US 20250259726A1

(19) United States
(12) Patent Application Publication
Naber et al.
(10) Pub. No.: US 2025/0259726 A1
(43) Pub. Date: Aug. 14, 2025

(54) TECHNIQUES FOR TRANSPORTING AUTONOMOUS PATIENT SUPPORT APPARATUSES AND MEDICAL EQUIPMENT TO AN INCIDENT SCENE

(71) Applicant: **Stryker Corporation**, Portage, MI (US)

(72) Inventors: **Brandon David Naber**, Portage, MI (US); **Scott Zufall**, Kalamazoo, MI (US); **Jeffrey S. Dunfee, II**, Kalamazoo, MI (US)

(73) Assignee: **Stryker Corporation**, Portage, MI (US)

(21) Appl. No.: **19/195,913**

(22) Filed: **May 1, 2025**

Related U.S. Application Data

(63) Continuation of application No. 18/436,077, filed on Feb. 8, 2024, now Pat. No. 12,315,613, which is a continuation of application No. 16/671,723, filed on Nov. 1, 2019, now Pat. No. 11,929,157.

(60) Provisional application No. 62/754,773, filed on Nov. 2, 2018, provisional application No. 62/754,798, filed on Nov. 2, 2018, provisional application No. 62/754,836, filed on Nov. 2, 2018.

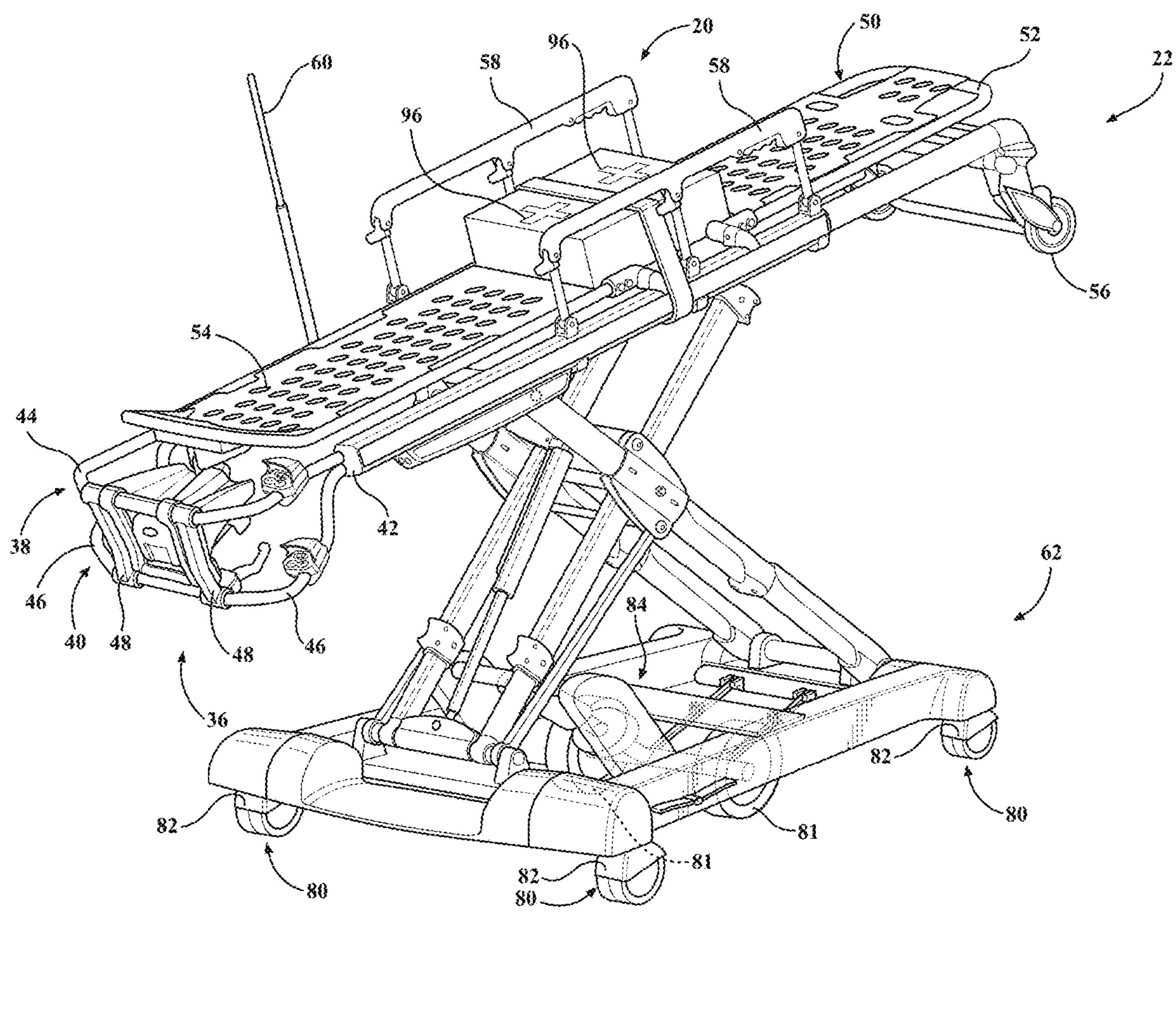
Publication Classification

(51) **Int. Cl.**
G16H 20/13 (2018.01)
G05D 1/228 (2024.01)

(52) **U.S. Cl.**
CPC ***G16H 20/13*** (2018.01); ***G05D 1/228*** (2024.01)

(57) **ABSTRACT**

A method of transporting equipment modules to an incident scene with an comprises: determining an initial location of the incident scene; dispatching an ambulance loaded with the autonomous mobile response unit and a plurality of equipment modules to the initial location; determining a refined location of the incident scene; selecting a first equipment module; dispensing the first equipment module from the ambulance onto the autonomous mobile response unit; deploying the autonomous mobile response unit from the ambulance at the initial location; communicating the refined location of the incident scene to the autonomous mobile response unit; generating, with the navigation system, a drive path from the initial location to the refined location; and driving, with the drive system, the autonomous mobile response unit loaded with the first equipment module based on the drive path such that the autonomous mobile response unit travels from the initial location to the refined location.



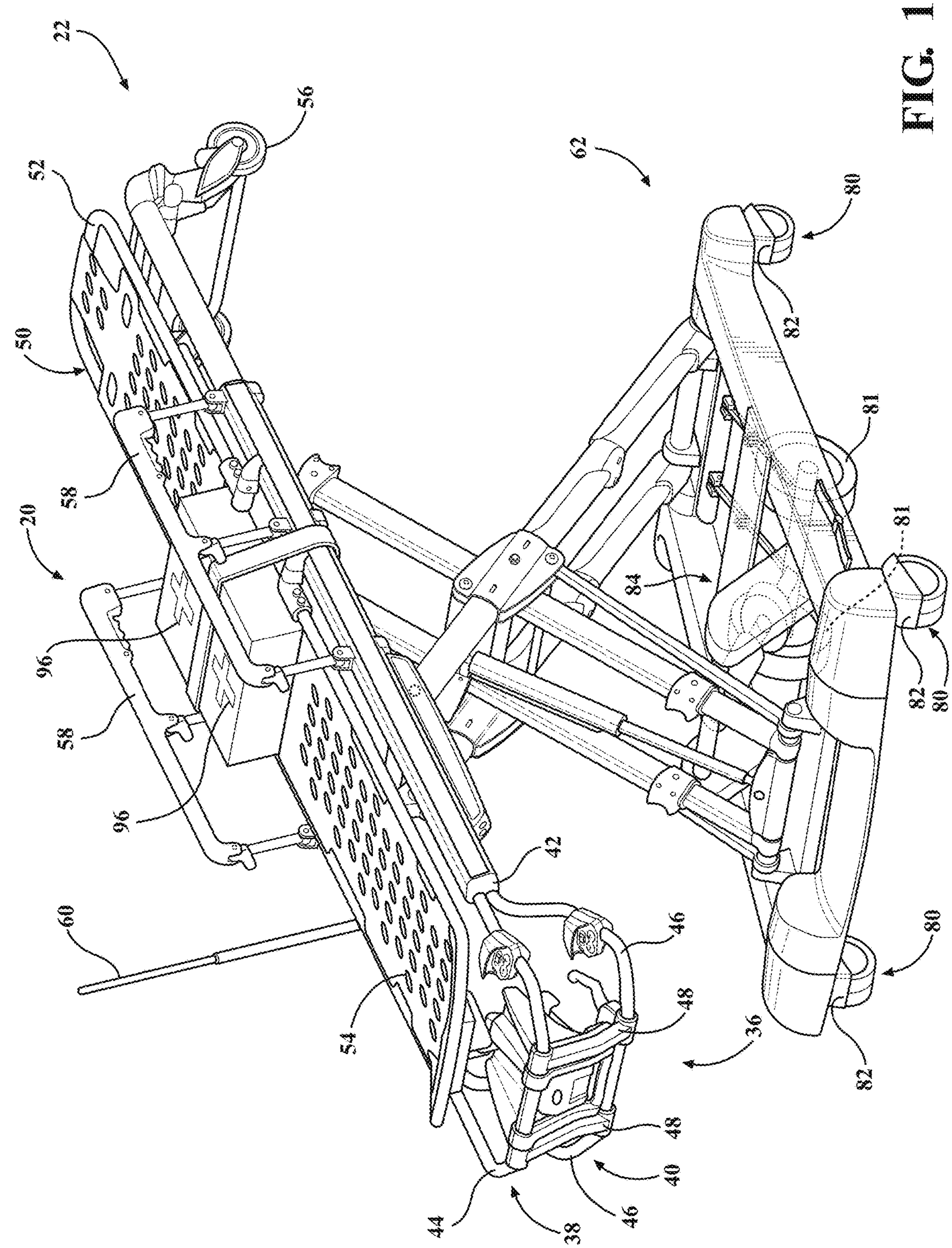


FIG. 1

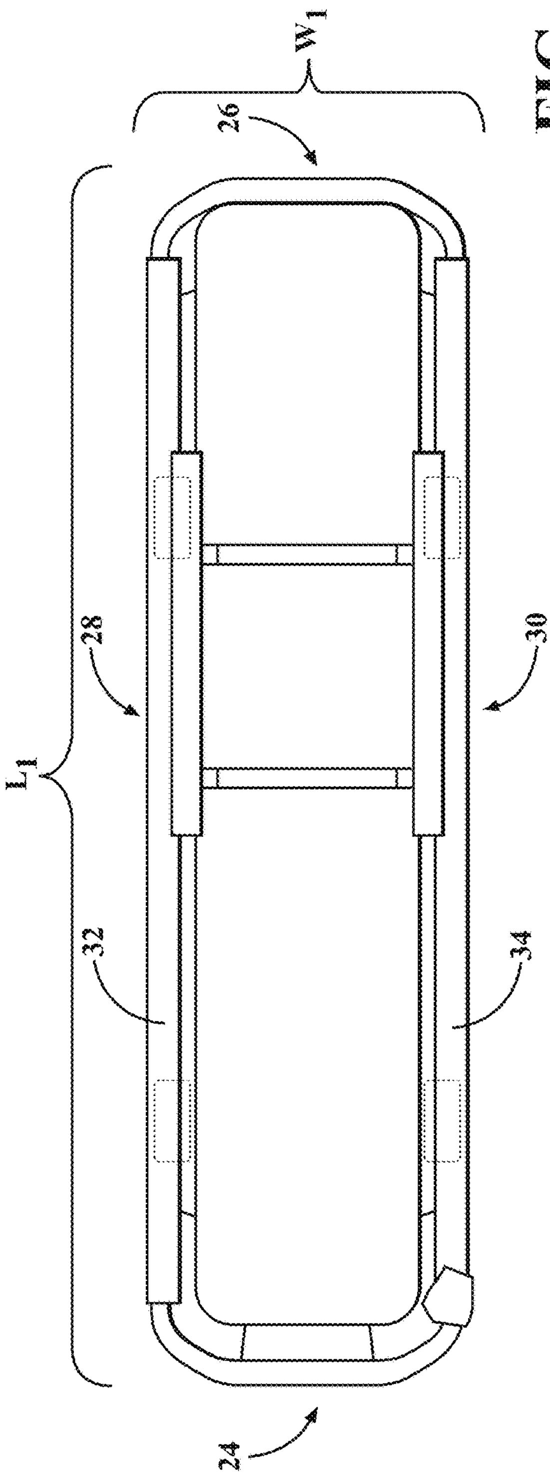


FIG. 2A

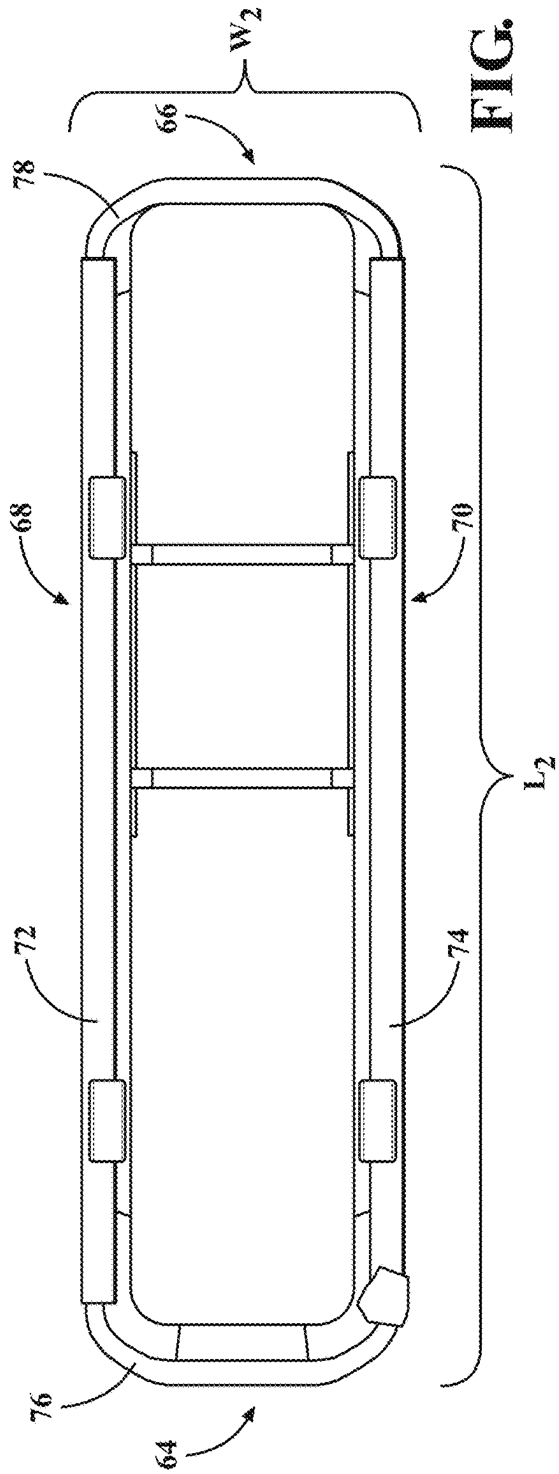


FIG. 2B

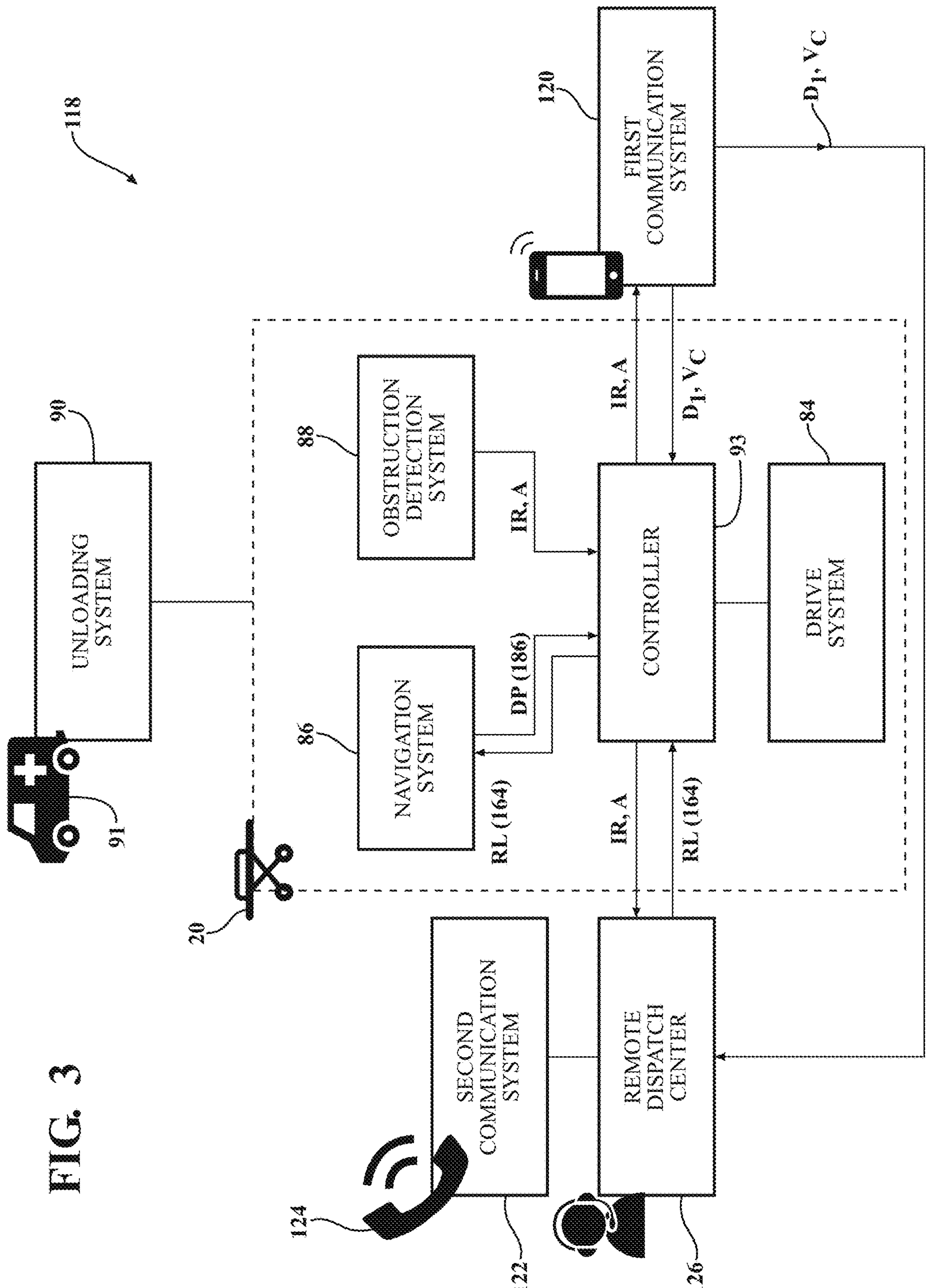

118
120
FIRST COMMUNICATION SYSTEM
D_1, V_C
90
UNLOADING SYSTEM
91
88
OBSTRUCTION DETECTION SYSTEM
IR, A
D_1, V_C
93
84
CONTROLLER
DRIVE SYSTEM
86
NAVIGATION SYSTEM
DP (186)
RL (164)
IR, A
RL (164)
20
SECOND COMMUNICATION SYSTEM
REMOTE DISPATCH CENTER
124
122
126

