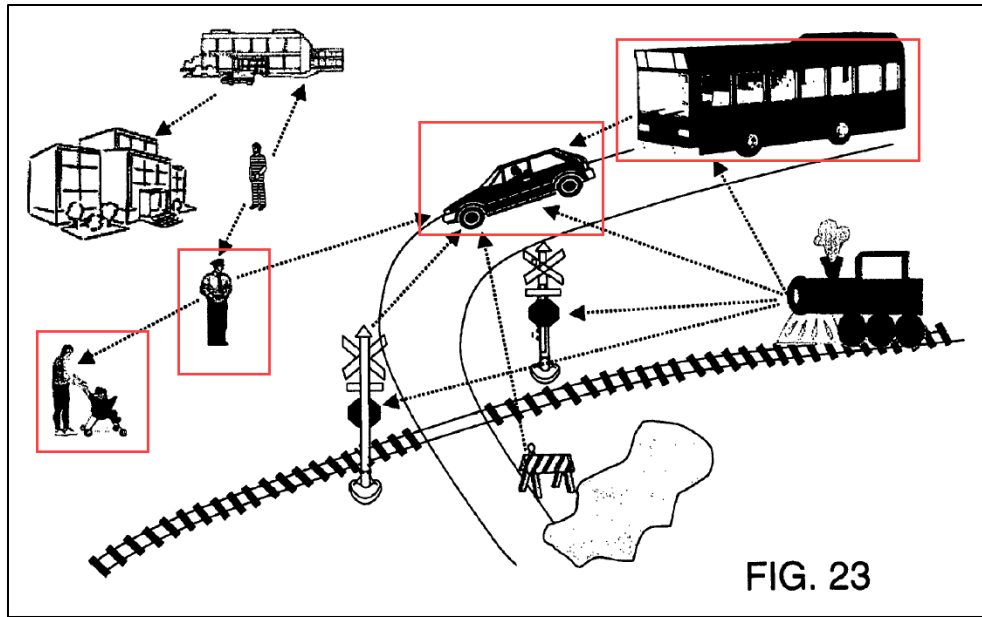


In both systems, these signals are used to determine that a train is approaching an area of the track where another object or person is located, such as another train, a vehicle, or a work crew. *Compare* Cross, [030], [036] *with* Grisham, 21:36-52. These signals are highlighted below:



When these signals indicate that there is a risk of collision, both systems trigger an alert/alarm to the object/individual at risk of collision and/or to the operator of the train. *Compare* Cross, [030], [044] *with* Grisham, 21:36-52; 24:4-20. These persons/vehicles are highlighted in the figures below:





POSAs would have had reason to combine Cross and Grisham such that Cross's system used Grisham's UWB-radios because both references are in the same field, address similar problems, and the combination would be a simple substitution of one known element (Cross's UHF-based wireless technology) for another (Grisham's UWB-based wireless technology) to obtain predictable results (a worker-safety system using wireless communication). Braasch-Decl., ¶¶219-224.

Furthermore, as discussed above in connection with the Meyer-Grisham combination, Grisham discloses that the signals exchanged in its system are UWB signals, which can be used to communicate information/data and to determine the distance between objects. *See supra*, §§VII.A.1-3. POSAs would have been motivated to implement Cross's "safety notification system" using the UWB impulse radios described in Grisham in place of the UHF radios described in Cross

to send and receive UWB signals to communicate information between devices in the system. Braasch-Decl., ¶¶225-233.

POSAs would have had a reasonable expectation of success in making this combination, as Cross’s components already “consistently send[] and receiv[e] location-based packaged data” using a “receiver” and a “transmitter.” Cross, [030]-[031]; Braasch-Decl., ¶¶223-233. Utilizing Grisham’s UWB radios to transmit this, and other, information would have been using a known technique (transmission of UWB signals using UWB radios) to improve similar devices (units sending/receiving location-based data) in the same way (by sending/receiving information used to determine whether to enter an alert mode). *KSR*, 550 U.S. at 417; Braasch-Decl., ¶¶223-233.

The implementation of Grisham’s UWB radios in Cross’s system would have yielded predictable benefits and would have been a straightforward implementation of UWB radio technology for the same reasons as discussed in connection with the Meyer-Grisham combination. *See supra*, §VII.A.3.

3. Independent Claim 1

a. 1[pre]: “A system for worker protection, the system comprises:”

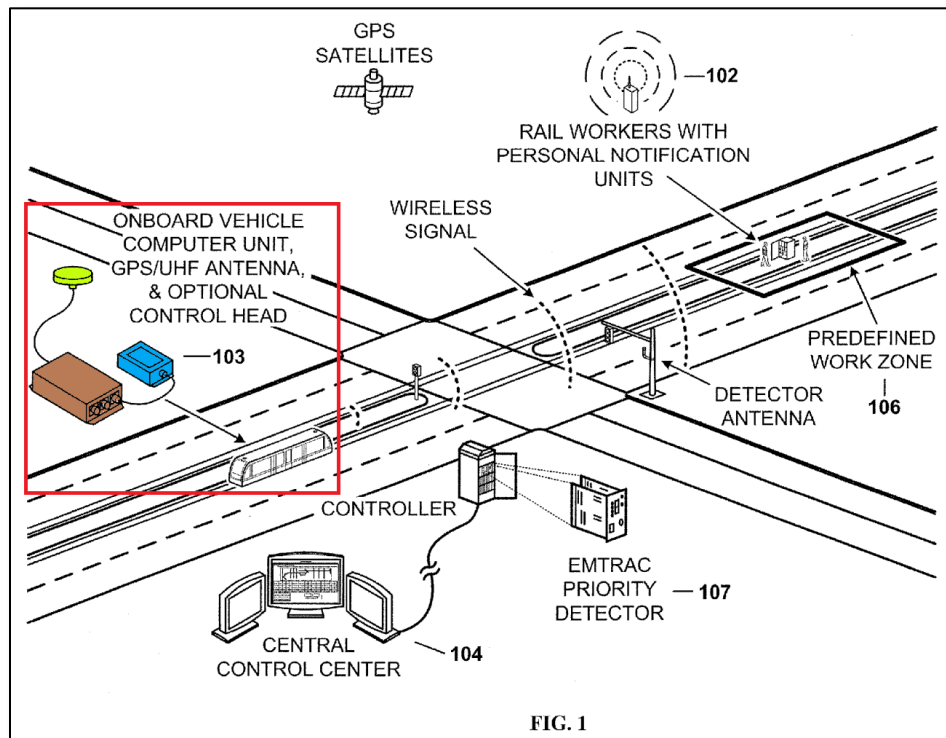
Cross discloses “a safety notification system” for protecting “maintenance workers.” Cross, [001]-Summary; *see also* Cross, [002]-Background, [046], [050]; Braasch-Decl., ¶¶238-239.

b. 1[A]: “a train-mounted unit for use on a train”

Cross’s system includes a “vehicle computer unit (VCU)” that is an “onboard unit” installed “into [a] mass transit vehicle.” Cross, [029], [034]-[035]; Braasch-Decl., ¶240.

c. 1[B]: “wherein the train-mounted unit comprises: a communication component, comprising one or more antennas, configured to transmit and/or receive wireless signals”

As Figure 1 (below) illustrates, the VCU has an “Antenna.” The VCU also has a transmitter/receiver that, using the antenna, “produce” and “receiv[e],” respectively, radio signals, *i.e.*, wireless signals. Cross, [031], [033]. Braasch-Decl., ¶¶241-243.



