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(54) Titre : DISPOSITIF DE DEMARRAGE DE RECHARGE DE BATTERIE RECHARGEABLE ET CADRE DE BATTERIE
(54) Title: RECHARGEABLE BATTERY JUMP STARTING DEVICE AND BATTERY FRAME

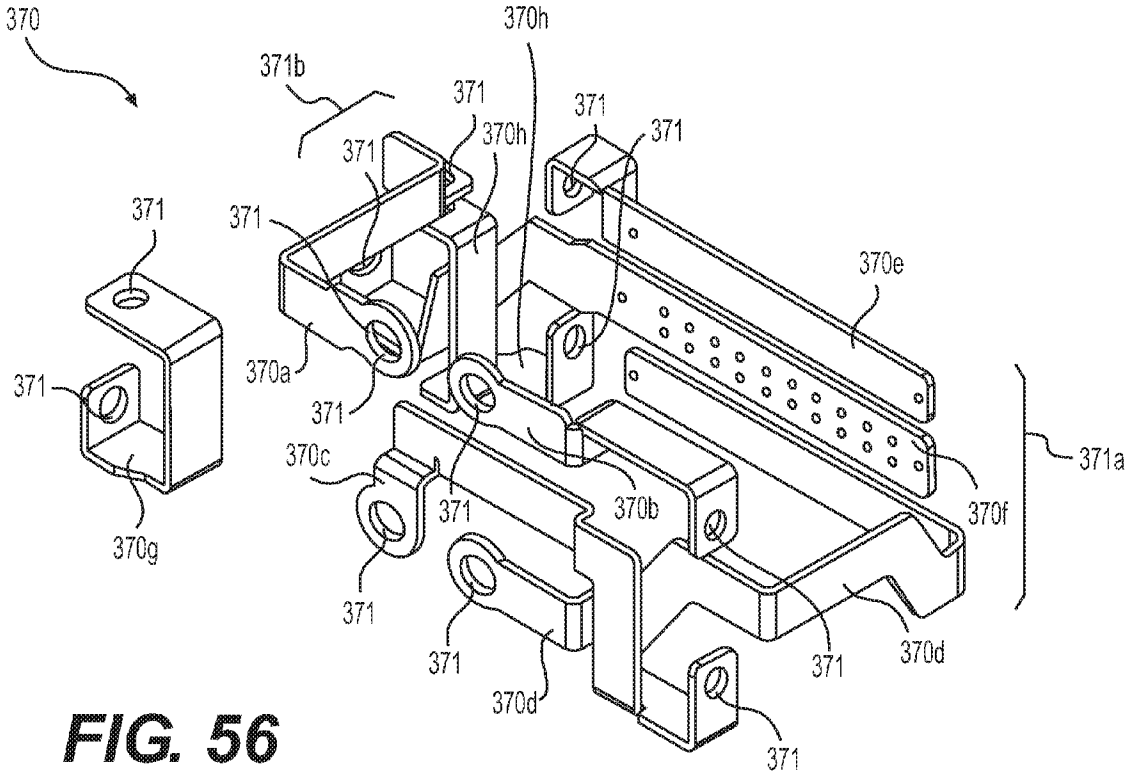

FIG. 56

(57) Abrégé/Abstract:
A rechargeable battery jump starting device and a battery frame for use in an electronic device such as a portable rechargeable battery jump starting device. The rechargeable battery jump starting device maximizes the power conducted from the rechargeable battery to a battery being jump started.

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(54) Title: RECHARGEABLE BATTERY JUMP STARTING DEVICE AND BATTERY FRAME

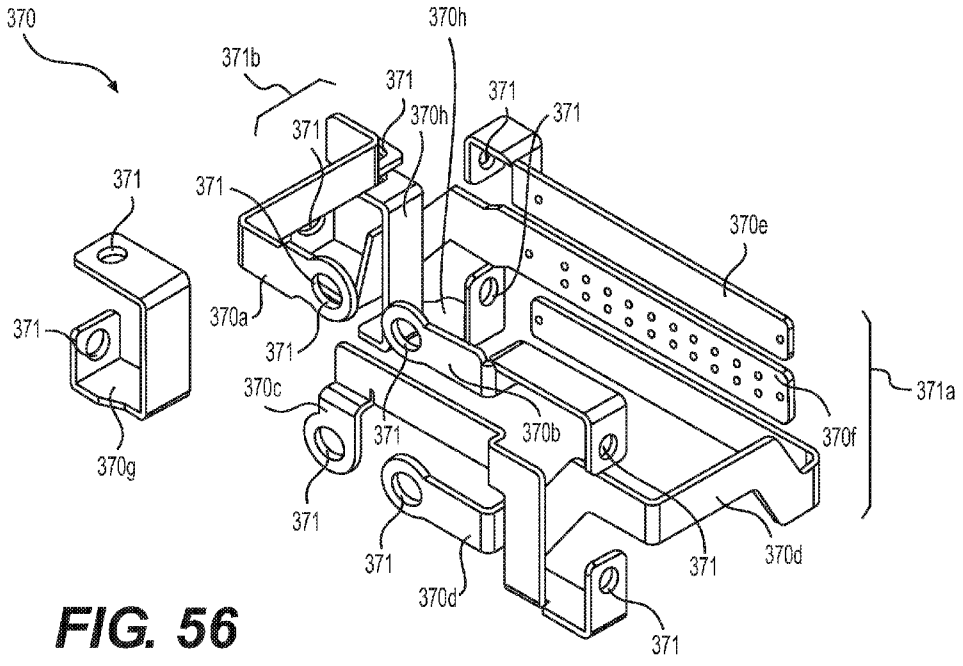

FIG. 56

(57) Abstract: A rechargeable battery jump starting device and a battery frame for use in an electronic device such as a portable rechargeable battery jump starting device. The rechargeable battery jump starting device maximizes the power conducted from the rechargeable battery to a battery being jump started.

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[Continued on next page]

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TITLE

RECHARGEABLE BATTERY JUMP STARTING DEVICE AND BATTERY FRAME

RELATED APPLICATIONS

This PCT application claims priority to U.S. provisional application 62/568,967 filed October 6, 2017, U.S. provisional application 62/569,243, filed October 6, 2017, U.S. provisional application 62/569,355, filed October 6, 2017, U.S. provisional application 29/621,403, filed October 6, 2017, U.S. provisional application 62/568,537, filed October 5, 2017 U.S. provisional application 62/568,044, filed October 4, 2017, U.S. provisional application 62/567,479, filed October 3, 2017, U.S. provisional application 62/562,713, filed September 25, 2017, U.S. provisional application 62/561,751, filed September 22, 2017, U.S. provisional application 62/561,850, filed September 22, 2017, which are all hereby incorporated by reference herein in their entirety.

FIELD

The present invention is directed to a rechargeable battery jump starting device and a battery frame, for example, a highly conductive battery frame, for use in an electronic device such as a portable rechargeable battery jump starting device for jump starting a battery, for example, a portable heavy duty rechargeable battery jump starting device for jump starting automobiles, heavy equipment, commercial vehicles, commercial equipment, trucks, commercial trucks, buses, front loaders, dozers, back hoes, excavators, rollers, fork lift, specialized commercial equipment, logging equipment, aircraft, airplanes, jets, and other vehicles and equipment.

BACKGROUND

Currently, there exist battery jump starters for light duty applications such as jump starting automobiles. These light duty jump starters have a power circuit comprising battery cables connected to or connectable to the battery.

Further, there exist heavy duty battery jump starters using conventional lead acid batteries. These jump starters are very heavy in weight (e.g. hundreds of pounds) and are large dimensionally requiring same to be moved, for example, using a fork lift. The current heavy duty battery jump starters are not portable in any manner.

Thus, there exists a need for a portable heavy duty rechargeable battery jump starting device having significantly reduced weight and size to replace conventional heavy duty battery jump starters.

Further, there exists a need for a portable heavy duty rechargeable battery jump starting device having detachable positive and negative cables.

In addition, there exists a need for a portable rechargeable battery jump starting device having a master switch back light system to assist a user viewing the master switch and control mode in day light, sunshine, low light, and in the dark.

Further, there exists a need for a portable rechargeable battery jump starting device having a 12V operational mode and a 24V operational mode.

Also, there exists a need for a portable rechargeable battery jump starting device having a dual battery diode bridge or a back-charge diode module.

Further, there exists a need for a portable rechargeable battery jump starting device having a leapfrog charging system.

In addition, there exists a need for a highly electrically conductive frame, for example, a highly electrically conductive rigid frame for use in a portable rechargeable battery jump starting device for conducting as much power as possible from the battery(ies) of the portable rechargeable battery jump starting device to a battery being jump started.

Also, there exists a need for an improved battery assembly, for example, a Li-ion battery assembly for use with an electronic device.

SUMMARY

The presently described subject matter is directed to a battery jump starting device.

The presently described subject matter is directed to a new portable rechargeable battery jump starting device.

The presently described subject matter is directed to an improved battery jump starting device.

The presently described subject matter is directed to an improved portable rechargeable battery jump starting device.

The presently described subject matter is directed to a heavy duty battery jump starting device.

The presently described subject matter is directed to a heavy duty portable rechargeable battery jump starting device.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more batteries connected to a highly electrically conductive frame.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable jump starting device, the device comprising or consisting of one or more rechargeable batteries connected to a highly electrically conductive frame.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable batteries connected to a highly electrically conductive frame, the highly electrically conductive frame connected to or connectable to positive and negative battery cables.

The presently described subject matter is directed to a battery jump starting device such as portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable batteries connected to a highly electrically conductive frame, the highly electrically conductive frame connected to or electrically connectable to positive and negative battery cables.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery assembly comprising or consisting of one or more rechargeable batteries connected to a highly electrically conductive frame.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery assembly comprising or consisting of one or more rechargeable batteries connected to a highly electrically conductive frame, the highly electrically conductive frame connected to or connectable to positive and negative battery cables.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable Lithium-ion batteries ("Li-ion") connected to a highly electrically conductive frame.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable Lithium-ion batteries ("Li-ion") connected to a highly electrically conductive frame.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable Lithium-ion batteries ("Li-ion") connected to a highly electrically conductive frame or a high electrical current capacity frame.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of two or more rechargeable batteries connected to a highly electrically conductive frame.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of two or more rechargeable Li-ion batteries connected to a highly electrically conductive frame.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising two or more rechargeable Li-ion batteries connected to a highly electrically conductive frame.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of two or more rechargeable Li-ion batteries connected to a highly electrically conductive frame or a high current capacity frame.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable batteries connected to a highly electrically conductive frame at least partially surrounding the one or more batteries.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable batteries connected to a highly electrically conductive rigid frame configured to at least partially surround the one or more batteries.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable batteries connected to a highly electrically conductive frame configured to fully surround the one or more batteries.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable batteries connected to a highly electrically conductive frame configured to fully surround the one or more rechargeable batteries.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable Li-ion batteries connected to a highly electrically conductive frame configured to at least partially surround the one or more rechargeable batteries.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable Li-ion batteries connected to a

highly electrically conductive frame configured to at least partially surround the one or more rechargeable batteries.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable Li-ion batteries connected to a highly electrically conductive frame configured to fully surround the one or more rechargeable batteries.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable Li-ion batteries connected to a highly electrically conductive frame configured to fully surround the one or more rechargeable batteries.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable batteries connected to a highly electrically conductive rigid frame.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable batteries connected to a highly electrically conductive rigid frame comprising one or more conductive frame members.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable batteries connected to a highly electrically conductive frame comprising one or more conductive frame members.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more rechargeable batteries connected to a highly electrically conductive frame comprising one or more conductors such as conductive metal plate, rod, bar, and/or tubing.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device

comprising or consisting of one or more rechargeable batteries connected to a highly electrically conductive frame comprising one or more conductors such as conductive copper (Cu) plate, rod, bar and/or tubing.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of one or more batteries connected to a highly electrically conductive rigid frame comprising one or more rigid conductors such as conductive copper (Cu) plate, rod, bar and/or tubing.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device for use in a battery jump starting device such as a portable rechargeable battery jump starting device.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device in combination with a battery jump starting device such as a portable rechargeable battery jump starting device.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device comprising or consisting of a male cam-lock end detachably connected to a female cam-lock end.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when coupled together.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when

coupled together, wherein the connecting arrangement is configured to tighten when the male cam-lock end is rotated within the female cam-lock device.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when coupled together, wherein the male cam-lock device and female cam-lock are made of highly electrically conductive material.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when coupled together, wherein the male cam-lock device and female cam-lock are made of highly electrically conductive material, wherein the male cam-lock end comprises a pin having a tooth and the female cam-lock end comprises a receptacle provided with a slot, wherein the receptacle is configured to accommodate the pin and tooth of the male cam-lock end.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when coupled together, wherein the male cam-lock device and female cam-lock are made of highly electrically conductive material, wherein the male cam-lock end comprises a pin having a tooth and the female cam-lock end comprises a receptacle provided with a slot, wherein the receptacle is configured to accommodate the pin and tooth of the male cam-lock end, wherein the receptacle of the female cam-lock end is provided with internal threading for cooperating with the tooth of the male cam-lock end.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when coupled together, wherein the male cam-lock device and female cam-lock are made of highly electrically conductive material, wherein the male cam-lock end comprises a pin having a tooth and the female cam-lock end comprises a receptacle provided with a slot, wherein the receptacle is configured to accommodate the pin and tooth of the male cam-lock end, wherein the receptacle of the female cam-lock end is provided with internal threading for cooperating with the tooth of the male cam-lock end, wherein the male cam-lock end includes an end face portion and the female cam-lock end includes an end face portion, wherein the end face portions engage each other when the cam-lock connection device is fully tightened.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when coupled together, further comprising a rubber molded cover fitted over the male cam-lock end and another rubber molded cover fitted over the female cam-lock end.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when coupled together, further comprising a rubber molded cover fitted over the male cam-lock end and another rubber molded cover fitted over the female cam-lock end, wherein the female cam-lock end is provided with an outer threaded portion and a nut for securing the rubber molded cover on the female cam-lock end.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when coupled together, further comprising a rubber molded cover fitted over the male cam-lock end and another rubber molded cover fitted over the female cam-lock end, wherein the male cam-lock end is provided with one or more outwardly extending protrusions cooperating with one or more inner slots in the rubber molded cover.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when coupled together, wherein the male cam-lock device and female cam-lock are made of highly electrically conductive material, wherein the male cam-lock end comprises a pin having a tooth and the female cam-lock end comprises a receptacle provided with a slot, wherein the receptacle is configured to accommodate the pin and tooth of the male cam-lock end, wherein the slot is provided with an inner surface serving as a stop for the tooth of the pin of the female cam-lock end.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when coupled together, further comprising a cable connected to the male cam-lock end.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when

coupled together, further comprising a cable connected to the male cam-lock end, wherein the cable is a battery cable.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when coupled together, further comprising a cable connected to the male cam-lock end, wherein the cable is a battery cable, including a battery jump starting device, wherein the female cam-lock end is connected to a battery jump starting device.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when coupled together, further comprising a cable connected to the male cam-lock end, wherein the cable is a battery cable, including a battery jump starting device, wherein the female cam-lock end is connected to a battery jump starting device, wherein the battery jump starting device comprises a highly electrically conductive rigid frame connected to one or more batteries, and wherein the female cam-lock is connected to the highly electrically conductive frame.

The presently described subject matter is directed to a highly conductive cam-lock electrical connecting device, comprising or consisting of an electrical highly conductive male cam-lock end; an electrical highly conductive female cam-lock end; and an electrical highly conductive connecting arrangement between the male cam-lock end and the female cam-lock for conducting electrical power therebetween when coupled together, further comprising a cable connected to the male cam-lock end, wherein the cable is a battery cable, including a battery jump starting device, wherein the female cam-lock end is connected to a battery jump starting device, wherein the battery jump starting device comprises a highly electrically conductive rigid frame connected to one or more batteries, and wherein the female cam-lock is connected to

the highly electrically conductive frame, wherein the battery jump starting device, comprising a positive battery cable having a positive battery clamp, the positive battery cable connected to the highly electrically conductive rigid frame; and a negative battery cable having a negative battery clamp, the negative battery cable being connected to the highly electrically conductive rigid frame.

The presently described subject matter is directed to an improved electrical control switch for an electronic device

The presently described subject matter is directed to an improved electrical control switch for use with a battery jump starting device such as a portable rechargeable battery jump starting device.

The presently described subject matter is directed to an improved electrical control switch in combination with a battery jump starting device such as a portable rechargeable battery jump starting device.

The present described subject matter is directed to an improved electrical control switch having a control knob provided with backlighting.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, wherein the control knob comprises a light blocking opaque portion and a clear portion or see through portion configured for serving as the light window.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight

is turned on, further comprising a printed circuit board located behind the control knob, the backlight being a light emitting diode (LED) mounted on the printed circuit board.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an electronic device, the control switch being mounted on the electronic device.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an electronic device, the control switch being mounted on the electronic device, wherein the electronic device is a battery jump starting device.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an electronic device, the control switch being mounted on the electronic device, wherein the jump staring device comprises a cover; a battery disposed within the cover; a positive cable having a positive clamp, the positive cable connected to the battery; and a negative cable having a negative clamp, the negative cable connected to the highly electrically conductive rigid frame.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an electronic device, the control switch being mounted on the electronic device, wherein the jump starting device comprises a cover; a first 12V battery disposed within the cover; a second 12V battery disposed within the cover; a positive cable having a positive clamp, the positive cable connected to the battery; and

a negative cable having a negative clamp, the negative cable connected to the highly electrically conductive rigid frame, wherein the control switch extends through the cover, the control switch electrically connected to the first 12V battery and the second 12V battery, the control knob configured to selectively rotate between a 12V operating position and a 24V operating position, the control switch configured to selectively operate the device in a 12V mode or 24V mode.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an electronic device, the control switch being mounted on the electronic device, wherein the jump starting device comprises a cover; a first 12V battery disposed within the cover; a second 12V battery disposed within the cover; a highly electrically conductive rigid frame connected to the first 12V battery and the second 12V battery; a backlight LED for lighting up the clear portion or see through portion of the control knob, the backlight LED being mounted on the printed circuit board; a positive cable having a positive clamp, the positive cable connected to the battery; a negative cable having a negative clamp, the negative cable connected to the highly electrically conductive rigid frame; and a printed circuit board disposed within the cover, wherein the control switch extends through the cover, the control switch being electrically connected to the highly electrically conductive rigid frame, the control knob configured to selectively rotate between a 12V operating position and a 24V operating position, the control switch configured to selectively operate the device in a 12V mode or 24V mode.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, wherein the system is configured to light up the backlight when the system is turned on.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an interface disposed behind the control knob.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an interface disposed behind the control knob, wherein the interface comprises a membrane label.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an interface disposed behind the control knob, wherein the interface comprises a membrane label, wherein the interface comprises one or more backlight indicators.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an interface disposed behind the control knob, wherein the interface comprises a membrane label, wherein the interface comprises one or more backlight indicators, and wherein the one or more backlight indicators are configured for selectively displaying a voltage mode of operation of the device.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an interface disposed behind the control knob, wherein

the interface comprises a membrane label, wherein the interface comprises one or more backlight indicators, and wherein the one or more backlight indicators are configured for variably displaying the real time operating voltage of the device.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an interface disposed behind the control knob, wherein the interface comprises a membrane label, wherein the interface comprises one or more backlight indicators, and wherein the one or more backlight indicators are configured for lighting up when the device is turned on.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an electronic device, the control switch being mounted on the electronic device, wherein the jump staring device comprises a cover; a battery disposed within the cover; a positive cable having a positive clamp, the positive cable connected to the battery; and a negative cable having a negative clamp, the negative cable connected to the highly electrically conductive rigid frame, wherein the battery is a first 12V battery and a second 12V battery.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an electronic device, the control switch being mounted on the electronic device, wherein the jump staring device comprises a cover; a battery disposed within the cover; a positive cable having a positive clamp, the positive cable connected to the battery; and a negative cable having a negative clamp, the negative cable connected to the highly electrically conductive rigid frame, wherein the battery is a Li-ion battery.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an electronic device, the control switch being mounted on the electronic device, the electronic device being a battery jump charging device comprising a cover; a first 12V battery disposed within the cover; a second 12V battery disposed within the cover; a positive cable having a positive clamp, the positive cable connected to the battery; and a negative cable having a negative clamp, the negative cable connected to the highly electrically conductive rigid frame, wherein the control switch extends through the cover, the control switch electrically connected to the first 12V battery and the second 12V battery, the control knob configured to selectively rotate between a 12V operating position and a 24V operating position, the control switch configured to selectively operate the device in a 12V mode or 24V mode, further comprising a highly electrically conductive rigid frame electrically connected to the first 12V battery, second 12V battery, and the control switch, and configured to selectively operate the device in a 12V mode or 24V mode.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an electronic device, the control switch being mounted on the electronic device, the electronic device being a battery jump charging device comprising a cover; a first 12V battery disposed within the cover; a second 12V battery disposed within the cover; a positive cable having a positive clamp, the positive cable connected to the battery; and a negative cable having a negative clamp, the negative cable connected to the highly electrically conductive rigid frame, wherein the control switch extends through the cover, the control switch electrically connected to the first 12V battery and the second 12V battery, the control knob configured to selectively rotate between a 12V operating position and a 24V operating position, the control switch configured to selectively operate the device in a 12V mode or 24V mode, further

comprising a highly electrically conductive rigid frame electrically connected to the first 12V battery, second 12V battery, and the control switch, and configured to selectively operate the device in a 12V mode or 24V mode, and further comprising an interface disposed between the control knob and the cover of the device.

The presently described subject matter is directed to an electrical control switch backlight system, comprising or consisting of an electrical control switch having a control knob, the control knob having a light window; and a backlight positioned behind the control knob for lighting up the light window of the control switch when the backlight is turned on, further comprising an electronic device, the control switch being mounted on the electronic device, the electronic device being a battery jump charging device comprising a cover; a first 12V battery disposed within the cover; a second 12V battery disposed within the cover; a positive cable having a positive clamp, the positive cable connected to the battery; and a negative cable having a negative clamp, the negative cable connected to the highly electrically conductive rigid frame, wherein the control switch extends through the cover, the control switch electrically connected to the first 12V battery and the second 12V battery, the control knob configured to selectively rotate between a 12V operating position and a 24V operating position, the control switch configured to selectively operate the device in a 12V mode or 24V mode, further comprising a highly electrically conductive rigid frame electrically connected to the first 12V battery, second 12V battery, and the control switch, and configured to selectively operate the device in a 12V mode or 24V mode, and further comprising an interface disposed between the control knob and the cover of the device, wherein the interface comprises a 12V backlight indicator and a 24V backlight indicator, the device configured to selectively turn on the 12V backlight indicator or 24V backlight indicator when a 12V or 24V mode of operation is selected by rotating the control know of the control switch.

The presently described subject matter is directed to an electrical optical position sensing switch system for an electronic device.

The presently described subject matter is directed to an improved electrical optical position sensing switch system for use in a battery jump starting device such as a portable rechargeable jump starting device.

The presently described subject matter is directed to an improved electrical optical position sensing switch system in combination with a battery jump starting device such as a portable rechargeable jump starting device.

The presently described subject matter is directed to an electrical optical position sensing switch system, comprising a first 12V battery; a second 12V battery; an electrical control switch electrically connected to the first 12V battery and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; a microcontroller electrically connected to the electrical control switch; and an optical coupler electrically connected to the microcontroller, the optical coupler providing a signal to the microcontroller for indicating the position of the electrical control switch.

The presently described subject matter is directed to an electrical optical position sensing switch system, comprising a first 12V battery; a second 12V battery; an electrical control switch electrically connected to the first 12V battery and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; a microcontroller electrically connected to the electrical control switch; and an optical coupler electrically connected to the microcontroller, the optical coupler providing a signal to the microcontroller for indicating the position of the electrical control switch, further comprising an enable circuit configured to reduce parasite current when the system is in an “off” state, wherein the circuit comprises a transistor acting as an electrical switch when the system is in an “on” state.

The presently described subject matter is directed to an electrical optical position sensing switch system, comprising a first 12V battery; a second 12V battery; an electrical control switch electrically connected to the first 12V battery and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; a microcontroller electrically connected to the electrical control switch; and an

optical coupler electrically connected to the microcontroller, the optical coupler providing a signal to the microcontroller for indicating the position of the electrical control switch, further comprising an enable circuit configured to reduce parasite current when the system is in an “off” state, wherein the circuit comprises a transistor acting as an electrical switch when the system is in an “on” state, wherein the circuit is configured so that when the transistor is “on”, current flows from the first battery to the second battery when the batteries are connected in parallel.

The presently described subject matter is directed to an electrical optical position sensing switch system, comprising a first 12V battery; a second 12V battery; an electrical control switch electrically connected to the first 12V battery and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; a microcontroller electrically connected to the electrical control switch; and an optical coupler electrically connected to the microcontroller, the optical coupler providing a signal to the microcontroller for indicating the position of the electrical control switch, further comprising an enable circuit configured to reduce parasite current when the system is in an “off” state, wherein the circuit comprises a transistor acting as an electrical switch when the system is in an “on” state, wherein the circuit is configured so that when the transistor is “on”, current flows from the first battery to the second battery when the batteries are connected in parallel, wherein the circuit is configured so that no current flows from the first battery to the second battery when the batteries are connected in series.

The presently described subject matter is directed to an electrical optical position sensing switch system, comprising a first 12V battery; a second 12V battery; an electrical control switch electrically connected to the first 12V battery and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; a microcontroller electrically connected to the electrical control switch; and an optical coupler electrically connected to the microcontroller, the optical coupler providing

a signal to the microcontroller for indicating the position of the electrical control switch, wherein the circuit is configured so that when there is current flow or lack thereof, this allows the optical coupler to provide a signal to the microcontroller indicating to the microcontroller which position the control switch is in.

The presently described subject matter is directed to an electrical optical position sensing switch system, comprising a first 12V battery; a second 12V battery; an electrical control switch electrically connected to the first 12V battery and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; a microcontroller electrically connected to the electrical control switch; and an optical coupler electrically connected to the microcontroller, the optical coupler providing a signal to the microcontroller for indicating the position of the electrical control switch, wherein the circuit is configured so that when there is current flow or lack thereof, this allows the optical coupler to provide a signal to the microcontroller indicating to the microcontroller which position the control switch is in, wherein the circuit is configured so that an opposite signal is provided as a separate input to the microcontroller so that the microcontroller can determine when the control switch is an “in between” position between a 12V position and a 24V position.

The presently described subject matter is directed to a portable battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a highly electrically conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the highly electrically conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; a microcontroller electrically connected to the highly electrically conductive frame; and a dual battery diode bridge connected to the highly electrically conductive frame, the dual battery diode bridge having two channels

of diodes supporting the first 12V battery and the second 12V battery for protecting against back-charge after jump starting a vehicle.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a highly electrically conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the highly electrically conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; a microcontroller electrically connected to the highly electrically conductive frame; and a dual battery diode bridge connected to the highly electrically conductive frame, the dual battery diode bridge having two channels of diodes supporting the first 12V battery and the second 12V battery for protecting against back-charge after jump starting a vehicle, wherein dual battery diode bridge is a back-charge diode module.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a highly electrically conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the highly electrically conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; a microcontroller electrically connected to the highly electrically conductive frame; and a dual battery diode bridge connected to the highly electrically conductive frame, the dual battery diode bridge having two channels of diodes supporting the first 12V battery and the second 12V battery for protecting against back-charge after jump starting a vehicle, wherein the back-charge diode module comprises an upper channel of diodes supporting current through the first 12V

battery and a lower channel of diodes supporting current through the second 12V battery.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a highly electrically conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the highly electrically conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; a microcontroller electrically connected to the highly electrically conductive frame; and a dual battery diode bridge connected to the highly electrically conductive frame, the dual battery diode bridge having two channels of diodes supporting the first 12V battery and the second 12V battery for protecting against back-charge after jump starting a vehicle, wherein the back-charge diode module comprises an upper channel of diodes supporting current through the first 12V battery and a lower channel of diodes supporting current through the second 12V battery, wherein the upper channel of diodes and lower channel of diodes are connected to a bar of the highly electrically conductive frame leading to a positive output of the battery jump starting device for combining current from the upper channel of diodes and lower channel of diodes.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a highly electrically conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; a microcontroller electrically connected to the highly electrically conductive frame; and a dual battery diode bridge connected to the highly electrically

conductive frame, the dual battery diode bridge having two channels of diodes supporting the first 12V battery and the second 12V battery for protecting against back-charge after jump starting a vehicle, wherein dual battery diode bridge is a back-charge diode module, wherein the back-charge diode module comprises an upper conductive bar electrically connected to the upper channel of diodes, a lower conductive bar electrically connected to the lower channel of diodes, and a center conductive bar located between the upper conductive bar and lower conductive bar and electrically connected to both the upper channel of diodes and lower channel of diodes.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a conductive wiring assembly or conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the conductive wiring or conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; and a charger connected to the conductive wiring assembly or a conductive frame, the charger configured for sequentially charging the first 12V battery and the second 12V battery.

The presently described subject matter is directed to a portable battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a conductive wiring assembly or conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the conductive wiring or conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; and a charger connected to the conductive wiring assembly or conductive frame, the charger configured for sequentially charging the first 12V battery and the second 12V battery, wherein the charger is configured to incrementally charge the first 12V battery and the

second 12V battery to maintain the first 12V battery and second 12V battery closed to the same potential during the charging sequence.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a conductive wiring assembly or conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the conductive wiring or conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; and a charger connected to the conductive wiring assembly or conductive frame, the charger configured for sequentially charging the first 12V battery and the second 12V battery, wherein the charger is operated to first charge the first 12V battery or second 12V battery, whichever has the lowest voltage or charge.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a conductive wiring assembly or conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the conductive wiring or conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; and a charger connected to the conductive wiring assembly or conductive frame, the charger configured for sequentially charging the first 12V battery and the second 12V battery, wherein the charger is configured to incrementally charge the first 12V battery and the second 12V battery to maintain the first 12V battery and second 12V battery closed to the same potential during the charging sequence, wherein the charger is operated to first charge the first 12V battery or second 12V battery, whichever has the lowest voltage or charge.

The presently described subject matter is directed to a portable battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a conductive wiring assembly or conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the conductive wiring or conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; and a charger connected to the conductive wiring assembly or conductive frame, the charger configured for sequentially charging the first 12V battery and the second 12V battery, wherein the charger is configured to sequentially charge the first 12V battery and second 12V battery incrementally in fixed voltage increases.

The presently described subject matter is directed to a battery jump starting device, the portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a conductive wiring assembly or conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the conductive wiring or conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; and a charger connected to the conductive wiring assembly or conductive frame, the charger configured for sequentially charging the first 12V battery and the second 12V battery, wherein the charger is configured to sequentially charge the first 12V battery and second 12V battery incrementally in varying voltage increases.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a conductive wiring assembly or conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the conductive wiring or

conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; and a charger connected to the conductive wiring assembly or conductive frame, the charger configured for sequentially charging the first 12V battery and the second 12V battery, wherein the charger is configured to sequentially charge the first 12V battery and second 12V battery incrementally in random voltage increases.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a conductive wiring assembly or conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the conductive wiring or conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; and a charger connected to the conductive wiring assembly or conductive frame, the charger configured for sequentially charging the first 12V battery and the second 12V battery, wherein the charger is configured to sequentially charge the first 12V battery and second 12V battery incrementally in fixed voltage increases, wherein the charger is configured to sequentially charge the first 12V battery and second 12V battery incrementally in 100 millivolt (mV) increases.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a conductive wiring assembly or conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the conductive wiring or conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for

connecting the first 12V battery and second 12V battery in series; and a charger connected to the conductive wiring assembly or conductive frame, the charger configured for sequentially charging the first 12V battery and the second 12V battery, wherein the charger is operated to first charge the first 12V battery or second 12V battery, whichever has the lowest voltage or charge, wherein voltage charging increments are a portion or fraction of a total voltage charge required to fully charge the first 12V battery or second 12V battery.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a conductive wiring assembly or conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the conductive wiring or conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; and a charger connected to the conductive wiring assembly or conductive frame, the charger configured for sequentially charging the first 12V battery and the second 12V battery, further comprising a programmable microcontroller electrically connected to the charger for controlling operation of the charger.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a conductive wiring assembly or conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the conductive wiring or conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; and a charger connected to the conductive wiring assembly or conductive frame, the charger configured for sequentially charging the first 12V battery and the second 12V battery,

further comprising a peak voltage shutoff to prevent overcharging the first 12V battery and second 12V battery.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; a conductive wiring assembly or conductive frame connected to the first 12V battery and second 12V battery; an electrical control switch electrically connected to the conductive wiring or conductive frame, first 12V battery, and second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series; and a charger connected to the conductive wiring assembly or conductive frame, the charger configured for sequentially charging the first 12V battery and the second 12V battery, wherein the charger is configured to sequentially charge the first 12V battery and second 12V battery incrementally in varying voltage increases, wherein the programmable microcontroller is configured to provided charge timeouts.

The presently described subject matter is directed to a leapfrog charging system and method for an electronic device.

The presently described subject matter is directed to a leapfrog charging system and method for use in a battery jump starting device such as a portable rechargeable battery jump starting device.

The presently described subject matter is directed to a leapfrog charging system and method for an electronic device having at least a first rechargeable battery and second rechargeable battery, comprising or consisting of selectively charging the first rechargeable battery and second rechargeable battery in a charge sequence.

The presently described subject matter is directed to a leapfrog charging system and method for an electronic device having at least a first rechargeable battery and second rechargeable battery, comprising or consisting of selectively charging the first rechargeable battery and second rechargeable battery in a charge sequence, wherein the charge sequence is an incremental charge sequence.

The presently described subject matter is directed to a leapfrog charging system and method for an electronic device having at least a first rechargeable battery and second rechargeable battery, comprising or consisting of selectively charging the first rechargeable battery and second rechargeable battery in a charge sequence, wherein the charge sequence is an incremental charge sequence, wherein the incremental charge sequence charges the first 12V battery or second 12V battery in increments less than a total charge increment to fully charge the first 12V battery or second 12V battery.

The presently described subject matter is directed to a leapfrog charging system and method for an electronic device having at least a first rechargeable battery and second rechargeable battery, comprising or consisting of selectively charging the first rechargeable battery and second rechargeable battery in a charge sequence, wherein the charging sequence is a back-and-forth charging sequence between the first 12V battery and second 12V battery.

The presently described subject matter is directed to a leapfrog charging system and method for an electronic device having at least a first rechargeable battery and second rechargeable battery, comprising or consisting of selectively charging the first rechargeable battery and second rechargeable battery in a charge sequence, wherein the charging sequence includes back-to-back charges of a same battery of the first 12V battery and second 12V battery two or more times prior to sequencing to the other battery.

The presently described subject matter is directed to a leapfrog charging system and method for an electronic device having at least a first rechargeable battery and second rechargeable battery, comprising or consisting of selectively charging the first rechargeable battery and second rechargeable battery in a charge sequence, wherein the sequence is a programmed sequence.

The presently described subject matter is directed to a leapfrog charging system and method for an electronic device having at least a first rechargeable battery and second rechargeable battery, comprising or consisting of selectively charging the first rechargeable battery and second rechargeable battery in a charge sequence, wherein the charging sequence includes one or more charging pauses.

The presently described subject matter is directed to a leapfrog charging system and method for an electronic device having at least a first rechargeable battery and second rechargeable battery, comprising or consisting of selectively charging the first rechargeable battery and second rechargeable battery in a charge sequence, wherein the sequence is a programmed sequence, wherein charging time increments, voltage increase amounts, and charging rates are all adjustable in the programmed sequence.

The presently described subject matter is directed to a highly conductive frame for use in an electronic device.

The presently described subject matter is directed to a highly conductive frame for use with or part of a battery assembly of an electronic device.

The presently described subject matter is directed to a highly conductive frame for use in a battery jump starting device such as a portable rechargeable battery jump starting device.

The presently described subject matter is directed to a highly conductive frame in combination with a battery jump starting device such as a portable rechargeable battery jump starting device.

The presently described subject matter is directed to a highly conductive frame for connecting a battery to positive and negative cables for use in a battery jump starting device such as a portable rechargeable battery jump starting device.

The presently describe subject matter is directed to a battery assembly comprising or consisting of a battery connected to a highly conductive frame.

The presently describe subject matter is directed to a battery assembly comprising or consisting of a battery connected to a highly conductive frame for use in a battery jump starting device such as a portable rechargeable battery jump starting device.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; and a highly conductive frame connected to the first 12V battery and second 12V battery.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device

comprising or consisting of a first 12V battery; a second 12V battery; and a highly conductive frame connected to the first 12V battery and second 12V battery, further comprising an electrical control switch electrically connected to the highly conductive frame, the first 12V battery, and the second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; and a highly conductive frame connected to the first 12V battery and second 12V battery, wherein the highly conductive frame is semi-rigid.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; and a highly conductive frame connected to the first 12V battery and second 12V battery, wherein the highly conductive frame is rigid.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; and a highly conductive frame connected to the first 12V battery and second 12V battery, wherein the highly conductive frame is a three-dimensional (3D) frame structure.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; and a highly conductive frame connected to the first 12V battery and second 12V battery, wherein the highly conductive frame comprises multiple highly conductive frame members connected together.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; and a highly conductive frame

connected to the first 12V battery and second 12V battery, wherein the highly conductive frame comprises multiple highly conductive frame members, wherein at least one conductive frame member includes a through hole.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; and a highly conductive frame connected to the first 12V battery and second 12V battery, wherein the highly conductive frame comprises multiple highly conductive frame members, wherein at least one conductive frame member includes at least one through hole located at one or more ends of the at least one conductive frame member.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; and a highly conductive frame connected to the first 12V battery and second 12V battery, wherein the highly conductive frame comprises multiple highly conductive frame members, wherein at least one of the multiple highly conductive frame member includes at least one through hole, wherein the at least one through hole is located at one end of the highly conductive frame member, wherein adjacent highly conductive frame members are fastened together using a highly conductive bolt and nut fastener.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; and a highly conductive frame connected to the first 12V battery and second 12V battery, wherein the highly conductive frame comprises multiple highly conductive frame members, wherein at least one frame member is provided with at least one flattened end having a through hole.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; and a highly conductive frame connected to the first 12V battery and second 12V battery, wherein the highly conductive frame comprises multiple highly conductive frame members,

wherein at least one conductive frame member includes a through hole, wherein the at least one frame member is provided on at least one end with a ring-shaped through hole.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; and a highly conductive frame connected to the first 12V battery and second 12V battery, wherein other electrical components of the portable jump starting device bolt onto the highly conductive frame.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; and a highly conductive frame connected to the first 12V battery and second 12V battery, further comprising an electrical control switch electrically connected to the highly conductive frame, the first 12V battery, and the second 12V battery, the electrical control switch having a parallel switch position for connecting the first 12V battery and second 12V battery in parallel, the electrical control switch having a series switch position for connecting the first 12V battery and second 12V battery in series, wherein the control switch bolts onto the highly conductive frame.

The presently described subject matter is directed to a battery jump starting device such as a portable rechargeable battery jump starting device, the device comprising or consisting of a first 12V battery; a second 12V battery; and a highly conductive frame connected to the first 12V battery and second 12V battery, wherein the highly conductive frame comprises multiple highly conductive frame members, wherein the highly conductive frame members are made of flat metal stock material.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery; a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an

opposite end of the positive conductive frame; a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an opposite end of the negative cable.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery; a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an opposite end of the positive conductive frame; a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an opposite end of the negative cable, wherein the electrically conductive frame comprises electrically conductive frame members connected together.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery; a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an opposite end of the positive conductive frame; a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an opposite end of the negative cable, wherein the electrically conductive frame comprises electrically conductive frame members connected together, and wherein the electrically

conductive frame members are one or more selected from the group of electrically conductive bars, plates, rods, and tubes.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery; a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an opposite end of the positive conductive frame; a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an opposite end of the negative cable, wherein the electrically conductive frame comprises electrically conductive frame members connected together, and wherein the electrically conductive frame members are flat conductive bars having one or more bends along a length of the conductive frame members.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery; a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an opposite end of the positive conductive frame; a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an opposite end of the negative cable, wherein the electrically conductive frame comprises electrically conductive frame members connected together, and wherein the electrically conductive frame members are located adjacent to sides of the rechargeable battery.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery; a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an opposite end of the positive conductive frame; a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an opposite end of the negative cable, wherein the electrically conductive frame comprises electrically conductive frame members connected together, wherein the electrically conductive frame members are located adjacent to sides of the rechargeable battery, and, wherein the electrically conductive frame at least partially surround the rechargeable battery.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery; a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an opposite end of the positive conductive frame; a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an opposite end of the negative cable, wherein the electrically conductive frame comprises electrically conductive frame members connected together, and wherein the electrically conductive frame members are each provided with a through hole located in at least one end of the respective frame member for accommodating a fastener for connecting

the electrically conductive frame members together or connecting the respective frame member to an electrical component.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery; a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an opposite end of the positive conductive frame; a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an opposite end of the negative cable, wherein the positive conductive frame is connected to a positive cam-lock for removably connecting with the positive cable and the negative conductive frame is connected to a negative cam-lock for removably connecting with the negative cable.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery; a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an opposite end of the positive conductive frame; a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an opposite end of the negative cable, wherein the rechargeable battery is a rechargeable battery assembly comprising one or more rechargeable battery cells, a positive electrically conductive bar connected to the positive terminal of the rechargeable

battery, and a negative electrically conductive bar connected to the negative terminal of the rechargeable battery.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery; a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an opposite end of the positive conductive frame; a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an opposite end of the negative cable, wherein the rechargeable battery is a rechargeable battery assembly comprising one or more rechargeable battery cells, a positive electrically conductive bar connected to the positive terminal of the rechargeable battery, and a negative electrically conductive bar connected to the negative terminal of the rechargeable battery, and wherein the positive electrically conductive bar and negative electrically conductive bar are both oriented transversely relative to a length of the one or more rechargeable battery cells.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery; a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an opposite end of the positive conductive frame; a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an

opposite end of the negative cable, wherein the rechargeable battery is a rechargeable battery assembly comprising one or more rechargeable battery cells, a positive electrically conductive bar connected to the positive terminal of the rechargeable battery, and a negative electrically conductive bar connected to the negative terminal of the rechargeable battery, wherein the positive electrically conductive bar and negative electrically conductive bar are both oriented transversely relative to a length of the one or more rechargeable battery cells, and wherein the electrically conductive bars are wider relative to a width of the one or more rechargeable battery cells and each protrudes from a side of the rechargeable battery assembly.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery; a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an opposite end of the positive conductive frame; a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an opposite end of the negative cable, wherein the rechargeable battery is a rechargeable battery assembly comprising one or more rechargeable battery cells, a positive electrically conductive bar connected to the positive terminal of the rechargeable battery, and a negative electrically conductive bar connected to the negative terminal of the rechargeable battery, and wherein the positive electrically conductive bar and negative electrically conductive bar are each provided with a through hole for connection with the electrically conductive frame.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a

positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery; a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an opposite end of the positive conductive frame; a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an opposite end of the negative cable, further comprising a switch connected between the negative conductor bar and the negative cable for selectively electrically connecting the negative conductor bar to the negative cable during operation of the rechargeable battery jump starting device.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery; a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an opposite end of the positive conductive frame; a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an opposite end of the negative cable, further comprising a switch connected between the negative conductor bar and the negative cable for selectively electrically connecting the negative conductor bar to the negative cable during operation of the rechargeable battery jump starting device, wherein the switch is a smart switch for electrically connecting the negative conductor bar to the negative cable only upon detecting the positive clamp and negative clamp are correctly connected to a positive a battery being jump started.

The presently described subject matter is direct to a rechargeable battery jump starting device, the device comprising or consisting of a rechargeable battery having a positive terminal and a negative terminal; an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of rechargeable battery assembly and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery assembly; a positive cam-lock connected to an opposite end of the positive conductive frame; a negative cam-lock connected to an opposite end of the negative conductive frame; a positive battery cable removably connected at one end to the positive cam-lock; a negative battery cable removably connected at one end to the negative cam-lock; a positive battery clamp connected to an opposite end of the positive cable; and a negative battery clamp connected to an opposite end of the negative cable.

The presently described subject matter is directed to a battery assembly for an electronic device.

The presently described subject matter is directed to a battery assembly for use in an electronic device.

The presently described subject matter is directed to a battery assembly for use in a battery jump starting device such as a portable rechargeable battery jump starting device.

The presently described subject matter is directed to a battery assembly in combination with a battery jump starting device such as a portable rechargeable battery jump starting device.

