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(54) **Location-based small arms control system**

(57) An apparatus includes a trigger mechanism (110) and a controller (320) coupled to the trigger mechanism. The controller is configured to disable the trigger

mechanism when the apparatus is within a gun-restricted zone.

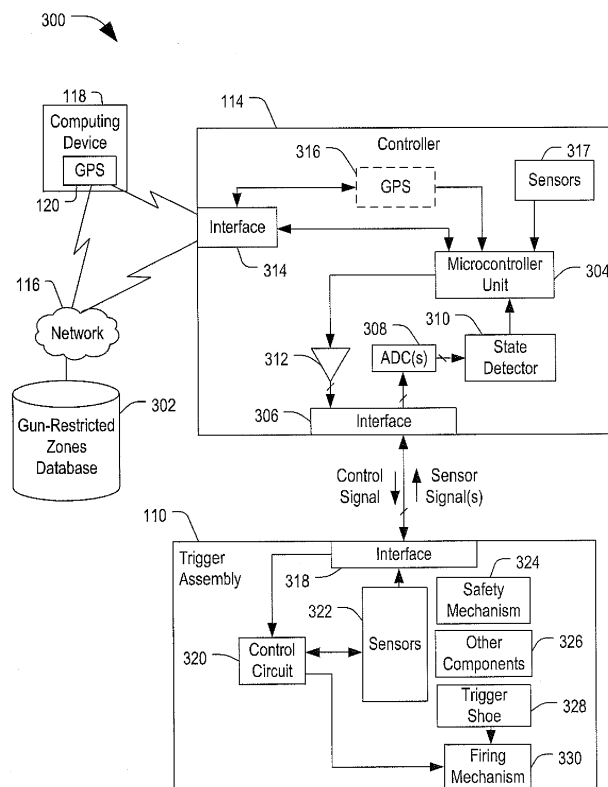


FIG. 3

Description

[0001] The present disclosure is generally related to small arms firearms, and more particularly to location-based control of discharge of such firearms.

BACKGROUND

[0002] In recent years, individuals have used firearms to kill or wound multiple victims in school environments, in movie theaters, and so on. Government agencies have established "gun free" zones prohibiting possession of a firearm within pre-defined areas, such as within a school zone or within government buildings. Additionally, some private companies have established "gun free" zones with respect to their business establishments. While such pre-defined areas may prevent lawful gun owners from carrying their weapons in such areas, a criminal may ignore such restrictions, carrying weapons into such zones.

SUMMARY

[0003] In an embodiment, an apparatus includes a trigger mechanism and a controller coupled to the trigger mechanism. The controller is configured to disable the trigger mechanism when the apparatus is within a gun-restricted zone.

[0004] In another embodiment, a method includes determining a distance between a location of a gun and a gun-restricted zone using a controller coupled to a trigger mechanism. The method further includes disabling the trigger mechanism to prevent discharge of a firearm when the distance falls below a pre-determined threshold.

[0005] In still another embodiment, a firearm system includes a small arms firearm and a trigger mechanism coupled to the small arms firearm. The trigger mechanism includes a firing mechanism configured to discharge the small arms firearm in response to a trigger pull. The firearm system further includes a controller communicatively coupled to the trigger mechanism and configured to disable the firing mechanism when the small arms firearm is within a pre-determined distance of a gun-restricted zone.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

FIG. 1 is a block diagram of an embodiment of a system including a firearm system configured to determine its location and to selectively disable a trigger mechanism based on the location.

FIG. 2 is a flow diagram of an embodiment of a method of selectively disabling a trigger mechanism of a firearm based on a location.

FIG. 3 is a block diagram of a second embodiment of a system including a firearm system configured to determine its location and to selectively disable a trigger mechanism of a firearm based on the location.

FIG. 4 is a diagram of a representative example of a gun-restricted zone.

FIG. 5 is a flow diagram of a second embodiment of a method of selectively disabling a trigger mechanism of a firearm.

[0007] In the following discussion, the same reference numbers are used in the various embodiments to indicate the same or similar elements.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0008] In the following detailed description of the embodiments, reference is made to the accompanying drawings which form a part hereof, and in which are shown by way of illustration of specific embodiments. It is to be understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the present disclosure.