When modified in view of Grisham, Cross's VCU would have retained an antenna but it would have been used to transmit/receive UWB-based signals, as Grisham's UWB radio similarly includes a "transmit antenna 624" that generates "propagating electromagnetic pulses," which form an "emitted signal." Grisham, 17:25-40; Braasch-Decl., ¶¶223-233.

d. 1[C]: "wherein the signals comprise ultra-wideband (UWB) signals"

Grisham describes several embodiments that "utilize impulse radio technology to effectively warn a person when there is a...locomotive in their vicinity." Grisham, 2:27-31. An "impulse radio" is interchangeable with other terminology, including "ultra-wideband system, or ultra-wideband communication systems." Grisham, 5:8-13. Indeed, Grisham teaches that "[i]n a preferred embodiment, the emitted signal is wide-band or ultrawide-band." Grisham, 17:34-35; Braasch-Decl., ¶¶244-246.

As previously discussed, POSAs would have been motivated to implement Grisham's UWB technology in Cross's system by using UWB-enabled devices (e.g., Grisham's "impulse radios") as the transmitting/receiving components of Cross's VCU, PNU, and wayside priority detectors. *See supra*, §VII.B.2.

- e. 1[D]: “and one or more circuits configured to process signals and data, and perform one or more applications or functions relating to operations of the train-mounted unit”**

The VCU includes a “computer,” which Cross broadly defines as “inclusive of all computational devices” including a “processor.” Cross, [031]-[032]; EX1001, 1:63-2:4 (defining “circuit” to include “processor”). The VCU’s computer processes “inputs received” from PNUs (i.e., signals conveying data) and performs various functions relating to the VCU’s operation including (i) “send[ing] safety signals to and receiv[ing] safety signals from PNUs” and/or (ii) “instruct[ing] the train to gradually slow down.” Cross, [036]-[037].

The VCU’s receiver is another “electronic circuit,” which performs “processing and converting [of] the [received] signal...into usable form” (Cross, [031]) for use in VCU functions like “track[ing] real-time vehicle location, transmit[ing] approaching vehicle-alerts,...alter[ing] vehicle function, and stor[ing] activity logs” (Cross, [34]). Braasch-Decl., ¶¶247-250.

- f. 1[E]: “and wherein the train-mounted unit is configured to operate cooperatively with one or more wayside units, configured for placement on or near a track traversed by the train, to provide alerts to one or more workers operating on or near the track, based on communication of the UWB signals with at least one of the one or more wayside units.”**

Cross-Grisham’s VCU operates cooperatively with wayside priority detectors. Braasch-Decl., ¶¶251-258. For example, the VCU sends “automatic vehicle

location (AVL) packets” to “other components of the network.” The AVL signal includes “location-based information about the vehicle (e.g., its velocity, acceleration, direction, route, bearing, etc.)”. Cross, [038]. After the VCU sends these signals, Cross’s wayside priority detectors “function as intermediaries..., receiving signals [communicated] from VCUs (103) and PNUs (102) and forwarding the real-time vehicle and worker activity and alert notifications...to...VCUs (103), or PNUs (102).” Cross, [049], [056], [061]. Thus, the VCU and priority detector operate cooperatively to transmit AVL packets from the VCU to PNU(s). Braasch-Decl., ¶¶251-258.

The transmission of AVL packets from the VCU to PNU(s) causes the PNU to provide alerts to workers on or near the track, as claimed. Braasch-Decl., ¶¶251-258. Cross’s worker PNU “receiv[es]” AVL signals containing information about the location of VCUs and, based on the signals, “can identify alert mode conditions” (Cross, [043]) and “go into alert mode” (Cross, [038]). *See also* Cross, [056]. If “an alert condition exists”, the PNU’s computer outputs “audio, movement and visual alert signals.” Cross, [043]; *see also* Cross, [056], [061].

In the Cross-Grisham combination, the VCUs, PNUs, and priority detectors described in Cross would utilize Grisham’s UWB radio technology to perform the transmitting/receiving functions described in Cross. *See supra*, §VII.B.2. This would include the “forwarding” of “real-time vehicle and worker activity and alert

notifications” from VCUs to PNUs. Thus, in this Cross-Grisham system, Cross’s priority detectors would be cooperating with the VCUs to provide alerts “*based on communication of the UWB signals*” from the VCU to the priority detector. Braasch-Decl., ¶¶251-258.

4. Dependent Claims 2-11

a. Claim 2: “The system of claim 1, wherein the train-mounted unit is configured to broadcast alert triggering signals.”

Cross-Grisham’s VCU includes a transmitter that “send[s] automatic vehicle location (AVL) packets to the other components of the networks, in particular to the plurality of PNUs (102) in the network.” Cross, [038]. *See also id.*, [034] (VCU’s “transmitter functions to transmit information and signals to a plurality of PNUs”), [035], [043]-[044]. The conventional technique for a single transmitting device to send wireless data packets simultaneously to a “plurality” of devices, including UWB devices, was to “broadcast” the data packets, *i.e.*, send the data packet to all devices in the network. Braasch-Decl., ¶¶259-260.

If Cross is not considered to disclose that its VCU “broadcasts” AVL packets, then POSAs would have recognized the benefit of implementing the VCU to broadcast its AVL packets so as to ensure that all companion devices within range of the VCU’s transmitter received the AVL packets. Braasch-Decl., ¶¶260-263.

“[A]n alert mode is triggered by” PNUs based on received AVL packets, which are processed by PNUs to determine a vehicle’s “route and bearing” and/or “location.” Cross, [030], [043] (explaining PNU “can identify alert mode conditions” based in part on “location data received from the plurality of VCUs”); [056]-[057], [043]. Thus, AVL packets broadcast by VCUs are alert-triggering signals, as claimed. Braasch-Decl., ¶¶259-263.

b. Claim 3: “The system of claim 1, wherein the train-mounted unit is configured to generate data relating to alerts and/or to other devices or objects in a path of the train, based on the communication of the UWB signals with at least one of the one or more wayside units.”

