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(54) **SYSTEM AND METHOD FOR MONITORING HANDLING OF A FIREARM OR OTHER TRIGGER-BASED DEVICE**

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(51) **Int. Cl.**
G08B 21/00 (2006.01)

(52) **U.S. Cl.**
USPC **340/686.1**; 434/11; 434/19; 434/21; 434/22; 434/247; 273/271; 250/222.1

(58) **Field of Classification Search**
USPC ..... 340/686.1; 434/11, 16, 18–22, 247, 434/307 R, 308, 365; 89/41.03, 7, 199; 73/379.02
See application file for complete search history.

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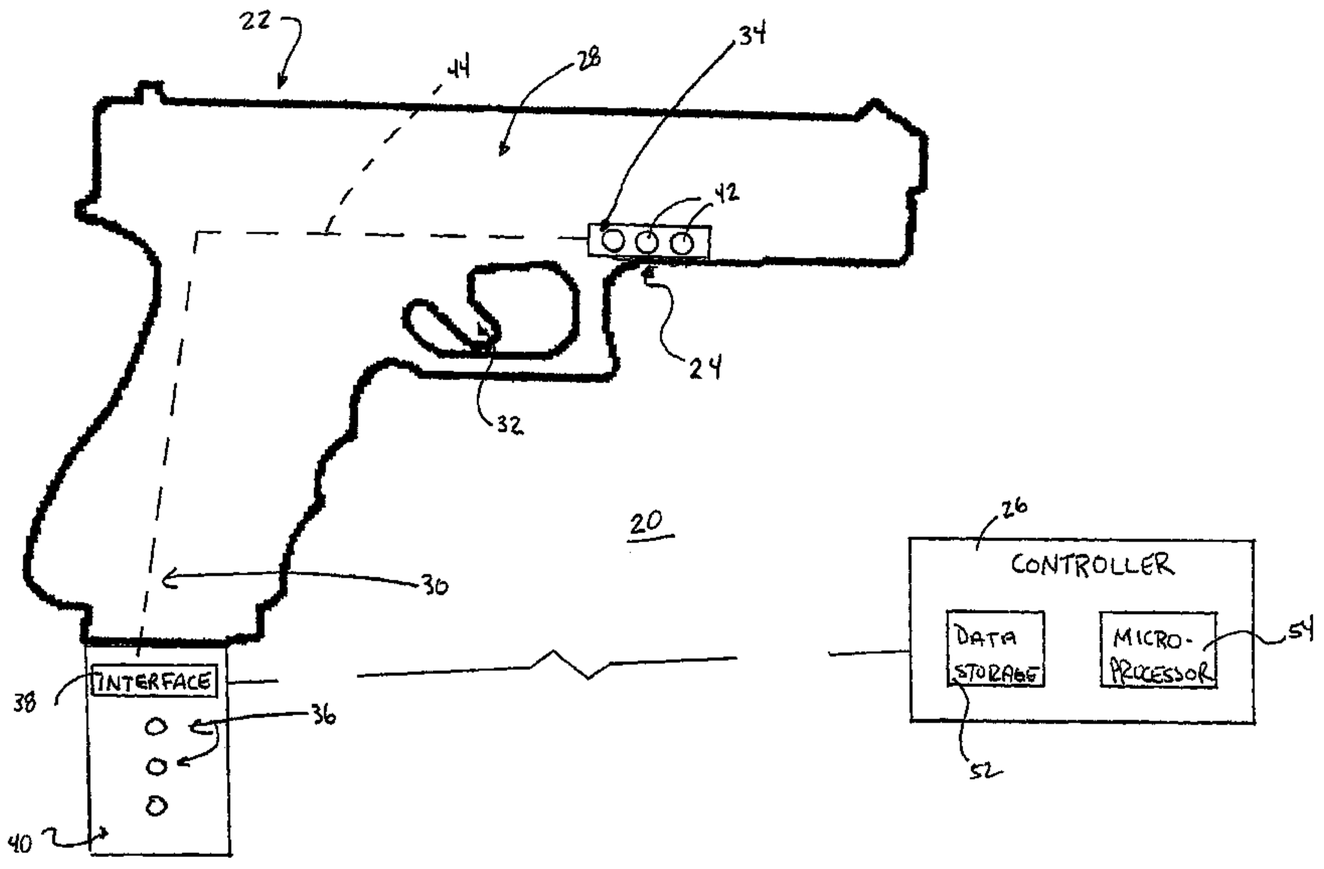
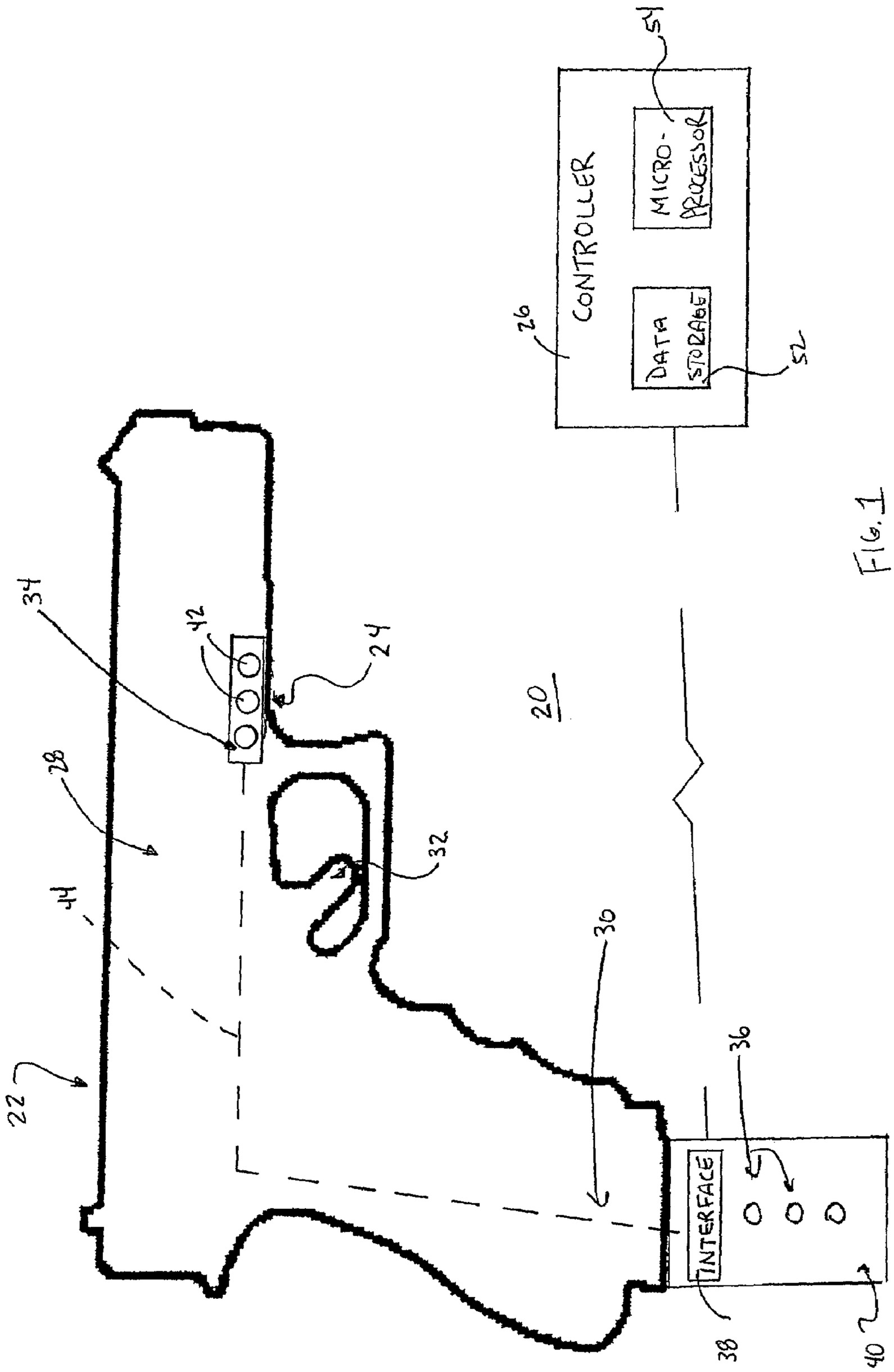
(57) **ABSTRACT**

Hand position monitoring systems and methods for use with firearms. The hand monitoring system monitors a hand position of a firearm user and includes a sensor assembly and a controller. The sensor assembly acquires hand position information (e.g., index or trigger finger position information) of a firearm user and electronically communicates the hand position information for review and/or analysis.

