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(54) **LOCAL ELECTRIC POWER GENERATION FOR TONG CONTROL SYSTEM**

(57) A method and apparatus for tong power and control. A tong includes a tong control system; and a local electric power generation system, wherein the tong control system is powered by the local electric power generation system. A method includes supplying hydraulic power to a motor on a tong; driving an electric generator on the tong with the motor; and supplying electric power to a tong control system on the tong. A method includes installing a tong control system on a tong; and installing a local electric power generation system on the tong, wherein the tong control system is powered by the local electric power generation system.

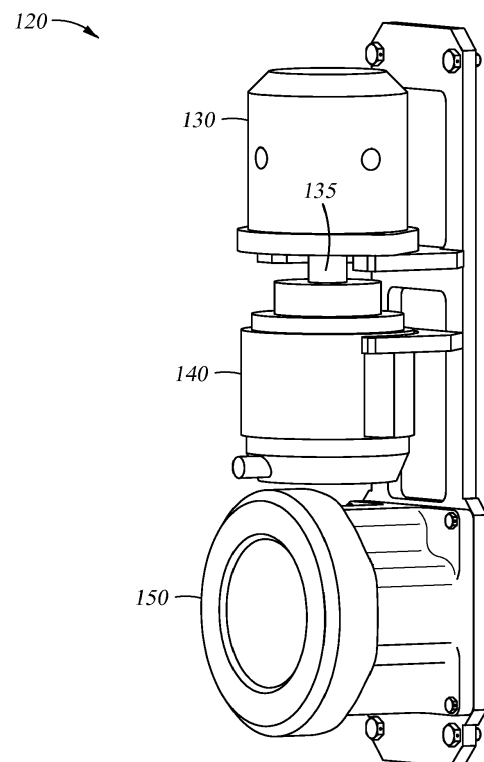


Fig. 2

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Description

[0001] Embodiments of the present invention generally relate to systems and methods for local control and/or electric power generation for a tong.

[0002] Tongs are devices used on oil and gas rigs for gripping and/or rotating tubular members, such as casing, drill pipe, drill collars, and coiled tubing (herein referred to collectively as tubulars and/or tubular strings). Tongs may be used to make-up or break-out threaded joints between tubulars. Tongs typically resemble large wrenches, and may sometime be referred to as power tongs, torque wrenches, spinning wrenches, and/or iron roughnecks. Tongs typically use hydraulic power to provide sufficiently high torque to make-up or break-out threaded joints between tubulars. Equipment utilized with/on tongs may also need some electric power, for example actuators and/or sensors. Supplying the electric power to such equipment commonly requires the routing of the electric wires through several junction boxes, cables, and/or connectors. Such routing can be expensive and hazardous due to the circumstances in explosive atmosphere. Such routing can also require manual mating/demating of connectors, which presents additional risks, costs, and reliability concerns. In some instances, adequate connectors may not be available or certified for the particular operational conditions.

[0003] Historically, tongs have been either manually operated or controlled remotely by an operator in the driller's cabin. Onboard tong control has heretofore not been achievable due to control system size, power, and safety requirements.

[0004] Onboard control of a tong - facilitated by local electric power generation - may provide improved handling, greater reliability, and increased safety and efficiency.

[0005] Embodiments of the present invention generally relate to systems and methods for local control and/or electric power generation for a tong, wherein the tong control system is powered by the local electric power generation system.

[0006] In accordance with one aspect of the present invention there is provided a tong. The tong includes a tong control system and a local electric power generation system.

[0007] In accordance with another aspect of the present invention there is provided a method which includes supplying hydraulic power to a motor on a tong; driving an electric generator on the tong with the motor; and supplying electric power to a tong control system on the tong.

[0008] In accordance with another aspect of the present invention, a method includes installing a tong control system on a tong; and installing a local electric power generation system on the tong, wherein the tong control system is powered by the local electric power generation system.

[0009] So that the manner in which the above recited

features of the present invention can be understood in detail, a more particular description of the invention, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only typical embodiments of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

Figure 1 is an illustration of an exemplary tong according to embodiments described herein.

Figure 2 is an illustration of an exemplary local electric power generation system for the tong of Figure 1.

Figure 3A is an illustration of an exemplary electric generator for the local electric power generation system of Figure 2. Figure 3B is an illustration of an exemplary electric generator and battery system for the local electric power generation system of Figure 2.

Figure 4 is an illustration of a component diagram of an exemplary tong in the context of an oil and gas rig.

[0010] Embodiments of the present invention generally relate to systems and methods for local control and/or electric power generation for a tong.

[0011] In some embodiments, a tong control system may be small (e.g., less than about 2 ft (61 cm) in any dimension; for example 16" x 16" x 6" (41 cm x 41 cm x 15 cm)), so that it can be placed on the tong. In some embodiments, data communication between the local tong control system and remote logging/monitoring equipment may be wireless. In some embodiments, electric power generation may occur locally on the tong by branching off a portion of an existing hydraulic supply line. Consequently, existing tongs may be beneficially retrofitted. Some embodiments may provide beneficial reduction in electrical connectors, supply boxes, and/or cables that could be damaged, cause accident or injury, contamination, and/or corrosion issues. There may be beneficially only a few required components (e.g., a hydraulic motor, a volume control valve, an alternator, and a belt or drive shaft to connect both). In some embodiments, a battery system may power the tong control system during the absence of hydraulic power in the event of an emergency shut-down.