When a PNU identifies an alert mode condition exists based on the AVL packet received from an approaching vehicle via a UWB-based wireless communication, the PNU “transmits a special high alert packet into the network and [to] each of the components of the network to notify them of the alert situation.” Cross, [044]; *see also id.*, [056] (“This special alert mode packet notifies the other components of the system [] of the high risk event.”). The VCU is thus notified of the alert that its AVL packet triggered at the PNU. Braasch-Decl., ¶¶264-268.

Cross further discloses that, after sending a signal that triggers a PNU to issue an alert, the VCU computer generates data relating to the alert and/or other companion devices in the path of the vehicle. For example, the VCU computer “create[s] detailed logs and reports which *show worker location* and *alert histories*

along the route.” Cross, [039] (emphasis added). Additionally, when an alert mode is activated in the system, the VCU generates data to initiate “alert signals” that “notify...a vehicle operator...of a potentially dangerous interaction between an equipped worker and a vehicle within the grid.” Cross, [030], [052]; Braasch-Decl., ¶¶264-268.

c. Claim 4: “The system of claim 1, wherein the train-mounted unit is configured to generate feedback information for outputting to an operator of the train, based on the communication of the UWB signals with at least one of the one or more wayside units.”

The VCU generates and outputs feedback information to the operator based on its UWB communication with one or more wayside priority detectors. For example, the VCU outputs “detailed logs and reports which *show* worker location and alert histories along the route” and which are accessed by “administrators or other interested individuals,” e.g., the vehicle operator. Cross, [039]. Similarly, the VCU outputs “alert signals” that “notify” the vehicle operator of a dangerous situation—another form of “feedback” to the operator. Cross, [030], [052]; Braasch-Decl., ¶¶269-271. This feedback information is generated when the VCU receives a “special alert mode packet,” the generation of which is based at least in part on UWB communication between the VCU and the priority detectors. Braasch-Decl., ¶¶269-271.

d. Claim 6: “The system of claim 1, wherein the train-mounted unit is configured to log data relating to alerts triggered in response to movement of the train.”

The VCU’s computer is operable “to create detailed logs and reports which show...alert histories along the route.” Cross, [039], [034]. The alert histories document the alerts triggered in response to movement of the vehicle (e.g., when the vehicle approaches PNUs or enters a “warning zone”). Cross, [027], [034]-[036], [038], [051], [061], FIGS. 3-4; Braasch-Decl., ¶¶272-273.

e. Claim 7: “The system of claim 1, wherein the train-mounted unit comprises one or more input/output (I/O) components, for receiving input from an operator of the train and/or for providing output to the operator of the train.”

The VCU “allows for the real-time monitoring and display of worker activity and locations on a user interface.” Cross, [039]. The “user interface can be located in the vehicle” and can be a “tablet computer.” *Id.* A tablet computer was a known I/O device that included a touchscreen display. Braasch-Decl., ¶274; *see also* EX1001, 11:16-46 (exemplary I/O components include “display” with “touch screen”).

Through its user interface, the VCU receives inputs. For example, a train operator can “manually” instruct the VCU to issue an AVL packet into the network. Cross, [038]. Similarly, the VCU can “set up and adjust” how PNUs respond to alert

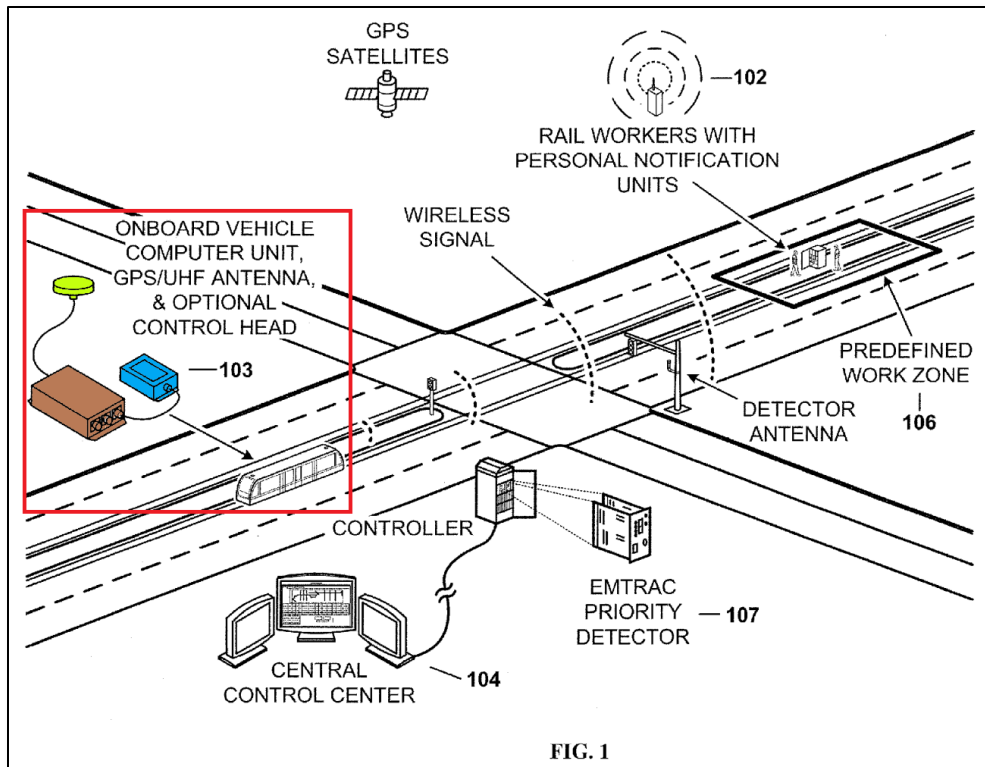
signals as well as “create[], modif[y], delete[] or otherwise control[]” warning areas. Cross, [055]; Braasch-Decl., ¶¶275-276.

Through its user interface, the VCU also produces outputs. For example, the user interface “displays the location” of VCUs and PNUs in the system “in real time.” Cross, [012]; *see also id.*, [039]. The VCU likewise issues “alerts to the operators of the vehicles...notifying them of the presence or lack of workers in the track area.” Cross, [052]; Braasch-Decl., ¶¶275-276.

POSAs would have known that these inputs/outputs would have been provided by/to the vehicle operator via the user interface. Braasch-Decl., ¶¶274-278.

f. Claim 8: “The system of claim 1, wherein the train-mounted unit comprises housing for enclosing components of the train-mounted unit.”

