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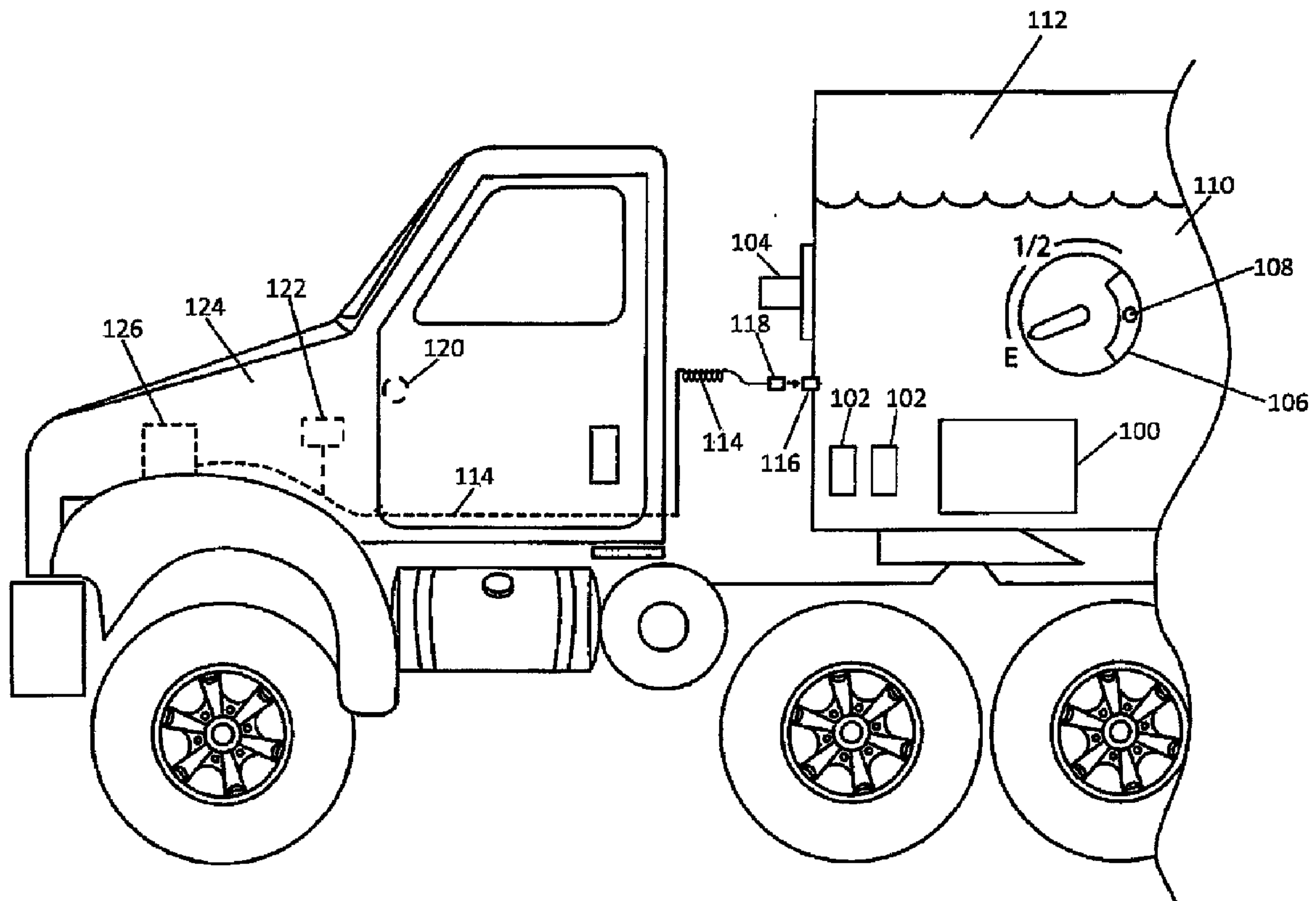
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(54) **Titre :** SYSTEME ET PROCEDE DE PREVENTION DE TROP-PLEIN DE CAMION-CITERNE

(54) **Title:** SYSTEM AND METHOD FOR PREVENTING TANKER TRUCK OVERFILL



(57) **Abrégé/Abstract:**

A system and method for preventing overfill of a tank, particularly a tank on a tanker truck wherein the fluid transfer is driven by a pump and entry of fluid into the tank is regulated by at least one control valve. The system and method provide for monitoring of a fluid level within the tank and direct shutdown of the pump and closure of the at least one control valve in response to the fluid reaching a predetermined level.



ABSTRACT

A system and method for preventing overfill of a tank, particularly a tank on a tanker truck wherein the fluid transfer is driven by a pump and entry of fluid into the tank is regulated by at least one control valve. The system and method provide for monitoring of a fluid level within the tank and direct shutdown of the pump and closure of the at least one control valve in response to the fluid reaching a predetermined level.

TITLE: System and Method for Preventing Tanker Truck Overfill**FIELD**

[0001] This disclosure relates to the field of overflow protection systems for tanker trucks. In particular the disclosure relates to systems that prevent storage tanks from being overfilled during the loading procedure, thereby preventing spills.

BACKGROUND

[0002] Tanker trucks are used to transport a wide variety of liquids, such as crude oil, gasoline, kerosene, waste oil, milk, and other liquids. Because of the hazardous nature of many liquids that are transported in such trucks and because of the costs associated with both loss of product and spill cleanup, it is desirable to prevent overfill of the tank. An overfill event can result in a spill of oil, gasoline, or other hazardous materials. Such spills can be very costly to clean up and may cause environmental damage if the spill is of significant quantity and/or occurs in an environmentally sensitive location.

[0003] Several devices have been installed on tanker trucks in order to attempt to solve the overfill problem. For example, trucks have been equipped with sight gauges that the driver must watch in order to visually identify when the tank is approaching its maximum capacity. However, sight gauges are susceptible to human error. For example, if a driver walks away from the truck, becomes injured, falls asleep, or becomes distracted while the loading process is underway; the sight gauge will not be monitored and the tank may overfill.