32 Claims, 5 Drawing Sheets




CONTROLLER
MICRO-PROCESSOR
DATA STORAGE
INTERFACE
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22
24
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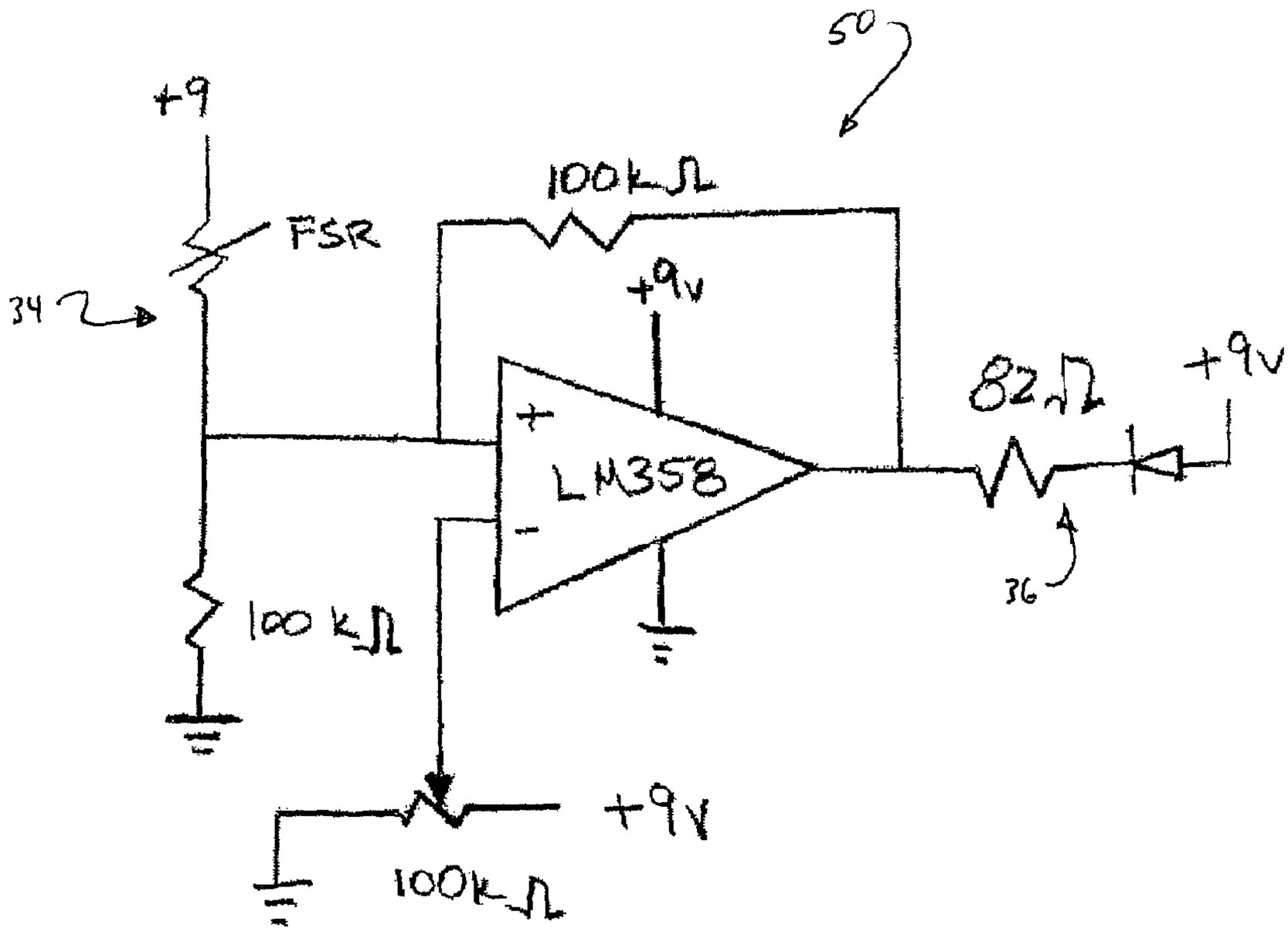
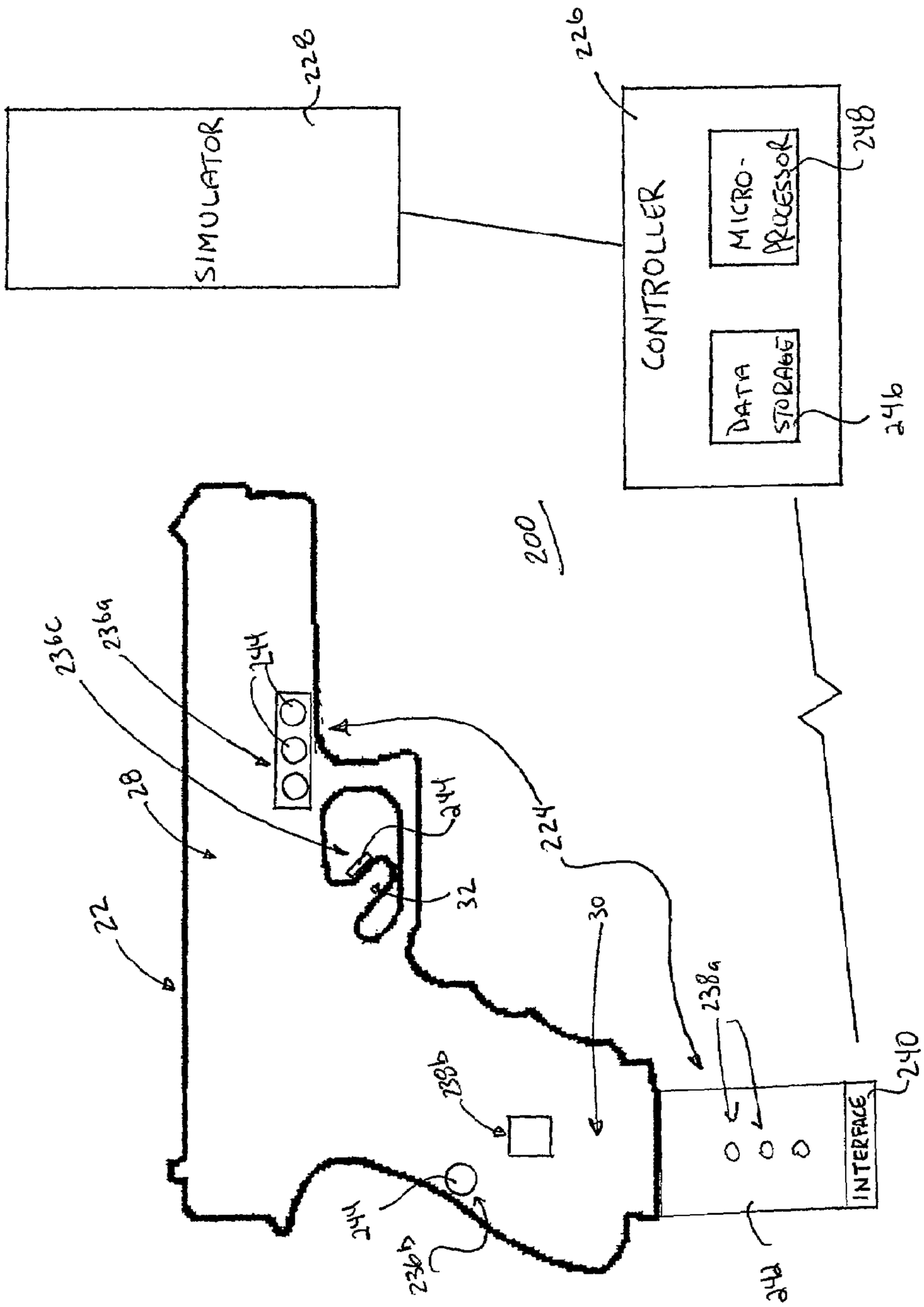
28
30
32
34
36
38
40
42
44
50
52