[0009] Described below are embodiments of a firearm system configured to determine its location relative to a gun-restricted zone, such as a school zone or other gun-restricted area. In an embodiment, a controller of the firearm system selectively disables the firing mechanism to prevent discharge of the firearm when the location is within the gun-restricted zone. In another embodiment, the controller selectively disables the firing mechanism when the location is within a pre-determined distance of the gun-restricted zone. In still another embodiment, the controller selectively disables the firing mechanism when the location is within a pre-determined distance of the gun-restricted zone and orientation data associated with the firearm indicates that the firearm is aimed toward the gun-restricted zone. One possible example of a system including such a firearm system is described below with respect to FIG. 1.

[0010] FIG. 1 is a block diagram of an embodiment of a system 100 including a firearm system configured to determine its location and to selectively disable a trigger mechanism based on the location. The system 100 includes an optical device 102 mounted to a firearm 104 that includes a muzzle 106, a handle or grip 108, and a trigger mechanism or trigger assembly 110. The trigger mechanism or assembly 110 includes circuitry responsive to control signals from a controller 114 within optical device 102 to selectively enable or disable a firing mechanism. In an embodiment, controller 114 may include location determination circuitry (such as a global positioning satellite (GPS) circuit, which it uses to determine its location. Alternatively, controller 114 may communicate with a network 116 to determine its location or may com-

municate with a computing device 118 to receive location data. In an example, computing device 118 may be a smart phone, laptop computer, or tablet computer with a GPS circuit 120 or with other location determination capability. In one example, computing device 118 may determine its approximate location by communication with an access point or by triangulating between multiple cell towers, for example.

[0011] Controller 114 may include a memory configured to store a database of gun-restricted zones. Alternatively, controller 114 may retrieve gun-restricted zone information from computing device 118 or from a data source coupled to network 116 and may compare its location data to the gun-restricted zone information to determine a distance between the location of firearm 104 and a nearest gun-restricted zone. In an embodiment, if the distance is below a pre-determined threshold, controller 114 disables the trigger assembly to prevent discharge of the firearm. In another embodiment, if the distance is below a threshold and the orientation of the firearm as determined from one or more orientation sensors within optical device 102 indicates that the firearm 104 is aimed toward the gun-restricted zone, controller 114 may disable trigger assembly 110 to prevent firing. In still another embodiment, if the firearm is within the gun-restricted zone, controller 114 may disable trigger assembly 110.

[0012] In an embodiment, controller 114 may determine its location using a GPS circuit internal to optical device 102 or may determine the location through communication with network 116, which may be the Internet, a satellite network, a wireless telephone network, or another type of network. In an alternative embodiment, controller 114 may determine its location based on the location of a nearby computing device 118, which may include GPS circuitry 120 or which may determine its location through communication with the network 116.

[0013] Controller 114 may retrieve gun-restricted zone information on startup or periodically. Further, controller 114 may retrieve its location on startup and continuously thereafter or in response to a user action. In an embodiment, controller 114 may determine its location relative to a gun-restricted zone in response to a trigger pull. In another embodiment, controller 114 may determine its location relative to a gun-restricted zone in response to receiving a target selection input. In an embodiment, controller 114 maintains trigger assembly 110 in a disabled state by default and enables the trigger assembly 110 only when the firearm 104 is determined to be in a safe firing location (i.e., outside of a gun-restricted zone or outside of such a zone and pointed away from such a zone). One possible example of a method selectively disabling a firearm based on its location is described below with respect to FIG. 2.

[0014] FIG. 2 is a flow diagram of an embodiment of a method 200 of selectively disabling a trigger mechanism of a firearm based on a location. At 202, a controller of the firearm receives location data corresponding to a lo-

cation of the firearm. The location data may be received from a network, from a GPS system internal to a rifle scope including the controller, from a GPS system of a computing device communicatively coupled to the controller, or from another source. Alternatively, the location data may be determined based on communications with one or more network towers or base stations of a communication network or based on communications with a network access point.

[0015] Advancing to 204, a distance between the location of the firearm and a gun-restricted zone is determined using the controller. In an example, the controller may compare the location of the firearm to a location of a plurality of gun-restricted zones to find a nearest gun-restricted zone. In one embodiment, the controller sends the location data to a computing device through a wireless communication link or through a network to retrieve the gun-restricted zone data. Alternatively, in another embodiment, the controller retrieves the gun-restricted zone data from a memory. Once the nearest gun-restricted zone is determined, the controller determines a distance between the location and the nearest gun-restricted zone.