The presently described subject matter is directed to a battery assembly for use in an electronic device such as a battery jump starting device, the device comprising or consisting of at least one battery cell having a positive foil end and a negative foil end; a positive highly conductive member connected to the positive foil; and a positive highly conductive member connected to the positive foil.

The presently described subject matter is directed to a battery assembly for use in an electronic device such as a battery jump starting device, the device comprising or consisting of at least one battery cell having a positive foil end and a negative foil end; a positive highly conductive member connected to the positive foil; and a positive highly

conductive member connected to the positive foil, wherein the positive highly conductive member and negative highly conductive member are both oriented transversely relative to a length of the positive and negative foil, respectively.

The presently described subject matter is directed to a battery assembly for use in an electronic device such as a battery jump starting device, the device comprising or consisting of at least one battery cell having a positive foil end and a negative foil end; a positive highly conductive member connected to the positive foil; and a positive highly conductive member connected to the positive foil, wherein the positive highly conductive member and negative highly conductive member are both oriented transversely relative to a length of the positive and negative foil, respectively, wherein the highly conductive members are wider than the positive and negative foil, respectively.

The presently described subject matter is directed to a battery assembly for use in an electronic device such as a battery jump starting device, the device comprising or consisting of at least one battery cell having a positive foil end and a negative foil end; a positive highly conductive member connected to the positive foil; and a positive highly conductive member connected to the positive foil, wherein the highly conductive members are oriented flat against opposite ends of the at least one battery cell.

The presently described subject matter is directed to a battery assembly for use in an electronic device such as a battery jump starting device, the device comprising or consisting of at least one battery cell having a positive foil end and a negative foil end; a positive highly conductive member connected to the positive foil; and a positive highly conductive member connected to the positive foil, wherein the highly conductive members are provided with a through hole for connection with the electronic device using a bolt and nut fastener.

The presently described subject matter is directed to a battery assembly for use in an electronic device such as a battery jump starting device, the device comprising or consisting of at least one battery cell having a positive foil end and a negative foil end; a positive highly conductive member connected to the positive foil; and a positive highly conductive member connected to the positive foil, wherein the highly conductive members are made from plate or bar type material.

The presently described subject matter is directed to a battery assembly for use in an electronic device such as a battery jump starting device, the device comprising or consisting of at least one battery cell having a positive foil end and a negative foil end; a positive highly conductive member connected to the positive foil; and a positive highly conductive member connected to the positive foil, wherein the positive foil at least partially wraps around the positive highly conductive member, and the negative foil at least partially wraps around the negative highly conductive member.

The presently described subject matter is directed to a battery assembly for use in an electronic device such as a battery jump starting device, the device comprising or consisting of at least one battery cell having a positive foil end and a negative foil end; a positive highly conductive member connected to the positive foil; and a positive highly conductive member connected to the positive foil, wherein the positive foil at least partially wraps around the positive highly conductive member, and the negative foil at least partially wraps around the negative highly conductive member, wherein the positive foil and negative foil fully wrap around the positive highly conductive member and the negative highly conducive member, respectively.

The presently described subject matter is directed to a battery assembly for use in an electronic device such as a battery jump starting device, the device comprising or consisting of at least one battery cell having a positive foil end and a negative foil end; a positive highly conductive member connected to the positive foil; and a positive highly conductive member connected to the positive foil, wherein the positive foil is soldered or welded to the positive highly conductive member and the negative foil is soldered or welded to the negative highly conductive member.

The presently described subject matter is directed to a battery assembly for use in an electronic device such as a battery jump starting device, the device comprising or consisting of at least one battery cell having a positive foil end and a negative foil end; a positive highly conductive member connected to the positive foil; and a positive highly conductive member connected to the positive foil, wherein the at least one battery cell is multiple battery cells layered one on top of the other.

The presently described subject matter is directed to a battery assembly for use in an electronic device such as a battery jump starting device, the device comprising or

consisting of at least one battery cell having a positive foil end and a negative foil end; a positive highly conductive member connected to the positive foil; and a positive highly conductive member connected to the positive foil, wherein the battery assembly is covered with heat shrink material.

The presently described subject matter is directed to a rechargeable battery jump starting device comprising or consisting of a power circuit including a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; and an electrically conductive frame connected to the battery assembly.

The presently described subject matter is directed to a rechargeable battery jump starting device comprising or consisting of a power circuit including a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; and an electrically conductive frame connected to the battery assembly; a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable.

The presently described subject matter is directed to a rechargeable battery jump starting device comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; an electrically conductive frame connected to the battery assembly; a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable.

The presently described subject matter is directed to a rechargeable battery jump starting device comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; an electrically conductive frame connected to the battery assembly; a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable, wherein the electrically conductive frame comprises a positive conductive pathway from the positive terminal connector of the battery assembly to the connection with the positive battery cable and a negative conductive pathway from the negative terminal connector of the battery assembly to the connection with the negative battery cable.

The presently described subject matter is directed to a rechargeable battery jump starting device, comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; an electrically conductive frame connected to the battery assembly; a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable, wherein the positive electrically conductive bar and negative electrically conductive bars are both oriented transversely relative to a length of the one or more rechargeable battery cells.

The presently described subject matter is directed to a rechargeable battery jump starting device, comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; an electrically conductive frame connected to the battery assembly;

a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable, wherein the positive electrically conductive bar and negative electrically conductive bars are both oriented transversely relative to a length of the one or more rechargeable battery cells, and wherein the electrically conductive bars are wider relative to a width of the one or more rechargeable battery cells and each protrude from a side of the rechargeable battery assembly.

The presently described subject matter is directed to a rechargeable battery jump starting device, comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; an electrically conductive frame connected to the battery assembly; a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable, wherein the positive terminal connector is a positive foil end of the one or more rechargeable battery cells and the negative terminal connector is a negative foil end of the one or more rechargeable battery cells.

The presently described subject matter is directed to a rechargeable battery jump starting device, comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; an electrically conductive frame connected to the battery assembly; a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable, wherein a side of the positive electrically conductive bar is connected flat against the positive foil end of the one or more battery cells and a side of the negative electrically

conductive bar is connected flat against the negative foil end of the one or more batteries.

The presently described subject matter is directed to a rechargeable battery jump starting device, comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; an electrically conductive frame connected to the battery assembly; a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable, wherein the positive electrically conductive bar and negative electrically conductive bar are each provided with a through hole for connection with the electrically conductive frame.

The presently described subject matter is directed to a rechargeable battery jump starting device, comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; an electrically conductive frame connected to the battery assembly; a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable, wherein the positive terminal connector is a positive foil end of the one or more rechargeable battery cells and the negative terminal connector is a negative foil end of the one or more rechargeable battery cells, wherein the positive foil end at least partially wraps around the positive electrically conductive bar, and the negative foil end at least partially wraps around the negative electrically conductive bar.

The presently described subject matter is directed to a rechargeable battery jump starting device, comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative

terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; an electrically conductive frame connected to the battery assembly; a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable, wherein the positive terminal connector is a positive foil end of the one or more rechargeable battery cells and the negative terminal connector is a negative foil end of the one or more rechargeable battery cells, wherein the positive foil end at least partially wraps around the positive electrically conductive bar, and the negative foil end at least partially wraps around the negative electrically conductive bar, wherein the positive foil end fully wraps around the positive electrically conductive bar and the negative foil end fully wraps around the negative electrically conducive bar of the rechargeable battery assembly.

The presently described subject matter is directed to a rechargeable battery jump starting device, comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; an electrically conductive frame connected to the battery assembly; a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable, wherein the positive foil end is soldered or welded to the positive electrically conductive bar and the negative foil end is soldered or welded to the negative electrically conductive bar.

The presently described subject matter is directed to a rechargeable battery jump starting device, comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative

terminal connector; an electrically conductive frame connected to the battery assembly; a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable, wherein the one or more battery cells are multiple battery cells connected in series and layered one on top of the other to provide the rechargeable battery assembly.

The presently described subject matter is directed to a rechargeable battery jump starting device, comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; an electrically conductive frame connected to the battery assembly; a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable, wherein the layered multiple battery cells are covered with heat shrink material.

The presently described subject matter is directed to a rechargeable battery jump starting device, comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; an electrically conductive frame connected to the battery assembly; a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable, wherein the electrically conductive frame comprises multiple electrically conductive frame members connected together.

The presently described subject matter is directed to a rechargeable battery jump starting device, comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive

terminal connector, and a negative electrically conductive bar connected to the negative terminal connector; an electrically conductive frame connected to the battery assembly; a positive battery cable connected to the highly conductive frame; a negative battery cable connectable to the highly conductive frame; a positive battery clamp connected to the positive cable; and a negative battery clamp connected to the negative cable, wherein the electrically conductive frame comprises multiple electrically conductive frame members connected together, wherein the frame members are electrically conductive bars bent along multiple axes.

The presently described subject matter is directed to a rechargeable battery assembly for use in a rechargeable jump starting device, the rechargeable battery assembly comprising or consisting of a rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector, a negative terminal connector, a positive electrically conductive bar connected to the positive terminal connector, and a negative electrically conductive bar connected to the negative terminal connector.

The battery jump starting device according to the present invention is configured to maximize the amount of power transmission from one or more batteries (e.g. Li-ion battery or batteries) to a battery (e.g. vehicle battery) being jump started. This requires a power circuit having a high or very high electrically conductive path from the one or more batteries to the battery clamps of the battery jump starting device. This physically requires the use of high or very high conductivity conductors such as metal (e.g. copper, aluminum) plates, bars, rods, and tubing. For example, a highly conductive rigid frame connects the one or more batteries to the positive and negative cables of the battery jump starting device during operation thereof.

The “rigidity” and “strength” of the highly conductive rigid frame provides structurally stability during storage and use of the battery jump starting device. This is important especially during use when high level of current is flowing through the highly conductive rigid frame potentially heating and softening the rigid frame. It is highly desired that the highly conductive rigid frame maintains its structurally stability and configuration during such use so as to avoid the risk of contact and electrically shorting with other electrical components of the battery jump starting device. This is especially

true when making a compact and portable configuration of the battery assembly and the battery jump starting device itself to allow minimizing distances between electrical components located with the battery jump starting device.

The battery assembly comprising or consisting of the one or more batteries and the highly conductive frame can provide a “compact battery assembly” for use in the battery jump starting device. The battery assembly can be removably connected (i.e. detachable) as a unit to the battery jump starting device for replacement or servicing thereof. For example, the highly conductive frame is configured to wrap around and partially or fully enclose the one or more batteries to provide a compact configuration (i.e. one or more batteries nested within conductive frame). The highly conductive frame can surround the one or more batteries in one or more planes or axes. For example, the highly conductive frame wraps around the sides of the one or more batteries. As another example, the highly conductive frame wraps around the sides and the top and/or bottom of the one or more batteries capturing the one or more batteries on five or six sides (i.e. length sides, width sides, top side and/or bottom side). The highly conductive frame can be a single piece construction or multiple pieces connected or assembled together. For example, the highly conductive frame is constructed of multiple highly conductive frame members connected or assembled together.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a front perspective view of a battery jump starting device according to the present invention.

FIG. 2 is a front elevational view of a battery jump starting device shown in FIG. 1.

FIG. 3 is a rear elevational view of the battery jump starting device shown in FIG. 1.

FIG. 4 is a left side elevational view of the battery jump starting device shown in FIG. 1.

FIG. 5 is a right side elevational view of the battery jump staring device shown in FIG. 1.

FIG. 6 is a top planar view of the battery jump starting device shown in FIG. 1.

FIG. 7 is a bottom planar view of the battery jump starting device shown in FIG. 1.

FIG. 8 is a perspective view of the battery jump starting device shown in FIG. 1 with detachable battery cables attached to the battery jump starting device.

FIG. 9 is a top view of the layout of interior components of the battery jump starting device shown in FIG. 1 having detachable battery cables.

FIG. 10 is a top view of the layout of interior components of the battery jump starting device shown in FIG. 1 having non-detachable battery cables.

FIG. 11 is a top view of the connection ends of the detachable battery cables shown in FIG. 9.

FIG. 12 is an exploded perspective view of the control switch installed on the front of the battery jump starting device shown in FIG. 1.

FIG. 13 is a front elevational view of the switch plate of the control switch shown in FIG. 12 operable between a first position and second position.

FIG. 14 is a rear perspective view of the switch plate shown in FIG. 13.

FIG. 15 is a perspective view of the control switch shown in FIG. 12.

FIG. 16 is a rear and left side perspective view of a second embodiment of the battery jump starting device according to the present invention with the cover removed.

FIG. 17 is a front and left side perspective view of the battery jump starting device shown in FIG. 1 with the cover removed.

FIG. 18 is a rear and right side perspective view of the battery jump starting device shown in FIG. 1 with the cover removed.

FIG. 19 is a front elevational view of the battery jump starting device shown in FIG. 1 with the cover removed.

FIG. 20 is a rear elevational view of the battery jump starting device shown in FIG. 1 with the cover removed.

FIG. 21 is a top planar view of the battery jump starting device shown in FIG. 1 with the cover removed.

FIG. 22 is a bottom planar view of the battery jump starting device shown in FIG. 1 with the cover removed.

FIG. 23 is a left side elevational view of the battery jump starting device shown in FIG. 1 with the cover removed.

FIG. 24 is a right side elevational view of the battery jump starting device shown in FIG. 1 with the cover removed.

FIG. 25 is a front and top perspective view of the battery jump starting device shown in FIG. 1 with the cover removed.

FIG. 26 is a disassembled front perspective view of a third embodiment of the battery jump starting device according to the present invention with the cover removed.

FIG. 27 is a disassembled partial front perspective view of the battery jump starting device shown in FIG. 26 with the cover removed.

FIG. 28 is a disassembled partial right side perspective view of the battery jump starting device shown in FIG. 26 with the cover removed.

FIG. 29 is a partial rear perspective view of the battery jump starting device shown in FIG. 26 with the cover removed.

FIG. 30 is a partial rear perspective view of the battery jump starting device shown in FIG. 26 with the cover removed.

FIG. 31 is a disassembled partial left side perspective view of the battery jump starting device shown in FIG. 26 with the cover removed.

FIG. 32 is a perspective view of the cam-lock connecting device according to the present invention for use, for example, with the battery jump starting device according to the present invention shown with the male cam-lock end disconnected from the female cam-lock end.

FIG. 33 is a perspective view of the cam-lock connecting device shown in FIG. 32 with the male cam-lock end partially connected to the female cam-lock end.

FIG. 34 is a perspective view of the male cam-lock end of the cam-lock connecting device shown in FIG. 32.

FIG. 35 is a disassembled perspective view of the male cam-lock end of the cam-lock connecting device shown in FIG 32.

FIG. 36 is a partially assembled perspective view of the male cam-lock end of the cam-lock connecting device shown in FIG. 32.

FIG. 37 is a partially assembled perspective view of the male cam-lock end of the cam-lock connecting device shown in FIG. 32.

FIG. 38 is a fully assembled perspective view of the male cam-lock end of the cam-lock connecting device shown in FIG. 32.

FIG. 39 is a partially assembled perspective view of the male cam-lock end of the cam-lock connecting device shown in FIG. 32.

FIG. 40 is a disassembled perspective end view of the female cam-lock end of the cam-lock connecting device shown in FIG. 32.

FIG. 41 is a disassembled perspective end view of the female cam-lock end of the cam-lock connecting device shown in FIG. 32.

FIG. 42 is a disassembled perspective end view of the female cam-lock end of the cam-lock connecting device shown in FIG. 32.

FIG. 43 is a partially assembled perspective end view of the female cam-lock end of the cam-lock connecting device shown in FIG. 32.

FIG. 44 is an assembled perspective end view of the female cam-lock end of the cam-lock connecting device shown in FIG. 32.

FIG. 45 is an assembled perspective end view of the female cam-lock end of the cam-lock connecting device shown in FIG. 32 along with a bolt for connecting to conductor such as a highly conductive frame of the battery jump starting device according to the present invention.

FIG. 46 is a front perspective view of the battery jump starting device shown in FIG. 16 with the cover removed showing the master control switch and interface backlight system according to the present invention.

FIG. 47 is a partial front perspective view of the battery jump starting device shown in FIG. 16 with the backlight of the control knob of the control switch for 12V turned “on.”

FIG. 48 is a partial front perspective view of the battery jump starting device shown in FIG. 16 with the backlight of the control knob of the control switch for 12V turned “off.”

FIG. 49 is a partial front perspective view of the battery jump starting device shown in FIG. 16 with the backlight of the control knob of the control switch for 12V

turned “on”, the backlight indicator for 12V on the interface turned “on”, the variable backlight indicator on the indicator showing 12.7V turned “on”, and the backlight for power “on.”

FIG. 50 is a partial front perspective view of the battery jump starting device shown in FIG. 16 with the backlight of the control knob of the control switch for 24V turned “on.”

FIG. 51 is a block diagram showing the 12V or 24V jump starting operational modes.

FIG. 52 is a block diagram showing the electrical optical position sensing system according to the present invention.

FIG. 53 is an electrical schematic diagram of the 12V/24V master switch read.

FIG. 54 is a diagrammatic view showing a single connection or dual connection arrangement of the battery jump starting device shown in FIG. 26.

FIG. 55 is a rear elevational view of the battery jump starting device shown in FIG. 26, with the cover removed, showing the dual battery diode bridge according to the present invention.

FIG. 56 is a front perspective view of the highly conductive frame according to the present invention used in the battery jump starting device shown in FIG. 26.

FIG. 57 is a front elevational view of the highly conductive frame shown in FIG. 56.

FIG. 58 is a rear elevational view of the highly conductive frame shown in FIG. 56.

FIG. 59 is a top planar view of the highly conductive frame shown in FIG. 56.

FIG. 60 is a bottom planar view of the highly conductive frame shown in FIG. 56.

FIG. 61 is a left side elevational view of the highly conductive frame shown in FIG. 56.

FIG. 62 is a right side elevational view of the highly conductive frame shown in FIG. 56.

FIG. 63 is a top planar view of an assembled Li-ion battery assembly according to the present invention.

FIG. 64 is a perspective view of the Li-ion battery assembly shown in FIG. 63 with the covering removed.

FIG. 65 is a perspective view of the Li-ion battery assembly shown in FIG. 63 with the covering removed.

FIG. 66 is a perspective view of the Li-ion battery assembly shown in FIG. 63 with the covering removed.

FIG. 67 is a functional block diagram of the rechargeable battery jump starting device shown in FIG. 26.

FIGS. 68A-1 thru 68F-3 are schematic circuit diagrams of the rechargeable battery jump starting device shown in FIG. 26.

FIG. 69 is a detailed front view of an example embodiment of a display for use with the rechargeable jump starting devices shown in FIGS. 10, 110, and 310.

DETAILED DESCRIPTION

The battery jump starting device 10 according to the present invention is shown in FIGS. 1-8.

The battery jump starting device 10 comprises a cover 12 fitted with a handle 14, and having the particular design shown in FIGS. 1-8..

The battery jump starting device 10 comprises a front interface 16, a power button 16a for turning the power on or off, and an electrical control switch 18 having a control knob 18a for operating the control switch 18. The main operational portion of the control switch 18 is located internally within the cover 12. The control switch 18 is configured so that a user can selectively rotate the control knob 18a to either a first position (12V mode) or a second position (24V mode) depending on the particular voltage system of the vehicle being jump started (e.g. 12V, 24V vehicle electrical system).

The detailed features of the interface 16 are shown in FIG. 69. The interface 16, includes:

1) Power Button 16a;
2) Power LED 16b (e.g. White colored LED);
3) 12V Mode LED 16c (e.g. White colored LED);

4) 24V Mode LED 16d at same location as 16c (e.g. Blue colored LED);
5) Error LED 16e (e.g. Red colored LED);
6) Cold Error LED 16f (e.g. Blue colored LED);
7) Hot Error LED 16g (e.g. Red colored LED);
8) Internal Battery Fuel Gauge LEDs 16h (e.g. Red, Red, Amber, Green colored LEDs);
9) Flashlight Mode Button 16i;
10) Flashlight LED 16j (e.g. White colored LED);
11) 12V IN LED 16k (e.g. White/Red colored LED);
12) 12V OUT LED 16l (e.g. White/Red colored LED);
13) USB OUT LED 16m (e.g. White colored LED);
14) Manual Override Button 16n:
15) Manual Override LED 16o (e.g. Red colored LED):
16) Voltmeter Display LED 16p (e.g. White colored LED);
17) 12V Mode LED 16q (e.g. White colored LED);
18) 24V Mode LED 16r (e.g. Blue colored LED); and
19) Boost LED 16s (e.g. White colored LED).

The above features can be modified with different colored LEDs and/or other arrangements on the face of the interface 16.

The battery jump starting device 10 further comprises a port 20 having left side port 20a and right side port 20b, as shown in FIG. 2. The port 20 is configured to extend through a through hole 16t located in the lower right corner of the interface 16. The left side port 20a accommodates dual 2.1 amp (A) USB OUT ports 20c, 20d and the right side port 20b accommodates an 18A 12V XGC OUT port 20e and a 5A 12V XGC IN port 20f, as shown in FIG. 2.

The cover 12 is provided with the resilient sealing cap 22, including left side sealing cap 22a for sealing left side port 20a and right side sealing cap 22b for sealing right side port 20b during non-use of the battery jump starting device 10.

The left side of the battery jump starting device 10 is also fitted with a pair of light emitting diodes 28 (LEDS) for using the battery jump starting device 10 as a work light.

For example, the LEDs 28 are dual 1100 Lumen high-intensity LED floodlights), as shown in FIGS. 1, 4, and 8. The LEDs 28 are configured to have seven (7) operational modes, including 100% intensity, 50% intensity, 10% intensity, SOS mode (emergency protocol), blink mode, strobe mode, and Off mode.

The left side of the battery jump starting device 10 is fitted with a heat sink 29 (FIG. 1) for dissipating heat from the LEDs 28. For example, the heat sink 29 is made of a heat conductive material (e.g. molded or die cast aluminum heat sink). The heat sink 29 is provided with ribs 29a (FIG. 1) to facilitate the heat sink 29 transferring heat to the surrounding atmosphere to prevent the LEDs 28 from overheating.

The battery jump starting device 10 is shown in FIG. 1 without battery cables having battery clamps for connecting the battery jump starting device 10 to a battery of a vehicle to be jump started. The battery jump starting device can be configured to removably or detachably connect to a set of battery cables each having a battery clamps (e.g. positive battery cable with a positive clamp, negative battery cable with a negative clamp). Alternatively, the battery jump starting device can be fitted with battery cables hard wired directly to the device and being non-removable or non-detachable.

As shown in FIGS. 1 and 4, the left side of the battery jump starting device 10 is provided with a POSITIVE (+) cam-lock 24a and a NEGATIVE (-) cam-lock 24b. The cam-locks 24a, 24b include receptacles 25a, 25b (FIG. 4) configured for removably or detachably connecting with connecting end 56a (FIG. 11) of the positive battery cable 56 (FIG. 8) and the connecting end 58a of negative battery cable 58, respectively. The cam-locks 24a, 24b are fitted with sealing caps 26 (FIG. 1) for closing and sealing the receptacles 25a, 25b of the cam-locks 24a, 24b, respectively, during non-use of the battery jump starting device 10 to keep dirt and moisture from entering the receptacles 25a, 25b.

The power circuit 30 of the battery jump starting device 10 is shown in FIG. 9.

The power circuit 30 comprises two (2) separate rechargeable Lithium ion (Li-ion) batteries 32 (e.g. two (2) 12V Li-ion batteries) connected to the control switch 18 via a pair of cables 34, 36 (e.g. insulated electrical copper cables), respectively.

The power circuit 30 further comprises a reverse current diode array 48 (i.e. a reverse flow protection device) connected to the control switch via the cable 40 and the right side battery 32 via cable 44.

The power circuit 30 even further comprises a smart switch 50 (e.g. 500 A solenoid device) connected to the control switch 18 via cable 42 and the left side battery 32 via cable 46.

The positive battery cable 56 having a positive battery clamp 60 is removably or detachably connected to the positive cam-lock 24a (FIG. 9), which is connected to the reverse current diode array 48 via cable section 52.

The negative battery cable 58 having a negative battery clamp 62 is detachably connected to the negative cam-lock 24b (FIG. 9), which is connected to the smart switch 50 via cable section 54.

In the above described first embodiment of the power circuit 30, the electrical components of the power circuit 30 are connected together via cables (e.g. heavy gauge flexible insulated copper cables). The ends of cables are soldered and/or mechanically fastened to the respective electrical components to provide highly conductive electrical connections between all the electrical components.

In a modified first embodiment shown in FIG. 10, the battery cables 56, 58 are directly hard wired to the reverse current diode array 48 and smart switch 50, respectively, eliminating the cam-locks 24a, 24b, so that the battery cables 56, 58 are no longer removable or detachable.

The cables 56, 58 shown in FIG. 9 are configured to cooperate with the cam-locks 24a, 24b. For example, the cables 56, 58 are provided with cable ends 56a, 58a (e.g. insulation removed) for fitting into the receptacles 25a, 25b of the cam-locks 24a, 24b.

In a second embodiment of the rechargeable jump starting device 110 and power circuit 130 to be described below, the cables 34, 36, 40, 42, 44, 46 (FIG. 9) of the first embodiment of the rechargeable jump starting device 10 located between the Li-ion batteries 32 and the reverse current diode array 48 and smart switch 50, respectively, and the cables 52 and 54 between the reverse current diode array 48 and the smart switch 50, respectively, are replaced with a highly electrically conductive rigid frame

170 (FIG. 16). For example, the highly electrically conductive frame 170 of the second embodiment of the rechargeable jump starting device 110 (FIG. 16) comprises frame members 170 a-h shown in FIGS. 16-25. Another highly electrically conductive frame 370 of the third embodiment of the rechargeable jump starting device 310 (FIG. 26) comprises frame members 370a-h shown in FIGS. 56-62.

CONTROL SWITCH

The control switch 18 is shown in FIGS. 12-15. The control switch 18 comprises the following:

1) control knob 18a;
2) front housing 72;
3) rear housing 74;
4) rotor 76 having a collar 76a, legs 76b, and legs 76c;
5) springs 78;
6) pivoting contact 80 each having two (2) points of contact (e.g. slots 80c);
7) separate terminals 82, 84, 86, 88;
8) connected terminals 90, 92;
9) conductive bar 94
10) O-ring 96;
11) O-ring 98; and
12) O-ring 100.

The control knob 18a comprises rear extension portions 18b, 18c. The extension portion 18c has a T-shaped cross section to connect into a T-shaped recess 76e (FIG. 12) in rotor 76 when assembled. The rotor 76 is provided with a flange 76a configured to accommodate the rear extension portion 18b (e.g. round cross-section) therein.

The pair of legs 76c (e.g. U-shaped legs) of the rotor 76 partially accommodate the springs 78, respectively, and the springs 78 apply force against the pivoting contacts 80 to maintain same is highly conductive contact with the selected contacts 82b-92c of the terminals 82-92.

The pivoting contacts 80 each have a pivoting contact plate 80a having a centered slot 80b configured to accommodate an end of each leg 76b of the rotor 76. When the rotor 76 is turned, each leg 76b actuates and pivots each pivoting contact plate 80a.

Further, the pivoting contact plates 80a each having a pair of spaced apart through holes 80c (e.g. oval-shaped through holes) serving as two (s) points of contact with selected contacts 82c-92c of the terminals 82-92.

The terminals 82-92 have threaded posts 82a-92a, spacer plates 82b-92b, and conductive bar 94, respectively, configured so that the contacts 82c-92c are all located in the same plane (i.e. plane transverse to longitudinal axis of the control switch 18) to allow selective pivoting movement of the pivoting contacts 80. The threaded posts 82a-92a of the terminals 82-92 are inserted through the through holes 74a, respectively, of the rear housing 74.

The O-rings 96, 98, 100, as shown in FIG. 12, seal the separate the various components of the control switch 18 as shown. After assembly of the control switch 18, a set of screws 75 connect with anchors 74b of the rear housing 74 to secure the front housing 72 to the rear housing 74 as shown in FIG. 12.

The control switch 18 is a 12V/24V selective type switch as shown in FIG. 13. The configuration of the pivoting contacts 80 in the first position or Position 1 (i.e. Parallel position) is shown on the left side of FIG. 13, and the second position or Position 2 (i.e. Series position) is shown on the right side of FIG. 13.

The rear side of the control switch 18 is shown in FIG. 14. Another highly conductive bar 94 is provided on the rear outer surface of the rear housing 74. The fully assembled control switch 18 is shown in FIG. 15.

The second embodiment of the battery jump starting device 110 is shown in FIGS. 16-25 with the cover 112 removed. The cover for the battery jump starting device 110, for example, is the same as the cover 12 of the battery jump starting device 10 shown in FIG. 1-8.

In the second embodiment of the battery jump starting device 110 (FIGS. 16-25) compared to the battery jump starting device 10 (FIGS. 1-8), the cable sections 34, 36, 40, 42, 44, 46 (FIG. 9) in the first embodiment are replaced with a highly conductive

frame 170. The highly conductive frame 170 is constructed of highly conductive metal (e.g. copper, aluminum) frame members 170a-h configured as conductive metal rods having flattened ends connected together.

The battery jump starting device 110 comprises a pair of 12V Li-ion batteries 132 directly connected to the highly conductive rigid frame 170. Specifically, terminals 132a, 132b (e.g. highly conductive bars of copper or aluminum) of the Li-ion batteries are mechanically connected and/or soldered to the positive and negative tabs or foils, respectively, of the battery cells and then connected to the highly conductive rigid frame 170 by highly conductive fasteners 206 comprising a bolt 206a and nut 206b and/or soldering.

The highly conductive rigid frame 170 is constructed of multiple highly conductive rigid frame members170a-h connected together by mechanical fasteners (e.g. metal nut and/or bolt fasteners) and/or soldering. For example, the highly conductive rigid frame members are made of highly conductive rigid metal rods having flattened ends with through holes. Alternatively, the highly conductive rigid metal rods can be replaced with highly conductive rigid metal plates, bars, tubing, or other suitably configured highly conductive metal material (e.g. copper or aluminum stock material). The highly conductive rigid frame members 170a-h can also be insulated (e.g. covered with heat shrink insulation) in at least the key areas to prevent any internal short circuiting.

The highly conductive rigid frame members 170a-h shown in FIGS. 16-25 are metal rods having flattened end portions (e.g. flattened using a hydraulic or mechanical press). The flattened end portions each have a through hole to provide a mechanical connection between adjoining highly conductive rigid frame members 170a-h and/or electrical components (e.g. battery 132, smart switch 150). The flattened end portions of adjoining highly conductive rigid frame members 170a-h are overlapped when being assembled together, and then a bolt is inserted through the overlapped through holes. A highly conductive nut is threaded onto the bolt fastener (e.g. copper or aluminum bolt and nut) and tightened. In the case of attaching a highly conductive rigid frame member 170a-h to an electrical component, the electrical component can be provided with a highly conductive plate base portion having a through hole for attachment to the frame member 170a-h. In addition, the end of the highly conductive rigid frame member 170a-

h can be provided with a base portion (e.g. plate or bar portion) configured for connecting with or being a portion or part of one or more electrical components.

For example, the reverse flow diode assembly 148 is constructed of three (3) base portions of three (3) highly conductive frame members 170d, 170e, 170f of the highly conductive rigid frame 170, including:

1) an upper highly conductive rigid bar 148a (FIG. 16) is a flattened end portion of the highly conductive frame member 170e also having an opposite flattened end portion 148ea connected to the flattened end portion 132aa of the battery terminal 132a using a highly conductive fastener 206 (e.g. made of copper or aluminum) having a highly conductive bolt 206a and highly conductive nut 206b;

2) a lower highly conductive rigid bar 148b (FIG. 16) is a flattened end portion of highly conductive rigid frame member 170d; and

3) a center highly conductive rigid bar 148c (FIG. 16) is a flattened end portion of the highly conductive rigid frame member 1170f.

As another example, the smart switch 150 (FIG. 16) comprises a highly conductive rigid plate 150a serving as a base portion supporting the solenoid 150b. The highly conductive rigid plate 150a is provided with through holes for connecting highly conductive rigid frame members 170a, 170h to the smart switch 150 using highly conductive fasteners 206.

The stock material (e.g. copper or aluminum rod, plate, bar, tubing) selected for construction of the highly conductive rigid frame 170 has substantial gauge to provide high conductivity and substantial rigidity. The “rigid” nature of the highly conductive rigid frame 170 provides the advantage that the highly conductive rigid frame 170 remains structurally stiff and stable during storage and use of the battery jump starting device 110.

For example, the highly conductive rigid frame 170 is designed and constructed to sufficiently prevent flexing, movement, bending and/or displacement of the highly

conductive rigid frame 170 during storage or use so as to prevent electrical shortages of the highly conductive rigid frame touching other internal electrical components or parts of the electronic assembly. This “rigid” nature is important due to the high conductivity path of electrical power from the Li-ion batteries 132 flowing through the power circuit and reaching the battery clamps 60, 62 (FIG. 9). It is a desired goal and feature of the present invention to conduct as much power as possible from the Li-ion batteries 132 to the battery being jump started by the battery jump starting device 110 by reducing or minimizing any electrical resistance by using the heavy duty and highly conductive rigid frame 170 arrangement disclosed.

As an alternative, the highly conductive rigid frame 170 can be constructed as a single piece having no mechanically fastened joints. For example, the highly conductive rigid frame 170 can be made from a single piece of stock material and then formed, bent, machined, or manufactured into the highly conductive rigid frame 170. For example, a billet of highly conductive copper can be machined (e.g. milled, lathed, drilled) into the highly conductive rigid frame 170. As another example, a copper sheet or plate can be bent and/or machined into the highly conductive rigid frame 170. As a further alternative, the highly conductive rigid frame 170 can be metal molded (e.g. loss wax process).

As another alternative, the highly conductive rigid frame 170 is made of multiple highly conductive rigid frame members 170a-h connected together into a unitary structure. For example, the highly conductive rigid frame 170 is made of highly conductive sections of stock material (e.g. copper or aluminum rod, plate, bar, tubing), which are extruded, machined and/or bent, and soldered and/or welded together.

The battery jump starting device 110 further comprises a resistor array 202 (e.g. 12 V 5A XGC) comprising a printed circuit board (PCB) 202a serving as a base supporting an array of individual resistors 202b, as shown in FIG. 17 and 19. The PCB 202a also supports the dual 2.1 amp (A) USB OUT ports 120c, 120d, the 18A 12V XGC OUT port 20e, and the 5A 12V XGC IN port 20e.

The left side of the battery jump starting device 110 is also fitted with a pair of light emitting diodes 128 (LEDS) for using the battery jump starting device 110 as a work light. For example, the LEDs 128 are dual 1100 Lumen high-intensity LED

floodlights), as shown in FIG. 16. The LEDs 128 are configured to have seven (7) operational modes, including 100% intensity, 50% intensity, 10% intensity, SOS (emergency protocol), Blink, Strobe, and Off.

The battery jump starting device 110 is fitted with a heat sink 129 (FIG. 16) for dissipating heat from the LEDs 128. For example, the heat sink 129 is made of a heat conductive material (e.g. molded or die cast metal plate). The heat sink 129 is provided with ribs 129a transferring heat to the surrounding atmosphere to prevent the LEDs128 from overheating.

The battery jump starting device 110 is shown in FIG. 16 without any battery cables having battery clamps for connecting the battery jump starting device 110 to a battery of a vehicle to be jump started. The battery jump starting device can be configured to removably or detachably connect to a set of battery cables having battery clamps (e.g. positive battery cable with a positive clamp, negative battery cable with a negative clamp). For example, see the detachable battery cables 56, 58 and battery clamps 60, 62 in FIG. 9, which can be detachably connected to the cam-locks 124a, 124b of the battery jump starting device 110. Alternatively, the battery jump starting device 110 can be fitted with battery cables hard wired to the device and non-removable or non-detachable the same or similar to those shown in FIG. 10.

For example, the left side of the battery jump starting device 110 is provided with POSITIVE (+) cam-lock 124a and NEGATIVE (-) cam-lock 124b, as shown in FIG. 16. The cam-locks 124a, 124b include receptacles 125a, 125b configured for detachably connecting with connecting end 56a (FIG. 11) of the positive battery cable 56 and the connecting end 58a of negative battery cable 58, respectively. The cam-locks 124a, 124b can be fitted with sealing caps the same or similar to the sealing caps 26 (FIG. 1) for closing and sealing the receptacles 125a, 125b of the cam-locks 124a, 124b, respectively, during non-use of the battery jump starting device 110.

A third embodiment of the battery jump starting device 210 is shown in FIGS. 26-31. In this embodiment, the highly conductive rigid frame 270 is made from flat copper bar stock material having a rectangular-shaped cross-sectional profile. The flat copper bar is bent to at least partially wrap around and envelop the Li-ion batteries.

Further, the battery jump starting device 210 comprises a main printed circuit board 208 serving as a base for LEDs for the control knob 218a and interface 216, and for supporting other electrical components of the battery jump starting device 210.

CAM-LOCK CONNECTORS

Again, the battery cables 56, 58 (FIG. 9) can be detachably connected to the battery jump starting device 10 via cam-locks 24a, 24b (FIG. 1) or cam-locks 124a, 124b (FIG. 16).

The cam-locks 24a, 124a, 24b, 124b and cables 56, 58 (FIG. 9) having conductive ends 56a, 56b (FIG. 11) can each have the construction of the cam-lock connector 27, as shown in FIGS. 32-45.

The cam-lock connector 27 can be used for other applications for detachably connecting a conductive electrical cable to an electronic device other than the battery jump starting device according to the present invention.

The cam-lock connector 27 comprises a male cam-lock end 27a and a female cam-lock end 27b for detachable connecting the battery cables 56, 58 (FIG. 10), respectively, to the battery jump starting device 10.

The male cam-lock end 27a comprises a pin 27aa having a tooth 27ab. The female cam-lock end 27b comprises a receptacle 27ba having a slot 27bb together located in a hex portion 27bc. The receptacle 27ba is configured to accommodate the pin 27aa and tooth 27ab of the male cam-lock end 27a. Specifically, the pin 27aa and tooth 27ab of the male cam-lock end 27a can be inserted (FIG. 33) into the receptacle 27ba and slot 27bb a fixed distance until the tooth 27ab contacts an interior surface of the internal thread of the female cam-lock 27b to be described below. The male cam-lock end 27a can be rotated (e.g. clockwise) to tighten within the female cam-lock end 27b until the end face portion 27ac of the male cam-lock end 27a engages with the end face portion 27bc of the female cam-lock end 27b. The more the cam-lock 24 is tightened, the better the electrical connection is between the male cam-lock end 27a and the female cam-lock end 27b.

The male cam-lock end 27a is fitted with a rubber molded cover 31, as shown in FIG. 34, to insulate and improve the grip on the male cam-lock end 27a. The highly conductive cable 33 is electrically and mechanically connected to the male cam-lock end 27a, and is fitted through a passageway in the rubber molded cover 31.

The assembly of the male cam-lock 27a is shown in FIG. 35. The male cam-lock 27a is provided with a thread hole 37 for accommodating Allen head fastener 39. The one end of the male cam-lock 27a is provided with a receptacle 27ad for accommodating the copper sleeve 41 fitted onto the end of the inner conductor 56a of the battery cable 56. The copper sleeve 41 is soldered onto the inner conductor 56a using solder 43.

The copper sleeve 41 is fitted into the receptacle 27ad of the male cam-lock end 27a, as shown in FIG. 36. When the copper sleeve 41 is fully inserted into the receptacle 27 of the male cam-lock end 27a, as shown in FIG. 36, then the Allen head fastener is threaded into the threaded hole 37 and tightened, as shown in FIG. 37.

It is noted that the inner end of the Allen head fastener makes an indent 45 when sufficiently tightened to firmly anchor the copper sleeve 41 and inner conductor 56a of the battery cable 56 to mechanically and electrically connect the cable 56 to the male cam-lock end 27a.

The rubber molded cover 31is provided with one or more inwardly extending protrusions 31a cooperating with one or more slots 27ae in an outer surface of the male cam-lock end 27a (FIG. 38).

Again, the male cam-lock end 27a and the female cam-lock end 27b are configured so as to tighten together when rotating the male cam-lock end 27a when inserted within the female cam-lock end 27b.

The female cam-lock end 27b, as shown in FIG. 40, is provided with the receptacle 27ba and slot 27bb for accommodating the end of the male cam-lock end 27a. The slot 27bb is provided with a surface 27bba serving as a stop for the tooth 27ab of the male cam-lock end 27a. The receptacle 27ba is provided with inner threading 27baa for cooperating with the tooth 27ab of the male cam-lock end 27a to provide a threaded connection therebetween. Specifically, the tooth 27ab engages with the surface 27bba and is stopped from being further inserted into the receptacle 27ba of the

female cam-lock end 27b. When the male cam-lock end 27a is rotated, the tooth 27ab engages and cooperates with the inner threading 27baa of the receptacle 27ba of the female cam-lock end 27b to begin tightening the male cam-lock end 27a within the female cam-lock end 27b with the tooth 27ab riding against an edge of the inner thread 27baa. The male cam-lock end 27a is further rotated to further tighten the connection with the female cam-lock end 27b. When the face 27ac (FIG. 32) of the male cam-lock end 27a engages with the face 27bd of the female cam-lock end 27b, then the cam-locks ends 27a, 27b are fully engage and rotation is stopped.

The female cam-lock end 27b is accommodated with a rubber molded cover 51 having cover portions 51a, 51b, as shown in FIGS. 42-45

The female cam-lock end 27b (FIGS. 40 and 41) is provided with inner threading 27bf (FIG. 40) to accommodate the bolt 47 and lock washer 49 (FIG. 41) for connecting the female cam-lock end 27b to the battery jump starting device 10 (e.g. connects to base plate for smart switch 50 (FIG. 9)).

The female cam-lock end 27b is accommodated within the molded rubber cover portions 51a, 51b, as shown in FIGS. 41-43. The molded rubber cover portions 51a, 51b are fitted onto the threaded portion 27be of the female cam-lock end 27b (FIGS. 43-45), and then secured in place using nut 53 and lock washer 55. The molded rubber cover portion 51a includes an outwardly extending protrusion 51aa.

ELECTRICAL CONTROL SWITCH BACKLIGHT SYSTEM

The battery jump charging device 10 can be provided with an electrical control switch backlight system 200, as shown in FIGS. 46-50.

The electrical control switch backlight system 200, for example, comprises control switch 18 having the control knob 18a, the interface 16 (e.g. membrane label), and the main printed circuit board 208.

The control knob 18a is made of plastic (e.g. injection molded plastic part). For example, the control knob 18a is mainly made of a colored opaque plastic material selected to prevent the transmission of light therethrough provided with a clear plastic slot 18b molded therein (e.g. insert molded). The clear plastic slot 18b serves as a light

window to allow light from one or more backlight LEDs mounted on the printed circuit board 208 to pass through the interface16 and the light window when the power button 17 of the interface 16 is turned on (e.g. touch power switch) lighting the one or more LEDs. Alternatively, the clear plastic slot 18b can be replaced with an open slot in the control knob 18b serving as the light window.

The control switch 18 is rotatable between a first position (Position 1) for a 12V mode of operation of the battery jump starting device 10 and a second position (Position 2) for a 24V mode of operation of the battery jump starting device 10. The power is shown “on” in FIG. 41 and “off” in FIG. 48.

The interface 16 is provided with a 12V backlight indicator 16a, a 24V backlight indicator 16b, a 12V backlight indicator 16c, a 24V backlight indicator 16d, a variable display backlight indicator 16e for indicating the actual operating voltage of the battery jump charging device 10, and a power “on” indicator 16f, as shown in FIG. 49.

The electrical control switch backlight system 200 can be configured to turn on white LEDs mounted on the printed circuit board 208 when the control switch 18 is located at Position 1 for the 12V mode of operation of the battery jump starting device 10, and turn on blue LEDs mounted on the printed circuit board 208 when the control switch 18 is located at Position 2 for the 24V mode of operation of the battery jump starting device 10. As show in FIG. 47, the light window provided by slot 18b on the control knob 18 lights up along with 12V backlight indicators 16a, 16c on the interface 16 when the control knob 18a is in Position 1. As shown in FIG. 50, the 24V backlight indicator 16b lights up along with the 24V backlight indicator 16d (FIG. 49) when the control knob 18b is in Position 2.

ELECTRICAL OPTICAL POSITION SENSING SWITCH SYSTEM

The portable jump starting device 10 can be configured as a dual purpose Li-ion jump starter to allow for jump starting either a 12V or 24V heavy duty vehicle or piece of equipment. This lightweight portable unit utilizes the manual rotary control switch 18 with the control knob 18a for switching between 12V or 24V jump starting or operational modes. Any of the above described portable jump starting devices according to the

present invention can be provided with the electrical optical position sensing system 300, as shown in FIGS. 51-53.