FIG. 1



F16. 2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SIMULATOR
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CONTROLLER
MICRO-PROCESSOR
248
DATA STORAGE
246
200
236c
236a
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224
22
30
238a
238b
240
INTERFACE
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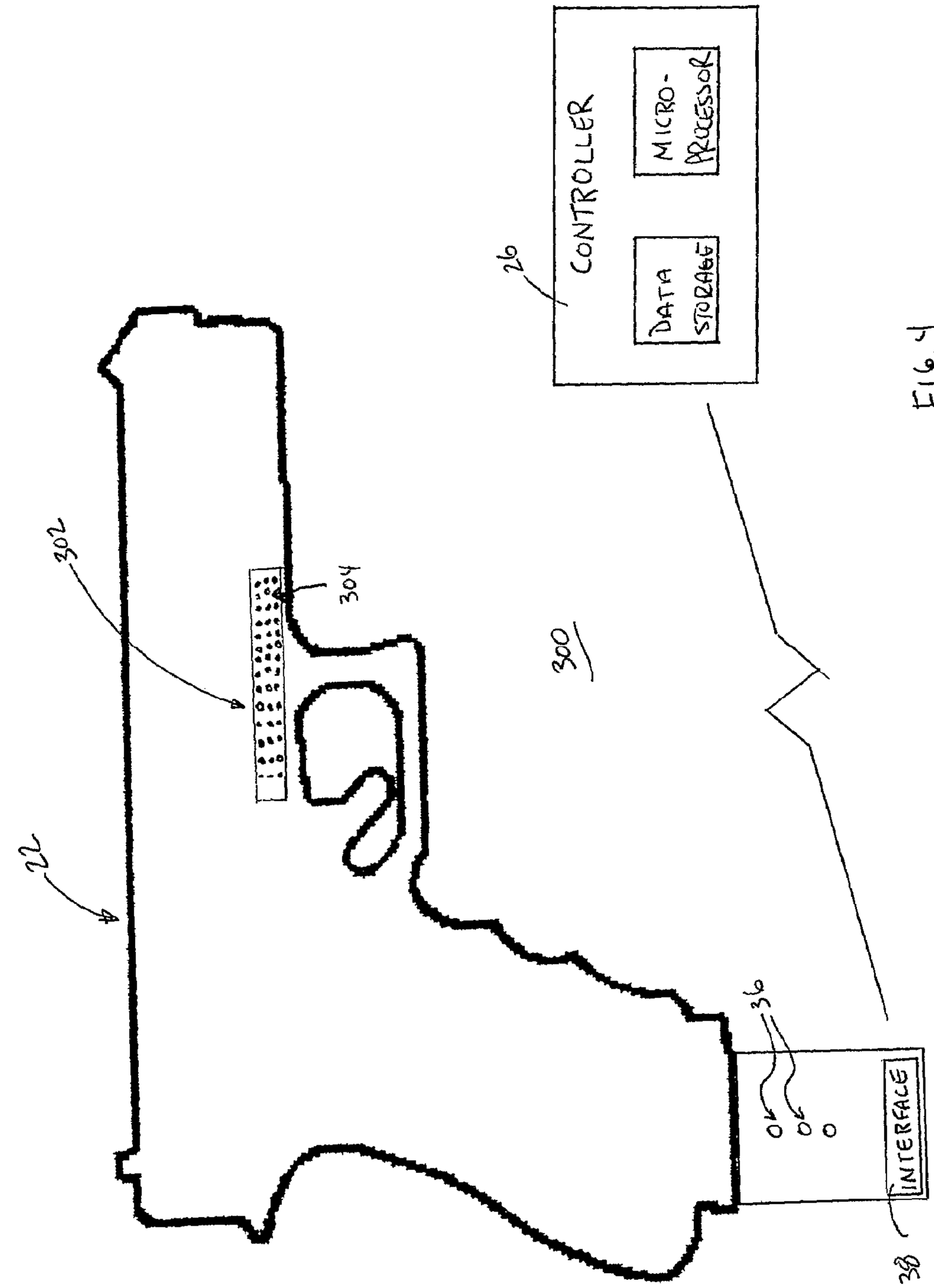
234c
234a