In Cross-Grisham, the VCU includes components like “a receiver, a transmitter, a computer and a navigation system.” Cross, [031]-[032]. As illustrated in FIG. 1 (below), VCU components are enclosed in housings, including a housing for a “mobile receiver that can be taken into and removed from the vehicle.” Cross, [035]; Braasch-Decl., ¶¶279-281.

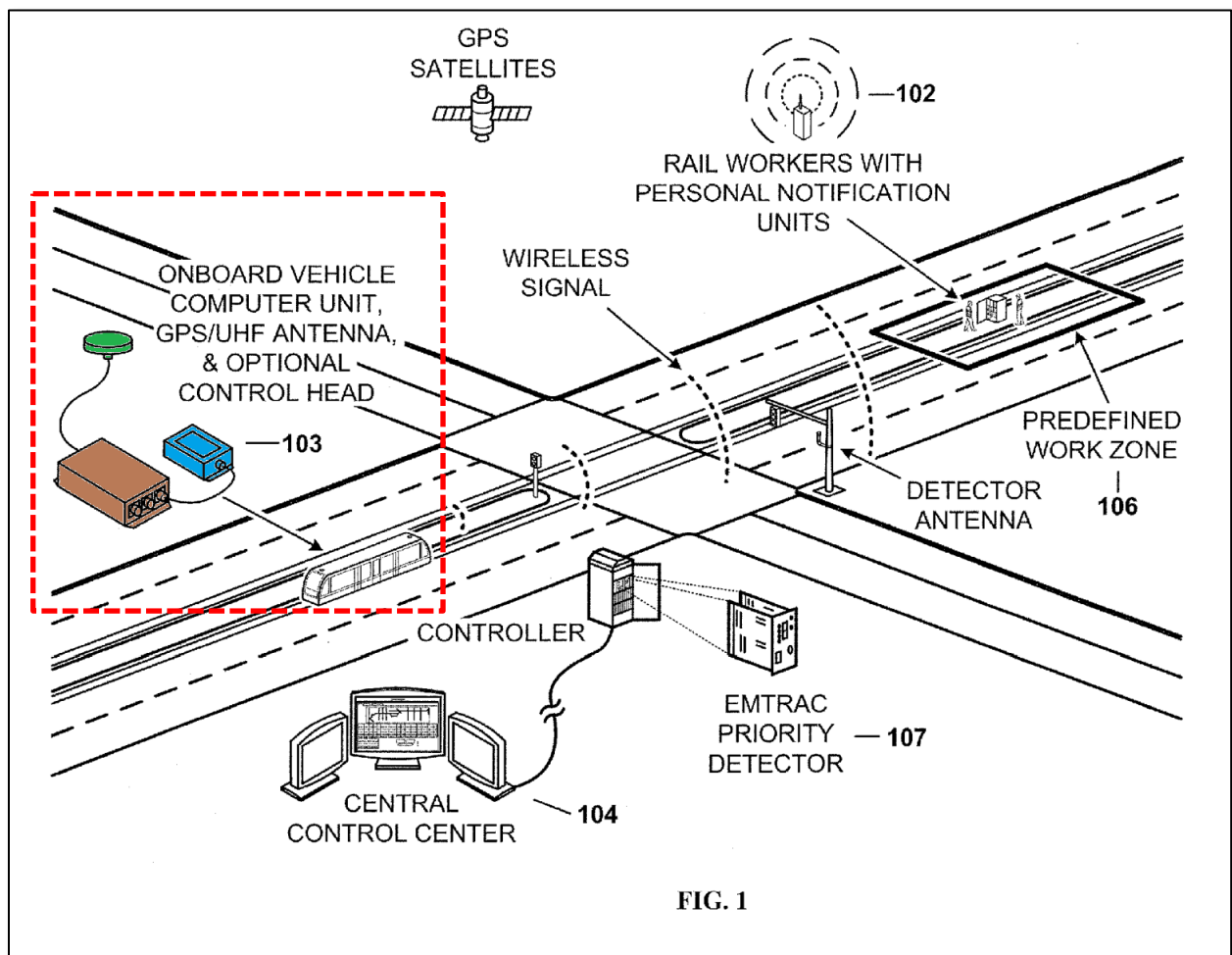


g. Claim 9: “The system of claim 1, wherein the train-mounted unit is configured, at least in part, as portable, detachable and moveable from the train.”

The VCU is configurable as a “temporar[ily]” installed “mobile receiver that can be taken into and removed from the vehicle,” and thus is portable, detachable and moveable from the vehicle, as claimed. Cross, [035], FIG. 1. If Cross is not considered to disclose that its mobile VCU is attachable to and “*detachable*” from the train, then POSAs had reason to implement such a design, *e.g.*, to ensure that its components were secure within the train. Braasch-Decl., ¶¶282-283. The user interface implemented as a tablet (Cross, [039]) also meets claim 9. *Id.*

- h. Claim 10: “The system of claim 1, wherein the train-mounted unit is arranged into a plurality of separate physical units that comprises at least a broadcast unit comprising at least the communication component, and wherein the broadcast unit is configured for deployment external to the train.”**

Cross’s Figure 1 (below) illustrates that the VCU comprises three separate physical units: (1) “onboard vehicle computer unit”; (2) antenna; and (3) “optional control head.”



The antenna (green above) is a broadcast unit that includes the VCU's communication component—i.e., the antenna. Although Cross does not explicitly state where each VCU's antenna is mounted on the vehicle, POSAs would have had reason to configure the VCU's antenna for attachment external to the vehicle, as claimed. Braasch-Decl., ¶¶284-289.

In general, there would have been only two locations to mount the antenna: inside or outside the vehicle. By 2015, it would have been conventional to locate an antenna(s) on top of a vehicle because mounting antennas externally would have improved line-of-sight thereby reducing interference. Braasch-Decl., ¶¶286-288 (citing EX1015, 1:30-42; EX1014, [0006]). Indeed, another prior-art application that Cross's first-named inventor filed discloses mounting a similar antenna for a similar VCU “*on top of* the [] vehicle.” EX1021, [0039], FIGS. 1-2. Accordingly, implementing Cross such that its antenna(s) are configured for attachment external to the VCU, as claimed, would have been obvious to POSAs. Braasch-Decl., ¶¶284-289.

- i. Claim 11: “The system of claim 10, wherein the plurality of separate physical units comprises an operator unit comprising at least the one or more I/O components, and wherein the operator unit is configured for use by an operator of the train.”**

As discussed above (Claim 7), each VCU includes a “user interface” (an operator unit, as claimed) comprising I/O components. The I/O components are

separate physical units—like a “tablet” and/or a “display” (Cross, [039])—as claimed. Braasch-Decl., ¶¶290-291.