[0012] A tong control system may monitor and actuate several parts of the tong. For example, the tong control system may monitor and actuate components of the tong to provide varying torque and/or angular displacement. Disconnection of a tubular joint may require both a high-torque/low-angular displacement "break" action to disengage the contact shoulders, and a low-torque/high-angular displacement "spin" action to screw-out the threads. Connection of a tubular joint may occur in the

reverse sequence. In the make/break action, torque may be high (e.g., 10,000-100,000 ft-lb (13,558-135,582 Nm)), having a small (e.g., 0.12-0.24 revolutions) angular displacement. In the spin action, torque may be low (e.g., 1,000-3,000 ft-lb (1,356-4,067 Nm)), having a large (e.g., 3-5 revolutions) angular displacement.

[0013] As another example, the tong control system may monitor and actuate components of the tong to provide varying clamping and rotation actions. Upper and lower jaws of the tong may turn relative to each other to break a connection between upper and lower tool joints. The upper jaw may then be released while the lower jaw remains clamped onto the lower tool joint. A spinning wrench, commonly separate from the torque wrench and mounted higher up on the carriage, may engage the stem of the upper joint of drill pipe to spin the upper joint until it is disconnected from the lower joint. Upper and lower jaws of the tong may turn relative to each other to make-up two joints of pipe. The lower jaw may grip the lower tool joint while the upper pipe is brought into position. The spinning wrench may engage the upper joint to spin it into the lower joint. The torque wrench may clamp the pipe and tighten the connection.

[0014] Figure 1 illustrates an exemplary tong 100. The tong 100 may include a frame 110 and a plurality of jaws 115, for example upper jaws 115-U and lower jaws 115-L. The jaws may be configured to grip and/or rotate tubulars. The jaws (or portions thereof) may move (e.g., rotate) relative to the frame 110. Consequently, the jaws 115 may be referred to as a rotating portion of the tong 100, and the frame 110 may be referred to as a stationary portion of the tong 100. In some embodiments, the tong 100 may include a system 120 for local electric power generation. In some embodiments, the tong 100 may include a system 160 for tong control (e.g., controllers, input/output devices). The tong 100 may also include electrical equipment 165 (e.g., actuators, sensors) and/or a hydraulic coupler 170. Each of the local electric power generation system 120, tong control system 160, and hydraulic coupler 170 may be disposed on a stationary portion of the tong 100, for example the frame 110. The electrical equipment 165 may be disposed on either or both of the rotating portion and stationary portion of the tong 100.

[0015] In some embodiments, tong control system 160 may be configured to control how the tong 100 handles tubulars, grips tubulars, turns tubulars, and/or manages hydraulic power for handling, gripping, and/or turning tubulars. In some embodiments, tong control system 160 may be configured to receive input (e.g., from sensors) regarding how the tong 100 interacts with tubulars. In some embodiments, tong control system 160 may be configured to process and/or store data (e.g., pipe size, thread size, thread count, etc.) regarding how the tong 100 interacts with tubulars. In some embodiments, tong control system 160 may be configured to generate and/or send control signals (e.g., to actuators) to control how the tong 100 interacts with tubulars. Tong control system

160 may include a torque sensor (e.g., a load cell) and/or a turns counter. In some embodiments, tong control system 160 may also include a clock (e.g., a timer). Tong control system 160 may be configured to receive input from a torque sensor and/or a turns counter. In some embodiments, tong control system 160 may be configured to also receive input from a clock. Tong control system 160 may include data storage and/or data processors. Tong control system 160 may be configured to store and/or process tong control data. Tong control system 160 may include a tubular gripping actuator, a tubular turning actuator, and/or a hydraulic power control actuator (e.g., a dump valve). In some embodiments, tong control system 160 may also include a jaw positioning actuator. Tong control system 160 may be configured to send control signals to a tubular gripping actuator, a tubular turning actuator, and/or a hydraulic power control actuator. In some embodiments, tong control system 160 may be configured to also send control signals to a jaw positioning actuator.

[0016] Figure 2 illustrates an exemplary local electric power generation system 120. The system 120 may include a motor 130 (e.g., a hydraulic motor) and an electric generator 140 (e.g., an alternator or a dynamo). In some embodiments, the system 120 includes a battery system 150. The electric generator 140 may be driven by motor 130. In some embodiments, the electric generator 140 is directly driven by motor 130, for example by drive shaft 135. In some embodiments, the motor 130 drives a belt drive or gearing (not shown) to drive electric generator 140. In some embodiments, the motor 130 is dedicated to drive only electric generator 140. The local electric power generation system 120 may supply electric power to the tong control system 160 and/or the electrical equipment 165.

[0017] In some embodiments, and at times during operations, the hydraulic coupler 170 may supply hydraulic power to the motor 130. In some embodiments, and at times during operations, the electric generator 140 may supply electric power to the battery system 150, the tong control system 160, and/or the electrical equipment 165.

[0018] At times during operations, hydraulic power from the hydraulic coupler 170 may be reduced or stopped. Consequently, it is expected that motor 130 may not run continuously and/or consistently. Likewise, it is expected that electric generator 140 may not run continuously and/or at a consistent output rate. In some embodiments, when electric generator 140 is not running, or is running at a low output rate, the battery system 150 may supply electric power to the tong control system 160 and/or the electrical equipment 165. In some embodiments, and at times during operations, the electric generator 140 and the battery system 150 may jointly supply electric power to the tong control system 160 and/or the electrical equipment 165.

[0019] Figure 3A illustrates an exemplary electric generator 140 for use in a local electric power generation system 120. Electric generator 140 may include a dyna-

mo 141 and regulating circuits 143. The electric generator 140 may include, and/or portions thereof may be encased in, a flameproof housing 151. Dynamo 141 may be connected to regulating circuits 143 so that output 147 may be suitable for direct connection to electronic circuits on tong 100. For example, regulating circuits 143 may include a rectifier 144, one or more smoothing capacitors 145, and/or a voltage regulator 142. Dynamo 141 may be any generator with a suitable load capacity. In some embodiments, dynamo 141 may produce an unstable voltage (e.g., due to non-constant speed). In some embodiments, dynamo 141 may be a self-energizing generator that provides a 28-29V rectified and regulated current with pulsating voltage. Regulating circuits 143 may smooth and regulate the voltage to 24V for use in subsequent circuits on tong 100. In some embodiments, electric generator 140 may provide 28V DC current, and voltage regulator 142 may convert that to 24V DC current. Electric generator 140 may produce an output 147. At times during operations, the electric generator 140 may supply output 147 to the tong control system 160 and/or the electrical equipment 165.