FIG. 3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CONTROLLER
MICRO-PROCESSOR
DATA STORAGE
36
INTERFACE
38

FIG. 4

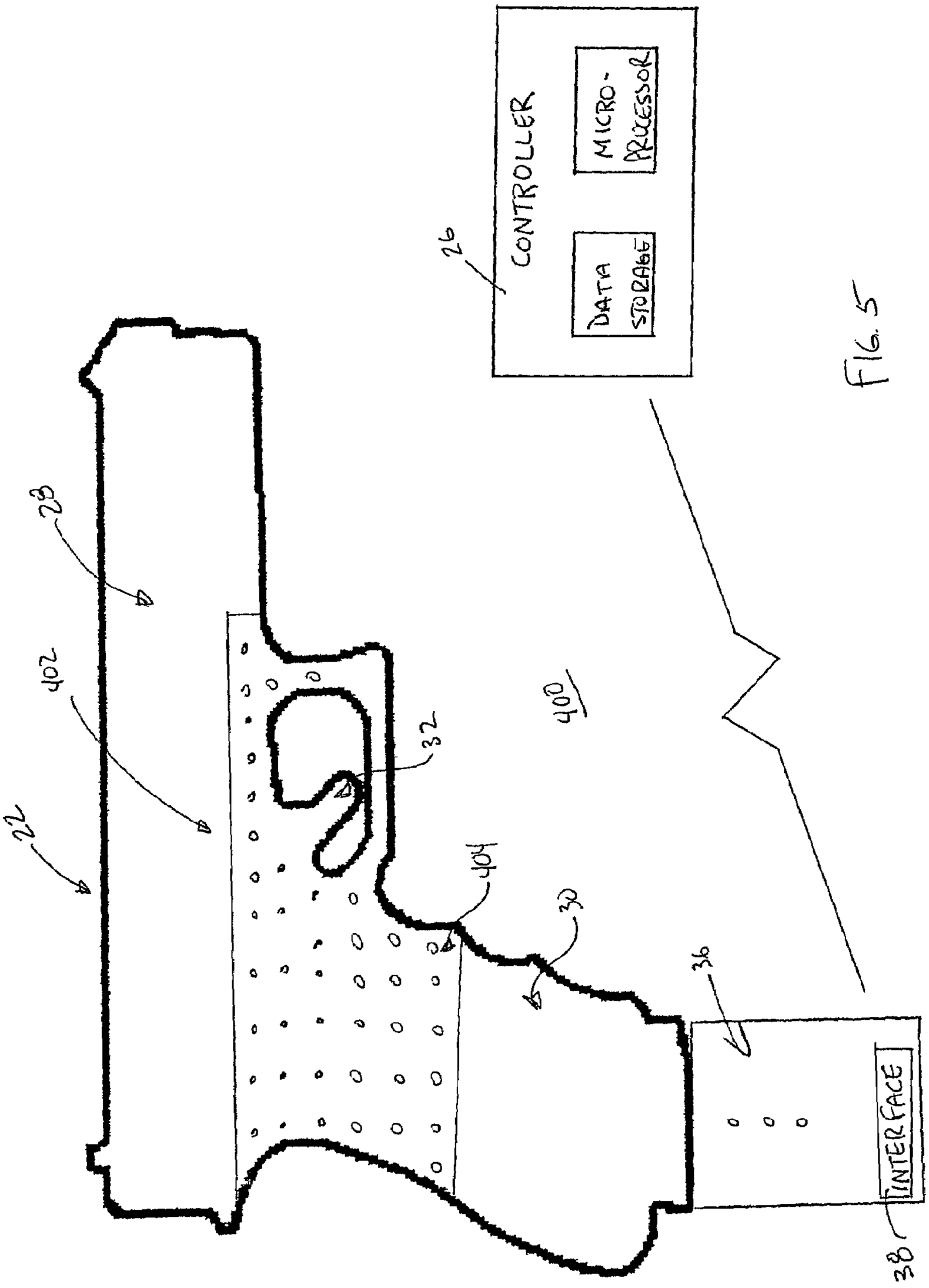
CONTROLLER
MICRO-PROCESSOR
DATA STORAGE
26
28
402
22
32
400
404
30
36
INTERFACE
38

FIG. 5

SYSTEM AND METHOD FOR MONITORING HANDLING OF A FIREARM OR OTHER TRIGGER-BASED DEVICE

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority under 35 U.S.C. §119(e)(1) to U.S. Provisional Patent Application Ser. No. 60/752,798, filed Dec. 22, 2005, entitled "Firearm Hand Position Monitoring System and Method," and bearing, the entire teachings of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

The present disclosure relates to systems and methods for monitoring user operation or handling of a trigger-based device, such as a firearm. In particular, it relates to monitoring a hand position of a user (e.g., a trigger finger of the user) handling a trigger-based device, for example a user handling a firearm.

Proper handling and use of a firearm requires many hours of training, especially for persons required to carry and possibly use a firearm on a regular basis. For example, training a firearm user to position his or her hand properly can facilitate safe and effective use of firearms. As a point of reference, as used throughout this specification, the word "hand" is inclusive of all portions of a human hand, for example the palm, fingers, thumb, etc. With this in mind, one type of firearm training includes ensuring that a user keeps his or her finger off of the firearm trigger up until a point where a decision to discharge the firearm has been made. Typically, situations giving rise to discharge decisions are highly stressful and exciting. Unfortunately, firearm users often regress and forget training during such highly stressful and exciting events. Furthermore, when firearm handling by a particular user is evaluated, it is often difficult for trainers, firearm users, or others to evaluate and recognize whether the firearm user is utilizing proper techniques. For certain users, such as police officers, an ability to evaluate hand position following an actual, in-the-field firing event would be highly beneficial, and may be critical for effective, proper training.

In light of the above, a need exists for systems and methods adapted to monitor and provide meaningful feedback information for a user handling a firearm, or any other trigger-based device.

SUMMARY OF THE INVENTION

Some aspects of the present disclosure relate to a hand position monitoring system for use with a firearm. The system includes a sensor assembly connected to a firearm. The sensor assembly, in turn, includes a sensor for acquiring hand position information of a firearm user and an interface in electronic communication with the sensor. The interface is adapted to receive and electronically communicate the hand position information. In some embodiments, the hand position information is indicative of a position of the user's trigger finger relative to the firearm being handled.

Other aspects of the present disclosure relate to a method of monitoring a hand position of a firearm user. The method includes the user grasping a firearm with the user's hand. Hand position information indicative of a user's hand position relative to the firearm is acquired with one or more sensors connected to the firearm. In some embodiments, the hand position information is index finger position information. Regardless, the hand position information is used to determine whether the user's hand position corresponds to a desired hand position. The determination can, in some embodiments, be communicated to the user, and/or a separate controller, etc.

The present invention is further applicable for monitoring and/or training individuals in the correct use of any system that has a trigger or critical contact point. Thus, while the following description makes specific reference to a handgun-related application, a wide variety of other implements, such as a crossbow, power drill, etc., are also within the scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a simplified schematic illustration of an embodiment hand position monitoring system in accordance with aspects of the present invention with portions shown in block form, along with a firearm;

FIG. **2** is a schematic illustration of circuitry useful with the system of FIG. **1**;

FIG. **3** is a simplified schematic illustration of another embodiment hand position monitoring system in accordance with the present invention with portions shown in block form, along with a firearm;

FIG. **4** is a simplified schematic illustration of another embodiment hand position monitor in accordance with aspects of the present invention with portions shown in block form, along with a firearm; and

FIG. **5** is a simplified schematic illustration of another embodiment hand position monitor system in accordance with aspects of the present invention with portions shown in block form, along with a firearm.

DETAILED DESCRIPTION OF THE INVENTION

One embodiment of a hand position monitoring system **20** for use with a firearm **22** in accordance with aspects of the present disclosure is shown schematically in FIG. **1**. The system **20** includes a sensor assembly **24** (referenced generally) attached to the firearm **22**, and a controller **26** in direct or indirect communication with the sensor assembly **24** via electronic (e.g., wired or wireless), hydraulic, mechanical, etc., connection.

The firearm **22** can be one of many recognized types of firearms. The firearm **22** can be a handgun, for example. The firearm **22** includes features recognized by those of skill in the art, including a frame **28**, a handle or grip **30**, and a trigger **32**. Generally, discharging the firearm **22** includes a firearm user (not shown) grasping the handle **30** with his/her hand (not shown) and squeezing the trigger **32** with a finger (not shown), such as an index finger, with the finger(s) being considered part of the user's hand. As a point of reference, the system **20** can be employed with other trigger-based devices other than the firearm **22** (e.g., power drill, crossbow, etc.).

The sensor assembly **24** includes, in some embodiments, a sensor device **34**, an indicator **36**, an interface **38**, and a housing **40**. The sensor assembly **24** also includes a power source (not shown) for powering the sensor device **34**, indicator **36**, and/or interface **38**. In one embodiment, the power source is a battery.

The sensor device **34** can assume a wide variety of forms, and includes one or more sensors **42** that may or may not be identical. For example, with the one embodiment of FIG. **1**, the sensor device **34** includes an array of the sensors **42** akin to a push button/membrane type sensor as known in the art by which a user can tactilely perceive that his/her hand (e.g., finger) is in contact with and depressing one of more of the sensors **42**. Thus, the sensor device **34** can include the sensor (s) **42** in the form of a variable force pressure sensor. Alternatively, one or more other sensor types can be equally acceptable including, for example, e-field sensors, motion sensors, proximity sensors, pressure switches, visual recorders and others. Regardless, the sensor device **34** is configured to provide sensor data including hand position information (e.g., index or "trigger" finger position information), for example force or pressure exerted by the user's hand (e.g., index finger) on a portion of the firearm **22**.