These user interfaces are configured for use by the operator to receive inputs and/or provide outputs, as discussed above (Claim 7). Cross, [039]; Braasch-Decl., ¶¶274-278, 290-291.

5. Independent Claim 12

a. 12[pre]: “A system for worker protection, the system comprises:”

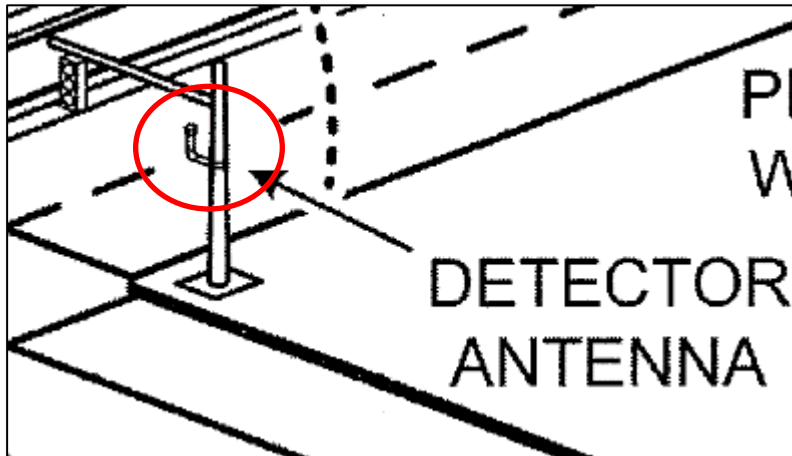
See Claim 1[pre], *supra* §VII.B.3. Braasch-Decl., ¶292.

b. 12[A]: “one or more wayside units configured for placement on or near a track;”

See Claim 1[E], *supra* §VII.B.3, discussing Cross’s “priority detectors,” which “are wayside devices” “located at various locations along a particular vehicle’s route.” Cross, [049], FIG. 1; Braasch-Decl., ¶293.

c. 12[B]: “wherein each wayside unit comprises: a communication component, comprising one or more antennas, configured to transmit and/or receive wireless signals,”

Cross’s priority detectors are “capable of receiving radio frequency (RF) signals and forwarding the received data through the network” to companion devices like PNUs or VCUs. Cross, [049]; Braasch-Decl., ¶¶294-297. To receive/transmit wireless signals, the priority detector includes an antenna, depicted in Figure 1 (below):



d. 12[C]: “wherein the signals comprise ultra-wideband (UWB) signals;”

See Claim 1[C], *supra* §VII.B.3, discussing Grisham’s disclosure of UWB signals and §VII.B.2, discussing the motivation to implement Grisham’s UWB signals in Cross’s worker-protection system. Braasch-Decl., ¶¶298-299.

e. 12[D]: “and one or more circuits configured to process signals and data, and perform one or more applications or functions relating to operations of the wayside detection unit;”

Cross’s priority detectors include receiver circuits operable to process received wireless signals and data, like “real-time vehicle and worker activity and alert notifications.” Cross, [049]. The units also include transmitter circuits to process signals and data for forwarding to PNUs and VCUs. Cross, [049]. *See also* Cross, [031] (“receivers...encompass an electronic circuit”). These receiving and transmitting functions are and relate to operations of the wayside priority detectors. Braasch-Decl., ¶300.

- f. **12[E]: “and wherein the one or more wayside units are configured to operate cooperatively with any train-mounted unit deployed on a train traversing the track, to provide alerts to one or more workers operating on or near the track, based on communication of the UWB signals between at least one of the one or more wayside units and the train-mounted unit.”**

See Claim 1[E], *supra* §VII.B.3. Braasch-Decl., ¶¶301-308.

6. Dependent Claims 17-19

- a. **Claim 17: “The system of claim 12, wherein at least one wayside unit is configured to forward alerts and/or alert related signals received from the train-mounted unit.”**

Cross’s priority detectors “function as intermediaries..., receiving signals [communicated] from VCUs (103) and PNU (102) and **forwarding** the real-time vehicle and worker activity and alert notifications [and ETA information (i.e., the alerts and alert-related signals discussed above §VII.B.1)]...to...VCUs (103), or PNU (102),” which are nearby vehicle and personal alert devices, respectively, as claimed. Cross, [049] (emphasis added); Braasch-Decl., ¶309.

- b. **Claim 18: “The system of claim 12, wherein at least one wayside unit is configured to log data relating to alerts triggered in response to broadcasted alert related signals.”**

Cross teaches “stor[ing] detailed activity and alert logs” in its PNU (Cross, [041]) and in its VCUs (Cross, [034]). POSAs would have had reason to include

similar functionality in Cross’s wayside priority detectors to log data regarding the alerts that the priority detector broadcasts. Braasch-Decl., ¶¶310-315.

POSAs would have recognized the benefits to giving the priority detectors the same ability to store logs that the PNUs and VCUs already had in the Cross system. Braasch-Decl., ¶¶311-315. Such logs “allow[] for administrators to evaluate trends and identify reoccurring safety issues and locations in the mass transit system as a whole.” Cross, [063]; *see also*; Braasch-Decl., ¶311 (citing EX1016, 5:19-25; EX1018, [0039]).

Additionally, if the VCU were to malfunction or otherwise fail to record the alert histories as described above, the additional logging of these alerts by the wayside unit would provide a back-up source for obtaining this information. Braasch-Decl., ¶¶312-313. The advantage of this back-up data logging may be even greater in the event that there is a collision involving the train, during which the VCU may be damaged or become otherwise inaccessible, leaving the data logged by the wayside unit as the only data accessible to investigators/administrators. *Id.*

The inclusion of data-logging functionality in Cross-Grisham’s priority detectors would have been particularly advantageous in light of Grisham’s disclosure of wayside units that are “capable of using a sensor . . . to sense the presence of a third object (e.g., locomotive 1102),” causing transmission of an alert-triggering signal by the wayside unit. Grisham, 23:12-16; Braasch-Decl., ¶313. As

discussed in greater detail below, POSAs would have had reason to incorporate this sensor-based technology in the Cross-Grisham wayside priority detectors. Braasch-Decl., ¶313. In this combination, POSAs would have had further reason to include data-logging capabilities in Cross-Grisham’s priority detectors so that the detectors could record data and/or alerts produced by the sensors. *Id.*

c. Claim 19: “The system of claim 12, wherein at least one wayside unit comprises one or more sensory components, for detecting, monitoring, and/or tracking trains, and wherein the at least one wayside unit configured to determine, based on sensory data obtained from the one or more sensors, when the train is approaching the wayside unit.”