[0004] Other systems have used digital gauges. A digital gauge, when operative, may provide the driver with a numeric reading of the percentage of fill or the number of gallons that are in the tank. Optionally, an alarm may sound once the level of fluid in the tank reaches a predetermined level. However, digital gauges are prone to failure, especially when installed on trucks that must drive on the bumpy roads, gravel areas and/or other rough terrain that is common in oil well fields, tank yards and other loading areas. In addition, even if a digital gauge does not completely fail, it may provide incorrect readings due to the jostling that it endures during transportation. When readings are inaccurate, frustrated drivers may physically bypass or cut the wires associated with the gauge, thus rendering the system useless. Further, even a perfectly functioning digital gauge or alarm system is only effective if continuously monitored by the driver.

[0005] Various attempts have been made to provide liquid tank monitoring and overflow protection systems and apparatuses. Examples of these attempts can be seen by references such as U.S. Patent No. 4,903,672; U.S. Patent No. 5,052,223; U.S. Patent No. 5,187,979; U.S. Patent No. 5,226,320; U.S. Patent No. 5,507,326, U.S. Patent No. 5,632,302; U.S. Patent No. 6,154,144; U.S. Patent No. 6,229,448, U.S. Patent Application 2005/0268971, and EP Patent No. 1,676,063.

[0006] Many of these systems are used only with stationary tanks and are unsuited for use with tanker trucks. In addition, while many such systems monitor or measure fluid levels, they are not capable of automatic operation in response to fluid conditions. Furthermore, many such systems are not able to be

incorporated with existing tanker truck electrical and mechanical components. Also, many such systems do not provide additional manual operation and data readout beyond fluid level to allow a user to make educated decisions while filling a tank.

[0007] Accordingly, there exists a desire for an overflow protection device that can be used with an existing tanker truck to provide automatic overfill protection without requiring direct monitoring or manual intervention by a user.

SUMMARY

[0008] A first embodiment is a control system for preventing overfill of a tanker truck, the tanker truck having a tank for containment of a fluid cargo, at least one control valve for regulating a flow of fluid into the tank, a level sensor for detecting a level of fluid within the tank, and a fluid transfer pump for transferring the fluid cargo into the tank, said control system comprising:

- (a) a sensor to detect when the level of fluid in the tank has reached a predetermined level; and
- (b) a control module to shut down the pump in response to the level of fluid in the tank reaching the predetermined level.

[0009] In an embodiment, the control system further comprises a control device to close the at least one control valve in response to the level of fluid in the tank reaching the predetermined level.

[0010] In an embodiment, the tanker truck comprises a parking brake and the control system is arranged to automatically activate in response to application of the parking brake.

[0011] In a further embodiment, the control system comprises an emergency stop, wherein activation of the emergency stop causes the pump to shut down irrespective of the level of fluid in the tank.

[0012] In an embodiment, the control system comprises a system override, wherein activation of the system override prevents the control system from shutting down the pump or closing the at least one control valve, irrespective of the level of fluid in the tank.

[0013] In another embodiment, the control system comprises a communication device for relaying a system status to a communication system.

[0014] In an embodiment, the control module is arranged to shut down the pump by shutting down the truck's engine, thereby cutting power to the pump.

[0015] In an embodiment, the control system comprises at least one indicator to indicate a system status. In a further embodiment, the at least one indicator is a visual indicator or an audible indicator.

[0016] An additional embodiment is a control system for preventing overfill of a tanker truck, the tanker truck having a tank for containment of a fluid cargo, at least one control valve for regulating a flow of fluid into the tank, a level sensor for detecting a level of fluid within the tank, an engine control unit for regulating the operation of the engine of the truck, and a fluid transfer pump powered by the engine, said control system comprising:

a controller arranged to receive a tank-full signal from the level sensor in response to the level of fluid in the tank reaching a predetermined level, said controller arranged to send a shut-down-engine signal to the engine control unit in response to the tank-full signal, thereby causing the engine to shut down.

[0017] In a further embodiment, the controller is arranged to receive an engine-off signal from the engine control unit once the engine has been shut down and to send a close-valve signal to the at least one control valve in response to the engine-off signal.

[0018] In an additional embodiment, the controller is configured to delay sending the close-valve signal for a predetermined period of time after receiving the engine-off signal from the engine control unit.

[0019] In an embodiment, the fluid is transferred into the tank by a fluid transfer member and the predetermined period of time is sufficient to allow the pressure within the fluid transfer member to subside to a level sufficiently low to ensure that closing the control valve will not cause a spill of fluid from the fluid transfer member.

[0020] In an embodiment, the tanker truck comprises a parking brake and the control system comprises a switch that closes in response to engagement of the parking brake and opens in response to release of the parking brake, said switch activating the system when in the closed position and deactivating the system when in the open position.

[0021] In an embodiment the control system comprises an emergency stop mechanism, wherein activation of the emergency stop mechanism causes the system to send the shut-down signal to the engine control unit irrespective of the level of fluid in the tank.

[0022] In an embodiment the control system comprises a system override for preventing the control system from shutting down the pump or closing the at least one control valve, irrespective of the level of fluid in the tank. In a further embodiment the system override is manually activatable. In an additional embodiment, the control system further comprises at least one override indicator to indicate when the system override is active. In yet another embodiment, the override indicator is an audible alarm.

[0023] In an embodiment, the control system comprises at least one system status indicator. In a further embodiment, the at least one system status indicator is a visual indicator or an audible indicator.

[0024] In an embodiment, the control system comprises a communication device for relaying a system status to a communication system. In yet another embodiment, the control system comprises a communication device for relaying a system status to a remote communication system. In an embodiment, the system status is system active, system fired, or system override.

[0025] In an embodiment of the control system, the controller comprises a main control module and an engine control module, wherein the main control module is arranged to receive the tank-full signal and to send the tank-full signal to the engine control module, the engine control module is arranged to relay the tank-full signal to the engine control unit and to receive the engine-off signal from the engine control unit, the engine control module is arranged to relay the engine-off signal to the main control module, and the main control module is arranged to send the close-valve signal to the at least one control valve.

[0026] In a further embodiment, the main control module is electrically joined to a first electrical connector and the engine control module is electrically joined to a second electrical connector, said first and second electrical connectors arranged to couple together, thereby electrically connecting the main control module and the engine control module.