FIG. 3

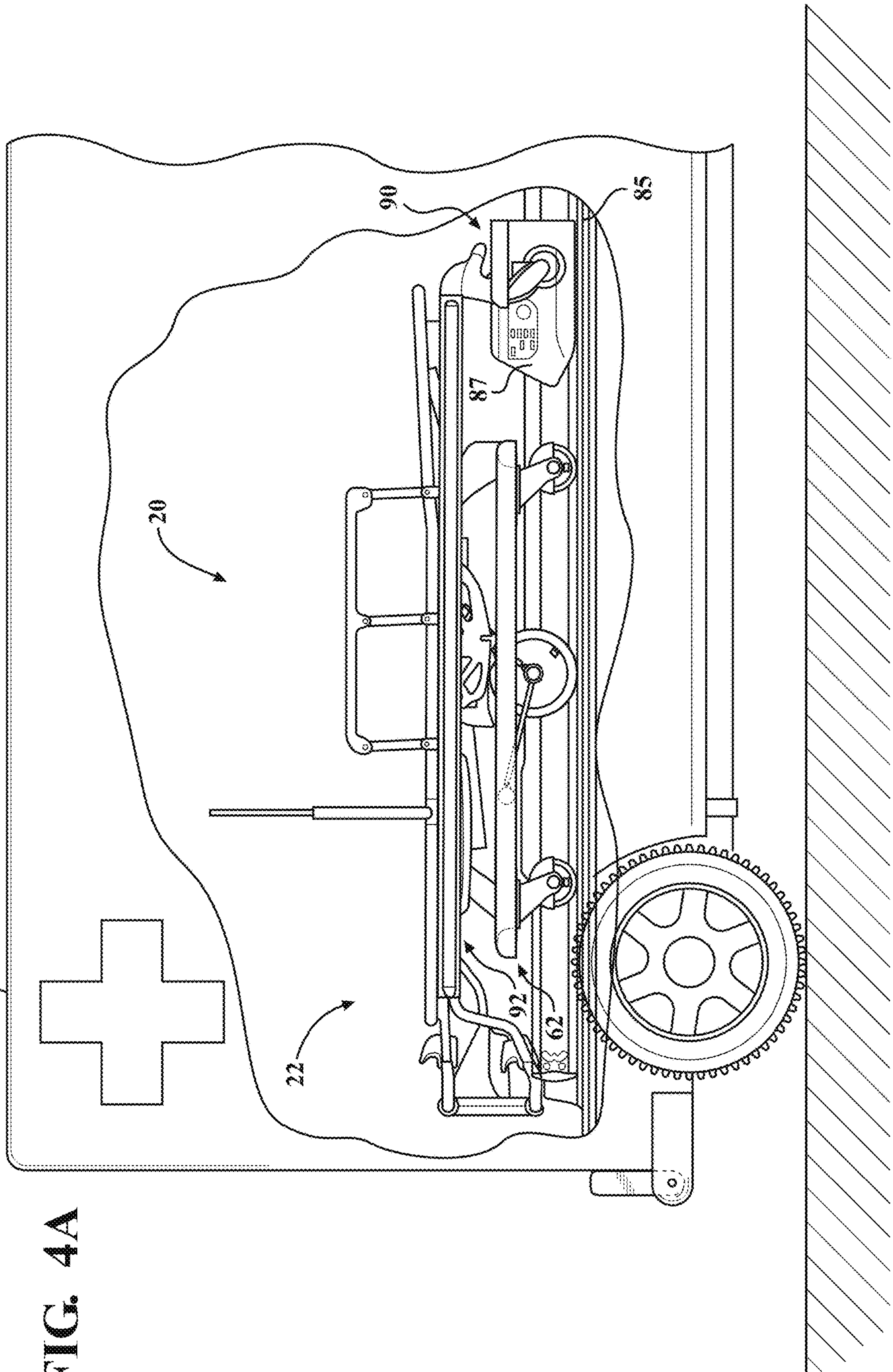


FIG. 4A

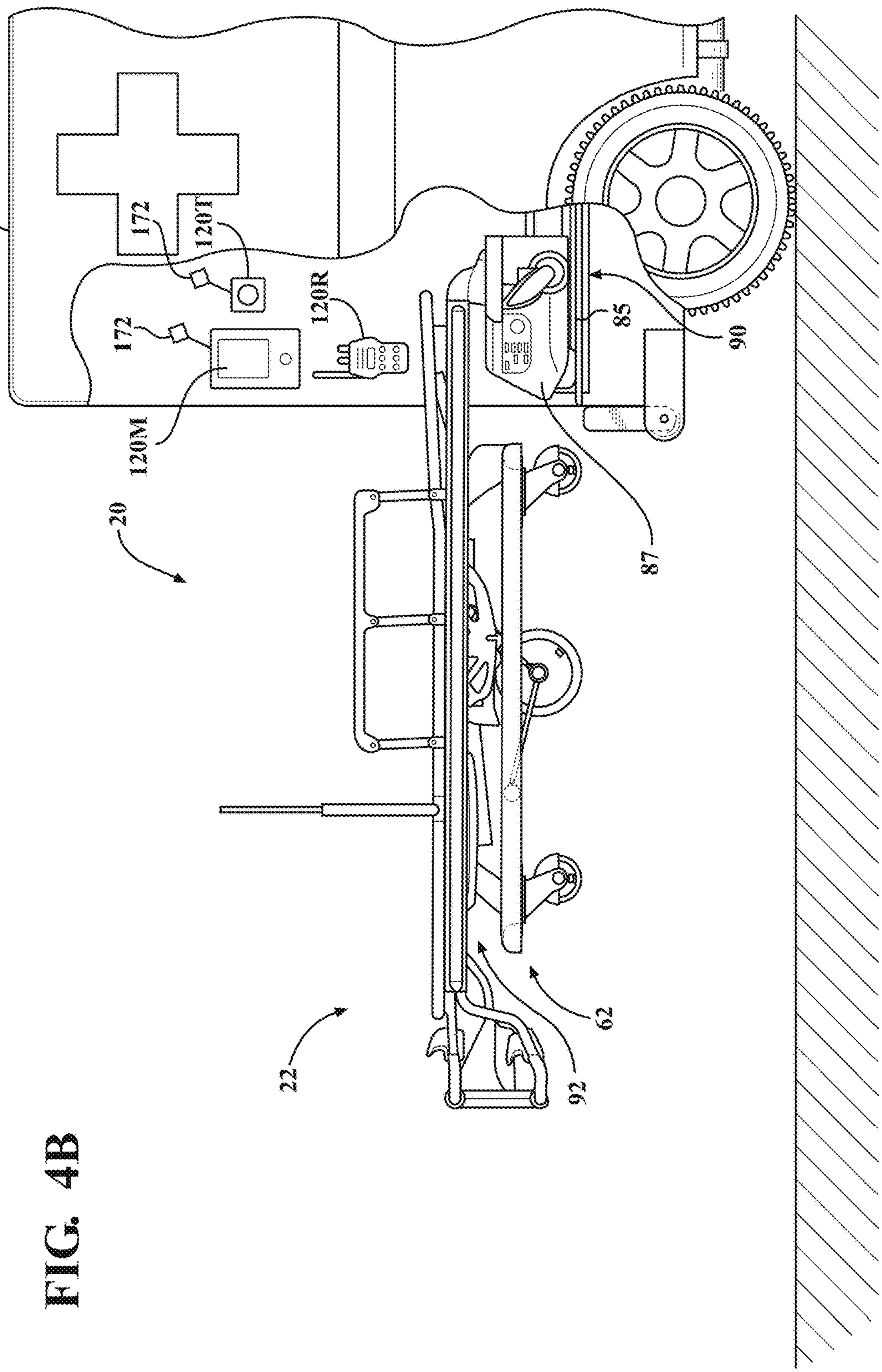


FIG. 4B

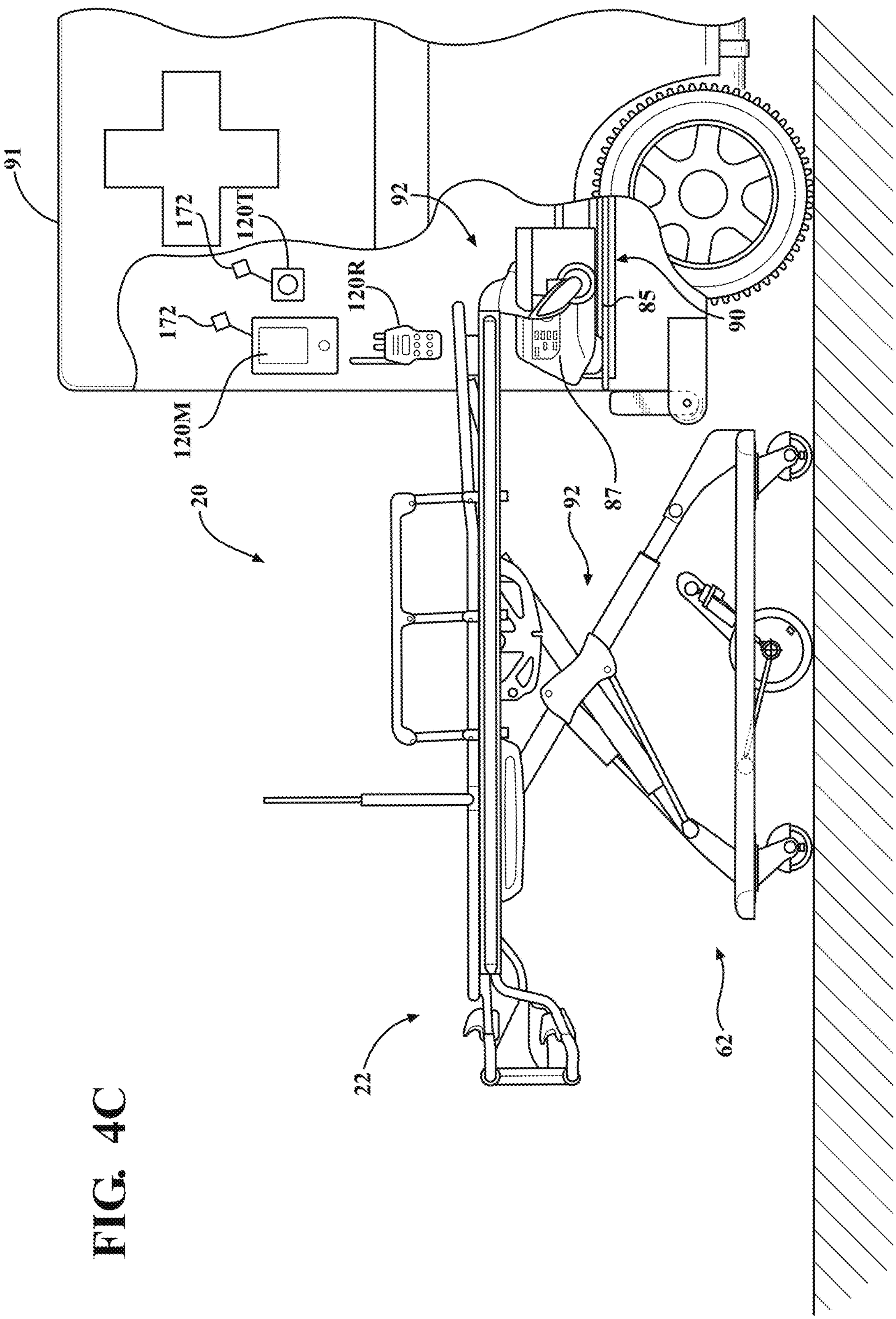


FIG. 4C

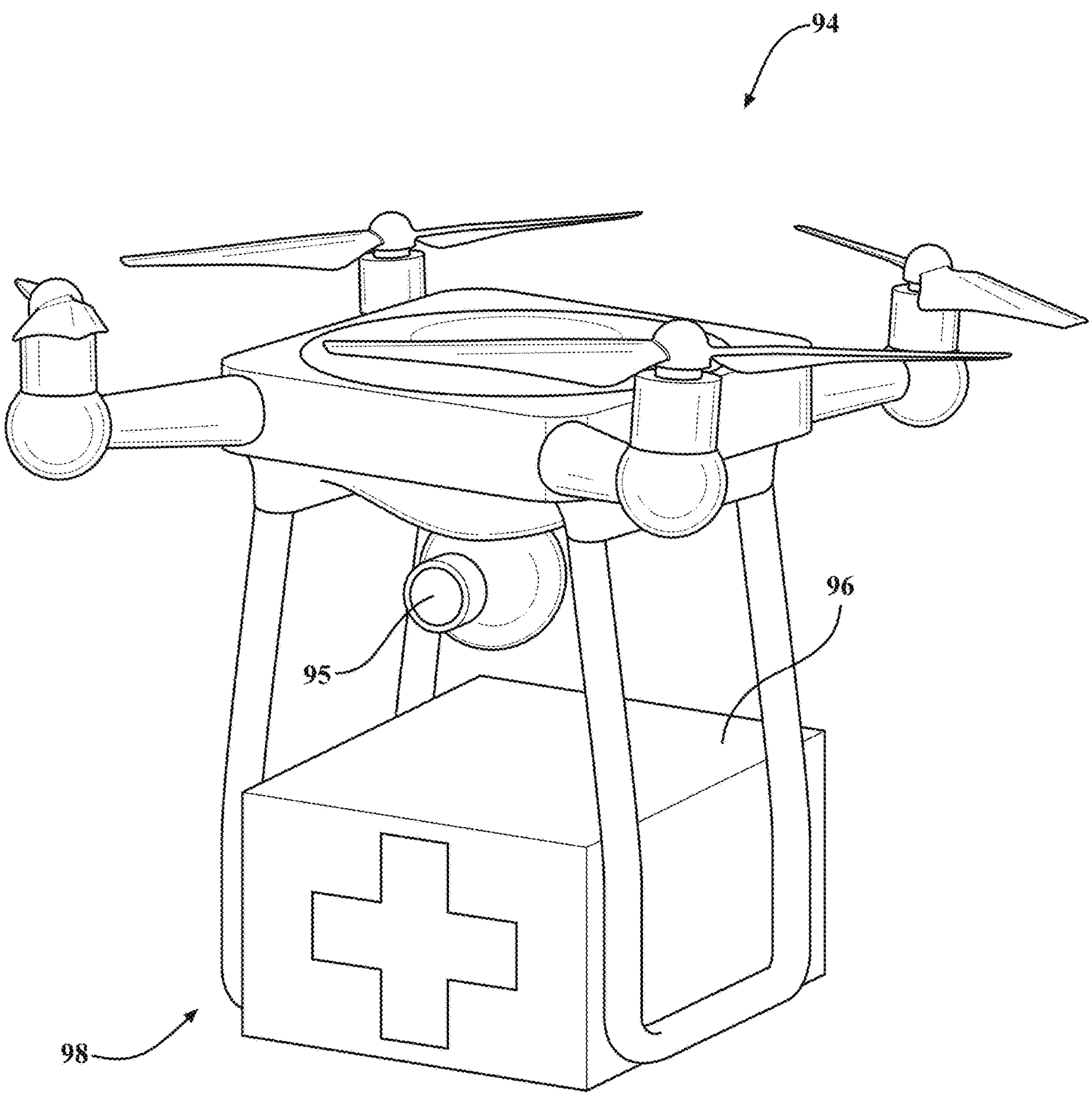


FIG. 5

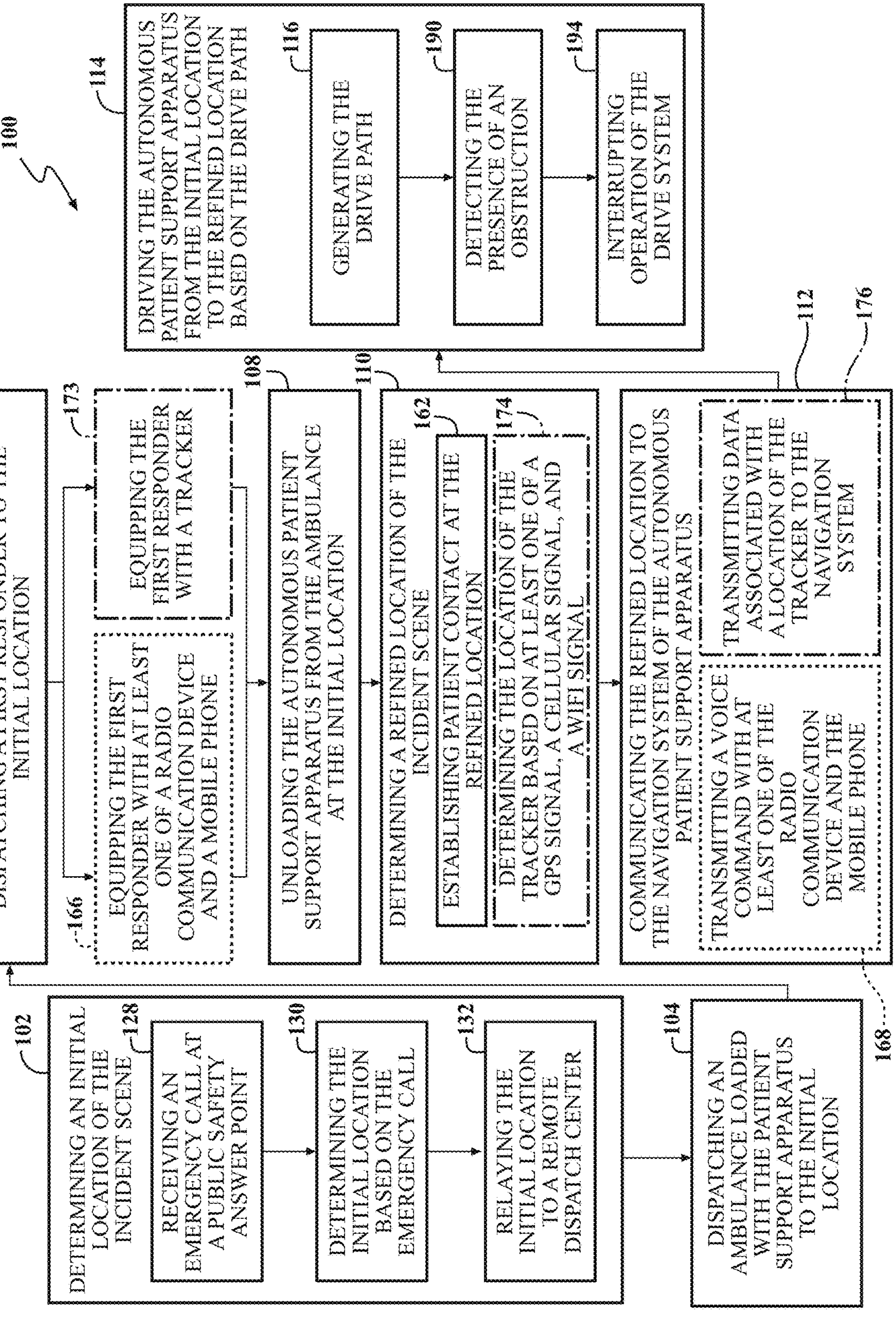

100
102
DETERMINING AN INITIAL LOCATION OF THE INCIDENT SCENE
128
RECEIVING AN EMERGENCY CALL AT A PUBLIC SAFETY ANSWER POINT
130
DETERMINING THE INITIAL LOCATION BASED ON THE EMERGENCY CALL
132
RELAYING THE INITIAL LOCATION TO A REMOTE DISPATCH CENTER
104
DISPATCHING AN AMBULANCE LOADED WITH THE PATIENT SUPPORT APPARATUS TO THE INITIAL LOCATION
106
DISPATCHING A FIRST RESPONDER TO THE INITIAL LOCATION
166
EQUIPPING THE FIRST RESPONDER WITH AT LEAST ONE OF A RADIO COMMUNICATION DEVICE AND A MOBILE PHONE
173
EQUIPPING THE FIRST RESPONDER WITH A TRACKER
108
UNLOADING THE AUTONOMOUS PATIENT SUPPORT APPARATUS FROM THE AMBULANCE AT THE INITIAL LOCATION
110
DETERMINING A REFINED LOCATION OF THE INCIDENT SCENE
162
ESTABLISHING PATIENT CONTACT AT THE REFINED LOCATION
174
DETERMINING THE LOCATION OF THE TRACKER BASED ON AT LEAST ONE OF A GPS SIGNAL, A CELLULAR SIGNAL, AND A WIFI SIGNAL
112
COMMUNICATING THE REFINED LOCATION TO THE NAVIGATION SYSTEM OF THE AUTONOMOUS PATIENT SUPPORT APPARATUS
168
TRANSMITTING A VOICE COMMAND WITH AT LEAST ONE OF THE RADIO COMMUNICATION DEVICE AND THE MOBILE PHONE
176
TRANSMITTING DATA ASSOCIATED WITH A LOCATION OF THE TRACKER TO THE NAVIGATION SYSTEM
114
DRIVING THE AUTONOMOUS PATIENT SUPPORT APPARATUS FROM THE INITIAL LOCATION TO THE REFINED LOCATION BASED ON THE DRIVE PATH
116
GENERATING THE DRIVE PATH
190
DETECTING THE PRESENCE OF AN OBSTRUCTION
194
INTERRUPTING OPERATION OF THE DRIVE SYSTEM

FIG. 6A

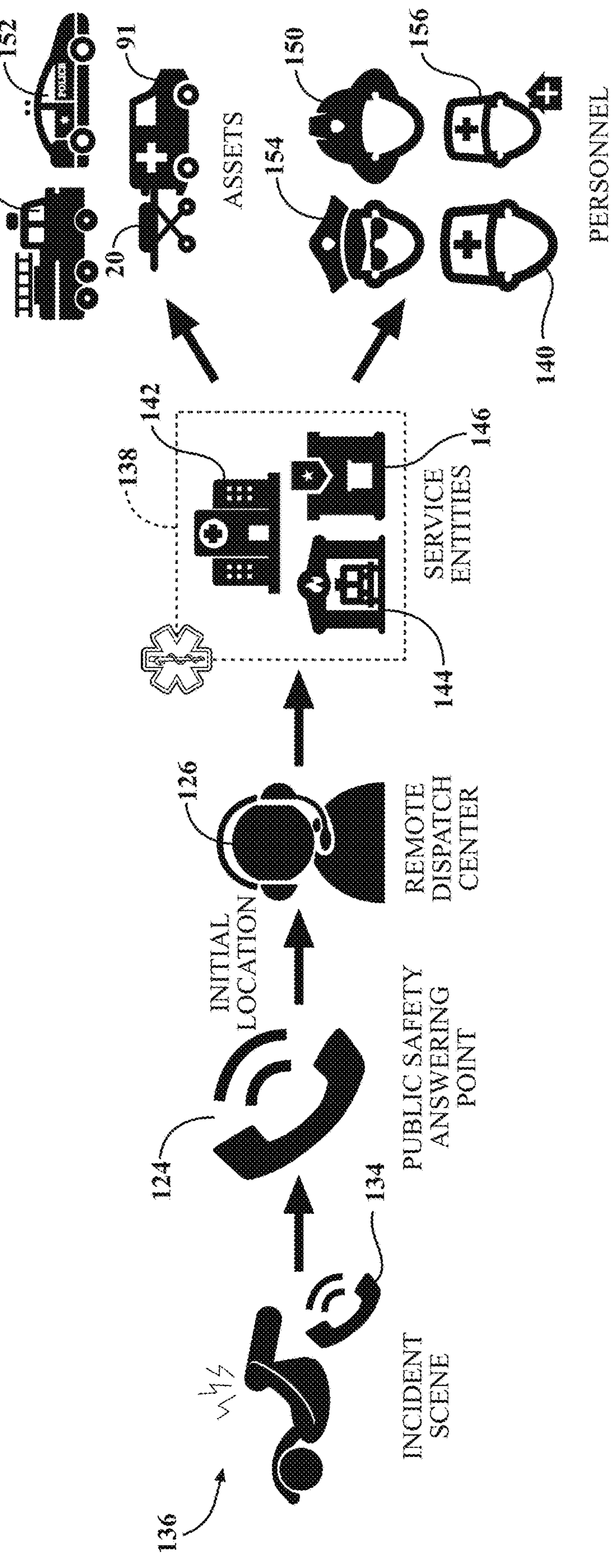

136
INCIDENT SCENE
134
124
PUBLIC SAFETY ANSWERING POINT
INITIAL LOCATION
126
REMOTE DISPATCH CENTER
138
142
144
146
SERVICE ENTITIES
148
152
20
91
ASSETS
154
150
140
156
PERSONNEL

FIG. 6B

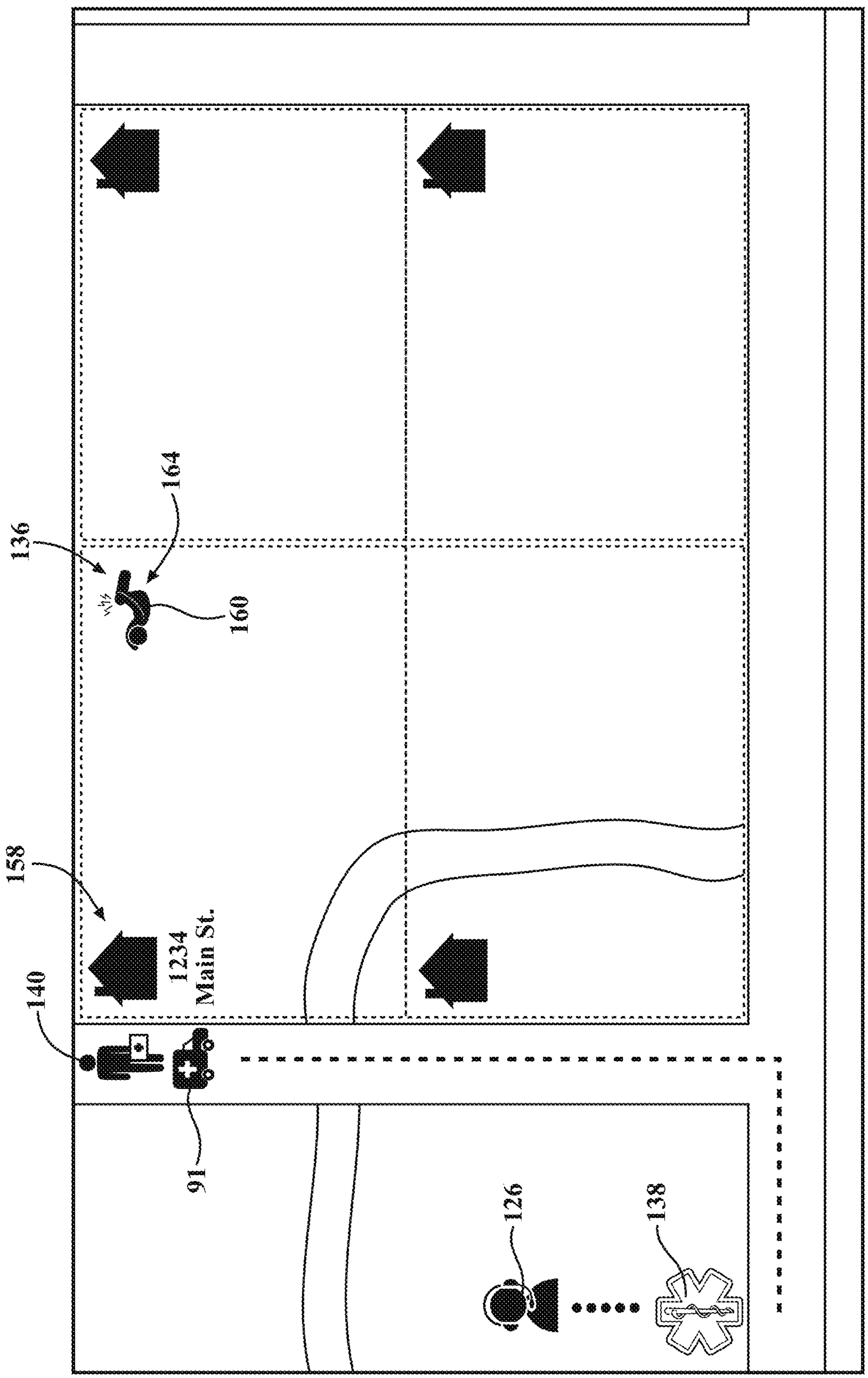


FIG. 6C

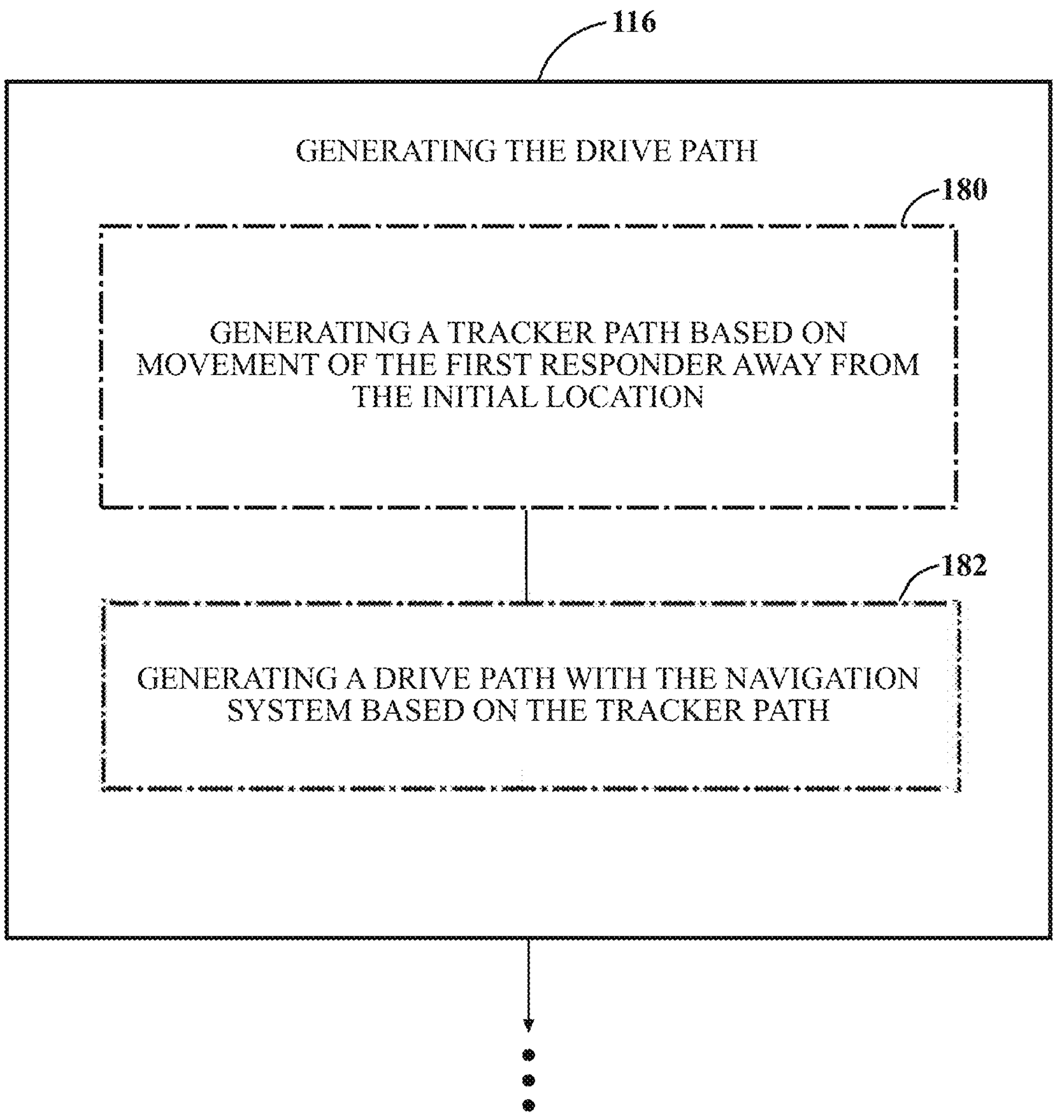

116
GENERATING THE DRIVE PATH
180
GENERATING A TRACKER PATH BASED ON MOVEMENT OF THE FIRST RESPONDER AWAY FROM THE INITIAL LOCATION
182
GENERATING A DRIVE PATH WITH THE NAVIGATION SYSTEM BASED ON THE TRACKER PATH

FIG. 6D

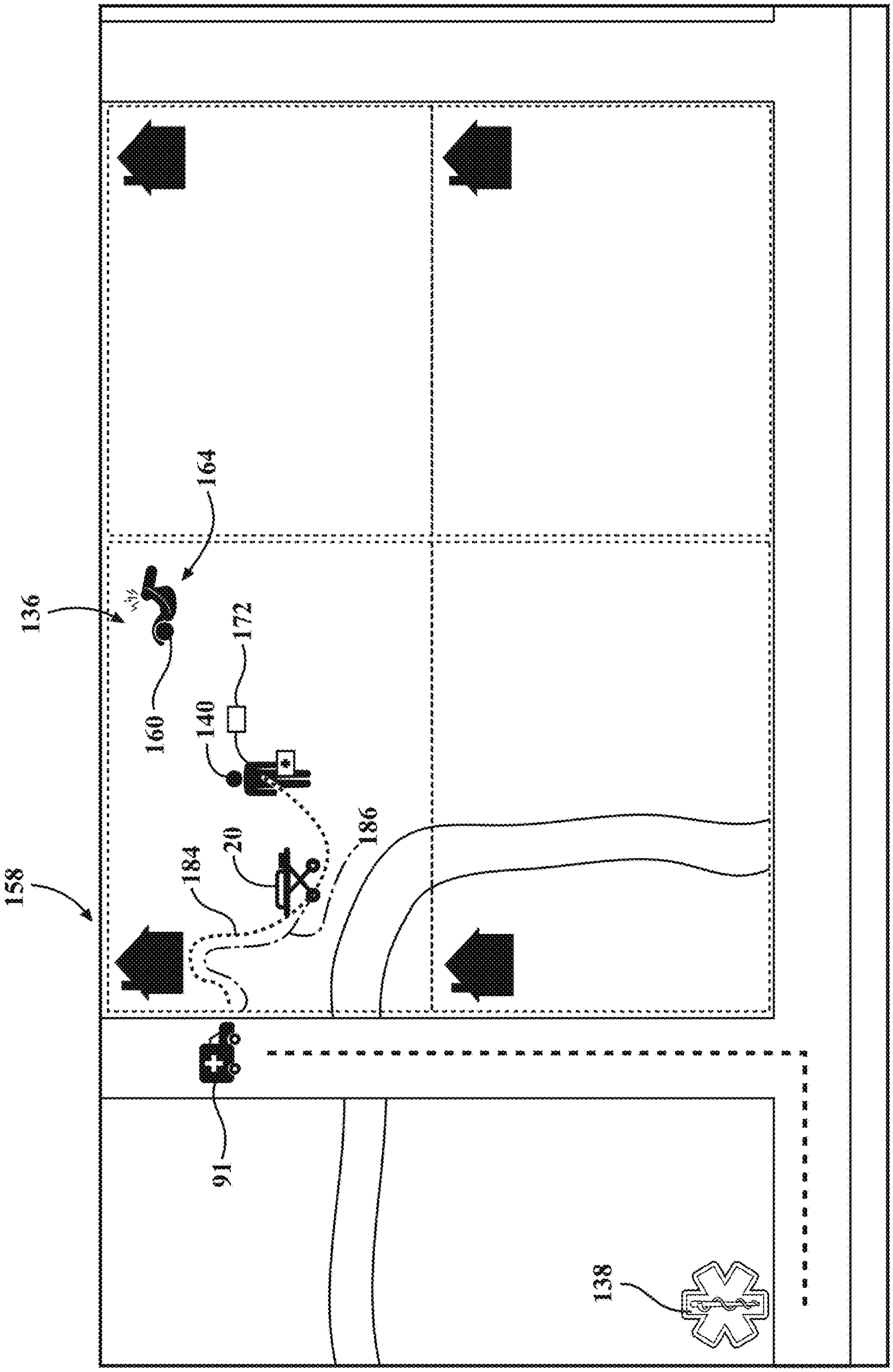


FIG. 6E

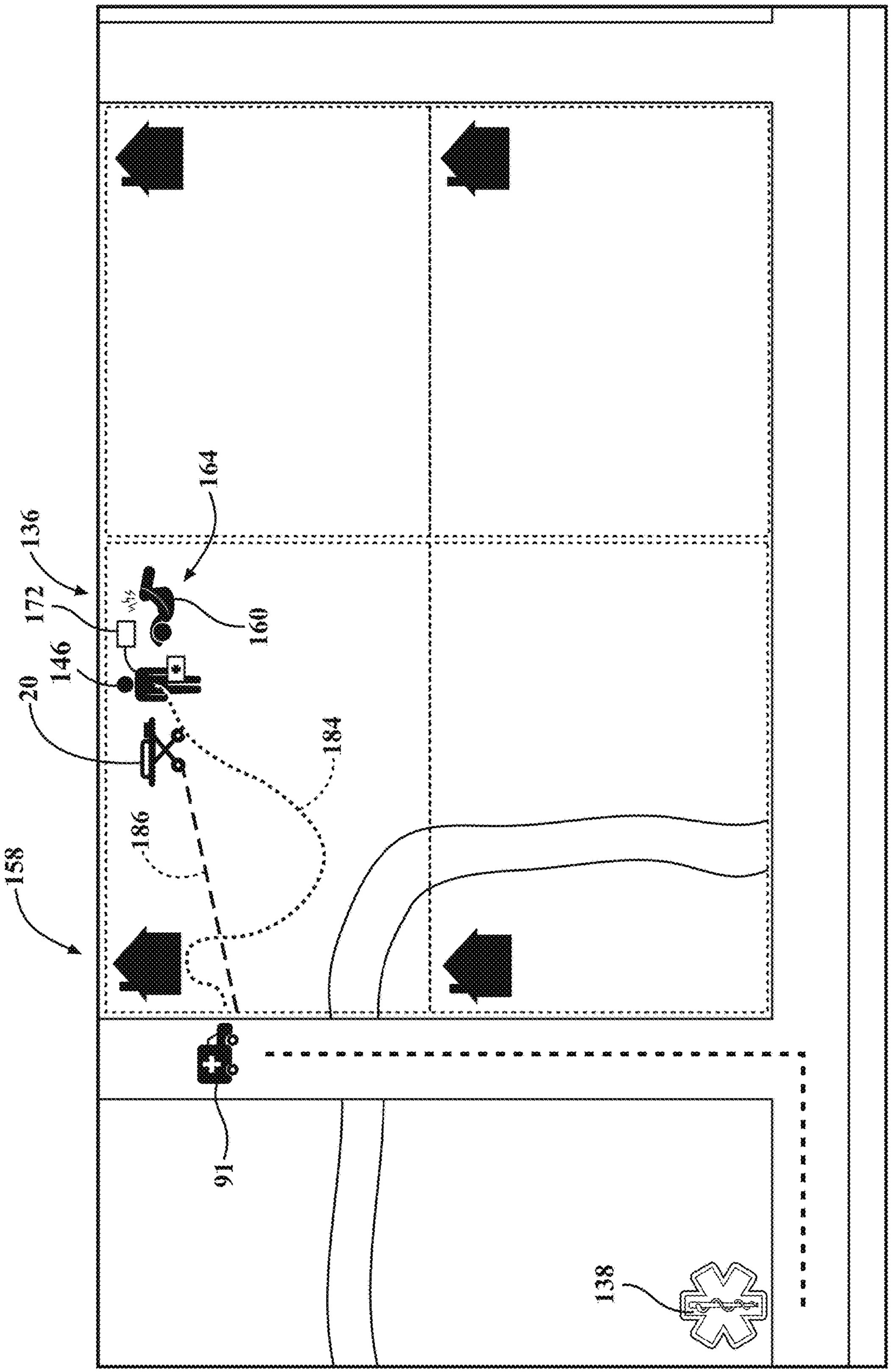


FIG. 6F

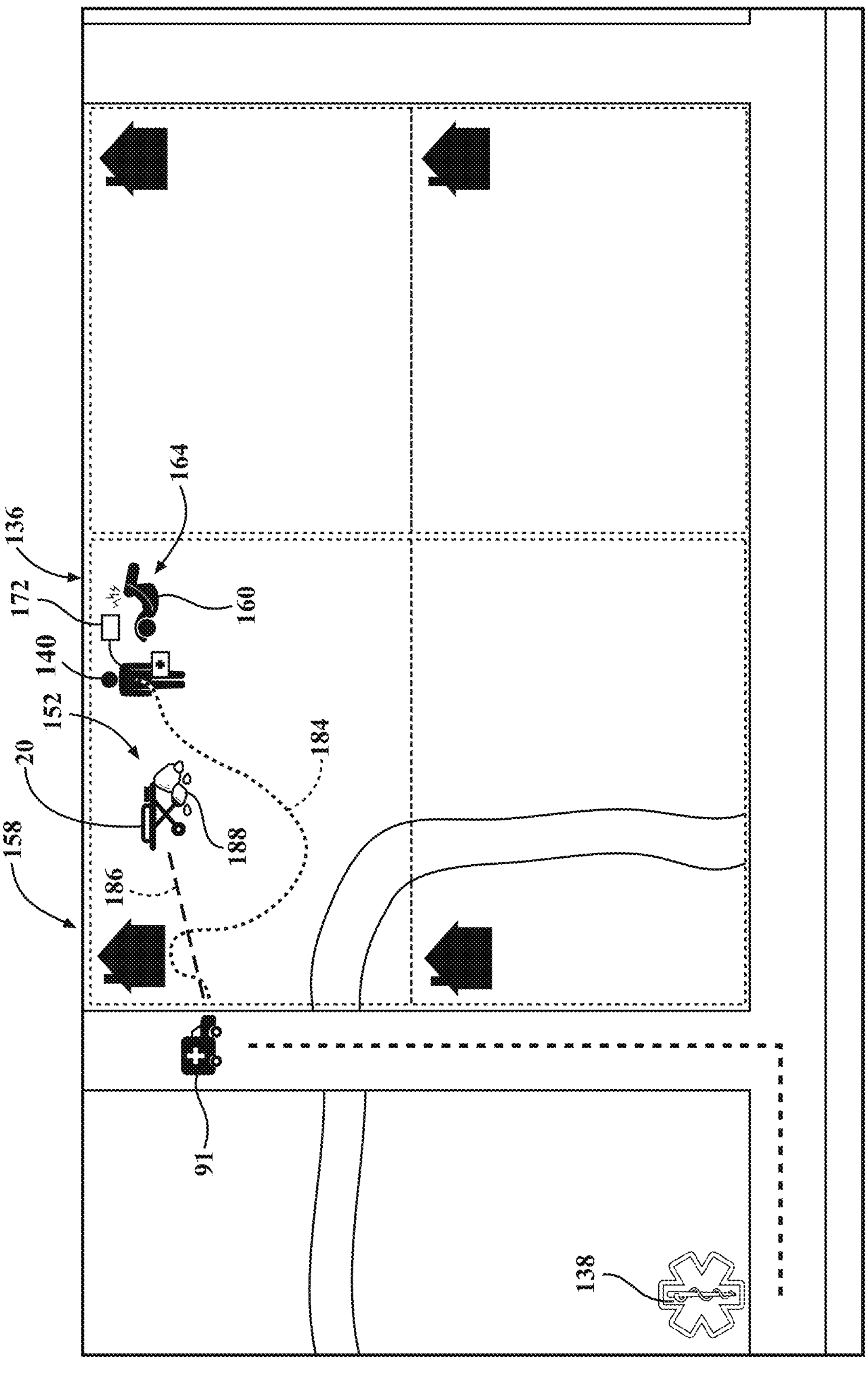


FIG. 6G

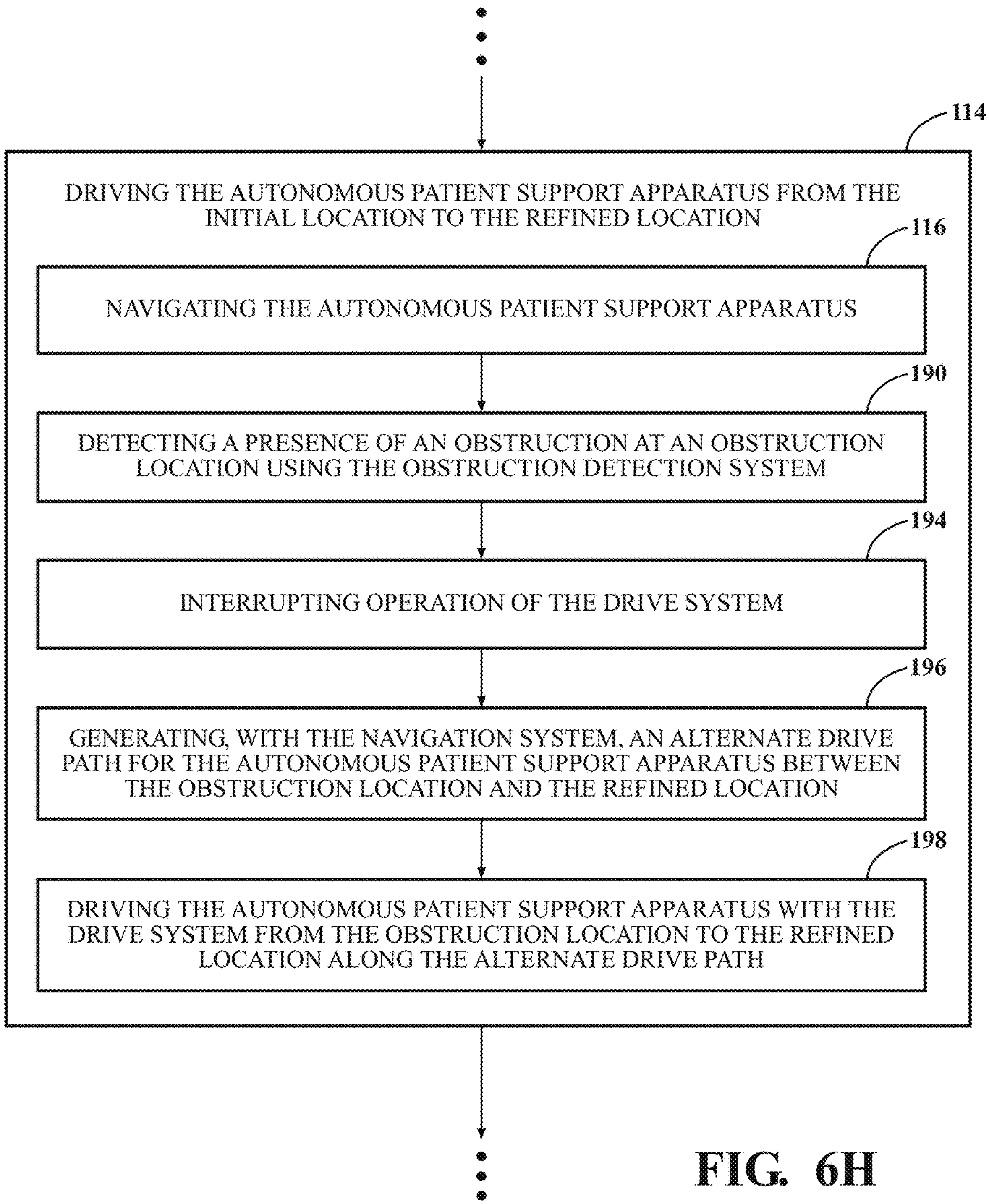

114
DRIVING THE AUTONOMOUS PATIENT SUPPORT APPARATUS FROM THE INITIAL LOCATION TO THE REFINED LOCATION
116
NAVIGATING THE AUTONOMOUS PATIENT SUPPORT APPARATUS
190
DETECTING A PRESENCE OF AN OBSTRUCTION AT AN OBSTRUCTION LOCATION USING THE OBSTRUCTION DETECTION SYSTEM
194
INTERRUPTING OPERATION OF THE DRIVE SYSTEM
196
GENERATING, WITH THE NAVIGATION SYSTEM, AN ALTERNATE DRIVE PATH FOR THE AUTONOMOUS PATIENT SUPPORT APPARATUS BETWEEN THE OBSTRUCTION LOCATION AND THE REFINED LOCATION
198
DRIVING THE AUTONOMOUS PATIENT SUPPORT APPARATUS WITH THE DRIVE SYSTEM FROM THE OBSTRUCTION LOCATION TO THE REFINED LOCATION ALONG THE ALTERNATE DRIVE PATH