The portable jump starting device 10 uses two 12V Li-ion batteries that are connected in parallel for 12V jumpstarting and in series for 24V jump starting. The series or parallel connections are accomplished with the rotary control switch 18 (e.g. Master Switch), as shown in FIG. 51.

The electrical optical position sensing system 300 is shown in FIG. 52. The optical position sensing system 300 is configured to allow for a safe and effective method for the system microcontroller to read the position of the control switch 18. The optical position sensing system 300 comprises a sensor 302 (FIG. 52) using optical coupling to insure the integrity of isolation on the 12V to 24V rotary control switch 18.

A schematic of the circuit of the optical position sensing system 300 is shown in FIG. 53. The top left portion of the schematic includes transistor Q28 and resistors R165, R168, R161 and R163. This circuit acts as an electrical enable when the main system 3.3V power is turned “on.” The purpose of this enable is to reduce parasite current when the portable jump starting device 10 is in the “off” state. When “on”, this enables current from battery A+ to flow through Q27, which acts as an electrical switch.

If Q27 is “on”, it allows current to flow from Battery A+ to Battery B- when the batteries are connected in parallel. When they are connected in series, no current flows because A+ and B- are connected together through the control switch 18.

The result of current flow or lack thereof, allows the optical coupler to provide a signal to the microcontroller telling it which position the Master Switch is in.

The second portion of the schematic (i.e. schematic located just below the first schematic), allows the opposite signal to be provided to a separate input of the microcontroller. The result of this is to provide the microcontroller an effective method of determining when the switch is “In Between” meaning it is not in 12V position or 24V position and is in between those two positions. This allows the microcontroller to provide diagnostics in case a user leaves the switch in an unusable position.

DUAL BATTERY DIODE BRIDGE

The battery jump starting device 310 (FIG. 26-31) can be provided with a dual diode battery bridge, for example, in the form of a back-charge diode module 348 configured for protecting against back-charge after a vehicle battery has been jump charged, as shown in FIG. 54.

The back-charge diode module 348 is configured to provide two (2) channels 348a, 348b of diodes to support the two (2) battery system (e.g. two batteries of jump starting device 310) and are bridged together to provide peak current output during jump starts.

The single wiring connection and dual wiring connections of the battery jump starting device 310 is shown in FIG. 54. The components are connected together by the highly conductive rigid frame 370. The copper or aluminum bar members 370a-h (FIG. 16-25) making up the highly conductive rigid frame 170 are more conductive than 2/0 copper cable. Further, the connection points between copper bar members of the highly conductive rigid frame 170 are configured to reduce power losses compared to copper cable. The copper or aluminum bar members of the highly conductive rigid frame 170 can be replaced with other highly conductive metals (e.g. aluminum, nickel, plated metal, silver plated metal, gold plated metal, stainless steel, and other suitable highly conductive metal alloys).

The dual diode battery bridge in the form of a back-charge diode module 348 is shown in FIG. 55. The top channel of diodes 348a connect to frame member 370e support current through one 12V battery 332, and the bottom channel of diodes 348b connected to frame member 370d support current through the second 12V battery 332. The combined current from both batteries 332, 332 through the two (2) diode channels 348a, 348b exits the back-charge diode module through the copper bar member 370f leading to the positive output (i.e. positive cam-lock) of the battery jump starting device 310.

The back-charge diode module 348 comprises an upper highly conductive plate 370e, a lower highly conductive plate 370d, and the center highly conductive plate 370f connected together by the channels of diodes 348a, 348b.

LEAPFROG CHARGING SYSTEM

The battery jump starting devices 10, 110, and 310 use two (2) 12V lithium batteries used for jumpstarting vehicles and other system functions. These two individual batteries are used in both series or parallel depending on whether the operator is jumpstarting a 12V vehicle or a 24V vehicle.

The battery jump starting device 10, 110, 310 can be charged using a charging device having a plug-in cord (e.g. 114 V to 126 V (RMS) AC charger) and charging control device (e.g. programmable micro-controller). Each battery is charged on its own by the battery jump starting device 10, 110, 310 separate from the other battery, but the batteries are kept close in potential during the charging process using a technique called “leapfrog charging”. This charging approach insures that both batteries are close to the same potential even if the battery jump starting device 10, 110, 310 is removed from charging early. This provides for equal power delivery during jumpstarts as well as other system functions.

The battery jump starting device 310 is provided with a charging device. For example, the circuit board 408 shown in FIG. 26 can be provided with charging components and a charging circuit for recharging the two (2) Li-ion batteries 332. The components, for example, includes a programmable microcontroller for controlling the recharging circuit for recharging the Li-ion batteries 332

This method is accomplished by charging one Li-ion battery 332, starting with the lowest charged battery, until it is approximately 100mv higher than the other battery 332, and then switching to charge the other battery 332. This process continues until both batteries 332 are completely charged.

Safeguards are provided in the battery jump starting device 310 to protect against any of the batteries 332 being overcharged as well as sensing if a battery cell is shorted. These safeguards include peak voltage shutoff as well as charge timeouts in software.

The leapfrog charging system and method can be design or configured to charge the rechargeable batteries 332 (e.g. Li-ion batteries) in a charging sequence. The

charging sequence can be designed or configured to ensure that both batteries become fully charge regardless of the operations of the battery jump starting device 310. In this manner, the batteries are fully charged on a regular basis to maximize the use and life of the batteries.

Further, the charging sequence can be tailored to most effectively charge particular types of rechargeable battery, in particular Li-ion batteries taking into account particular charging properties of the batteries (e.g. reduce heat generation of batteries over a time interval, apply best charging rate(s) for batteries, charging in a sequence increase life of batteries. The charging sequence, for example, can be to partially charge the batteries 332, one at a time, and back-and-forth. For example, the charging sequence can be configured to incrementally charge the batteries 332 in a back-and-forth sequence until both batteries are fully charged. For example, a voltage increase increment can be selected (e.g. 100mV) for charging the batteries in a back-and-forth sequence.

In addition, the charging sequencing between the two batteries 332 can be selected or programmed to provide back-to-back charging of one battery two or more increments before switching to the other battery for charging. Also, the charging sequence can include one or more pauses to prevent the charging battery 332 from becoming too hot (e.g. temperature limit) or so that the charging sequence matches with the charging chemistry of the charging battery.

HIGHLY CONDUCTIVE FRAME

The highly electrically conductive frame 370 (“highly conductive frame”), is shown in FIGS. 56-62. The highly conductive frame 370 comprises highly conductive frame members 370a-h.

The highly conductive frame 370 can replace the electrically conductive cables 34, 36, 40, 42, 44, 46, 52, 54 (FIGS. 9 and 10) of the portable battery jump starting device 10, or the highly conductive frame 170 (FIG. 16) of the battery jump starting device 110.

The highly conductive frame 370 comprises a positive conductive frame 371a and negative conductive frame 371b, as shown in FIG. 56. The positive conductive frame 371a comprises highly conductive frame members 170c, 170d, 170e, 170f providing a positive conductive pathway between the rechargeable batteries 332 and the positive cam-lock 324a. The negative conductive frame 371b comprises highly conductive frame members 170a, 170b, 170g, 170h providing a negative conductive pathway between the rechargeable batteries 332 and the negative cam-lock 324b of the rechargeable battery jump starting device 310. The highly conductive frame members 370a-h each carry or transfer power a distance between connecting ends of the highly conductive frame members 370a-h.

The highly electrically conductive frame 370 comprises the multiple electrically conductive frame members 370a-h electrically and mechanically connected together. For example, the highly electrically conductive frame members 370a-h are each provided with connecting ends having through holes 371 to allow a fastener (e.g. highly electrically conductive nuts and bolts) to connect the electrically conductive frame members 370a-h to each other or to other electrical components (e.g. rechargeable batteries 332, cam-locks 324a, 324b, back-charge diode module 348, smart switch 450). The highly electrically frame members 370a-h, for example, are flat highly electrically conductive bars (e.g. copper or aluminum bars) bent along multiple spaced apart axes to provide a three dimensionally (3D) arrangement of each highly electrically conductive bar 370a-h, which cooperate together to define a three dimensional (3D) highly electrically conductive frame 370. As shown in FIG. 56, one or both ends of the electrically conductive frame members 370a-h have bent ends each provided with a through hole 371.

The highly electrically conductive frame 370, for example, can be a highly electrically conductive semi-rigid or rigid frame 370 made of semi-rigid or rigid highly conductive material (e.g. copper, aluminum, plated metal, gold plated metal, silver plated metal, steel, coated steel, stainless steel). The highly electrically conductive frame 370 is structurally stable (i.e. does not move or flex) so that it does not contact and electrically short with components or parts of the portable jump starting device. The

more rigid the highly electrically conductive frame 370 typically the more structurally stable is the highly electrically conductive frame 370.

The highly electrically conductive frame 370 electrically connects together the two (2) batteries 332, for example Li-ion batteries 332 with the cam-locks 324a, 324b. The cam-locks 324a, 324b connect to the removable or detachable positive and negative battery cables 56, 58 (FIG. 9).

The highly electrically conductive frame 370 comprises multiple highly electrically conductive frame members 370a-h. For example, highly electrically conductive frame members 370a, 370b, 370c, 370d are connected to the control switch 318 via the terminals 382a, 384a, 386a, 388a (also see terminals 82a, 84a, 86a, 88a of the control switch 18 shown in FIG. 14).

The highly electrically conductive frame members 370d, 370e, 370f are part of the reverse flow diode assembly 348 (see reverse flow diode assembly 48 in FIG. 18).

The highly electrically conductive frame member 370f is connected to the positive cam-lock 324a (also see positive cam-lock 24a shown in FIGS. 1 and 9 and positive cam-lock 124a shown in FIG. 20).

The highly electrically conductive frame member 370g is connected to the negative cam-lock 324b (see negative cam-lock 24b shown in FIG. 1 or negative cam-lock 124b shown in FIG. 19).

The highly electrically conductive frame member 370h connects to the smart switch 450 (also see smart switch 150 shown in FIG. 18).

The highly electrically conductive frame 370 is a three-dimensional (3D) structure configured to wrap around and partially or fully enclose the Li-ion batteries 332 (also see the rechargeable Li-ion batteries 132 shown in FIGS 16-25). This arrangement provides the shortest conductive pathways from the rechargeable Li-ion batteries 332 to the other internal electrical components of the portable jump starting device 310 to maximize the power output to the positive cam-lock 324a and negative cam-lock 324b. The highly electrically conductive frame members 370a-h have multiple bends along multiple spaced apart axes.

The highly electrically conductive frame members 370a-h are provided with ends having through holes to accommodate highly conductive fasteners 406 (e.g. see

conductive fasteners 206, including bolts 206a and nuts 206b shown in FIGS. 16-25). Further, the highly electrically conductive frame members 370a-h are made of flat bar stock bent at one or more locations so as to wrap around the Li-ions batteries 332. For example, the highly electrically conductive frame members 370a-h are bent at multiple locations to form a three-dimensional (3D) frame structure. For example, the highly electrically conductive frame members 370a-h can have bent ends provided with ring-shaped through holes. Alternatively, the high electrically conductive frame 370 can be made as a single piece (e.g. single piece of plate or bar bent into shape, multiple pieces welded or soldered together, machined from a block of stock material). Further, the highly electrically conductive frame members 370a-h are located adjacent to the sides of the Li-ion batteries 332 to make the combination of the Li-ion battery assembly and highly electrically conductive frame 370 as compact as possible.

The highly electrically conductive frame 370 is made from flat highly electrically conductive plate stock material (e.g. flat bars or strips of copper or aluminum stock material cut to length, bent, and drilled).

BATTERY ASSEMBLY

The Li-ion battery assembly 333 according to the present invention is shown in FIGS. 63-66.

The Li-ion battery assembly 333 comprises the one or more rechargeable Li-ion batteries 332. For example, the rechargeable battery jump starting device comprises two (2) rechargeable batteries 332.

The Li-ion batteries 332 each comprise multiple battery cells 335 connected together in series (i.e. positive tab of one rechargeable battery cell 335 connected to negative tab of adjoining rechargeable battery cell 335) resulting in one rechargeable battery cell 335 situated at one end of the multiple battery cells 335 having a positive terminal (+) and another rechargeable battery cell 335 situated at an opposite end of the multiple battery cells 335 having a negative terminal (-).

A positive highly conductive battery member 332a is connected to the positive terminal (+), and a negative highly conductive battery member 332b is connected to the

negative terminal (-). The positive highly conductive battery member 332a and the negative highly conductive battery members 332b can be highly electrically conductive bars, plates, rods, and tubes. The rods and tubes can have flattened ends to facilitate connection with the highly electrically conductive frame 370 (FIG. 56).

Each Li-ion battery 332 comprises multiple Li-ion battery cells 332c layered one on top of the other, as shown in FIGS. 64-66 (i.e. stacked arrangement).

The positive foil tab or end 335a of the positive terminal (+) of the Li-ion battery cells 335 is connected (e.g. soldered, welded, and/or mechanically fastened) to the positive highly conductive battery member 332a. The negative foil tab or end 335b of the negative terminal (-) of the Li-ion battery cells 335 is connected (e.g. soldered, welded, and/or mechanically fastened) to the negative highly conductive battery member 332b.

The positive highly conductive battery member 332a and the negative highly conductive battery member 332b are made from highly conductive flat plate or bar stock material (e.g. copper plate, copper bar, aluminum plate, aluminum bar, steel plate, steel bar, metal coated plate, gold plated plate, silver plated plate). The positive highly conductive battery member 332a is provided with a through hole 332c located at an end extending a distance outwardly from a side of the rechargeable Li-ion battery 332 (i.e. transverse to longitudinal axis or length the rechargeable battery cells 335 and the rechargeable Li-ion battery 332). The negative highly conductive battery member 332b is provided with a through hole 332c located at an end extending a distance outwardly from and oriented transversely relative to the rechargeable battery cells 335 and the rechargeable Li-ion battery 332.

The highly conductive battery members 332a, 332b are made of relatively thick plate or bar material. The foil tabs or ends 335a, 335b of the battery cells 332c can at least partially or fully wrap around the highly conductive battery members 332a, 332b, as shown in FIGS. 64-66. Further, the highly conductive battery members 332, 332b are connected flat against the foil tabs or ends 335a, 335b, respectively, to maximize contact area therebetween.

The rechargeable battery cells 335 are covered with protective heat shrink material to package the rechargeable batteries 332.

The highly conductive battery members 332a, 332b are connected by highly conductive fasteners (e.g. nuts and bolts) to the highly electrically conductive frame such as highly electrically conductive frame 370 (FIGS. 56-62) of the portable jump starting devices 310.

The rechargeable battery jump starting device 310 (FIG. 26-31) comprises the rechargeable battery assembly comprising one or more rechargeable battery cells having a positive terminal connector tab or end 335a (FIGS. 64-66) and a negative terminal connector tab or end 335b. A positive electrically conductive bar 332a is connected to the positive terminal connector tab or end 335a and a negative electrically conductive bar 332b is connected to the negative terminal connector tab or end 335b. The highly electrically conductive frame 370 (FIG. 56-62) is connected to the battery assembly 333 (FIG. 64-66). The positive battery cable 56 (FIGS. 9 and10) is connected to the highly electrically conductive frame 370, for example, directly or through cam-locks 324a, 324b (FIG. 31). The negative battery cable 58 (FIGS. 9 and 10) is electronically connectable to the highly electrically conductive frame 370 via the smart switch 150 (also see smart switch 50 in FIGS. 9 and 10). The positive battery clamp 60 is connected to the positive battery cable 56 and the negative battery clamp 62 is connected to the negative battery cable 58.

The highly electrically conductive frame 370 comprises positive conductive pathways from the positive terminal connectors 332a, 332a of the rechargeable batteries 332, 332 of the rechargeable battery assembly 333 to the connection with the positive battery cable 56 (e.g. direct cable connection or via cam-lock 324a) and negative conductive pathways from the negative terminal connectors 332b, 332b of the rechargeable batteries 332, 332 of the rechargeable battery assembly 33 to the connection with the negative battery cable (e.g. direct cable connection or via cam-lock 324b).

As shown in FIGS. 64-66, the positive electrically conductive member 332a (e.g. highly conductive bar) and the negative electrically conductive member 332b (e.g. highly conductive bar) are both oriented transversely relative to a length or longitudinal axis of the rechargeable battery cells 335 of each rechargeable battery 332. More specifically, the positive electrically conductive member 332a and negative electrically

conductive member 332b protrude from opposite sides of the rechargeable batteries 332 and the rechargeable battery assembly 333. Further, the positive electrically conductive member 332a and the negative electrically conductive member 332b are wider (FIG. 64) relative to a width of the rechargeable battery cells 335 and protrude from the opposite sides of the rechargeable battery cells 335 and the rechargeable battery assembly 333.

The positive terminal connector tab or end 332a is a positive terminal foil tab or end of the rechargeable battery cells 335 connected in series at one end and the negative terminal connector tab or end 332b is a negative foil tab or end of the rechargeable battery cells 335 connected in series at an opposite end. A side of the positive electrically conductive member 332a (i.e. highly electrically conductive bar 332a) is connected flat against the positive foil tab or end 335a of the series of rechargeable battery cells 335 and a side of the negative electrically conductive member 332b (i.e. highly conductive bar 332b) is connected flat against the negative foil tab or end 335b of the series of rechargeable battery cells 335. For example, the positive foil tab or end 335a and the negative foil tab or end 335b are soldered to the positive electrically conductive member 332a and the negative electrically conductive member 332b, respectively. Further, the positive electrically conductive member 332a (i.e. highly conductive bar 332a) and negative electrically conductive member 332b (i.e. highly conductive bar 332b) are each provided with a through hole 332c for connection with the highly electrically conductive frame 370 (FIG. 56).

To enhance the conductivity between the series of rechargeable battery cells 335 and the positive electrically conductive member 332a (i.e. highly conductive bar 332a) and negative electrically conductive member 332b (i.e. highly conductive bar 332b), the positive foil tab or end 335a and the negative foil tab or end 335b are at least partially or fully wrapped around the positive electrically conductive member 332a (i.e. highly conductive bar 332a) and negative electrically conductive member 332b (i.e. highly conductive bar 332b), respectively, and also soldered and/or welded thereto. The ends of the positive electrically conductive member 332a (i.e. highly conductive bar 332a) and negative electrically conductive member 332b (i.e. highly conductive bar 332b)

protrude from the sides of the positive foil tab or end 335 and the negative foil tab or end 335b, respectively.

Again, the rechargeable battery cells 335 are connected in series and layered one on top of the other to provide the rechargeable battery assembly, as shown in FIGS. 64-66, to provide a stacked arrangement to make the rechargeable battery assembly 333 compact in size. The multi-layered battery cells 335 then covered with heat shrink material to package same.

The rechargeable battery assembly 332 used in a rechargeable jump starting device 310 comprises one or more rechargeable battery cells having a positive terminal connector; a negative terminal connector; a positive electrically conductive bar connected to the positive terminal connector; and a negative electrically conductive bar connected to the negative terminal connector.

CIRCUITS

The functional block diagram of the rechargeable battery jump starting device 310 (FIG. 26) is shown in FIG. 67. The schematic circuit diagrams of the rechargeable battery jump starting device 310 are shown in FIGS. 68A-1 thru 68F-3.

CLAIMS

1. A rechargeable battery jump starting device, comprising:

a rechargeable battery having a positive terminal and a negative terminal;

an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of the rechargeable battery and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery;

a positive battery cable having one end connected during operation of the rechargeable battery jump starting device to an opposite end of the positive conductive frame;

a negative battery cable having one end connected during operation of the rechargeable battery jump starting device to the opposite end of the negative conductive frame;

a positive battery clamp connected to an opposite end of the positive cable; and

a negative battery clamp connected to an opposite end of the negative cable.

2. The device according to claim 1, wherein the electrically conductive frame comprises electrically conductive frame members connected together.

3. The device according to claim 2, wherein the electrically conductive frame members are one or more selected from the group of electrically conductive bars, plates, rods, and tubes.

4. The device according to claim 2, wherein the electrically conductive frame members are flat conductive bars having one or more bends along a length of the conductive frame members.

5. The device according to claim 2, wherein the electrically conductive frame members are located adjacent to sides of the rechargeable battery.

6. The device according to claim 5, wherein the electrically conductive frame at least partially surrounds the rechargeable battery.

7. The device according to claim 2, wherein the electrically conductive frame members are each provided with a through hole located in at least one end of the respective frame member for accommodating a fastener for connecting the electrically conductive frame members together or connecting the respective frame member to an electrical component.

8. The device according to claim 1, wherein the positive conductive frame is connected to a positive cam-lock for removably connecting with the positive cable and the negative conductive frame is connected to a negative cam-lock for removably connecting with the negative cable.

9. The device according to claim 1, wherein the rechargeable battery is a rechargeable battery assembly comprising one or more rechargeable battery cells, a positive electrically conductive bar connected to the positive terminal of the rechargeable battery, and a negative electrically conductive bar connected to the negative terminal of the rechargeable battery.

10. The device according to claim 9, wherein the positive electrically conductive bar and negative electrically conductive bar are both oriented transversely relative to a length of the one or more rechargeable battery cells.

11. The device according to claim 10, wherein the electrically conductive bars are wider relative to a width of the one or more rechargeable battery cells and each protrudes from a side of the rechargeable battery assembly.

12. The device according to claim 9, wherein the positive electrically conductive bar and negative electrically conductive bar are each provided with a through hole for connection with the electrically conductive frame.

13. The device according to claim 1, further comprising a switch connected between the negative conductor bar and the negative cable for selectively electrically connecting the negative conductor bar to the negative cable during operation of the rechargeable battery jump starting device.

14. The device according to claim 13, wherein the switch is a smart switch for electrically connecting the negative conductor bar to the negative cable only upon detecting the positive clamp and negative clamp are correctly connected to a battery being jump started.

15. A rechargeable battery jump starting device, comprising:

a rechargeable battery having a positive terminal and a negative terminal;

an electrically conductive frame comprising a positive conductive frame connected at one end to the positive terminal of rechargeable battery assembly and a negative conductive frame connected at one end to the negative terminal of the rechargeable battery assembly;

a positive cam-lock connected to an opposite end of the positive conductive frame;

a negative cam-lock connected to an opposite end of the negative conductive frame;

a positive battery cable removably connected at one end to the positive cam-lock;

a negative battery cable removably connected at one end to the negative cam-lock;

a positive battery clamp connected to an opposite end of the positive cable; and

a negative battery clamp connected to an opposite end of the negative cable.

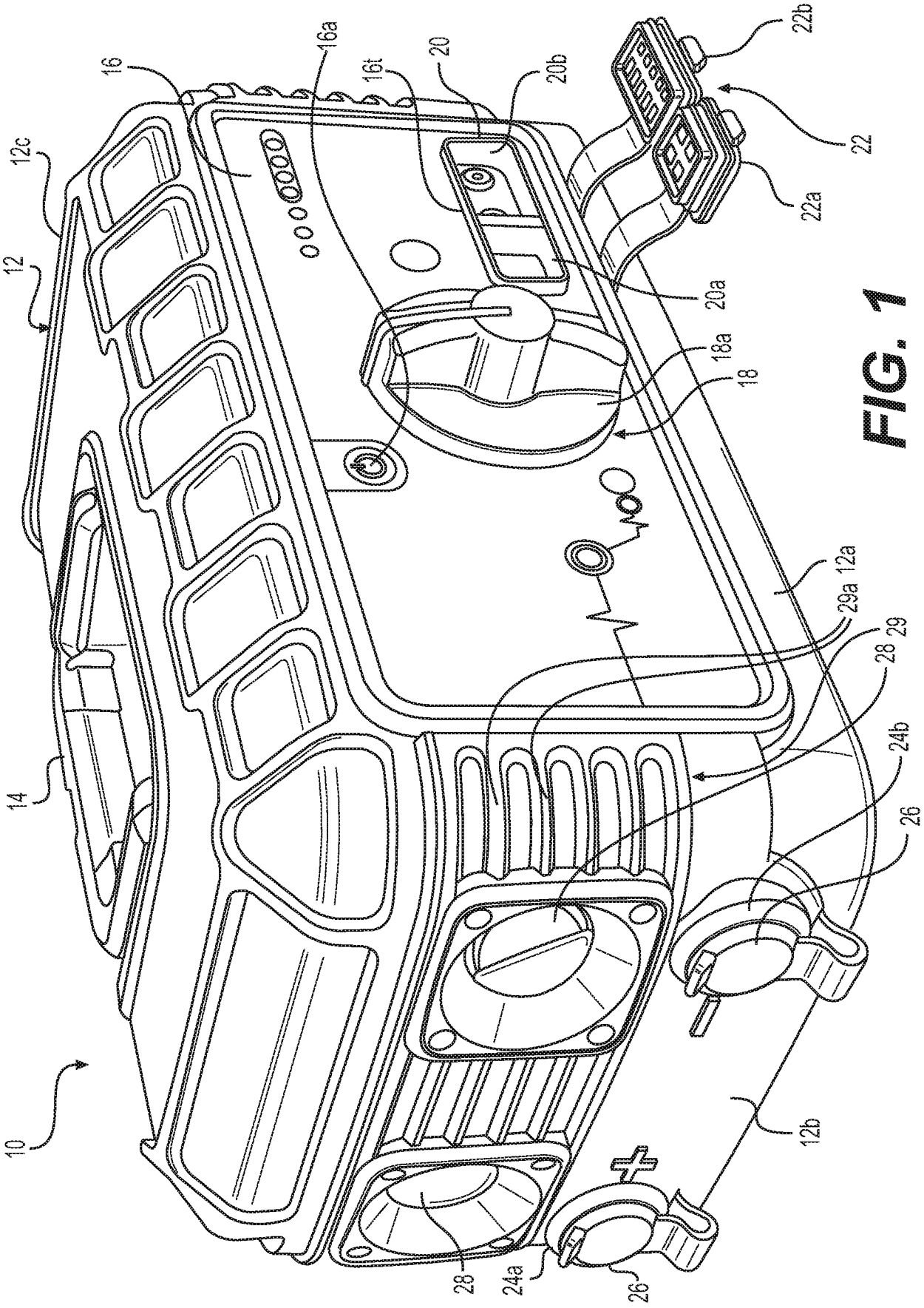

10
12
12a
12b
12c
14
16
16a
16t
18
18a
20
20a
20b
22
22a
22b
24a
24b
26
28
29
29a

FIG. 1

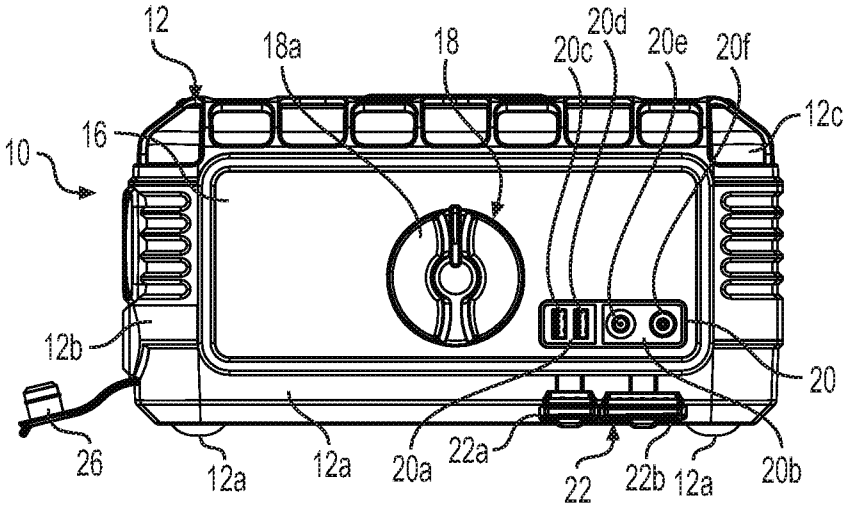


FIG. 2

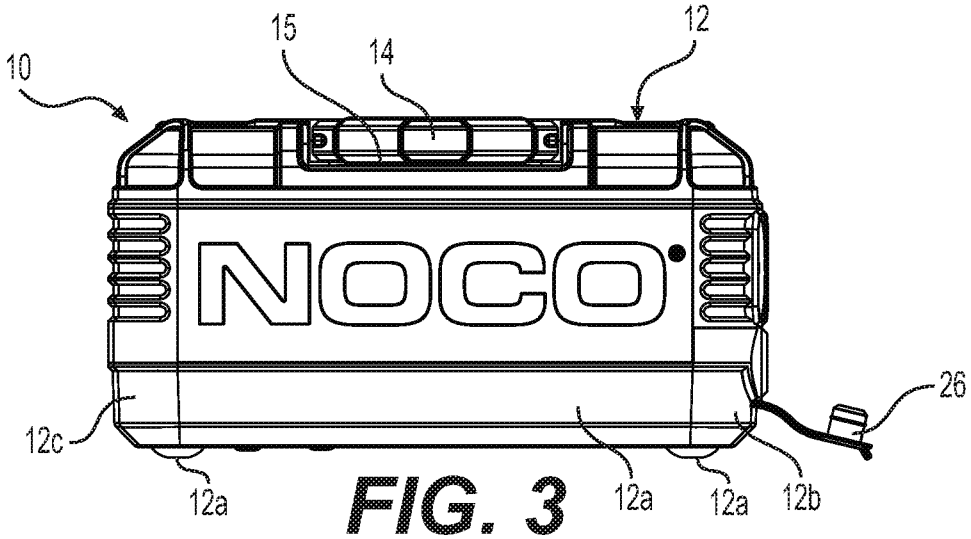


FIG. 3

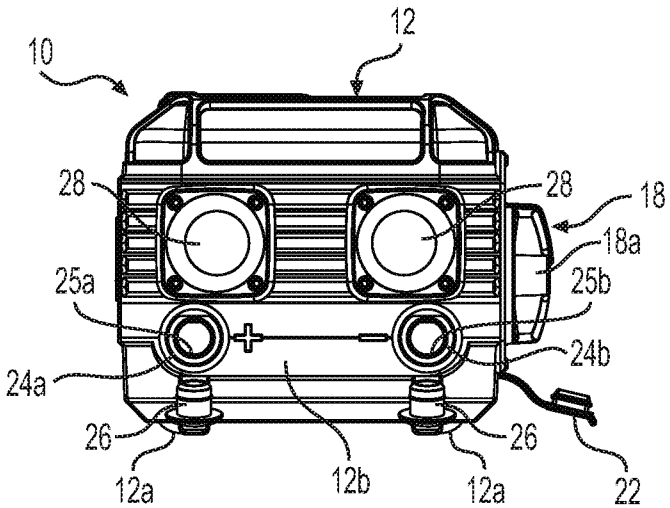


FIG. 4

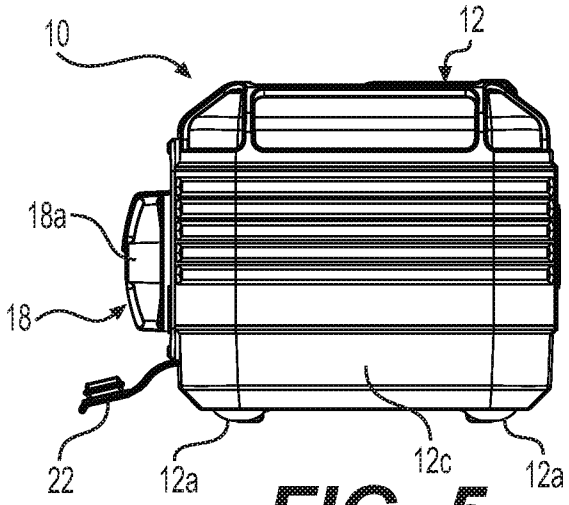


FIG. 5

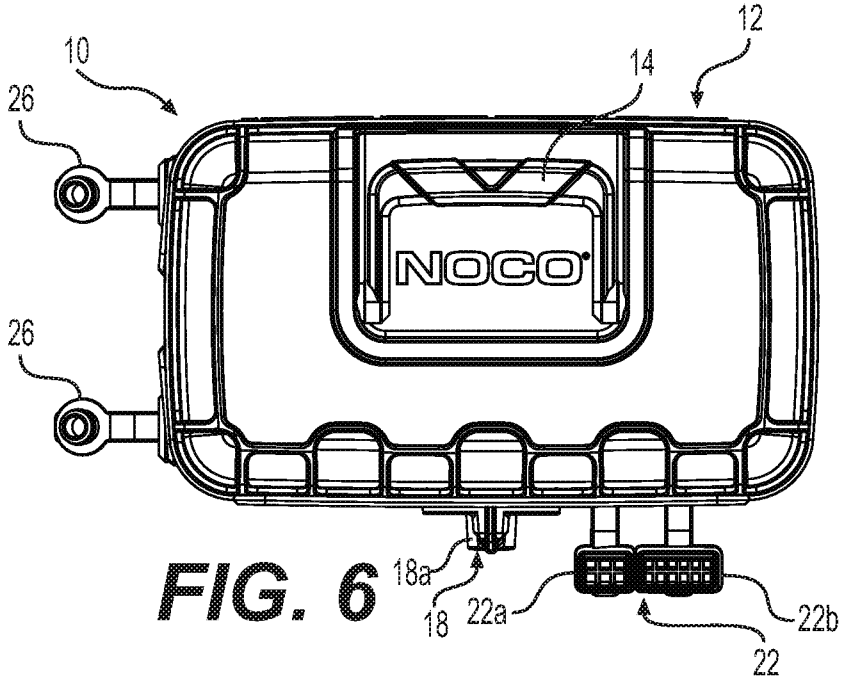


FIG. 6

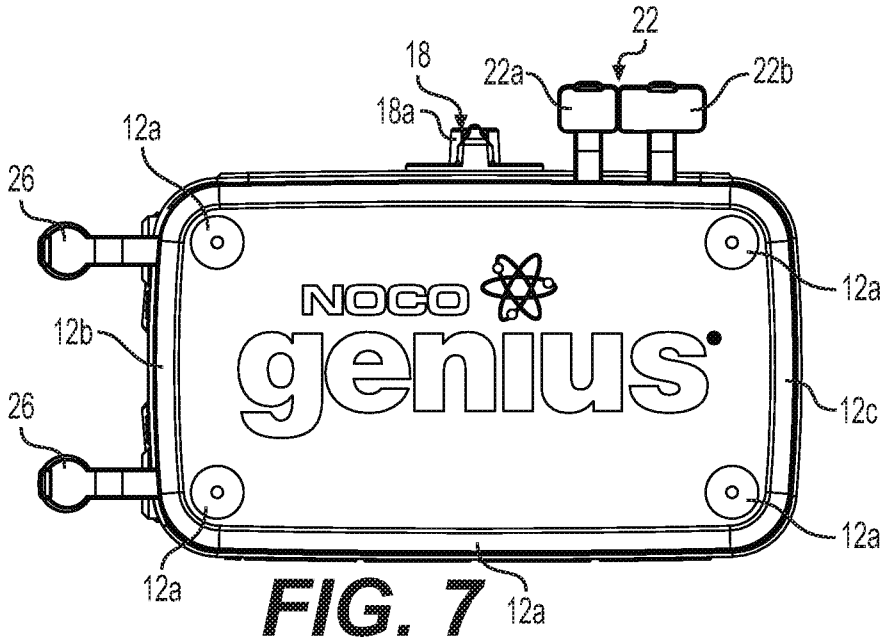


FIG. 7

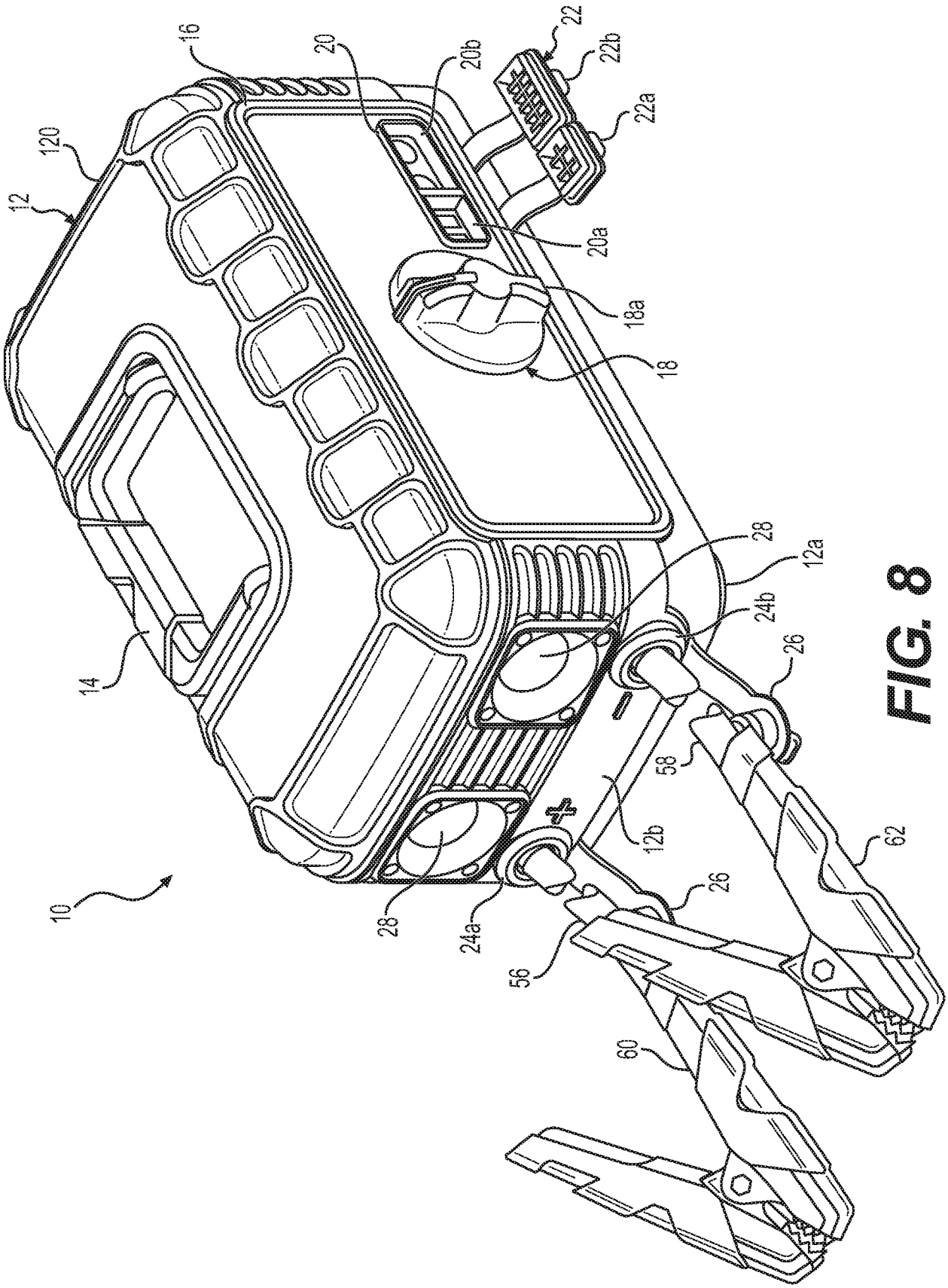

16
20
20b
22
22b
22a
120
12
20a
18a
18
28
12a
24b
26
14
58
12b
62
26
10
28
24a
56
60