[0016] Continuing to 206, the controller selectively disables a trigger mechanism of the firearm to prevent discharge when the distance is less than a pre-determined threshold (i.e., when the gun-restricted zone may within firing range of the firearm). In an example, the threshold may represent a range of a firearm associated with the trigger mechanism. If a particular firearm is capable of firing a bullet approximately 400 yards, the threshold may be set at twice that range to prevent firing in an area that could reach the gun-restricted zone. In an alternative embodiment, controller may determine a direction of orientation of the firearm and selectively disable the trigger mechanism when the firearm is aimed toward the gun-restricted zone when the distance is below the threshold. The threshold may be programmed by the manufacturer or by a reseller to prevent a user from mistakenly or intentionally discharging the firearm within or into a gun-restricted zone.

[0017] In general, the gun-restricted zone information may be maintained in a database. In one example, the Bureau of Alcohol, Tobacco, and Firearms may maintain such a database and make the database accessible for searching. In another example, the database may maintain a list of school and government building locations and the controller may automatically calculate a distance from the perimeters of such structures to determine a gun-free or gun-restricted zone based on gun laws or other restrictions. One possible example of a system including a firearm system configured to prevent discharge of a firearm in a gun-restricted zone is described below with respect to FIG. 3.

[0018] FIG. 3 is a block diagram of a second embodiment of a system 300 including a firearm system configured to determine its location and to selectively disable a trigger mechanism of a firearm based on the location.

In this embodiment, the system 300 includes a gun-restricted zones database 302 coupled to a network 116 which may be coupled to computing device 118 and/or to controller 114. Controller 114 is coupled to trigger assembly 110. Controller 114 includes a microcontroller unit (MCU) 304 that is coupled to trigger assembly 110 through an interface 306, one or more analog-to-digital converters (ADCs) 308 and a state detector 310. MCU 304 is also coupled to an input of a driver circuit 312 that includes an output coupled to the interface 306. Further, MCU 304 is coupled to interface 314, which may be coupled to network 116 and/or computing device 118. Controller 114 may also include a GPS circuit 316, which may be coupled to interface 314 and to MCU 304. MCU 304 may also be coupled to one or more sensors 317, such as motion sensors, inclinometers, and directional sensors configured to determine orientation data.

[0019] Trigger assembly 110 includes an interface 318 configured to couple to controller 114. Trigger assembly 110 further includes a control circuit 320 coupled to interface 318, sensors 322 to determine states of various components of the trigger assembly 110, and firing mechanism 330, which may be coupled to trigger shoe 328. In an embodiment, one or more components of sensors 322 may be coupled to trigger shoe 328 or other components of firing mechanism 330. In one example, a magnet may be included within a portion of trigger shoe 328 and sensors 322 may include a Hall Effect sensor to detect movement of trigger shoe 328. Trigger assembly 110 may further include a safety mechanism 324 and other components 326. In an embodiment, sensors 322 may monitor a state of trigger shoe 328 to detect a trigger pull event. Further, sensors 322 may monitor the state of safety mechanism 324 and other components 326.

[0020] In an embodiment, sensors 322 communicate sensor signals to controller 114 via interface 318. Controller 114 converts the sensor signals to digital data using one or more ADCs 308 and uses the digital data to determine a state of trigger assembly 110 using state detector 310. The state information is provided to MCU 304.

[0021] In an embodiment, MCU 304 may continuously monitor a location of the trigger assembly 110. The location may be determined from a network access point of network 116, from a GPS circuit 316 within controller 114, or from GPS circuit 120 within computing device 118. When state detector 310 determines that safety mechanism 324 is engaged, MCU 304 may delay determination of the location of trigger assembly 110 relative to a gun-restricted zone. When state detector 310 determines that safety mechanism 324 is disengaged, MCU 304 may determine a distance between trigger assembly 110 and a gun-restricted zone by identifying a nearest gun-restricted zone and determining a relative distance. If the distance is less than a threshold, MCU 304 may control driver circuit 312 to send a control signal to control circuit 320 to disengage the firing mechanism 330, preventing discharge of the firearm. In a particular embodiment, con-

trol circuit 320 may activate an electrical component, such as a solenoid or other circuitry, or may deactivate circuitry to disable the firing mechanism 330 to prevent discharge of the firearm within a gun-restricted zone.