FIG. 6H

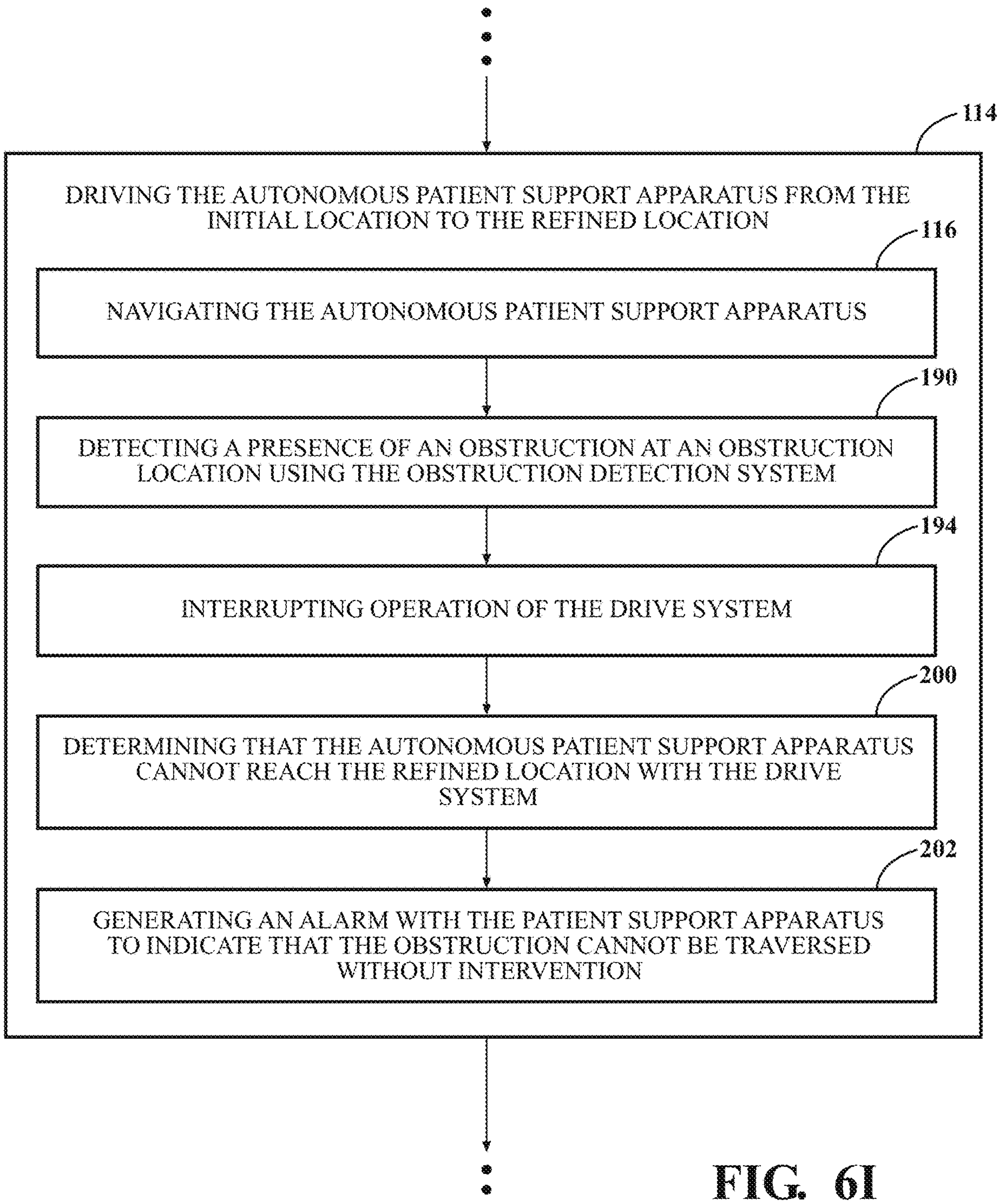

114
DRIVING THE AUTONOMOUS PATIENT SUPPORT APPARATUS FROM THE INITIAL LOCATION TO THE REFINED LOCATION
116
NAVIGATING THE AUTONOMOUS PATIENT SUPPORT APPARATUS
190
DETECTING A PRESENCE OF AN OBSTRUCTION AT AN OBSTRUCTION LOCATION USING THE OBSTRUCTION DETECTION SYSTEM
194
INTERRUPTING OPERATION OF THE DRIVE SYSTEM
200
DETERMINING THAT THE AUTONOMOUS PATIENT SUPPORT APPARATUS CANNOT REACH THE REFINED LOCATION WITH THE DRIVE SYSTEM
202
GENERATING AN ALARM WITH THE PATIENT SUPPORT APPARATUS TO INDICATE THAT THE OBSTRUCTION CANNOT BE TRAVERSED WITHOUT INTERVENTION

FIG. 6I

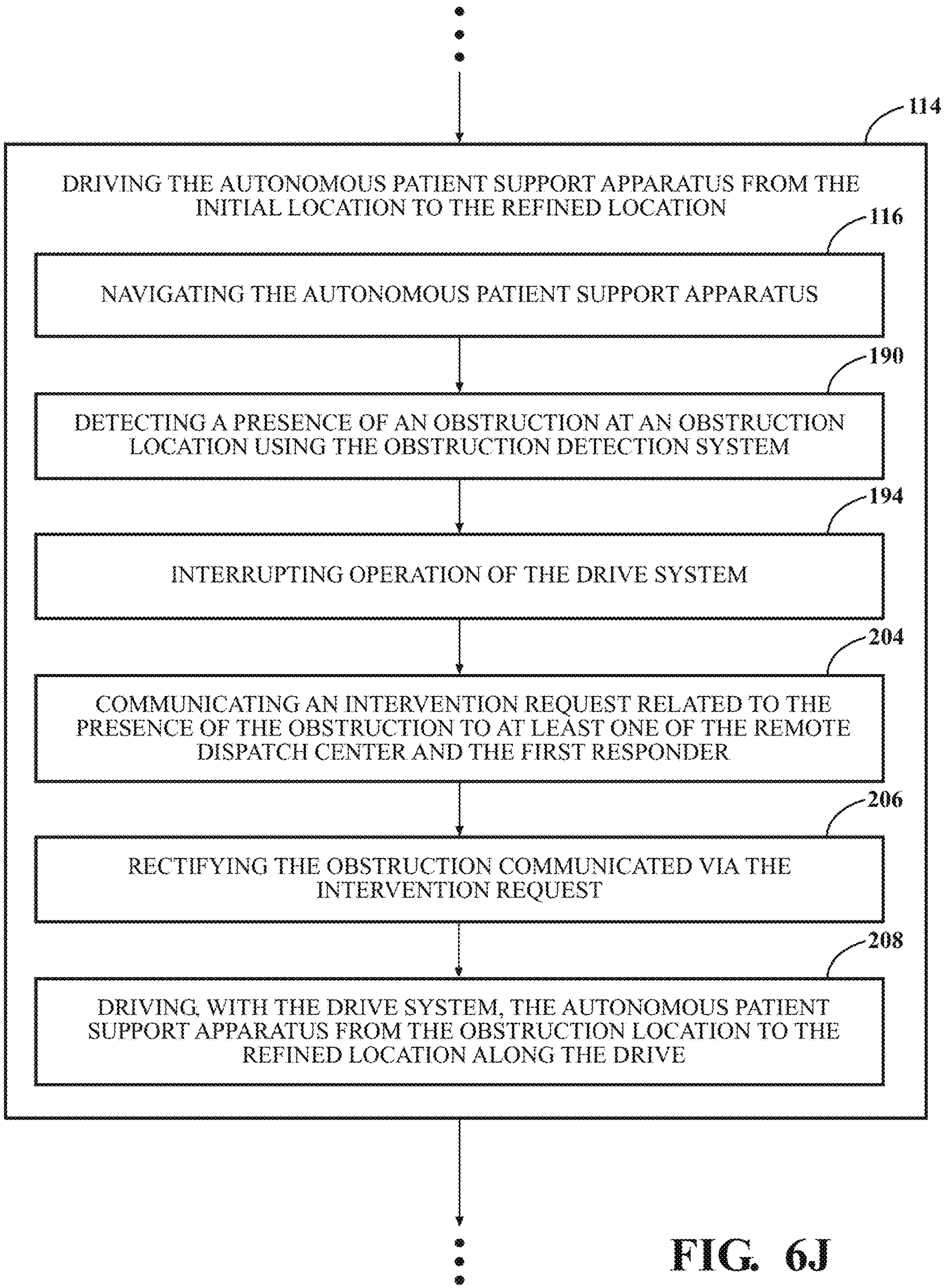

114
DRIVING THE AUTONOMOUS PATIENT SUPPORT APPARATUS FROM THE INITIAL LOCATION TO THE REFINED LOCATION
116
NAVIGATING THE AUTONOMOUS PATIENT SUPPORT APPARATUS
190
DETECTING A PRESENCE OF AN OBSTRUCTION AT AN OBSTRUCTION LOCATION USING THE OBSTRUCTION DETECTION SYSTEM
194
INTERRUPTING OPERATION OF THE DRIVE SYSTEM
204
COMMUNICATING AN INTERVENTION REQUEST RELATED TO THE PRESENCE OF THE OBSTRUCTION TO AT LEAST ONE OF THE REMOTE DISPATCH CENTER AND THE FIRST RESPONDER
206
RECTIFYING THE OBSTRUCTION COMMUNICATED VIA THE INTERVENTION REQUEST
208
DRIVING, WITH THE DRIVE SYSTEM, THE AUTONOMOUS PATIENT SUPPORT APPARATUS FROM THE OBSTRUCTION LOCATION TO THE REFINED LOCATION ALONG THE DRIVE

FIG. 6J

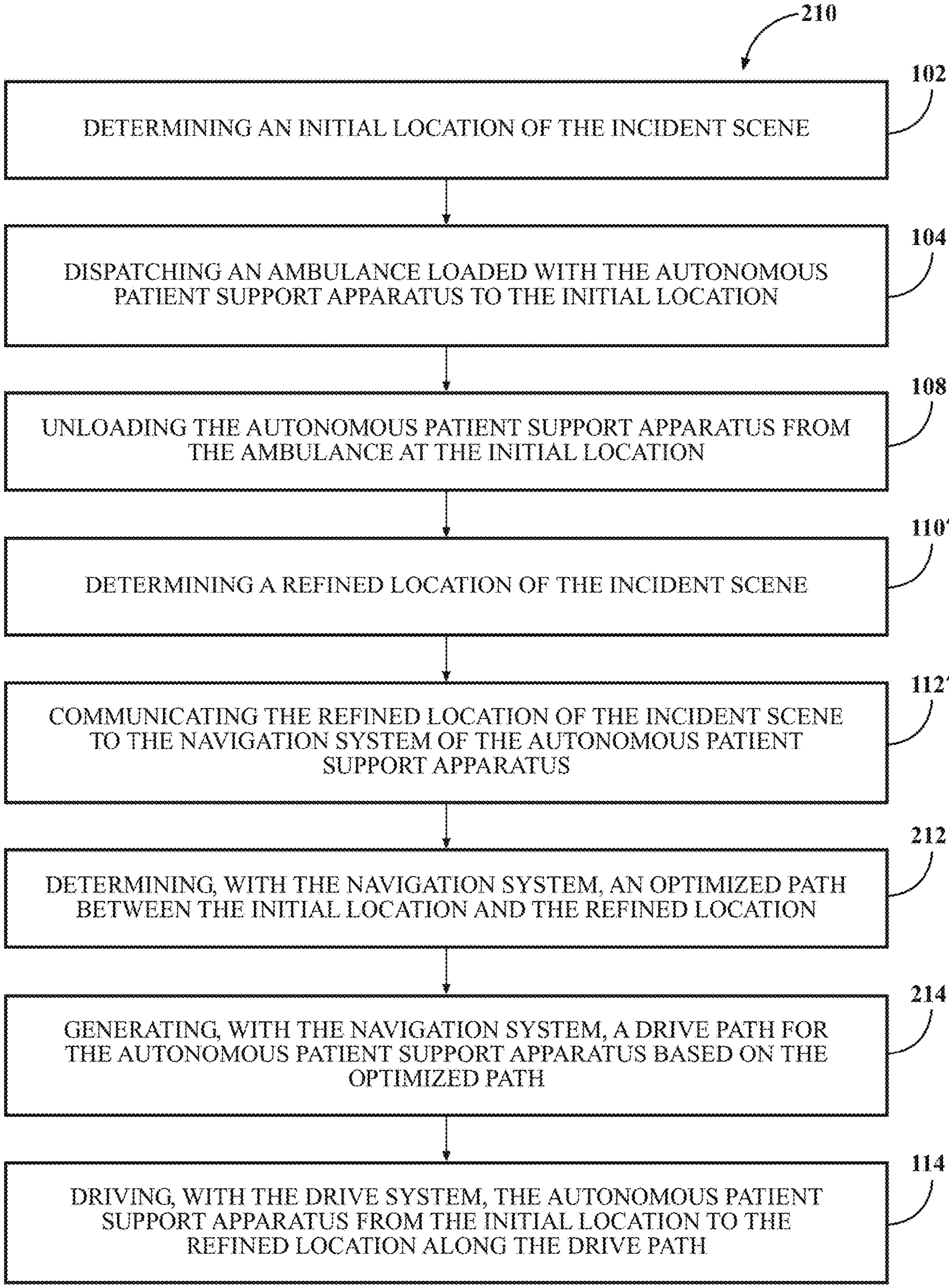

210
102
DETERMINING AN INITIAL LOCATION OF THE INCIDENT SCENE
104
DISPATCHING AN AMBULANCE LOADED WITH THE AUTONOMOUS PATIENT SUPPORT APPARATUS TO THE INITIAL LOCATION
108
UNLOADING THE AUTONOMOUS PATIENT SUPPORT APPARATUS FROM THE AMBULANCE AT THE INITIAL LOCATION
110′
DETERMINING A REFINED LOCATION OF THE INCIDENT SCENE
112′
COMMUNICATING THE REFINED LOCATION OF THE INCIDENT SCENE TO THE NAVIGATION SYSTEM OF THE AUTONOMOUS PATIENT SUPPORT APPARATUS
212
DETERMINING, WITH THE NAVIGATION SYSTEM, AN OPTIMIZED PATH BETWEEN THE INITIAL LOCATION AND THE REFINED LOCATION
214
GENERATING, WITH THE NAVIGATION SYSTEM, A DRIVE PATH FOR THE AUTONOMOUS PATIENT SUPPORT APPARATUS BASED ON THE OPTIMIZED PATH
114
DRIVING, WITH THE DRIVE SYSTEM, THE AUTONOMOUS PATIENT SUPPORT APPARATUS FROM THE INITIAL LOCATION TO THE REFINED LOCATION ALONG THE DRIVE PATH

FIG. 7A

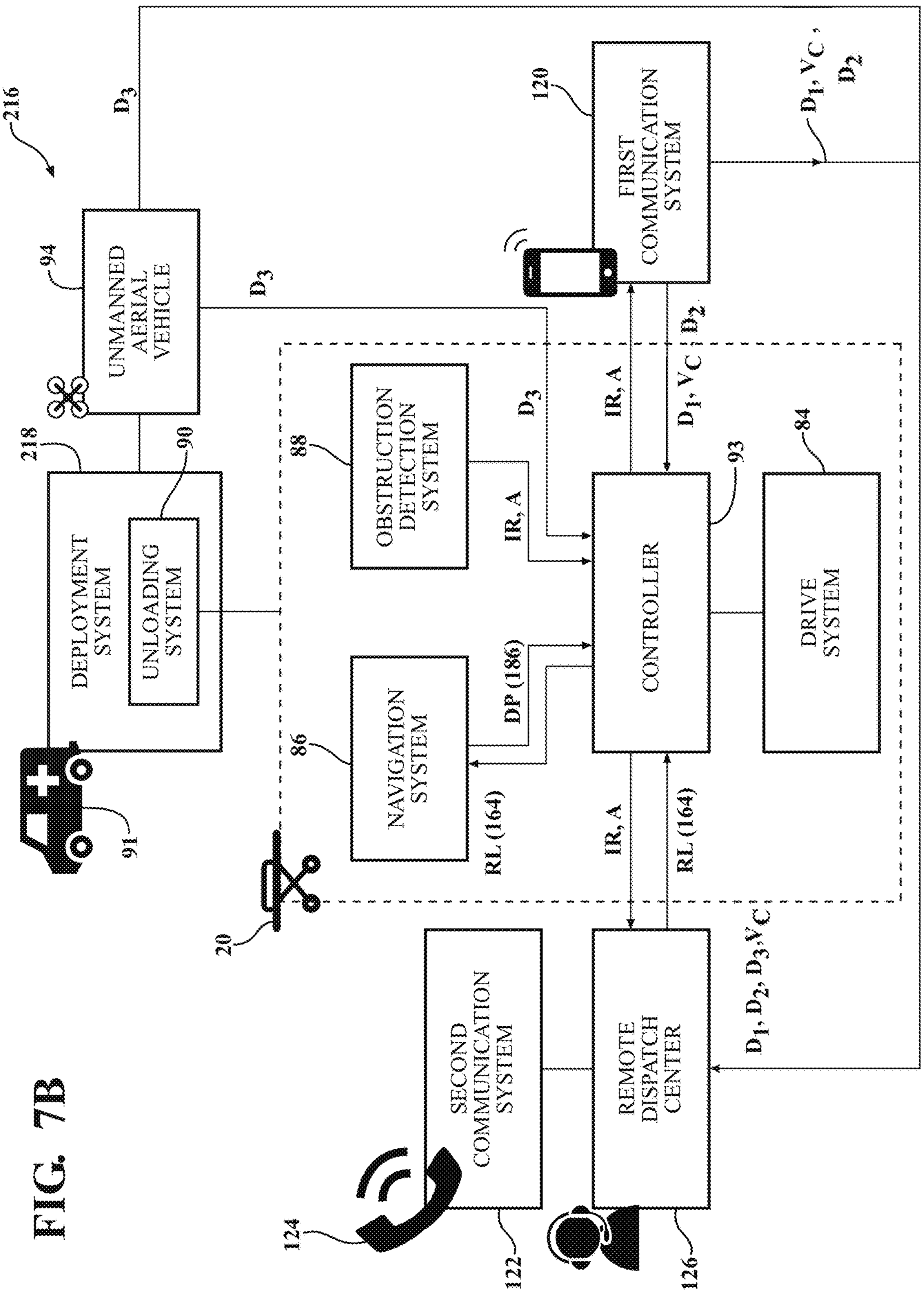

216
218
DEPLOYMENT SYSTEM
UNLOADING SYSTEM
90
91
94
UNMANNED AERIAL VEHICLE
D_3
D_3
88
OBSTRUCTION DETECTION SYSTEM
D_3
IR, A
86
NAVIGATION SYSTEM
DP (186)
RL (164)
CONTROLLER
93
84
DRIVE SYSTEM
IR, A
D_1, V_C
D_2
120
FIRST COMMUNICATION SYSTEM
D_1, V_C, D_2
IR, A
RL (164)
20
SECOND COMMUNICATION SYSTEM
REMOTE DISPATCH CENTER
D_1, D_2, D_3, V_C
124
122
126

FIG. 7B

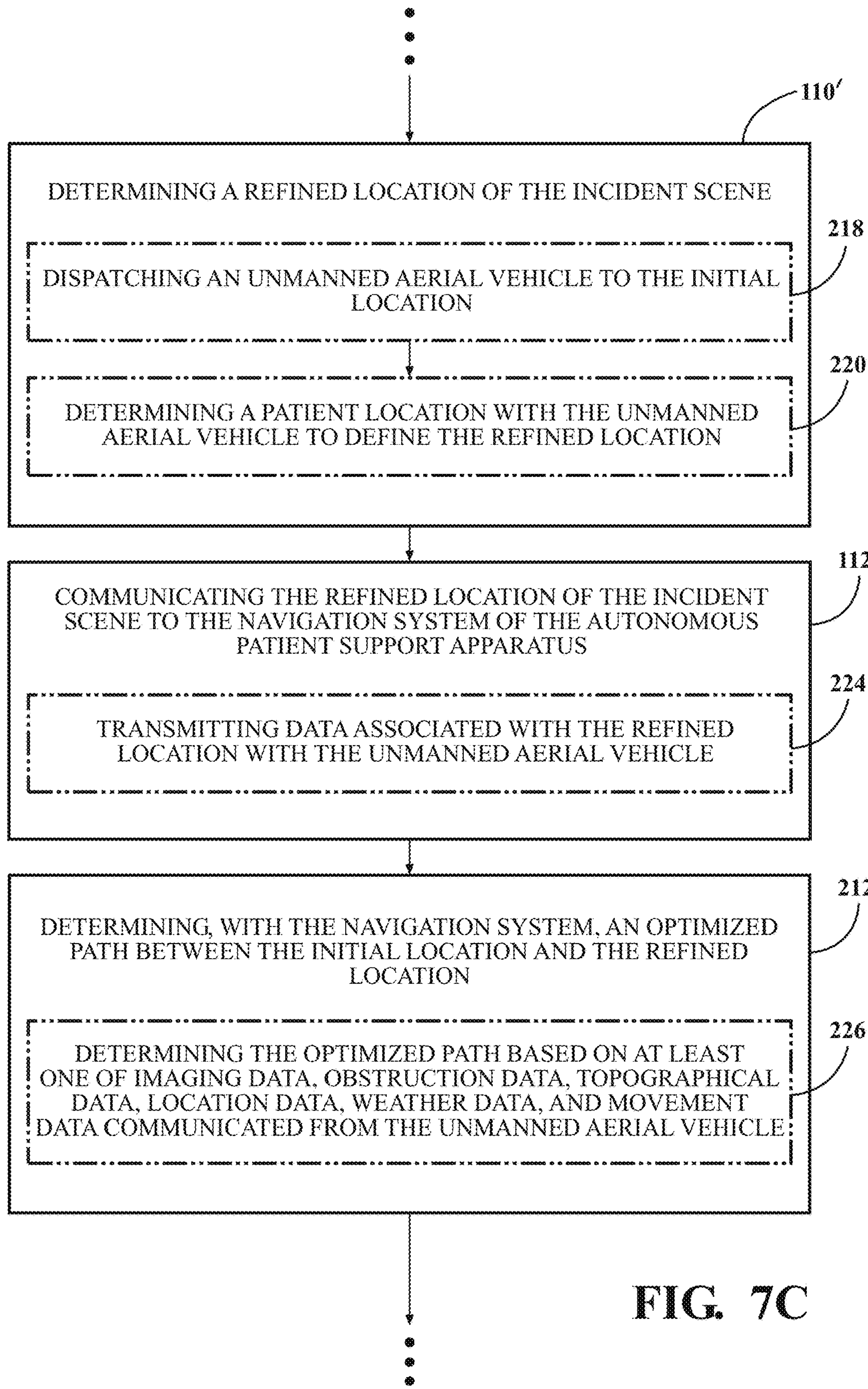

110′
DETERMINING A REFINED LOCATION OF THE INCIDENT SCENE
218
DISPATCHING AN UNMANNED AERIAL VEHICLE TO THE INITIAL LOCATION
220
DETERMINING A PATIENT LOCATION WITH THE UNMANNED AERIAL VEHICLE TO DEFINE THE REFINED LOCATION
112′
COMMUNICATING THE REFINED LOCATION OF THE INCIDENT SCENE TO THE NAVIGATION SYSTEM OF THE AUTONOMOUS PATIENT SUPPORT APPARATUS
224
TRANSMITTING DATA ASSOCIATED WITH THE REFINED LOCATION WITH THE UNMANNED AERIAL VEHICLE
212
DETERMINING, WITH THE NAVIGATION SYSTEM, AN OPTIMIZED PATH BETWEEN THE INITIAL LOCATION AND THE REFINED LOCATION
226
DETERMINING THE OPTIMIZED PATH BASED ON AT LEAST ONE OF IMAGING DATA, OBSTRUCTION DATA, TOPOGRAPHICAL DATA, LOCATION DATA, WEATHER DATA, AND MOVEMENT DATA COMMUNICATED FROM THE UNMANNED AERIAL VEHICLE