In some embodiments, the sensor(s) **42** is physically attached to, or formed on an exterior of, the firearm **22**. Thus, the sensor(s) **42** can be components formed separately from, and subsequently attached to, an existing firearm; alternatively, the system **20** can include the firearm **22** being specially manufactured for training/monitoring procedures, with the sensor(s) **42** being integrally formed into the firearm **22**. Regardless, and by way of but one example, with the embodiment of FIG. **1**, the sensor(s) **42** is attached to the frame **28** of the firearm **22** such that by extending his/her index finger (not shown) along the frame **28** of the firearm **22**, the firearm user touches, engages, or otherwise causes the sensor(s) **42**, and thus the sensor device **34**, to signal a change in sensor status indicative of user interaction (e.g., sensor may provide differing signals depending upon whether the user's finger is in contact therewith; may provide an "on" or "off" signal depending upon user contact (or lack thereof); etc). With a configuration in which the sensor device **34** includes the membrane array of one or more sensors **42**, the sensor(s) **42** can be located/formed adjacent the trigger **32** and thus at a recommended or accepted trigger/index finger location for user a user otherwise handling the firearm **22** prior to actuation of the trigger **32**. As a point of reference, the location of the sensor(s) **42** relative to the firearm **22** of FIG. **1** is, in some embodiments, intended for applications in which a right-handed user handles the firearm **22**. That is to say, with the orientation of FIG. **1**, when the firearm **22** is conventionally grasped by the right hand of a user, the user's third, fourth and fifth fingers will naturally wrap around the handle/grip **30** and thus into the page of the view of FIG. **1**. Further, the user's right hand index finger will naturally reside against the one or more sensors **42**, except in discharge situations whereby the right hand index finger will properly be placed against or around the trigger **32**. For left handed users, then, the one or more sensors **42** can be located on an opposite side (hidden in FIG. **1**) of the firearm frame **28**. Regardless, in some embodiments where the sensor device **34** further includes wire(s) **44** (shown with dashed lines in FIG. **1**) electronically connecting the sensor(s) **42** to the interface **38** (as described below), the wire(s) **44** can be exteriorly located along the frame **28**, extending along a side of the frame **28** opposite that of the sensor(s) **42**. With this arrangement, interference with normal user grasping of the handle **30** by the wire(s) **44** is minimized. Alternatively, the wire(s) **44**, if provided, can be located anywhere along the frame **28**.

The indicator **36** is configured to provide an alert or other human perceptible notification to the firearm user and/or a third-party of a current firearm handling status (e.g., whether or not the user's index finger is in contact with a certain region of the firearm frame **28**). The indicator **36** can be a visual alert, for example one or more LED-type lights, although other indicator types can be equally acceptable including, for example, tactile alerts, such as vibrators or static discharge; audible alerts, such as alarms; and others. The indicator **36** is attached to the housing **40**, although other locations can be equally acceptable, for example the handle **30** of the firearm **22**. Even further, in other embodiments, the indicator **36** can be eliminated and thus is an optional component of the present disclosure.

The interface **38** is in electronic communication with the sensor device **34**, the indicator **36** (where provided), and the controller **26**. The interface **38** is maintained within the housing **40**, which, in turn is attached to the handle **30** of the firearm **22** (e.g., mechanical fastener, adhesive, etc.). Alternatively, the housing **40** can be integrally formed with the firearm handle **30**/frame **28**. Regardless, and in general terms, the interface **36** includes circuitry **50** (FIG. **2**) and/or a microprocessor (not shown), and is adapted to acquire data from the sensor device **34** (either continuously or periodically) and communicate the sensor data to the controller **26**. The interface **38** can be connected to the sensor device **34** with wiring (e.g., the wire(s) **44**), although other connections can be equally acceptable, for example wireless connectors. Along these lines, the interface **38** includes a wireless connector (not shown) for communicating with the controller **26** as is know in the art (e.g., a transceiver). As described below, the interface **38** can be adapted or programmed to continuously transmit acquired sensor data to the controller **26**, or periodically transmit the acquired sensor data, and/or transmit the sensor data in response to a polling/request from the controller **26**. In other embodiments, the interface **38** can include a memory component (e.g., a memory chip or removable storage card) that stores the acquired sensor data for subsequent downloading to the controller **26** (e.g., via a direct, wired or wireless link).

In some embodiments, the interface **38** is further adapted or programmed to prompt operation of the indicator **36**, causing the indicator **36** to generate a perceptible notification indicative of a user's hand position relative to the sensor(s) **42**, and thus relative to the firearm frame **28**. With this in mind, a schematic of exemplary circuitry **50** is provided in FIG. **2**, along with possible schematic representations of the sensor device **34** and the indicator **36**. With additional reference to FIG. **1**, in general terms, the interface **38** acquires the sensor data from the sensor device **34**, and at a certain, pre-determined threshold (or other threshold depending upon the type of sensor employed), causes the indicator **36** to actuate on or off. However, the interface **38** can also cause the indicator **36** to be activated proportionately to levels "sensed" by or at the sensor device **34**; for example, where the indicator **36** is an LED and the sensor device **34** includes a force/pressure sensor **42**, the indicator **36** can be actuated to produce lower or higher light intensities as force/pressure increases or decreases. A wide variety of other notification protocols can be implemented by or with the interface **38**, such that the present disclosure is in no way limited to the circuitry **50** of FIG. **2**.

With specific reference to FIG. **1**, the controller **26** includes a wireless connector (not shown), for example a transceiver, for receiving the sensor data from the interface **38**, although other connector formats are also acceptable. The controller **26** also includes a data storage device **52** and a microprocessor **54**. The data storage device **52** is configured to store the sensor data for subsequent and/or contemporary use, while the microprocessor **54** is configured to translate, analyze, evaluate, display, and/or communicate the sensor data to the firearm user and/or third parties as described below. The data

storage device **52** and the microprocessor **54** can assume a variety of forms, and are of types known in the art.

In some embodiments, the system **20** provides information indicative of whether the firearm user is handling the firearm **22** in a desired, predetermined manner, including using and maintaining a first hand position at desired times, such as when the user is encountering circumstances deemed to not be a firearm discharge situation and/or when the firearm user has not yet made a decision to discharge the firearm **22**. The first hand position includes placing the index (or trigger) finger of the firearm user on the frame **28** of the firearm **22** adjacent, but not on, the trigger **32**. Thus, for a right-handed user, the first hand position entails the user's right hand trigger finger positioned and maintained along the frame **28** in the region of the sensor(s) **42**.

A method of monitoring the hand position (including, or in some embodiments limited to, the user's index or trigger finger position) of the firearm user can be described in association with use of the system **20**. Initially, it can be assumed that the firearm user will grasp the firearm **22** by the handle **30**, employing the first hand position described above. The sensor device **34**, and in particular the sensor(s) **42**, is positioned along the frame **28** of the firearm **22** (and relative to the trigger **32**) at a location being generally accepted as a proper, non-firing, trigger finger position. As a result, when the firearm user assumes the first hand position, or the proper non-firing position, the index finger of the firearm user exerts some force against the sensor(s) **42**. In turn, the sensor device **34** provides hand position information, for example an amount of force the index finger is exerting on the sensor(s) **42**, to the interface **38**. The interface **38** acquires the sensor data from the sensor device **34** and prompts operation of the indicator **36** (where provided) to notify or otherwise indicate to the firearm user and/or third parties that the firearm user is using the first hand position. For example, where the indicator **36** is an LED, the indicator **36** is illuminated in response to a prompt from the interface **38**.