FIG. 8

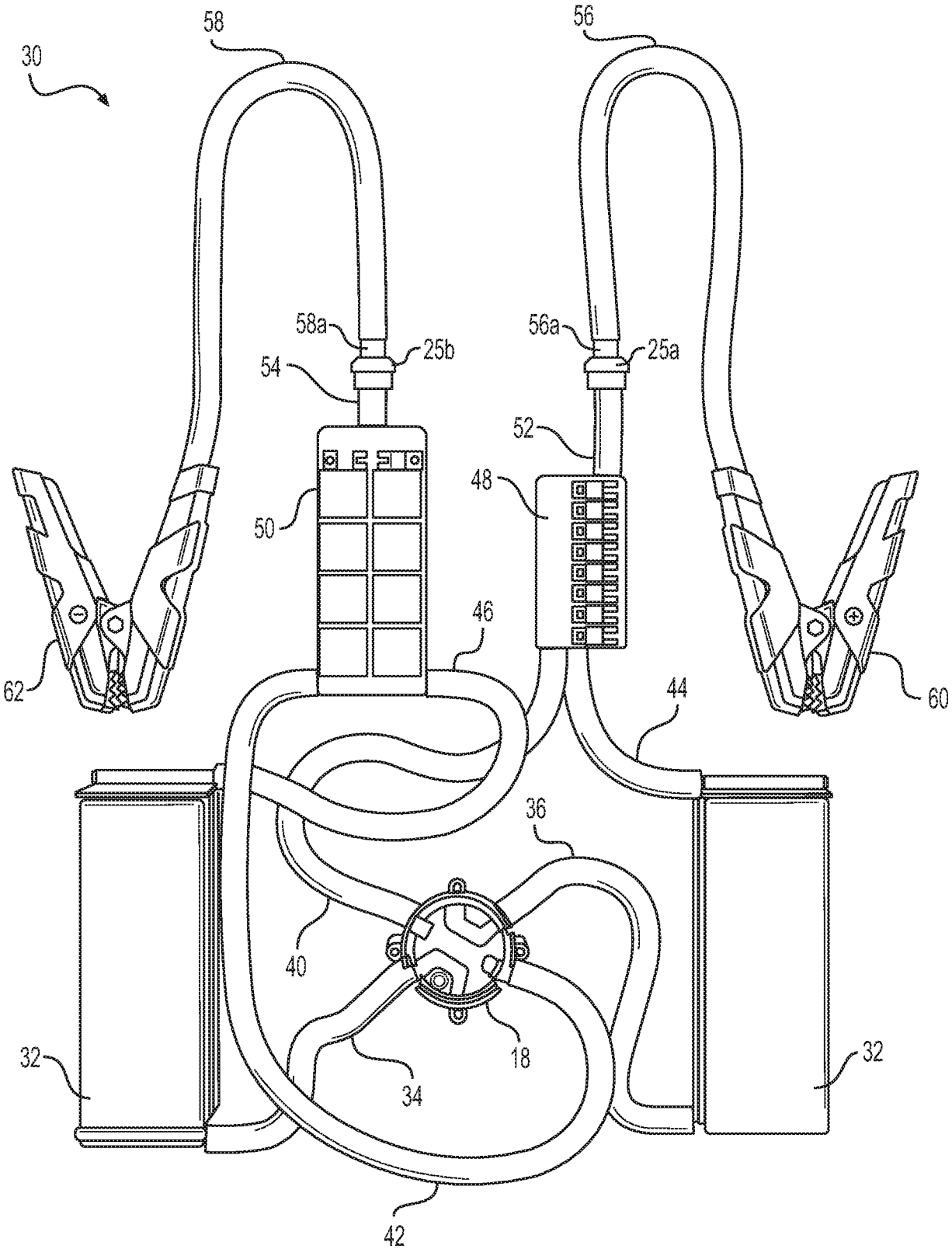


FIG. 9

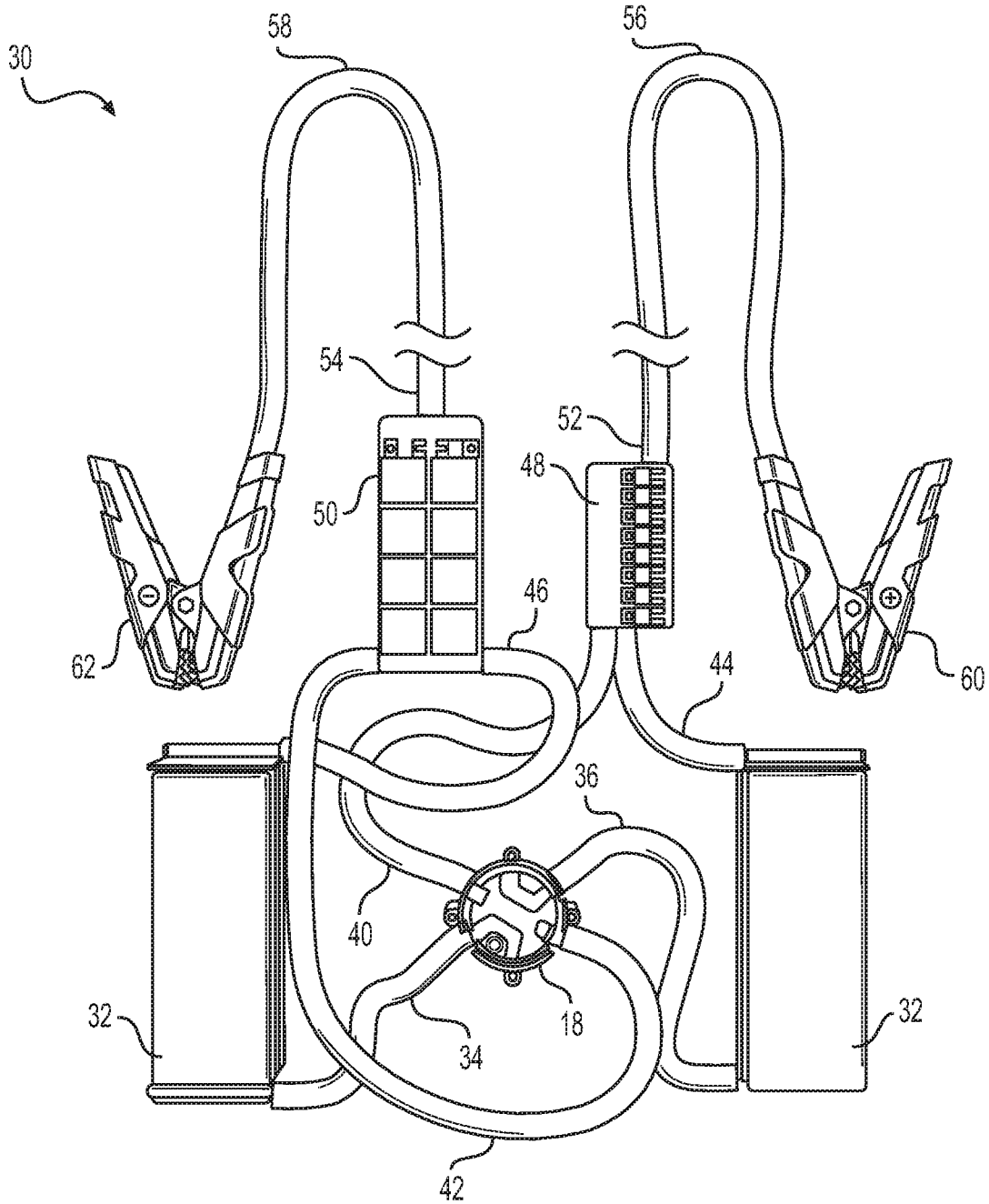


FIG. 10

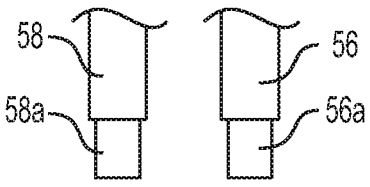


FIG. 11

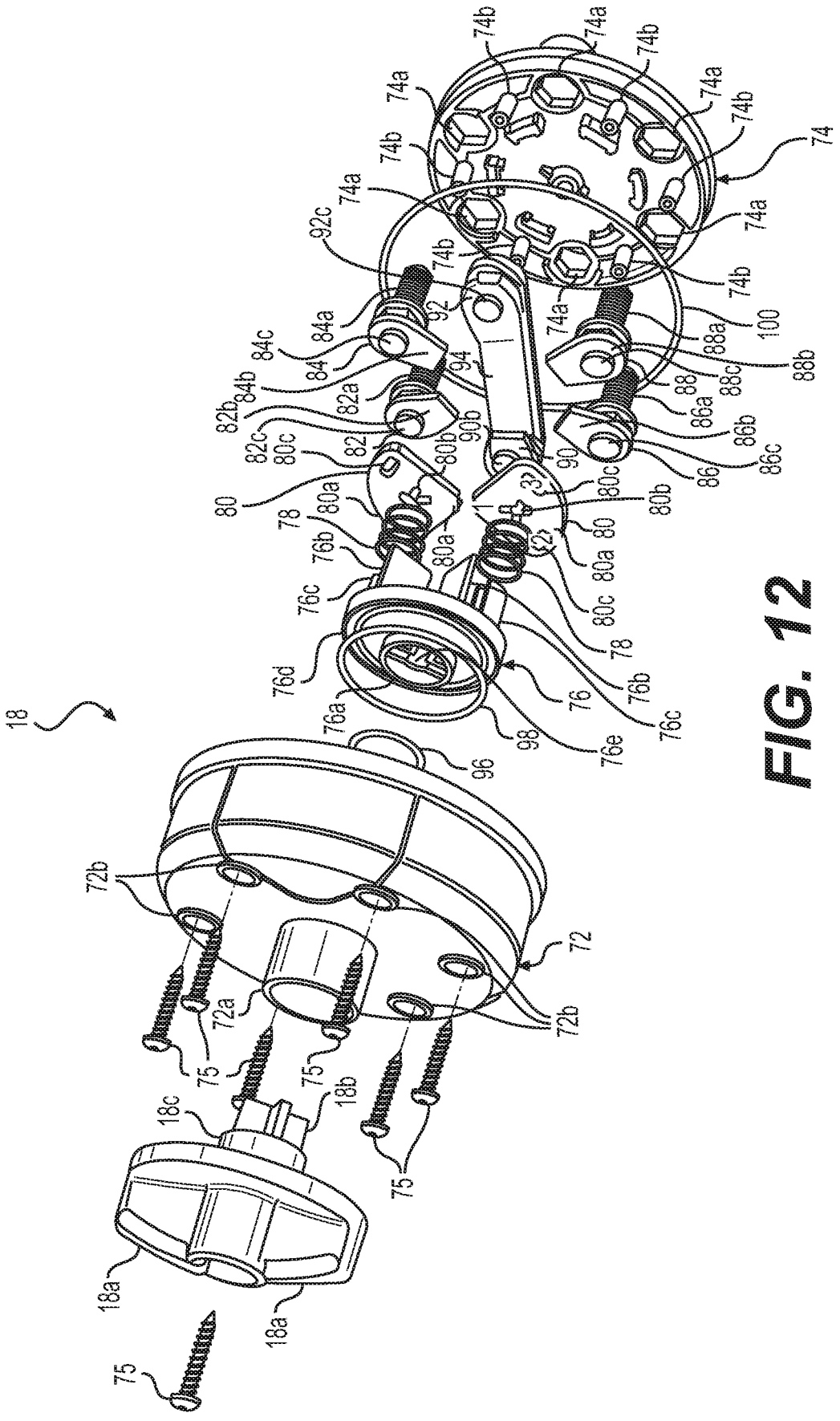

18
18a
18b
18c
72
72a
72b
74
74a
74b
75
76
76a
76b
76c
76d
76e
78
80
80a
80b
80c
82
82a
82b
82c
84
84a
84b
84c
86
86a
86b
86c
88
88a
88b
88c
90
90b
92
92c
94
96
98
100

FIG. 12

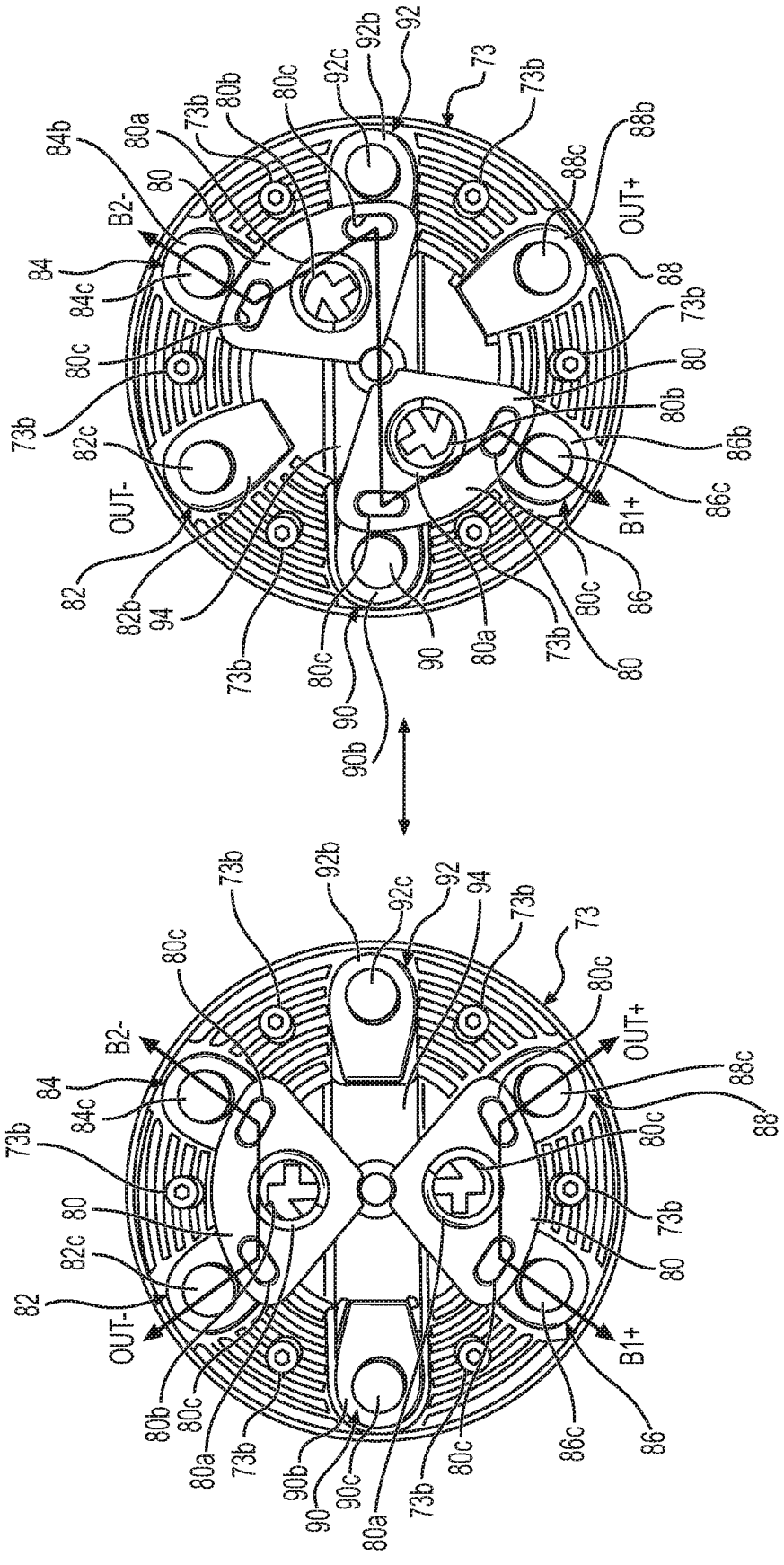

92b
92
73
73b
92c
80b
80c
80a
84b
B2-
80
84
84c
82c
OUT-
82
82b
94
90
90b
88b
88c
OUT+
88
86b
86c
B1+
86
92
92c
94
73
84
84c
82c
82
80
80b
80a
90
90b
90c
86c

FIG. 13

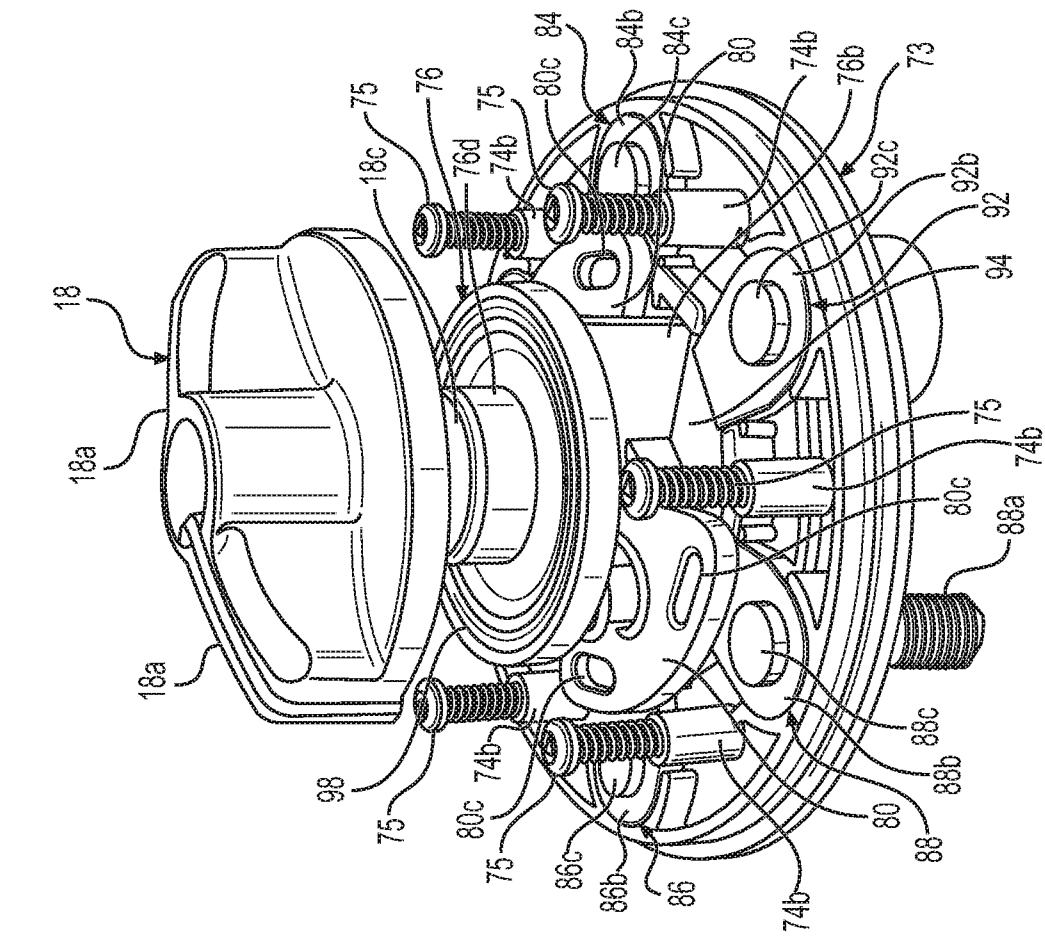

18
18a
18a
18c
75
76
76d
75
74b
80c
84
84b
84c
80
74b
76b
73
92c
92b
92
94
75
74b
80c
88a
88c
88b
80
88
74b
98
75
74b
80c
75
86c
86b
86
74b

FIG. 15

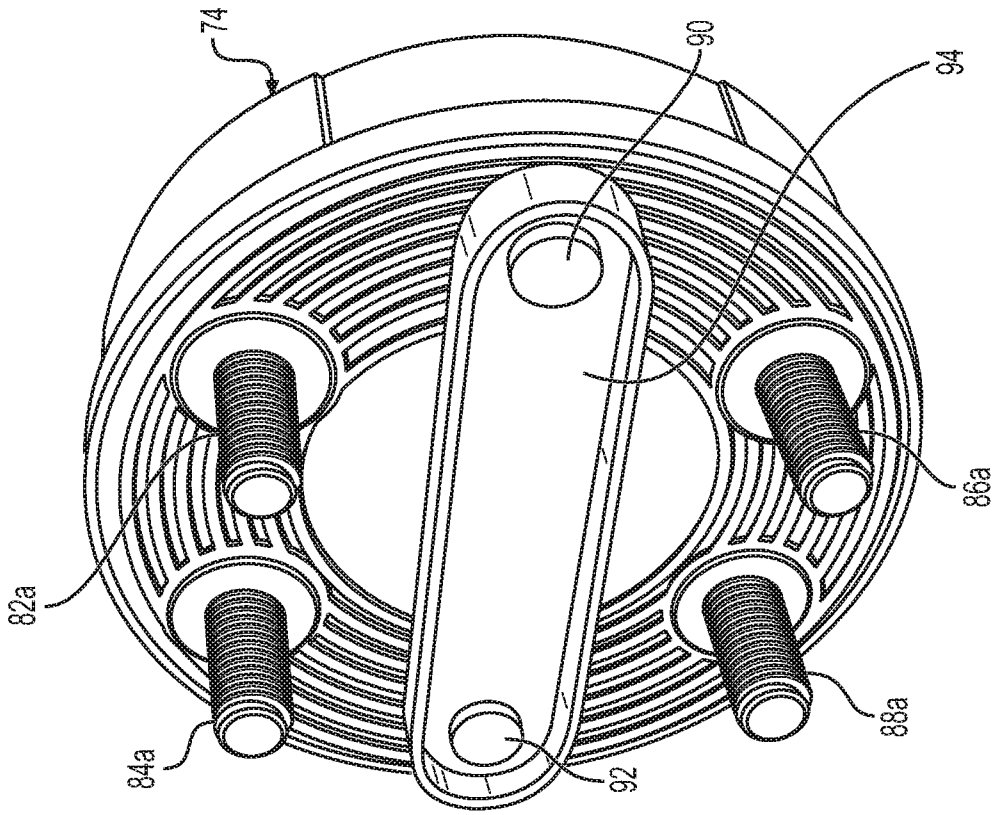

74
90
94
82a
86a
84a
92
88a

FIG. 14

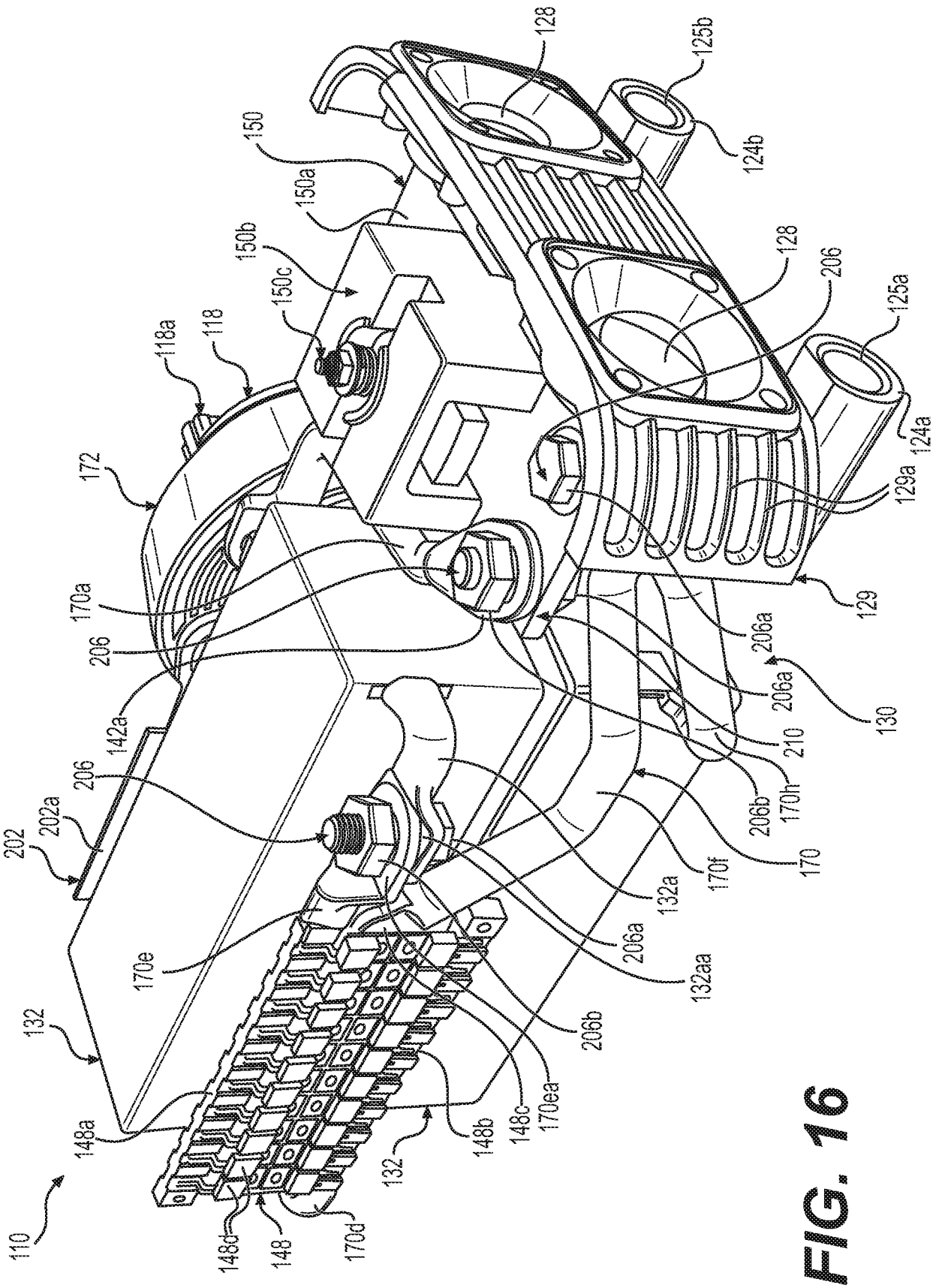

110
148a
148d
148
170d
132
148b
148c
170ea
206b
132aa
206a
170e
132a
170f
170
206b
170h
206a
210
206a
130
129
206a
129a
124a
125a
206
128
124b
125b
128
150
150a
150b
150c
118
118a
172
170a
206
142a
206
202a
202

FIG. 16

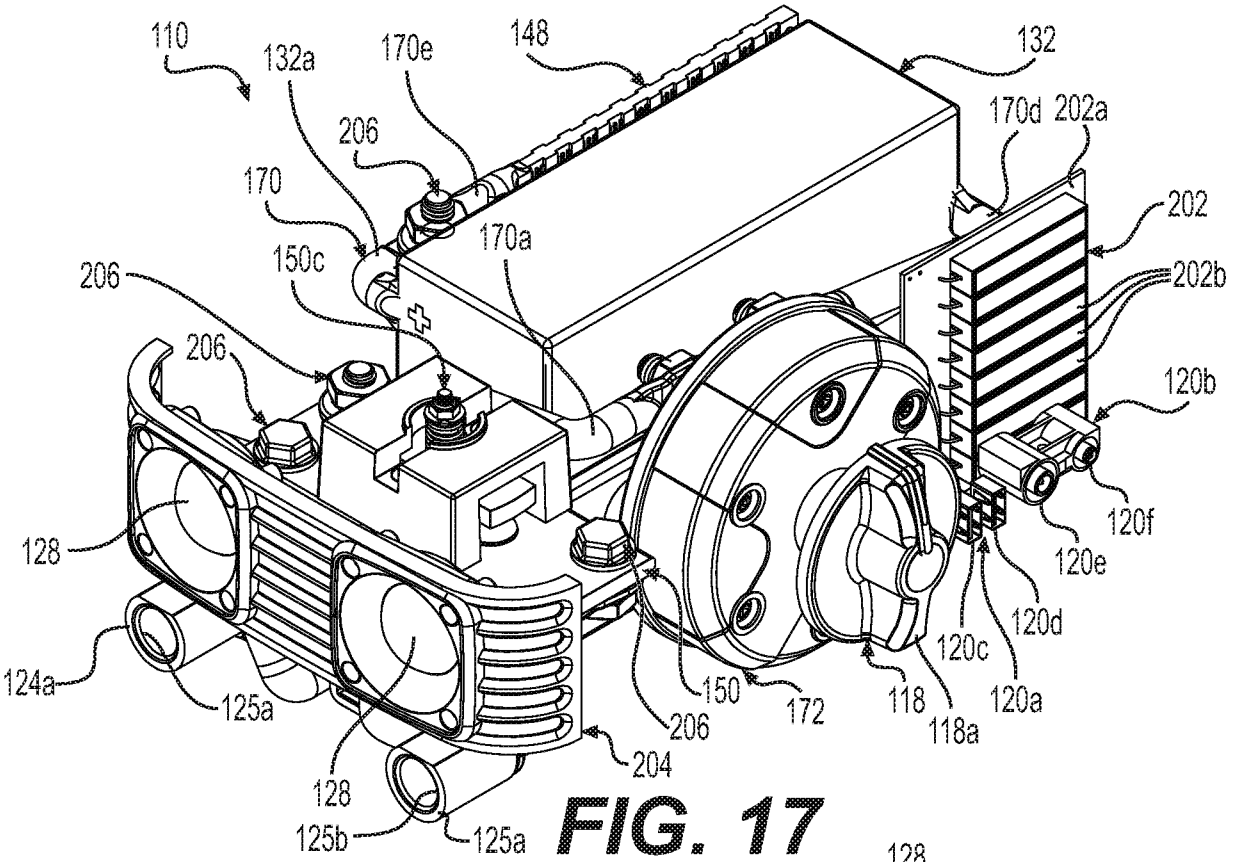

110
132a
170e
148
132
170d
202a
206
170
202
170a
150c
202b
206
206
120b
128
120f
120e
120d
120c
120a
124a
125a
150
172
118
118a
206
204
128
125b
125a

FIG. 17

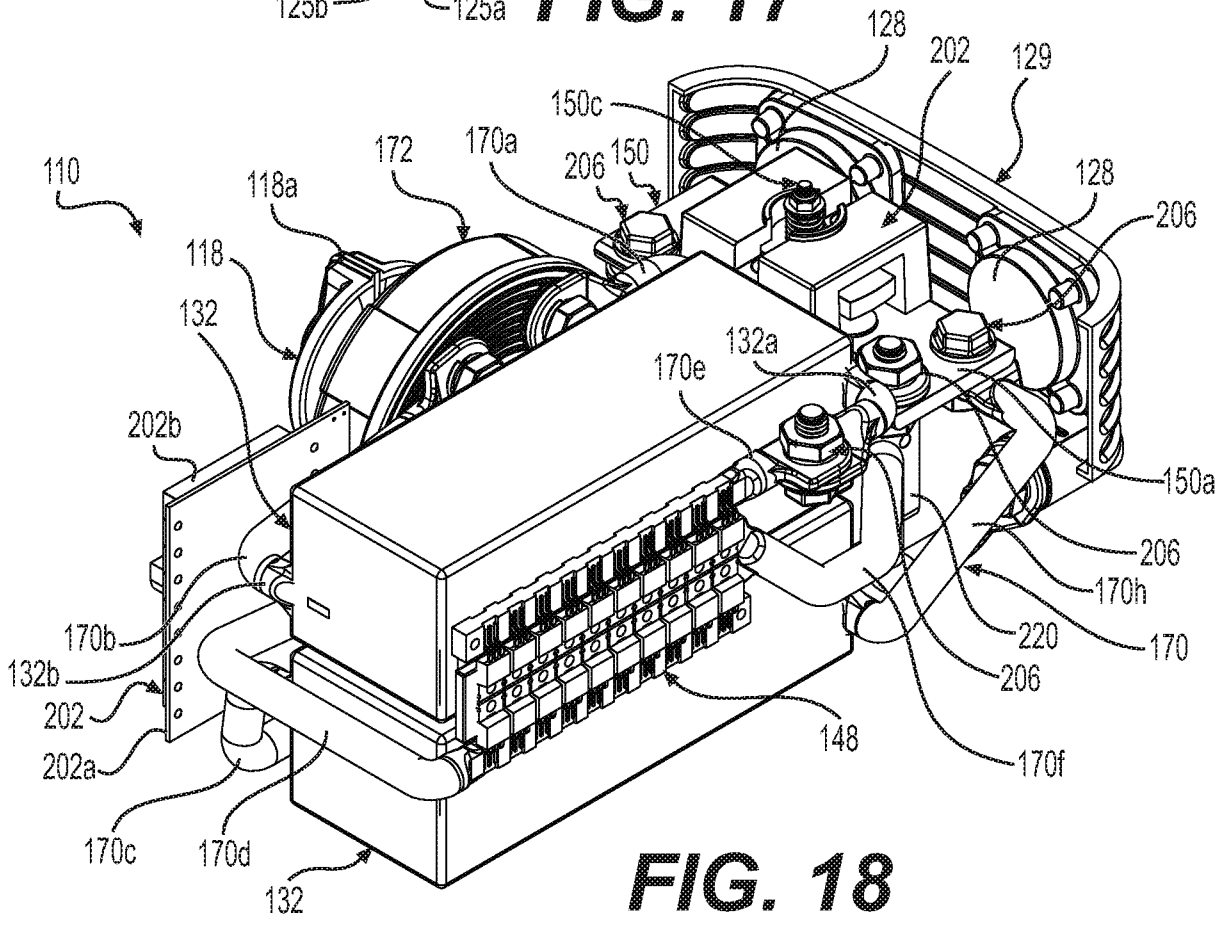

128
202
129
150c
172
170a
206
150
110
118a
128
206
118
132
132a
170e
150a
202b
206
170h
170b
220
170
132b
206
202
148
202a
170f
170c
170d
132

FIG. 18

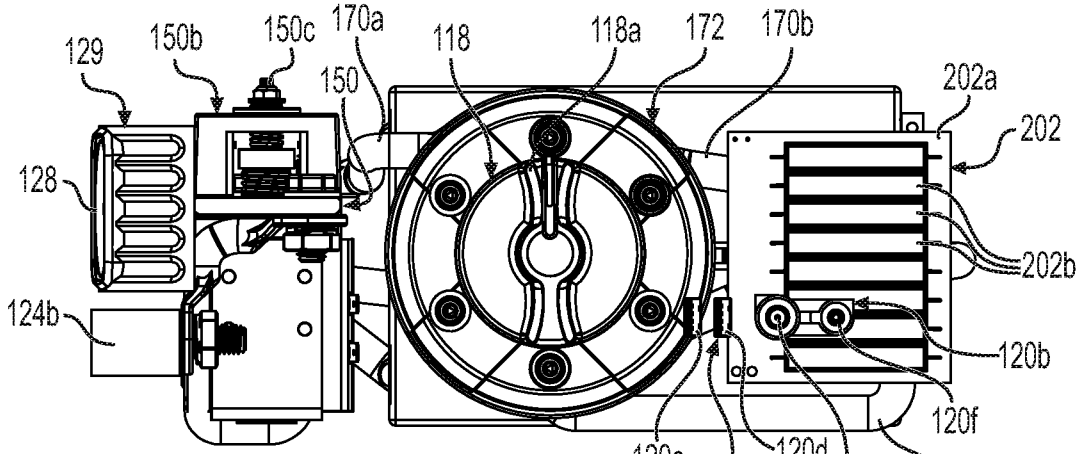


FIG. 19

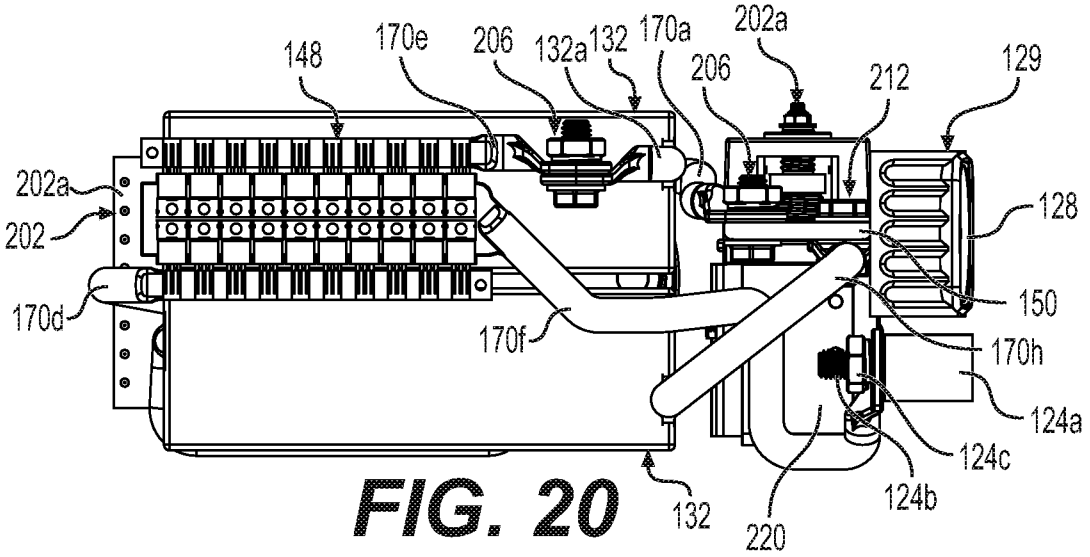


FIG. 20

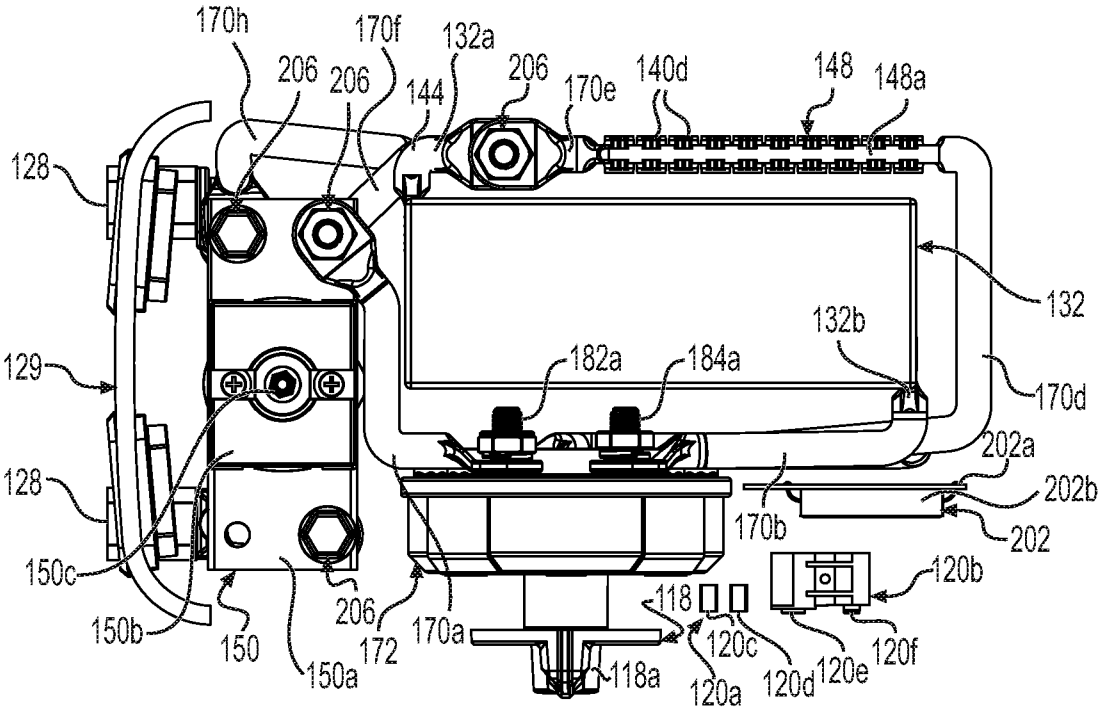


FIG. 21

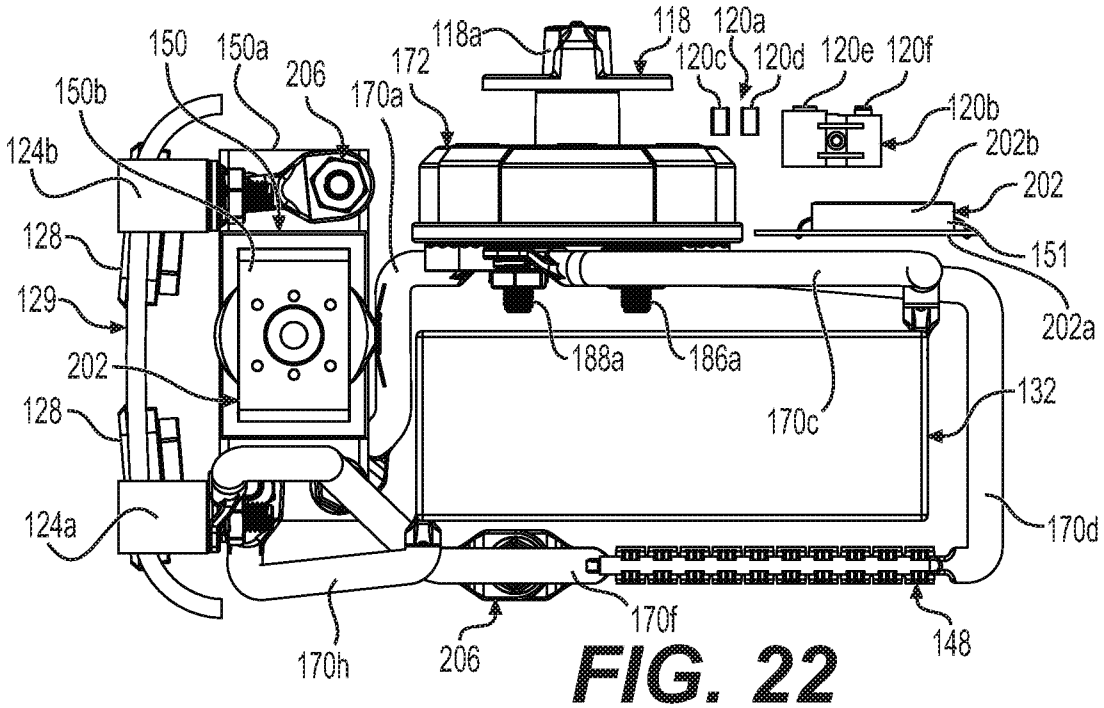


FIG. 22

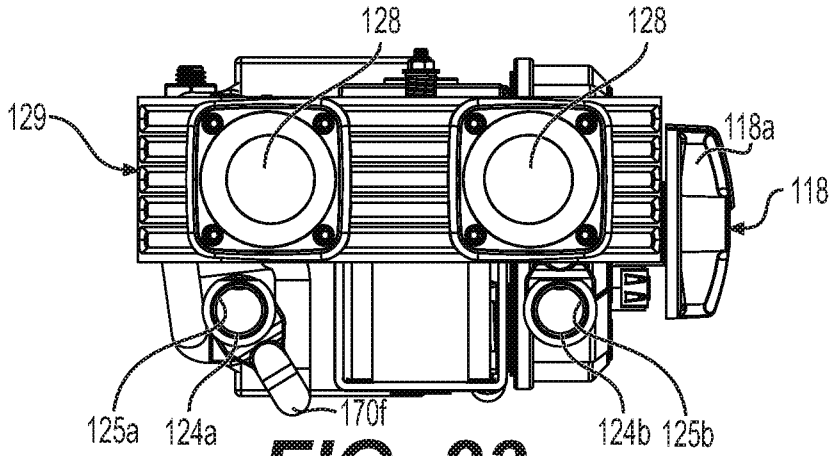


FIG. 23

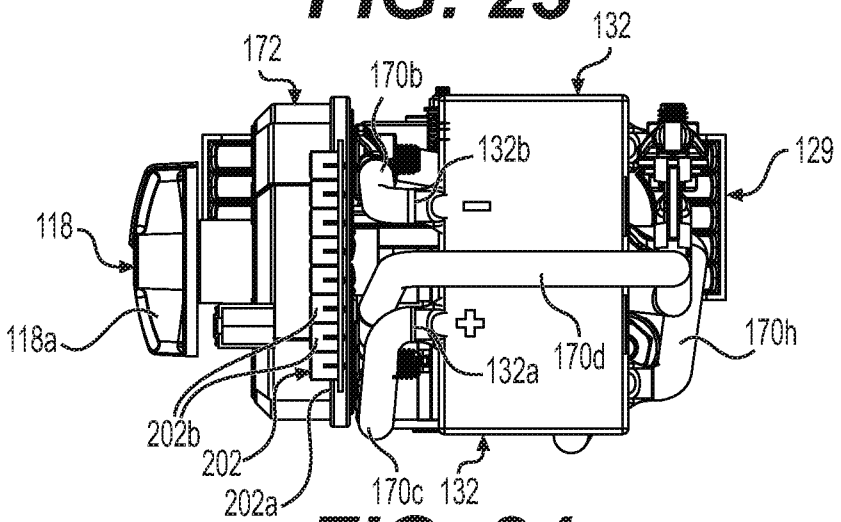


FIG. 24

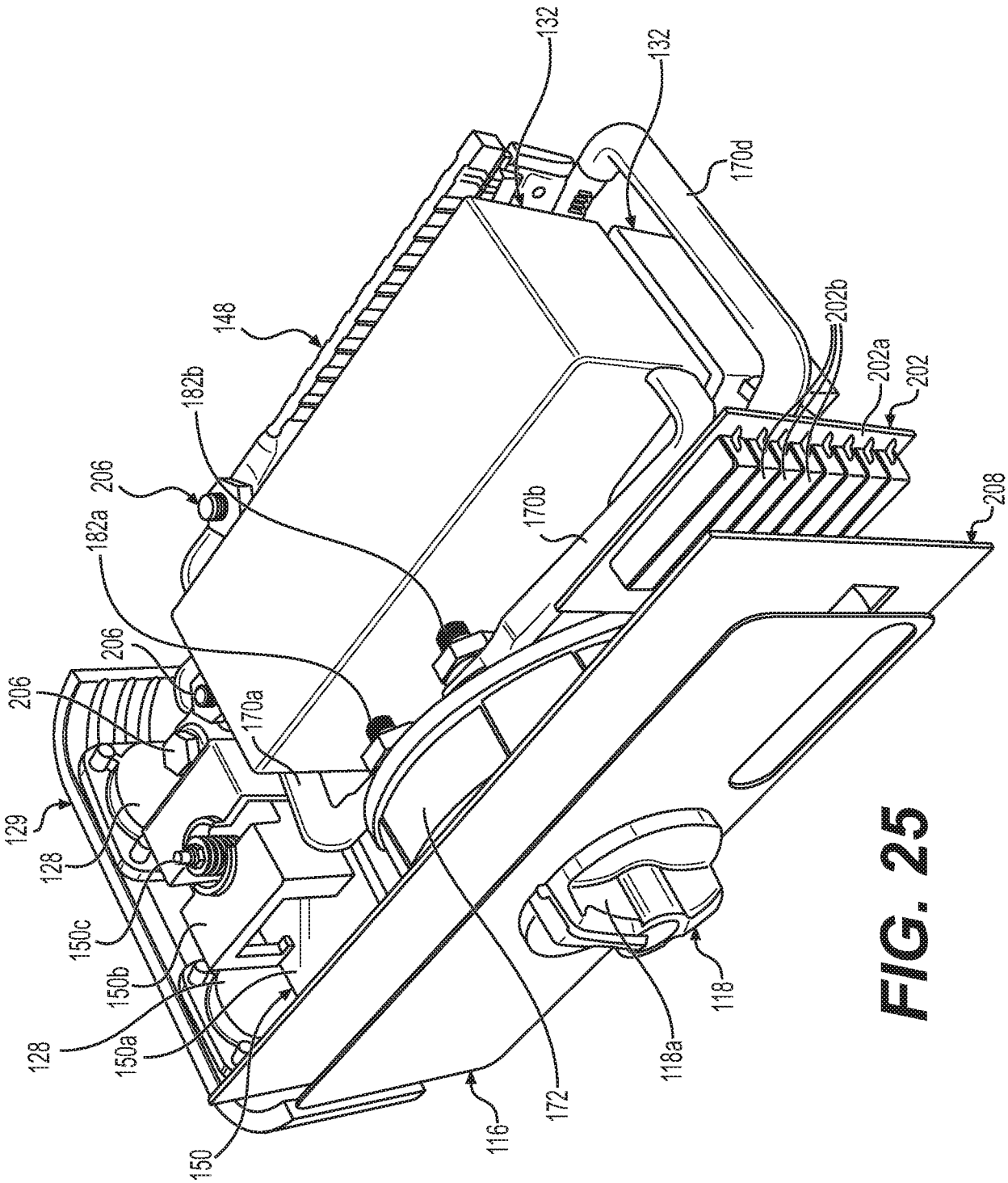

132
132
170d
148
202b
202a
202
182b
206
208
182a
206
170b
206
170a
129
128
150c
150b
128
150a
150
116
172
118a
118