FIG. 7C

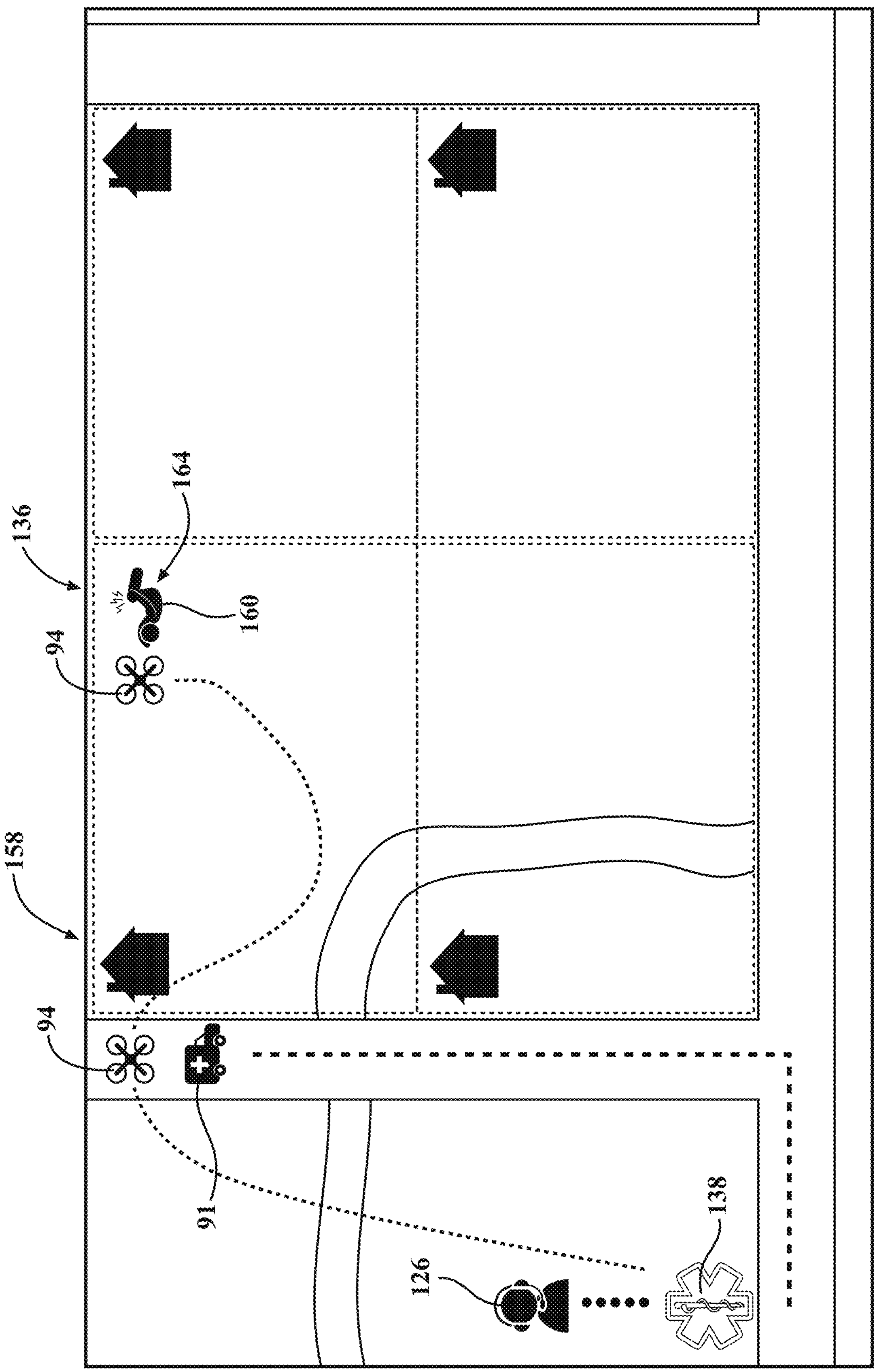


FIG. 7D

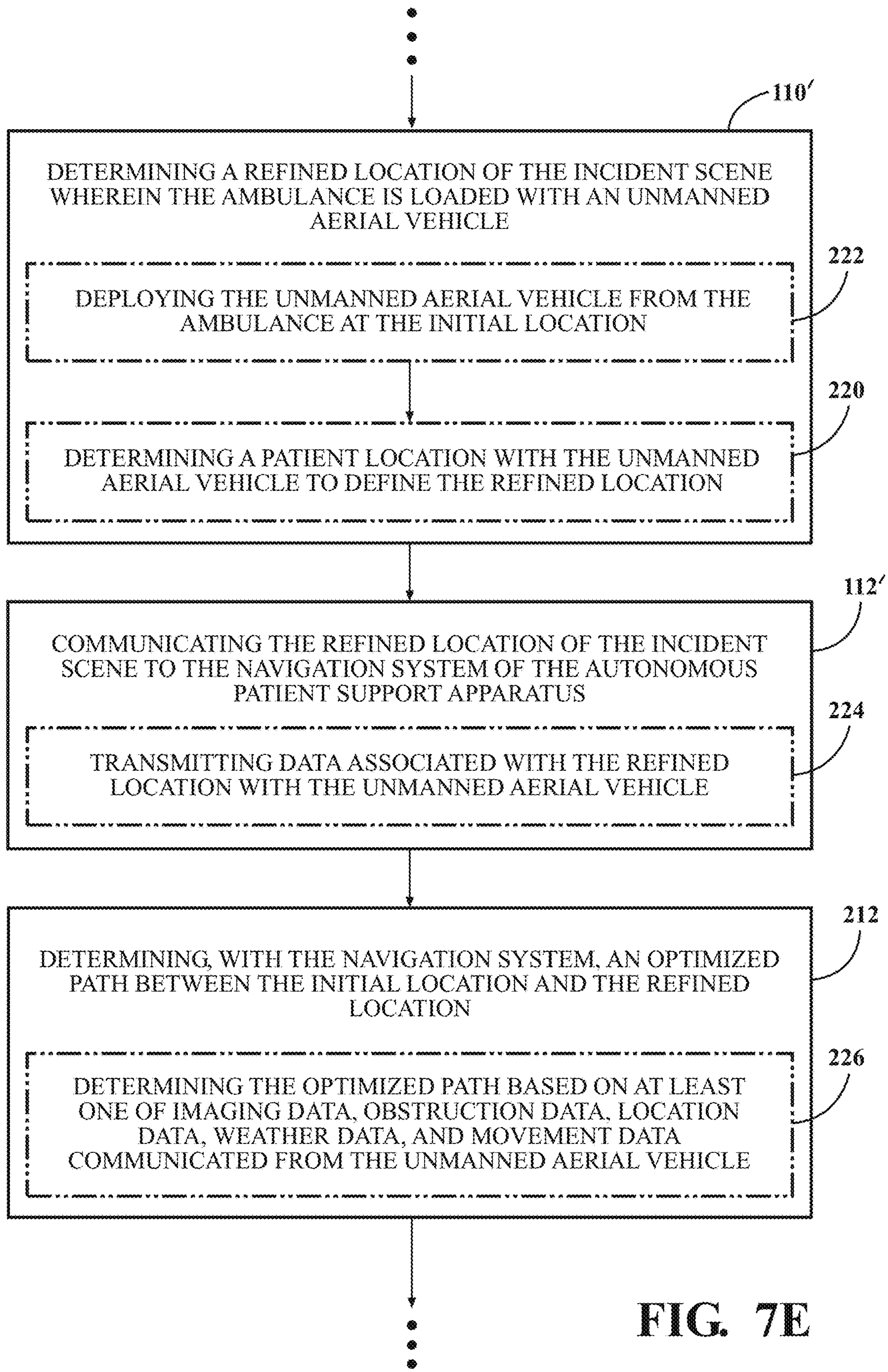

110′
DETERMINING A REFINED LOCATION OF THE INCIDENT SCENE WHEREIN THE AMBULANCE IS LOADED WITH AN UNMANNED AERIAL VEHICLE
222
DEPLOYING THE UNMANNED AERIAL VEHICLE FROM THE AMBULANCE AT THE INITIAL LOCATION
220
DETERMINING A PATIENT LOCATION WITH THE UNMANNED AERIAL VEHICLE TO DEFINE THE REFINED LOCATION
112′
COMMUNICATING THE REFINED LOCATION OF THE INCIDENT SCENE TO THE NAVIGATION SYSTEM OF THE AUTONOMOUS PATIENT SUPPORT APPARATUS
224
TRANSMITTING DATA ASSOCIATED WITH THE REFINED LOCATION WITH THE UNMANNED AERIAL VEHICLE
212
DETERMINING, WITH THE NAVIGATION SYSTEM, AN OPTIMIZED PATH BETWEEN THE INITIAL LOCATION AND THE REFINED LOCATION
226
DETERMINING THE OPTIMIZED PATH BASED ON AT LEAST ONE OF IMAGING DATA, OBSTRUCTION DATA, LOCATION DATA, WEATHER DATA, AND MOVEMENT DATA COMMUNICATED FROM THE UNMANNED AERIAL VEHICLE

FIG. 7E

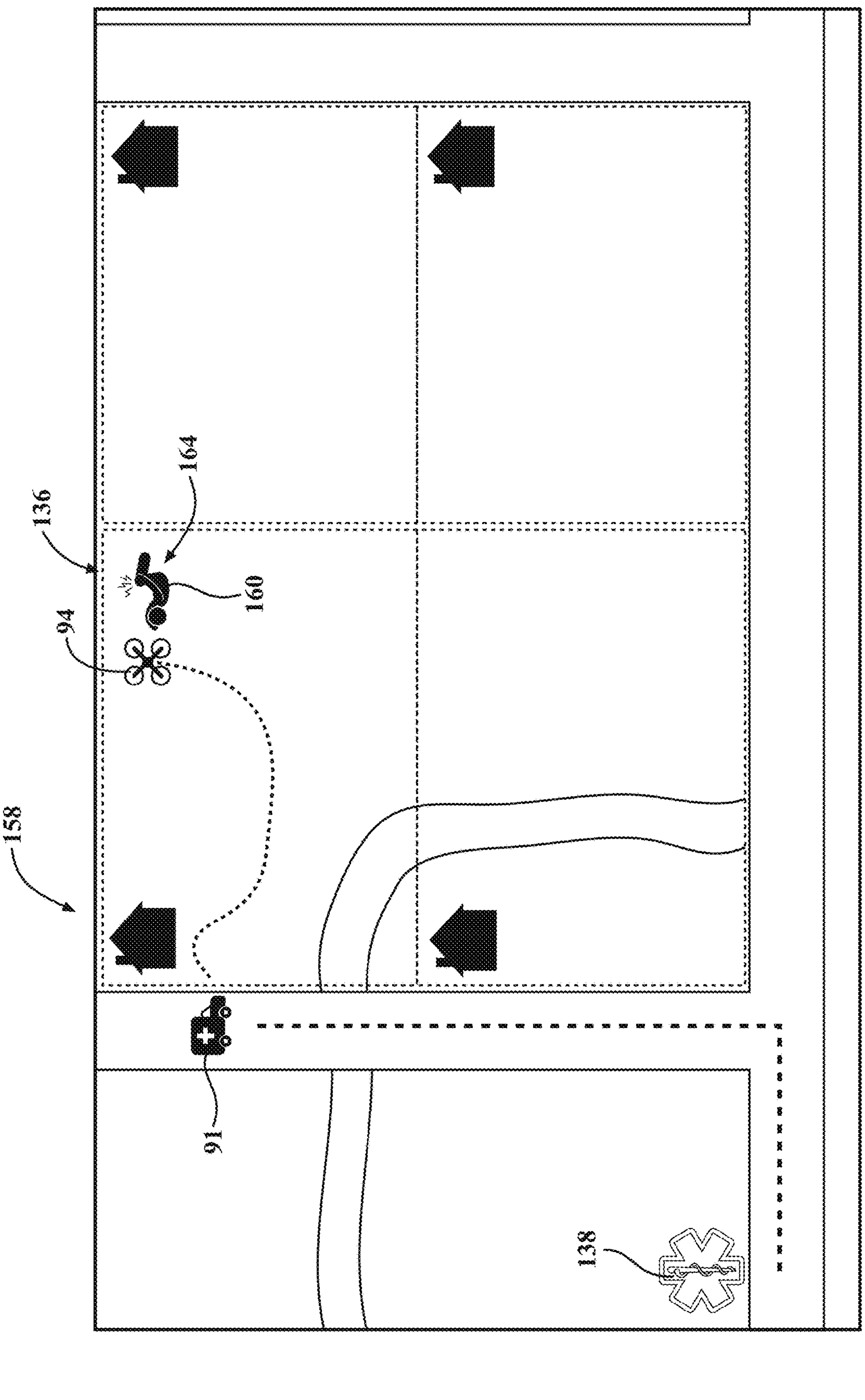


FIG. 7F

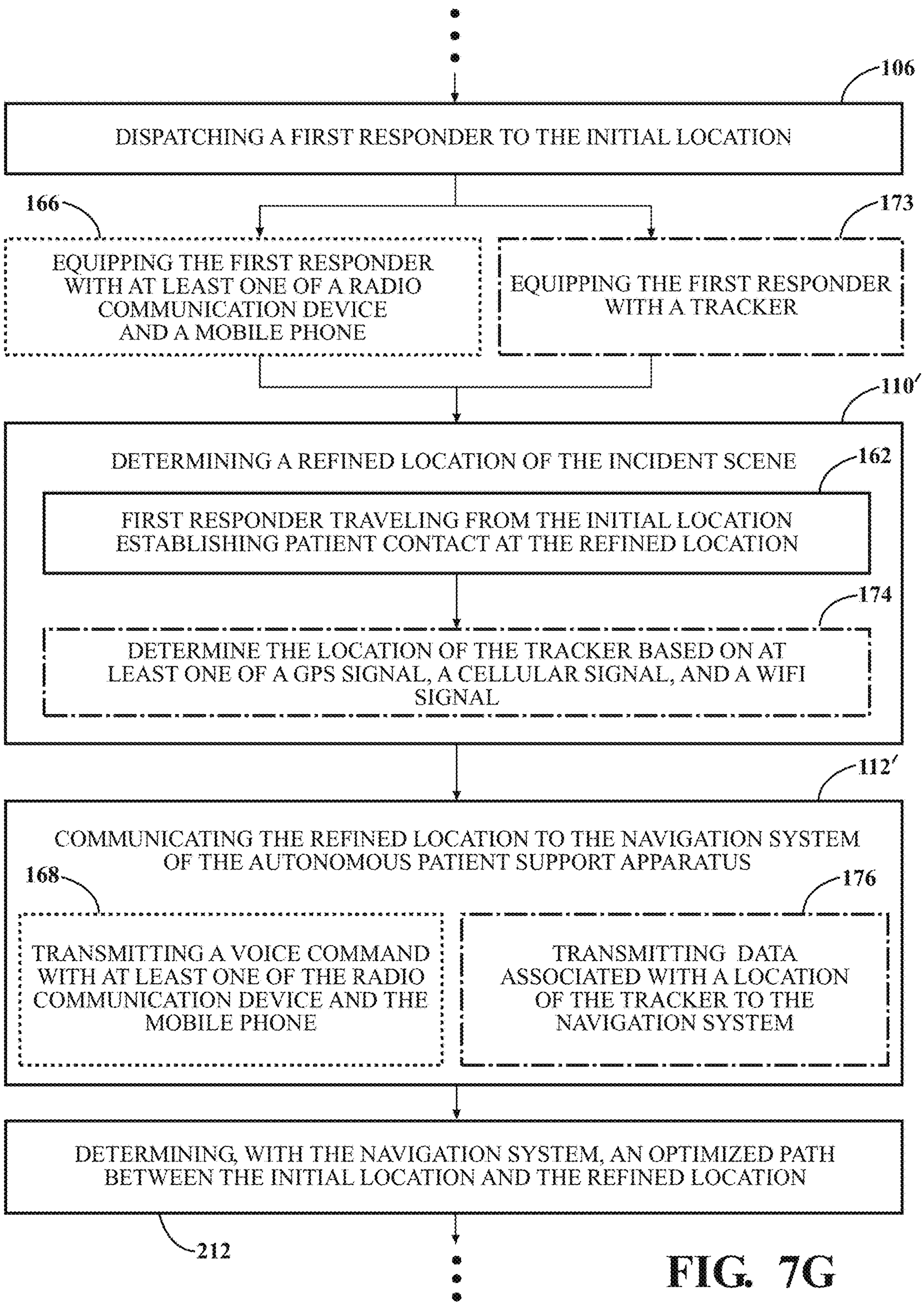

106
DISPATCHING A FIRST RESPONDER TO THE INITIAL LOCATION
166
EQUIPPING THE FIRST RESPONDER WITH AT LEAST ONE OF A RADIO COMMUNICATION DEVICE AND A MOBILE PHONE
173
EQUIPPING THE FIRST RESPONDER WITH A TRACKER
110′
DETERMINING A REFINED LOCATION OF THE INCIDENT SCENE
162
FIRST RESPONDER TRAVELING FROM THE INITIAL LOCATION ESTABLISHING PATIENT CONTACT AT THE REFINED LOCATION
174
DETERMINE THE LOCATION OF THE TRACKER BASED ON AT LEAST ONE OF A GPS SIGNAL, A CELLULAR SIGNAL, AND A WIFI SIGNAL
112′
COMMUNICATING THE REFINED LOCATION TO THE NAVIGATION SYSTEM OF THE AUTONOMOUS PATIENT SUPPORT APPARATUS
168
TRANSMITTING A VOICE COMMAND WITH AT LEAST ONE OF THE RADIO COMMUNICATION DEVICE AND THE MOBILE PHONE
176
TRANSMITTING DATA ASSOCIATED WITH A LOCATION OF THE TRACKER TO THE NAVIGATION SYSTEM
DETERMINING, WITH THE NAVIGATION SYSTEM, AN OPTIMIZED PATH BETWEEN THE INITIAL LOCATION AND THE REFINED LOCATION
212

FIG. 7G

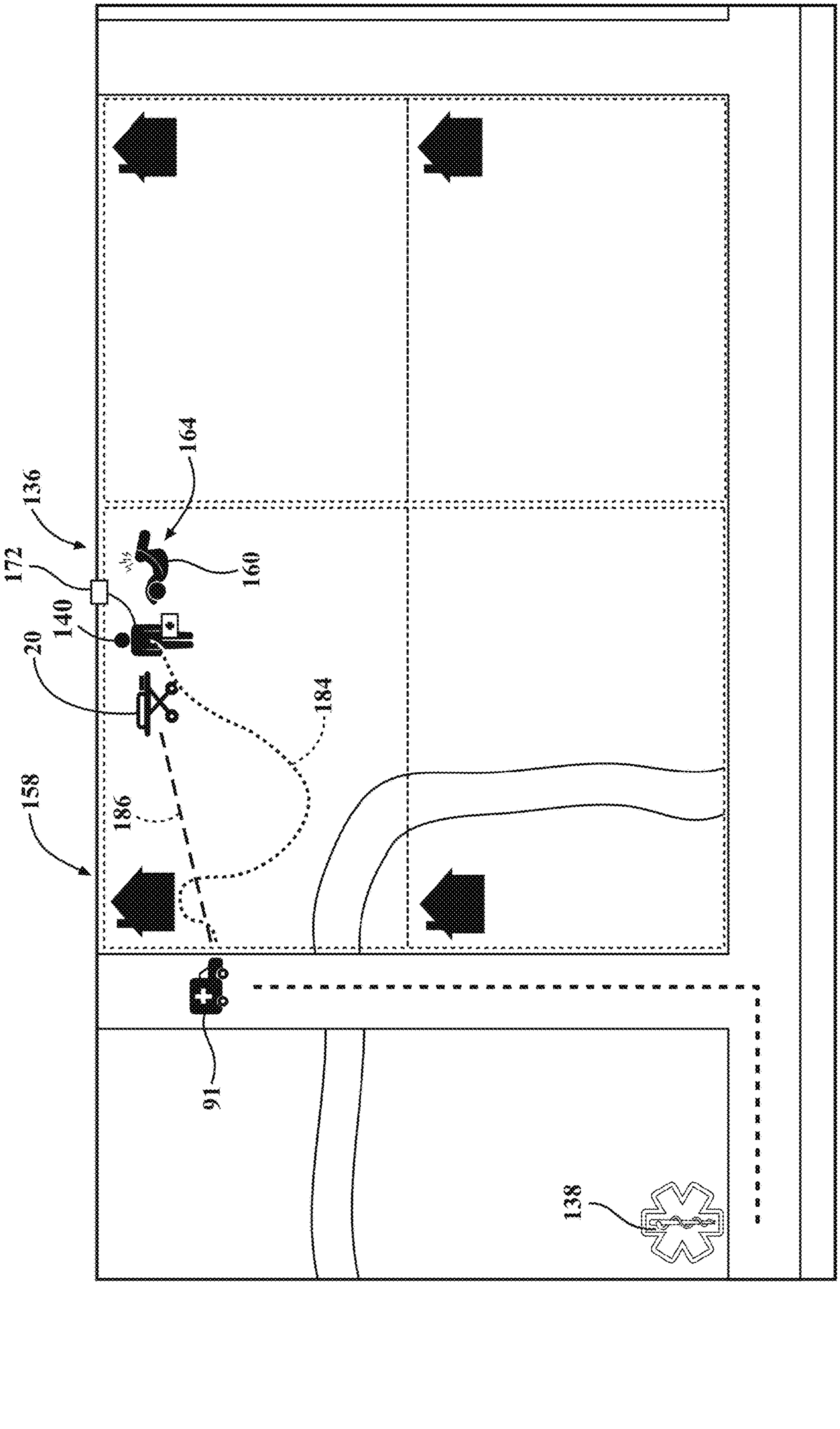


FIG. 7H

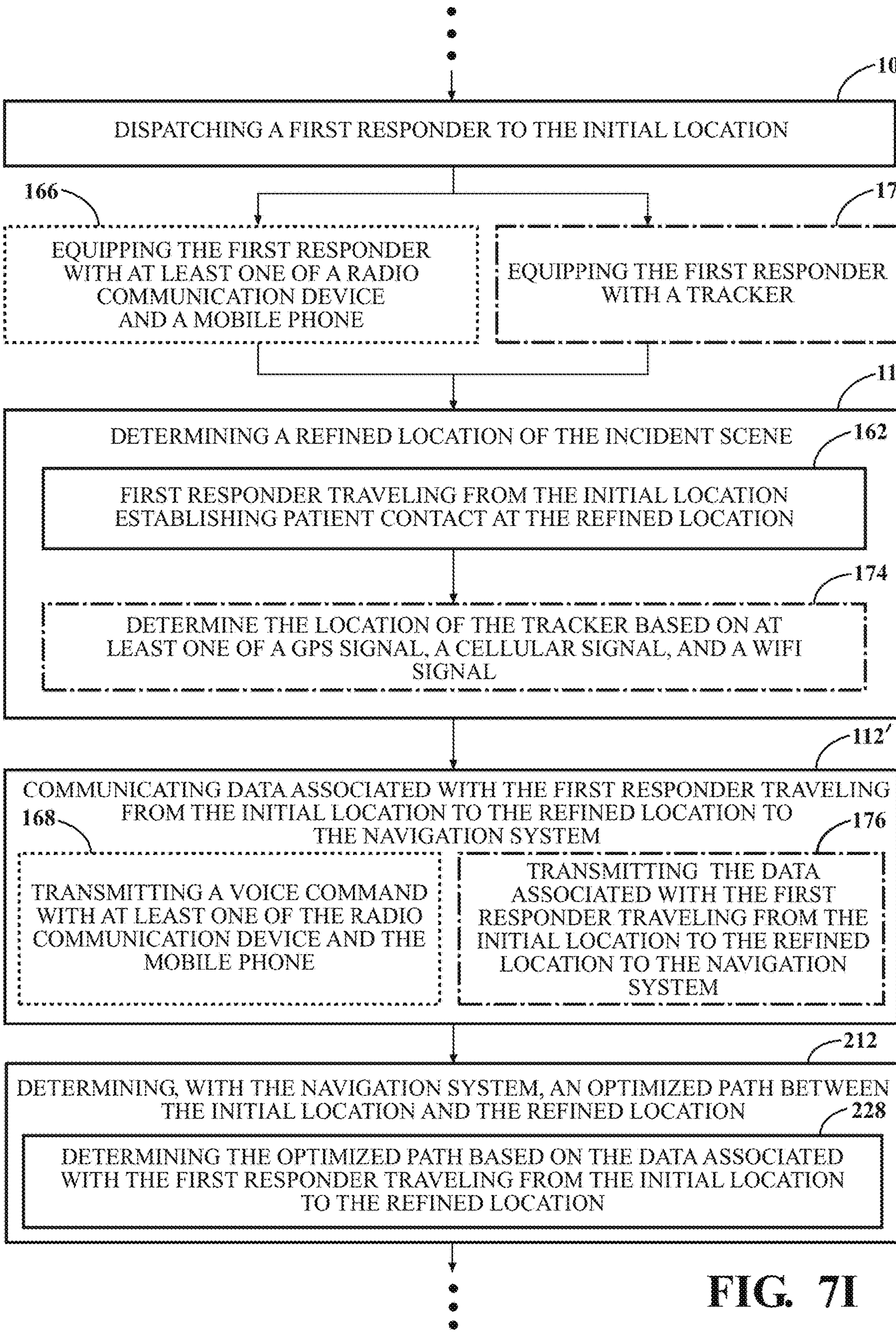

106
DISPATCHING A FIRST RESPONDER TO THE INITIAL LOCATION
166
EQUIPPING THE FIRST RESPONDER WITH AT LEAST ONE OF A RADIO COMMUNICATION DEVICE AND A MOBILE PHONE
173
EQUIPPING THE FIRST RESPONDER WITH A TRACKER
110′
DETERMINING A REFINED LOCATION OF THE INCIDENT SCENE
162
FIRST RESPONDER TRAVELING FROM THE INITIAL LOCATION ESTABLISHING PATIENT CONTACT AT THE REFINED LOCATION
174
DETERMINE THE LOCATION OF THE TRACKER BASED ON AT LEAST ONE OF A GPS SIGNAL, A CELLULAR SIGNAL, AND A WIFI SIGNAL
112′
COMMUNICATING DATA ASSOCIATED WITH THE FIRST RESPONDER TRAVELING FROM THE INITIAL LOCATION TO THE REFINED LOCATION TO THE NAVIGATION SYSTEM
168
TRANSMITTING A VOICE COMMAND WITH AT LEAST ONE OF THE RADIO COMMUNICATION DEVICE AND THE MOBILE PHONE
176
TRANSMITTING THE DATA ASSOCIATED WITH THE FIRST RESPONDER TRAVELING FROM THE INITIAL LOCATION TO THE REFINED LOCATION TO THE NAVIGATION SYSTEM
212
DETERMINING, WITH THE NAVIGATION SYSTEM, AN OPTIMIZED PATH BETWEEN THE INITIAL LOCATION AND THE REFINED LOCATION
228
DETERMINING THE OPTIMIZED PATH BASED ON THE DATA ASSOCIATED WITH THE FIRST RESPONDER TRAVELING FROM THE INITIAL LOCATION TO THE REFINED LOCATION

FIG. 7I

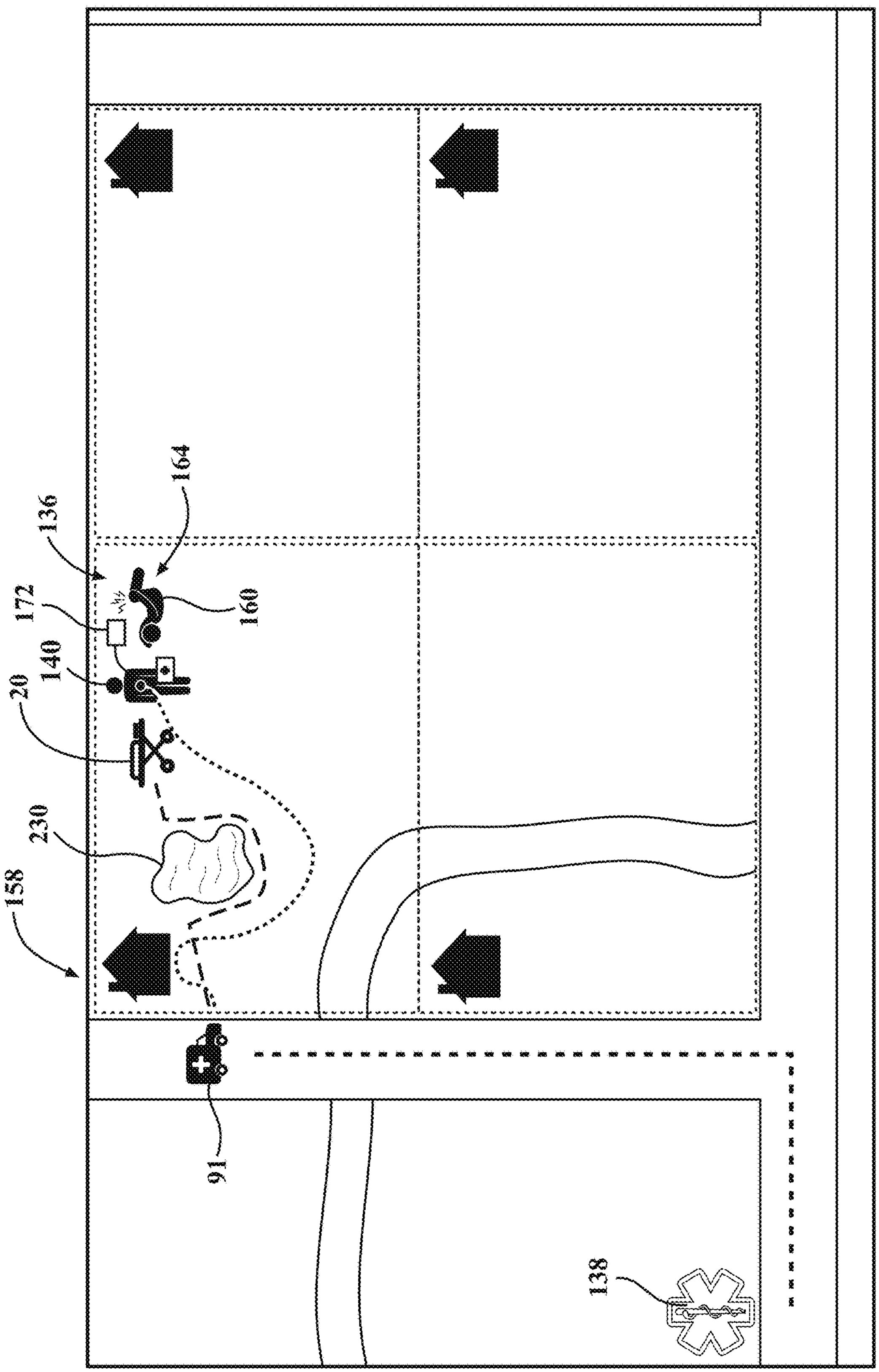


FIG. 7J

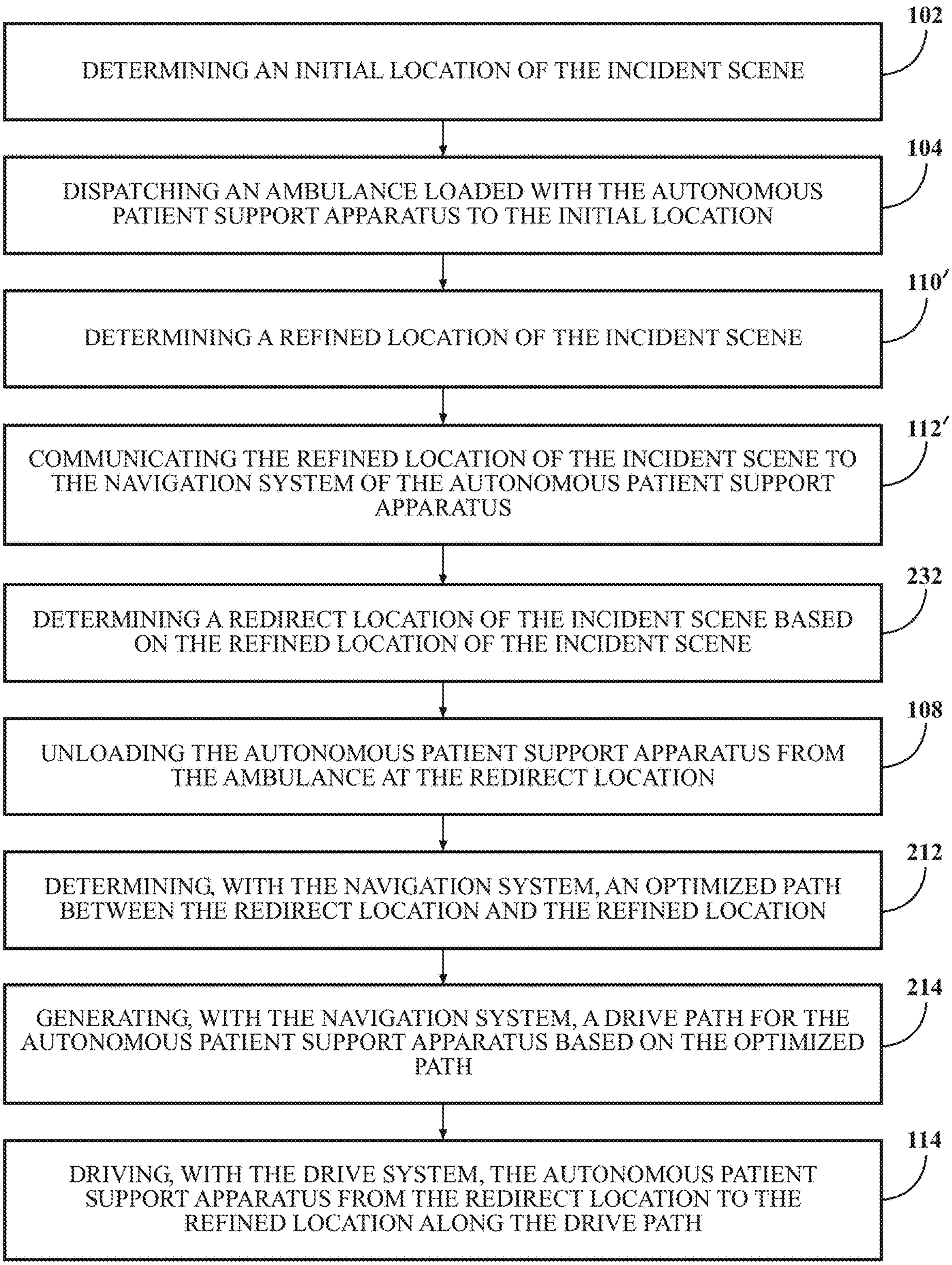

102
DETERMINING AN INITIAL LOCATION OF THE INCIDENT SCENE
104
DISPATCHING AN AMBULANCE LOADED WITH THE AUTONOMOUS PATIENT SUPPORT APPARATUS TO THE INITIAL LOCATION
110′
DETERMINING A REFINED LOCATION OF THE INCIDENT SCENE
112′
COMMUNICATING THE REFINED LOCATION OF THE INCIDENT SCENE TO THE NAVIGATION SYSTEM OF THE AUTONOMOUS PATIENT SUPPORT APPARATUS
232
DETERMINING A REDIRECT LOCATION OF THE INCIDENT SCENE BASED ON THE REFINED LOCATION OF THE INCIDENT SCENE
108
UNLOADING THE AUTONOMOUS PATIENT SUPPORT APPARATUS FROM THE AMBULANCE AT THE REDIRECT LOCATION
212
DETERMINING, WITH THE NAVIGATION SYSTEM, AN OPTIMIZED PATH BETWEEN THE REDIRECT LOCATION AND THE REFINED LOCATION
214
GENERATING, WITH THE NAVIGATION SYSTEM, A DRIVE PATH FOR THE AUTONOMOUS PATIENT SUPPORT APPARATUS BASED ON THE OPTIMIZED PATH
114
DRIVING, WITH THE DRIVE SYSTEM, THE AUTONOMOUS PATIENT SUPPORT APPARATUS FROM THE REDIRECT LOCATION TO THE REFINED LOCATION ALONG THE DRIVE PATH