[0027] Yet another embodiment is an automated method for preventing overfill of a tanker truck, the tanker truck having a tank for containment of a fluid cargo, at least one control valve for regulating a flow of fluid into the tank, and a fluid transfer pump for transferring the fluid cargo into the tank through a fluid transfer member, said method comprising:

- (a) determining a level of fluid within the tank; and
- (b) shutting down the pump once the fluid has reached a predetermined level.

[0028] In an additional embodiment, the method further comprises a step of closing the at least one control valve after the pump has been shut down.

[0029] In an embodiment the method further comprises a step of waiting for a period of time between the steps of shutting down the pump and closing the at least one control valve. In a further embodiment, the period of time is a period of time sufficient to allow the pressure in the fluid transfer member to subside to a level that will not cause a spill once the at least one control valve is closed.

[0030] In an embodiment of the method, the pump is powered by the engine of the truck and the step of shutting down the pump is accomplished by shutting down the engine of the truck.

[0031] In yet another embodiment of the method, the predetermined level is higher than the legal fill limit for the tank and lower than the full volume of the tank.

BRIEF DESCRIPTION OF DRAWINGS

[0032] Figure 1 depicts a side view of an embodiment of a control system for preventing overfill of a tanker truck, installed on a tanker truck.

[0033] Figure 2 depicts a front view of an embodiment of a main control module.

[0034] Figure 3 depicts an electrical schematic block diagram showing the major electrical components of an embodiment of a main control module.

[0035] Figure 4 depicts an electrical schematic block diagram showing the major electrical components of an embodiment of an engine control module.

[0036] Figure 5 depicts a flow chart of a series of events that may occur during a tank-filling operation with a threatened overfill prevented by an embodiment of the control system.

[0037] Figure 6 depicts a flow chart detailing the series of events that occurs once the fluid reaches the predetermined level during a tank-filling operation with a threatened overfill prevented by an embodiment of the control system.

DESCRIPTION

[0038] Throughout the following description specific details are set forth in order to provide a more thorough understanding to persons skilled in the art. However, well known elements may not have been shown or described in detail to avoid unnecessarily obscuring the disclosure. Accordingly, the description and drawings are to be regarded in an illustrative, rather than a restrictive, sense. Further, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements.

[0039] Provided generally is a control system for preventing overfill of a tanker truck, said system configured to shut down the fluid transfer pump and close the entry and exit valves on the tank once the fluid in the tank has reached a predetermined level. The system comprises a level sensor for detecting when the level of fluid within the tank has reached the predetermined level. The system further comprises a control device to shut down the pump once the fluid has reached the predetermined level. The system may additionally comprise a control module to shut down a control valve on the tank in response to a signal that the engine has been shut down. The control system is suitable for use with a tanker truck hauling any type of fluid. Examples of fluids commonly hauled in tanker trucks include gasoline, diesel, oil, kerosene, and milk.

[0040] An embodiment of the system installed on a tanker truck is shown in Figure 1. In the illustrated embodiment, the tanker truck comprises a cab comprising an engine compartment 124 and a trailer comprising a tank 112 for containing a fluid 110. Included within the engine compartment 124 is an engine control unit 122; also known as an engine control module (ECM), powertrain control module (PCM) or vehicle control module (VCM); which is an electronic control unit that regulates operation of the truck's engine. Included within the cab of the truck is a parking brake 120. The system comprises an engine control module 126 that is arranged to communicate with the engine control unit 122. The engine control module 126 is further arranged to receive a signal from the parking brake 120, such that the system is activated into an active state, also referred to as a ready state, by engagement of the parking brake. The tanker truck further comprises a fluid transfer pump (not shown) that is used to pump fluid into the tank 112 when the tank is being filled. The fluid transfer pump is powered by the truck's engine, such that shutting down the engine shuts down the fluid transfer pump.

[0041] In the embodiment depicted in Figure 1, the trailer of the tanker truck comprises a tank 112. Flow of fluid into the tank is regulated by one or more control valves 104, which may be controlled by solenoid valves 102. In an embodiment, the trailer comprises at least one entry valve and at least one exit valve, wherein both the entry and exit valves are operable in response to the control system. The trailer further comprises a level indicating system 106 that may comprise an inductive float sensor 108 or other proximity switch to determine when the fluid in the tank reaches a predetermined fill level. The predetermined level may be any level selected by a user. For example, the predetermined level may be set at or near the legal fill limit of the tank. As another example, the predetermined fill level may be set beyond the legal fill limit of the tank, but below the level at which the tank will begin to overflow.

[0042] The control system comprises a main control module 100 that may be mounted on the trailer. When the system is installed and in use, the main control module 100 and the engine control module

122 are in communication allowing signals to be sent back and forth between the two modules. In the illustrated embodiment, the engine control module **122** and the main control module **100** are connected by a wiring **114** and coupled by male **118** and female **116** connectors.

[0043] The main control module **100** comprises a level sensor for detecting when the level of fluid in the tank has reached a predetermined fill level. In an embodiment, the level sensor detects when the level of fluid in the tank has reached the predetermined fill level by receiving a tank-full signal from the inductive float sensor **108**. Once the tank-full signal has been received by the main control module **100**, a signal is sent to the engine control module **122**. The engine control module **122** is arranged to receive the tank-full signal from the main control module **100** and in response to send a shut-down-engine signal to the engine control unit. In response to the shut-down-engine signal, the engine control unit shuts down the engine, thereby shutting down the fluid transfer pump and stopping active transfer of fluid into the tank.

[0044] Once the engine has been shut down by the system, an engine-off signal is sent from the engine control module to the main control module. In response to the engine-off signal, the main control module sends a close-valve signal to the solenoid valves **102** which in turn causes the at least one control valve **104** to close. In an embodiment, the at least one control valve is an air operated control valve to which the supply of control air is controlled by the solenoid valve **102**, though the system may be used with any type of valve that can be operated in response to a signal from the main control module. In a further embodiment, the tank comprises entry and exit control valves, both of which are closed in response to the close-valve signal.