The firearm user can then experience or otherwise be placed in a "discharge scenario" (hypothetical or actual), where the firearm user must make decisions relating to whether or not to discharge the firearm **22**. The discharge scenario can include proper discharge events and/or improper discharge events. A proper discharge event is an event that accepted practice dictates should cause the firearm user to decide to discharge the firearm **22**. An improper discharge event is an event that accepted practice dictates should not cause the firearm user to discharge the firearm **22**.

Along these lines, the method includes presenting the firearm user with, or monitoring the firearm user under circumstances later deemed to be, an improper discharge event (hypothetical or actual), and determining whether the user ceases to use the first hand position. The method also includes presenting the firearm user with, or monitoring the firearm user under circumstances later deemed to be, a proper discharge event (hypothetical or actual), and determining whether the user ceases to use the first hand position.

In particular, ceasing to use the first hand position is characterized by the firearm user removing his or her index finger from the frame **28** of the firearm **22**. In turn, the sensor device **34** provides corresponding hand position information to the interface **38**, including, for example, an amount of force (or lack thereof) exerted on the sensor(s) **42**. As the index finger is removed from the sensor(s) **42**, the sensed force decreases or becomes zero. The interface **38** acquires the sensor data from the sensor device **34** and prompts operation of the indicator **36** (where provided) to notify the firearm user and/or third parties that the firearm user is no longer using the first hand position. For example, where the indicator **36** is an LED, the interface **38** prompts the indicator **36** to reduce or cease illumination.

Alternatively or in addition to activating the indicator **36**, the interface **38** sends the sensor data to the controller **26**. In turn, the data storage device **52** stores the sensor data. The microprocessor **54** of the controller **26** performs various analytical and/or display functions. For example, the microprocessor **54** can utilize evaluation software to provide the firearm user and/or third parties with data related to the hand position information acquired during the discharge scenario.

A response of the firearm user during the discharge scenario can be reviewed and evaluated with the system **20**. The discharge scenario can occur as a part of a controlled environment, e.g., a simulation, or an uncontrolled environment, e.g., an in-the-field environment. For example, when used in a simulation, the discharge scenario or a portion thereof can be viewed, reviewed, videotaped, and/or recorded with the system **20**. As another example, when used in-the-field, the response of the firearm user during the discharge scenario can viewed, reviewed, videotaped, and/or recorded with the system **20** as evidence that the firearm user, e.g., a police officer, a hunter, a hobbyist, etc., acted properly or improperly during the discharge event or events (before, during, and/or after discharge).

In addition, or as an alternative to the above, one or more components of the system **20** can operate to serve as a trigger safety for the firearm **22**. In particular, the sensor device **34** can be linked (e.g., via the interface **38**) to a mechanical lock or safety mechanism associated with the trigger **32** that otherwise serves to selectively allow or prevent actuation of the trigger **32** (and thus discharge of the firearm **22** by a user). With this configuration, then, the system **20** can be configured such that when the sensor device **34** "senses" the presence of the user's index finger on the corresponding portion of the frame **28**, the safety mechanism is automatically engaged to prevent movement/actuation of the trigger **32** (and thus accidental discharge of the firearm **28**). Conversely, when the sensor device **34** signals information indicative of the user's index finger being withdrawn from the frame **28**, the system **20** operates to disengage the safety mechanism (and/or allows a user to manually disengage the safety mechanism).

Another hand position monitoring system **200** for use with the firearm **22** is shown in FIG. **3**. The system **200** includes a sensor assembly **224** (referenced generally), a controller **226**, and a simulator **228**. The firearm **22** again includes the frame **28**, the handle **30** connected to the frame **28**, and the trigger **32** connected to the frame **28**. Conventional operation of the firearm **22** is described above.

The sensor assembly **224** includes a plurality of sensors devices **236**, one or more indicators **238**, an interface **240**, and a housing **242**. The sensor assembly **224** can also include a power source, for example a battery, to power the plurality of sensors devices **236**, the indicator(s) **238**, and/or the interface **240**. In one embodiment, each of the plurality of sensors **236** is attached to various parts of the firearm **22**. For example, as shown, at least one of the plurality of sensor devices **236**a includes one or more sensors **244** disposed on (and exteriorly accessible at) the frame **28**; the sensor device **236**b includes one or more sensors **244** disposed on the handle **30**; and the sensor device **236**c includes a one or more sensors **244** disposed on the trigger **32**, respectively. Each of the plurality of sensors **244** can be a sensor array or a single sensor, and can assume a variety of forms such as a variable force pressure sensor, although other types such as those previously described are also contemplated. Each of the plurality of sensor devices **236** is configured to provide sensor data

indicative of hand position information. As a point of reference, the sensors **244** can each be electronically connected to the interface **240** via wiring (not shown), wirelessly connected, etc.

The indicator(s) **238** is configured to notify or alert the user and/or third parties of hand position-related information. For example, the indicator **238**a can be or include an LED, while the indicator **238**b (drawn in block form) can be a vibratory motor (e.g., akin to a vibration motor used in cell phones). However, as described above in association with the indicator **36**, other types of indicators can be equally acceptable. In but one acceptable embodiment, the indicator **238**a is affixed to the interface **240**, while the indicator **238**b is affixed to the handle **30** of the firearm **22**; alternatively, a wide variety of other locations are also acceptable, and one or more of the indicators **238** can be eliminated (or additional indicator(s) **238** added).

The interface **240** is in electronic communication with the plurality of sensor devices **236**, the plurality of indicators **238**, and the controller **226**. The interface **240** is disposed in the housing **242**, which is connected to the frame **28** of the firearm **22** in some embodiments. The interface **240** can operate under substantially similar principles to the interface **38** (FIG. **1**) described above. Generally, the interface **240** acquires sensor data from the plurality of sensor devices **236** and is adapted to prompt operation of the indicator(s) **238**. The interface **240** is also adapted to communicate and/or translate the sensor data to the controller **226**. The interface **240** is connected to the plurality of sensor devices **236** and the indicator(s) **238** with wiring (not shown), although other connections can be equally acceptable. The interface **240** also includes a wireless connector (not shown) for communicating with the controller **226**.

The controller **226**, in turn, includes a first wireless connector (not shown), such as a transceiver, for receiving the sensor data from the interface **240** and/or sending control commands or prompts to the interface **240**, although other connectors can be equally acceptable. In this regard, the controller **226** also includes a data storage device **246** and a microprocessor **248** as are known in the art.

The simulator **228** is represented in block form in FIG. **3**, and is generally configured to present a firearm user with hypothetical discharge scenarios, including proper and/or improper discharge events as described above. The simulator **228** is in electronic communication with the controller **226** and can send simulation data to the controller **226** and receive simulation control commands/data from the controller **226**. For example, the simulator **228** can send information related to whether a proper or an improper simulation discharge event has been presented (or is currently being presented) to the firearm user. Additionally, the simulator **228** can receive information from the controller **226** to modify the discharge event presented by the simulator **228** to the firearm user and/or can include a user input device (not shown), such as a keyboard or touch screen, via which a user can enter simulation-related information or commands. In other embodiments, the simulator **228** need not be directly linked to the controller **226**. With these parameters in mind, the simulator **228** can include a number of components appropriate for presenting discharge/training scenarios to the firearm user, such as a display screen, speaker(s), pre-programmed hardware or software containing various, predetermined scenarios, etc.