FIG. 7K

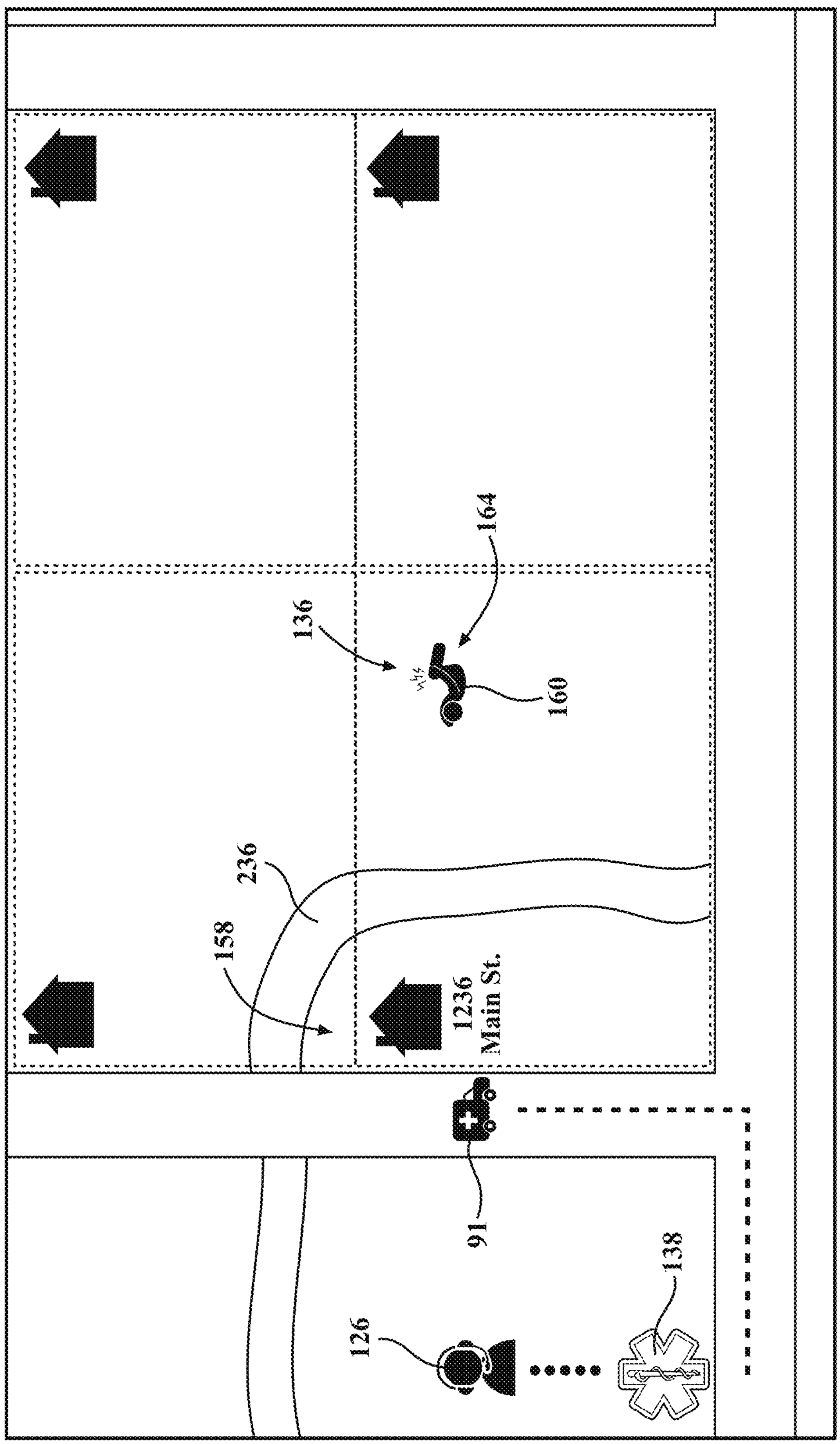


FIG. 7L

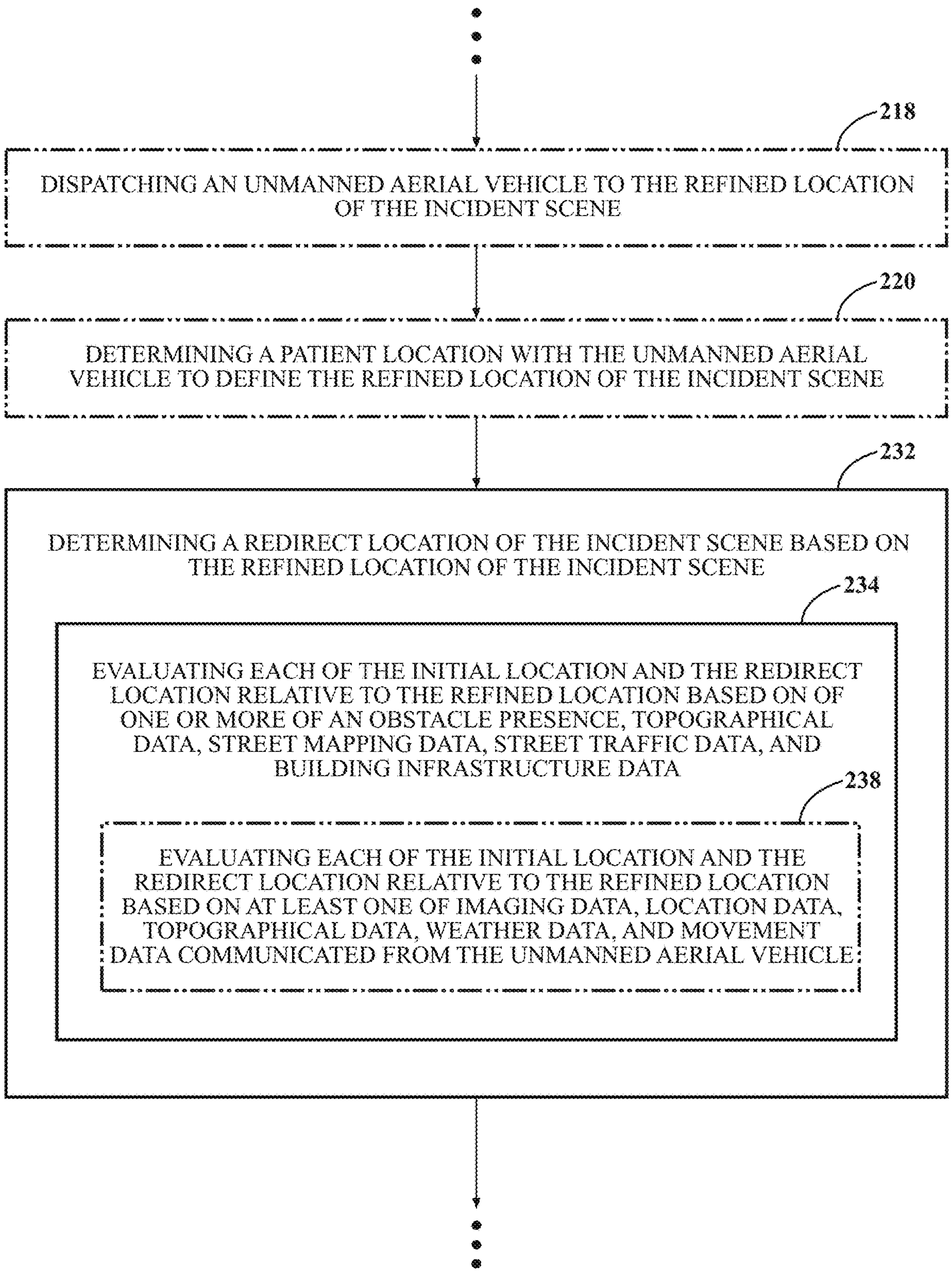

218
DISPATCHING AN UNMANNED AERIAL VEHICLE TO THE REFINED LOCATION OF THE INCIDENT SCENE
220
DETERMINING A PATIENT LOCATION WITH THE UNMANNED AERIAL VEHICLE TO DEFINE THE REFINED LOCATION OF THE INCIDENT SCENE
232
DETERMINING A REDIRECT LOCATION OF THE INCIDENT SCENE BASED ON THE REFINED LOCATION OF THE INCIDENT SCENE
234
EVALUATING EACH OF THE INITIAL LOCATION AND THE REDIRECT LOCATION RELATIVE TO THE REFINED LOCATION BASED ON OF ONE OR MORE OF AN OBSTACLE PRESENCE, TOPOGRAPHICAL DATA, STREET MAPPING DATA, STREET TRAFFIC DATA, AND BUILDING INFRASTRUCTURE DATA
238
EVALUATING EACH OF THE INITIAL LOCATION AND THE REDIRECT LOCATION RELATIVE TO THE REFINED LOCATION BASED ON AT LEAST ONE OF IMAGING DATA, LOCATION DATA, TOPOGRAPHICAL DATA, WEATHER DATA, AND MOVEMENT DATA COMMUNICATED FROM THE UNMANNED AERIAL VEHICLE

FIG. 7M

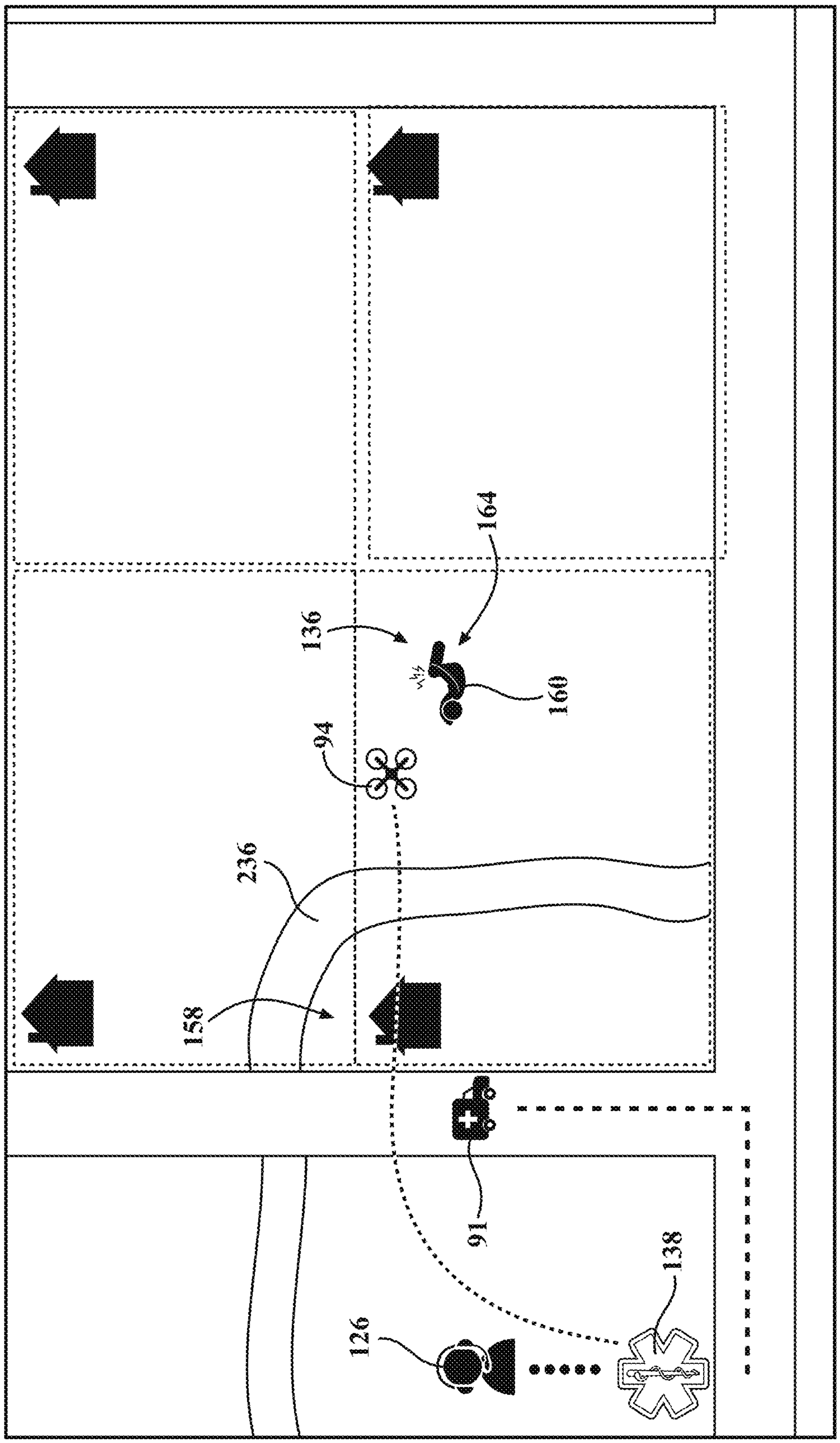


FIG. 7N

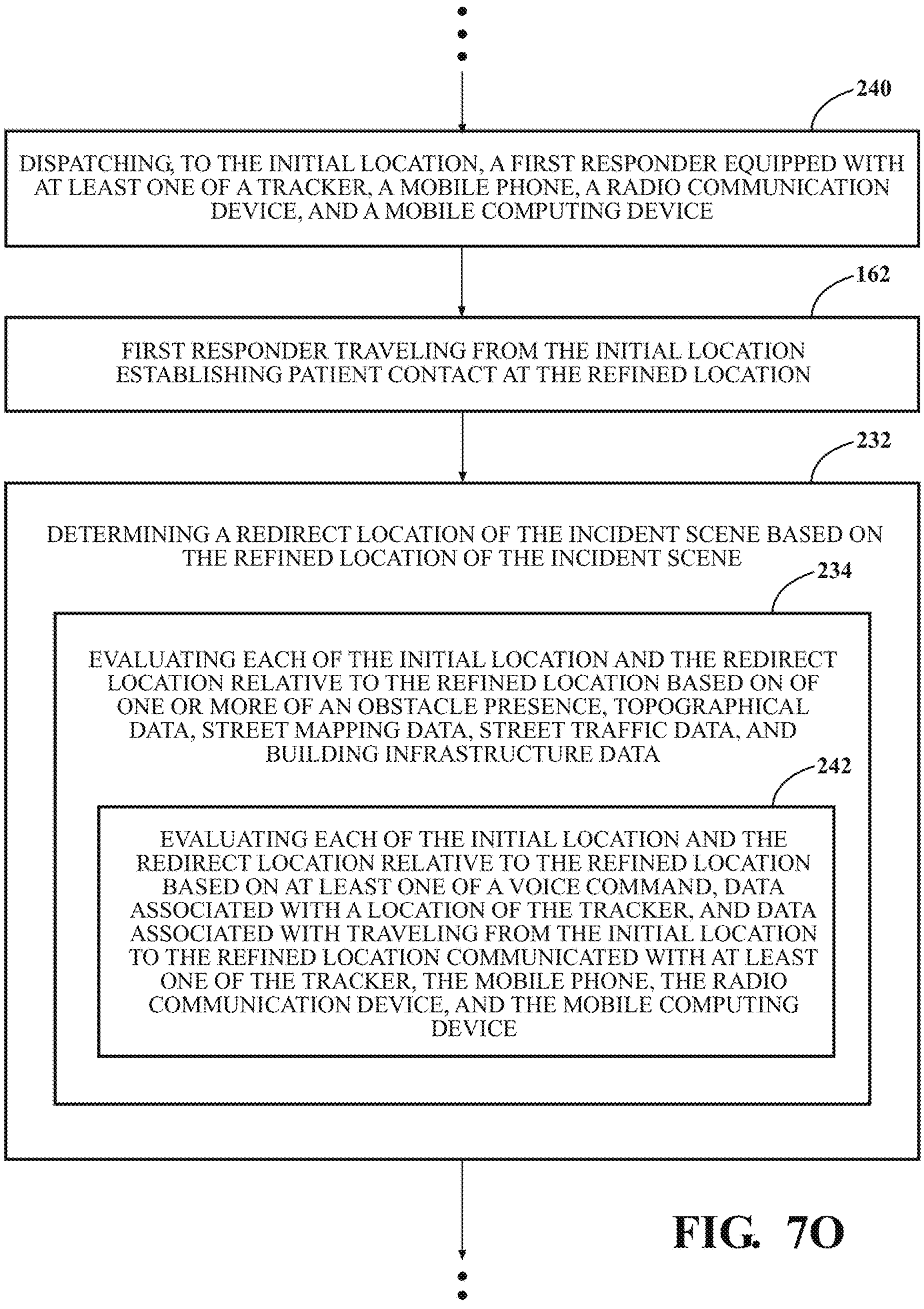

240
DISPATCHING, TO THE INITIAL LOCATION, A FIRST RESPONDER EQUIPPED WITH AT LEAST ONE OF A TRACKER, A MOBILE PHONE, A RADIO COMMUNICATION DEVICE, AND A MOBILE COMPUTING DEVICE
162
FIRST RESPONDER TRAVELING FROM THE INITIAL LOCATION ESTABLISHING PATIENT CONTACT AT THE REFINED LOCATION
232
DETERMINING A REDIRECT LOCATION OF THE INCIDENT SCENE BASED ON THE REFINED LOCATION OF THE INCIDENT SCENE
234
EVALUATING EACH OF THE INITIAL LOCATION AND THE REDIRECT LOCATION RELATIVE TO THE REFINED LOCATION BASED ON OF ONE OR MORE OF AN OBSTACLE PRESENCE, TOPOGRAPHICAL DATA, STREET MAPPING DATA, STREET TRAFFIC DATA, AND BUILDING INFRASTRUCTURE DATA
242
EVALUATING EACH OF THE INITIAL LOCATION AND THE REDIRECT LOCATION RELATIVE TO THE REFINED LOCATION BASED ON AT LEAST ONE OF A VOICE COMMAND, DATA ASSOCIATED WITH A LOCATION OF THE TRACKER, AND DATA ASSOCIATED WITH TRAVELING FROM THE INITIAL LOCATION TO THE REFINED LOCATION COMMUNICATED WITH AT LEAST ONE OF THE TRACKER, THE MOBILE PHONE, THE RADIO COMMUNICATION DEVICE, AND THE MOBILE COMPUTING DEVICE

FIG. 7O

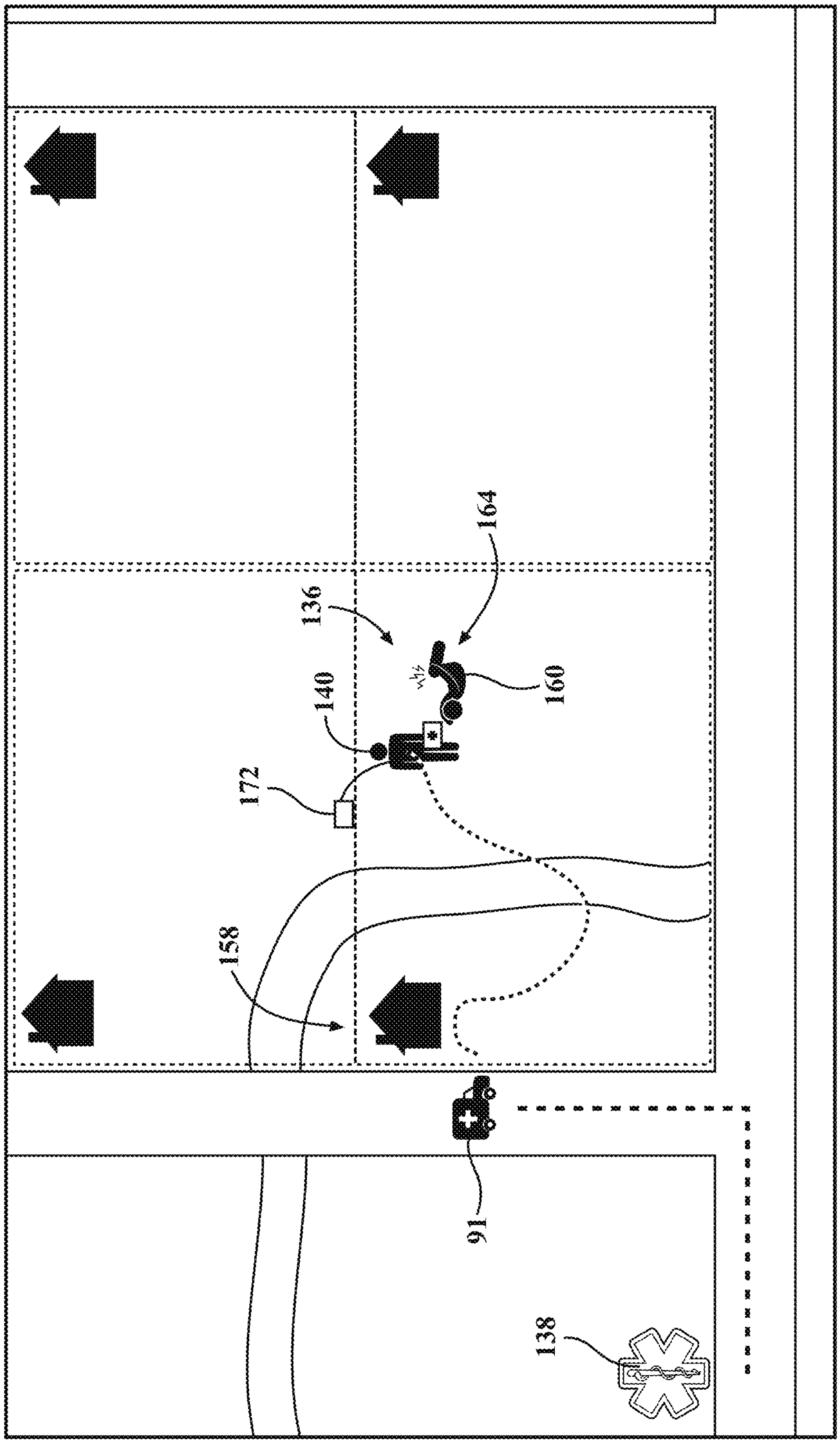


FIG. 7P

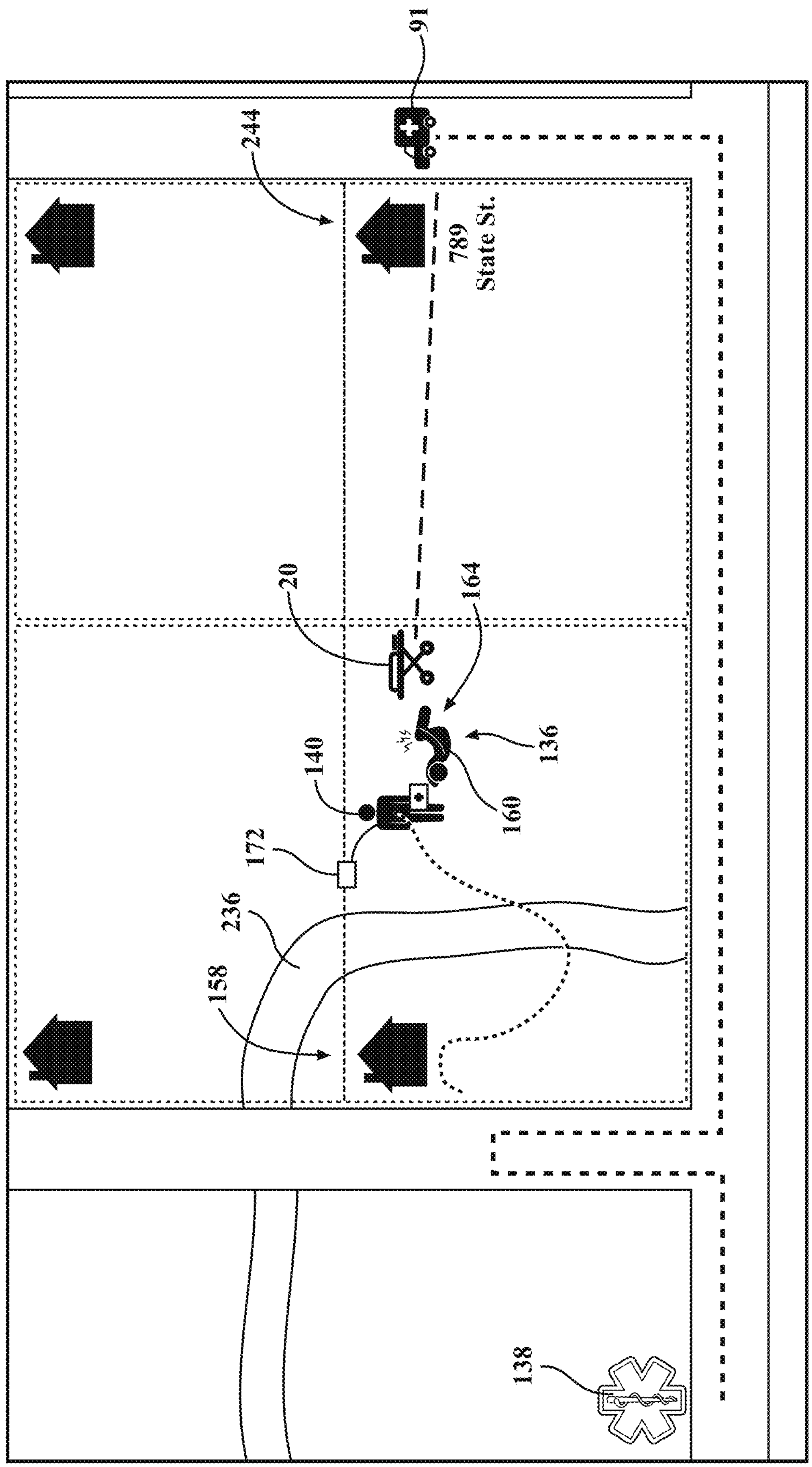


FIG. 7Q

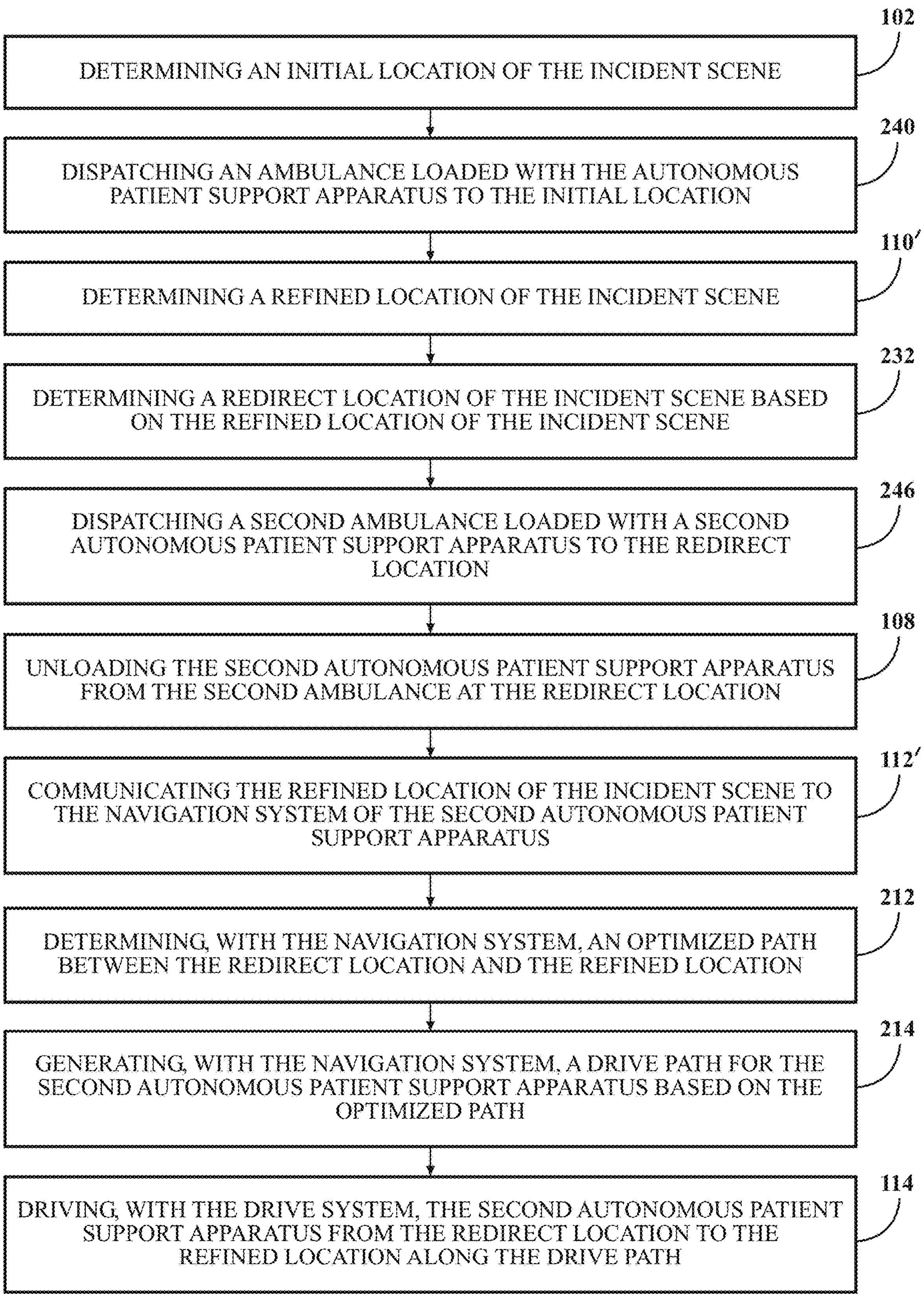

102
DETERMINING AN INITIAL LOCATION OF THE INCIDENT SCENE
240
DISPATCHING AN AMBULANCE LOADED WITH THE AUTONOMOUS PATIENT SUPPORT APPARATUS TO THE INITIAL LOCATION
110′
DETERMINING A REFINED LOCATION OF THE INCIDENT SCENE
232
DETERMINING A REDIRECT LOCATION OF THE INCIDENT SCENE BASED ON THE REFINED LOCATION OF THE INCIDENT SCENE
246
DISPATCHING A SECOND AMBULANCE LOADED WITH A SECOND AUTONOMOUS PATIENT SUPPORT APPARATUS TO THE REDIRECT LOCATION
108
UNLOADING THE SECOND AUTONOMOUS PATIENT SUPPORT APPARATUS FROM THE SECOND AMBULANCE AT THE REDIRECT LOCATION
112′
COMMUNICATING THE REFINED LOCATION OF THE INCIDENT SCENE TO THE NAVIGATION SYSTEM OF THE SECOND AUTONOMOUS PATIENT SUPPORT APPARATUS
212
DETERMINING, WITH THE NAVIGATION SYSTEM, AN OPTIMIZED PATH BETWEEN THE REDIRECT LOCATION AND THE REFINED LOCATION
214
GENERATING, WITH THE NAVIGATION SYSTEM, A DRIVE PATH FOR THE SECOND AUTONOMOUS PATIENT SUPPORT APPARATUS BASED ON THE OPTIMIZED PATH
114
DRIVING, WITH THE DRIVE SYSTEM, THE SECOND AUTONOMOUS PATIENT SUPPORT APPARATUS FROM THE REDIRECT LOCATION TO THE REFINED LOCATION ALONG THE DRIVE PATH