[0045] Once the engine has been shut down, there may still be considerable pressure in the pipe, hose, or other fluid transfer member that is being used to transfer fluid into the tank. If this pressure is not reduced before closing the at least one control valve **104**, the pressure may cause a breakage and/or release of the fluid transfer member once the at least one control valve **104** is closed, leading to a spill of fluid. To ameliorate this problem, the system may be configured to introduce a delay between receiving the engine-off signal and sending the close-valve signal, the delay being for a period of time sufficient to allow the pressure to subside from pumping pressure to a level that will not cause a spill once the at least one control valve **104** is closed. In an embodiment, the delay is sufficient to allow the pressure to drop below pumping pressure. In another embodiment, the delay is sufficient to allow the pressure to drop to atmospheric pressure. The amount of time required for the pressure to drop is expected to vary depending on the transfer hose volume and the plumbing volume. For example, the delay may range from about 2 seconds to about 30 seconds, though shorter or longer delays are possible.

[0046] Figure 2 shows an example of a main control module **100**. The main control module **100** comprises a system override switch **200**, emergency stop button **208**, audible alarm **202**, override indicator light **204**, system active indicator light **206**, system-fired indicator light **212**, and a weatherproof enclosure **210** to protect the internal electronic components of the main control module **100**. The system override switch allows a user to override the system. If the system has been triggered, also referred to as the system having been fired, by receiving a tank-full signal from the level sensor, the system will carry out the sequence of events described above to shut down the engine and close the at least one control valve. The at least one control valve will remain closed and the engine will remain off

until the system override is engaged by an operator. Once the operator has engaged the system override, then the truck can be restarted and any excess fluid can be pumped off to the legal fluid level. Once the fluid is at or below the legal level the operator should disengage the override to reactivate the system in its ready state. To discourage leaving the system override engaged, the system may comprise an audible alarm 202 that emits an audible signal as long as the override is engaged. For example, the audible alarm 202 may emit an intermittent buzz or beep as long as the system is in override. The system may further comprise a system override indicator light 204 that shines or flashes as long as the system is in override. The system may further comprise additional indicators of system status. For example, the system may comprise a system active indicator light 206 that shines or flashes as long as the system is active and the system may further comprise a system-fired indicator light 212 to indicate that the system has fired, causing engine shut-down and control valve closure.

[0047] The system may further comprise a communication device (not shown) allowing the system to communicate at least one system status to a remote communication device. For example, the system may comprise a communication device for communicating a system status via a satellite, cellular, or GPS network. In an embodiment, the system is configured to communicate when any of the following events occur: the system is activated, the system is fired, or the system is put into override. In a further embodiment, the system may be configured to communicate with an existing communications network used to track company assets such as GeoTrack or Geoforce. The communication may be any type of remote communication, including but not limited to, an SMS message, an e-mail, an electronic alert, or a telephone call.

[0048] Figure 3 depicts an exemplary wiring diagram for a main control module wired to a trailer. The main control module comprises a fire/bypass relay 306, bypass relay 308, and a fire relay 310 electrically connected to a ground 300, emergency stop 208, override 200, audible alarm 202, system active indicator light 206, system fired indicator light 212, and a level sensor 304. The main control module is further connected to an electrical plug 116, allowing the main control module to be electrically connected to an engine control module.

[0049] Figure 4 depicts an exemplary wiring diagram for an engine control module wired to a truck, within the engine compartment. The engine control module comprises a cutout relay 420, solenoid control valve relay 422, and power relay 424 electrically connected to a ground 300, the fire relay 310 in the main control module, solenoid control valve 102, ignition power 410, feed from parking brake 412, feed to solenoid control valve 102, and battery power 416. The cutout relay 420 is connected to an engine control unit 404 allowing the shut-down-engine and engine-off signals to pass between the engine control unit and the engine control module. The installed engine control module further comprises a parking brake switch 402 and an ISA fuse 418 that can isolate the engine control module from the truck battery 400 if the current exceeds the capacity of the fuse. The main control module is further connected to an electrical plug 118, allowing the main control module to be electrically connected to an engine control module.

[0050] Figure 5 depicts a flow chart of a series of events that may occur during a tank-filling operation with a threatened overfill prevented by an embodiment of the control system. In the depicted embodiment, the control system is arranged to communicate system status to a remote communication

system; specifically sending a communication whenever the system is activated and whenever the system is fired.

[0051] Figure 6 depicts a flow chart outlining a series of events that occurs once the fluid reaches the predetermined level during a tank-filling operation with a threatened overflow prevented by an embodiment of the control system.

[0052] The truck to which the system is mounted may comprise a level gauge having an inductive float sensor 108 or other proximity switch. If so, a user can test the operation of the system by placing a metal wand or other metal object in close proximity to the proximity switch. Doing so will activate the level sensor, causing the system to fire. This allows the system to be readily tested by a user, without requiring the user to perform any strenuous operations or to enter the tank. As such, the system can be easily tested on a regular basis and be timely maintained or replaced if not functioning properly.

[0053] The illustrated embodiments depict a system comprising a main control module and an engine control module, with the main control module being mounted to the trailer of a tanker truck and the engine control module being mounted within the cab of a trailer truck. This arrangement allows for multiple trailers and multiple cabs to be equipped with control modules, allowing any cab and trailer combination to be used, so long as the cab comprises an engine control module and the trailer comprises a main control module. However, other arrangements may be employed. The system could comprise a single control module or a plurality of modules that are arranged to communicate with an engine control unit, a level sensor, and at least one control valve. The single control module, the main control module plus engine control module, or the plurality of control modules combined are each collectively referred to as a controller.

[0054] The illustrated embodiments depict the system interacting with an electronic engine control unit to shut down the engine of the truck, thereby stopping the fluid transfer pump. In a non-illustrated embodiment, the control system may send a signal directly to a pump control unit that regulates the fluid transfer pump, allowing the fluid transfer pump to shut down without requiring the engine to be shut down. In this embodiment, a shut-down-pump signal would be sent to the pump control unit by the control system and a pump-off signal would be sent from the pump control unit to the control system in response to the fluid reaching a predetermined level.

[0055] Numerous specific details are set forth herein in order to provide a thorough understanding of the exemplary embodiments described herein. However, it will be understood by those of ordinary skill in the art that these embodiments may be practiced without these specific details. In other instances, well-known methods, procedures and components have not been described in detail so as not to obscure the description of the embodiments.