Grisham discloses a “control box” that “is located at a monitoring location such as next to railroad tracks.” Grisham, 23:12-16. This trackside equipment is “capable of using a sensor 1560 (e.g., electromagnetic sensor, motion detector, percussion sensor) to sense the presence of a third object (e.g., locomotive 1102).” Grisham, 23:14-16. When the sensor detects “a dangerous situation such as the presence of a locomotive,” an impulse radio associated with the sensor can “transmit” a signal that would result in the triggering of a warning that the locomotive is approaching. *See* Grisham, 23:25-35.

POSAs would have been motivated to implement Grisham’s “sensor” in Cross-Grisham in association with the wayside priority detector. Braasch-Decl., ¶¶234-237. Although Cross-Grisham would rely on UWB communications to

determine that a train is approaching a wayside unit and to trigger alerts POSAs would have understood the benefits of having a secondary, fallback method of detecting approaching trains to protect against any risk of malfunction in the UWB communication equipment. Braasch-Decl., ¶¶234-237. Indeed, Grisham discloses the use of UWB transmission and non-UWB “sensor” components in combination. *See* Grisham, 23:4-35. Thus, POSAs would have been motivated, based on Grisham’s disclosure of a “sensor” to detect approaching trains, to implement a similar sensor in the “priority detector” of Cross-Grisham, such that the priority detector would include “*sensory components, for detecting, monitoring, and/or tracking trains.*” Braasch-Decl., ¶¶234-237, 316-318.

POSAs would have had a reasonable expectation of success in implementing this modification of Cross-Grisham, as the sensors of the type described in Grisham are conventional equipment and are small, low-powered, and highly adaptable devices that could be placed at any point on the train’s track. *Id.*

C. Ground 3: Claims 6, 8-9, and 17-18 Would Have Been Obvious over Meyer and Grisham in view of Cross

1. Meyer-Grisham-Cross

As discussed in connection with Ground 2, POSAs would have been motivated to combine Cross with Grisham to utilize Grisham’s UWB radio technology for the transmitting and receiving of the wireless signals described in Cross.

Additionally, POSAs would have been motivated to modify Meyer-Grisham to include beneficial aspects of Cross’s VCU, PNU, and wayside priority detectors. Braasch-Decl., ¶¶319-323.

First, POSAs would have been motivated to implement Cross’s data-generating and data-logging operations in Meyer-Grisham. Cross, [028], [033], [039], [063]; Braasch-Decl., ¶321. POSAs would have been motivated to implement these data-logging operations because POSAs would have understood the benefits of keeping track of when, where, and why alerts were triggered during operation of the system. *Id.* Such operations would allow system administrators to determine, e.g., whether train operators and/or workers responded appropriately in response to safety alerts. *Id.* And, in the event of a collision, the data logs would provide insight into whether/how the collision could have been prevented. *Id.*

Second, POSAs would have been motivated to implement Meyer-Grisham using the physical configuration of Cross’s VCU. Braasch-Decl., ¶322. In particular, POSAs would have been motivated to enclose Meyer’s stationary unit within a housing and to configure this housing as portable, detachable, and movable from the train, as described in Cross. *Id.* As Cross explains, configuring the stationary unit in this way would allow the unit to be “taken into and removed from the vehicle,” which POSAs would understand to be a beneficial feature allowing the stationary

unit to be more easily repaired, replaced, or moved between trains. Cross, [035]; Braasch-Decl., ¶322.

Third, POSAs would have been motivated to configure Meyer-Grisham's mobile units to forward received data to other components within the system. Braasch-Decl., ¶323. Cross's wayside priority detectors are "capable of receiving radio frequency (RF) signals and forwarding the received data through the network" to other devices in the system, like Cross's PNUs or VCU's. Cross, [049]. Because the wayside mobile units of Meyer-Grisham already have the capability to send and receive data, it would have been a routine combination of known elements to configure these mobile units to forward data received from one device (e.g., the stationary unit) to other devices in the system (e.g., the worker-carried mobile transponders), thus acting as an "intermediary" between the train's stationary unit and the worker transponders, in the very manner described in Cross. Braasch-Decl., ¶323; Cross, [049]. In particular, POSAs would have utilized Cross's data-forwarding techniques in Meyer-Grisham-Cross's mobile unit to forward an "acknowledgement signal" sent by the worker transponders to the train's stationary unit. Braasch-Decl., ¶324. In Meyer, the mobile unit receives these "acknowledgement signals," generates a "collision status signal" that is a "function of the determined number of [acknowledgements] received," and sends the status signal to the stationary unit. Meyer, ¶¶24-27. However, POSAs would have

appreciated that configuring the mobile unit to operate as an “intermediary” and “forward” these acknowledgement signals directly to the stationary unit would have been more efficient both in terms of data processing required at the mobile unit and in terms of total time taken for the signal to travel from worker to train. Braasch-Decl., ¶324.

a. Claim 6: “The system of claim 1, wherein the train-mounted unit is configured to log data relating to alerts triggered in response to movement of the train.”

Cross’s “VCU” is “equipped with monitor software which allows for the real-time monitoring and display of worker activity and locations on a user interface.” Cross, [039]. The VCU “will have the capability to create detailed logs and reports which show worker location and alert histories along the route. These logs and reports may be generated and automatically e-mailed to administrators or other interested individuals.” Cross, [039]. Meyer-Grisham-Cross would implement this data-logging functionality within the stationary unit described in Meyer to create detailed logs of “alert histories,” which would include data relating to alerts triggered by the system. Braasch-Decl., ¶¶326-327.

Moreover, Cross motivates this implementation in Meyer-Grisham-Cross, explaining that this “reporting and log creation function” “allows for administrators to evaluate trends and identify reoccurring safety issues and locations in the mass transit system as a whole.” Cross, [063]; Braasch-Decl., ¶¶326-327.

- b. Claim 18: “The system of claim 12, wherein at least one wayside unit is configured to log data relating to alerts triggered in response to broadcasted alert related signals.”**

POSAs would have been further motivated to implement Cross’s data-logging functionality within the mobile units of Meyer-Grisham f. Braasch-Decl., ¶328. For instance, if the stationary unit of the system were to malfunction or otherwise fail to record the alert histories as described above, the additional logging of these alerts by the wayside mobile unit would provide a back-up source for obtaining this information, particularly in a scenario in which the alert was triggered by the wayside unit in response to detecting, via a sensory component, an approaching train. *Id.*

- c. Claim 8: “The system of claim 1, wherein the train-mounted unit comprises housing for enclosing components of the train-mounted unit.”**

- d. Claim 9: “The system of claim 1, wherein the train-mounted unit is configured, at least in part, as portable, detachable and moveable from the train.”**

In Meyer-Grisham-Cross, the “[i]nstallation of the VCU” may be “temporary, through a mobile receiver that can be taken into and removed from the vehicle.” Cross, [035].