[0020] Figure 3B illustrates an exemplary battery system 150 with input from an exemplary electric generator 140. In some embodiments, electric generator 140 includes only a dynamo 141, but no regulating circuits 143 before output 147. Battery system 150 may include and/or be encased in a flameproof housing 151. Battery system 150 may include a voltage regulator 152. For example, in some embodiments, electric generator 140 may provide 28V DC current to battery system 150, and voltage regulator 152 may convert that to 24V DC current. In some embodiments, voltage regulator 142 may provide a charging voltage (e.g., for lead acid battery charging, either 14.4V or 28.8V). In some embodiments, voltage regulator 142 may provide a switching power supply with a wide input range. Battery system 150 may include a battery pack 153, a charge controller 154, an indicator 155 (e.g., a lamp), and/or a start/stop switch 156. The battery pack 153 may include one or more types of batteries, such as a lead-acid, or lithium iron phosphate, or lithium titanium oxide. The batteries may be selected to meet the requirements of explosion protection and environmental conditions. For example, the battery pack 153 may include a battery of about 1 kg size, which may be capable of powering the tong 100 for up to about 1 hour. In some embodiments, battery system 150 may include one or more backup battery packs (not shown) to supplement battery pack 153. The charge controller 154 may regulate the charging current to battery pack 153. For example, the charge controller 154 may provide voltage supervision, voltage balancing, and/or temperature supervision for battery pack 153. The charge controller 154 may also include logic and/or circuitry to control the status display of the indicator 155. Battery system 150 may produce an output 157. At times during operations, the battery system 150 may supply output 157 to the tong control system 160 and/or the electrical equipment 165. In some

embodiments, the output 157 of battery system 150 may be determined by the status one or more of the components thereof. For example, the output 157 may be activated when the voltage regulator 152 receives a current from generator 140. As another example, the output 157 may be activated when the generator 140 does not produce current, but the battery pack 153 is not fully discharged. At times, when the generator 140 is not producing current, the battery system 150 may maintain output 157 for a pre-determined time (e.g., up to about 10 minutes, up to about 1 hour, etc.). This may be beneficial in cases when power to motor 130 is unexpectedly lost. In such instances, battery system 150 may maintain output 157 so that tong control system 160 and/or electrical equipment 165 may continue to function. In some embodiments, tong control system 160 may record operational status while battery system 150 maintains output 157. This may beneficially provide for quick restart after hydraulic power failure. As another example, the output 157 may be activated when the start/stop switch 156 is switched on. As another example, the output 157 may be deactivated when the start/stop switch 156 is switched off. As another example, the output 157 may be deactivated when the battery pack 153 is fully discharged. As another example, the output 157 may be deactivated when the charge controller 154 determines that the temperature of the battery pack 153 exceeds the operational temperature range (e.g., above about 70 °C). As another example, the output 157 may be deactivated when the charge controller 154 determines that one or more cells of battery pack 153 is below a predefined voltage. As another example, the output 157 may be deactivated when the charge controller 154 determines certain output deactivation conditions exist (e.g., lack of current draw for a specified time period (e.g., two minutes), lack of current change for a specified time period (e.g., five minutes)). In some embodiments, the indicator 155 may provide an external indication of the status of one or more of the components of the battery system 150. For example, the indicator may provide a first indication (e.g., solid light) when the voltage regulator 152 receives a current from generator 140 and the battery pack 153 is charging. As another example, the indicator may provide a second indication (e.g., slowly blinking light) when battery pack 153 is supplying output 157 (e.g., no current from generator 140). As another example, the indicator may provide a third indication (e.g., fast blinking light) when the output 157 will be deactivated soon (e.g., low charge in battery pack 153 and no current from generator 140).

[0021] Figure 4 illustrates a component diagram of an exemplary tong 100 in the context of an oil and gas rig 200. The interface 210 between the tong 100 and the rig 200 is indicated by a dashed line. The rig 200 is divided into a section 220 for components (other than tong 100) that may be located on the rig floor, and a section 230 for components that may be located remotely (e.g., in a driller's cabin) from the rig floor section 220. As in Figure 1, the local electric power generation system 120 is dis-

posed on tong 100. Heretofore, various types of controllers and electrical equipment would typically be located on the rig floor section 220 and connected to tong 100 through a series of junction boxes, cables, and/or connectors. In one embodiment, the local electric power generation system 120 is movable with the tong 100. As illustrated in Figure 4, such controllers and electrical equipment, with accompanying junction boxes, cables, and/or connectors, have been removed from the rig floor section 220. For example, tong control system 160 that is disposed on tong 100 may include programmable logic controllers, input/output systems, and control systems (e.g., joint-analyzed makeup ("JAM") system) that had heretofore been located on the rig floor section 220. Local electric power generation system 120 may thereby provide power to tong control system 160. As another example, electrical equipment 165 that is disposed on tong 100 previously would have been connected to electrical power from the rig floor section 220 through a series of junction boxes, cables, and/or connectors. As illustrated in Figure 4, electrical equipment 165 is powered from the local electric power generation system 120. As another example, load cells, turns sensors, and/or dump valve actuators that are disposed on tong 100 previously would have been connected to electrical power from the rig floor section 220 through a series of junction boxes, cables, and/or connectors. As illustrated in Figure 4, such load cells, turns sensors, and/or dump valve actuators are powered from the local electric power generation system 120. In some embodiments, such load cells, turns sensors, and/or dump valve actuators are directly connected to programmable logic controllers, input/output systems, and control systems on tong 100, thereby reducing or removing the risk of failure of intervening junction boxes, cables, and/or connectors which were required when electrical equipment 165 was located on rig floor section 220.