[0056] Further, while the above description provides examples of the embodiments, it will be appreciated that some features and/or functions of the described embodiments are susceptible to modification without departing from the spirit and principles of operation of the described embodiments. Accordingly, what has been described above has been intended to be illustrative of the invention and non-limiting. It will be understood by persons skilled in the art that other variants and

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modifications may be made without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. A control system for preventing overfill of a tanker truck, the tanker truck having a tank for containment of a fluid cargo, at least one control valve for regulating a flow of fluid into the tank, a level sensor for detecting a level of fluid within the tank, and a fluid transfer pump for transferring the fluid cargo into the tank, said control system comprising:
 - (a) a sensor to detect when the level of fluid in the tank has reached a predetermined level; and
 - (b) a control module to shut down the pump in response to the level of fluid in the tank reaching the predetermined level.
2. The control system of claim 1, further comprising a control device to close the at least one control valve in response to the level of fluid in the tank reaching the predetermined level.
3. The control system of claim 1 or 2, wherein the tanker truck comprises a parking brake and the control system is arranged to automatically activate in response to application of the parking brake.
4. The system of any one of claims 1 to 3, further comprising an emergency stop, wherein activation of the emergency stop causes the pump to shut down irrespective of the level of fluid in the tank.
5. The system of any one of claims 1 to 4, further comprising a system override, wherein activation of the system override prevents the control system from shutting down the pump or closing the at least one control valve, irrespective of the level of fluid in the tank.
6. The system of any one of claims 1 to 5, further comprising a communication device for relaying a system status to a communication system.
7. The system of any one of claims 1 to 6, wherein the control module is arranged to shut down the pump by shutting down the truck's engine, thereby cutting power to the pump.
8. The system of any one of claims 1 to 7, further comprising at least one indicator to indicate a system status.
9. The system of claim 8, wherein the at least one indicator is a visual indicator or an audible indicator.
10. An automated method for preventing overfill of a tanker truck, the tanker truck having a tank for containment of a fluid cargo, at least one control valve for regulating a flow of fluid into the tank, and a fluid transfer pump for transferring the fluid cargo into the tank through a fluid transfer member, said method comprising:
 - (a) determining a level of fluid within the tank; and
 - (b) shutting down the pump once the fluid has reached a predetermined level.
11. The method of claim 10, further comprising a step of closing the at least one control valve after the pump has been shut down.

12. The method of claim 11, further comprising a step of waiting for a period of time between the steps of shutting down the pump and closing the at least one control valve.
13. The method of claim 12, wherein the period of time is a period of time sufficient to allow the pressure in the fluid transfer member to subside to a level that will not cause a spill once the at least one control valve is closed.
14. The method of any one of claims 10 to 13, wherein the pump is powered by the engine of the truck and the step of shutting down the pump is accomplished by shutting down the engine of the truck.
15. The method of any one of claims 10 to 14, wherein the predetermined level is higher than the legal fill limit for the tank and lower than the full volume of the tank.