POSAs would have been motivated to utilize the construction of the VCU described in Cross for Meyer-Grisham’s train-mounted unit. Braasch-Decl., ¶¶329-330. Using a portable, detachable, and movable train-mounted unit would provide

greater flexibility, as it would allow the train-mounted unit to be more easily moved between (and attached to) trains and/or within a train. Braasch-Decl., ¶¶329-330. And, if Cross is not considered to disclose that its mobile VCU is attachable to and “*detachable*” from the train, then POSAs had reason to implement such a design, *e.g.*, to ensure that its components were secure within the train. Braasch-Decl., ¶330.

e. Claim 17: “The system of claim 12, wherein at least one wayside unit is configured to forward alerts and/or alert related signals received from the train-mounted unit.”

When Meyer’s mobile unit receives a signal from the stationary unit and detects a collision risk, the mobile unit “transmit[s] a near-range warning signal 14 that can be received by [] mobile transponders” that are carried by workers. Meyer, ¶41. POSAs would have been motivated to configure these mobile units to include the capability of Cross’s “wayside devices,” which “receiv[e] radio frequency (RF) signals and forward[] the received data through the network to...a plurality of PNUs[.]” Cross, [049]; Braasch-Decl., ¶¶331-332. This functionality allows these wayside devices to “function as intermediaries in the overall system (101), receiving signals from ...VCUs (103) and PNUs (102) and forwarding the real-time vehicle and worker activity and alert notifications received in these signals to the...VCUs (103), or PNUs (102).” *Id.* POSAs would have understood that including this functionality in Meyer-Grisham-Cross would have improved Meyer’s existing ability to communicate worker acknowledgement signals to a train operator,

removing the unnecessary processing of the worker acknowledgement signals at the mobile unit and instead functioning as an “intermediary” and forwarding the acknowledgment signal to the train’s stationary unit. Braasch-Decl., ¶¶331-332.

VIII. THERE IS NO BASIS FOR DISCRETIONARY DENIAL

A. Section 314(a)

“[T]he PTAB will not deny institution based on *Fintiv*’ if there is compelling evidence of unpatentability,” which this Petition provides. Director’s Interim Procedure for Discretionary Denials (June 21, 2022) (“Interim Procedure”). That should conclude the *Fintiv* analysis here. Regardless, the *Fintiv* factors also weigh against discretionary denial.

1. Potential for Stay

Without “specific evidence” how the court will rule regarding a stay, this factor is neutral. *Sand Revolution II v. Continental Intermodal Group–Trucking*, IPR2019-01393, Paper 24, 7 (June 16, 2020) (informative).

2. Timing of Trial

Petitioners filed this Petition before the district court has ruled on Petitioners’ motions to dismiss and before any procedural schedule has been set. EX1025 (docket). This factor thus weighs against discretionary denial. *Samsung Elecs. v. Netlist, Inc.*, IPR2022-00063, Paper 13, 8 (May 5, 2022).

3. Litigation Investment

Fact discovery has not begun in the district court litigation, and therefore Factor 3 weighs against denial because the parties have not invested significantly in invalidity issues. *Id.*

4. Overlap of Issues

Given its early stage, the validity issues in the litigation are unknown. However, Petitioners challenge all 20 claims of the '709 patent, whereas patent owner asserts only ten claims in district court. EX1026, 71. A trial before the Board will thus address 10 claims that the district court will not address, which weighs against discretionary denial. *Markforged Inc. v. Continuous Composites, Inc.*, IPR2022-00679, Paper 7 at 32-33 (Oct. 25, 2022).

5. Whether Petitioner Is a Litigation Defendant

Although Petitioners are litigation defendants, the Board will reach a final decision before any district court trial thereby simplifying the litigations. *Samsung Elecs*, IPR2022-00063, Paper 13, 8.

6. Other Circumstances

The Petition's "strong showing on the merits" weighs against discretionary denial. Interim Procedure, 3-5.

B. Section 325(d)

Under *Advanced Bionics, LLC v. Med-El*, IPR2019-01469, Paper 6 (Feb. 13, 2020) (precedential), the Board considers whether the petition presents the same or substantially the same art/argument previously presented and, if so, whether it shows that the Office materially erred in its prior evaluation.

1. Step 1: The Petition Advances Art and Arguments Not Previously Considered

Though Grisham was cited in an IDS filed by patent owner during prosecution, it was never applied as a reference against any of the claims. The Board has “consistently held that a reference that was neither applied against the claims nor discussed by the Examiner does not weigh in favor of exercising discretionary denial under §325(d).” *Bowtech, Inc. v. MCP IP, LLC*, IPR2019-00382, Paper 12, 12 (PTAB Aug. 6, 2019).

Even if Grisham had been relied upon by the examiner to reject any of the challenged claims, the petition relies on Grisham only in combination with other references that were neither disclosed nor relied upon during prosecution. Accordingly, Step 1 is not satisfied. *SHDS v. Truinject*, IPR2020-00937, Paper 11, 8-12 (Nov. 17, 2020) (Step 1 not satisfied even though petition relied on art applied during prosecution because petition combined it with new art)

2. Step 2: The Office Erred Materially

If the Board finds Step 1 satisfied merely because Grisham was cited in an IDS during prosecution, discretionary denial is still unwarranted because the Office erred materially in its prior “evaluation.” Step 2 focuses on *Becton, Dickinson* factors (c), (e), and (f) (*Advanced Bionics*, 10), which all weigh against denial.

a. Factor (c): Grisham Was Not Evaluated

Although Grisham was cited in an IDS during prosecution, it was not used by the examiner as the basis for any rejection. The Board has “consistently held that a reference that was neither applied against the claims not discussed by the Examiner does not weigh in favor of exercising discretion under §325(d).” *Bowtech, Inc. v. MCP IP, LLC*, IPR2019-00382, Paper 12, 12 (PTAB Aug. 6, 2019). Petitioners are not asking the Office to reconsider any arguments regarding Grisham; they are asking the Office to consider for the first time whether the combination of Grisham with other new references renders obvious the challenged claims.

b. Factors (e)-(f): The Office Erred

Where “the Office’s previous consideration of the art is not well developed or silent, then a petitioner may show the Office erred by overlooking something persuasive under factors (e) and (f).” *Advanced Bionics*, 10.