[0022] Figure 4 also illustrates hydraulic lines 180 powering motor 130 of local electric power generation system 120. Jaws 115 may be powered with hydraulic power to provide sufficiently high torque to make-up and/or break-out tubulars. In some embodiments, the same hydraulic power system may be used to power motor 130. For example, a volume control valve 185 may regulate the volume of hydraulic power supplied to local electric power generation system 120 as opposed to jaws 115. When electrical equipment 165 was previously located on rig floor section 220, the couplings at interface 210 would include both electrical couplings and hydraulic couplings. The electrical couplings at interface 210 may have required manual intervention. In some instances, adequate connectors for electrical coupling may not be available or certified for the particular operational conditions. As illustrated in Figure 4, tong 100 no longer utilizes electrical couplings at interface 210. Hydraulic coupler 170 may provide the complete coupling assembly. Consequently, automated connectors that are certified for rig floor environments may be utilized. Moreover, battery system

150 may power tong control system 160 prior to connection to hydraulic lines 180. Startup routines within tong control system 160 may thereby be run first, and then tong control system 160 may facilitate automated coupling of hydraulic coupler 170.

[0023] Figure 4 also illustrates wireless communication equipment 190 (e.g., Wi-Fi antennas and routers) on tong 100 and in remotely located section 230 of rig 200. The tong 100 may communicate with systems and/or operators that are in remotely located section 230 with wireless communication equipment 190. When electrical equipment 165 was located on rig floor section 220, communications between tong 100 and remote systems and/or operators required a series of junction boxes, cables, and/or connectors on the rig floor section 220. By communicating through wireless communication equipment 190, the risk of failure of intervening junction boxes, cables, and/or connectors is reduced or removed.

[0024] As a normal part of operations, tong 100 may be disconnected from rig 200, for example to be stored between jobs. Battery system 150 may remain charged, even while hydraulic lines 180 are disconnected from motor 130. At times, information that has been logged by and/or stored in tong control system 160 may be accessed and/or downloaded while tong 100 is disconnected from rig 200. Battery system 150 may provide electrical power to tong control system 160 and/or wireless communication equipment 190 to facilitate accessing and/or downloading data while tong 100 is disconnected from rig 200. Likewise, data, software, firmware updates, etc., may be uploaded to control system 160 while tong 100 is disconnected from rig 200. Battery system 150 may provide electrical power to tong control system 160 and/or wireless communication equipment 190 to facilitate uploading data and/or software while tong 100 is disconnected from rig 200.

[0025] Conventional tongs may be retrofitted with one or more embodiments of local tong control systems and/or local electric power generation.

[0026] In an embodiment a tong includes a tong control system; and a local electric power generation system, wherein the tong control system is powered by the local electric power generation system.

[0027] In one or more embodiments disclosed herein, the tong control system includes: a torque sensor; a turns counter; a tubular gripping actuator; and a tubular turning actuator.

[0028] In one or more embodiments disclosed herein, the tong control system further includes a clock.

[0029] In one or more embodiments disclosed herein, the tong control system further includes a jaw positioning actuator.

[0030] In one or more embodiments disclosed herein, the tong control system further includes data storage and a data processor.

[0031] In one or more embodiments disclosed herein, the tong control system further includes a hydraulic power control actuator.

[0032] In one or more embodiments disclosed herein, the tong control system is configured to: receive input from: a torque sensor and a turns counter; and send control signals to: a tubular gripping actuator, and a tubular turning actuator.

[0033] In one or more embodiments disclosed herein, the tong control system is further configured to receive input from a clock.

[0034] In one or more embodiments disclosed herein, the tong control system is further configured to send control signals to a jaw positioning actuator.

[0035] In one or more embodiments disclosed herein, the tong control system is further configured to store tong control data and process tong control data.

[0036] In one or more embodiments disclosed herein, the tong control system is further configured to send control signals to a hydraulic power control actuator.

[0037] In one or more embodiments disclosed herein, the local electric power generation system includes a motor; and an electric generator.

[0038] In one or more embodiments disclosed herein, the motor directly drives the electric generator.

[0039] In one or more embodiments disclosed herein, the motor is dedicated to drive only the electric generator.

[0040] In one or more embodiments disclosed herein, the local electric power generation system further comprises a battery system.

[0041] In one or more embodiments disclosed herein, the battery system comprises a charge controller.

[0042] In one or more embodiments disclosed herein, the motor is a hydraulic motor.

[0043] In one or more embodiments disclosed herein, the tong also includes a frame, wherein the local electric power generation system is disposed on the frame.

[0044] In one or more embodiments disclosed herein, the tong also includes electrical equipment, wherein the local electric power generation system powers the electrical equipment.

[0045] In one or more embodiments disclosed herein, the electrical equipment is located on a stationary portion of the tong.

[0046] In one or more embodiments disclosed herein, the tong also includes a hydraulic coupler; and a plurality of jaws, wherein power for the plurality of jaws comes through the hydraulic coupler.

[0047] In one or more embodiments disclosed herein, the local electric power generation system comprises a hydraulic motor; and power for the hydraulic motor comes through the hydraulic coupler.

[0048] In one or more embodiments disclosed herein, the tong also includes a volume control valve between the hydraulic coupler and the hydraulic motor.