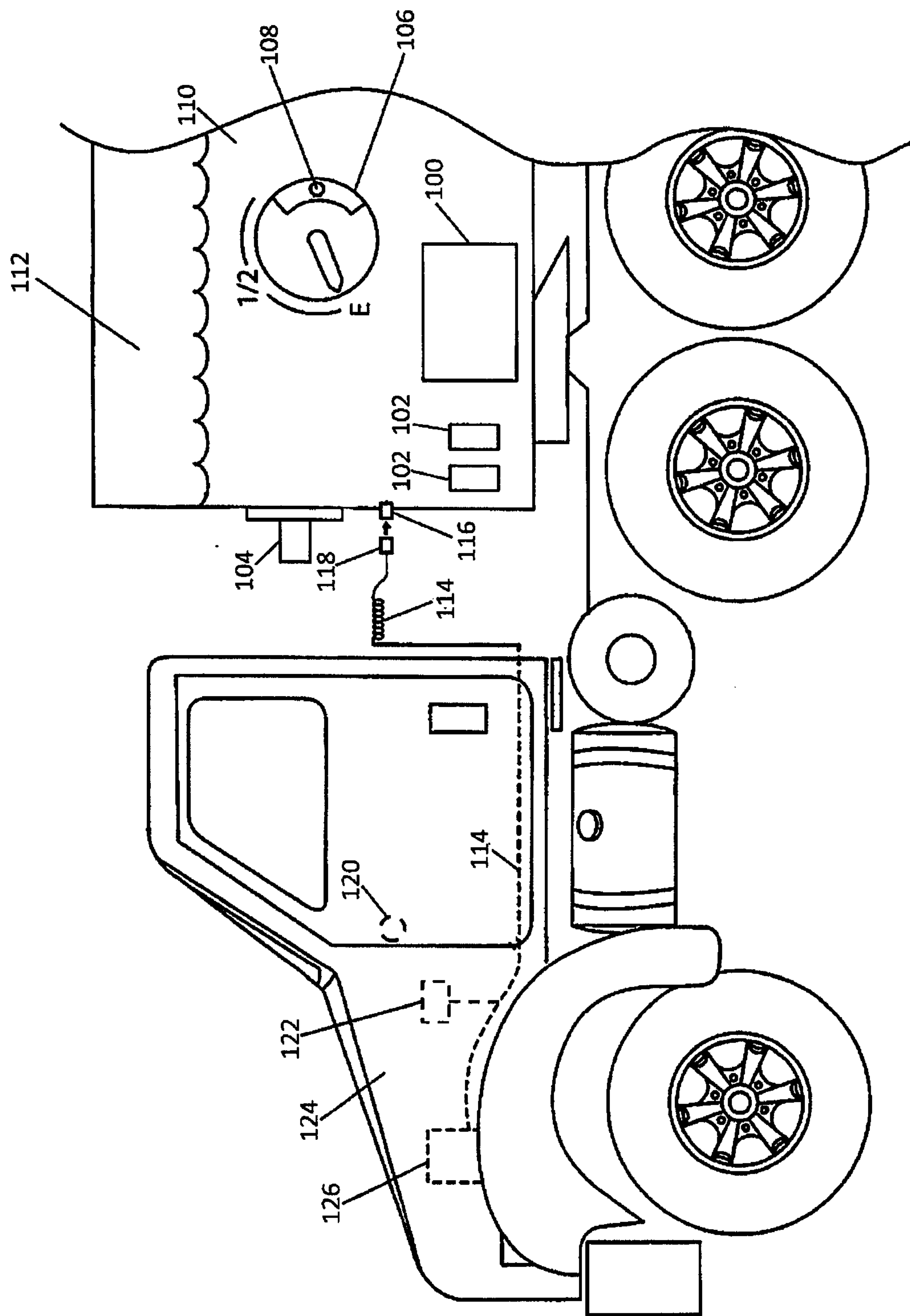


FIG. 1

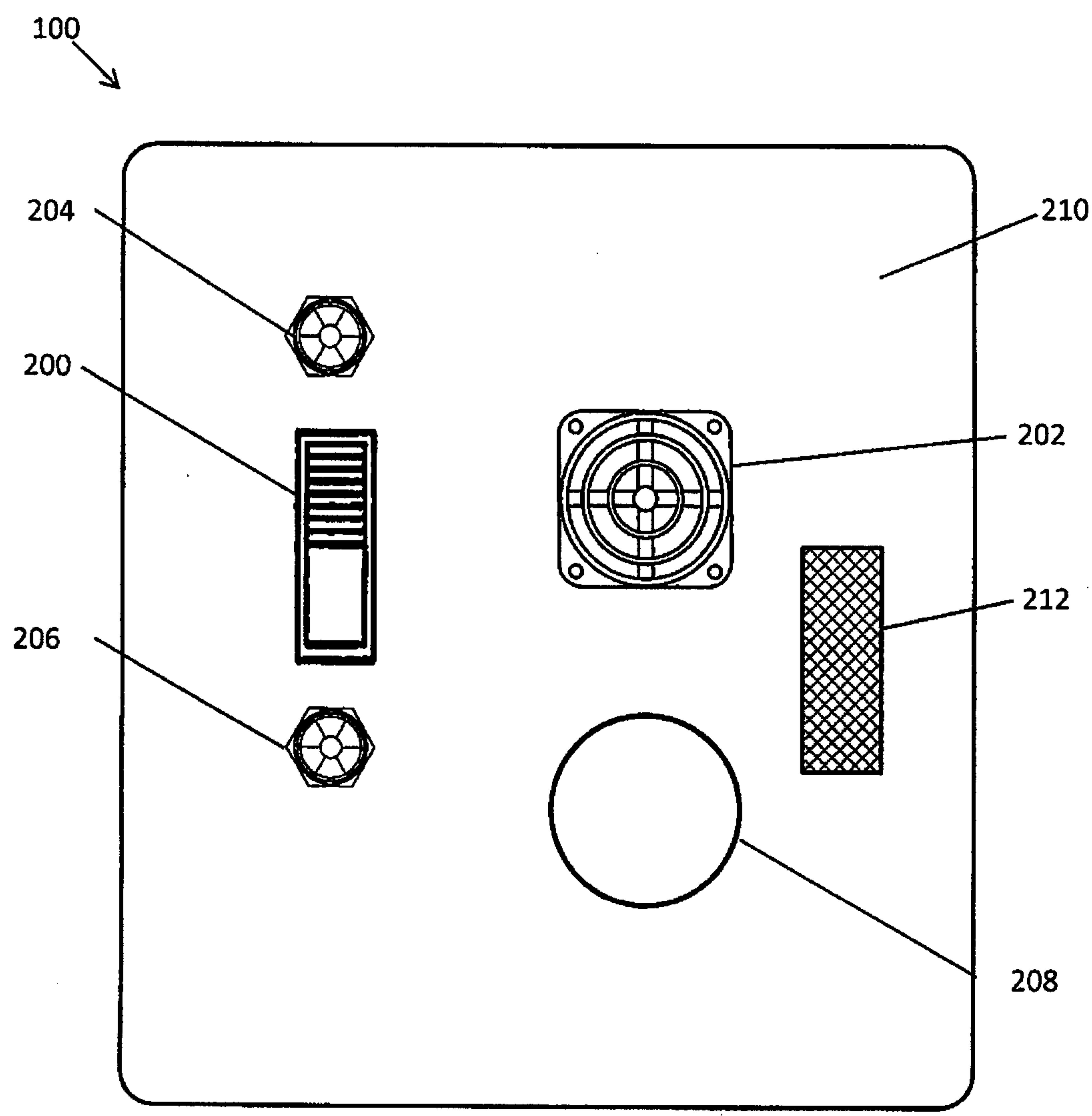


FIG. 2