FIG. 25

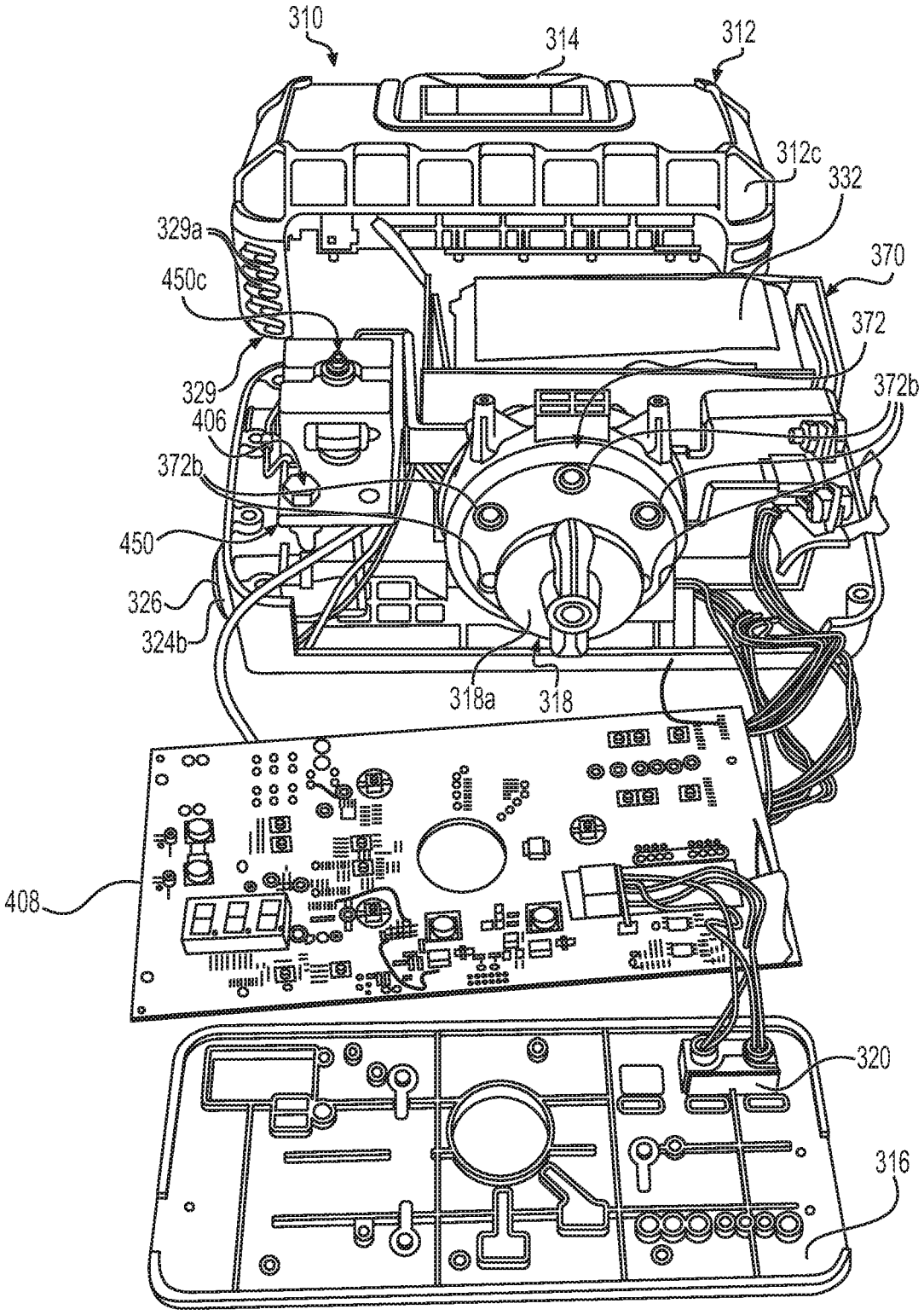

310
314
312
312c
332
329a
370
450c
372
329
372b
406
372b
450
326
324b
318a
318
408
320
316