[0049] In one or more embodiments disclosed herein, the tong control system comprises wireless communication equipment.

[0050] In an embodiment, a method includes supplying hydraulic power to a motor on a tong; driving an electric generator on the tong with the motor; and supplying elec-

tric power to a tong control system on the tong.

[0051] In one or more embodiments disclosed herein, the method also includes supplying electric power to a battery system on the tong.

5 **[0052]** In one or more embodiments disclosed herein, the electric power is supplied to the tong control system by at least one of the electric generator and the battery system.

10 **[0053]** In one or more embodiments disclosed herein, the method also includes stopping the driving the electric generator with the motor; and while the driving is stopped, continuing to supply electric power to the tong control system.

15 **[0054]** In one or more embodiments disclosed herein, the electric power is supplied to the tong control system by the battery system while the driving is stopped.

[0055] In one or more embodiments disclosed herein, the method also includes recording operational status information while the driving is stopped.

20 **[0056]** In one or more embodiments disclosed herein, the method also includes supplying electric power to a battery system on the tong; then disconnecting the hydraulic power supply from the motor and the electric power from the tong control system, leaving the battery system charged; then supplying electric power to the tong control system with the battery system.

25 **[0057]** In one or more embodiments disclosed herein, the method also includes, while the hydraulic power supply is disconnected from the motor, at least one of: running a startup routine for the tong control system; accessing data from the tong control system; downloading data from the tong control system; uploading data to the tong control system; and uploading software to the tong control system.

30 **[0058]** In an embodiment, a method includes installing a tong control system on a tong; and installing a local electric power generation system on the tong, wherein the tong control system is powered by the local electric power generation system.

35 **[0059]** In one or more embodiments disclosed herein, the tong is located on a rig floor, the method further comprising disconnecting from the tong and removing from the rig floor at least one of programmable logic controllers, input/output systems, joint-analyzed makeup systems, junction boxes, cables, connectors, and electrical couplings.

40 **[0060]** While the foregoing is directed to embodiments of the present invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

Claims

55 1. A tong comprising:

a tong control system; and

- a local electric power generation system, wherein the tong control system is powered by the local electric power generation system.
2. The tong of claim 1, wherein the tong control system comprises:
- a torque sensor;
a turns counter;
a tubular gripping actuator; and
a tubular turning actuator.
3. The tong of claim 1 or 2, wherein the tong control system further comprises one or more of:
- a clock;
a jaw positioning actuator;
data storage and a data processor;
a hydraulic power control actuator.
4. The tong of any preceding claim, wherein the local electric power generation system comprises:
- a motor; and
an electric generator.
5. The tong of claim 4, wherein the motor directly drives the electric generator, and is dedicated to drive only the electric generator.
6. The tong of any preceding claim, wherein the local electric power generation system further comprises a battery system.
7. The tong of any preceding claim, further comprising a frame, wherein the local electric power generation system is disposed on the frame.
8. The tong of any preceding claim, further comprising electrical equipment, wherein the local electric power generation system powers the electrical equipment, and the electrical equipment is located on a stationary portion of the tong.
9. The tong of any preceding claim, further comprising:
- a hydraulic coupler; and
a plurality of jaws, wherein:
- power for the plurality of jaws comes through the hydraulic coupler;
the local electric power generation system comprises a hydraulic motor; and
power for the hydraulic motor comes through the hydraulic coupler;
- the tong optionally further comprising a volume control valve between the hydraulic coupler and
- the hydraulic motor;
and/or wherein the tong control system comprises wireless communication equipment.
10. A method comprising:
- supplying hydraulic power to a motor on a tong;
driving an electric generator on the tong with the motor; and
supplying electric power to a tong control system on the tong.
11. The method of claim 10, further comprising supplying electric power to a battery system on the tong, wherein optionally the electric power is supplied to the tong control system by at least one of the electric generator and the battery system.
12. The method of claim 11, further comprising:
- stopping the driving the electric generator with the motor; and
while the driving is stopped, continuing to supply electric power to the tong control system;
wherein optionally the electric power is supplied to the tong control system by the battery system while the driving is stopped;
and/or wherein the method further comprises recording operational status information while the driving is stopped.
13. The method of any one of claims 11 to 12, further comprising:
- after supplying electric power to a battery system on the tong, disconnecting the hydraulic power supply from the motor and the electric power from the tong control system, leaving the battery system charged;
then supplying electric power to the tong control system with the battery system.
14. A method comprising:
- installing a tong control system on a tong; and
installing a local electric power generation system on the tong, wherein the tong control system is powered by the local electric power generation system.
15. The method of claim 14, wherein the tong is located on a rig floor, the method further comprising disconnecting from the tong and removing from the rig floor at least one of programmable logic controllers, input/output systems, joint-analyzed makeup systems, junction boxes, cables, connectors, and electrical couplings.