FIG. 7R

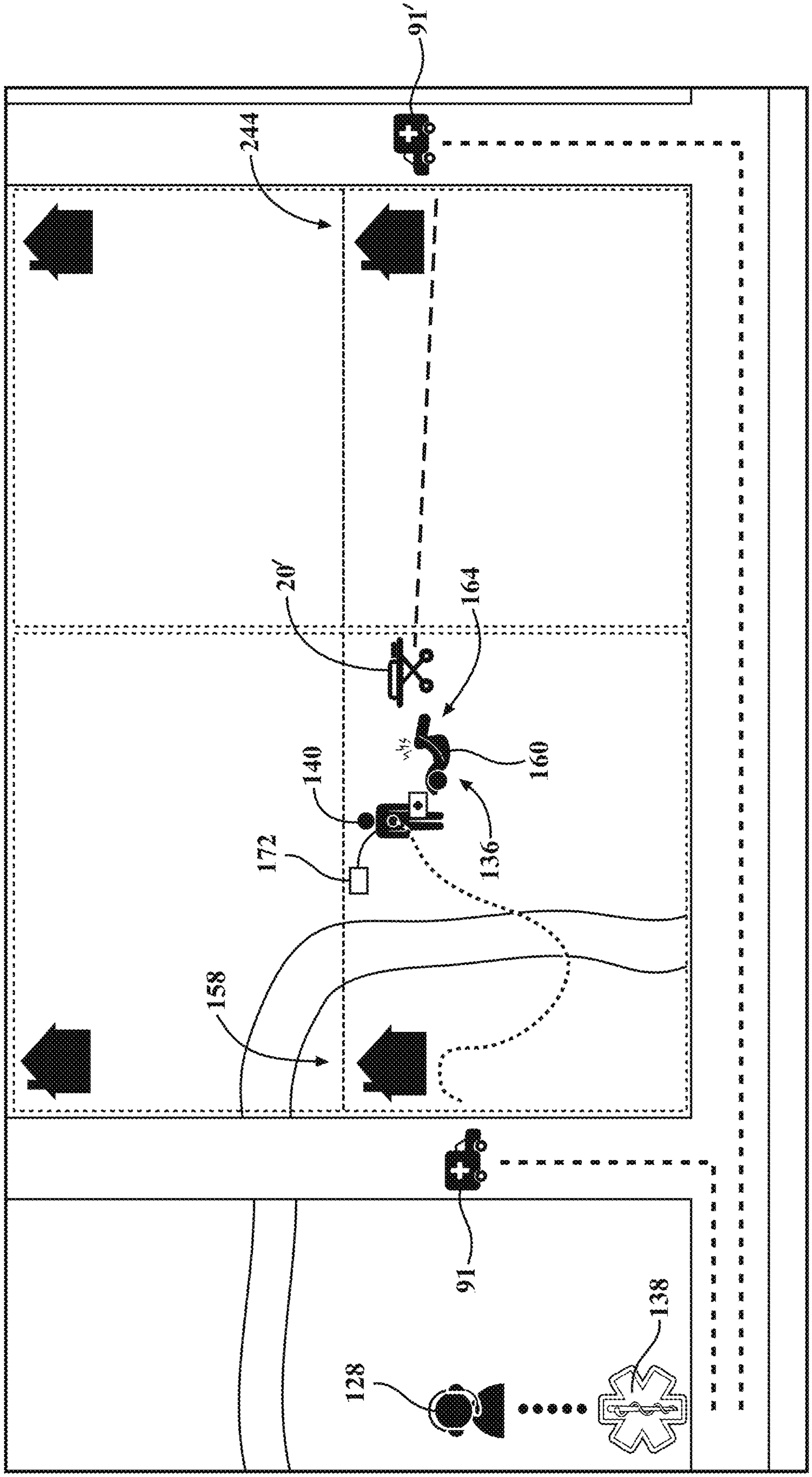


FIG. 7S

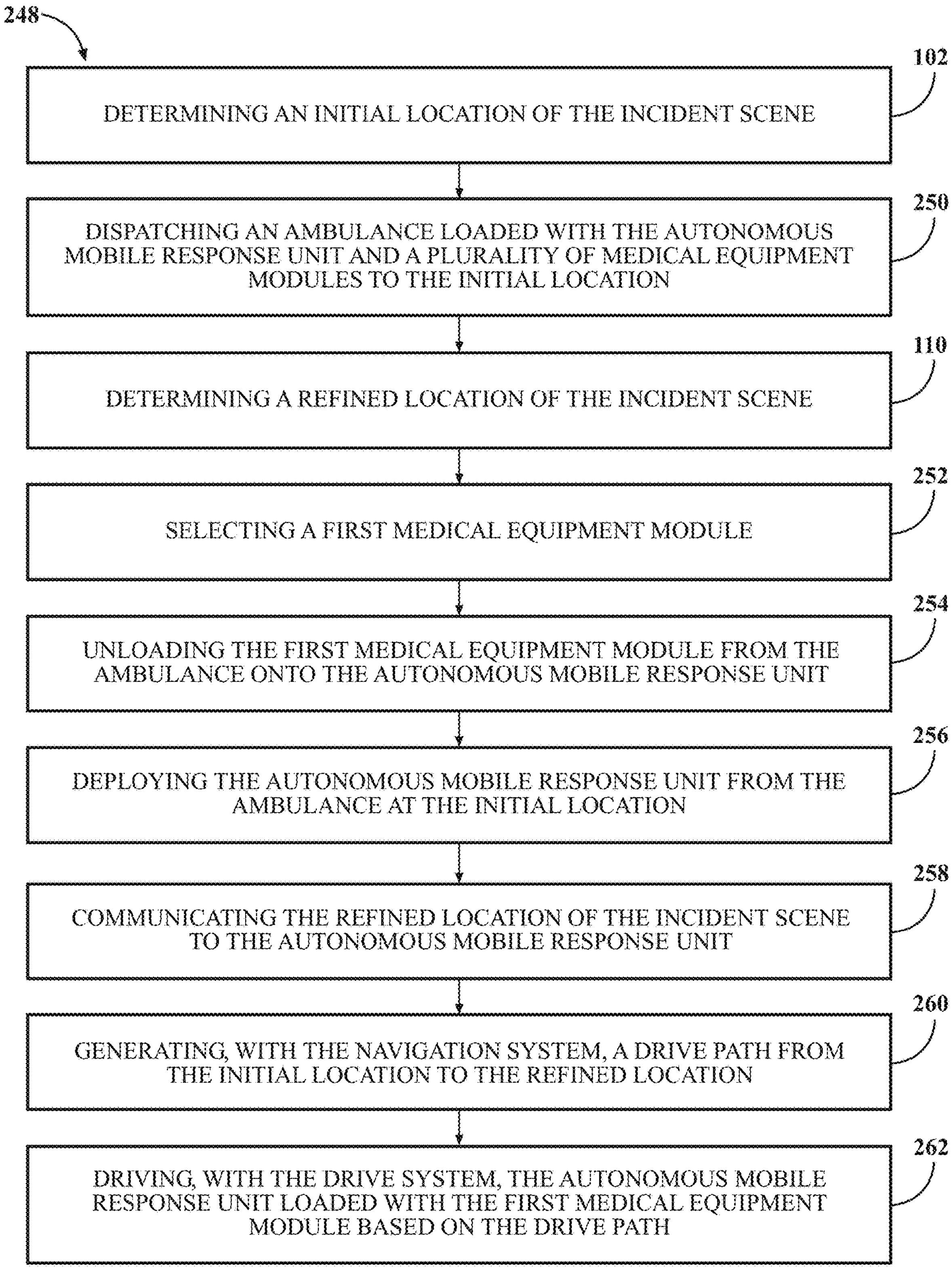

248
102
DETERMINING AN INITIAL LOCATION OF THE INCIDENT SCENE
250
DISPATCHING AN AMBULANCE LOADED WITH THE AUTONOMOUS MOBILE RESPONSE UNIT AND A PLURALITY OF MEDICAL EQUIPMENT MODULES TO THE INITIAL LOCATION
110
DETERMINING A REFINED LOCATION OF THE INCIDENT SCENE
252
SELECTING A FIRST MEDICAL EQUIPMENT MODULE
254
UNLOADING THE FIRST MEDICAL EQUIPMENT MODULE FROM THE AMBULANCE ONTO THE AUTONOMOUS MOBILE RESPONSE UNIT
256
DEPLOYING THE AUTONOMOUS MOBILE RESPONSE UNIT FROM THE AMBULANCE AT THE INITIAL LOCATION
258
COMMUNICATING THE REFINED LOCATION OF THE INCIDENT SCENE TO THE AUTONOMOUS MOBILE RESPONSE UNIT
260
GENERATING, WITH THE NAVIGATION SYSTEM, A DRIVE PATH FROM THE INITIAL LOCATION TO THE REFINED LOCATION
262
DRIVING, WITH THE DRIVE SYSTEM, THE AUTONOMOUS MOBILE RESPONSE UNIT LOADED WITH THE FIRST MEDICAL EQUIPMENT MODULE BASED ON THE DRIVE PATH

FIG. 8A

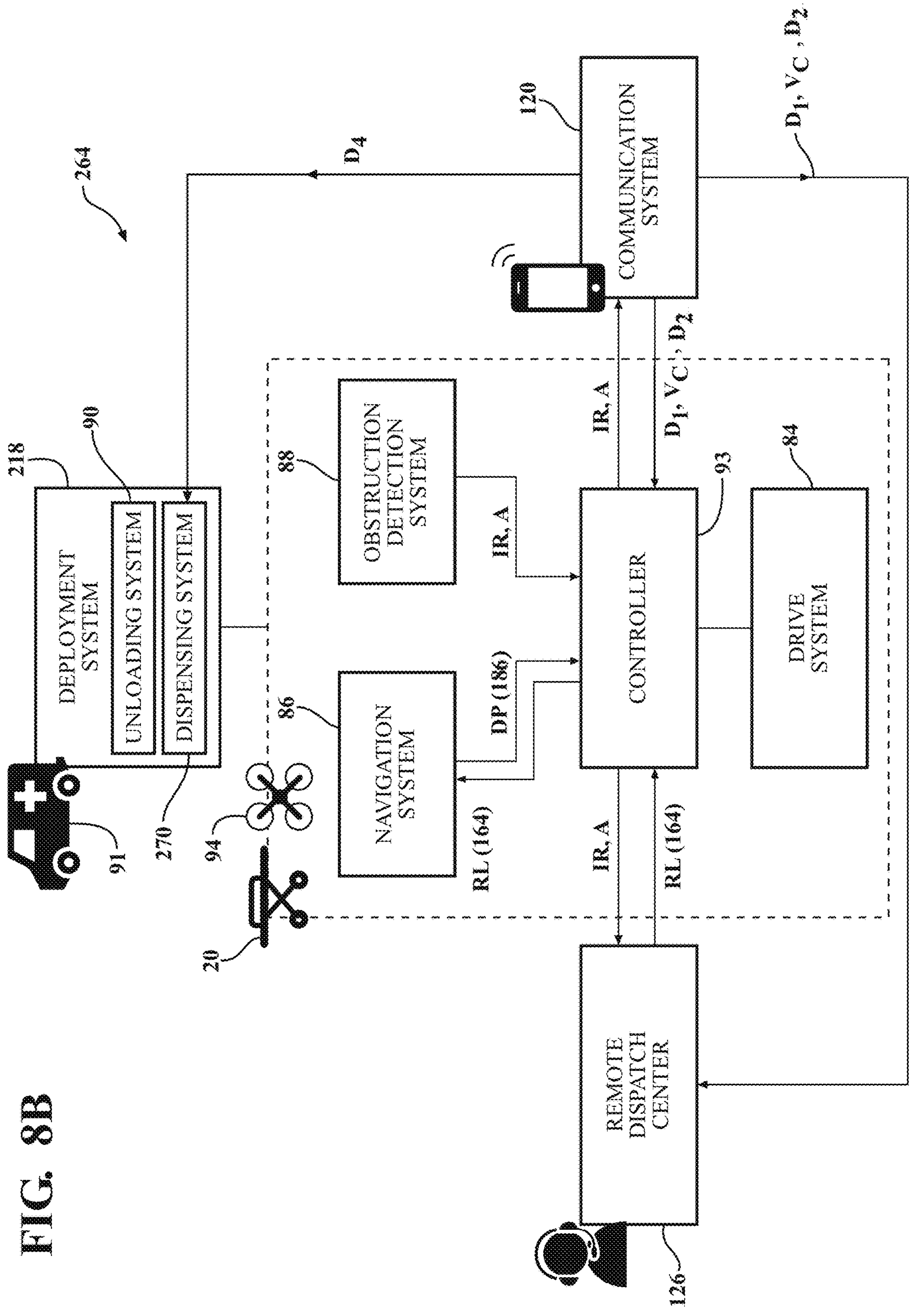

264
DEPLOYMENT SYSTEM
UNLOADING SYSTEM
DISPENSING SYSTEM
218
90
270
91
94
20
86
NAVIGATION SYSTEM
88
OBSTRUCTION DETECTION SYSTEM
IR, A
DP (186)
RL (164)
CONTROLLER
93
DRIVE SYSTEM
84
IR, A
D_1, V_C, D_2
COMMUNICATION SYSTEM
120
D_4
D_1, V_C, D_2
IR, A
RL (164)
REMOTE DISPATCH CENTER
126

FIG. 8B

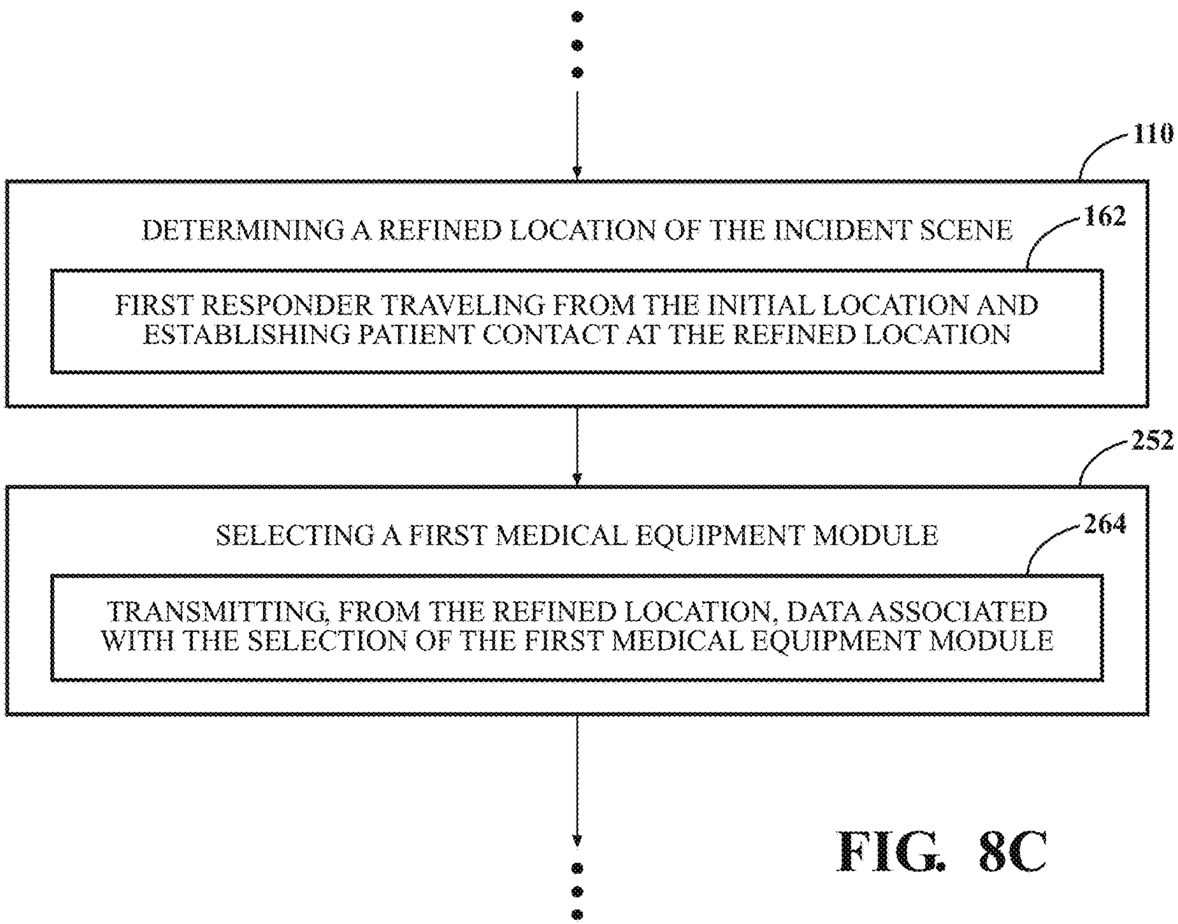

110
DETERMINING A REFINED LOCATION OF THE INCIDENT SCENE
162
FIRST RESPONDER TRAVELING FROM THE INITIAL LOCATION AND ESTABLISHING PATIENT CONTACT AT THE REFINED LOCATION
252
SELECTING A FIRST MEDICAL EQUIPMENT MODULE
264
TRANSMITTING, FROM THE REFINED LOCATION, DATA ASSOCIATED WITH THE SELECTION OF THE FIRST MEDICAL EQUIPMENT MODULE

FIG. 8C

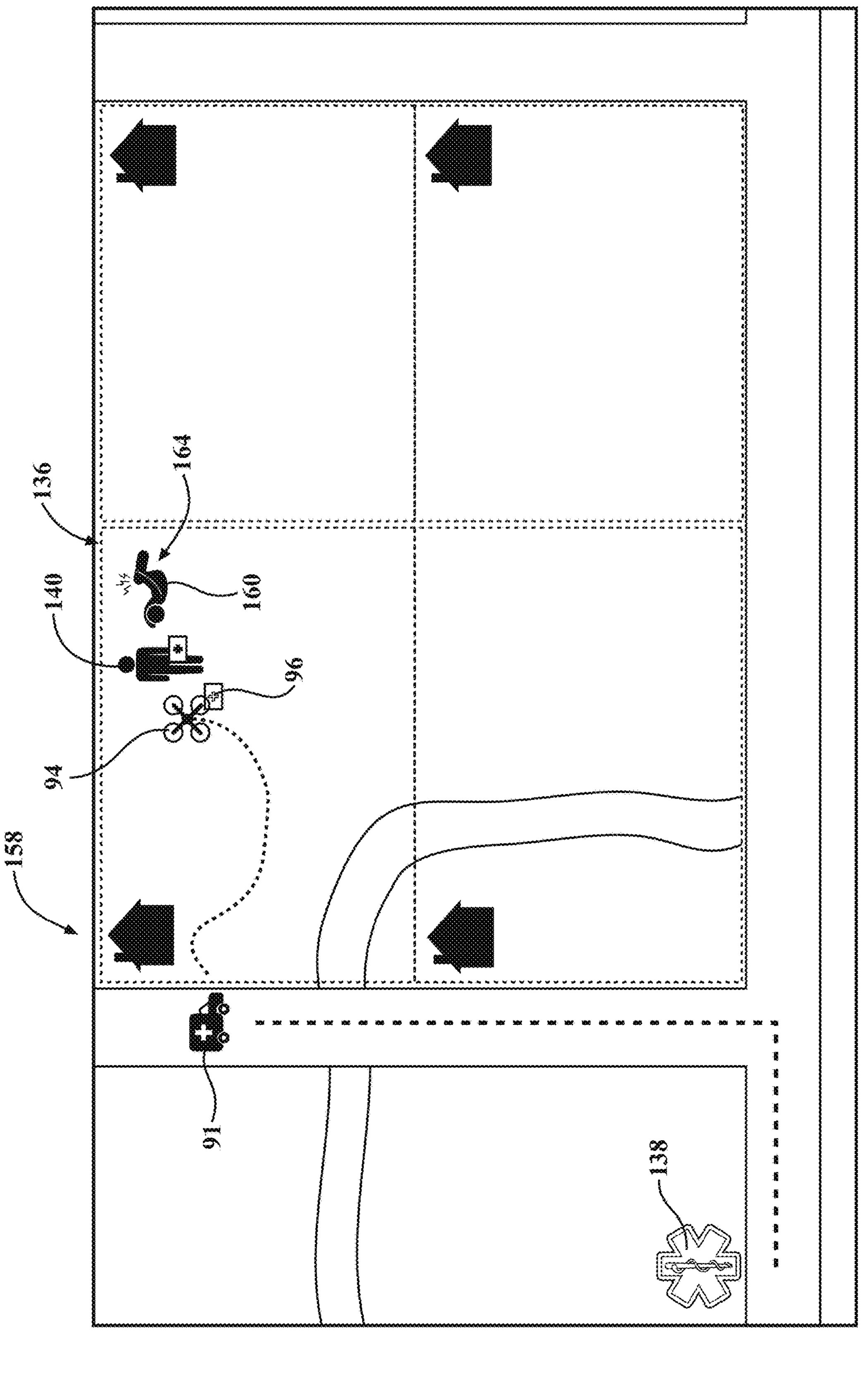


FIG. 8D

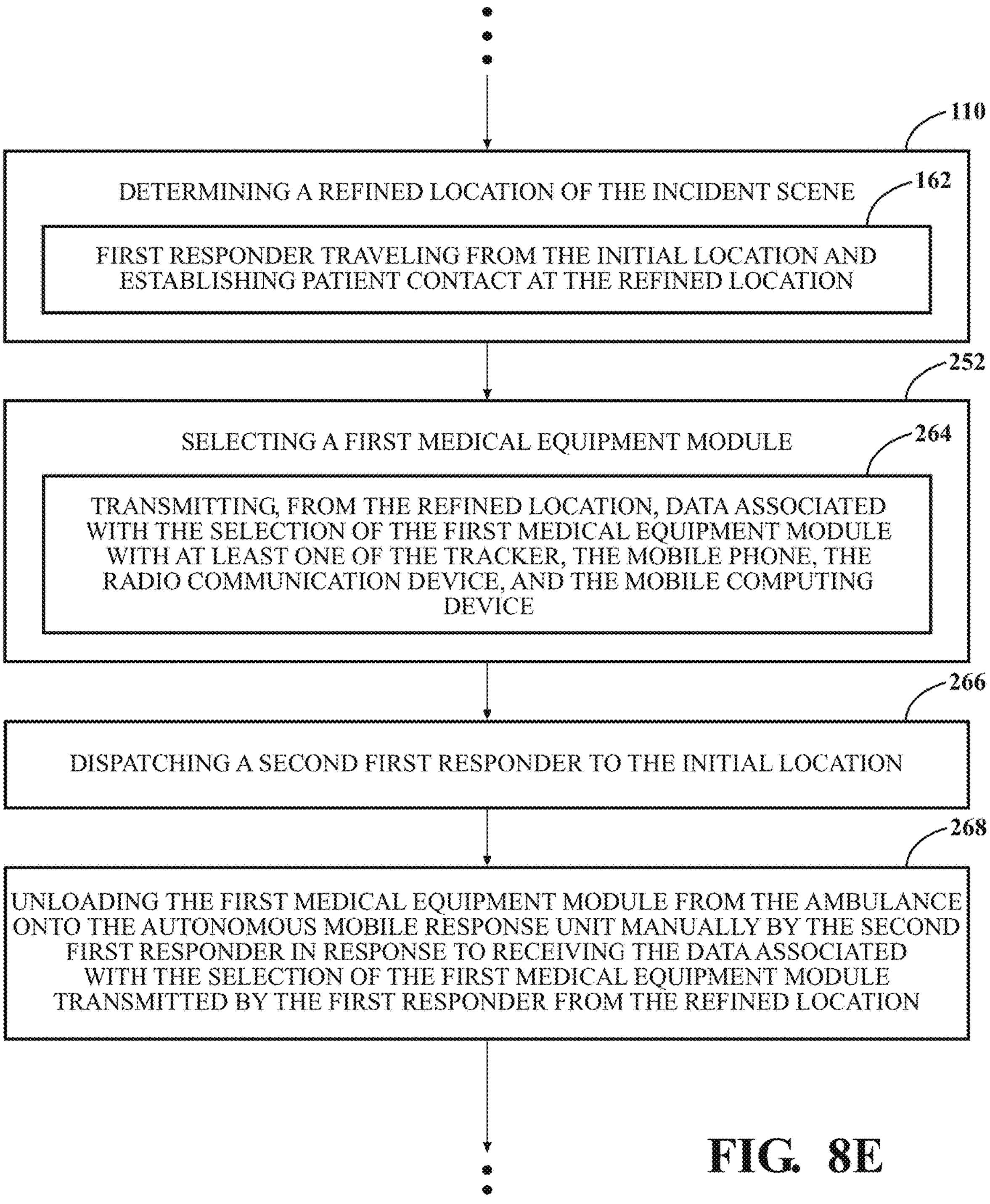

110
DETERMINING A REFINED LOCATION OF THE INCIDENT SCENE
162
FIRST RESPONDER TRAVELING FROM THE INITIAL LOCATION AND ESTABLISHING PATIENT CONTACT AT THE REFINED LOCATION
252
SELECTING A FIRST MEDICAL EQUIPMENT MODULE
264
TRANSMITTING, FROM THE REFINED LOCATION, DATA ASSOCIATED WITH THE SELECTION OF THE FIRST MEDICAL EQUIPMENT MODULE WITH AT LEAST ONE OF THE TRACKER, THE MOBILE PHONE, THE RADIO COMMUNICATION DEVICE, AND THE MOBILE COMPUTING DEVICE
266
DISPATCHING A SECOND FIRST RESPONDER TO THE INITIAL LOCATION
268
UNLOADING THE FIRST MEDICAL EQUIPMENT MODULE FROM THE AMBULANCE ONTO THE AUTONOMOUS MOBILE RESPONSE UNIT MANUALLY BY THE SECOND FIRST RESPONDER IN RESPONSE TO RECEIVING THE DATA ASSOCIATED WITH THE SELECTION OF THE FIRST MEDICAL EQUIPMENT MODULE TRANSMITTED BY THE FIRST RESPONDER FROM THE REFINED LOCATION

FIG. 8E

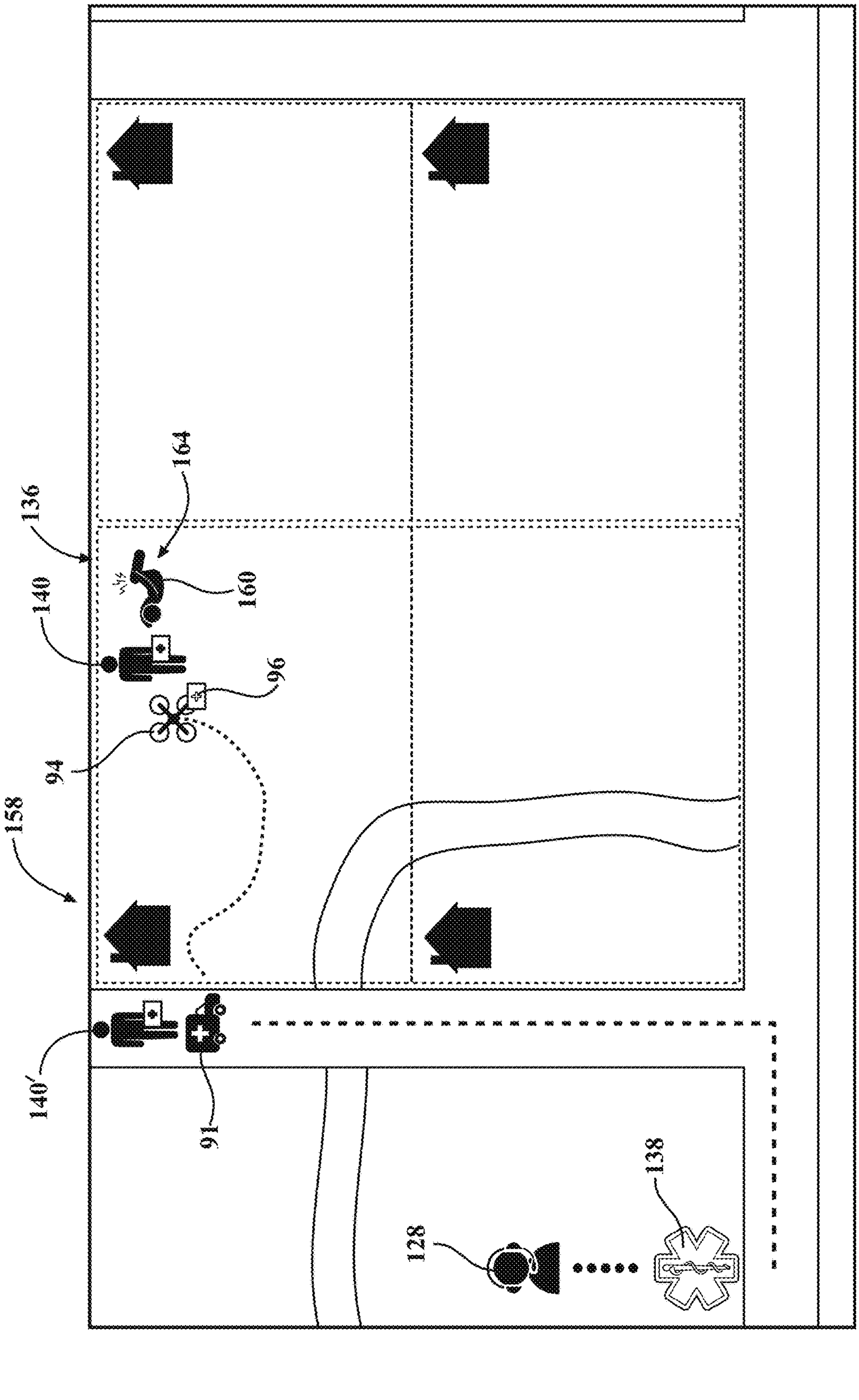


FIG. 8F

TECHNIQUES FOR TRANSPORTING AUTONOMOUS PATIENT SUPPORT APPARATUSES AND MEDICAL EQUIPMENT TO AN INCIDENT SCENE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The subject patent application is a Continuation of U.S. patent application Ser. No. 18/436,077 filed on Feb. 8, 2024, which is a Continuation of U.S. patent application Ser. No. 16/671,723 filed on Nov. 11, 2019 and issued as U.S. Pat. No. 11,929,157 on Mar. 12, 2024, which claims priority to and all the benefits of U.S. Provisional Patent Application No. 62/754,773 filed on Nov. 2, 2018, U.S. Provisional Patent Application No. 62/754,798 filed on Nov. 2, 2018, and U.S. Provisional Patent Application No. 62/754,836 filed on Nov. 2, 2018, the disclosures of each of which are hereby incorporated by reference in their entirety.

BACKGROUND

[0002] When an emergency occurs at an incident scene, service entities such as fire departments typically dispatch a variety of assets, such as an ambulance or other vehicles loaded with a patient support apparatus, a trauma kit, a drug box, an O_2 bottle, a defibrillator, and/or a heart monitor, as well as personnel, such as a first responder, an emergency medical technician (EMT), a firefighter, and/or a police officer, to a location near the incident scene. In some situations, the incident scene is a location the dispatched assets and personnel may reach directly. For example, if the incident scene is a place of residence or a public building, the dispatched assets and personnel may be dispatched to an address associated with the place of residence or public building.

[0003] Sometimes, however, the incident scene is a location that may be difficult to reach for dispatched assets and personnel. For example, the incident scene may be a backyard of a place of residence, a location along a hiking trail, or a disaster zone. In such situations, the service entity may be required to dispatch multiple personnel to efficiently and successfully locate the incident scene and subsequently treat one or more patients involved in the emergency. For example, one first responder may locate the incident scene and another first responder may subsequently receive the location of the incident scene before transporting medical supplies to the incident scene. There remains a need in the art for dispatching personnel and/or equipment to incident scenes with improved accuracy and efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Advantages of the present disclosure will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings.

[0005] FIG. **1** is a perspective view of an autonomous patient support apparatus.

[0006] FIG. **2**A is a top view of the autonomous patient support apparatus of FIG. **1**.

[0007] FIG. **2**B is a bottom view of the autonomous patient support apparatus of FIG. **1**.

[0008] FIG. **3** is a schematic view of a system for transporting the autonomous patient support apparatus to an incident scene.

[0009] FIGS. **4**A-**4**C are side views of the patient transport apparatus of FIG. **1** being unloaded from an emergency response vehicle.

[0010] FIG. **5** is a perspective view of an unmanned aerial vehicle.

[0011] FIG. **6**A is a diagrammatic view of a method of transporting the autonomous patient support apparatus to the incident scene.