[0022] In an alternative embodiment, MCU 304 may determine the relative distance between trigger assembly 110 and the gun-restricted zone and may determine an orientation of the firearm based on sensors 317 or sensors within other components 326 and may selectively disable firing mechanism 330. In an example, the MCU 304 may signal control circuit 320 to disable firing mechanism 330 when the firearm is within a predetermined distance of a gun-restricted zone and the gun is aimed toward the gun-restricted zone to prevent a shooter from firing within or into a gun-restricted area. In some embodiments, MCU 304 may permit discharge of the firearm in a direction other than toward the gun-restricted zone.

[0023] In the illustrated embodiment, gun restricted zones database 302 is external to controller 114. In some embodiments, MCU 304 may maintain a local database in memory, which may include a list of gun-restricted zones that are within a few hundred miles of the current location of the shooter. Once the data is downloaded from gun restricted zones database 302 and stored in a local memory (not shown), MCU 304 may determine the relative distance based on the data stored in the local memory. Periodically thereafter (such as every 20 minutes or so), MCU 304 may update its local data store, assuming that the shooter does not move hundreds of miles in 20 minutes and the gun restricted zones database 302 does not change continuously.

[0024] In an embodiment, controller 114 may be part of an optical scope coupled to a firearm. In another embodiment, controller 114 may be an electronic device, such as a smart phone that is configured to communicate with trigger assembly 110. In an embodiment, interface 318 and interface 306 may include wireless transceivers configured to establish a wireless communication link and to communicate data and control signals through the wireless communication link.

[0025] In another particular embodiment, computing device 118 may be a server device at the gun-restricted location, and the computing device 118 may communicate a gun-restricted zone signal to the controller 114, which may disable the firing mechanism in response to receiving the signal. In such an instance, the controller 114 may determine the distance based on receipt of the signal, which may be a short-range wireless signal that can only be received within a limited range.

[0026] It should be appreciated that the embodiment depicted in FIG. 3 is one possible example of a system configured to selectively prevent discharge of a firearm based on its location. If the firearm is within a gun-restricted zone or is within a distance of such a zone, the firing mechanism may be disabled to prevent accidental or malicious discharge of the weapon within or into the gun-restricted zone. Gun-restricted zones may be created by governmental regulation or by private institutions

establishing gun restrictions. One example of a gun-free or gun-restricted zone is a school. Law enforcement agencies prohibit gun possession within pre-determined distance from such entities. One example of a gun-restricted zone surrounding a school is described below with respect to FIG. 4.

[0027] FIG. 4 is a diagram 400 of a representative example of a gun-restricted zone 404. Gun-restricted zone 404 represents an area surrounding a protected structure, such as school 402. A controller of a firearm system (such as controller 114) may disable a firing mechanism of a firearm when it is within gun-restricted zone 404, such as at location A (generally indicated at 408). Diagram 400 further includes a restricted firing area 406. Controller 114 may selectively disable the firing mechanism of the firearm when it is within the restricted firing area 406 but outside of the gun-restricted zone 404, as indicated at location C (generally indicated at 412). Within this restricted firing area 406, controller 114 may determine an aim direction of the firearm and may disable firing mechanism 330 when the firearm is within the restricted firing area 406 and aimed toward the gun-restricted zone 404. When the gun is located outside of the restricted firing area 406 such as at location B (generally indicated at 410), controller 114 may not restrict discharge of the firearm.

[0028] In an example, controller 114 may disable the firing mechanism 330 by activating an electrical component, such as a solenoid, or by deactivating one or more components of the trigger assembly 110 to prevent discharge of the firearm. Alternatively, controller 114 may selectively enable the firing mechanism 330 when the firearm is in a safe location (e.g., location B 410) or within the restricted firing area 406 (e.g., at location C 412) but pointed away from gun-restricted zone 404. One possible method of implementing the example with respect to location C 412 is described below with respect to FIG. 5.

[0029] FIG. 5 is a flow diagram of a method 500 of selectively disabling a trigger mechanism of a firearm according to a second embodiment. At 502, the controller of a firearm determines a distance between a location of the firearm and a gun-restricted zone. As discussed above, the controller may determine GPS coordinates and compare them to the perimeter of the gun-restricted zone. GPS coordinates may be retrieved from a GPS circuit 316 or from a network 116 or external computing device 118 that could include a GPS circuit 120. The perimeter of the gun-restricted zone may be determined from gun restricted zones database 302 or from an internal data store.