In light of the above, it can be understood that the system **200** provides information as to whether the firearm user is using the first hand position under simulation circumstances deemed improper to discharge the firearm **22** and/or when the firearm user has not yet made a decision to discharge the firearm **22**. The system **200** also provides information as to whether the firearm user is using a second hand position under simulation circumstances deemed proper to discharge the firearm **22** and/or when the firearm user has made a decision to discharge the firearm. The second hand position can include placing the index finger on the trigger **32** of the firearm **22**.

In particular, the system **200** senses movement of the hand with greater resolution by including the plurality of sensor devices **236**, as opposed to a single sensor device, for example. The additional information can be used in a variety of manners; for example, when the firearm **22** is first grasped by the handle **30**, the interface **242** can send sensor data to the controller **226**. The controller **226** can, in turn, send simulator control data to the simulator **228** to initiate a presentation of a discharge scenario to the firearm user; initiate storing sensor data in the data storage device **246**; send control data to the interface **242** to activate one of the plurality of indicators **238**; and others. Regardless, the system **200** acquires sensor data from the plurality of sensor devices **236** to determine and electronically communicate to the user and/or third parties the movement of at least a relevant portion of the hand (e.g., the index or trigger finger) of the firearm user.

One embodiment method of monitoring the hand position of the firearm user can be described in association with use of the system **200**. In particular, the method includes presenting the firearm user with a discharge event with the simulator **228**, acquiring sensor data related to the relative position of the hand of the user, and conveying to the user and/or third parties the relative position of the hand.

The simulator **228** operates to present the firearm user with a hypothetical discharge scenario previously deemed to indicate that firearm discharge is necessary or proper (e.g., a proper discharge event) or deemed to indicate that firearm discharge is not necessary (e.g., an improper discharge event). The simulator **228** can send event data to the controller **226** indicating whether the current simulator scenario is indicative of a proper or improper discharge event. Assuming the firearm user follows accepted firearm handling techniques or protocols, the user initially grasps the firearm **22** with the first hand position, and subsequently in response to the discharge event (as presented by the simulator **228**) changes his or her hand position to grasp the firearm **22** with the second hand position. Conversely, when the discharge scenario is an improper discharge event, the user's hand position should not, in theory, deviate from the first hand position.

The interface **240** acquires and sends sensor data to the controller **226** throughout the above firearm user simulation. For example, sensor data related to how/with what force the user is grasping the handle **30**, the force applied to the trigger **32**, how far the index finger moves, and/or how fast the index finger moves during the discharge event.

The event data from the simulator **228** and the sensor data from the interface **240** are collected by the controller **226** and stored in the data storage device **246**. The microprocessor **248** can then operate (either automatically or in response to a user request) to analyze, evaluate, and/or display the collected data based upon appropriate programming provided to or with the microprocessor **248** (e.g., software). Such analysis, evaluation, and/or display of the collected data can be presented to the user and/or third parties (e.g., in electronic and/or paper form). In particular, the combined event data and sensor data can be used to facilitate an analysis of how the firearm user reacted to various discharge events presented during the hypothetical simulator-created discharge scenario(s). Furthermore, the controller **226** can optionally operate, in some

embodiments, to prompt operation of the interface **240** in a predetermined fashion upon recognizing (e.g., via pre-programmed parameters) that the firearm user has reacted improperly to a discharge event. For example, the controller **226** can cause the interface **240** to actuate one or more of the plurality of indicators **238**, for example the indicator **238**b to vibrate, notifying or alerting the firearm user that he or she has responded in a manner deviating from expected firearm handling protocol(s).

In light of the above, a response of the firearm user during the discharge scenario can be reviewed and/or evaluated. When used with the simulator **228**, the discharge scenario occurs as a part of a controlled environment. However, the simulator **228** can be omitted such that the system **200** is used in an uncontrolled environment, e.g., in-the-field. When used in a simulation, the discharge scenario or a portion thereof can be viewed, videotaped, and/or recorded with the system **200**. This applies equally to in-the-field applications. When used in-the-field, the response of the firearm user during the discharge scenario can also be viewed, reviewed, videotaped, and/or recorded with the system **200** as evidence that the firearm user, e.g., a police officer, a hunter, a hobbyist, etc., acted properly or improperly during the discharge scenario.

While the systems **20**, **200** described above have described the corresponding sensor device(s) as including a membrane/pressure-type sensor, other sensor configurations are also envisioned. For example, FIG. **4** schematically illustrates an alternative embodiment firearm handling monitoring system **300** in connection with the firearm **22**. The system **300** is similar to previous embodiments, and includes the controller **26**, the indicator **36**, and the interface **38** as previously described. In addition, the system **300** includes one or more sensor devices **302** that each includes a sensor **304** electronically connected to the interface **38**, for example by wiring (not shown), wireless, etc. With the embodiment of FIG. **4**, the sensor **304** is an electronic field (or e-field) sensor. In general terms, the e-field sensor **304** generates a low level electric field and then detects changes in that field caused, for example, by a position or change in position of a user's hand (or relevant portion thereof) relative to the e-field sensor. E-field sensors are known, and are available, for example, from Freescale Semiconductor, Inc. under the trade designation of MC34940. Essentially, then, the e-field sensor **304** provides a relatively large array of small sensors that facilitate "tracking" of a user's finger relative to the region of the firearm frame **28** to which the e-field sensor **304** is applied. Regardless, the e-field sensor **304** can electronically communicate with the interface **38** via wired or wireless connection.

In use, the system **300** operates in a manner akin to the above descriptions. Though not shown, the system **300** can further include the simulator **228** (FIG. **3**) as previously described. In general terms, the sensor device **302** provides information to the interface **38** indicative of a position of the user's index or trigger finger relative to the firearm frame **28** (or other hand position information). The interface **38**, in turn, transmits the sensor data to the controller **26** for concurrent and/or subsequent analysis. In this regard, the sensor data can be compared with one or more discharge events (hypothetical or actual) in evaluating whether the firearm user is/was handling the firearm **22** in a desired fashion (e.g., time stamps associated with the sensor data can be correlated with timing of various aspects of one or more discharge events (proper or improper) in evaluating the user's handling of the firearm **22**). Further, and as previously described, the interface **38** can prompt operation of the indicator(s) **36** (where provided) in response to the sensor data.

Yet another embodiment monitoring system **400** is schematically provided in FIG. **5** in connection with the firearm **22**. The system **400** is similar to previous embodiments, and includes the controller **26**, the optional indicator **36**, and the interface **38**. In addition, the system **400** includes a sensor device **402** including at least one sensor **404** electronically connected to the interface **38** (wired or wireless). As compared to previous embodiments, the sensor **404** encompasses a larger portion of the firearm frame **28**, and thus can provide an even greater amount of hand position-related information. For example, the sensor **404** (or a plurality of sensors) can be disposed not only adjacent the trigger **32**, but also along a majority, and in some embodiments an entirety, of the grip/handle **30**. With this approach, then, the system **400** can operate to provide hand position information indicative of index/trigger finger position as well as user hand position along the grip **30** during various discharge events.