The Petition details how Grisham combines with other, new references to render obvious the challenged claims. This is “something persuasive” that the Office

necessarily overlooked when it allowed the claims despite Grisham being disclosed in an IDS.

The Office also lacked the benefit of expert testimony regarding the prior art cited herein. This new evidence weighs “heavily against denying institution.” *Adobe v. Rah Color*, IPR2019-00627, Paper 41, 20 (Sept. 10, 2019).

IX. CONCLUSION

Petitioners request cancellation of claims 1-20.

Dated: January 9, 2023

Respectfully submitted,

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CERTIFICATE OF SERVICE UNDER 37 C.F.R. §42.6 (E)(4)

I certify that on January 9, 2023, I will cause a copy of the foregoing document, including any exhibits or appendices filed therewith, to be served via UPS overnight at the following correspondence address of record for the patent:

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Date: January 9, 2023

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CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24, the undersigned certifies that the foregoing IPR petition contains 13,985 words excluding a table of contents, a table of authorities, Mandatory Notices under § 42.8, a certificate of service or word count, or appendix of exhibits or claim listing. Petitioners have relied on the word count feature of the word processing system used to create this paper in making this certification.

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X. CLAIM LISTING

The following claim listing assigns element labels (e.g., 1[A], 1[B], etc.) to certain claims for clarity.

Claim 1
1[pre] A system for worker protection, the system comprises:
1[A] a train-mounted unit for use on a train
1[B] wherein the train-mounted unit comprises: a communication component, comprising one or more antennas, configured to transmit and/or receive wireless signals
1[C] wherein the signals comprise ultra-wideband (UWB) signals
1[D] and one or more circuits configured to process signals and data, and perform one or more applications or functions relating to operations of the train-mounted unit
1[E] and wherein the train-mounted unit is configured to operate cooperatively with one or more wayside units, configured for placement on or near a track traversed by the train, to provide alerts to one or more workers operating on or near the track, based on communication of the UWB signals with at least one of the one or more wayside units.
Claim 2
2. The system of claim 1, wherein the train-mounted unit is configured to broadcast alert triggering signals.
Claim 3
3. The system of claim 1, wherein the train-mounted unit is configured to generate data relating to alerts and/or to other devices or objects in a path of the train, based on the communication of the UWB signals with at least one of the one or more wayside units.
Claim 4
4. The system of claim 1, wherein the train-mounted unit is configured to generate feedback information for outputting to an operator of the train, based on the communication of the UWB signals with at least one of the one or more wayside units.
Claim 5
5. The system of claim 1, wherein the train-mounted unit is configured to: receive a signal indicating an acknowledgment of a safety alert by a worker of the one or more workers, in response to broadcasted alert triggering signals; and provide an indication of the acknowledgment to an operator of the train.

Claim 6
6. The system of claim 1, wherein the train-mounted unit is configured to log data relating to alerts triggered in response to movement of the train.
Claim 7
7. The system of claim 1, wherein the train-mounted unit comprises one or more input/output (I/O) components, for receiving input from an operator of the train and/or for providing output to the operator of the train.
Claim 8
8. The system of claim 1, wherein the train-mounted unit comprises housing for enclosing components of the train-mounted unit.
Claim 9
9. The system of claim 1, wherein the train-mounted unit is configured, at least in part, as portable, detachable and moveable from the train.
Claim 10
10. The system of claim 1, wherein the train-mounted unit is arranged into a plurality of separate physical units that comprises at least a broadcast unit comprising at least the communication component, and wherein the broadcast unit is configured for deployment external to the train.
Claim 11
11. The system of claim 10, wherein the plurality of separate physical units comprises an operator unit comprising at least the one or more I/O components, and wherein the operator unit is configured for use by an operator of the train.
Claim 12
12[pre] A system for worker protection, the system comprises:
12[A] one or more wayside units configured for placement on or near a track;
12[B] wherein each wayside unit comprises: a communication component, comprising one or more antennas, configured to transmit and/or receive wireless signals,
12[C] wherein the signals comprise ultra-wideband (UWB) signals;
12[D] and one or more circuits configured to process signals and data, and perform one or more applications or functions relating to operations of the wayside detection unit;
12[E] and wherein the one or more wayside units are configured to operate cooperatively with any train-mounted unit deployed on a train traversing the track, to provide alerts to one or more workers operating on or near the track, based on communication of the UWB signals between at least one of the one or more wayside units and the train-mounted unit.

Claim 13
13. The system of claim 12, wherein each wayside unit comprises a power supply for powering components of the wayside unit.
Claim 14
14. The system of claim 12, wherein each wayside unit comprises a housing for enclosing components of the wayside unit.
Claim 15
15. The system of claim 12, wherein each wayside unit comprises a support structure for holding and supporting the wayside unit when placed on or near the track.
Claim 16
16. The system of claim 12, wherein at least one wayside unit is configured to broadcast alert related signals, relating to the train when approaching the wayside unit.
Claim 17
17. The system of claim 12, wherein at least one wayside unit is configured to forward alerts and/or alert related signals received from the train-mounted unit.
Claim 18
18. The system of claim 12, wherein at least one wayside unit is configured to log data relating to alerts triggered in response to broadcasted alert related signals.
Claim 19
19. The system of claim 12, wherein at least one wayside unit comprises one or more sensory components, for detecting, monitoring, and/or tracking trains, and wherein the at least one wayside unit configured to determine, based on sensory data obtained from the one or more sensors, when the train is approaching the wayside unit.
Claim 20
20[pre] A system for protecting workers near railroad tracks, comprising:
20[A] one or more UWB radios at pre-determined locations along the railroad tracks;
20[B] one or more worker UWB radios associated with one or more workers on or near the railroad tracks;
20[C] a vehicle UWB radio associated with a vehicle on the railroad track;
20[D] wherein: the vehicle UWB radio is in communication with a processor,

20[E] wherein: the processor determines a position of the vehicle based on time of flight measurements obtained based on communication between the vehicle UWB radio and at least one of the one or more UWB radios that are located at pre-determined locations;

20[F] the processor determines a location in which the one or more workers are working based on time of flight information obtained based on communication with at least one of the one or more worker UWB radios;

20[G] and the processor generates an alert to an operator of the vehicle based on the determined location of the one or more workers;

20[H] and at least one worker UWB radio communicates time of flight information between the at least one worker UWB radio and the vehicle UWB radio to a processor in communication with the at least one worker UWB radio,

20[I] wherein the processor generates alerts to a worker associated with the at least one worker UWB radio based on one or more of: a determined distance to the vehicle UWB radio, an estimated time of closest approach of the vehicle UWB radio to a location of the at least one worker UWB radio, and an approach speed of the vehicle UWB radio.