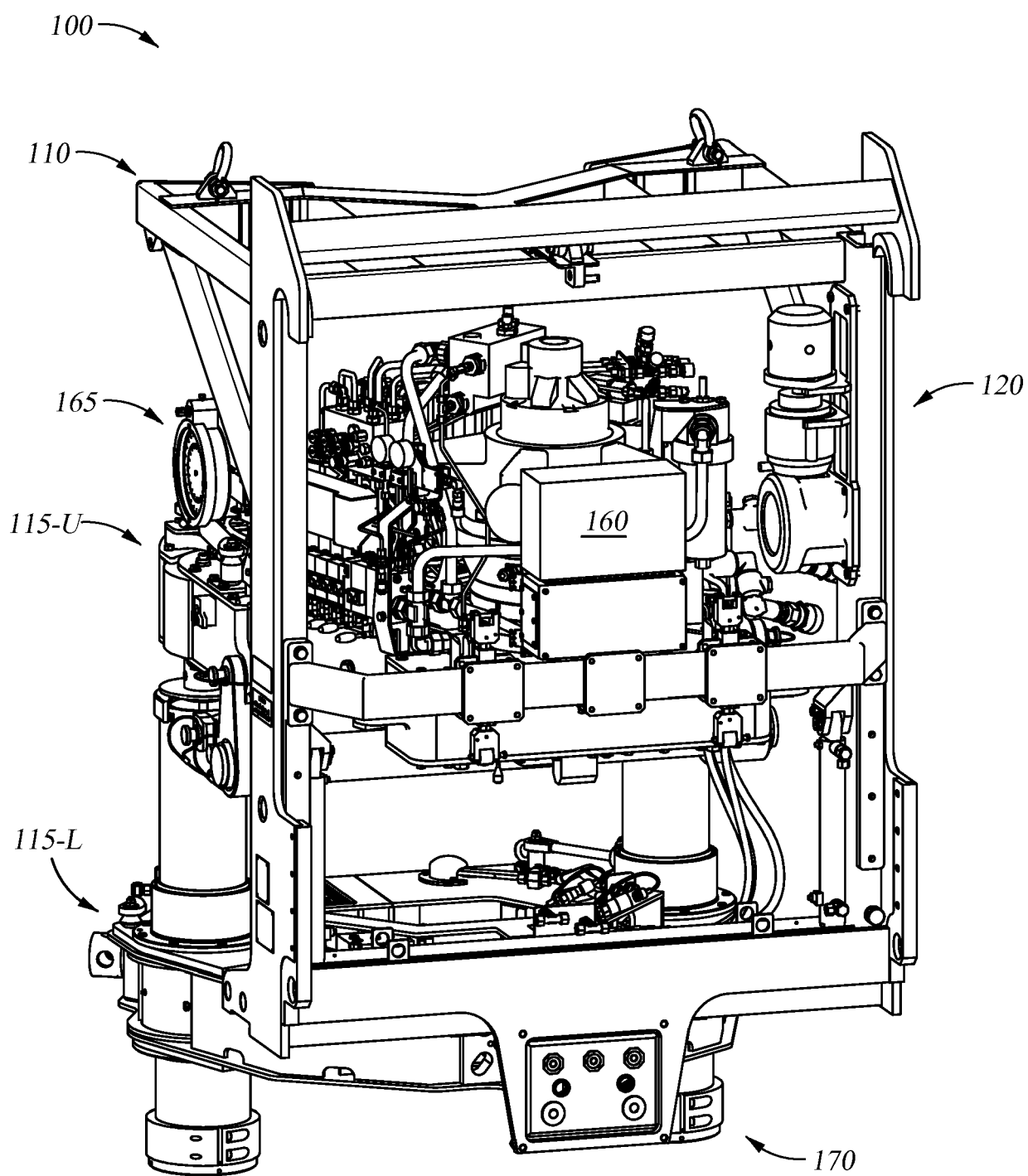


Fig. 1

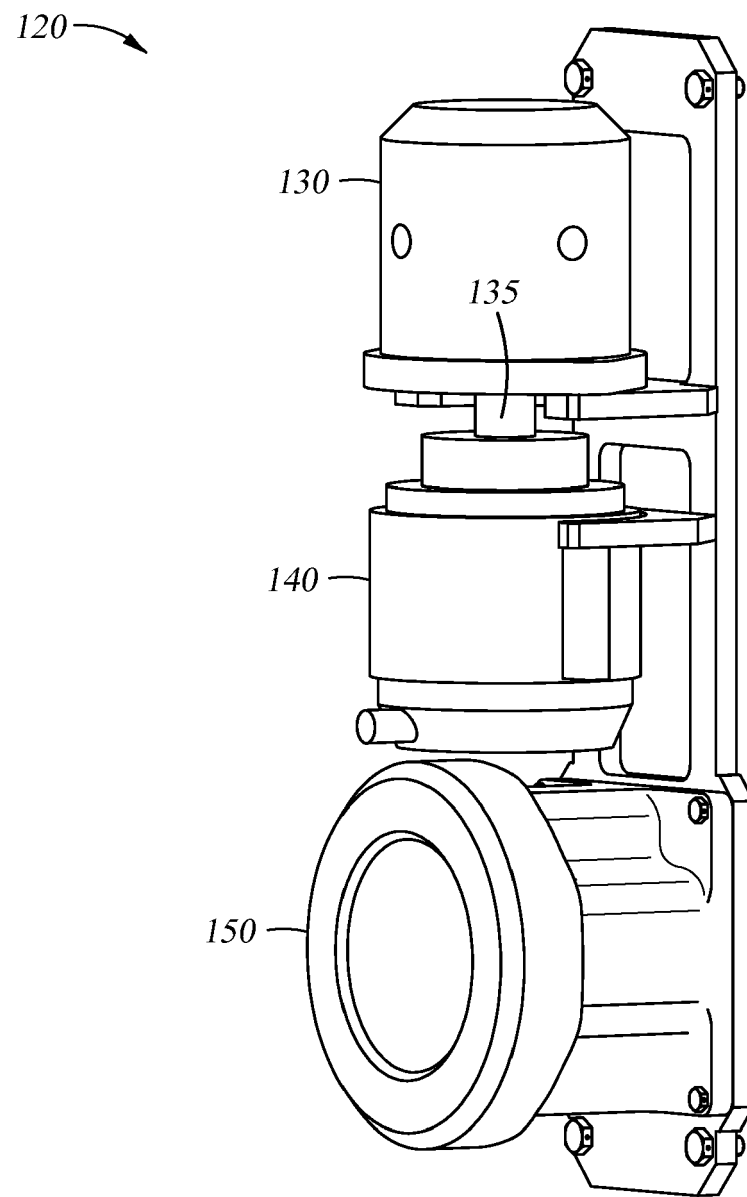