[0030] Advancing to 504, the controller determines an orientation of the firearm relative to the gun-restricted zone. In an embodiment, the controller may be part of a gun scope that includes one or more orientation sensors (such as an inclinometer, gyroscopes, accelerometers, a compass, and so on) configured to determine an orientation of the aim point of the firearm. Continuing to 506, the controller may selectively disable a trigger mechanism

of the firearm to prevent discharge when the distance is less than a pre-determined threshold and the firearm is aimed toward the gun-restricted zone. The controller may allow the gun to discharge when the firearm is aimed in a different direction.

[0031] In conjunction with the systems and methods described above with respect to FIGs. 1-5, a firearm system is disclosed that determines a location of a firearm relative to a gun-restricted area, such as a school zone, and selectively disables a trigger mechanism to prevent firing when the firearm is too close to a school zone. In one example, the controller of the firearm system determines a distance between the firearm and the gun-restricted zone based on the location and compares the distance to a threshold. When the distance is less than the threshold, the controller disables the firing mechanism. In another example, the controller also determines an orientation of the firearm and disables the firearm when the distance is less than a threshold and the firearm is aimed toward the gun-restricted zone. The controller may permit discharge when the firearm is outside of the gun-restricted area and directed away from the gun-restricted zone.

[0032] Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the scope of the invention.

Claims

1. An apparatus comprising:

a trigger mechanism; and
a controller coupled to the trigger mechanism and configured to disable the trigger mechanism when the apparatus is within a gun-restricted zone.

2. The apparatus of claim 1, further comprising a gun scope including the controller.

3. The apparatus of claim 1, wherein the trigger mechanism comprises at least one electrical component responsive to the controller and configured to selectively disable the trigger mechanism in response to a signal from the controller.

4. The apparatus of claim 1, wherein the controller comprises:

a transceiver configured to receive a radio frequency signal;
a processor coupled to the transceiver and configured to determine a location of the controller in response to the radio frequency signal.

5. The apparatus of claim 4, wherein:

the controller is configured to determine a distance between the location of the controller and location data of a nearest one of a plurality of gun-restricted zones in a database of gun-restricted zones; and
the controller disables the trigger mechanism when the distance is less than or equal to a distance threshold.

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6. The apparatus of claim 5, wherein the controller further comprises a memory configured to store the database of gun-restricted zones.

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7. The apparatus of claim 5, wherein the controller sends a query including the location of the controller to a database to retrieve the location data associated with the nearest one of the plurality of gun-restricted zones.

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8. The apparatus of claim 1, wherein the controller continuously monitors a location of the trigger mechanism and searches a database of gun-restricted zones for a nearest gun-restricted zone during power up and periodically thereafter.

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9. A firearm system comprising:

a small arms firearm;
a trigger mechanism coupled to the small arms firearm and including a firing mechanism configured to discharge the small arms firearm in response to a trigger pull; and
a controller communicatively coupled to the trigger mechanism and configured to disable the firing mechanism when the small arms firearm is within a pre-determined distance of a gun-restricted zone.

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10. The firearm system of claim 9, wherein the controller comprises a gun scope.

11. The firearm system of claim 9, wherein the controller comprises at least one of a smart phone, a laptop computer, and a tablet computer.

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12. The firearm system of claim 9, wherein the controller includes:

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a global positioning satellite (GPS) circuit configured to determine GPS coordinates of the small arms firearm;
a processor coupled to the GPS circuit, the processor configured to compare the GPS coordinates to location data of a plurality of gun-restricted zones in a database to identify a nearest gun-restricted zone, the processor configured

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to determine a distance between the GPS coordinates of the small arms firearm and a perimeter edge of the gun-restricted zone; and wherein the controller disables the trigger mechanism when the distance is less than a threshold.

13. The firearm system of claim 9, wherein the trigger mechanism includes an electrical component that is responsive to a control signal from the controller to prevent discharge of the small arms firearm.

14. The firearm system of claim 9, wherein the gun-restricted zone comprises at least one of a school zone and a government agency zone.