While the various monitoring systems described above have included one or more sensors physically disposed or formed on or along the firearm frame **28**, in yet other embodiments, one or more sensors can be provided that are not directly mounted to the firearm **22**. For example, one or more of the systems above can include a sensor device in the form of remote imaging equipment loaded with programmed with appropriate pattern recognition software. As is known in the art, the remote imaging equipment includes one or more cameras that can remotely "track" the user's hand position relative to the firearm **22** via the pattern recognition software, with this resultant sensor information being correlated to a discharge event (hypothetical or actual) in evaluating user's handling of the firearm **22**. In fact, in some embodiments, the monitoring system of the present disclosure does not include any sensors directly mounted to or formed by the firearm frame **28**.

Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a variety of alternate and/or equivalent implementations may be substituted for the specific embodiments shown and described without departing from the scope of the present invention. This application is intended to cover any adaptations or variations of the specific embodiments discussed herein. Therefore, it is intended that this invention be limited only by the claims and the equivalents thereof. For example, the systems and methods disclosed herein are equally useful with other trigger-based devices in addition to firearms (e.g., power drills, crossbows, etc.). With these implementations, the device in question is operated by actuating a trigger such that a "trigger event" can be defined (with the "trigger event" being the "discharge" event" referenced above).

What is claimed is:

1. A hand position monitoring system for use with a firearm including a grip, a frame, and a trigger, the system comprising:

a sensor assembly connected to a firearm, the sensor assembly including: a sensor for acquiring hand position information of a firearm user grasping the grip with a hand of the firearm user, the information including:

an index trigger finger of the firearm user's hand in contact with the frame apart from the grip and the trigger;

an interface in electronic communication with the sensor, the interface for receiving and electronically communicating the hand position information; and

an indicator in electronic communication with the interface, wherein the interface is adapted to prompt operation of the indicator based upon the hand position information.

2. The system of claim **1**, wherein the sensor comprises a pressure sensor.

3. The system of claim **1**, wherein the indicator includes an LED.

4. The system of claim **1**, further comprising:

a controller in electronic communication with the interface of the sensor assembly, the controller including:

a data storage device for storing the hand position information, and

a processor for evaluating the hand position information.

5. The system of claim **1**, wherein the sensor assembly further includes a second sensor disposed on the trigger for acquiring hand position information of the firearm user.

6. A method of monitoring a hand position of a firearm user comprising:

prompting the user to grasp a firearm with a hand of the user, the firearm including a grip, a handle, and a trigger;

acquiring, via a sensor connected to the firearm, hand position information during a non-firing time period in which the trigger is not actuated, the acquired hand position information indicative of a user's first hand position relative to the firearm;

automatically determining whether the user's first hand position during the non-firing time period corresponds to a first desired hand position based upon the acquired hand position information, wherein the first desired hand position includes the index trigger finger of the user's hand in contact with the frame and not in contact with the trigger or the grip; and

communicating the determination of whether the user's first hand position corresponds to the first desired hand position.

7. The method of claim **6**, wherein communicating the determination includes actuating an LED.

8. The method of claim **6**, wherein the acquired hand position information is indicative of a presence or absence of the index trigger finger of the user's hand in contact with the frame of the firearm.

9. The method of claim **8**, wherein the sensor is located on the frame, immediately adjacent the trigger to establish that the index finger is correctly positioned relative to the firearm whenever the firearm is being grasped by the user but not being fired.

10. The method of claim **9**, wherein communicating the determination includes automatically prompting operation of an indicator associated with the firearm in response to a determination that the index trigger finger of the user's hand is not in contact with the sensor.

11. The method of claim **6**, further comprising:

subjecting the user to a discharge scenario including an improper discharge event in which the firearm should not be fired;

monitoring the acquired hand position information during the discharge scenario; and

evaluating whether the acquired hand position information is indicative of the user acting correctly during the discharge scenario.

12. The method of claim **11**, wherein the discharge scenario is an actual situation experienced by the user.

13. The method of claim **11**, wherein the discharge scenario is a hypothetical situation presented to the user.

14. The method of claim **6**, further comprising:

identify a change in a manner in which the user grasps the firearm to a second user's hand position; and

automatically determining whether the second user's hand position corresponds with the first desired hand position based upon the acquired hand position information.

15. The method of claim **14**, further comprising:

automatically determining whether the determined second user's hand position corresponds with a second desired hand position, the second desired hand position including the index trigger finger of the user's hand being in contact with the trigger of the firearm.

16. The method of claim **15**, further comprising:

subjecting the user to a simulated discharge scenario including a proper discharge event; and

determining whether a timing of a change from the first user's hand position to the second user's hand position corresponds with a timing of the proper discharge event.

17. The method of claim **6**, further comprising:

placing a firearm user in a discharge scenario including a discharge event;

receiving simulation information related to whether the discharge event is a proper or an improper discharge event; and

automatically evaluating the acquired hand position information and the simulation information to determine whether the first user's hand position corresponds to the first desired hand position.

18. A method of monitoring a user handling a trigger-based device, the operation of which includes actuating a trigger with an index trigger finger of the user as part of a triggering event, the method comprising:

associating at least one sensor with a frame portion of the device immediately adjacent, but not on the trigger at which the index trigger finger of the user is expected to reside when handling the device during periods other than a triggering event;

acquiring hand position information from the sensor indicative of a hand position of the user relative to the device including indicating the index trigger finger of user's hand in contact with the frame and not in contact with the trigger; and

evaluating a manner in which the user handles the device based upon the acquired hand position information and communicating the results of said evaluation.

19. The system of claim **1**, further comprising a simulator including:

a display screen;

a speaker; and

a computing device programmed with predetermined firearm discharge training scenarios including:

a first scenario in which the user's index trigger finger should remain on the frame,

a second scenario in which the user's index trigger finger should lift from the frame and be placed in contact with the trigger.

20. A system comprising:

a trigger-based device comprising a frame and a trigger operable by a trigger finger of a user;

means for sensing the trigger finger proximate to a predetermined region of the frame where the trigger finger is expected to be positioned when the user handles the device during periods other than during a triggering event;

means for acquiring hand position information from the sensing means, said hand position information compris-

ing information indicative of a position of the trigger finger relative to the predetermined region; and

means for indicating information about a manner in which the user handles the trigger-based device in response to the acquired hand position information.

21. The system of claim 20, wherein the trigger-based device comprises a firearm.

22. The system of claim 20, wherein the trigger-based device comprises a tool operable by a trigger.

23. The system of claim 22, wherein the trigger-based device comprises a power drill.

24. The system of claim 20, wherein the trigger-based device comprises a crossbow.

25. The system of claim 20, wherein the indicating means operates during at least one time interval other than a trigger event.

26. The system of claim 20, wherein the sensing means comprises a proximity sensor.

27. The system of claim 20, wherein the sensing means comprises a sensor responsive to force or pressure exerted by the user on a portion of the frame.

28. The system of claim 20, wherein the sensing means comprises a sensor responsive to motion of the trigger finger being proximate to the predetermined region without actuating the trigger.

29. The system of claim 20, wherein the sensing means comprises means for remotely imaging and tracking the hand position of the user relative to the trigger based device.

30. The system of claim 20, further comprising a simulator including:

means for presenting a simulation scenario to the user; and

a computing device programmed with predetermined trigger actuation training scenarios and coupled to the presenting means for presenting the simulation training scenario, the simulation training scenario comprising:

a first scenario in which the user's trigger finger should remain proximate to the predetermined region but not in contact with the trigger, and

a second scenario in which the user's trigger finger should be placed in contact with the trigger.

31. The system of claim 20, wherein the indicating means further indicates information about the manner in which the user handles the device in association with temporal information relative to a trigger event.

32. The system of claim 20, further comprising means for locking the trigger against inadvertent actuation in response to the sensing means detecting the trigger finger proximate to the predetermined region of the frame.

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