[0012] FIGS. **6**B-**6**J are diagrammatic views of embodiments of the method of transporting the autonomous patient support apparatus to the incident scene.

[0013] FIG. **7**A is a diagrammatic view of a method of transporting the autonomous patient support apparatus to the incident scene via an optimized path.

[0014] FIG. **7**B is a schematic view of a system for transporting the autonomous patient support apparatus to the incident scene via the optimized path.

[0015] FIGS. **7**C-**7**S are diagrammatic views of embodiments of the method of transporting the autonomous patient support apparatus to the incident scene via the optimized path.

[0016] FIG. **8**A is a diagrammatic view of a method of transporting medical equipment to the incident scene with an autonomous mobile response unit.

[0017] FIG. **8**B is a schematic view of a system for transporting medical equipment to the incident scene with the autonomous mobile response unit.

[0018] FIGS. **8**C-**8**F are diagrammatic views of embodiments of the method of transporting medical equipment to the incident scene with the autonomous mobile response unit.

DETAILED DESCRIPTION

[0019] Herein, an autonomous mobile response unit is described. The autonomous mobile response unit may include an autonomous patient support apparatus **20**, as shown in FIGS. **1**-**4**C. The autonomous patient support apparatus **20** may be configured to support and autonomously transport a patient and/or a medical equipment module in a health care or emergency response setting. The autonomous patient support apparatus **20** illustrated in FIGS. **1**-**4**C includes a cot. In other embodiments, however, the autonomous patient support apparatus **20** may include an autonomous hospital bed, stretcher, table, wheelchair, chair, or similar apparatus utilized in the autonomous transportation and care of a patient.

[0020] As shown in FIG. **1**, the autonomous patient support apparatus **20** includes a support frame **22** configured to support a patient. The support frame **22** can be like that shown in U.S. Patent Application Publication No. 2018/0303689A1, which claims priority to U.S. Provisional Patent App. No. 62/488,441, filed on Apr. 21, 2017, entitled "Emergency Cot With A Litter Height Adjustment Mechanism," the disclosures of which are hereby incorporated by reference in their entirety.

[0021] The support frame **22** is further illustrated from a top view of the autonomous patient support apparatus **20** in FIG. **2**A. As shown in FIG. **2**A, the support frame **22** has a length L_1 defined extending longitudinally, and a width W_1 defined extending laterally, which is smaller than the length L_1. The support frame **22** may include two opposing lateral sides **24**, **26** extending along the width W_1 coupled to two opposing end sides **28**, **30** extending along the length L_1.

[0022] The support frame **22** may have various configurations and may include a variety of components. For example, in FIG. **1**, end sides **28**, **30** of the support frame **22** include hollow side rails **32**, **34** (side rail **32** shown in FIG. 2A). In the example of FIG. **1**, side **24** of the autonomous patient support apparatus **20** includes a foot end handle **36**, which may include a pair of vertically spaced U-shaped frame members **38** and **40**. The frame members **38**, **40** may be joined together by frame brackets **42** (only one frame bracket **42** is shown in FIG. **1**), which may be telescopingly affixed inside side rails **32**, **34**, as illustrated in FIG. **1**. A fastener or pin (not illustrated) may be utilized to facilitate a connection of the frame brackets **42** to the interior of each of the respective side rails **32**, **34**. Furthermore, as shown, frame member **40** may diverge from frame member **38**, providing pairs of vertically spaced hand grip areas **44**, **46** on frame members **38**, **40**, respectively. Additionally, spacer brackets **48** may be connected to opposing portions of each of the frame members **38** and **40** to maintain the vertical spacing between the hand grip areas **44** and **46**.

[0023] The support frame **22** may be coupled to a variety of components that aid in supporting and/or transporting the patient. For example, in FIG. **1**, the support frame **22** is coupled to a patient support surface **50**, upon which the patient directly rests. The patient support surface **50** may be defined by one or more articulable deck sections, for example, a back section **52** and a foot section **54**, to facilitate care and/or transportation of the patient in various patient positions.

[0024] The support frame **22** may also be coupled to loading wheels **56**. As shown in FIG. **1**, the loading wheels **56** may extend from the support frame **22** proximal to the back section **52** of the patient support surface **50** and may facilitate loading and unloading of the autonomous patient support apparatus **20** from a vehicle. In one example, the loading wheels **56** may be positioned and configured to facilitate loading and unloading the autonomous patient support apparatus **20** into or from an ambulance.

[0025] The support frame **22** may also be coupled to hand rails **58**. In FIG. **1**, the hand rails **58** extend from opposing sides of the support frame **22** and provide egress barriers for the patient on the patient support surface **50**. The hand rails **58** may also be utilized by an individual, such as a caregiver, an emergency medical technician (EMT), or another medical professional, to move or manipulate the autonomous patient support apparatus **20** manually. In some embodiments, the hand rails **58** may include a hinge, pivot or similar mechanism to allow the hand rails **58** to be folded or stored adjacent to or below the patient support surface **50**. The support frame **22** may also be coupled to a vertical support member **60**. The vertical support member **60** may be configured to hold a medical device or medication delivery system, such as a bag of fluid to be administered via an IV. The vertical support member **60** may also be configured for the operator of the autonomous patient support apparatus **20** to push or pull on the vertical support member **60** to manipulate or move the autonomous patient support apparatus **20**.

[0026] The autonomous patient support apparatus **20** may include a base **62**. As shown in FIG. 2B, the base **62** has a length L_2 defined longitudinally, and a width W_2, which is smaller than the length L_2. The base **62** may include two opposing lateral base sides **64**, **66** extending along the width W_2 coupled to two opposing longitudinal base sides **68**, **70** extending along the length L_2. As shown in FIG. **1**, the longitudinal base sides **68**, **70** may include longitudinally-extending rails **72**, **74** and the lateral base sides **64**, **66** may include crosswise-extending rails **76**, **78** which may be coupled at the ends thereof to the rails **72**, **74**.

[0027] The base **62** may further include a plurality of caster wheel assemblies **80** operatively connected adjacent to each corner of the base **62** defined by the longitudinally-extending rails **72**, **74** and the crosswise-extending rails **76**, **78**. As such, the autonomous patient support apparatus **20** of FIG. **1** may include four caster wheel assemblies **80**. The wheel assemblies **80** may be configured to swivel to facilitate turning of the autonomous patient support apparatus **20**. The wheel assemblies **80** may include a swivel locking mechanism to prevent the wheel assemblies **80** from swiveling when engaged. The wheel assemblies **80** may also include wheel brakes **82** to prevent rotation of the wheel.

[0028] The base **62** may also include at least one auxiliary wheel **81**. The auxiliary wheel **81** may be configured to swivel to steer the autonomous patient support apparatus **20**. In instances where the base **62** includes more than one auxiliary wheel **81**, the auxiliary wheels **81** may be configured to swivel about their own, separate swivel axes, or a common swivel axis in order to steer the autonomous patient support apparatus **20**. Additionally, in some instances, the auxiliary wheel may be deployed from the base **62** in a deployed position or stowed within the base **62** in a stowed position. The auxiliary wheels **81** can be like that shown in U.S. Pat. No. 10,045,893,which claims priority to U.S. Provisional Patent App. No. 62/270,704, filed on Dec. 22, 2015, entitled "Patient Transport Apparatus With Controllable Auxiliary Wheel Assembly," the disclosures of which are hereby incorporated by reference in their entirety.

[0029] Referring to FIGS. **1** and **3**, the autonomous patient support apparatus **20** may include a drive system **84** configured to drive the autonomous patient support apparatus **20** by driving the at least one auxiliary wheel **81**. As shown in the embodiment of FIG. **1**, the drive system **84** may be coupled to the at least one auxiliary wheel **81**. The drive system **84** may be configured to drive the patient support apparatus **20** by driving, steering, deploying, and/or stowing the at least one auxiliary wheel **81**. In some instances, the drive system **84** may also be configured to move the auxiliary wheel **81** between the deployed position and the stowed position. The drive system **84** may include an electric actuator, a hydraulic actuator, and/or a pneumatic actuator. The drive system **84** may also include rotary actuators, linear actuators, or any other suitable actuators for moving the at least one auxiliary wheel **81**. Additionally, the drive system **84** may include reversible, DC motors, or other types of motors. The drive system **84** can be like that shown in U.S. Patent Application Publication No. 2016/0367415A1, which claims priority to U.S. Provisional Patent App. No. 62/184,911, filed on Jun. 22, 2015, entitled "Patient Support Apparatuses With Navigation And Guidance Systems," the disclosures of which are hereby incorporated by reference in their entirety.

[0030] As shown in FIG. **3**, the autonomous patient support apparatus **20** may include a navigation system **86** configured to generate a drive path (shown as "DP (**186**)" in FIG. **3**) for the autonomous patient support apparatus **20**. The navigation system **86** may include a variety of sensors that provide a variety of inputs, which the navigation system **86** may use to generate the drive path **186**. For example, the navigation system **86** may include an accelerometer for detecting accelerations of the autonomous patient support apparatus **20**, including both the magnitude and direction of the accelerations. The navigation system **86** may also include a magnetometer for detecting a geographical orientation of the autonomous patient support apparatus **20** with respect to the Earth's magnetic field. A wheel counting sensor may also, or alternatively, be included that detects revolutions of at least one of the caster wheel assemblies **80** and/or auxiliary wheels **81**. Still further, the navigation system **86** may include an altimeter adapted to detect an elevation of the autonomous patient support apparatus **20**. In this way, the navigation system **86** can be like the navigation system shown in U.S. Patent Application Publication No. 2016/0367415A1.

[0031] Additionally, the navigation system **86** may generate the drive path **186** for the autonomous patient support apparatus **20** based on the variety of sensors. For example, the navigation system **86** may generate the drive path **186** based on a location and an acceleration of the autonomous patient support apparatus **20** received from the accelerometer and the magnetometer. Furthermore, the navigation system **86** may generate the drive path **186** prior to or concurrent with the autonomous patient support apparatus **20** being driven by the drive system **84**.

[0032] Referring to FIG. **3**, the autonomous patient support apparatus **20** may also include an obstruction detection system **88** configured to detect a presence of an obstruction. An obstruction may be defined as an object preventing, or that will prevent, the drive system **84** from driving the autonomous patient support apparatus **20** along the drive path **186** generated by the navigation system **86**. As such, the obstruction detection system **88** may include a variety of sensors, such as an impact sensor, a proximity sensor, and/or a wheel position sensor configured to detect the presence of an obstruction. For example, an impact sensor, such as a strain gauge, may detect a force applied to a component, such as a wheel assembly **80**, an auxiliary wheel **81**, or the base **62** of the autonomous patient support apparatus **20**, which may indicate the presence of an obstruction. In another example, a proximity sensor may use sonar, LiDAR, or imaging technology to determine a proximity of an obstruction. For instance, the proximity sensor may be a camera configured to capture an image, which the obstruction detection system **88** may process to determine the presence of an obstruction. In yet another example, the obstruction detection system **88** may include wheel position sensors configured to detect an actual speed of the autonomous patient support apparatus **20**. The obstruction detection system **88** may then compare the actual speed to a commanded speed to determine the presence of an obstruction. The obstruction detection system **88** can be like the object/landmark detection system shown in U.S. Patent Application Publication No. 2016/0367415A1.

[0033] Also shown in FIG. **3**, the autonomous patient support apparatus **20** may include a controller **93** configured to control the drive system **84** based on the drive path **186** generated by the navigation system **86**. As such, the controller **93** may be coupled to the navigation system **86** and to the drive system **84**, as shown in FIG. **3**. Furthermore, the controller **93** may serve as a hub, allowing for communication between the drive system **84**, the navigation system **86**, and the obstruction detection system **88**. For example, the controller **93** may be coupled to the obstruction detection system **88**, which allows the obstruction detection system **88** to communicate a presence of an obstruction to the navigation system **86** via the controller **93**. Additionally, the controller **93** may allow the drive system **84**, the navigation system **86**, and the obstruction detection system **88** to communicate with a first communication system **120** (described in further detail below), a remote dispatch center **126** (described in further detail below), and an unmanned aerial vehicle **94** (described in further detail below). The controller **93** can be like the controller shown in U.S. Patent Application Publication No. 2016/0367415A1.

[0034] The autonomous patient support apparatus **20** may be loaded in an ambulance **91**. Furthermore, as shown in FIG. **3**, the ambulance **91** loaded with the autonomous patient support apparatus **20** may include an unloading system **90** for unloading the autonomous patient support apparatus **20** from an ambulance **91**. An operation of the unloading system **90** is shown in FIGS. **4A-4C**. As shown in FIGS. **4A-4C**, the autonomous patient support apparatus **20** may be coupled to a trolley **87** and a track **85** of the unloading system **90**. The trolley **87** may then move along the track **85** such that the autonomous patient support apparatus **20** may be positioned within the ambulance **91** (as shown in FIG. **4A**) and unloaded from the ambulance (as shown in FIGS. **4B** and **4C**). The unloading system **90**, the trolley **87**, and the track **85** can be like the unloading apparatus, the trolley, and the track shown in U.S. Pat. No. 8,439,416, which claims priority to U.S. Provisional Patent App. No. 61/248,374, filed on Oct. 2, 2009, entitled "Ambulance Cot and Loading and Unloading System," the disclosures of which are hereby incorporated by reference in their entirety.

[0035] The unloading system **90** may also include a lift mechanism **92**, which may be configured to move between a plurality of vertical configurations including a retracted configuration, as shown in FIGS. **4A** and **4B**, and an extended configuration, as shown in FIG. **4C**. The lift mechanism **92** may be configured to facilitate movement of the support frame **22** relative to the base **62**. When the autonomous patient support apparatus **20** is being unloaded from the ambulance **91**, the lift mechanism **92** moves from the retracted configuration to the extended configuration by moving the base **62**. When the autonomous patient support apparatus **20** has been unloaded from the ambulance **91**, the lift mechanism **92** can be utilized to move from the extended configuration back to the retracted configuration, or to other configurations therebetween, to position the support frame **22** closer to the base **62**. The lift mechanism **92** can be like that shown in the U.S. Patent Application Publication No. 2018/0303689A1.

[0036] The unloading system **90** may be operated manually or autonomously. For example, a first responder may manually operate the unloading system **90** when unloading the autonomous patient support apparatus **20** from the ambulance **91**. In another instance, the first responder may operate the unloading system **90** by physically depressing a button to activate the unloading system **90**. In yet another instance, the unloading system **90** may unload the autonomous patient support apparatus **20** autonomously after the ambulance **91** reaches a location or after receiving an input from a remote computing device.

[0037] The autonomous mobile response unit may also include the unmanned aerial vehicle **94**, as shown in FIG. **5**. The unmanned aerial vehicle **94** may be configured to autonomously transport a medical equipment module **96** to an incident scene, from the ambulance **91** or from another location, in a health care or emergency response setting. The unmanned aerial vehicle **94** shown in FIG. **5** is realized as a multirotor drone; however, the unmanned aerial vehicle **94** may comprise a fixed wing drone or a single rotor drone, or a wheeled vehicle in some embodiments. Additionally, the unmanned aerial vehicle **94** may also include the navigation system **86**, the drive system **84**, the controller **93**, and the obstruction detection system **88**.

[0038] Furthermore, the unmanned aerial vehicle **94** may include a variety of sensors. For example, the unmanned aerial vehicle **94** may include a variety of imaging sensors, location sensors, and environmental sensors, which may be used to collect imaging data, obstruction data, topographical data, location data, movement data, and weather data. In one example, the unmanned aerial vehicle **94** may include a camera **95**, as shown in FIG. **5**. The camera **95** may collect imaging data, which may be used to determine a presence of an obstruction, topographical data, and a location of the incident scene.

[0039] As shown in FIGS. **1** and **5**, the autonomous mobile response unit, realized as the autonomous patient support apparatus **20** in FIG. **1** and the unmanned aerial vehicle **94** in FIG. **5**, may be configured to transport a medical equipment module **96**. For example, in FIG. **1**, the medical equipment module **96** is disposed on and affixed to the patient support surface **50** while being transported by the autonomous patient support apparatus **20**. In FIG. **5**, a retaining system **98** of the unmanned aerial vehicle **94** retains the medical equipment module **96** while the unmanned aerial vehicle **94** transports the medical equipment module **96**, and can be released automatically or manually. In other instances, alternative mechanisms may be employed for transporting the medical equipment module **96**. For example, the autonomous patient support apparatus **20** may include a dedicated compartment for housing the medical equipment module **96** during transport. As another example, the retaining system **98** of the unmanned aerial vehicle **94** may include a variety of components, such as a crate, a rope, adhesive, or any other components suitable for retaining and transporting the medical equipment module **96**.

[0040] A method **100** of transporting an autonomous patient support apparatus, such as the above-described autonomous patient support apparatus **20**, to an incident scene is represented as a flow chart in FIG. **6**A. As shown, the method **100** includes a step **102** of determining an initial location of the incident scene; a step **104** of dispatching an ambulance (such as the above-described ambulance **91**) loaded with an autonomous patient support apparatus (such as the above-described autonomous patient support apparatus **20**) to the initial location; a step **106** of dispatching a first responder to the initial location; a step **108** of unloading the autonomous patient support apparatus **20** from the ambulance **91** at the initial location; a step **110** of determining a refined location of the incident scene; a step **112** of communicating the refined location of the incident scene to the navigation system **86** of the autonomous patient support apparatus **20**; a step **114** of driving, with the drive system **84**, the autonomous patient support apparatus **20** based on a drive path **186** such that the autonomous patient support apparatus **20** travels from the ambulance **91** to the refined location; and a step **116** of generating, with the navigation system **86**, the drive path **186** from the initial location to the refined location.

[0041] The steps of the method **100**, and the steps of any other method described herein, may be ordered differently in some embodiments. For example, the step **104** of dispatching an ambulance **91** to the initial location may occur after the step **106** of dispatching a first responder to the initial location. As another example, the step **116** of generating the drive path **186** may occur prior to the step **114** of driving the drive system **84**. In such an example, the navigation system **86** may generate the drive path **186** and provide the drive system **84** with the drive path **186**, which the drive system **84** subsequently follows to drive the autonomous patient support apparatus **20** during step **114**.

[0042] Additionally, the steps of the method **100** may include other steps. For instance, referring to the embodiment of FIG. **6**A, the step **114** of driving the autonomous patient support apparatus **20** may also include the step **116** of generating the drive path **186**. In such an embodiment, the navigation system **86** may be configured to generate the drive path **186** while the drive system **84** is driving the autonomous patient support apparatus **20**. As such, the navigation system **86** may generate the drive path **186** based on inputs received while the drive system **84** is driving. Similarly, the steps of any other method described herein may include other steps of the method illustrated in FIG. **6**A. For example, in any method described herein, any step of generating a drive path **186** may be included in any step of driving an autonomous mobile response unit, such as the autonomous patient support apparatus **20** or the unmanned aerial vehicle **94**.

[0043] Referring back to FIG. **3**, the steps **102**-**116** of the method **100** may be executed by components of a system **118** configured to facilitate transporting the autonomous patient support apparatus **20** to the incident scene. As shown, the system **118** includes the unloading system **90** of the ambulance **91**, the autonomous patient support apparatus **20**, as well as the navigation system **86**, drive system **84**, obstruction detection system **88**, and controller **93**. The system **118** also includes a first communication system **120** in communication with the navigation system **86** of the autonomous patient support apparatus **20**, a second communication system **122** corresponding to a public safety answering point **124**, and a remote dispatch center **126** in communication with the navigation system **86** and the obstruction detection system **88** of the autonomous patient support apparatus **20**. In some embodiments, certain components of the system **118** may be omitted.

[0044] As shown in FIG. **6**A, the step **102** of determining the initial location of the incident scene may include a step **128** of receiving an emergency call at the public safety answering point **124**; a step **130** of determining the initial location based on the emergency call; and a step **132** of relaying the initial location from the public safety answering point **124** to the remote dispatch center **126** in communication with the navigation system **86** of the autonomous patient support apparatus **20**. Once the initial location is determined during step **102**, the method proceeds to steps **104** and **106** of dispatching the ambulance **91** loaded with the autonomous patient support apparatus **20** and the first responder to the initial location.

[0045] Additional aspects of step **102** of the method **100**, including additional steps **128**, **130**, and **132**, are illustrated in FIG. **6**B. As shown, the public safety answering point **124** receives an emergency call **134** from an incident scene **136**. For example, in some instances, a call-taker operating the second communication system **122**, such as a landline telephone system, at the public safety answering point **124** may receive the emergency call **134** from someone "dialing 9-1-1" or another emergency telephone number. In such instances, after the call-taker receives the emergency call **134**, the call-taker may begin collecting information regarding the incident scene **136**, such as what type of emergency has occurred at the incident scene **136**, an approximate location of the incident scene **136**, and/or a nearby address of the incident scene **136**. In this way, the call-taker may determine the initial location during step **130** based on the approximate location of the emergency. For example, the call-taker may determine an address and/or GPS coordinates of the initial location during step **130** based on the approximate location of the emergency. The call-taker then relays the initial location and any other information regarding the incident scene to the remote dispatch center **126** during step **132**. In some instances, the call-taker routes the emergency call to the remote dispatch center **126** via the second communication system **122** and the remote dispatch center **126** continues collecting information regarding the incident scene.

[0046] Steps **104** and **106** are also illustrated in FIG. **6**B. As shown, the remote dispatch center **126** may communicate with a service entity **138** to dispatch the ambulance **91** loaded with the autonomous patient support apparatus **20** to the incident scene **136** during step **104**. Also shown, the remote dispatch center **126** may communicate with the service entity **138** to dispatch the first responder **140** to the incident scene **136** during step **106**.

[0047] As shown in FIG. **6**B, the service entity **138** may comprise one or more of a variety of different types, such as a hospital **142**, a fire department **144**, a police station **146**, or any other suitable type of service entity. Additionally, in various instances, the service entity **138** may have access to or may otherwise comprise a variety of different types of assets, which may be positioned at a physical location, such as at a station or department associated with a service entity **138**. The service entity **138** may also communicate with a variety of personnel, who may be "on duty" at a station or department associated with a service entity **138**, or may be "off duty" but nevertheless may dispatch or otherwise respond from their place of residence or another location. In one instance, the remote dispatch center **126** may communicate with the fire department **144** to dispatch the ambulance **91**, a fire truck **148**, a firefighter **150**, and the first responder **140** to the incident scene **136**. In another instance, the remote dispatch center **126** may communicate with the police station **146** to dispatch the ambulance **91**, a police vehicle **150**, and a police officer **154** to the incident scene **136**. In yet another instance, the remote dispatch center **126** may communicate with the hospital **142** to dispatch the ambulance **91**, and a first responder **156** responding from their place of residence. It will be appreciated that the forgoing examples are illustrative and non-limiting. Other instances, including dispatching various types of assets and/or personnel from various locations and/or types of service entities, are contemplated.

[0048] Aspects of steps **104** and **106** are illustrated in FIG. **6**C. As shown in this illustrative instance, the remote dispatch center **126** communicates with the service entity **138** to dispatch the ambulance **91** loaded with the autonomous patient support apparatus **20** and the first responder **140** to the initial location **158** of the incident scene **136**. In the embodiment of FIG. **6**C, four homes are shown, each of which include a respective property area illustrated by dotted lines. In this illustrative instance, the incident scene **136** corresponds to a leg injury to a patient **160** located within a property area of a home with an address of 1234 Main St. As such, the initial location **158** corresponds to the home and the ambulance **91** and the first responder **140** are dispatched to the associated address, 1234 Main St.

[0049] Referring back to FIG. **6**A, after steps **104** and **106**, the method **100** proceeds to the step **108** of unloading the autonomous patient support apparatus **20** from the ambulance **91** at the initial location **158**. As previously stated, the autonomous patient support apparatus **20** may be unloaded from the ambulance **91** by the unloading system **90**. Here, the unloading system **90** may be manually operated by the first responder **140**, or the unloading system **90** may autonomously unload the autonomous patient support apparatus **20** after the ambulance **91** reaches the initial location **158**. In still other instances, the unloading system **90** may unload the autonomous patient support apparatus **20** after the unloading system **90** is manually activated by the first responder **140** or remotely activated by the remote dispatch center **126**.

[0050] The method **100** also includes the step **110** of determining the refined location of the incident scene **136**, which may include a step **162** of establishing patient contact at the refined location **164** with the first responder **140**. Referring to FIG. **6**C, in this illustrative instance, the refined location **164** of the incident scene **136** corresponds to a location suitable for treating the patient **160**. For example, in FIG. **6**C, the refined location **164** corresponds to a location within the property area of 1234 Main St. where the patient **160** was found by the first responder **140**. In some embodiments, step **110** includes the step **162** of establishing contact between the patient **160** at the refined location **164** and the first responder **140**. In such an embodiment, the first responder **140** may travel from the initial location **158** while searching for the patient **160** within the property area. Here, establishing contact with the patient **160** when found by the first responder **140** would then define the refined location **164**.

[0051] The method also includes the step **112** of communicating the refined location **164** of the incident scene **136** to the navigation system **86** of the autonomous patient support apparatus **20**. In some instances, the first communication system **120** may be configured to communicate the refined location **164** to the navigation system **86** during step **112**. For example, in some embodiments, the method **100** may include a step **166** of equipping the first responder **140** with at least one of a radio communication device and a mobile phone. In such embodiments, the first communication system **120** includes the radio communication device and/or the mobile phone. As shown in FIG. **4**B, the radio communication device **120**R and the mobile phone **120**M may be affixed to the ambulance **91**, allowing the first responder **140** to equip the radio communication device **120**R and/or the mobile phone **120**M upon reaching the initial location **158**. Additionally, in such embodiments, step **112** may include a step **168** of transmitting a voice command VC (shown in FIG. **3**) with the radio communication device **120**R and/or the mobile phone **120**M to communicate the refined location **164** to the navigation system **86**. For example, the voice command VC may include a description of the refined location **164** from the first responder **140**. The radio communication device **120**R and/or the mobile phone **120**M may transmit the voice command VC to communicate the refined location **164** of the incident scene **136** to the navigation system **86**.

[0052] In some embodiments, such as the embodiment of FIG. **3**, the radio communication device **120**R and/or the mobile phone **120**M may transmit the voice command VC to the remote dispatch center **126** to communicate the refined location **164** (shown as "RL (**164**)" in FIG. **3**) to the navigation system **86**. In such embodiments, the remote dispatch center **126** may process the voice command VC to determine the refined location **164**. The remote dispatch center **126** may then transmit the refined location **164** to the navigation system **86**. For example, in the embodiment of FIG. **3**, the remote dispatch center **126** transmits the refined location **164** to the navigation system **86** via the controller **93**.

[0053] In embodiments where the method **100** includes the steps **166** and **168**, the method **100** may not necessarily include the step **162** of establishing patient contact at the refined location **164**. In some instances, the first responder **140** may transmit the voice command VC during step **168** without establishing patient contact at the refined location **164**. In one such instance, the refined location **164** may be a location that the autonomous patient support apparatus **20** could reach, but the first responder **140** is unable to reach. As such, the first responder **140** may transmit a voice command VC describing the refined location **164** to communicate the refined location **164** to the navigation system **86**. In this way, the autonomous patient support apparatus **20** may reach the patient **160** even if the first responder **140** is not able to.

[0054] The method **100** may include a step **173** of equipping the first responder **140** with a tracker **172**, which is shown in FIGS. **6**E and **6**F. In such embodiments, the method may include the above-described step **162** of establishing patient contact at the refined location **164** with the first responder **140**. As such, the tracker **172** may be configured to determine the refined location **164** of the incident scene **136** based on the first responder **140** traveling from the initial location **158** and establishing patient contact at the refined location **164**. In some embodiments, the tracker **172** includes at least one of a GPS tracker, a cellular tracker, and a WiFi tracker. In such embodiments, the step **110** of determining the refined location **164** includes a step **174** in which the tracker **172** determines its location based on at least one of a GPS signal, a cellular signal, and a WiFi signal. As such, to determine the refined location **164** during step **110**, the first responder **140** may establish patient contact at the refined location **164** with the tracker **172** during step **162**, and the tracker **172** may determine its location using a GPS signal, a cellular signal, and/or a WiFi signal during step **174**.

[0055] In some embodiments, the first communication system **120** includes a mobile computing device such as the mobile phone **120**M, a laptop computer, a tablet, or any other computing system suitable for communicating the refined location **164**. In such embodiments, the tracker **172** may be coupled to the mobile computing device and the step **112** of communicating the refined location **164** of the incident scene **136** includes a step **176** of transmitting data D**1** (shown in FIG. **3**) associated with a location of the tracker **172** to the navigation system **86** of the autonomous patient support apparatus **20**. In embodiments where the tracker **172** is coupled to the mobile computing device, the mobile computing device may execute the step **176**. Furthermore, in such embodiments, the mobile computing device may transmit the data D**1** associated with the location of the tracker **172** to the navigation system **86** via the remote dispatch center **126**. As such, the remote dispatch center **126** may process the data DI associated with the location of the tracker **172** prior to transmitting the data to the navigation system **86**.

[0056] In other embodiments, the first communication system **120** may include the tracker **172** and the tracker **172** may include a tracker user interface, such as a touchscreen, a button, a switch, or any other user interface suitable for receiving an input from a user of the tracker **172**. For example, the tracker user interface may be a handheld device comprising a button, such as the tracker user interface **120**T shown in FIG. **4**B. In such embodiments, the step **112** of communicating the refined location **164** of the incident scene **136** includes the step **176** of transmitting data DI associated with the location of the tracker **172** to the navigation system **86** of the autonomous patient support apparatus **20**. In embodiments where the tracker **172** includes the tracker user interface **120**T, the tracker **172** may execute the step **176** after the tracker user interface **120**T is actuated. For example, in an instance where the tracker user interface **120**T is realized as a touchscreen, the tracker **172** may transmit data DI associated with the location of the tracker **172** after a "TRANSMIT" button is actuated on the touchscreen. Additionally, the tracker **172** may transmit the data DI associated with the location of the tracker **172** to the navigation system **86** via the remote dispatch center **126**.

[0057] As shown in FIG. **6**D, the method **100** includes the step **116** of generating the drive path **186** with the navigation system **86**. In an embodiment including the step **166** of equipping the first responder **140** with at least one of a radio communication device **120**R and a mobile phone **120**M, the navigation system **86** may determine the drive path **186** during step **116** based on a voice command VC received from the first responder **140** via the radio communication device **120**R and/or the mobile phone **120**M. The controller **93** may then control the drive system **84** based on the drive path **186** such that the autonomous patient support apparatus **20** travels from the initial location **158** to the refined location **164**.

[0058] In embodiments including the tracker **172**, the step **116** of generating the drive path **186** may include a step **180** of generating a tracker path **184** based on movement of the first responder **140** away from the initial location **158**. In such embodiments, step **180** may be executed by the tracker **172** and the tracker path **184** includes a plurality of locations associated with the tracker **172**. Additionally, in embodiments including step **180**, the step **116** of generating the drive path **186** may also include a step **182** of generating the drive path **186** with the navigation system **86** based on the tracker path **184**. The controller **93** may then control the drive system **84** based on the drive path **186**.

[0059] FIG. **6**E illustrates one embodiment of steps **180** and **182**. As shown, the first responder **140** is equipped with the tracker **172** and is moving towards the refined location **164** of the incident scene **136**. Accordingly, during step **180**, the tracker **172** generates the tracker path **184** based on the movement of the first responder **140** and during step **182**, the navigation system **86** generates the drive path **186**. In FIG.

6E, the drive path **186** is generated in accordance with a "follow me" mode as disclosed in U.S. Patent Application Publication No. 2014/0076644A1, which claims priority to U.S. Provisional Patent App. No. 61/702,316, filed on Sep. 18, 2012, entitled "Powered Patient Support Apparatus," the disclosures of which are hereby incorporated by reference in their entirety. As shown, the controller **93** controls the drive system **84** based on the drive path **186** such that the autonomous patient support apparatus **20** follows the first responder **140**.