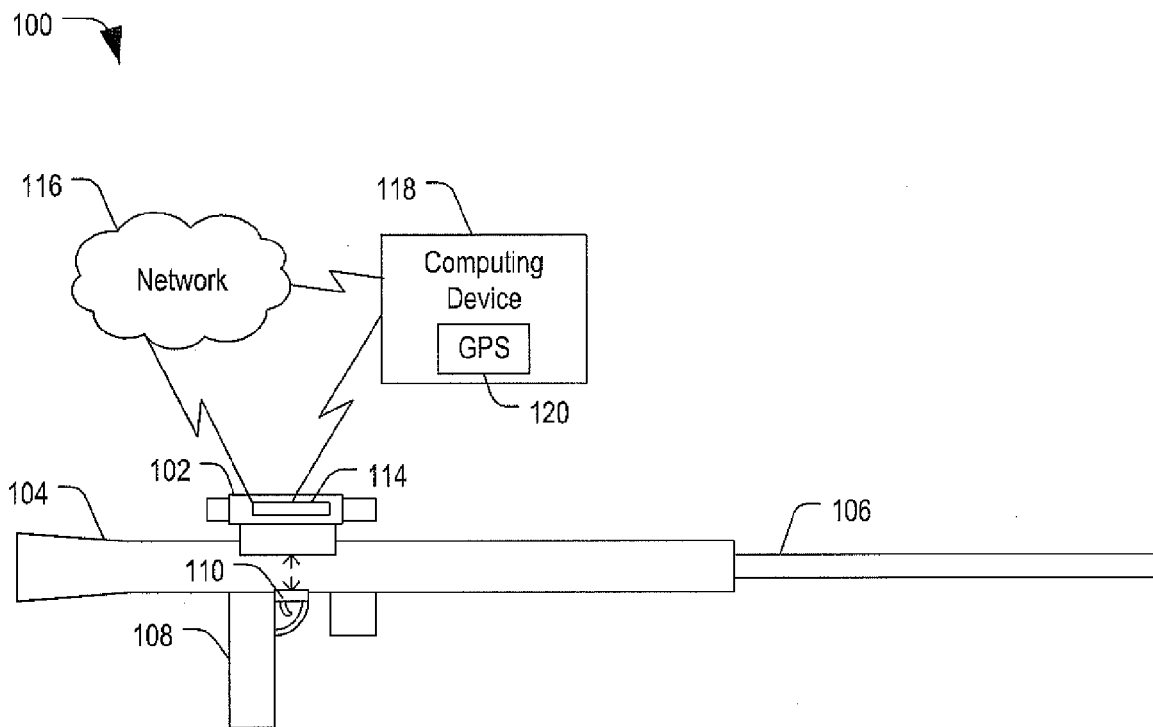


FIG. 1

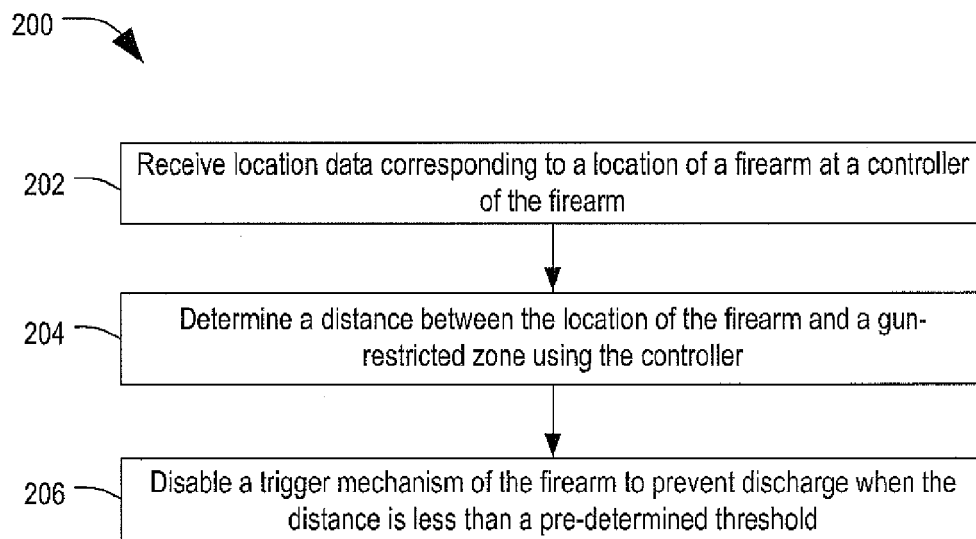