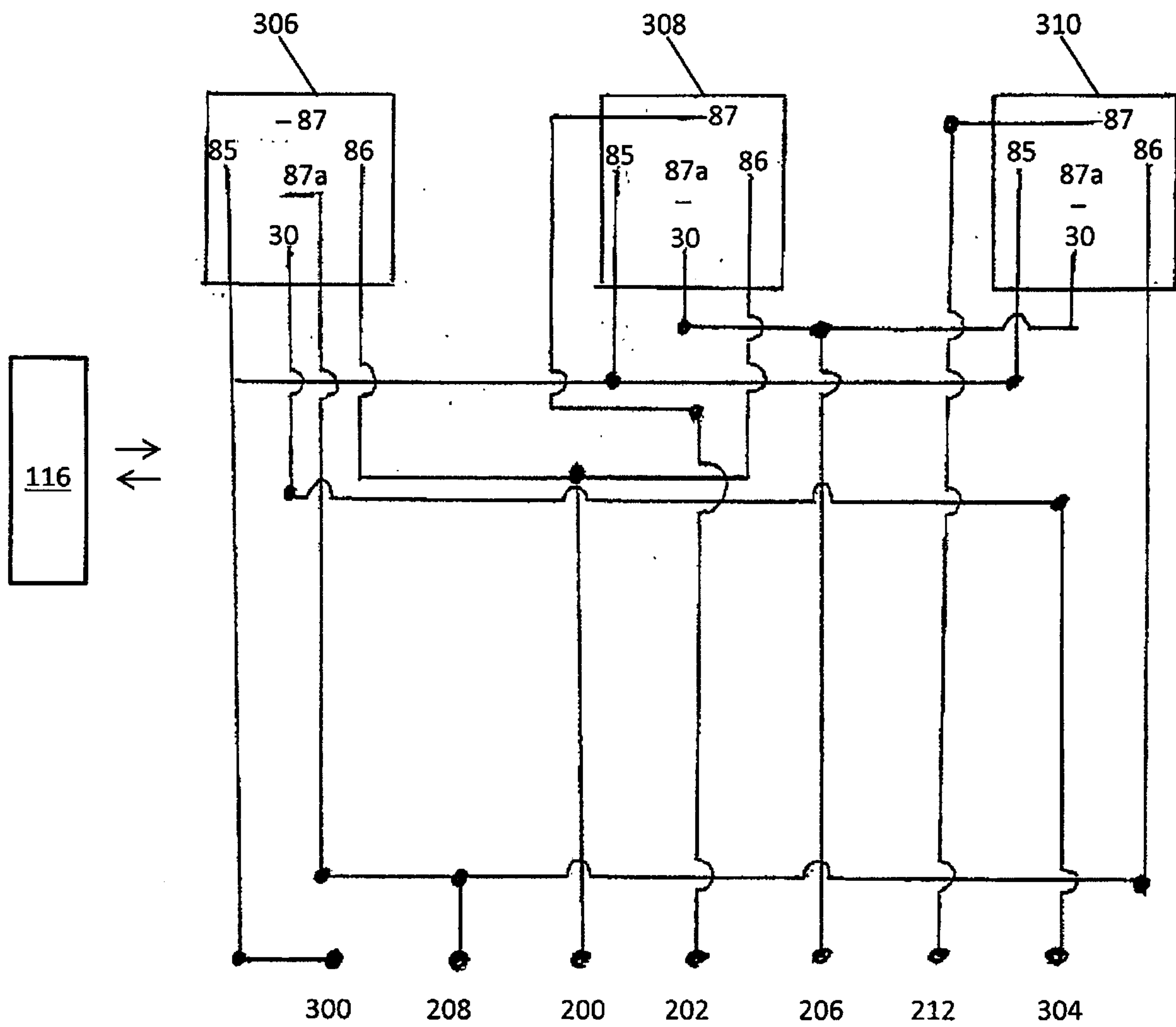


FIG. 3

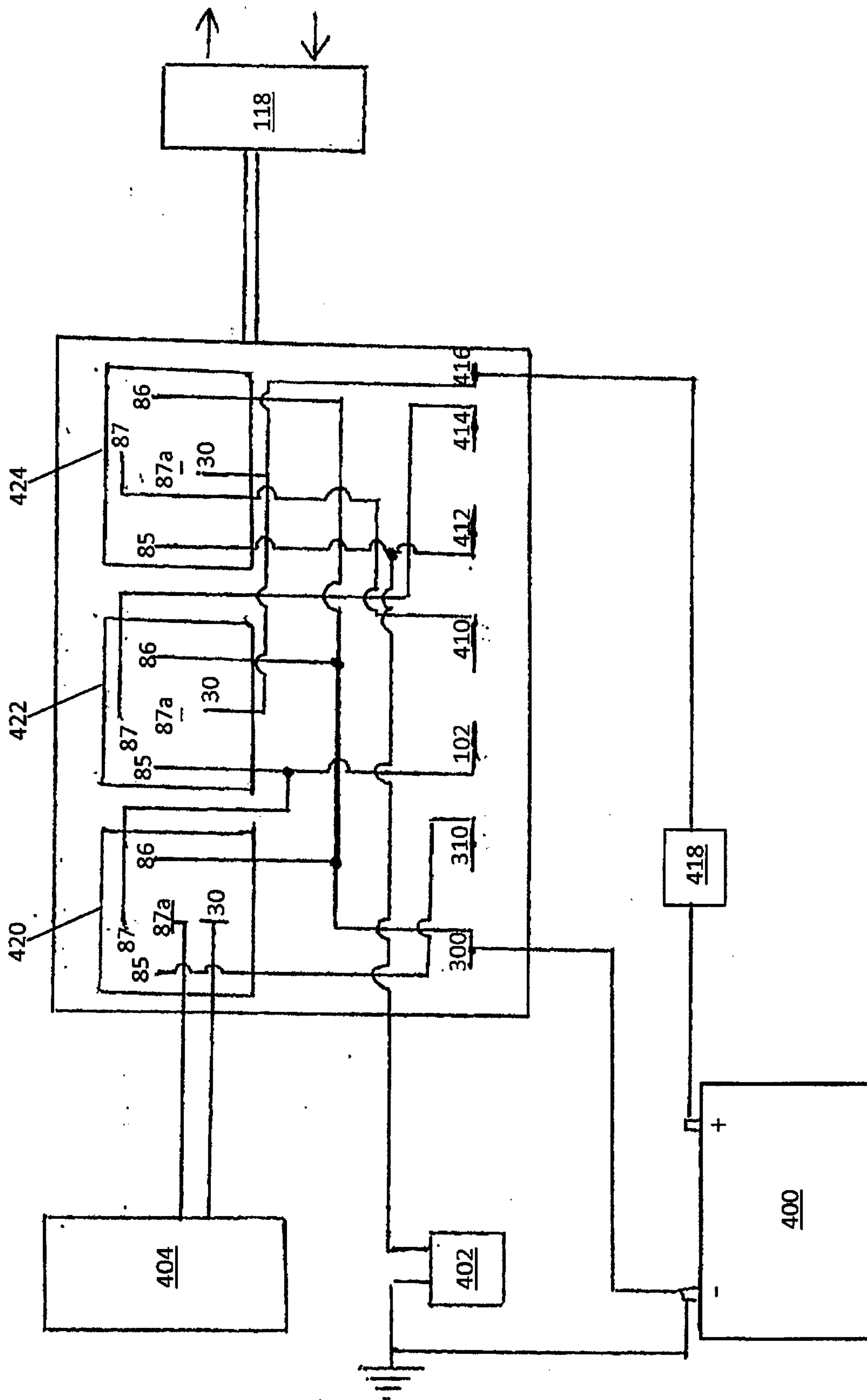


FIG. 4