Fig. 2

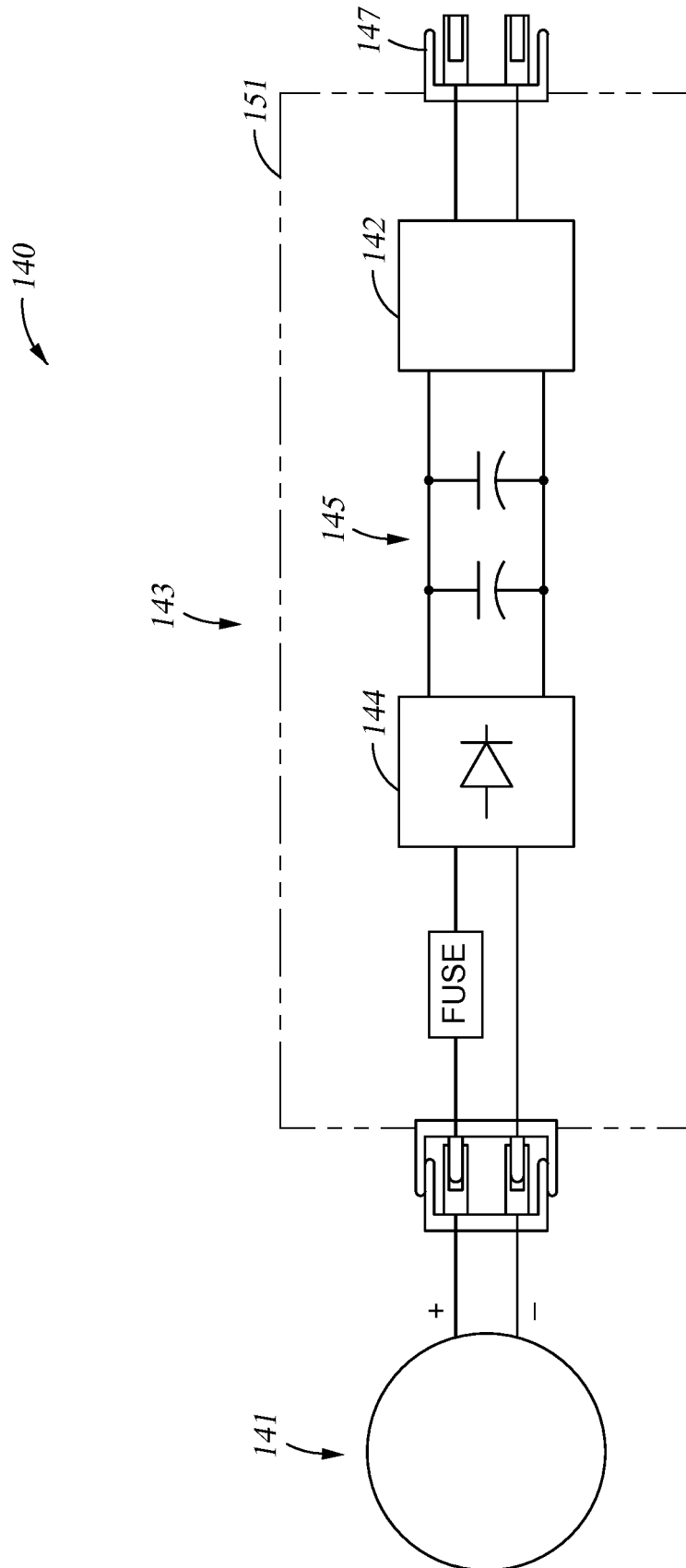


Fig. 3A