FIG. 2

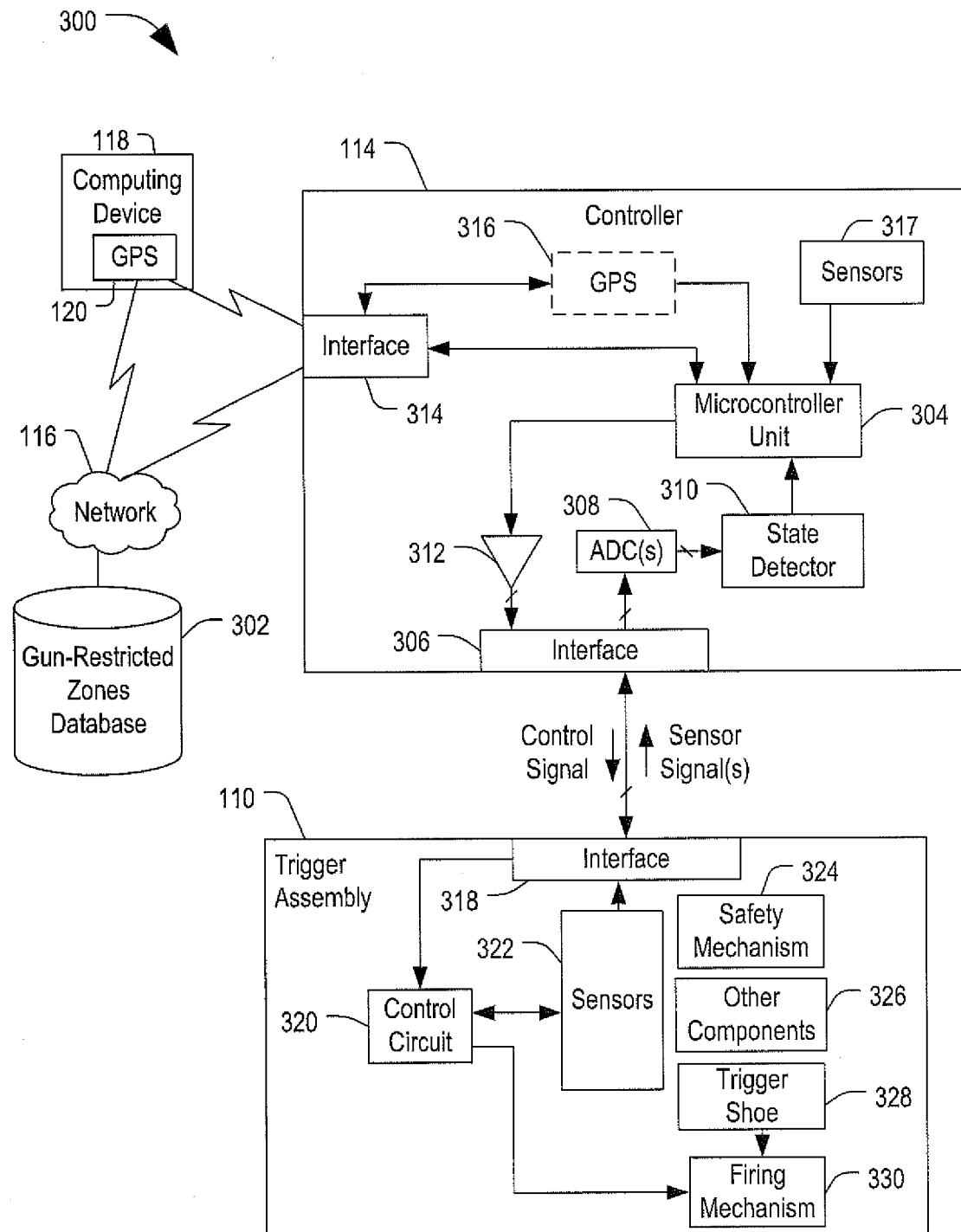


FIG. 3