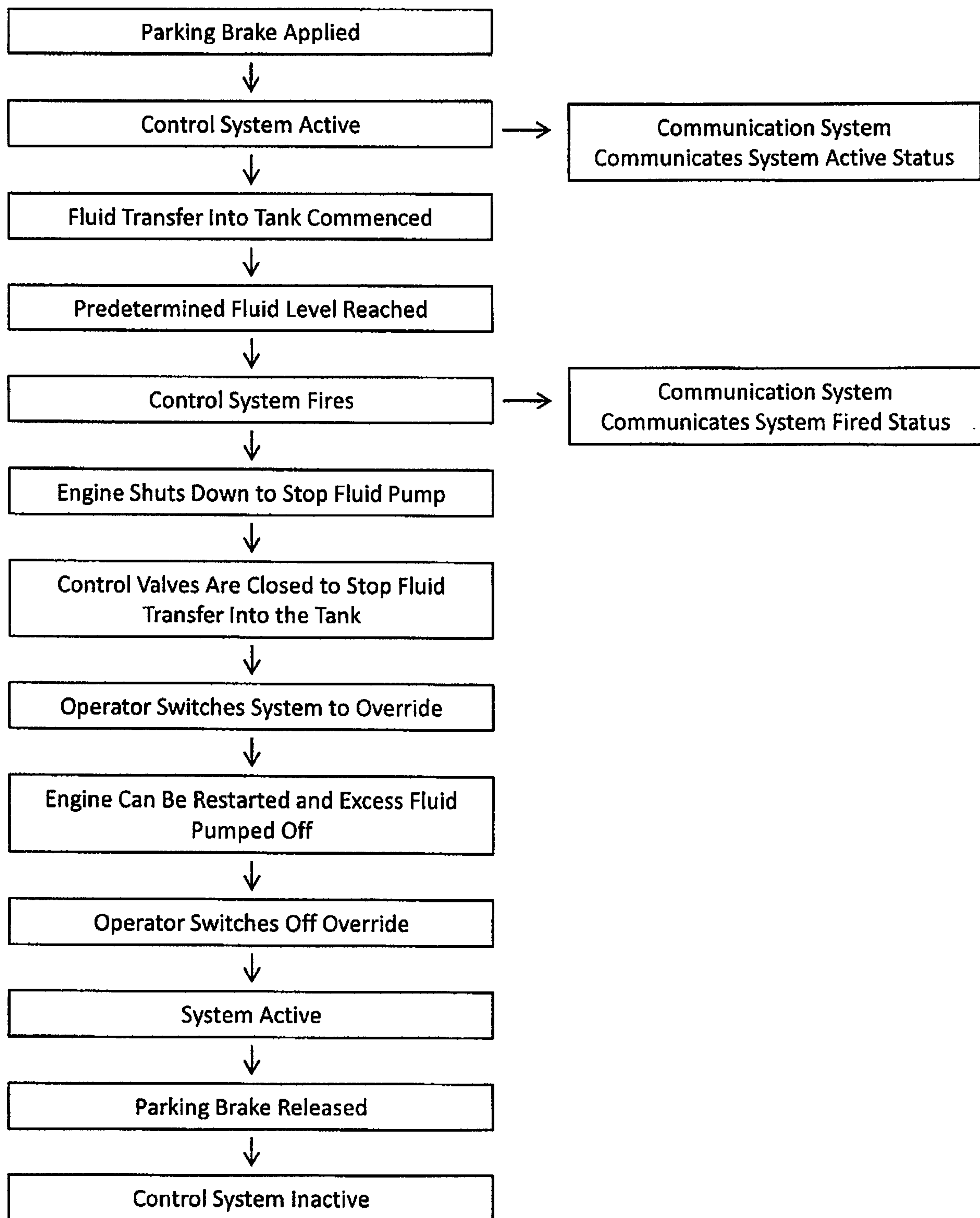


FIG. 5

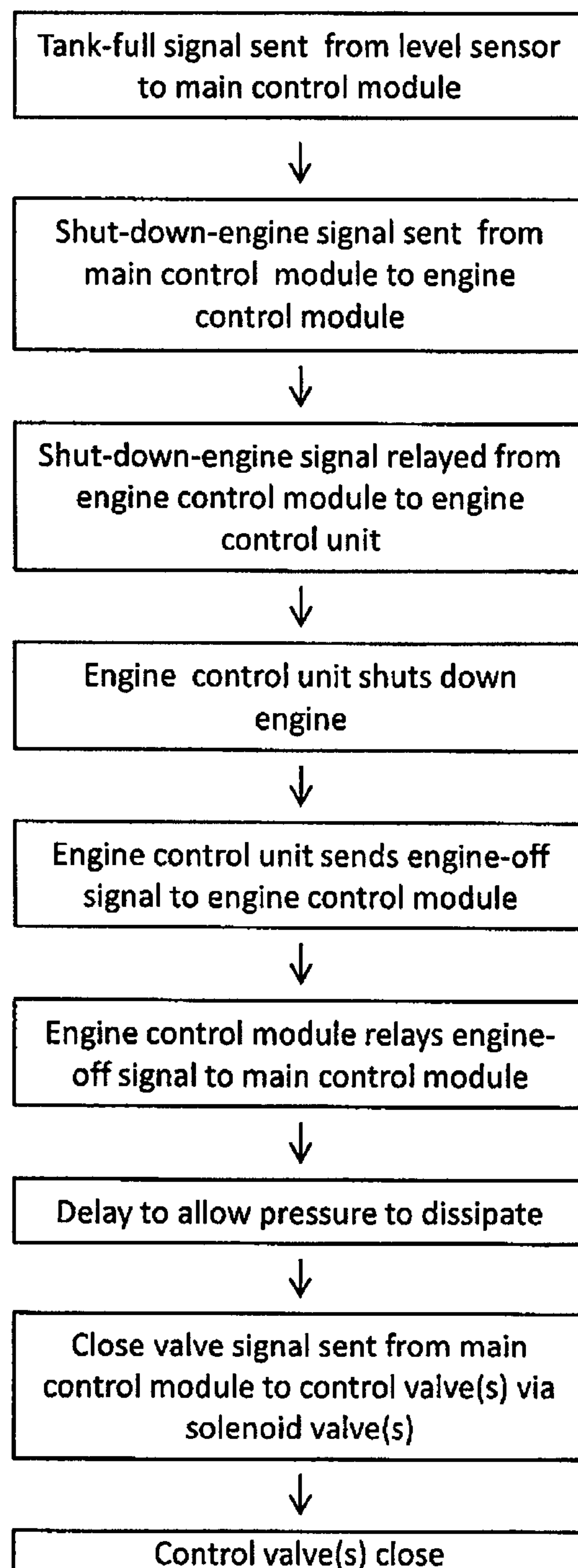


FIG. 6