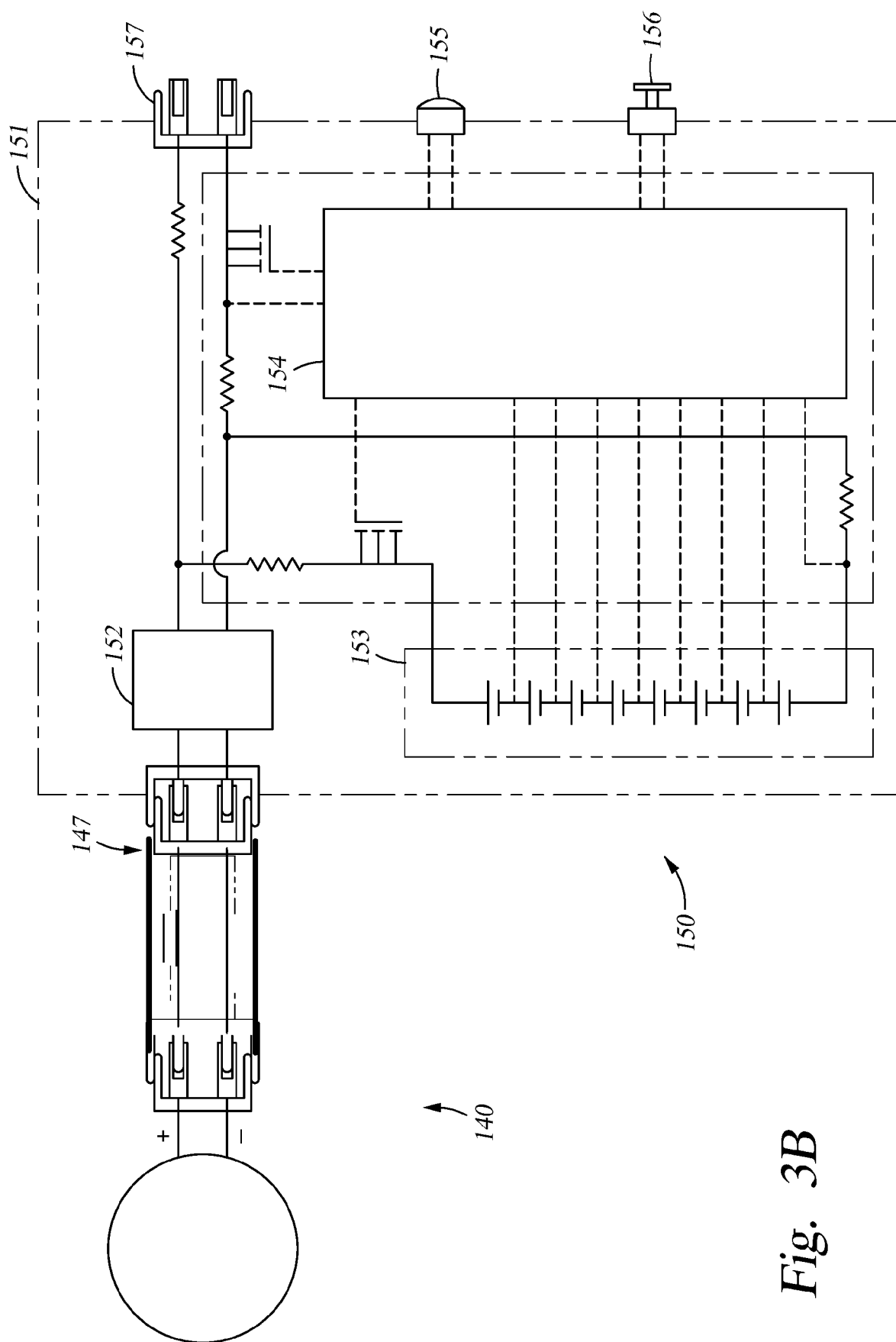


Fig. 3B

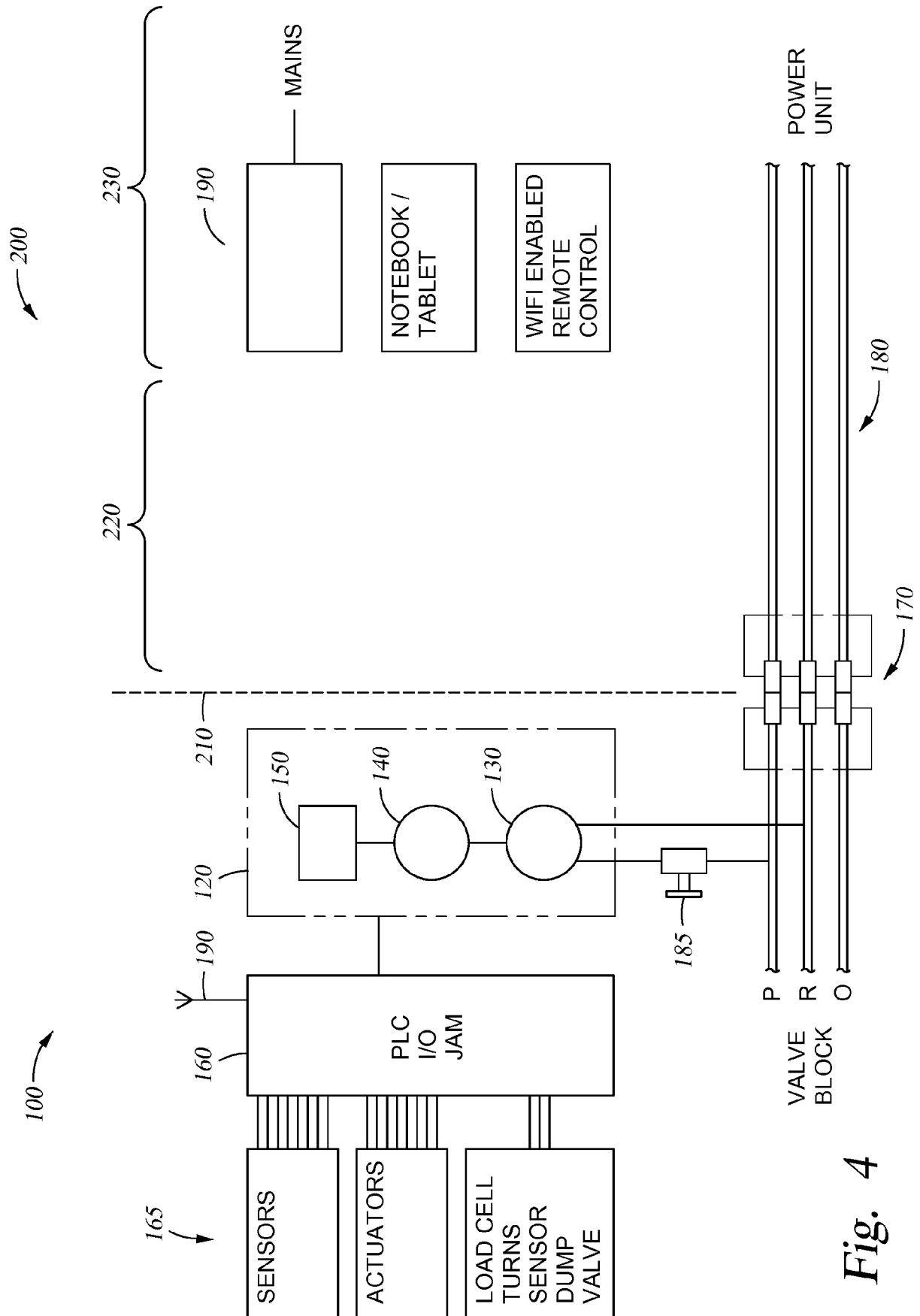


Fig. 4