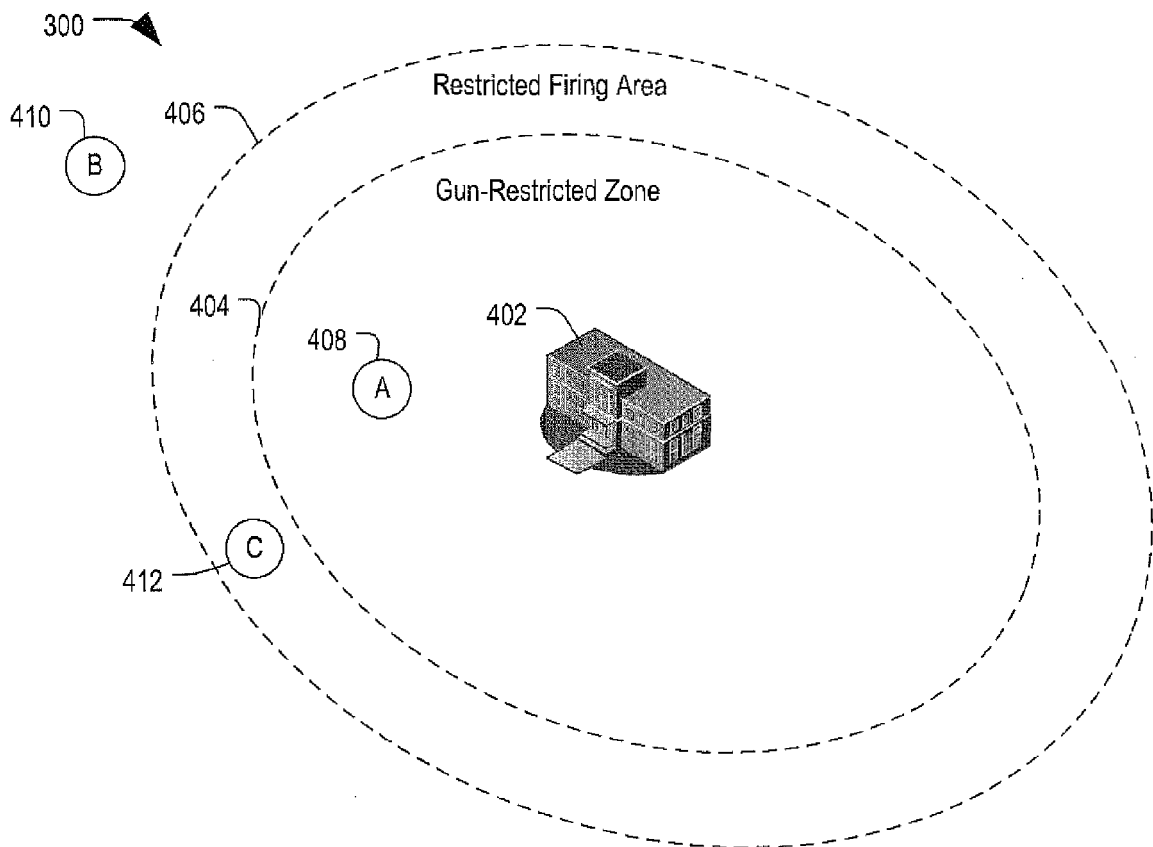


FIG. 4

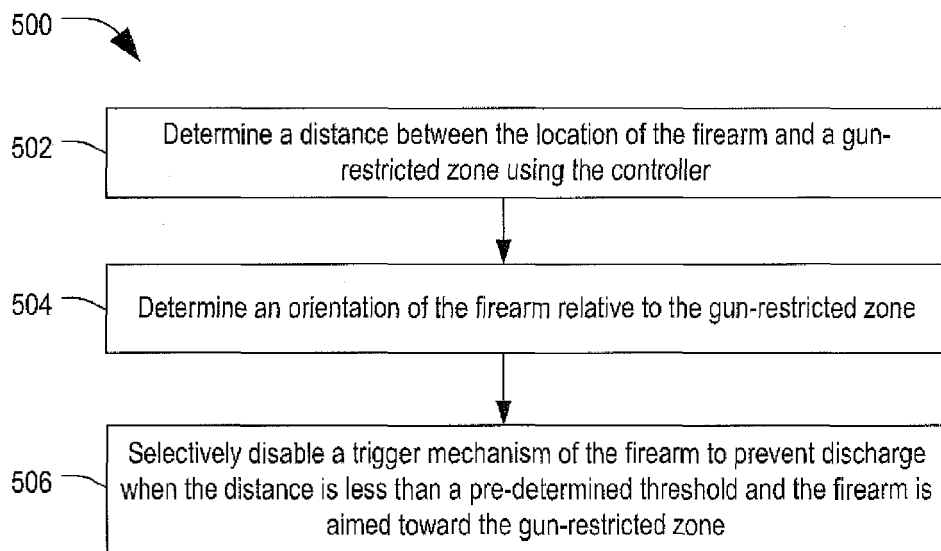


FIG. 5