FIG. 26

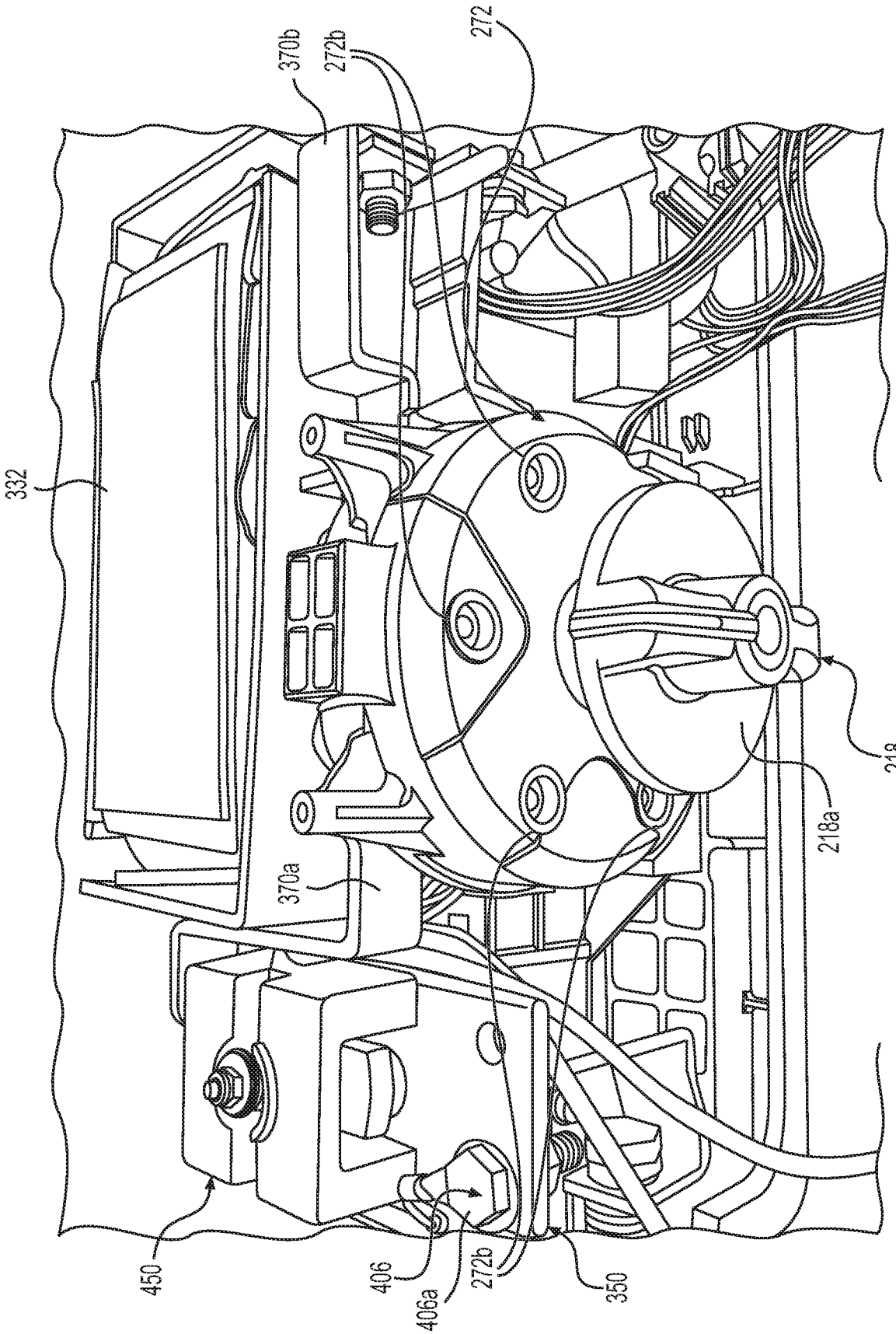


FIG. 27

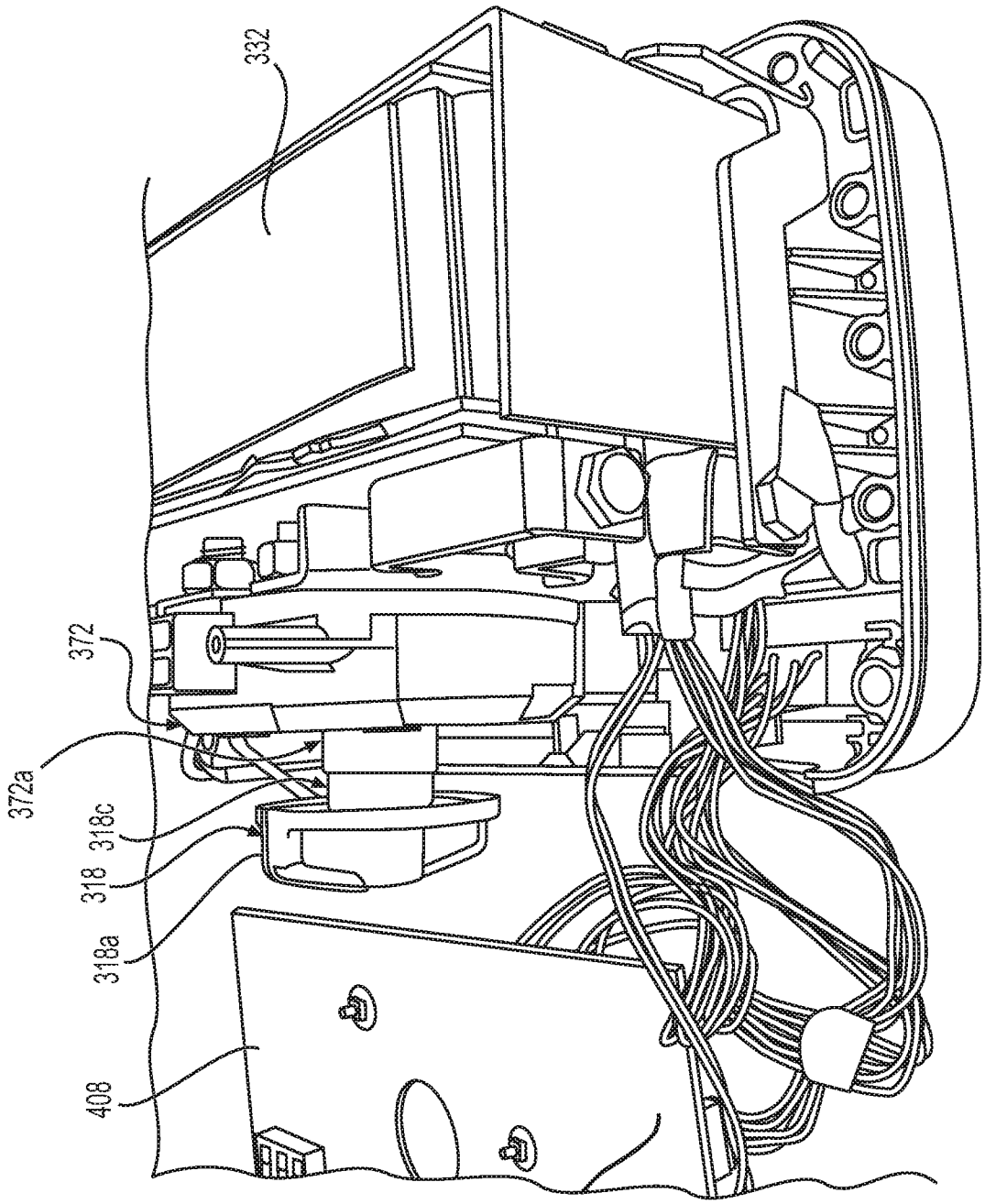


FIG. 28

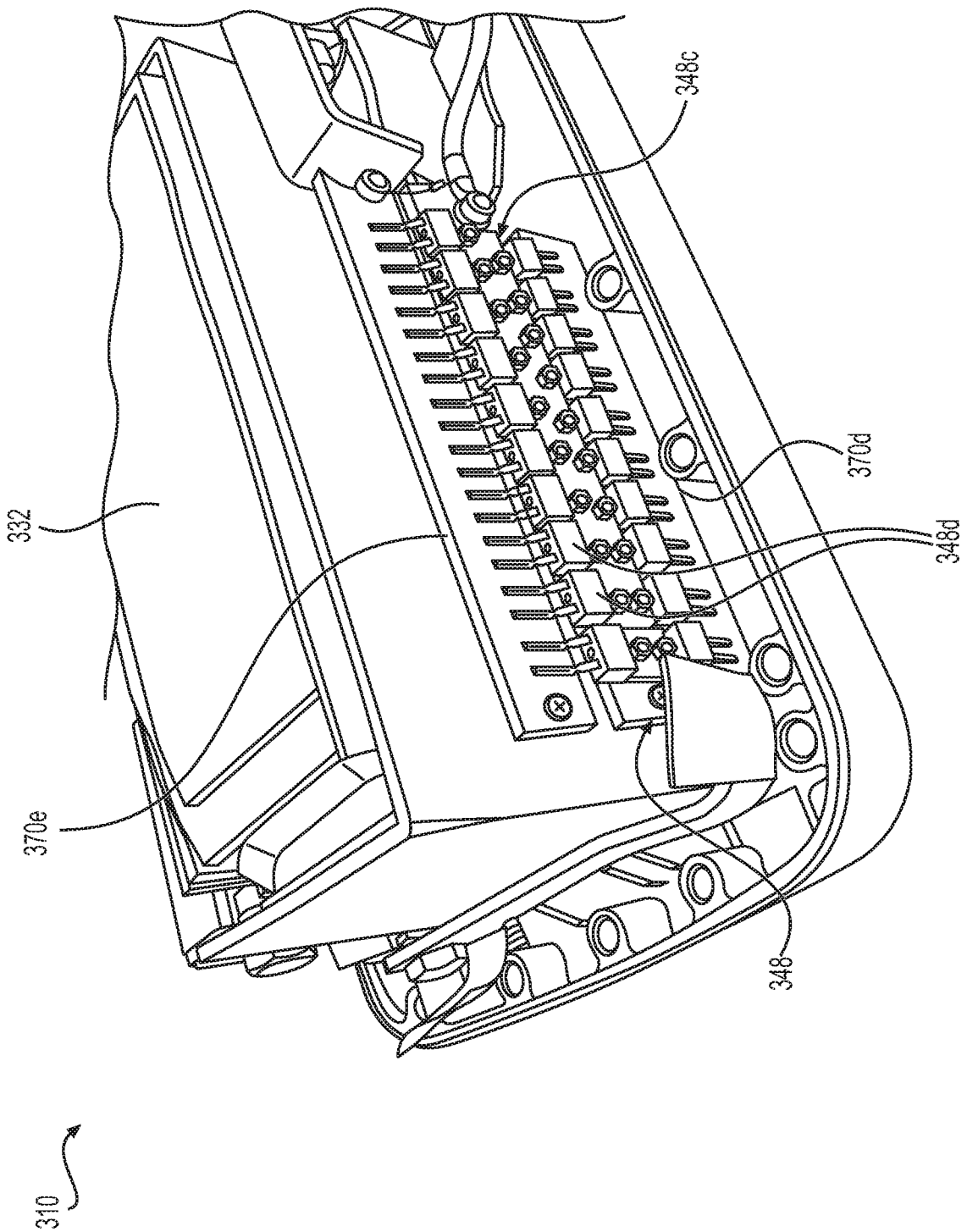


FIG. 29

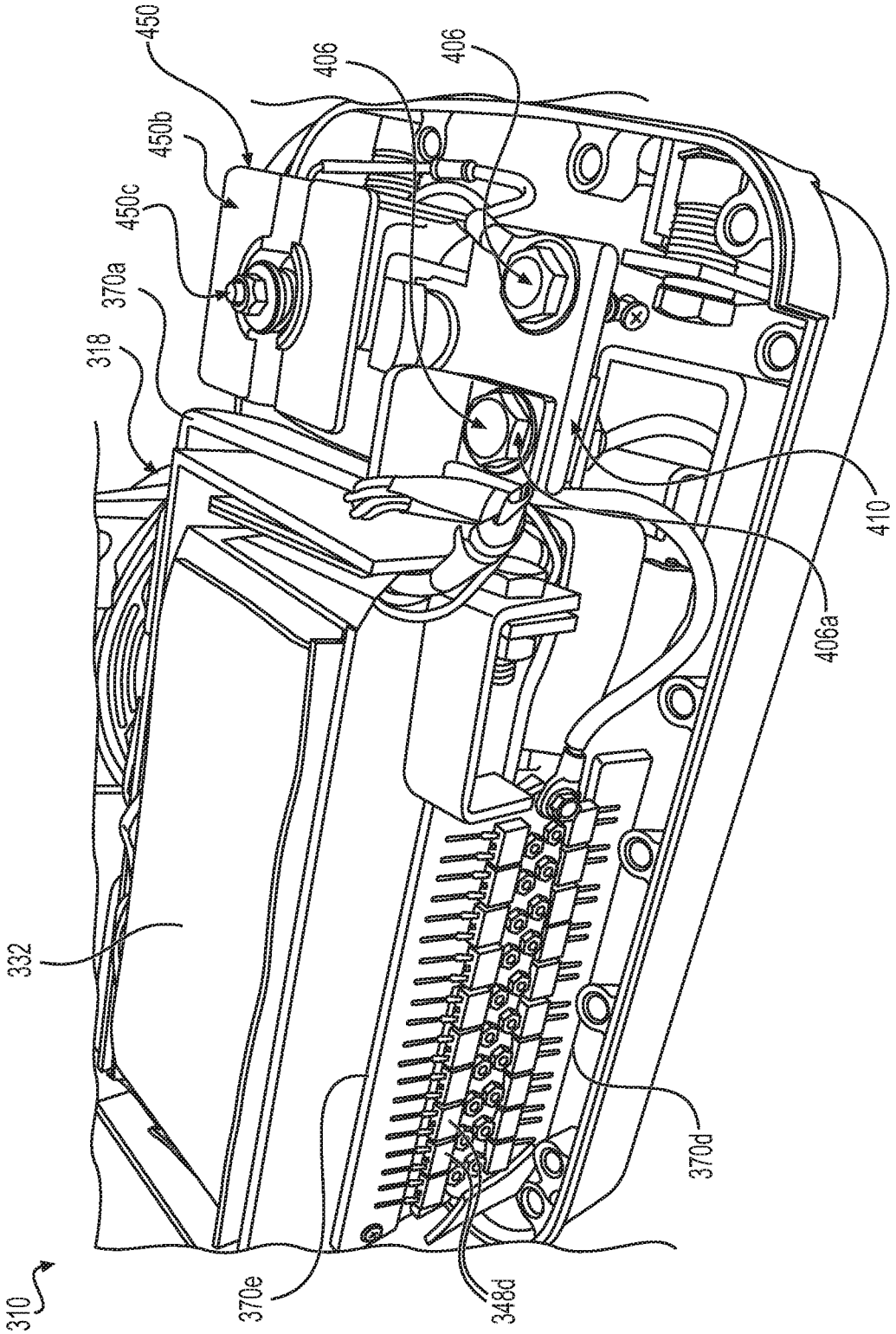


FIG. 30

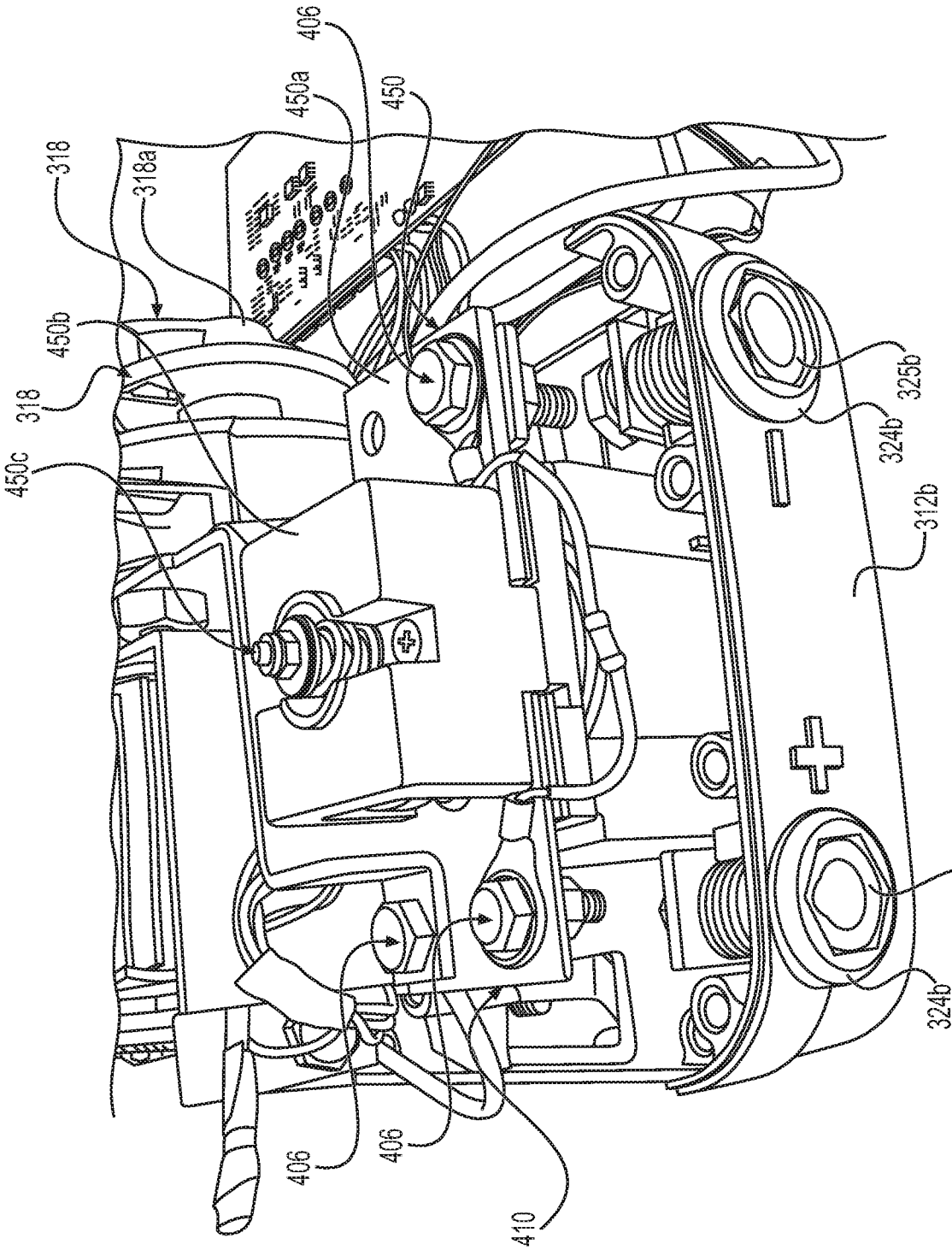

406
450a
450
318
318a
450b
318
450c
325b
324b
312b
325b
324b
406
406
410

FIG. 31

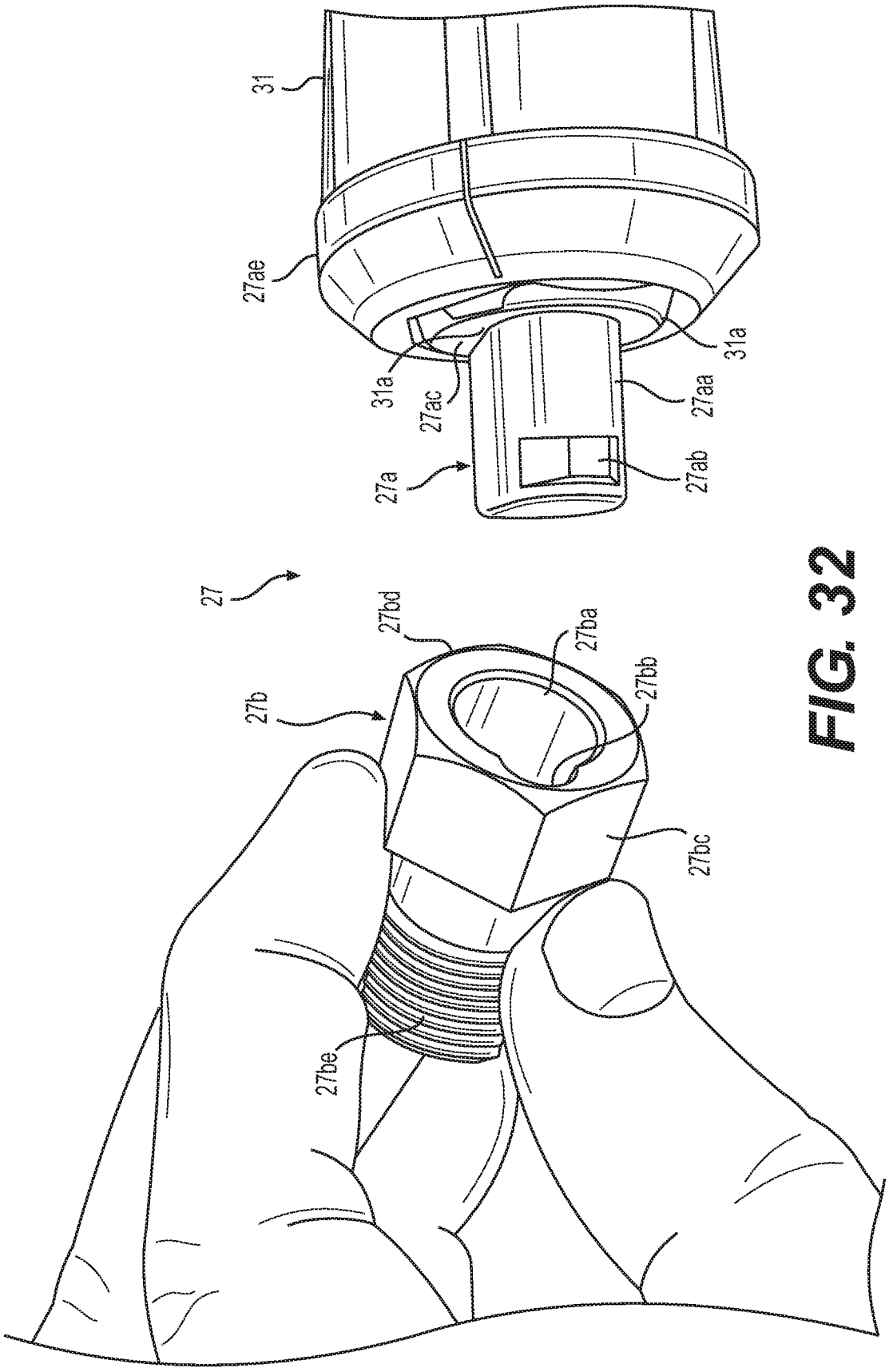

31
27ae
31a
31a
27ac
27aa
27a
27ab
27
27bd
27ba
27b
27bb
27bc
27be

FIG. 32

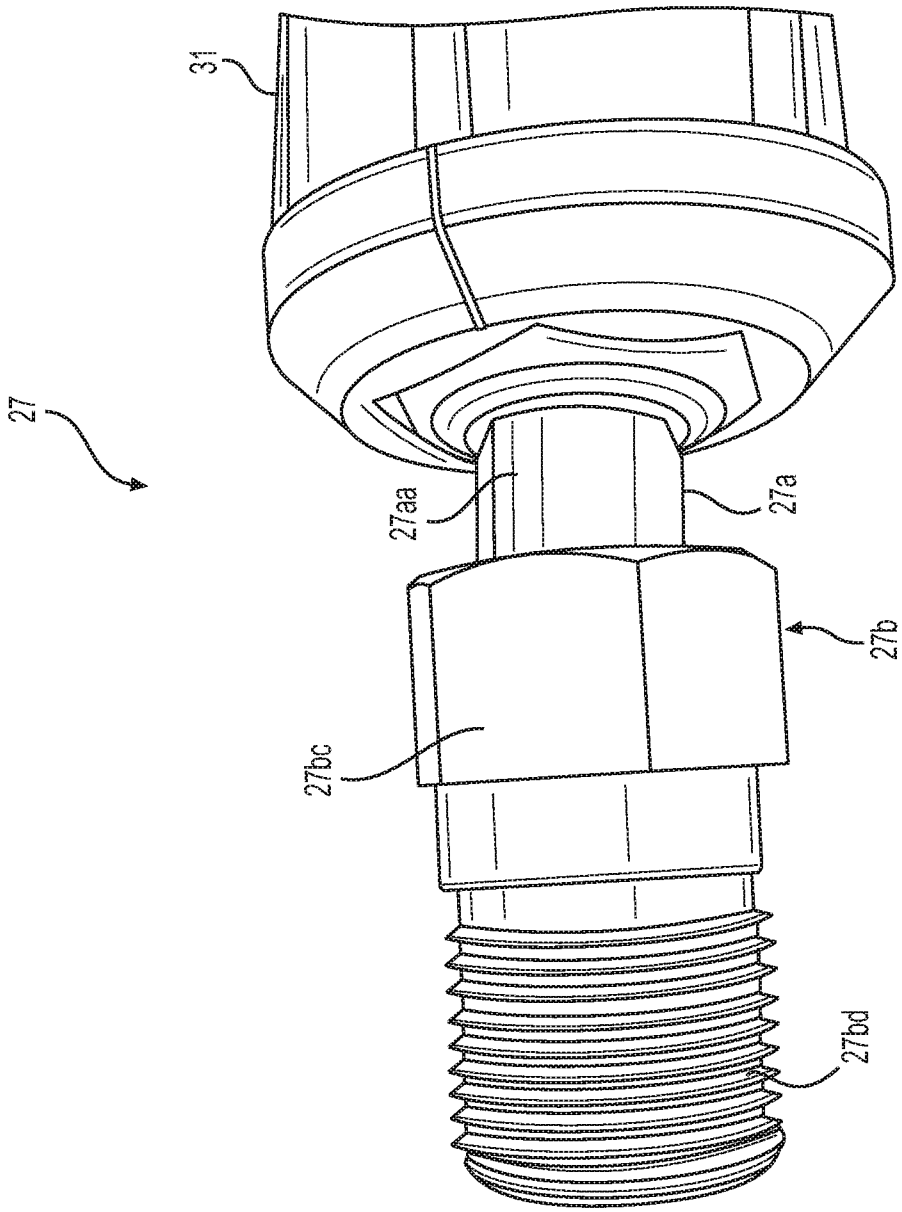


FIG. 33

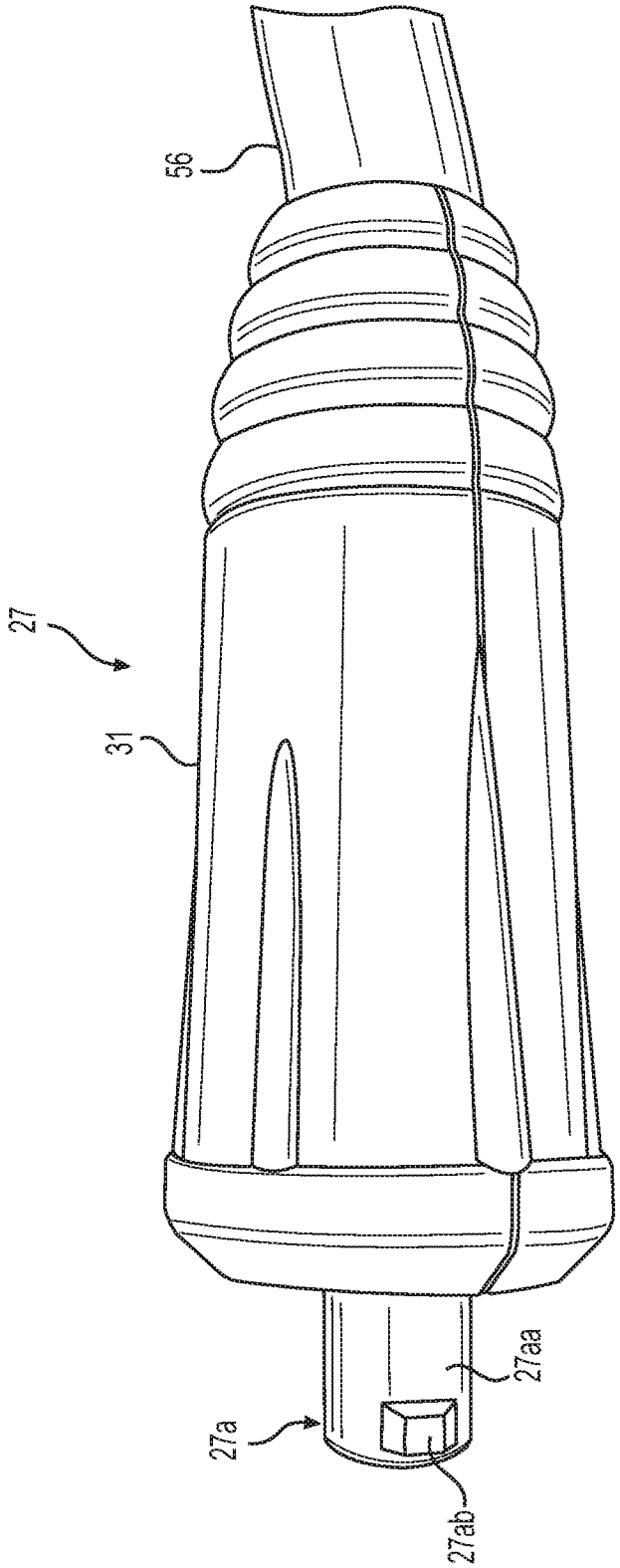


FIG. 34

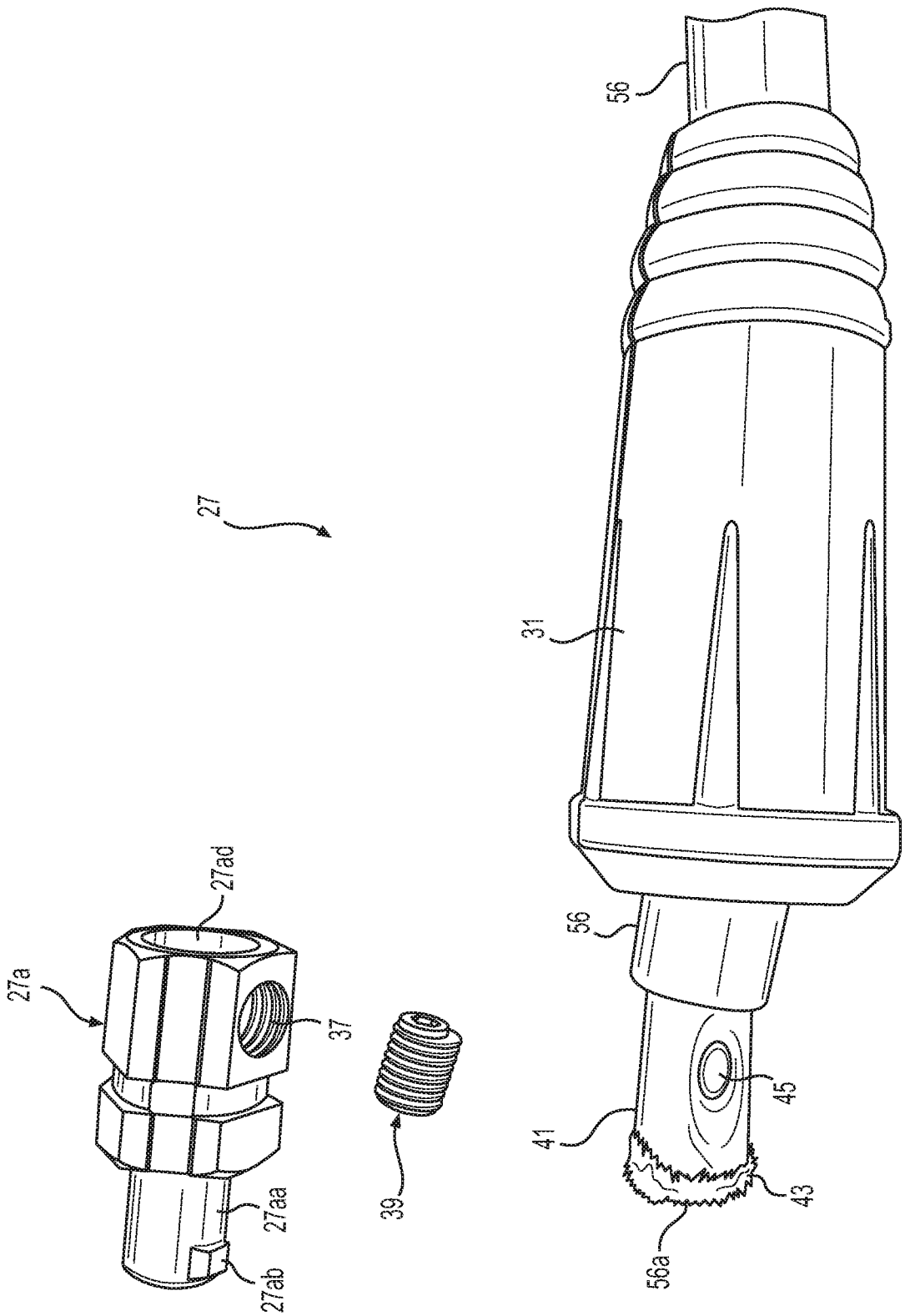


FIG. 35

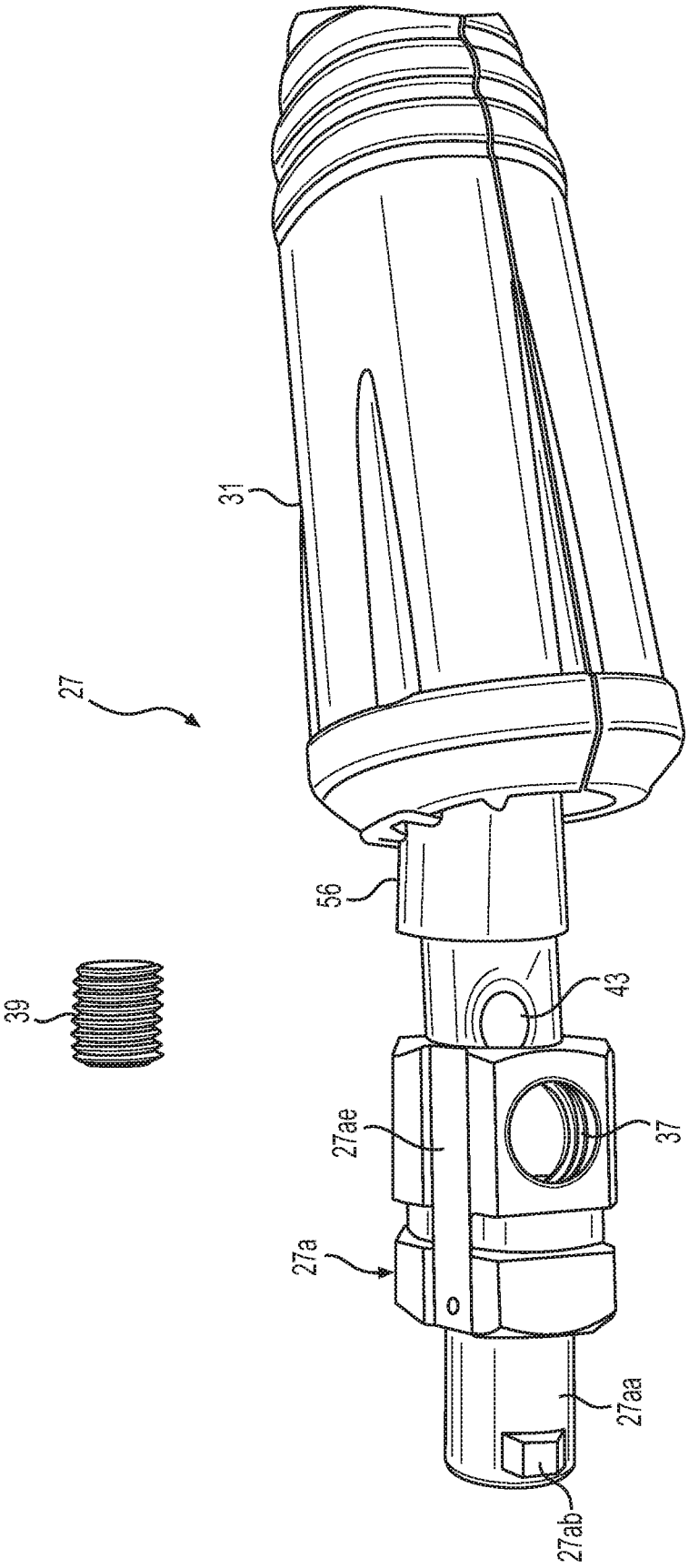


FIG. 36

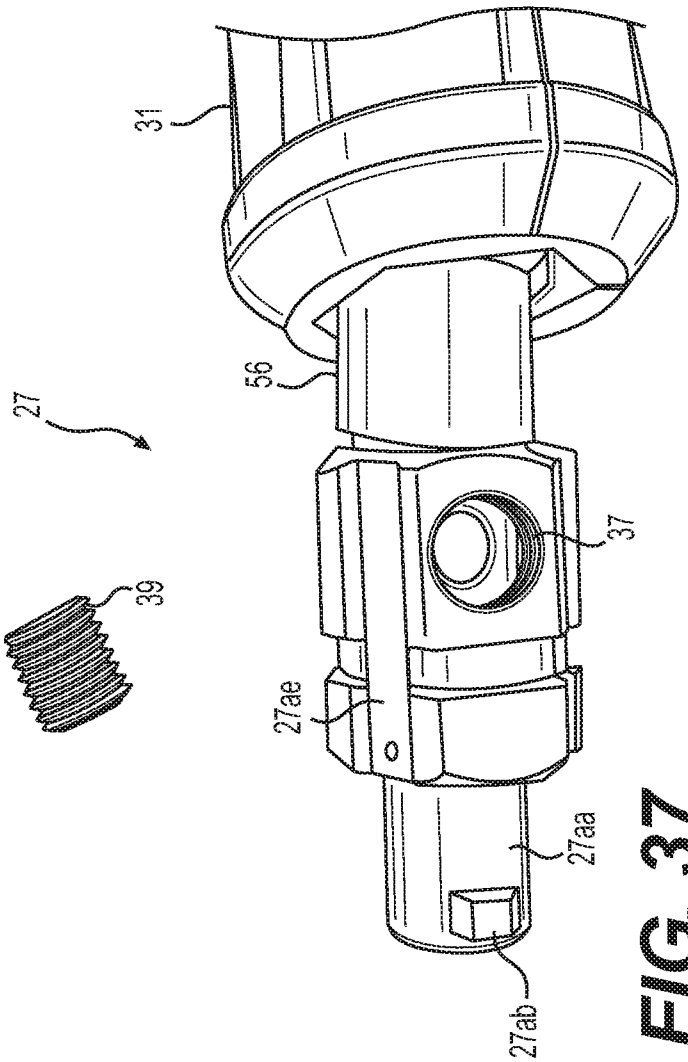


FIG. 37

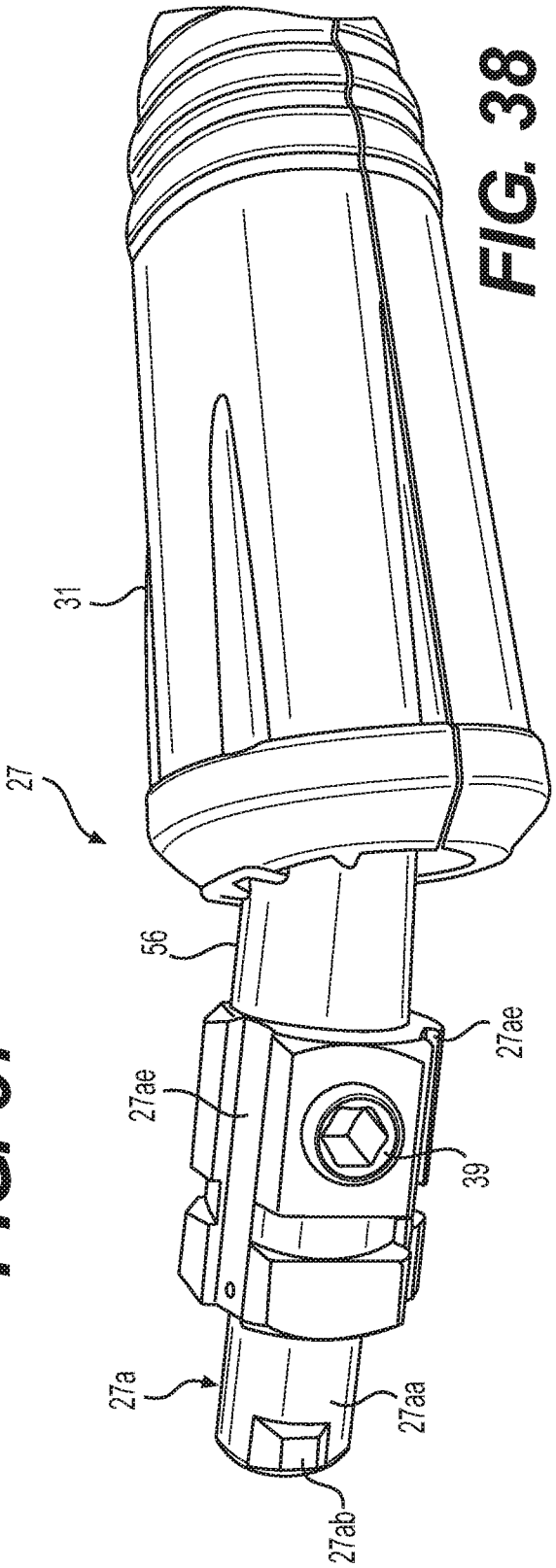


FIG. 38

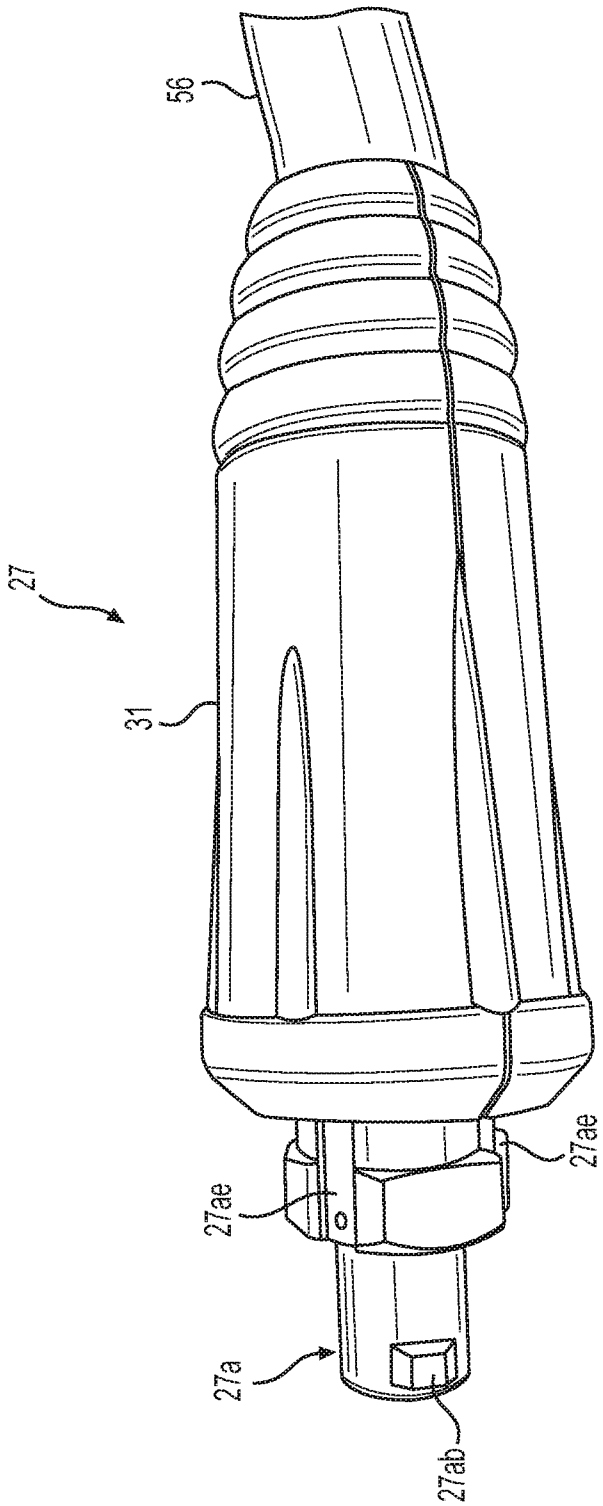


FIG. 39

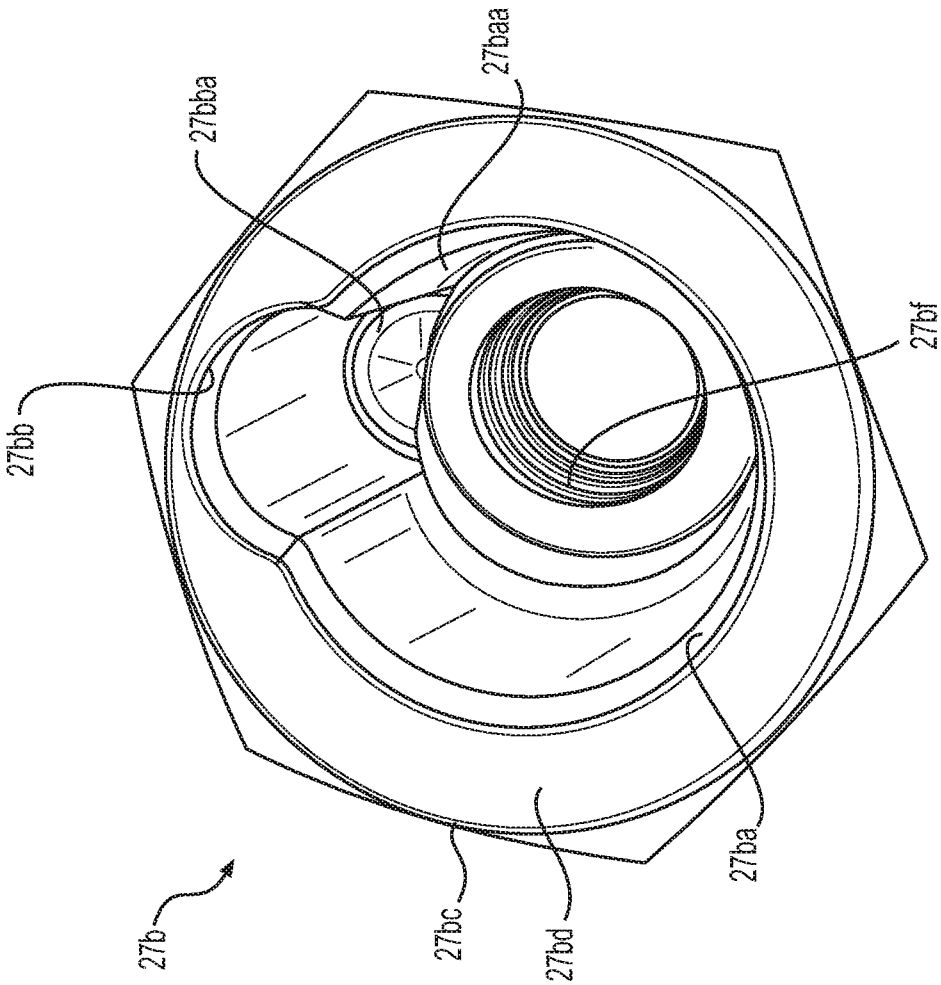


FIG. 40

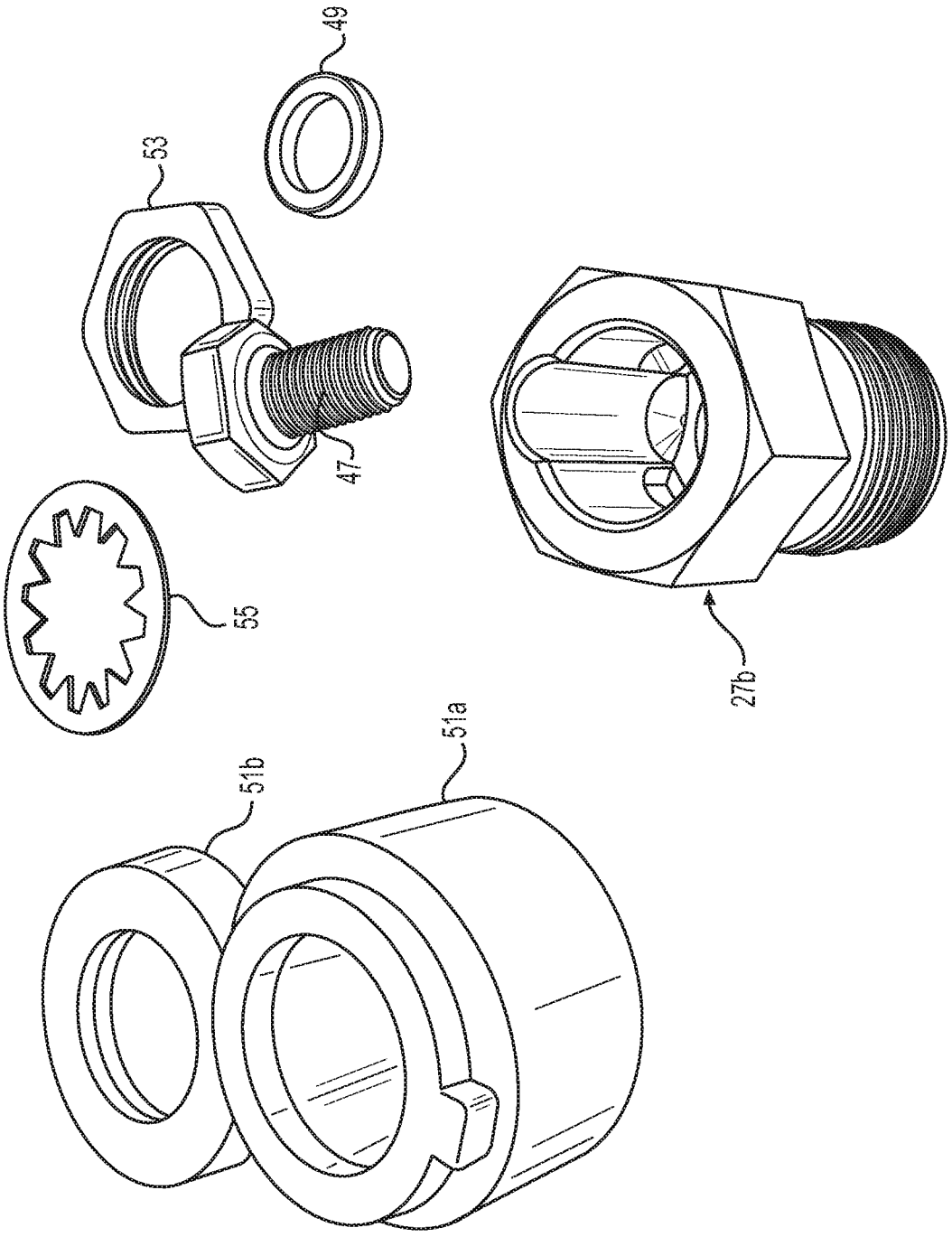


FIG. 41

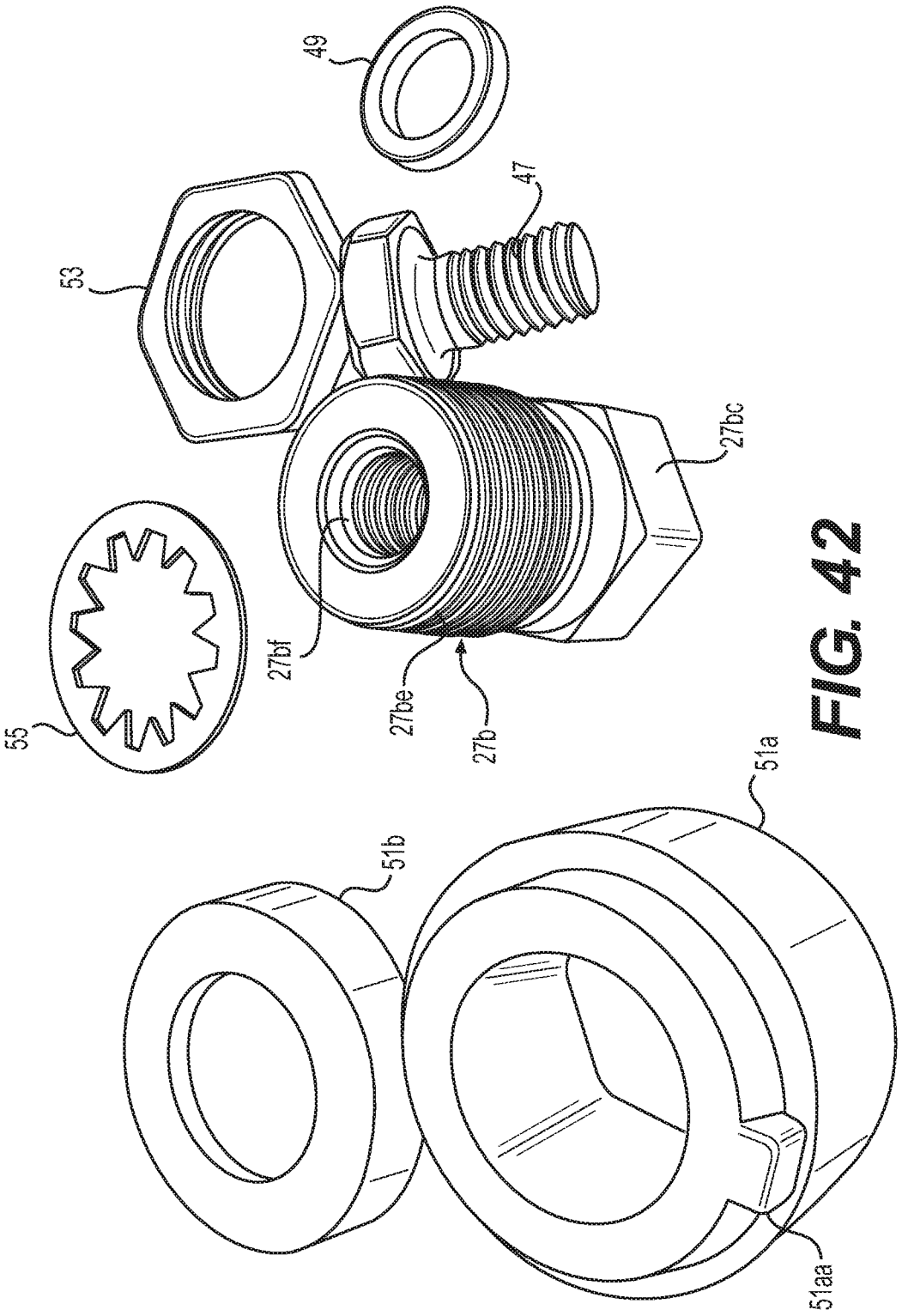


FIG. 42

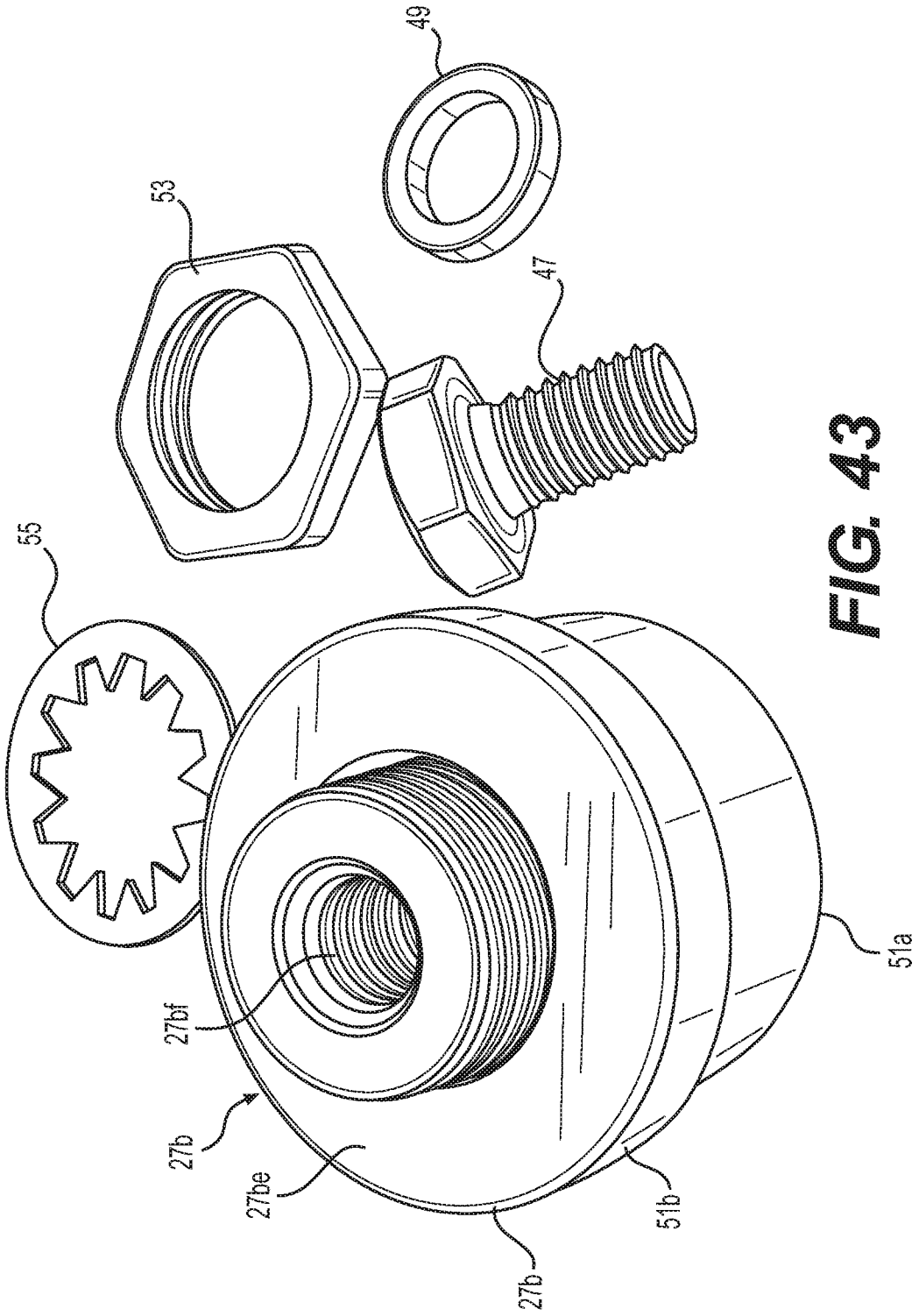


FIG. 43

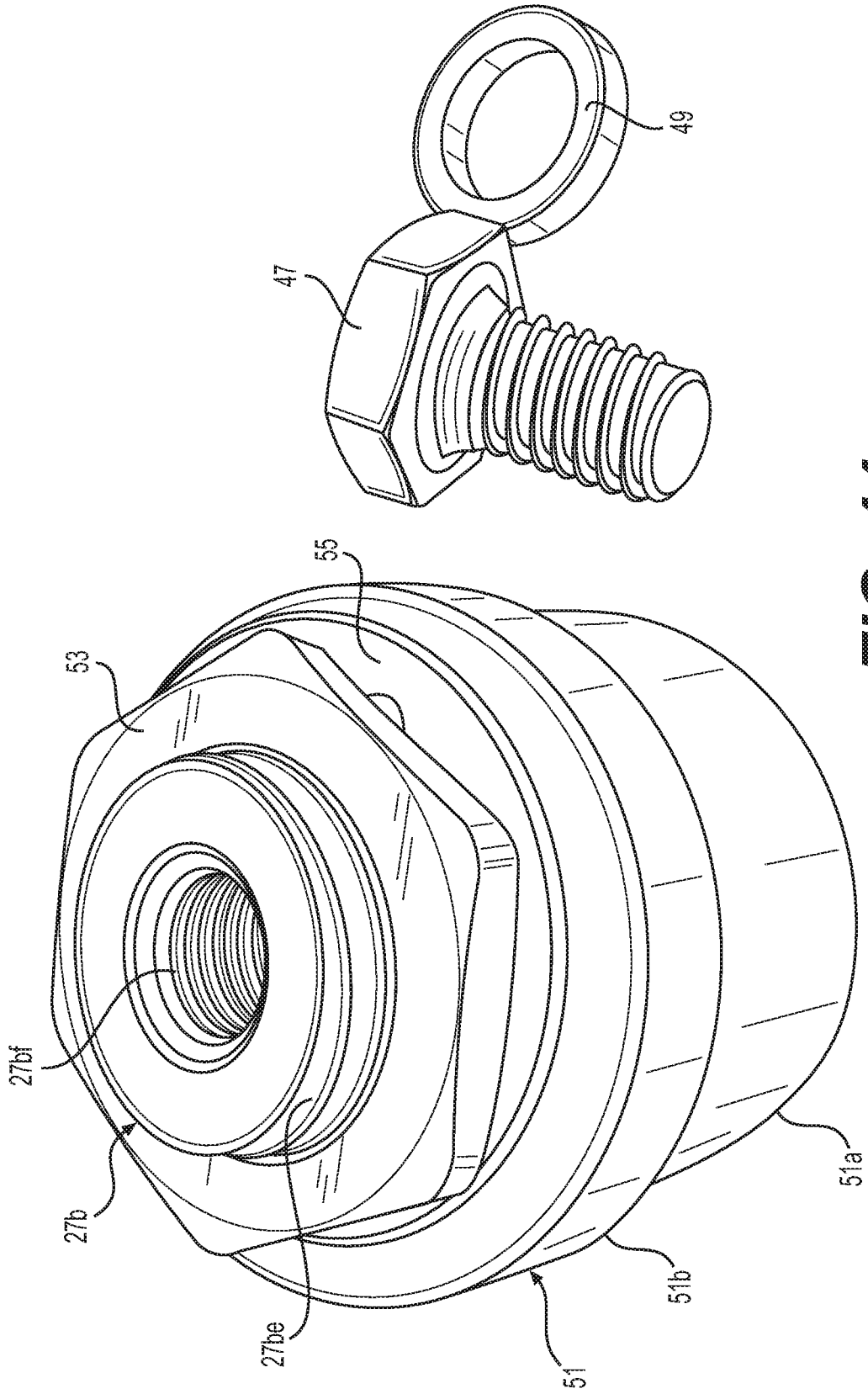


FIG. 44

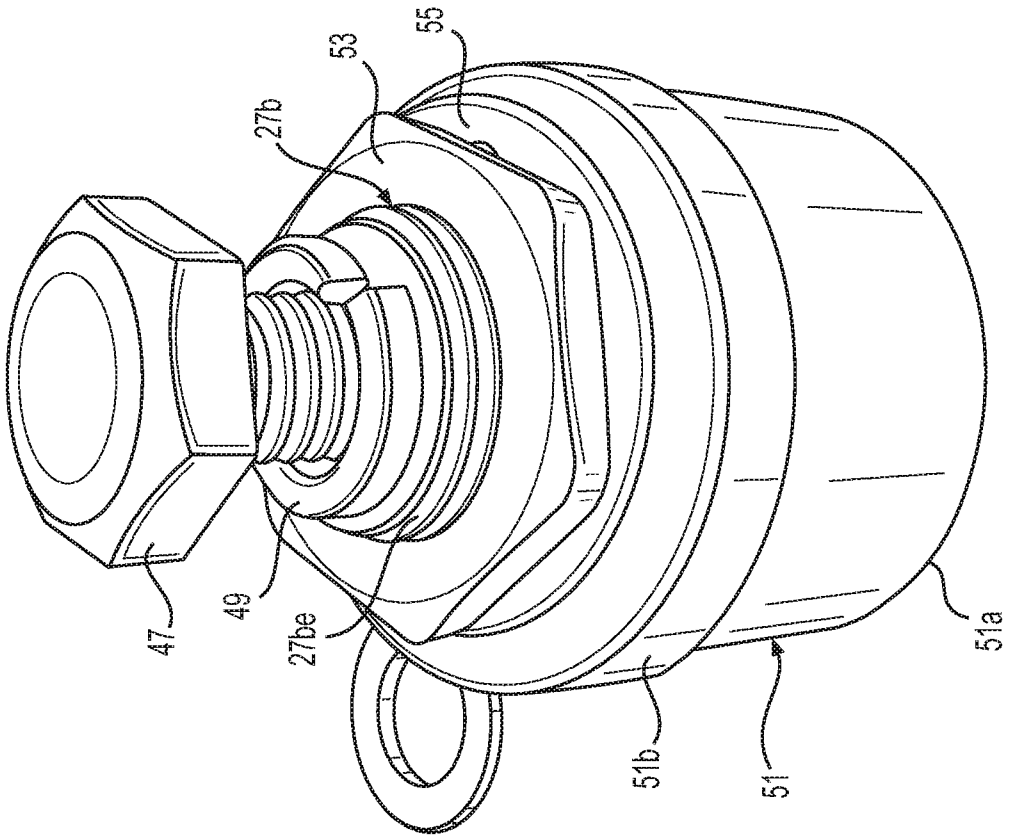


FIG. 45

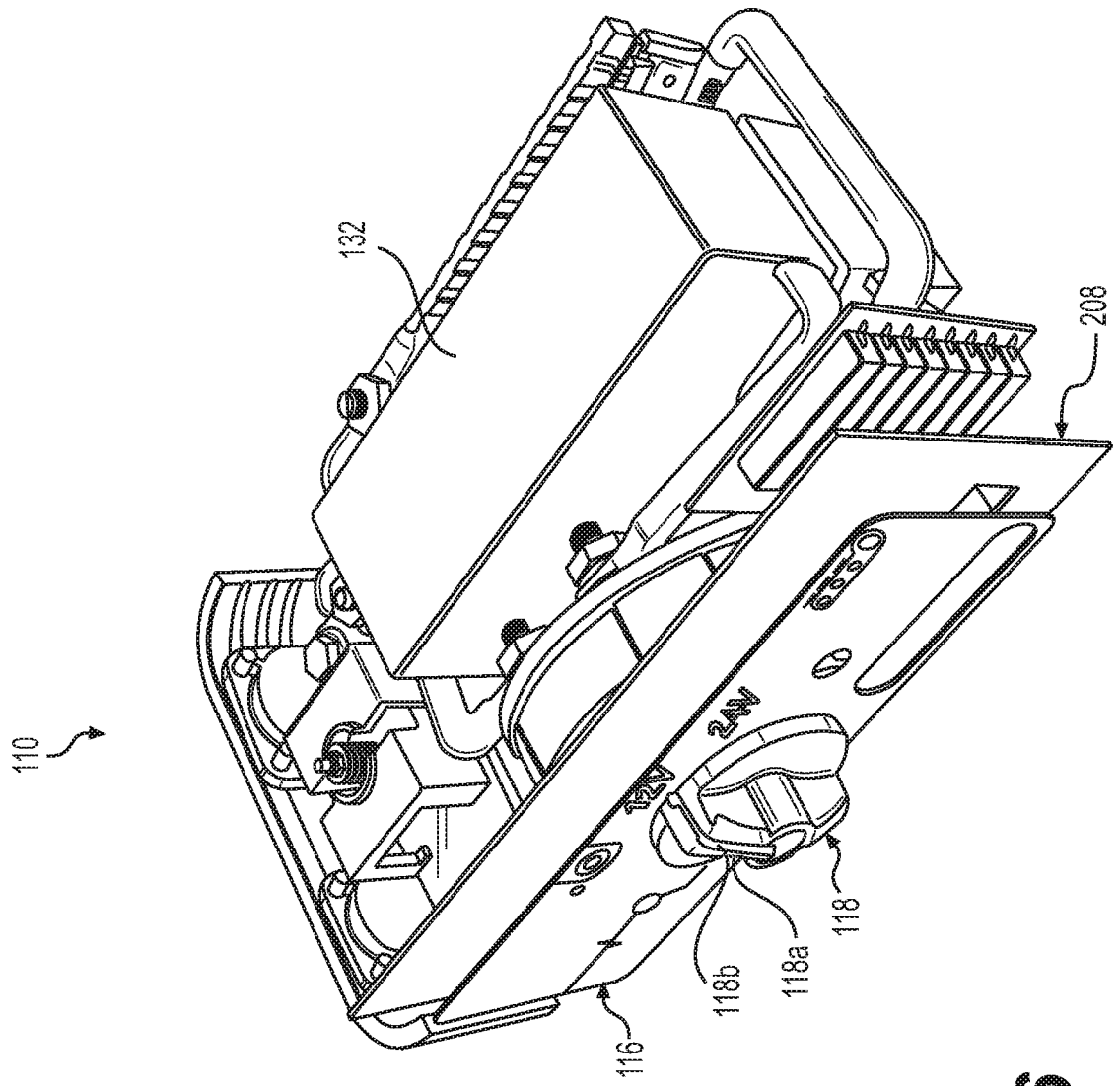


FIG. 46

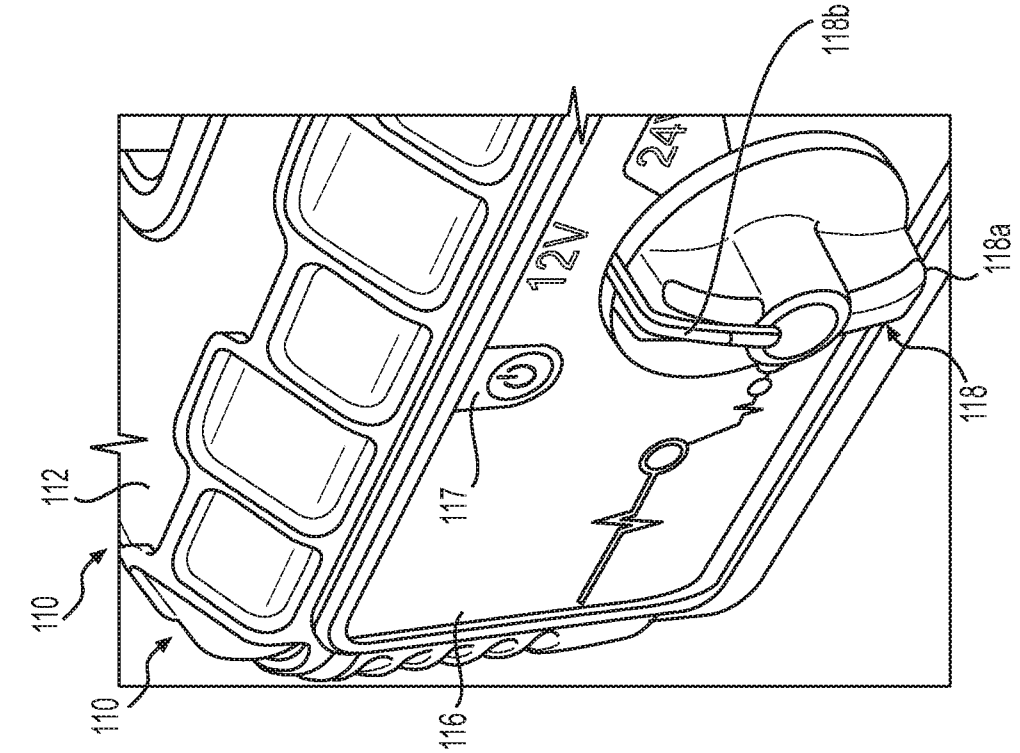

118b
24
12V
118a
118
112
117
110
110
116

FIG. 48

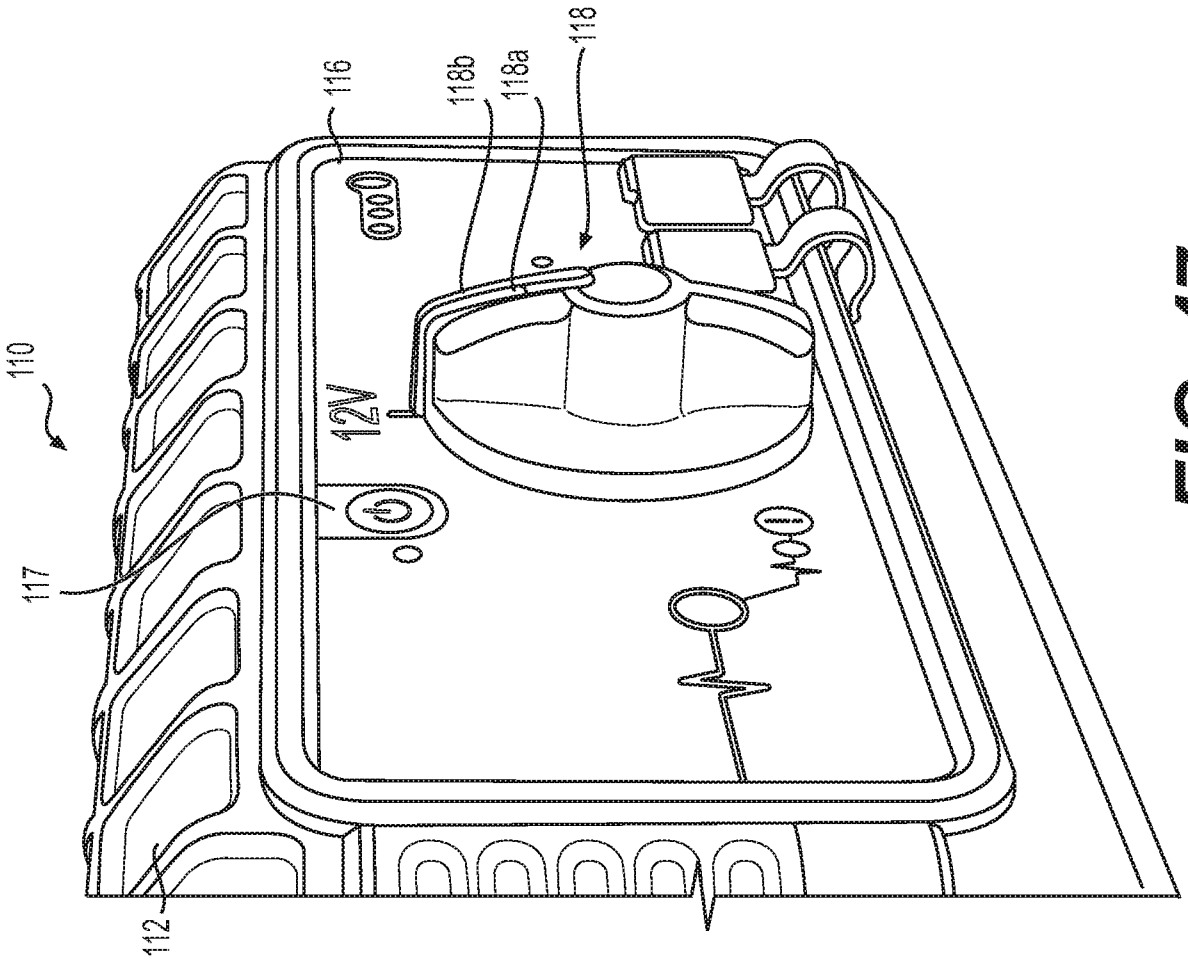

116
118b
118a
118
110
12V
117
112

FIG. 47

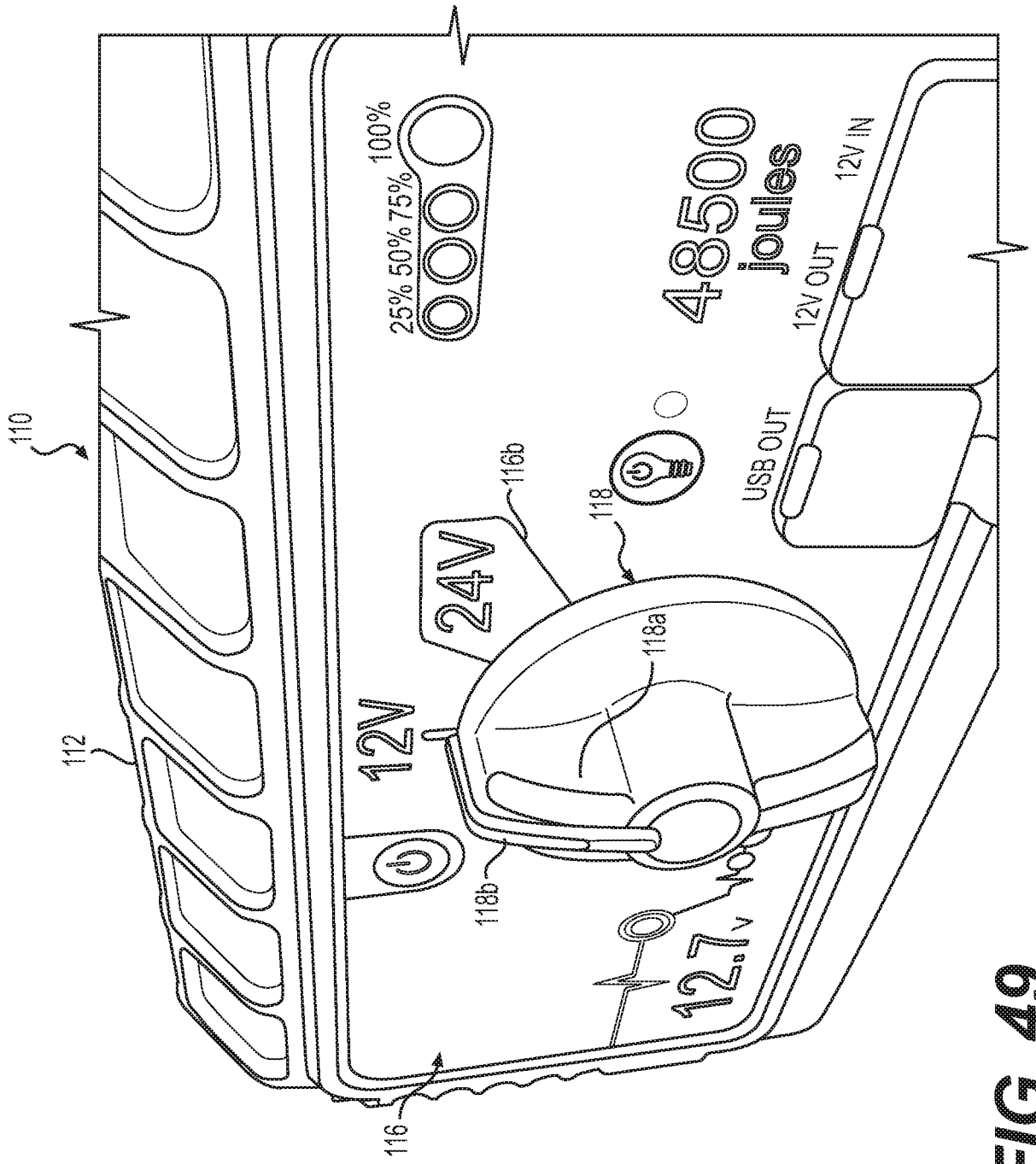

110
112
116
116b
118
118a
118b
12V
24V
25% 50% 75% 100%
48500 joules
12V OUT
12V IN
USB OUT
12.7v

FIG. 49

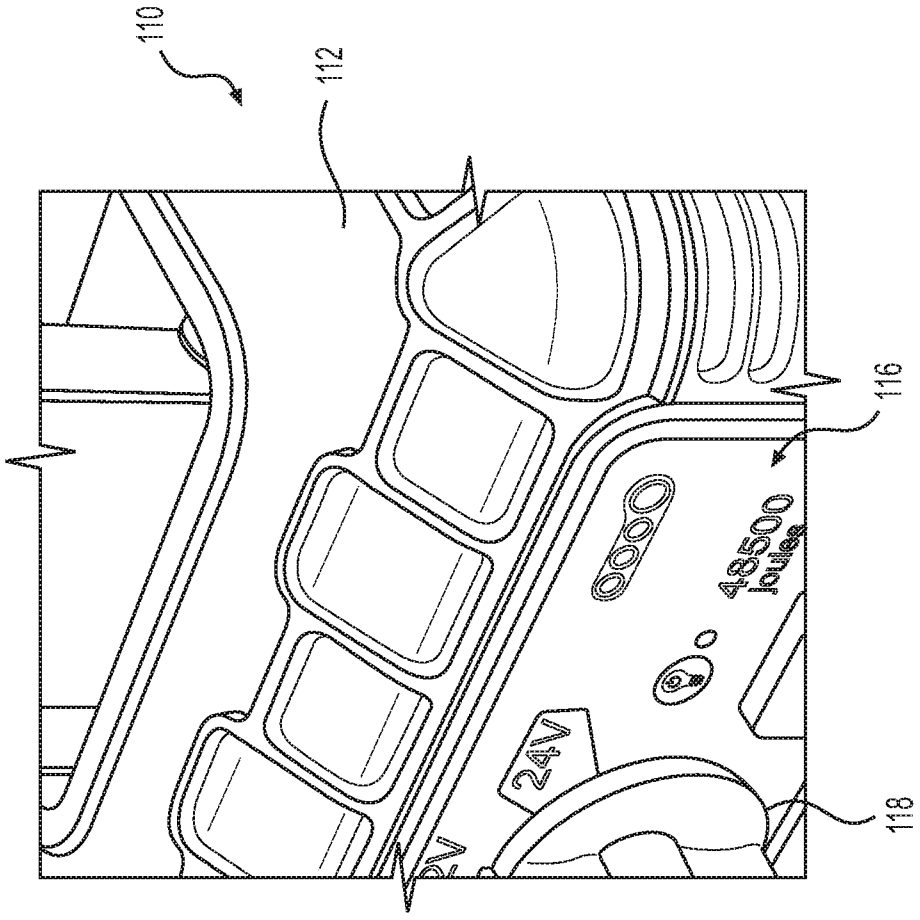


FIG. 50

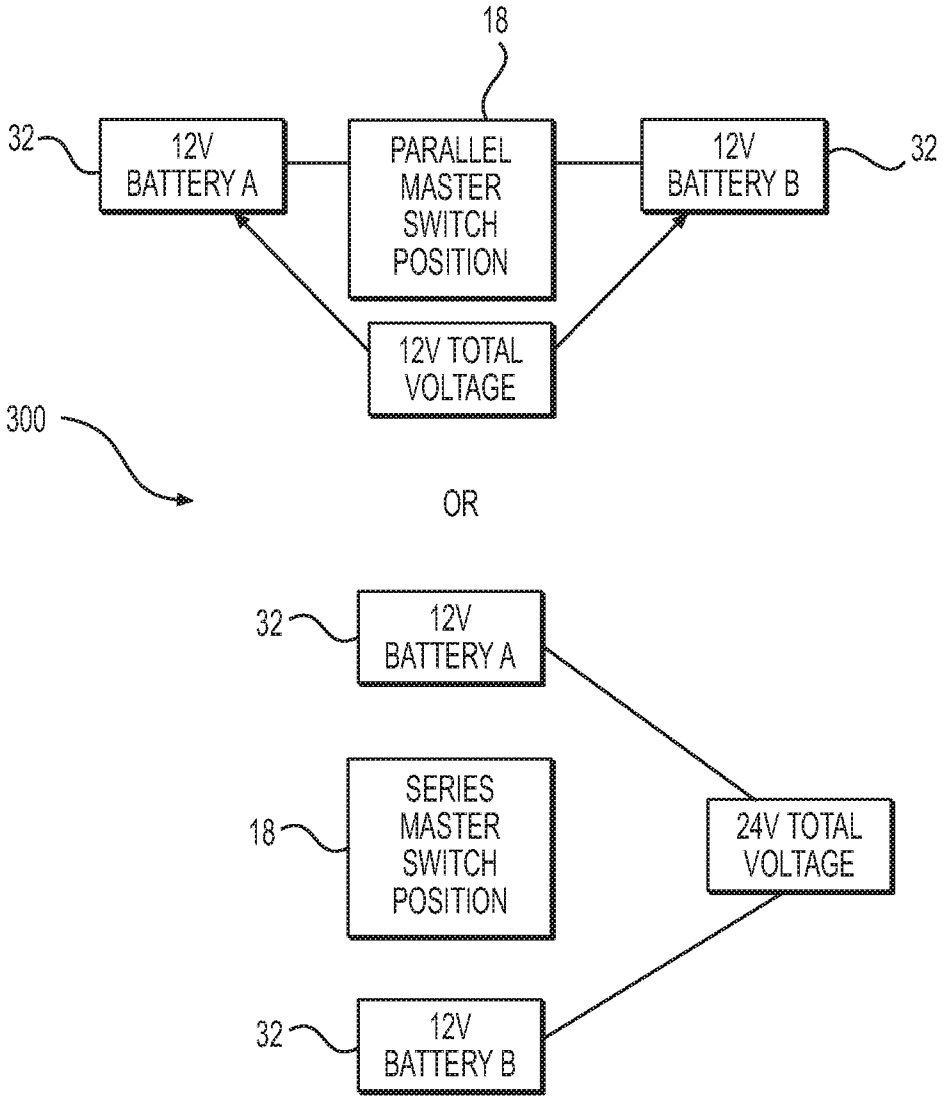

18
32
12V BATTERY A
PARALLEL MASTER SWITCH POSITION
12V BATTERY B
32
12V TOTAL VOLTAGE
300
OR
32
12V BATTERY A
18
SERIES MASTER SWITCH POSITION
24V TOTAL VOLTAGE
32
12V BATTERY B