[0060] FIG. **6**F illustrates another embodiment of steps **180** and **182**. As shown, the first responder **140** is equipped with the tracker **172** and has established patient contact at the incident scene **136**. Accordingly, during step **180**, the tracker **172** generates the tracker path **184** based on the movement of the first responder **140** and during step **182**, the navigation system **86** generates the drive path **186**. However, in the embodiment of FIG. **6**F, the drive path **186** is generated such that a distance between the initial location **158** and the refined location **164** is minimized.

[0061] Referring to FIG. **6**A, steps **166** and **168** are illustrated using dotted lines ("- - -"). Embodiments of any method herein including a step that is illustrated using the dotted lines also include step **166**. For example, embodiments of the method **100** that include the step **168** of transmitting the voice command VC with the radio communication device **120**R and/or the mobile phone **120**M also include the step **166** of equipping the first responder **140** with the radio communication device **120**R and/or the mobile phone **120**M.

[0062] Referring to FIGS. **6**A and **6**D, steps **173**, **174**, **176**, **180**, and **182** are illustrated using dot-dash lines ("-.-"). Embodiments of any method herein including a step that is illustrated using the dot-dash lines also include step **173**. For example, embodiments of the method **100** that include the step **176** of transmitting data D**1** associated with the location of the tracker **172** to the navigation system **86** also include the step **173** of equipping the first responder **140** with the tracker **172**. As another example, embodiments of the method **100** that include the step **180** of generating the tracker path **184** also include the step **173** of equipping the first responder **140** with the tracker **172**.

[0063] In FIG. **6**G, an instance where the autonomous patient support apparatus **20** has encountered an obstruction **188** is shown. As shown in FIG. **6**G, the obstruction **188** prevents the drive system **84** from driving the autonomous patient support apparatus **20** to the refined location **20**. In such instances, the autonomous patient support apparatus **20** may include the above-described obstruction detection system **88**. Referring back to FIG. **6**A, the method **100** may further include a step **190** of detecting a presence of the obstruction **188** at an obstruction location **192** and a step **194** of interrupting operation of the drive system **84** in response to detecting the obstruction **188** at the obstruction location **192**. The obstruction detection system **88** may be configured to detect the presence of the obstruction **188** during step **190** and may be configured to communicate with the controller **93** to interrupt operation of the drive system **84** during step **194**.

[0064] After detecting the presence of the obstruction **188**, the method **100** may proceed in a variety of ways. For example, as shown in FIG. **6**H, the method may proceed to a step **196** of generating, with the navigation system **86**, an alternate drive path for the autonomous patient support apparatus **20** between a location of the obstruction location **192** and the refined location **164**. In such an embodiment, the obstruction detection system **88** may communicate with the navigation system **86** via the controller **93**. The method may then proceed to a step **198** of driving the autonomous patient support apparatus **20** with the drive system **84** from the obstruction location **192** along the alternate drive path. For example, in FIG. **6**G, the obstruction **188** is illustrated as a pile of rocks, which are preventing the drive system **84** from driving the patient support apparatus **20** along the drive path **186**. During step **196**, the navigation system **86** may generate an alternate drive path, which bypasses the obstruction **188**. Accordingly, the autonomous patient support apparatus **20** may bypass the obstruction **188** by driving from the obstruction location **192** along the alternate drive path.

[0065] In another example, shown in FIG. **6**I, the method **100** may proceed to a step **200** of determining that the autonomous patient support apparatus **20** cannot reach the refined location **164** with the drive system **84**. The method **100** may then proceed to a step **202** of generating an alarm A (shown in FIG. **3**) with the patient support apparatus **20** to indicate that the obstruction **188** cannot be traversed without intervention. As shown in FIG. **3**, the alarm A may include an alarm A transmitted to the remote dispatch center **126** and/or to the first responder **140** via the first communication system **120**. The alarm A may also include an audible alarm, a visual alarm, a tactile alarm, or any other alarm suitable for indicating that the obstruction **188** cannot be traversed without intervention. Steps **200** and **202** may be executed by the obstruction detection system **88**.

[0066] In yet another example, shown in FIG. **6**J, the method **100** may proceed to a step **204** of communicating, with the obstruction detection system **88**, an intervention request IR (shown in FIG. **3**) related to the presence of the obstruction **188** to the remote dispatch center **126** and/or to the first responder **140** via the first communication system **120**. Accordingly, the method **100** may then proceed to a step **206** of rectifying the obstruction **188** communicated via the intervention request IR and a step **208** of driving, with the drive system **84**, the autonomous patient support apparatus **20** from the obstruction location **192** to the refined location **164** along the drive path **186**. For example, referring to FIG. **6**G, the obstruction **188** is illustrated as a pile of rocks, which are preventing the drive system **84** from driving the patient support apparatus **20** along the drive path **186**. During step **206**, the first responder **140** may move the pile of rocks to rectify the obstruction **188**. Accordingly, the drive system **84** may then continue driving the autonomous patient support apparatus **20** along the drive path **186**.

[0067] FIG. **7**A illustrates a method **210** of transporting an autonomous patient support apparatus, such as the above-described autonomous patient support apparatus **20**, to an incident scene **136** via an optimized drive path. As shown, the method **210** includes the above-described step **102** of determining the initial location **158** of the incident scene **136**; the above-described step **104** of dispatching the ambulance **91** loaded with the autonomous patient support apparatus **20** to the initial location **158**; the above-described step **108** of unloading the autonomous patient support apparatus **20** from the ambulance **91** at the initial location **158**; and the above-described step **114** of driving, with the drive system **84**, the autonomous patient support apparatus **20** from the initial location **158** to the refined location **164**.

[0068] The method **210** also includes a second embodiment **110'** of the step **110** of determining the refined location **164** of the incident scene **136** and a second embodiment **112'** of the step **112** of communicating the refined location **164** of the incident scene **136** to the navigation system **86** of the autonomous patient support apparatus **20**. Additionally, the method **210** includes a step **212** of determining, with the navigation system **86**, an optimized path between the initial location **158** and the refined location **164**; and a step **214** of generating, with the navigation system **86**, the drive path (also shown as "DP (**186**)" in FIG. **7**B) for the autonomous patient support apparatus **20** based on the optimized path.

[0069] Referring to FIG. **7**H, one instance of the method **210** is shown. As shown, the first responder **140** establishes patient contact to determine the refined location **164** of the incident scene **136**. The navigation system **86** then determines an optimized path (not shown in FIG. **7**H) between the initial location **158** and the refined location **164** during step **212**. In some embodiments, the optimized path may be based on at least one of topographical data, street mapping data, traffic data, and building infrastructure data. In such embodiments, the navigation system **86** may receive this information from the first responder **140** in the form of data D**2** (shown in FIG. **7**B) associated with the first responder **140** traveling from the initial location **158** to the refined location **164**. The navigation system **86** may also receive this information from an internet connection. Accordingly, the navigation system **86** generates the drive path **186** for the autonomous patient support apparatus **20** based on the optimized path during step **214**. The controller **93** then controls the drive system **84** to drive the autonomous patient support apparatus **20** from the initial location **158** to the refined location **164** along the drive path **186**.

[0070] As shown in FIG. **7**B, the steps **102**, **104**, **108**, **110'**, **112'**, **212**, and **214** may be executed by components of a system **216** for transporting the autonomous patient support apparatus **20** to the incident scene **136** via the optimized path. As shown, the system **216** includes the components of system **118** and a deployment system **218** of the ambulance **91**. In one instance, the deployment system **218** may deploy an unmanned aerial vehicle, such as the above-described unmanned aerial vehicle **94** from the ambulance **91**. In another instance, the deployment system **218** may include the unloading system **90** and may unload the autonomous patient support apparatus **20** from the ambulance **91**. In some embodiments, some of the components of system **216** may be omitted.

[0071] In some embodiments, the ambulance **91** may be loaded with an unmanned aerial vehicle, such as the above-described unmanned aerial vehicle **94**. In such embodiments, the step **110'** may include a step **218** of dispatching the unmanned aerial vehicle **94** from the ambulance **91** to the initial location **158** as shown in FIG. **7**C. The step **110'** also includes a step **220** of determining a location of the patient **160** with the unmanned aerial vehicle **94** to define the refined location **164** of the incident scene. The steps **218** and **220** are further illustrated in FIG. **7**D. As shown, the unmanned aerial vehicle **94** is dispatched to the initial location **158** and then determines the location of the patient **160** by travelling toward the incident scene **136** in order to define the refined location **164**. For example, as previously stated, the unmanned aerial vehicle **94** may include a variety of sensors, such as an imaging sensor realized as the camera **95** (shown in FIG. **5**) and a location sensor. As such, the camera **95** may capture imaging data while the unmanned aerial vehicle **94** travels towards the incident scene **136**. The imaging data may then be analyzed to determine the refined location **164** relative to the location of the unmanned aerial vehicle **94**.

[0072] In another embodiment where the ambulance **91** is loaded with the unmanned aerial vehicle **94**, the step **110'** includes a step **222** of deploying the unmanned aerial vehicle **94** from the ambulance **91** at the initial location **158**, as shown in FIG. **7**E. The step **110'** also includes the above-described step **220**. The steps **222** and **220** are further illustrated in FIG. **7**F. As shown, the unmanned aerial vehicle **94** is deployed from the ambulance **91** at the initial location **158** and then determines the location of the patient **160** by travelling toward the incident scene **136** in order to define the refined location **164**. The unmanned aerial vehicle **94** may be deployed from the ambulance **91** by the deployment system **218**.

[0073] In embodiments where the ambulance **91** is loaded with the unmanned aerial vehicle **94**, the step **112'**, as shown in FIGS. **7**C and **7**E, may include a step **224** of transmitting data D**3** (shown in FIG. **7**B) associated with the refined location **164** with the unmanned aerial vehicle **94**. As shown in FIG. **7**B, the data D**3** associated with the refined location **164** may be transmitted from the unmanned aerial vehicle **94** to the navigation system **86** via the controller **93** and via the remote dispatch center **126**. The data D**3** associated with the refined location **164** may include imaging data, obstruction data, topographical data, location data, weather data, and movement data. As such, the step **212** of determining, with the navigation system **86**, an optimized path between the initial location **158** and the refined location **164** may include a step **226** of determining the optimized path based on at least one of imaging data, obstruction data, topographical data, location data, weather data, and movement data communicated from the unmanned aerial vehicle **94**. For example, during step **226**, the navigation system **86** may determine the optimized path based on imaging data of topographical features communicated from the unmanned aerial vehicle **94**.

[0074] Referring to FIGS. **7**C and **7**E, steps **218**, **220**, **222**, **224**, and **226** are illustrated using dot-dot-dash lines (". . -"). Embodiments of any method herein including a step that is illustrated using the dot-dot-dash lines also include either step **218** or **222**. For example, embodiments of the method **210** that include the step **226** of determining the optimized path based on imaging data, obstruction data, topographical data, location data, weather data, and/or movement data communicated from the unmanned aerial vehicle **94** include either the step **218** of dispatching the unmanned aerial vehicle **94** to the initial location **158** or the step **222** of deploying the unmanned aerial vehicle **94** from the ambulance **91** at the initial location **158**.

[0075] FIG. **7**G illustrates an embodiment where the method **210** includes the step **112'** of communicating the refined location **164** to the navigation system **86**. In embodiments where the first responder **140** is equipped with the radio communication device **120**R and/or the mobile phone **120**M, the step **112'** may include the above-described step **168** of transmitting the voice command VC (also shown in FIG. **7**B) with the radio communication device **120**R and/or the mobile phone **120**M. In such an embodiment, the voice command VC may include a description of the refined location **164** from the first responder **140**. During step **212**, the navigation system **86** may then determine the optimized path between the initial location **158** and the refined location **164** based on the voice command VC. In embodiments where the tracker **172** is coupled to the above-described mobile computing device or where the tracker **172** includes the above-described tracker user interface **120**T, the step **112'** may also include the above-described step **176** of transmitting data D**1** (also shown in FIG. 7B) associated with the location of the tracker **172** to the navigation system **86**. During step **212**, the navigation system **86** may then determine the optimized path between the initial location **158** and the refined location **164** based on the data D**1** associated with the location of the tracker **172**.

[0076] FIG. 7H illustrates the embodiment where the method includes the step **112'** and where the tracker is coupled to the mobile computing device. In such an embodiment, the method **210** includes the steps **106**, **173**, **110'**, **162**, **174**, **112'**, **176**, and **212**. As shown, the first responder **140** is equipped with the tracker **172**, the first responder **140** establishes patient contact at the refined location **164**, the tracker **172** determines its location at the refined location **164** during step **174**, and the mobile computing device transmits data D**1** associated with the location of the tracker **172** to the navigation system **86**. The navigation system **86** then determines the optimized path based on the data DI associated with the location of the tracker **172** and generates the drive path **186** accordingly. The controller **93** then controls the drive system **84** to drive the autonomous patient support apparatus **20** from the initial location **158** to the refined location **164** along the drive path **186**.

[0077] FIG. 7I illustrates an embodiment where the method **210** includes a step **112'** of communicating data D**2** (shown in FIG. 7B) associated with the first responder **140** traveling from the initial location **158** to the refined location **164** to the navigation system **86** of the autonomous patient support apparatus **20**. As shown, the data D**2** associated with the first responder **140** traveling from the initial location **158** to the refined location **164** may be transmitted to the navigation system **86** via the controller **93** and via the remote dispatch center **126**. Additionally, the step **212** of determining the optimized path with the navigation system **86** may include a step **228** of determining the optimized path based on the data D**2** associated with the first responder **140** traveling from the initial location **158** to the refined location **164**.

[0078] In embodiments where the first responder **140** is equipped with at least one of the radio communication device **120**R and the mobile phone **120**M, the step **112'** may include the step **168** of transmitting the voice command VC with the radio communication device **120**R and/or the mobile phone **120**M. In such an embodiment, the voice command VC may include a description of any suitable information associated with the first responder **140** traveling from the initial location **158** to the refined location **164**. For example, the voice command VC may include a description of topographical features, a warning of a potential obstruction, and/or a suggested optimized path.

[0079] Similarly, in embodiments where the first responder **140** is equipped with the tracker **172**, the step **112'** includes the step **176** of transmitting the data D**2** associated with the first responder **140** traveling from the initial location **158** to the refined location **164** to the navigation system **86**. For example, the data D**2** may include a notification of topographical features, a warning of a potential obstruction, and/or a suggested optimized path. In an embodiment where the tracker **172** is coupled to the mobile computing device, the mobile computing device may transmit the data D**2** associated with the first responder **140** traveling from the initial location **158** to the refined location **164** to the navigation system **86**. For example, the mobile computing device may transmit data D**2** indicating a location and an approximate size of a pond that the first responder **140** encountered. In an embodiment where the tracker **172** includes the tracker user interface **120**T, the tracker **172** may transmit the data D**2** associated with the first responder **140** after the first responder **140** actuates the tracker user interface **120**T. For example, the tracker **172** may transmit data D**2** indicating a location of a steep cliff after the first responder **140** depresses a button on the tracker user interface **120**T.

[0080] FIG. **7**J illustrates an embodiment where the first responder **140** is equipped with the tracker **172**, and the method **210** includes the step **112'** of transmitting the data D**2** associated with the first responder **140** traveling from the initial location **158**. In such an embodiment, the method **210** includes the steps **106**, **173**, **162**, **176**, **174**, **112'**, **176**, **212**, and **228**. As shown, the tracker **172** is carried by the first responder **140** and the first responder **140** observes a pond **230** while traveling from the initial location **158** to the refined location **164**. In FIG. **7**J, the tracker **172** may be coupled to the mobile computing device. Accordingly, the mobile computing device transmits data D**2** indicating a location of the pond **230** to the navigation system **86** in the form of data D**2** associated with the first responder **140** traveling from the initial location **158** to the refined location **164**. For example, the first responder **140** may transmit the location of the pond **230** to the navigation system **86** by pressing an "OBSTRUCTION DETECTED" button on a touchscreen of the mobile computing device. The navigation system **86** then determines the optimized path such that the autonomous patient support apparatus **20** avoids the pond **230** when traveling to the refined location **164** and generates the drive path **186** around the pond **230**. The controller **93** then controls the drive system **84** to drive the autonomous patient support apparatus **20** from the initial location **158** to the refined location **164** along the drive path **186**.

[0081] FIG. **7**K illustrates an embodiment where the method **210** includes a step **232** of determining a redirect location of the incident scene **136** based on the refined location **164** of the incident scene **136**. For example, the first responder **140** may determine that the autonomous patient support apparatus **20** may not reach or will encounter great difficulty when attempting to reach the refined location **164**. In such embodiments, the navigation system **86** determines the redirect location of the incident scene **136** after the refined location **164** is determined and communicated to the navigation system **86** during steps **110'** and **112'**, respectively. For instance, during step **112'**, data D**1** associated with the location of the tracker **172** and/or data D**2** associated with the first responder **140** traveling from the initial location **158** to the refined location **164** may be transmitted to the navigation system **86**. For example, the first responder **140** may encounter a river or hazardous terrain, and may notify the navigation system **86** via data D**2** associated with the first responder **140** traveling from the initial location **158** to the refined location **164**. The navigation system **86** may then determine a redirect location.

[0082] During step **232**, the navigation system **86** may determine the redirect location of the incident scene based on the refined location **164**. As shown in FIG. **7**M, step **232** may include the step **234** of evaluating each of the initial location **158** and the redirect location relative to the refined location **164** based on one or more of an obstacle presence, topographical data, street mapping data, street traffic data, and building infrastructure data. The navigation system **86** may also evaluate a distance between the initial location **158** and the refined location compared to a distance between the redirect location and the refined location **164**.

[0083] After the navigation system **86** determines the redirect location, the unloading system **90** unloads the autonomous patient support apparatus **20** during step **108** at the redirect location. The method **210** then proceeds to the above-described step **212** of determining, with the navigation system **86**, the optimized path. However, in this instance of step **212**, the navigation system **86** determines the optimized path between the redirect location and the refined location **164**. The method **210** then proceeds to generate the drive path **186** during step **214** and drives the autonomous patient support apparatus along the drive path **186** during step **114**.

[0084] To illustrate the embodiment where the method **210** includes the step **232** of determining the redirect location of the incident scene **136**, FIG. **7**L illustrates an embodiment where the incident scene occurs in a backyard of a home with a river **236**. As shown in FIG. **7**L, the ambulance **91** is dispatched to the home with the address 1236 Main St. by the remote dispatch center **126**.

[0085] In an embodiment shown in FIG. **7**M and FIG. **7**N, the method **210** may include an instance of the step **218** where the unmanned aerial vehicle **94** is dispatched to the refined location **164**, and the step **220** where the unmanned aerial vehicle **94** determines the patient location to define the refined location **164**. The unmanned aerial vehicle **94** may then communicate the refined location **164** to the navigation system **86** during step **112'**. The navigation system **86** may then determine, during a step **232** and step **234**, the redirect location based on the refined location **164**. In the embodiment of FIG. **7**M, the step **234** may include a step **238** of evaluating each of the initial location **158** and the redirect location relative to the refined location **164** based on at least one of imaging data, location data, weather data, and movement data communicated from the unmanned aerial vehicle **94**. For example, the unmanned aerial vehicle **94** of FIG. **7**N may communicate imaging data of the river **236**. Accordingly, during step **232**, the navigation system **86** may determine the redirect location based on the imaging data of the river **236**.

[0086] In an embodiment of FIGS. **7**O and **7**P, the method **210** may include a step **240** of dispatching, to the initial location **158**, the first responder **140** equipped with at least one of the tracker **172**, the mobile phone **120**M, the radio communication device **120**R, and the mobile computing device. The method **210** also includes the step **162** of establishing patient contact at the refined location **164** with the first responder **140**. The navigation system **86** may then determine, during step **232** and step **234**, the redirect location based on the refined location **164**. In the embodiment of FIG. **7**O, the step **234** may include a step **242** of evaluating each of the initial location **158** and the redirect location relative to the refined location **164** based on at least one of a voice command VC, data associated with a location of the tracker **172**, and data associated with traveling from the initial location **158** to the refined location **164** communicated with at least one of the tracker **172**, the mobile phone **120**M, the radio communication device **120**R, and the mobile computing device.

[0087] For example, in the embodiment of FIG. **7**P, the first responder **140** equipped with the tracker **172** travels to the refined location **164**. Accordingly, the navigation system **86** may determine the redirect location after evaluating each of the initial location **158** and the redirect location relative to the refined location **164** based on data D**1** associated with the location of the tracker **172** and/or data associated with traveling from the initial location **158** to the refined location **164**. In one instance, the first responder **140** may cross the river **236** and notify the navigation system **86** of the location of the river **236** and that the navigation system **86** should determine a redirect location because, for example, the first responder **140** recognizes that the autonomous patient support apparatus **20** will be unable to traverse the river **236**.

[0088] In the embodiment of FIGS. **7**K and **7**Q, after the method **210** determines the redirect location during step **232**, the method **210** proceeds to an instance of the step **108** of unloading the autonomous patient support apparatus **20**. However, in this instance, the autonomous patient support apparatus **20** is unloaded at the redirect location **244** instead of the initial location **158**. As shown in FIG. **7**Q, the ambulance **91** travels to the redirect location **244**, a home associated with an address 789 State St., and unloads the autonomous patient support apparatus **20** there. The controller **93** then controls the drive system **84** to drive the autonomous patient support apparatus **20** to the refined location **164** from the redirect location **244**.

[0089] In the embodiment of FIGS. **7**R and **7**S, the method **210** includes a step **246** of dispatching a second ambulance **91'** loaded with a second autonomous patient support apparatus **20'** to the redirect location **244**. To drive the second ambulance **91'** to the refined location **164**, the method **210** also includes an instance of the step **108** of unloading the second autonomous patient support apparatus **20'** from the second ambulance **91'** at the redirect location **244**; an instance of the step **112'** where the refined location **164** is communicated to the navigation system **86** of the second autonomous patient support apparatus **20'**; an instance of the steps **212** and **214** where the navigation system **86** determines the optimized path and generates a drive path for the second autonomous patient support apparatus **20'**; and an instance of the step **114** where the drive system **84** drives the second autonomous patient support apparatus **20'** from the redirect location **244** to the refined location **164**. As shown in FIG. **7**S, the second ambulance **91'** is dispatched by the remote dispatch center **126** to the redirect location **244**. The second autonomous patient support apparatus **20'** is then unloaded from the second ambulance **91'** and drives to the refined location **164**.

[0090] FIG. **8**A illustrates a method **248** of transporting medical equipment modules **96**, such as a trauma kit, a drug box, an O_2 bottle, a defibrillator, and/or a heart monitor, to an incident scene. As shown, the method **210** includes the above-described step **102** of determining the initial location **158** of the incident scene **136** and the above-described step **110** of determining the refined location **164** of the incident scene **136**.

[0091] The method **248** also includes a step **250** of dispatching an ambulance **91** loaded with the autonomous mobile response unit and a plurality of medical equipment modules **96** to the initial location **158**; a step **252** of selecting a first medical equipment module, such as one of the medical equipment modules **96** shown in FIG. **1** or the medical equipment module **96** shown in FIG. **5**; a step **254** of dispensing the first medical equipment module **96** from the ambulance **91** onto the autonomous mobile response unit; a step **256** of deploying the autonomous mobile response unit from the ambulance **91** at the initial location **158**; a step **258** of communicating the refined location **164** of the incident scene **136** to the autonomous mobile response unit; a step **260** of generating, with the navigation system **86**, a drive path **186** from the initial location **158** to the refined location **164**; and a step **262** of driving, with the drive system **84**, the autonomous mobile response unit loaded with the first medical equipment module **96** based on the drive path **186**.

[0092] As shown in FIG. **8**B, the steps **102**, **110**, and **250-262** may be executed by components of a system **264** for transporting medical equipment modules **96** to an incident scene **136**. As previously stated, the autonomous mobile response unit may include the autonomous patient support apparatus **20** and/or the unmanned aerial vehicle **94**. As shown in FIG. **8**B, the autonomous patient support apparatus **20** and the unmanned aerial vehicle **94** may include the navigation system **86**, the drive system **84**, the controller **93**, and the obstruction detection system **88**.

[0093] The system **264** may also include a dispensing system **270** configured to dispense medical equipment modules **96** from the ambulance **91** onto the autonomous mobile response unit. For example, in an embodiment where the autonomous mobile response unit is the unmanned aerial vehicle **94**, the dispensing system **270** may dispense a medical equipment module **96** into the retaining system **98** (see FIG. **5**) of the unmanned aerial vehicle **94**. In an embodiment where the autonomous mobile response unit is the autonomous patient support apparatus **20**, a medical equipment module **96** may be dispensed onto and affixed to the patient support surface **50** (see FIG. **5**) of the autonomous patient support apparatus **20**. The dispensing system **270** may be operated manually or autonomously. For example, a first responder **140** may activate the dispensing system **270** by physically depressing a button. In another example, the dispensing system **270** may dispense a medical equipment module **96** after receiving an input from a remote computing device.

[0094] As shown, the system **264** may also include components of the above-described system **216**. However, the system **264** may omit the second communication system **122**, which is included in systems **118**, **216**. In some embodiments, components of the system **264** may be omitted.

[0095] FIG. **8**C further illustrates the step **252** of selecting a first medical equipment module **96**. As shown, the step **252** may include a step **264** of transmitting from the refined location **164**, with the communication system **120**, data D**4** associated with the selection of the first medical equipment module **96**. In such embodiments, the first responder **140** travels to the refined location **164** during step **162** and, after evaluating the patient's **160** condition, determines types of equipment that are needed. The first responder **140** then selects the first medical equipment module **96** accordingly using the communication system **120**.

[0096] FIG. **8**D illustrates an embodiment where the autonomous mobile response unit is the unmanned aerial vehicle **94** and the method **248** includes the step **252** of selecting the first medical equipment module **96**. As shown, the first responder **140** travels to the refined location **164** during step **110**. The first responder **140** then selects the first medical equipment module **96** during step **252** by transmitting, from the refined location **164**, data D**4** associated with the selection of the first medical equipment module **96**. After the first medical equipment module **96** is dispensed onto the unmanned aerial vehicle **94** by the dispensing system **270** during step **254**, the unmanned aerial vehicle **94** is deployed from the ambulance **91** during step **256**, receives the refined location **164** during step **258**, generates a drive path **186** during step **260**, and drives to the refined location **164** during step **262**. As such, the first medical equipment module **96** is transported to the incident scene **136**.

[0097] FIG. **8**E illustrates an embodiment where the method **248** includes a step **266** of dispatching a second first responder **140'** (shown in FIG. **8**F) to the initial location **158** and a step **268** of manually dispensing the first medical equipment module **96** from the ambulance **91** onto the autonomous mobile response unit with the second first responder **140'** in response to receiving the data D**4** associated with the selection of the first medical equipment module **96** transmitted by the first responder **140** from the refined location **164**. FIG. **8**F further illustrates this embodiment. In FIG. **8**F, the first responder **140** has traveled to the refined location **164** and has selected the first medical equipment module **96** during step **252**. As shown, the second first responder **140'** is then dispatched to the initial location **158** during step **266** and manually dispenses the first medical equipment module **96** from the ambulance **91** onto the unmanned aerial vehicle **94** using the dispensing system **270**. The unmanned aerial vehicle **94** then drives to the refined location **164**, providing the first responder **140** with the first medical equipment module **96**.

[0098] It will be further appreciated that the terms "include," "includes," and "including" have the same meaning as the terms "comprise," "comprises," and "comprising." Moreover, it will be appreciated that terms such as "first," "second," "third," and the like are used herein to differentiate certain structural features and components for the non-limiting, illustrative purposes of clarity and consistency.

[0099] Several configurations have been discussed in the foregoing description. However, the configurations discussed herein are not intended to be exhaustive or limit the invention to any particular form. The terminology which has been used is intended to be in the nature of words of description rather than of limitation. Many modifications and variations are possible in light of the above teachings and the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A system for use with a remote dispatch center configured to dispatch a vehicle to an initial location of an incident scene, the system comprising:

a patient support apparatus including:

- a base supporting a plurality of caster wheels,
- a support frame disposed above the base,
- a patient support surface coupled to the support frame for supporting a patient,
- a lift mechanism to move the support frame relative to the base between a plurality of vertical configurations, and
- a navigation system configured to generate a path from the initial location to a refined location; and

an unloading system configured to unload the patient support apparatus from the vehicle at the initial location, the unloading system including a trolley and a track, wherein the patient support apparatus is configured to couple to the trolley and the trolley is configured to move along the track.

2. The system of claim **1**, further comprising a portable electronic device configured to communicate the refined location of the incident scene.

3. The system of claim **2**, wherein the remote dispatch center is further configured to dispatch a first responder to the initial location such that the first responder travels from the initial location and establishes patient contact at the refined location; and

wherein the first responder is equipped with the portable electronic device.

4. The system of claim **3**, wherein the portable electronic device is further defined as at least one of a tracker, a mobile phone, a radio communication device, and a mobile computing device.

5. The system as set forth in claim **4**, wherein the portable electronic device includes at least one of a GPS tracker configured to determine the location of the tracker based on a GPS signal, a cellular tracker configured to determine the location of the tracker based on a cellular signal, and a WiFi tracker configured to determine the location of the tracker based on a WiFi signal.

6. The system of claim **2**, wherein the portable electronic device is configured determine the refined location of the incident scene based on a first responder traveling from the initial location and establishing patient contact at the refined location.

7. The system of claim **2**, wherein the portable electronic device is further configured to transmit, from the refined location, data associated with one or more medical equipment modules.

8. The system of claim **7**, wherein the remote dispatch center is further configured to dispatch a second first responder to the initial location; and

wherein the second first responder manually dispenses the one or more medical equipment modules from the vehicle onto the patient support apparatus in response to receiving the data associated with the one or more medical equipment modules transmitted from the refined location.

9. The system of claim **1**, wherein the unloading system is further configured to unload the patient support apparatus from the vehicle in response to remote activation.

10. The system of claim **9**, wherein the remote activation is sent by the remote dispatch center.

11. The system of claim **1**, wherein unloading system is further configured to autonomous unload the patient support apparatus from the vehicle in response to the vehicle reaching a predetermined location.

12. The system of claim **1**, wherein the unloading system is further configured for manual operation by a first responder.

13. The system of claim **1**, wherein the patient support apparatus includes a drive system and a controller configured to control the drive system based on the path such that the drive system drives the patient support apparatus from the vehicle to the refined location.

14. The system of claim **13**, wherein the drive system of the patient support apparatus is fixed to the base and includes at least one auxiliary wheel arranged between the plurality of caster wheels to drive the patient support apparatus.

15. The system of claim **14**, wherein the navigation system is configured to generate the path between the initial location and the refined location for the drive system to drive the patient support apparatus along from the initial location to the refined location with the at least one auxiliary wheel.

16. The system of claim **14**, wherein the drive system is configured to move the auxiliary wheel to a deployed position.

17. The system of claim **13**, wherein the patient support apparatus is configured to autonomously drive along the path between the initial location and the refined location with the drive system.

18. The system of claim **1**, further comprising a communication system configured to receive an emergency call at a public safety answering point.

19. The system, of claim **18**, wherein the communication system is further configured to relay the initial location from the public safety answering point to the remote dispatch center.

20. A system for use with a remote dispatch center configured to dispatch a vehicle to an initial location of an incident scene, the system comprising:

a patient support apparatus including:

a base supporting a plurality of caster wheels,

a support frame disposed above the base,

a patient support surface coupled to the support frame for supporting a patient, and

a lift mechanism to move the support frame relative to the base between a plurality of vertical configurations, and

a navigation system configured to generate a path from the initial location to the refined location;

an unloading system configured to unload the patient support apparatus from the vehicle at the initial location, the unloading system including a trolley and a track, wherein the patient support apparatus is configured to couple to the trolley and the trolley is configured to move along the track; and

a portable electronic device configured to communicate a refined location of the incident scene.

* * * * *