FIG. 51

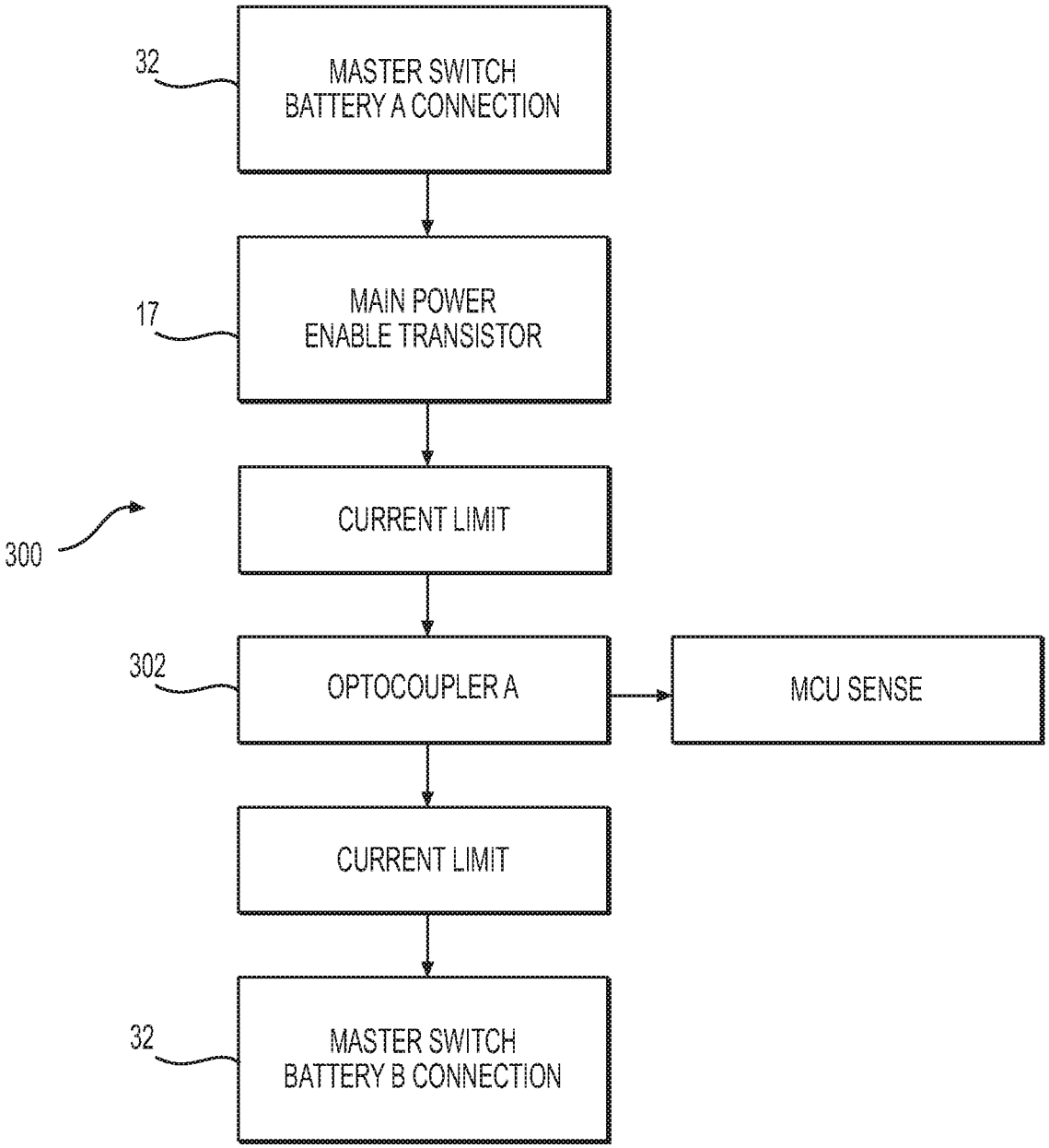

32
MASTER SWITCH
BATTERY A CONNECTION
17
MAIN POWER
ENABLE TRANSISTOR
300
CURRENT LIMIT
302
OPTOCOUPLER A
MCU SENSE
CURRENT LIMIT
32
MASTER SWITCH
BATTERY B CONNECTION

FIG. 52

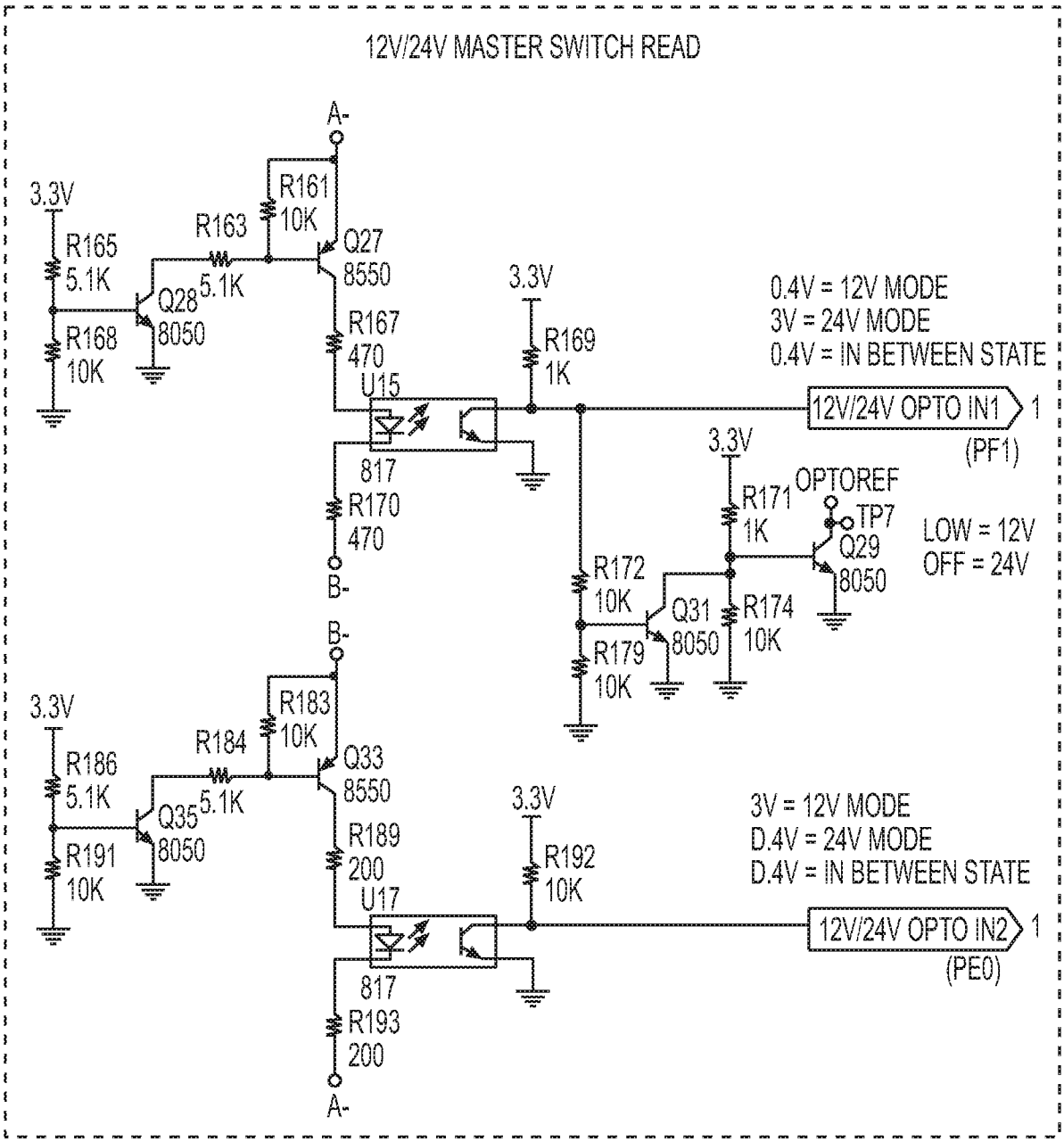

12V/24V MASTER SWITCH READ
A-
3.3V
R165
5.1K
R168
10K
R163
5.1K
Q28
8050
R161
10K
Q27
8550
R167
470
U15
817
R170
470
B-
3.3V
R169
1K
0.4V = 12V MODE
3V = 24V MODE
0.4V = IN BETWEEN STATE
12V/24V OPTO IN1
1
(PF1)
3.3V
R171
1K
OPTOREF
TP7
Q29
8050
LOW = 12V
OFF = 24V
R172
10K
Q31
8050
R174
10K
R179
10K
B-
3.3V
R186
5.1K
R191
10K
R184
5.1K
Q35
8050
R183
10K
Q33
8550
R189
200
U17
817
R193
200
A-
3.3V
R192
10K
3V = 12V MODE
D.4V = 24V MODE
D.4V = IN BETWEEN STATE
12V/24V OPTO IN2
1
(PE0)

FIG. 53

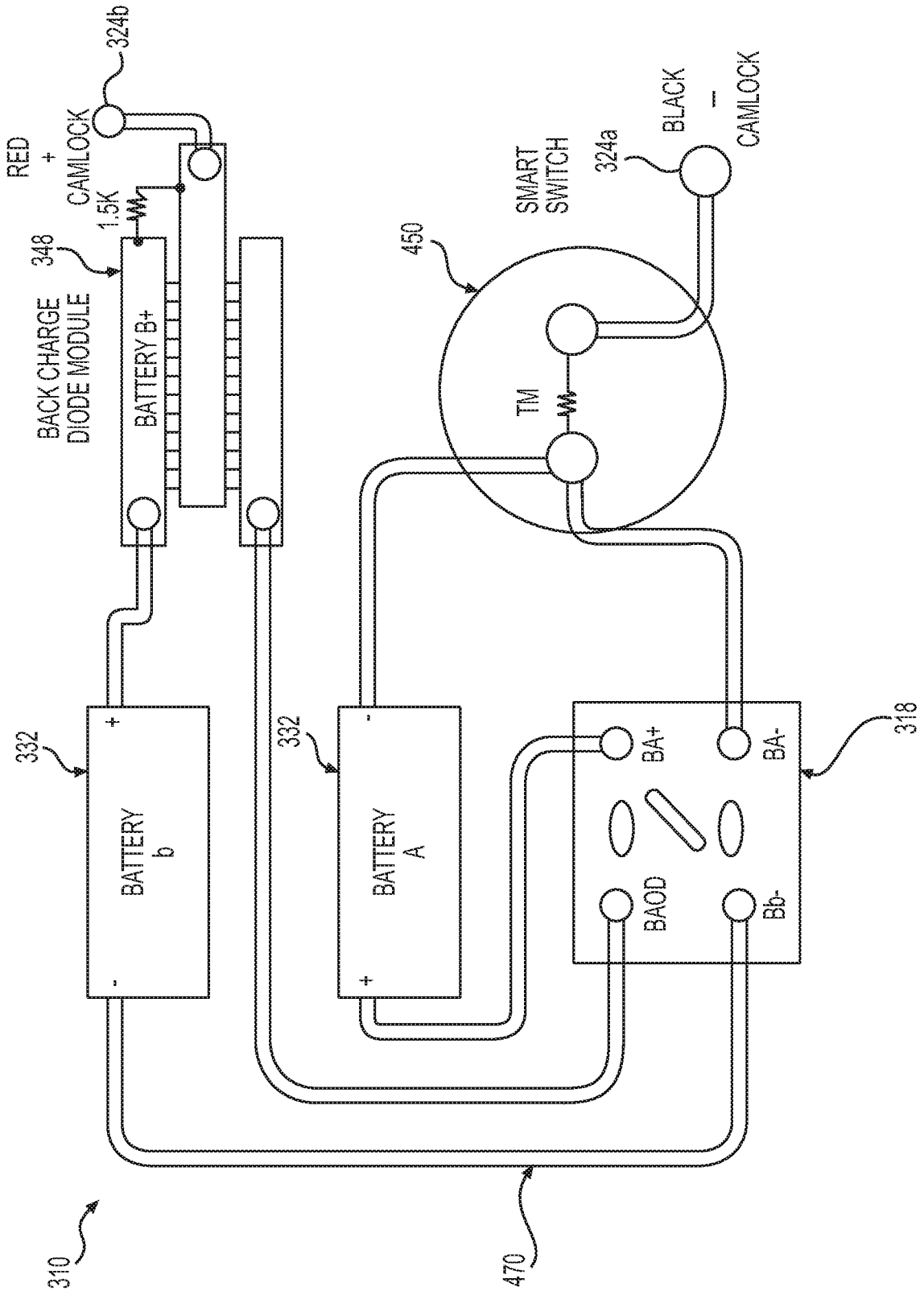

RED
+
CAMLOCK
324b
1.5K
348
BACK CHARGE
DIODE MODULE
BATTERY B+
SMART
SWITCH
324a
BLACK
–
CAMLOCK
450
TM
332
+
BATTERY
b
-
332
-
BATTERY
A
+
BA+
BA-
318
BAOD
Bb-
310
470

FIG. 54

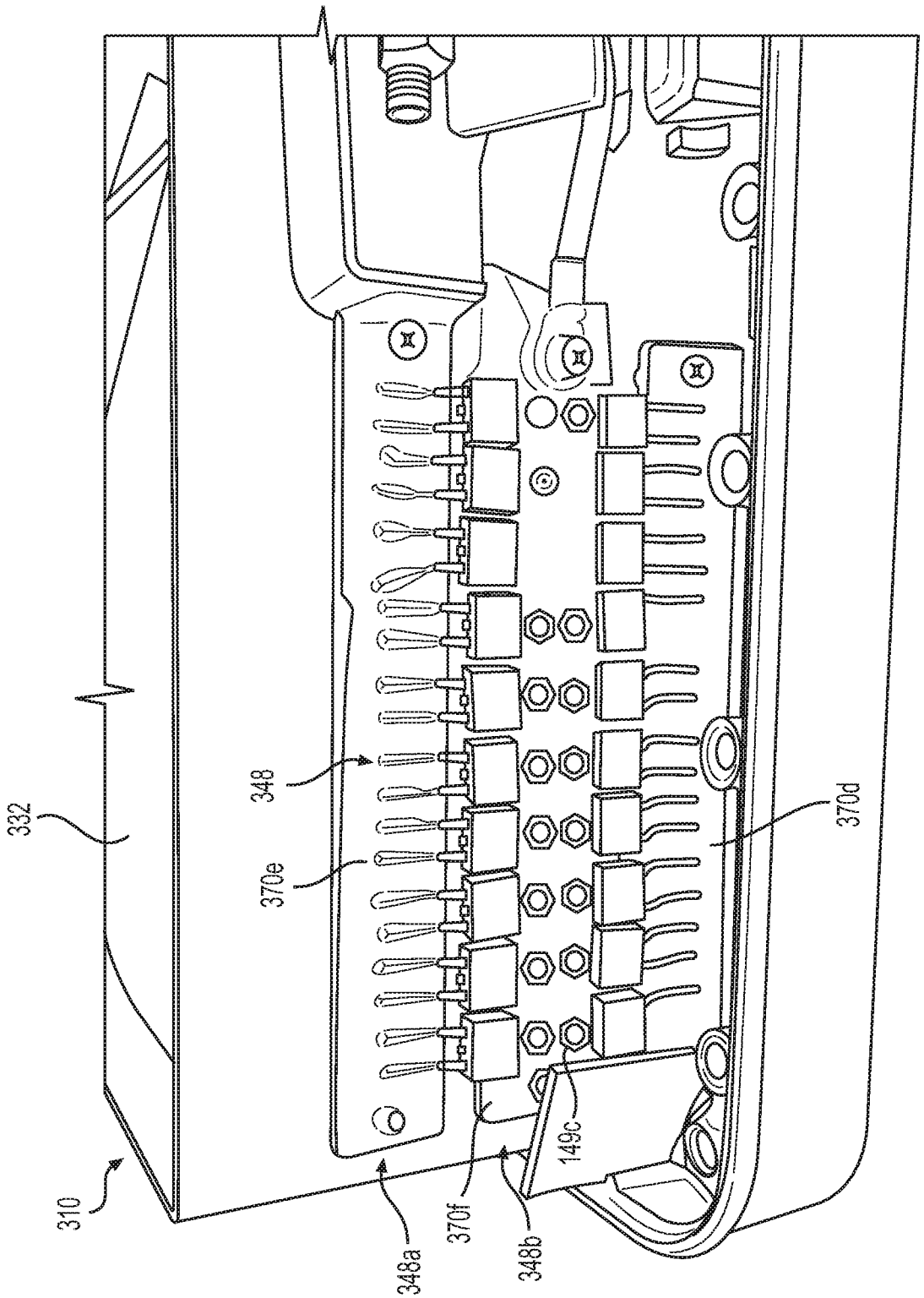


FIG. 55

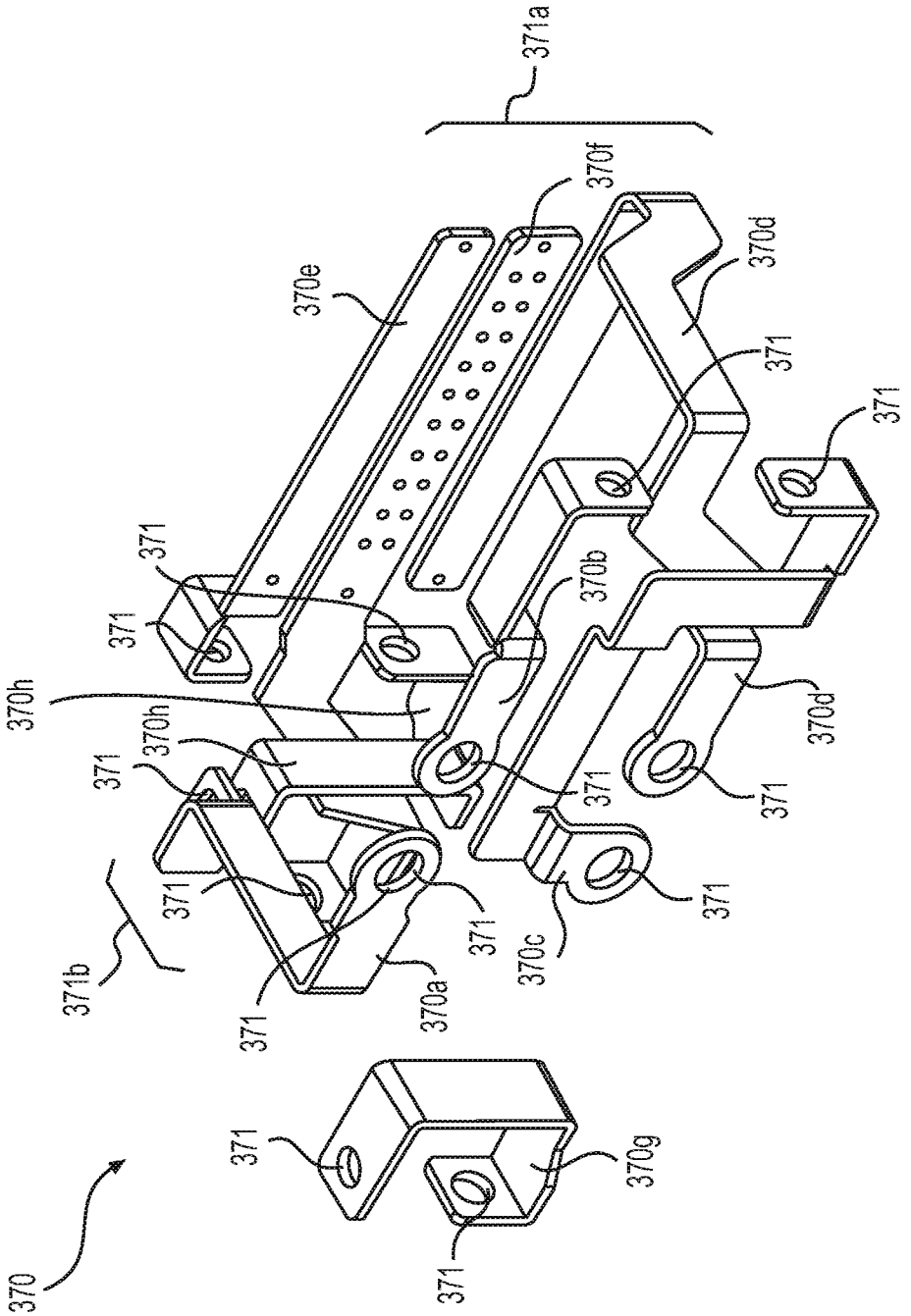

371a
370f
370e
370d
371
370h
370b
370d
370h
371
371b
370a
370c
370
370g

FIG. 56

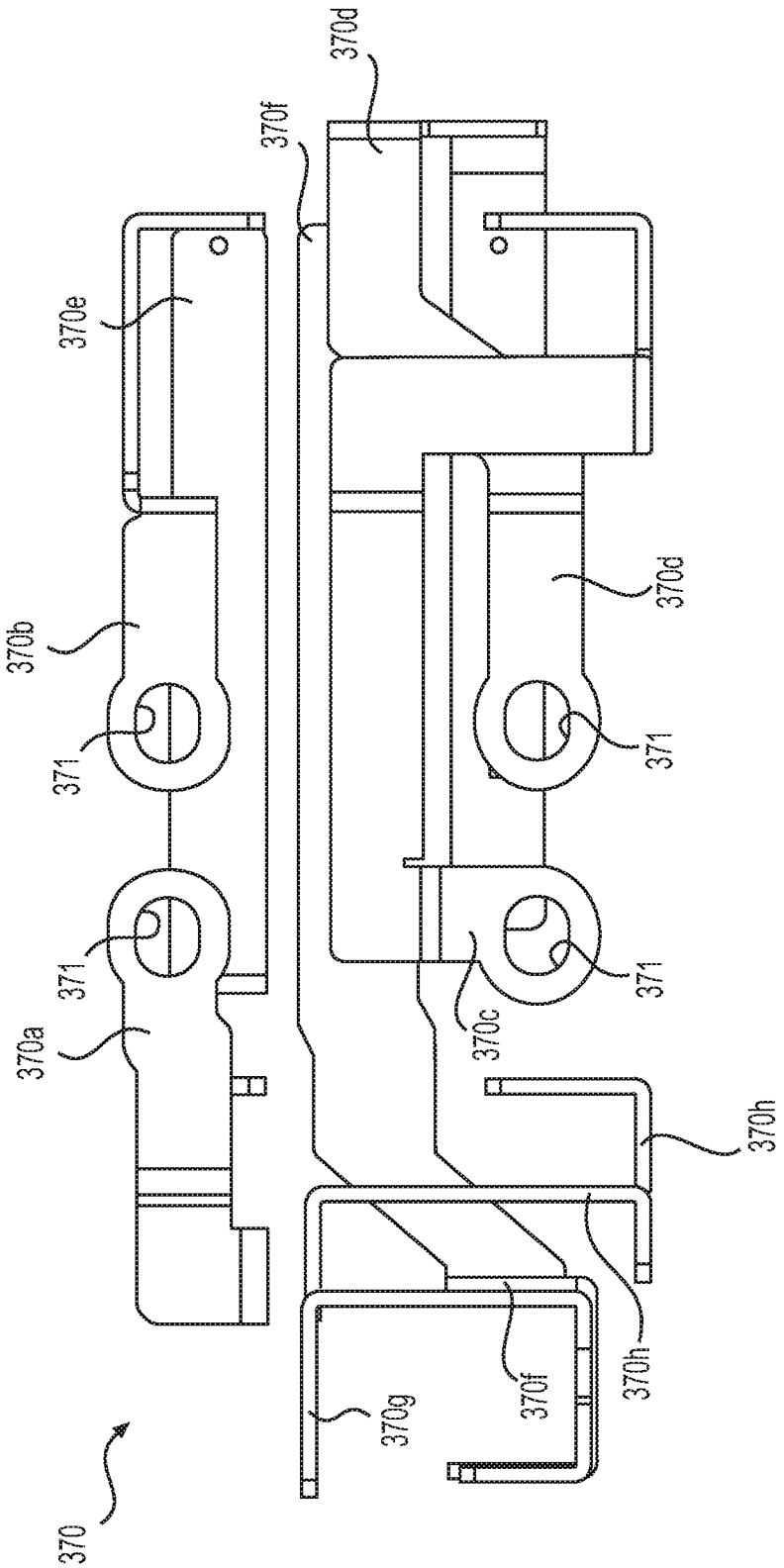

370
370a
370b
370c
370d
370d
370e
370f
370f
370g
370h
370h
371
371
371
371

FIG. 57

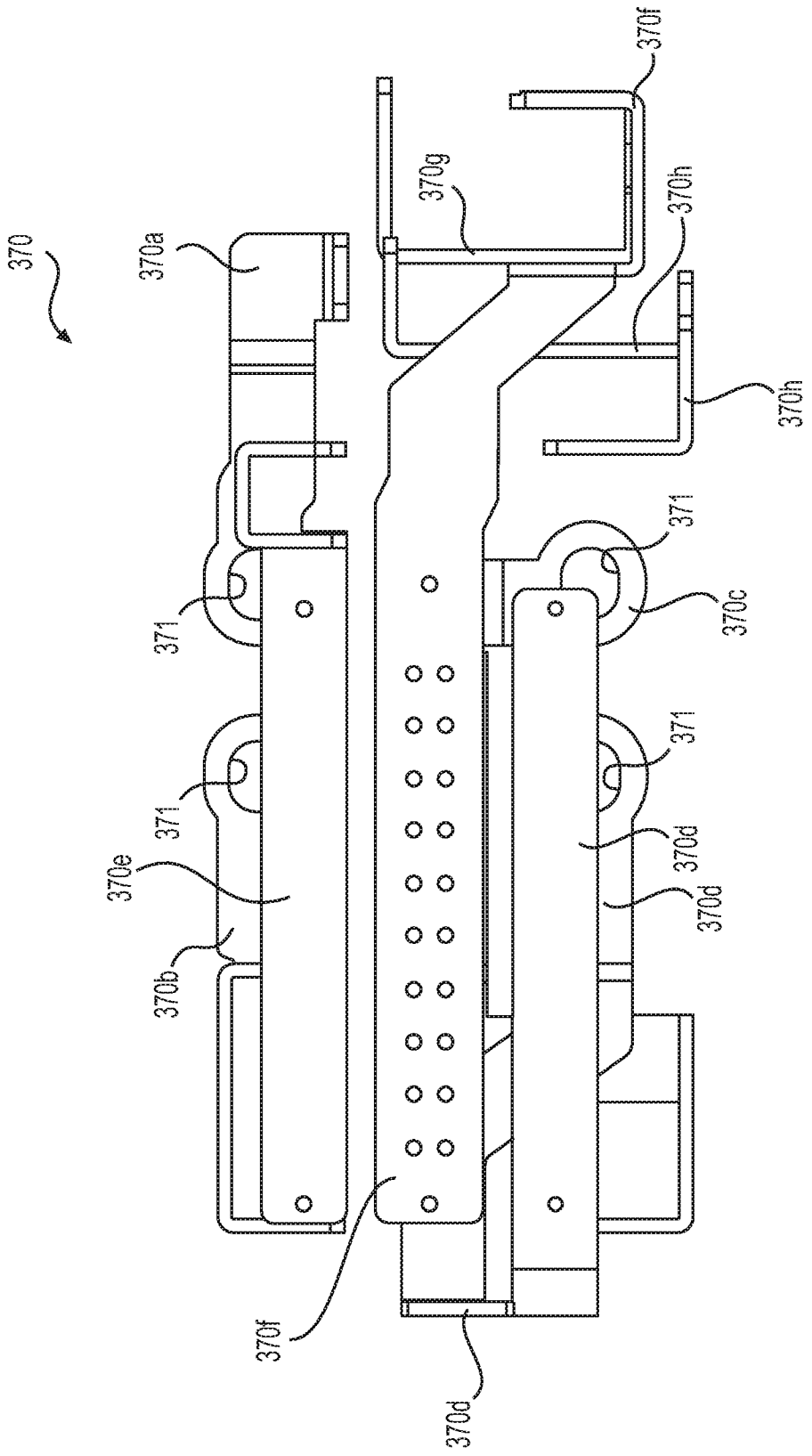

370
370a
370f
370g
370h
370h
371
370c
371
371
370e
371
370d
370b
370d
370f
370d

FIG. 58

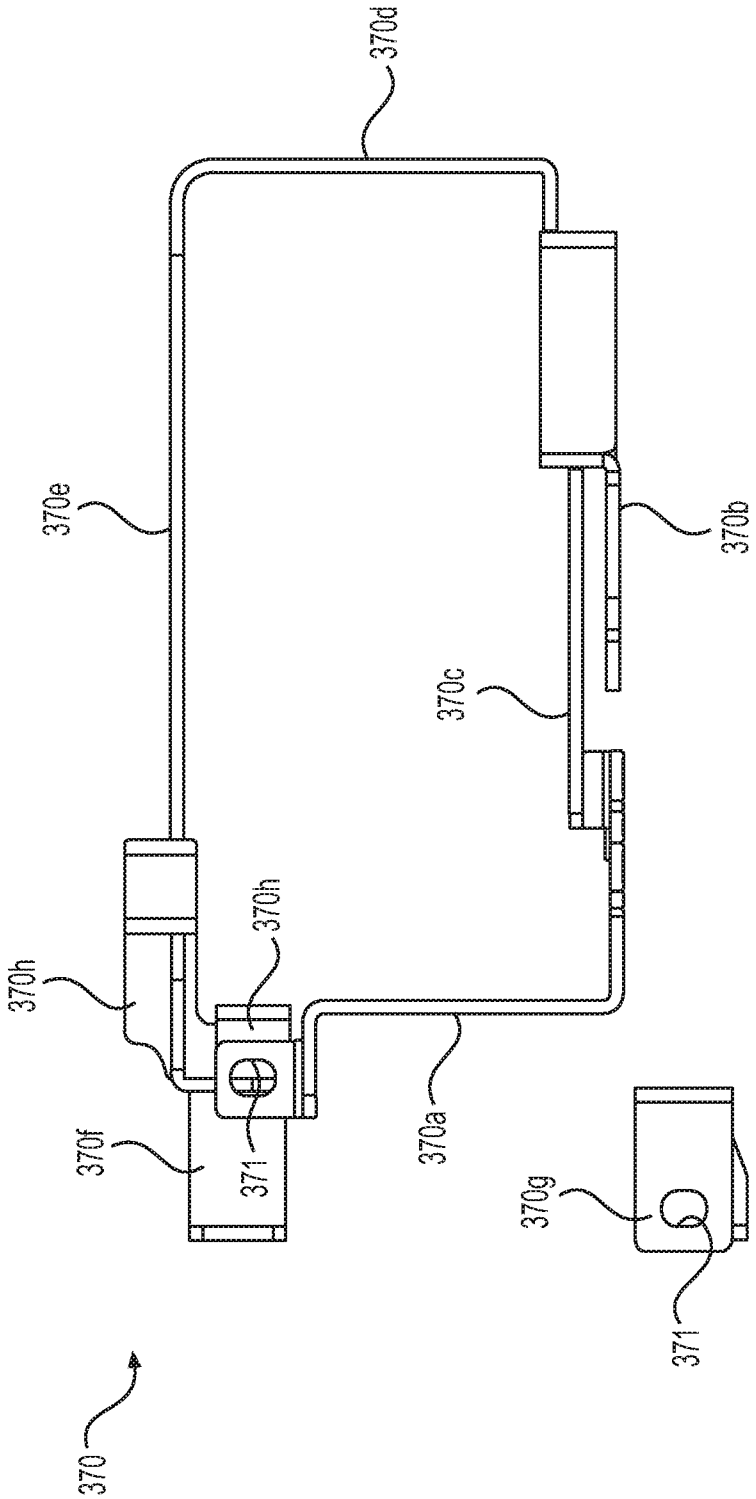


FIG. 59

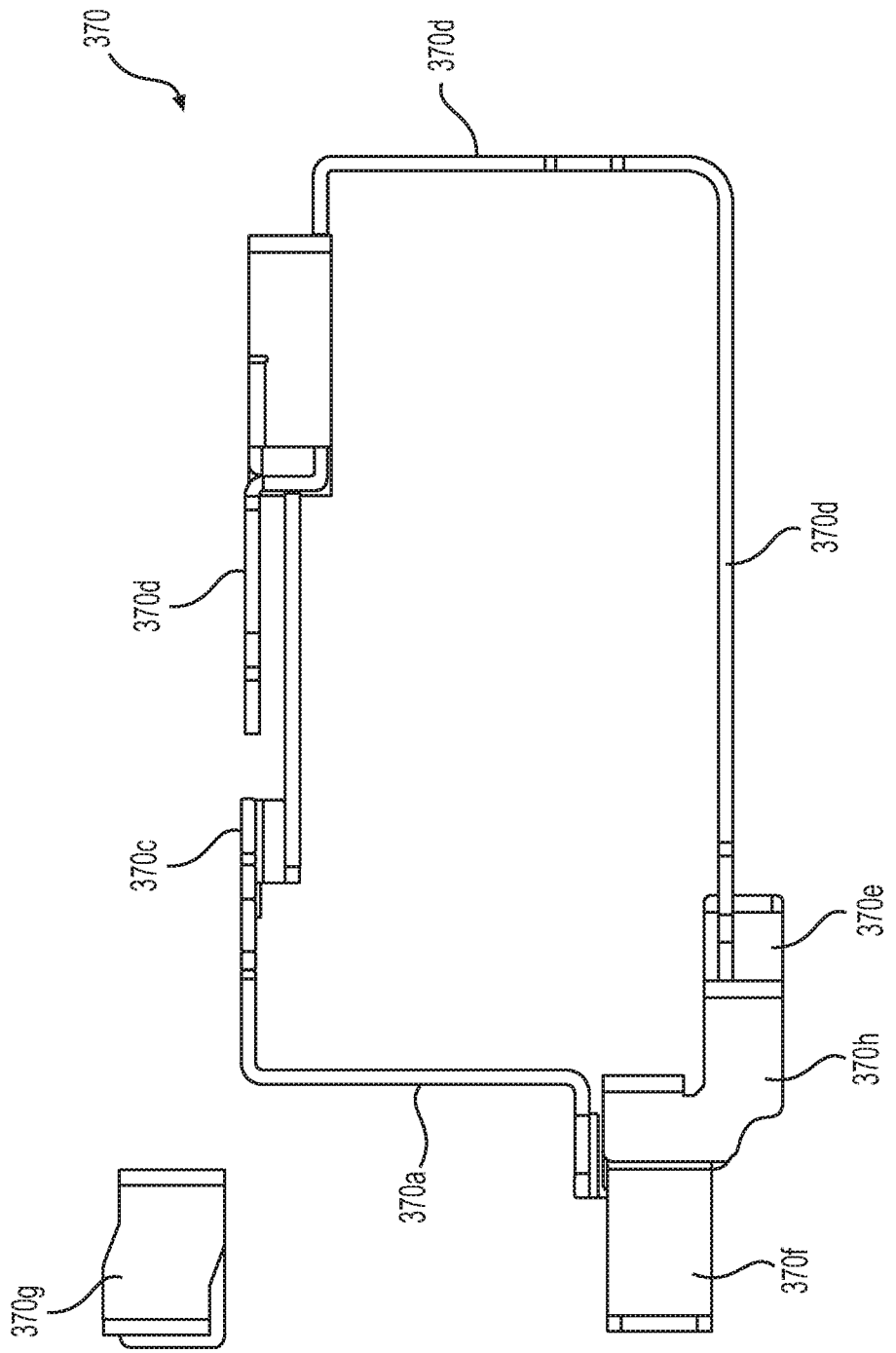


FIG. 60

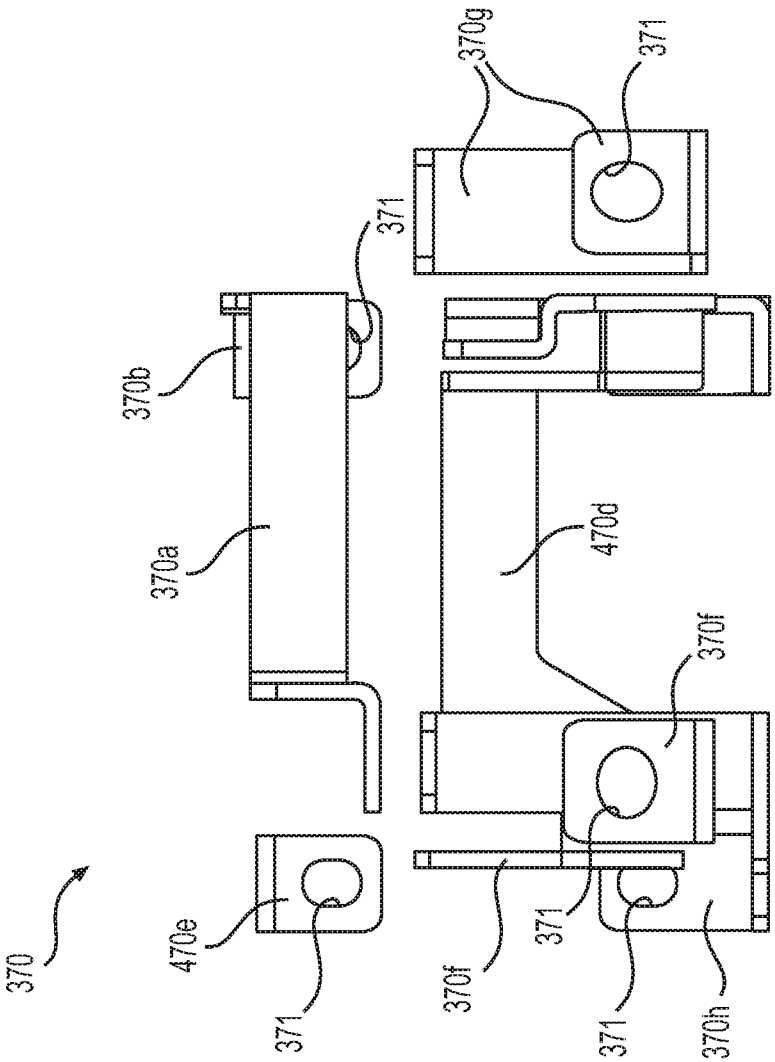

370
470e
371
370b
370a
371
370g
371
470d
370f
370f
371
371
370h

FIG. 61

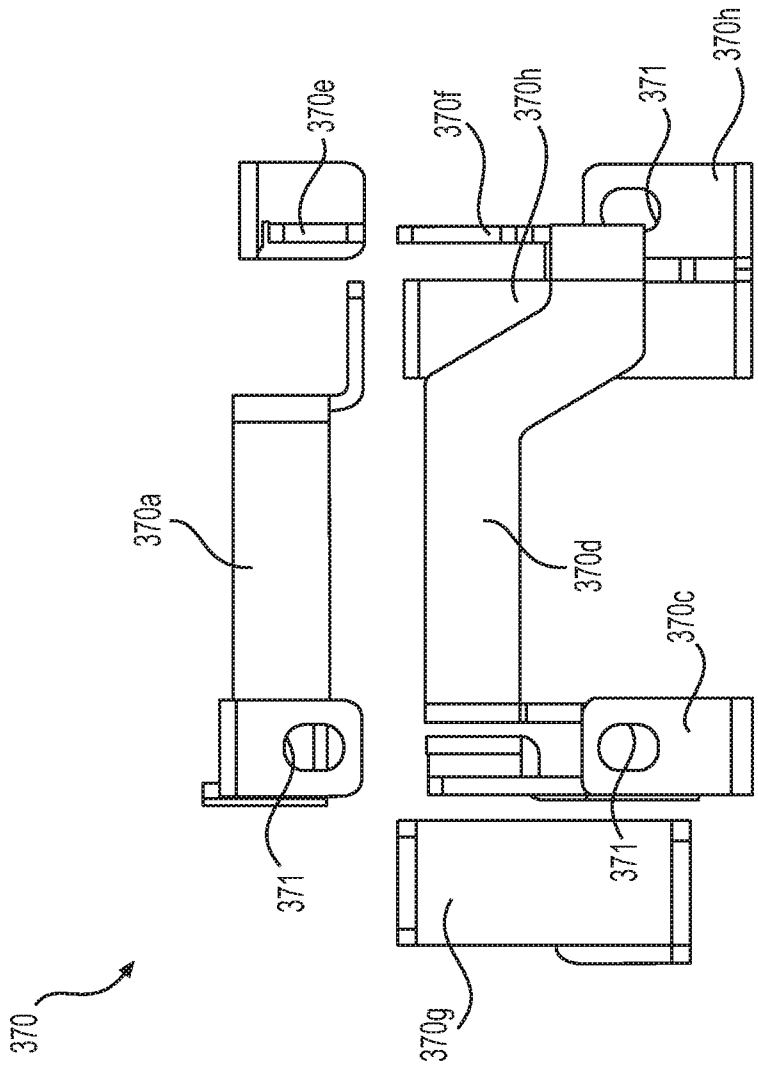


FIG. 62

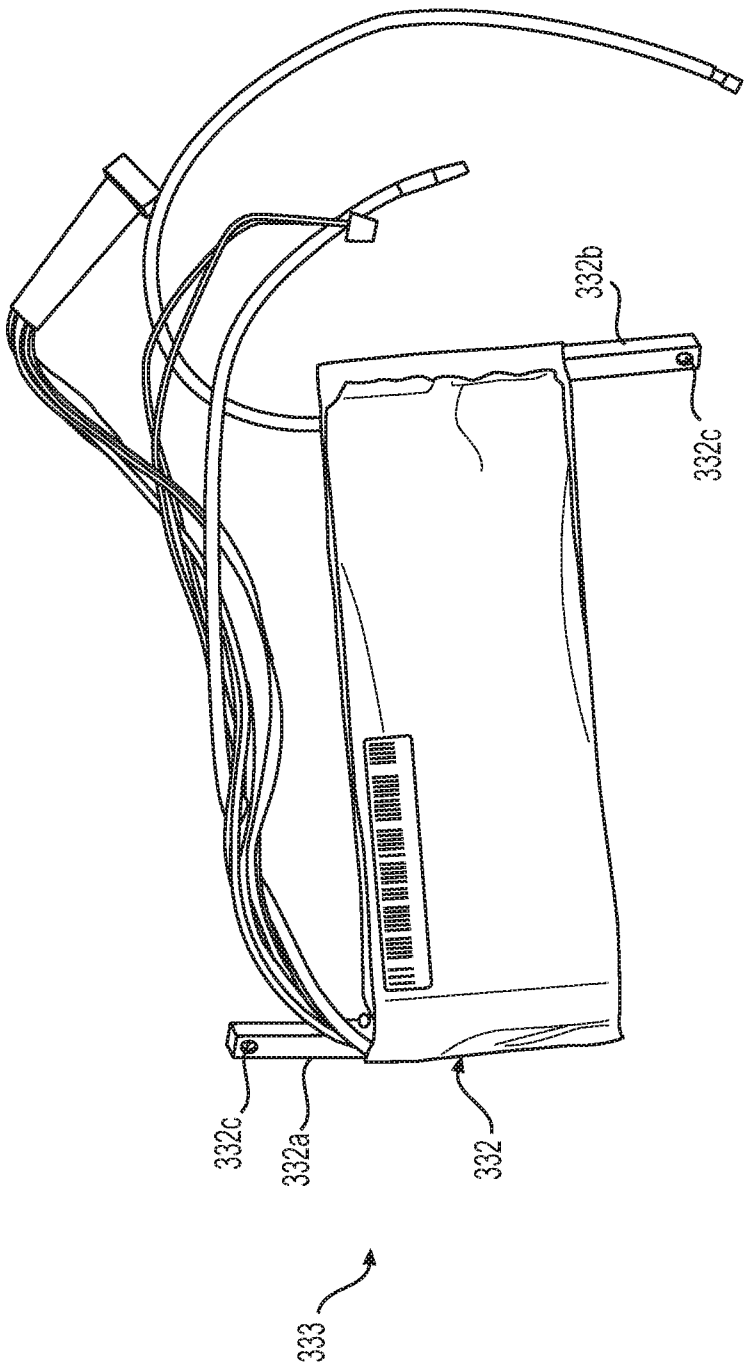


FIG. 63

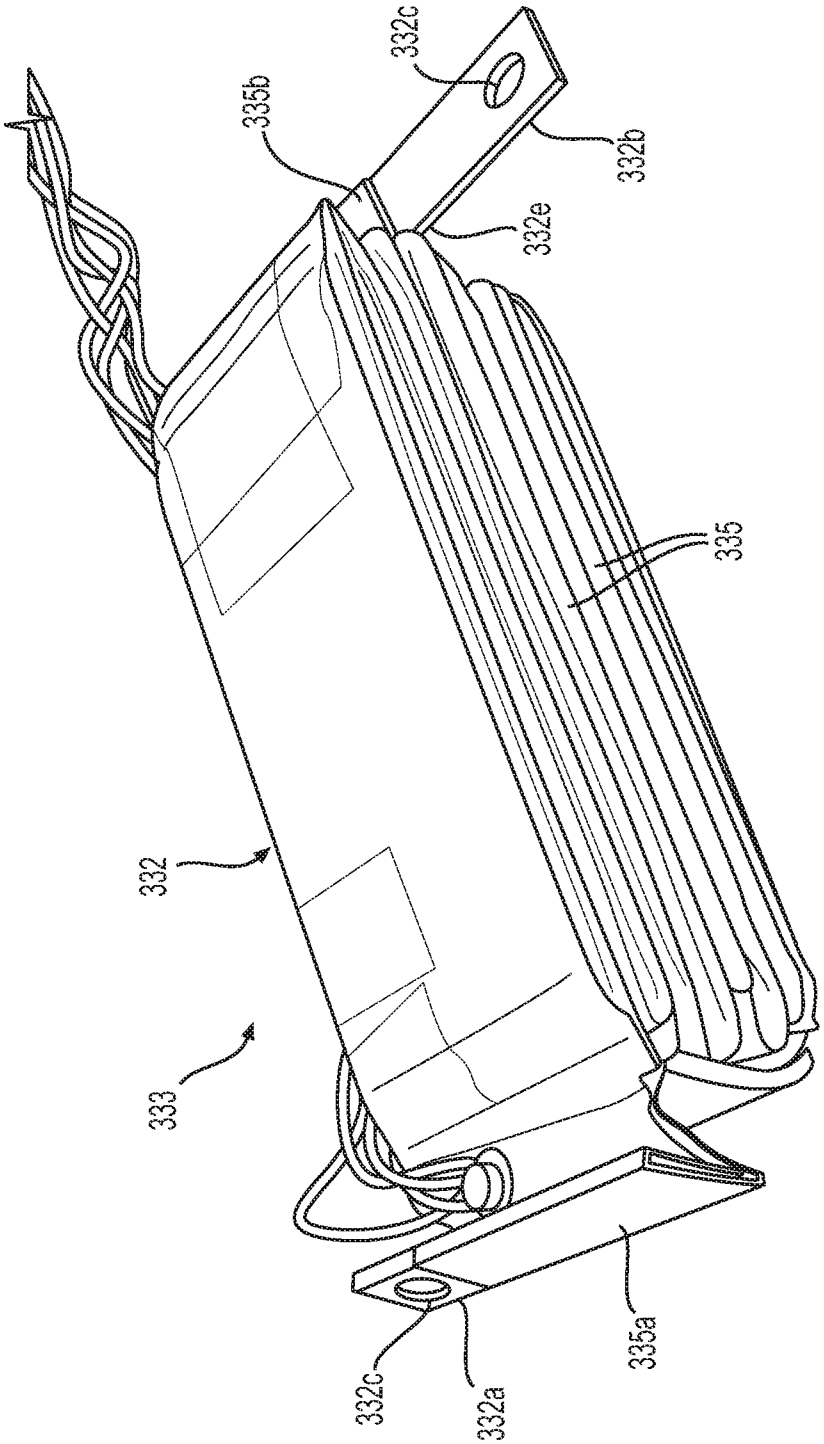


FIG. 64

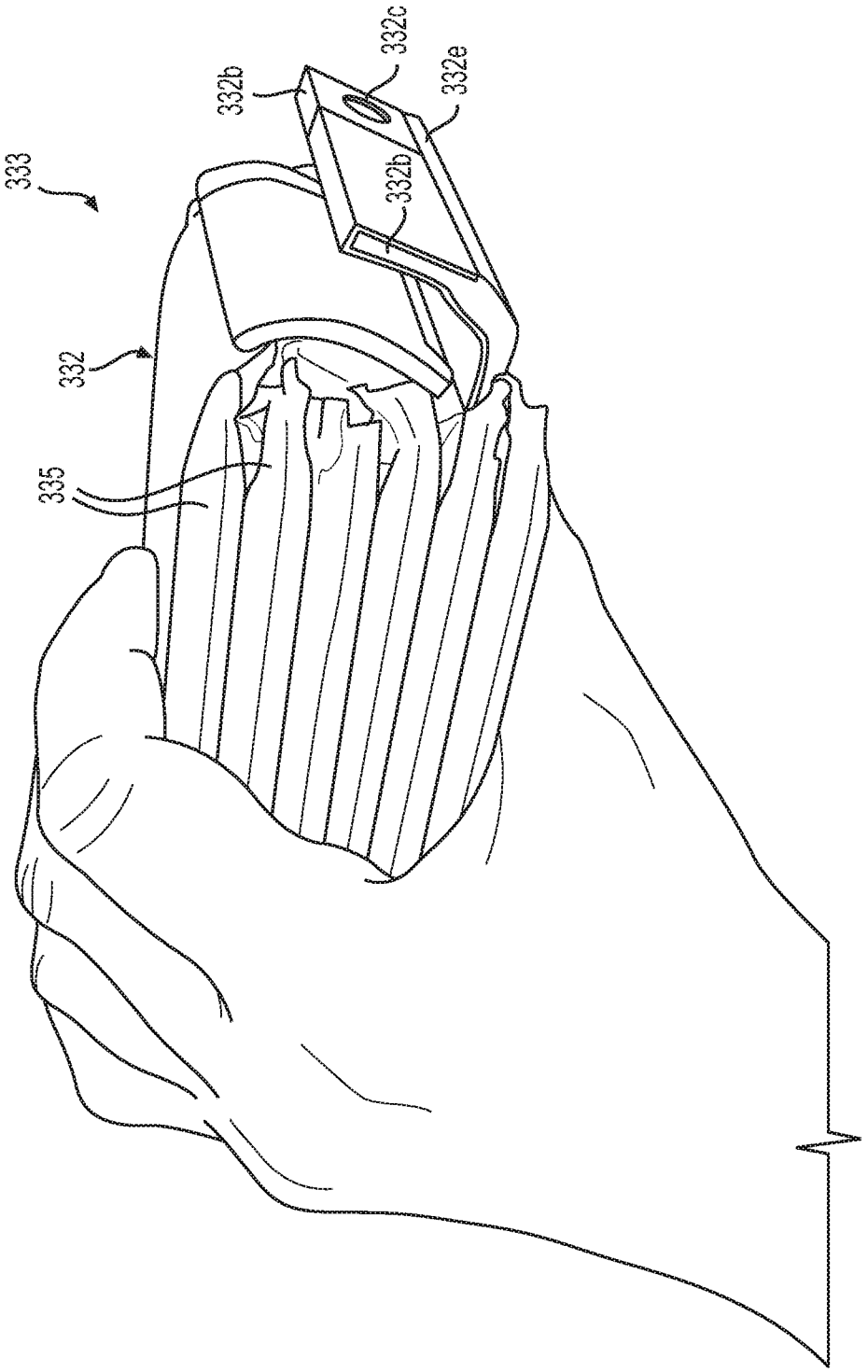


FIG. 65

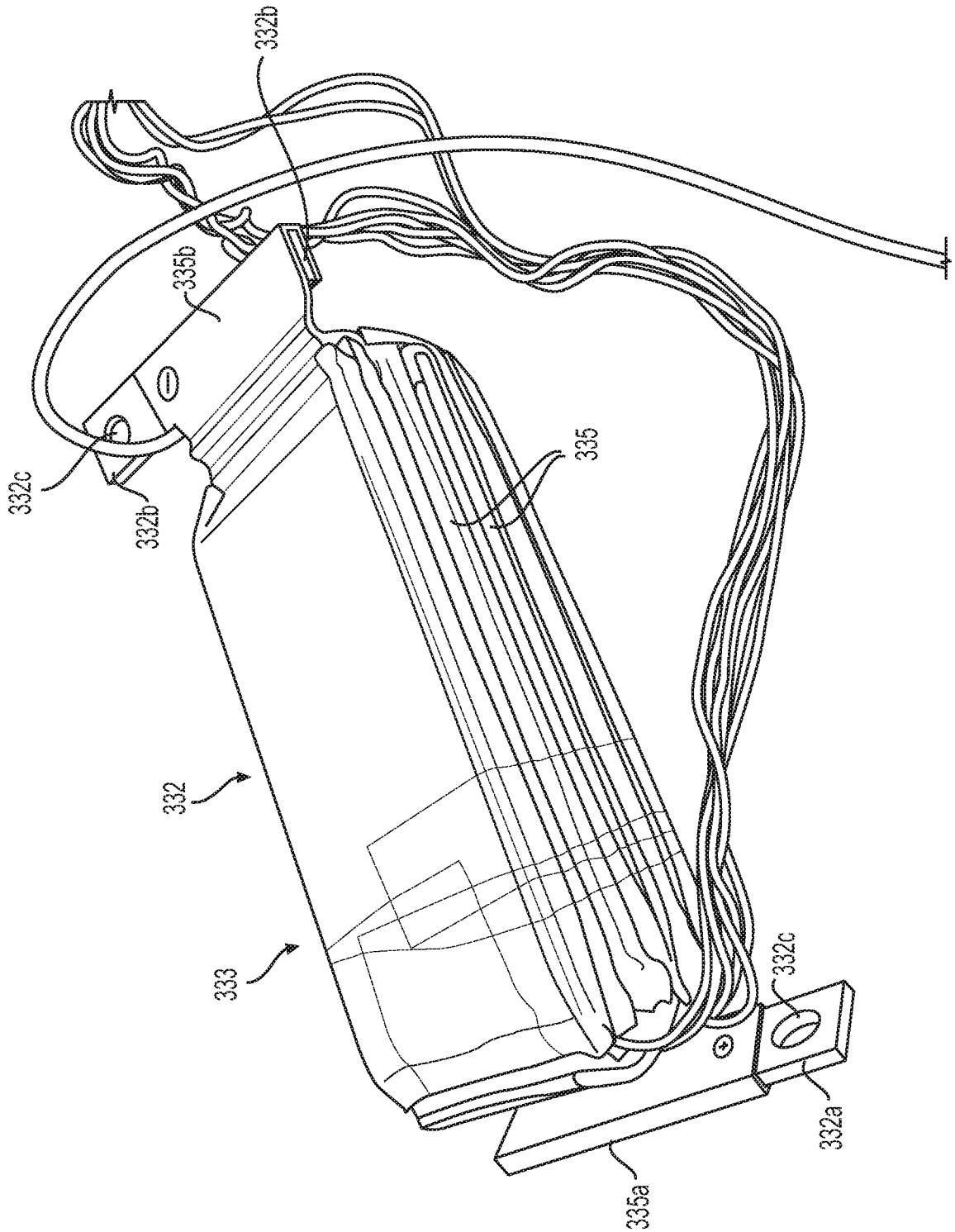


FIG. 66

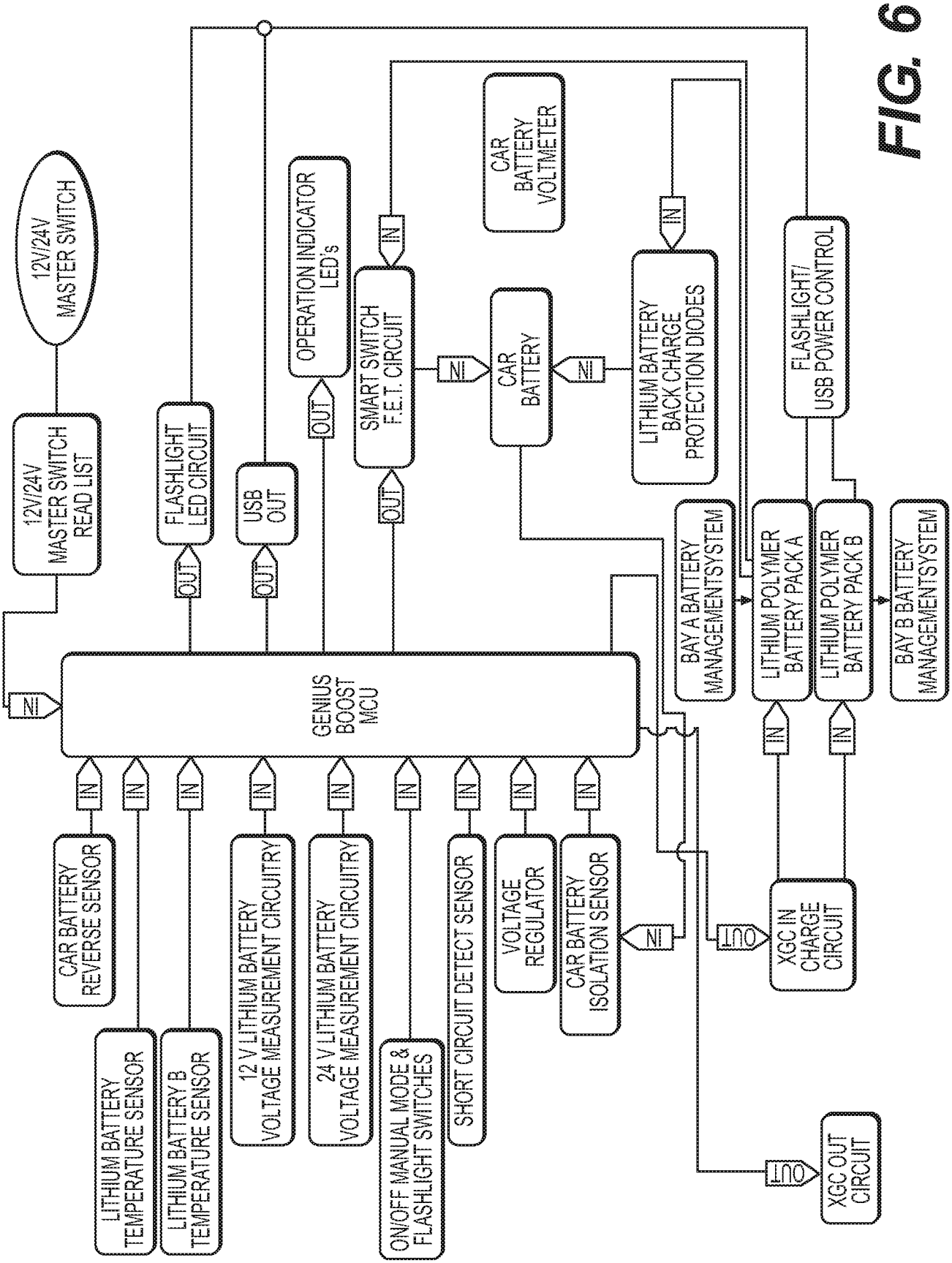

12V/24V MASTER SWITCH
12V/24V MASTER SWITCH READ LIST
FLASHLIGHT LED CIRCUIT
USB OUT
OPERATION INDICATOR LED's
SMART SWITCH F.E.T. CIRCUIT
CAR BATTERY VOLTMETER
CAR BATTERY
LITHIUM BATTERY BACK CHARGE PROTECTION DIODES
FLASHLIGHT/ USB POWER CONTROL
GENIUS BOOST MCU
BAY A BATTERY MANAGEMENTSYSTEM
LITHIUM POLYMER BATTERY PACK A
LITHIUM POLYMER BATTERY PACK B
BAY B BATTERY MANAGEMENTSYSTEM
CAR BATTERY REVERSE SENSOR
LITHIUM BATTERY TEMPERATURE SENSOR
LITHIUM BATTERY B TEMPERATURE SENSOR
12 V LITHIUM BATTERY VOLTAGE MEASUREMENT CIRCUITRY
24 V LITHIUM BATTERY VOLTAGE MEASUREMENT CIRCUITRY
ON/OFF MANUAL MODE & FLASHLIGHT SWITCHES
SHORT CIRCUIT DETECT SENSOR
VOLTAGE REGULATOR
CAR BATTERY ISOLATION SENSOR
XGC IN CHARGE CIRCUIT
XGC OUT CIRCUIT
IN
OUT

FIG. 67

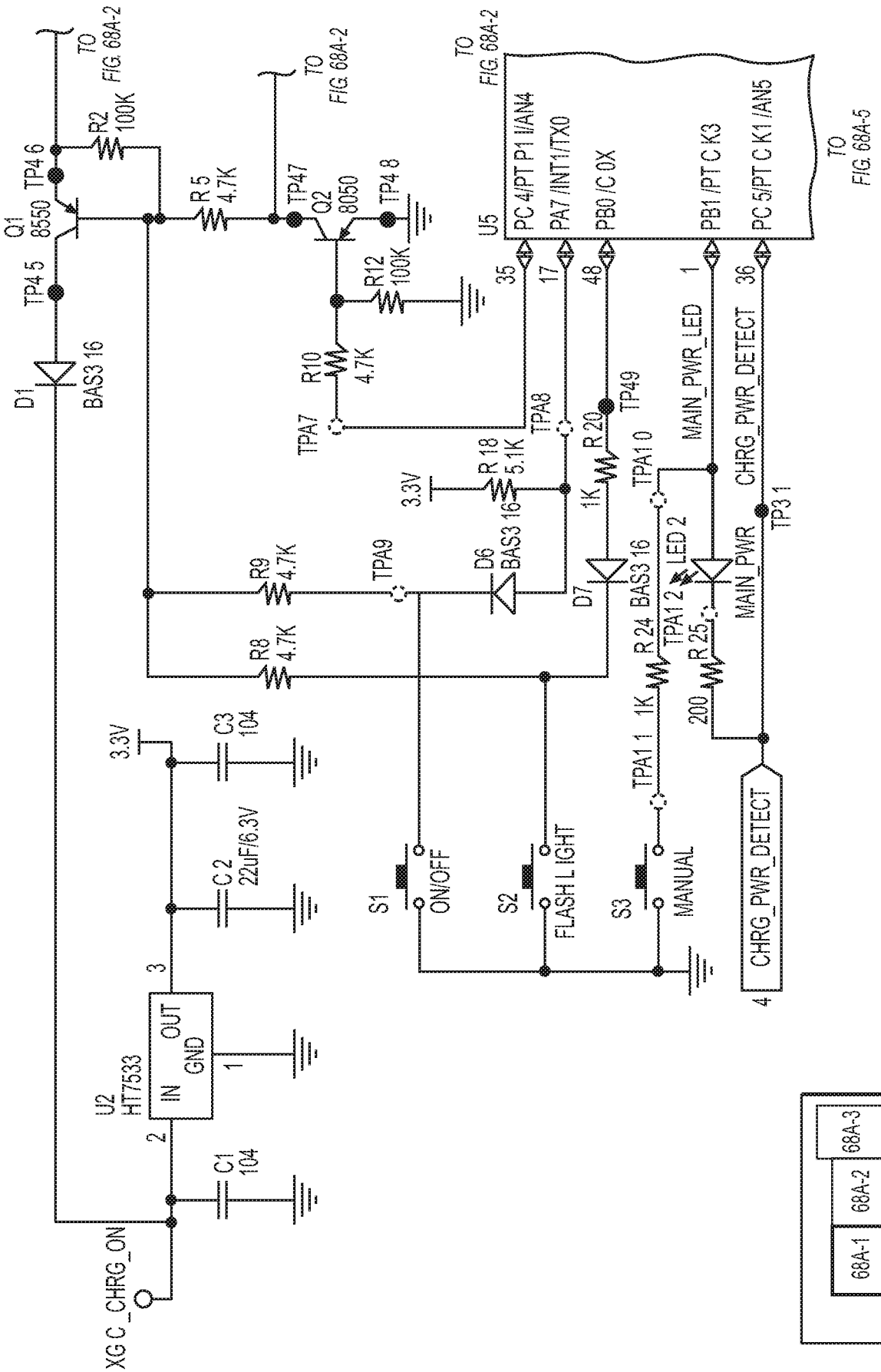

TO FIG. 68A-2
TO FIG. 68A-2
TO FIG. 68A-2
TO FIG. 68A-5
R2 100K
R 5 4.7K
TP47
Q2 8050
TP4 8
TP4 6
Q1 8550
TP4 5
D1 BAS3 16
R12 100K
R10 4.7K
TPA7
TPA8
TP49
R 20
R 18 5.1K
3.3V
TPA9
D6 BAS3 16
D7
1K
TPA1 0
MAIN_PWR_LED
CHRG_PWR_DETECT
TP3 1
MAIN_PWR
LED 2
TPA1 2
R 24 1K
R 25 200
TPA1 1
R9 4.7K
R8 4.7K
U5
PC 4/PT P1 I/AN4
PA7 /INT1/TX0
PB0 /C 0X
PB1 /PT C K3
PC 5/PT C K1 /AN5
35
17
48
1
36
4
3.3V
C3 104
C 2 22UF/6.3V
C1 104
U2 HT7533
IN
OUT
GND
3
2
1
S1 ON/OFF
S2 FLASH LIGHT
S3 MANUAL
CHRG_PWR_DETECT
XG C_CHRG_ON
68A-1
68A-2
68A-3
68A-4
68A-5
68A-6
68A-7

FIG. 68A-1

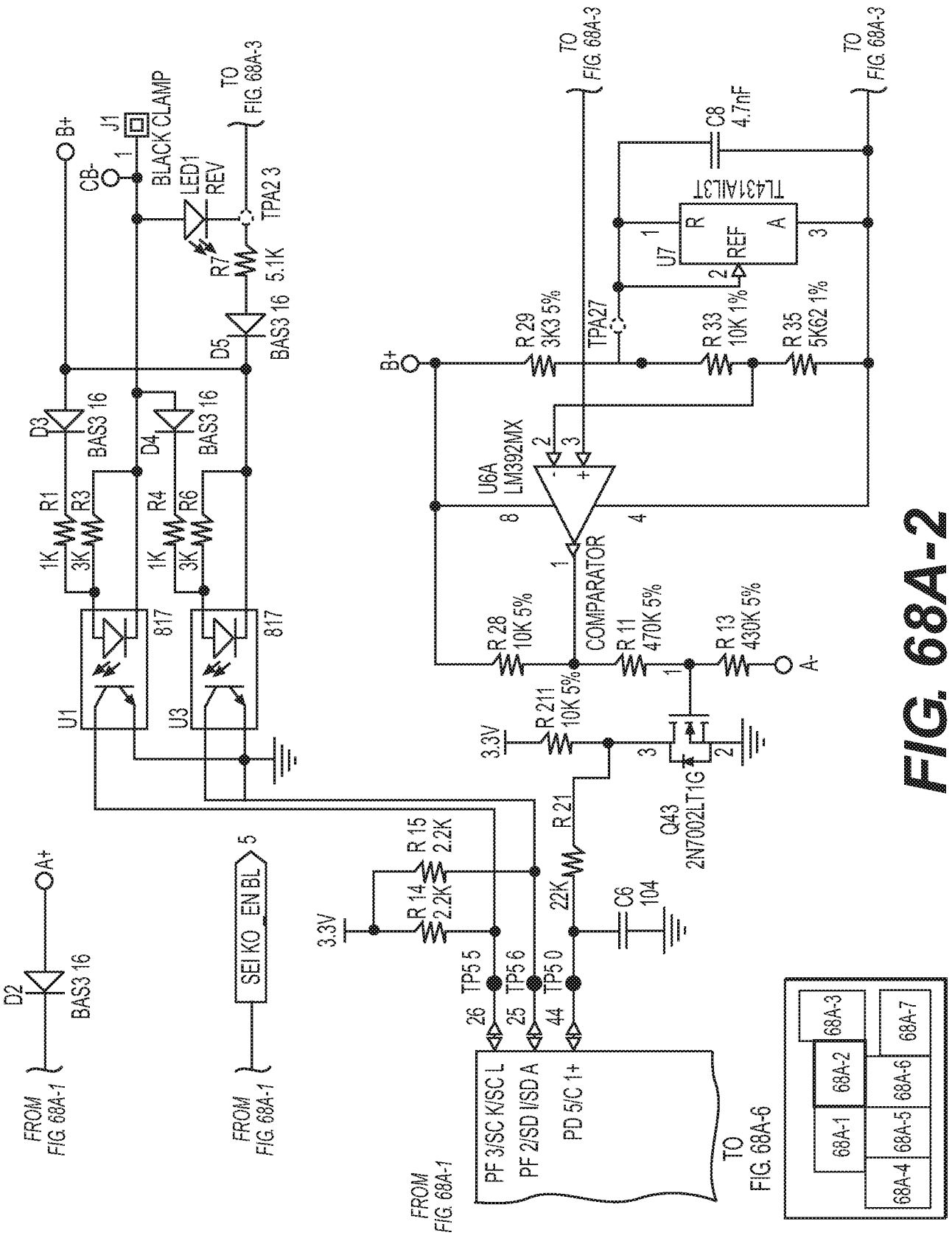
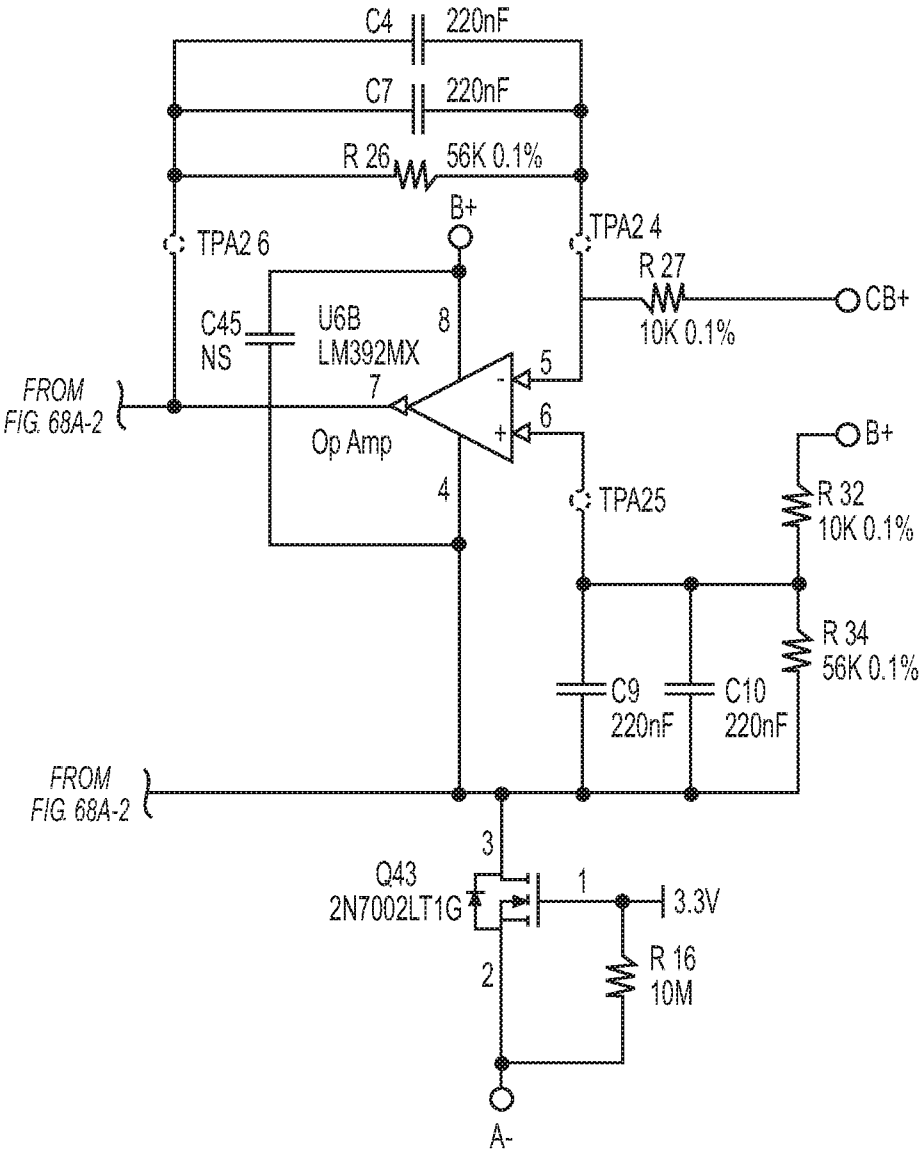

B+
CB-
J1
1
BLACK CLAMP
LED1
REV
R7
5.1K
TPA2 3
TO
FIG. 68A-3
D5
BAS3 16
D3
D4
BAS3 16
R1
R3
R4
R6
1K
3K
817
U1
U3
A+
D2
BAS3 16
FROM
FIG 68A-1
SEI KO EN BL
5
R 15
2.2K
R 14
2.2K
3.3V
TP5 5
TP5 6
TP5 0
26
25
44
22K
R 21
C6
104
PF 3/SC K/SC L
PF 2/SD I/SD A
PD 5/C 1+
TO
FIG 68A-6
Q43
2N7002LT1G
R 211
10K 5%
R 28
10K 5%
R 11
470K 5%
R 13
430K 5%
A-
U6A
LM392MX
COMPARATOR
8
4
2
3
1
R 29
3K3 5%
TPA27
R 33
10K 1%
R 35
5K62 1%
U7
TL431AILJT
REF
C8
4.7nF
68A-1
68A-2
68A-3
68A-4
68A-5
68A-6
68A-7

FIG. 68A-2


C4
220nF
C7
220nF
R 26
56K 0.1%
B+
TPA2 6
TPA2 4
R 27
10K 0.1%
CB+
C45
NS
U6B
LM392MX
8
5
7
6
FROM
FIG. 68A-2
Op Amp
B+
4
TPA25
R 32
10K 0.1%
R 34
56K 0.1%
C9
220nF
C10
220nF
FROM
FIG. 68A-2
3
Q43
2N7002LT1G
1
3.3V
2
R 16
10M
A-

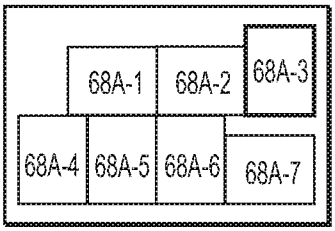

68A-1
68A-2
68A-3
68A-4
68A-5
68A-6
68A-7

FIG. 68A-3

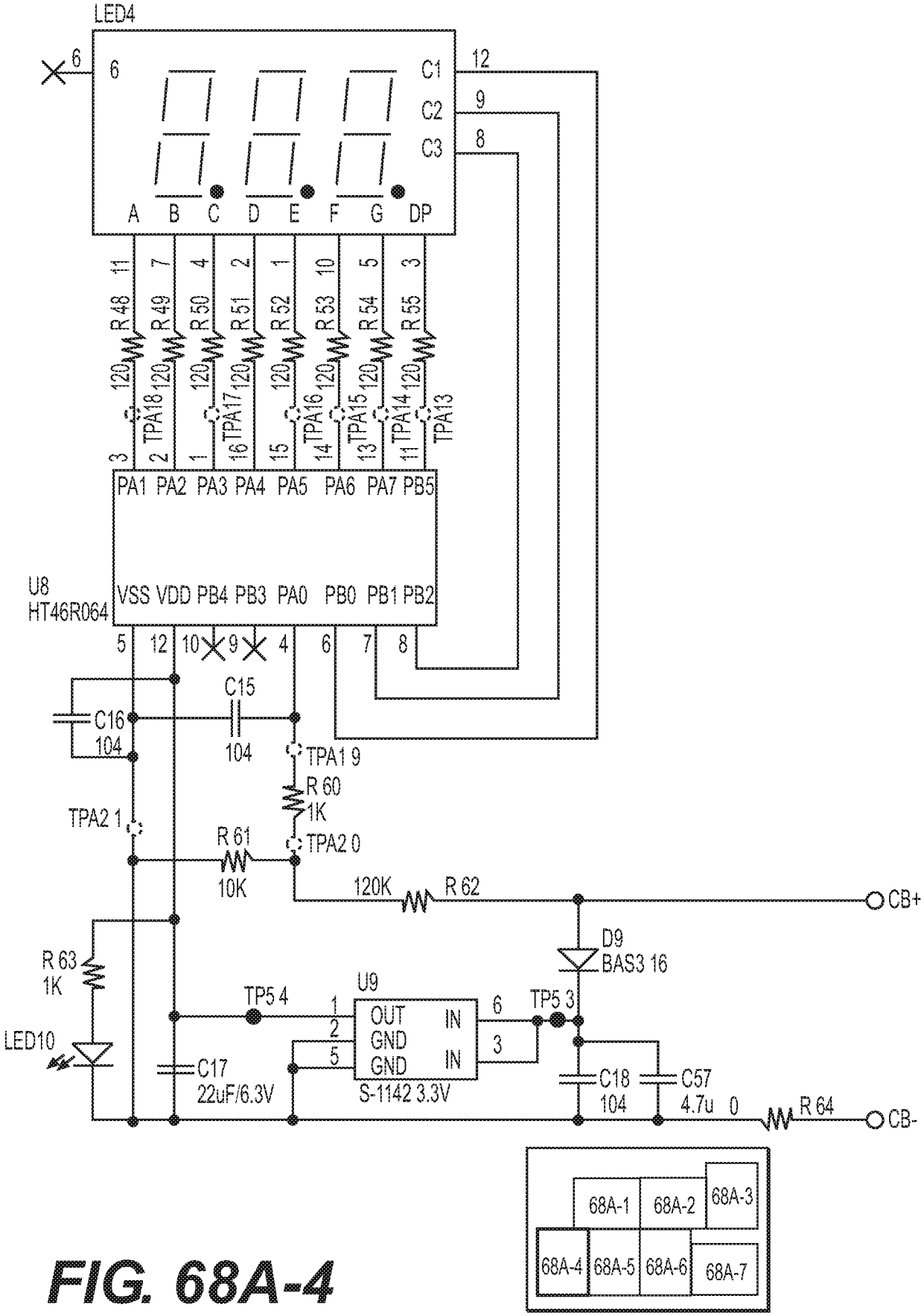

LED4
6
6
C1
C2
C3
12
9
8
A B C D E F G DP
R 48 120
R 49 120
R 50 120
R 51 120
R 52 120
R 53 120
R 54 120
R 55 120
TPA18
TPA17
TPA16
TPA15
TPA14
TPA13
PA1 PA2 PA3 PA4 PA5 PA6 PA7 PB5
U8
HT46R064
VSS VDD PB4 PB3 PA0 PB0 PB1 PB2
5 12 10 9 4 6 7 8
C15
C16
104
104
TPA1 9
R 60
1K
TPA2 1
R 61
10K
TPA2 0
120K
R 62
CB+
D9
BAS3 16
R 63
1K
TP5 4
U9
OUT IN
GND IN
GND
S-1142 3.3V
TP5 3
LED10
C17
22uF/6.3V
C18
104
C57
4.7u
R 64
CB-
68A-1
68A-2
68A-3
68A-4
68A-5
68A-6
68A-7

FIG. 68A-4

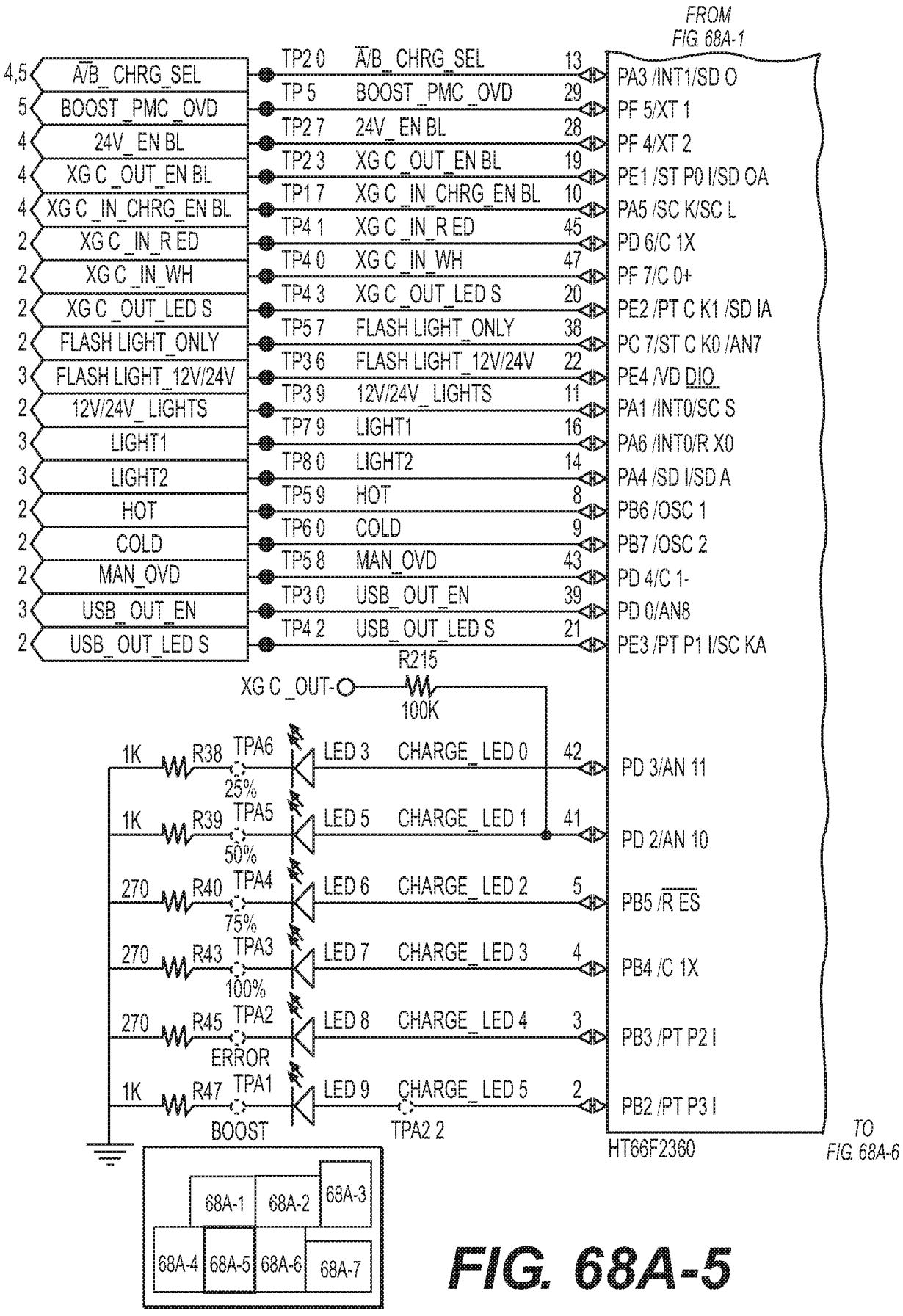

FROM FIG. 68A-1
4,5 A/B_CHRG_SEL
5 BOOST_PMC_OVD
4 24V_EN BL
4 XG C_OUT_EN BL
4 XG C_IN_CHRG_EN BL
2 XG C_IN_R ED
2 XG C_IN_WH
2 XG C_OUT_LED S
2 FLASH LIGHT_ONLY
3 FLASH LIGHT_12V/24V
2 12V/24V_LIGHTS
3 LIGHT1
3 LIGHT2
2 HOT
2 COLD
2 MAN_OVD
3 USB_OUT_EN
2 USB_OUT_LED S
TP2 0 A/B_CHRG_SEL 13 PA3 /INT1/SD O
TP 5 BOOST_PMC_OVD 29 PF 5/XT 1
TP2 7 24V_EN BL 28 PF 4/XT 2
TP2 3 XG C_OUT_EN BL 19 PE1 /ST P0 I/SD OA
TP1 7 XG C_IN_CHRG_EN BL 10 PA5 /SC K/SC L
TP4 1 XG C_IN_R ED 45 PD 6/C 1X
TP4 0 XG C_IN_WH 47 PF 7/C 0+
TP4 3 XG C_OUT_LED S 20 PE2 /PT C K1 /SD IA
TP5 7 FLASH LIGHT_ONLY 38 PC 7/ST C K0 /AN7
TP3 6 FLASH LIGHT_12V/24V 22 PE4 /VD DIO
TP3 9 12V/24V_LIGHTS 11 PA1 /INT0/SC S
TP7 9 LIGHT1 16 PA6 /INT0/R X0
TP8 0 LIGHT2 14 PA4 /SD I/SD A
TP5 9 HOT 8 PB6 /OSC 1
TP6 0 COLD 9 PB7 /OSC 2
TP5 8 MAN_OVD 43 PD 4/C 1-
TP3 0 USB_OUT_EN 39 PD 0/AN8
TP4 2 USB_OUT_LED S 21 PE3 /PT P1 I/SC KA
R215
XG C_OUT- 100K
1K R38 TPA6 25% LED 3 CHARGE_LED 0 42 PD 3/AN 11
1K R39 TPA5 50% LED 5 CHARGE_LED 1 41 PD 2/AN 10
270 R40 TPA4 75% LED 6 CHARGE_LED 2 5 PB5 /R ES
270 R43 TPA3 100% LED 7 CHARGE_LED 3 4 PB4 /C 1X
270 R45 TPA2 ERROR LED 8 CHARGE_LED 4 3 PB3 /PT P2 I
1K R47 TPA1 BOOST LED 9 CHARGE_LED 5 2 PB2 /PT P3 I
TPA2 2
HT66F2360
TO FIG. 68A-6
68A-1 68A-2 68A-3
68A-4 68A-5 68A-6 68A-7

FIG. 68A-5

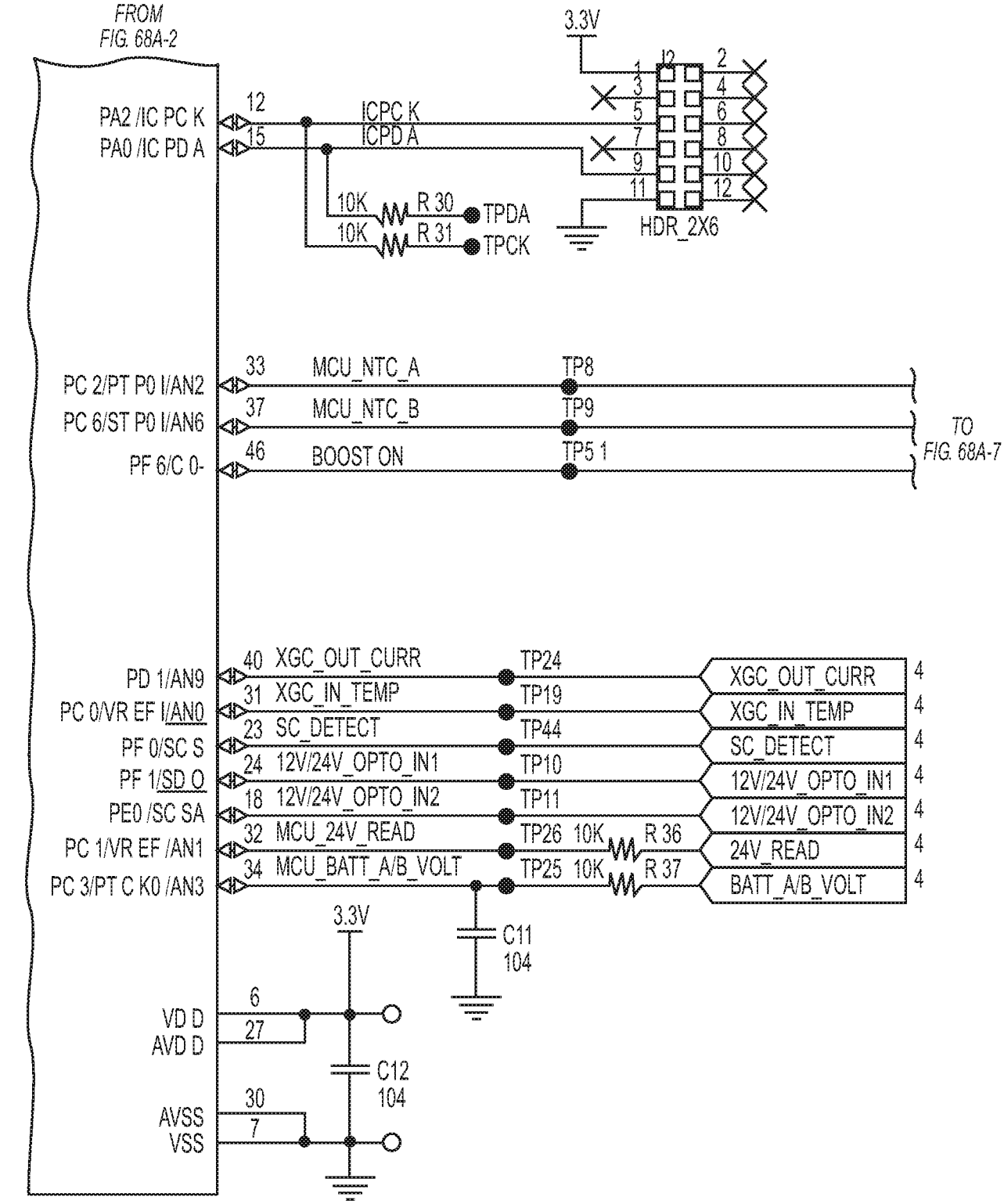

FROM FIG. 68A-2
3.3V
J2
HDR_2X6
PA2 /IC PC K
PA0 /IC PD A
12
15
ICPC K
ICPD A
10K R 30
10K R 31
TPDA
TPCK
PC 2/PT P0 I/AN2
PC 6/ST P0 I/AN6
PF 6/C 0-
33 MCU_NTC_A
37 MCU_NTC_B
46 BOOST ON
TP8
TP9
TP5 1
TO FIG. 68A-7
PD 1/AN9
PC 0/VR EF I/AN0
PF 0/SC S
PF 1/SD O
PE0 /SC SA
PC 1/VR EF /AN1
PC 3/PT C K0 /AN3
40 XGC_OUT_CURR
31 XGC_IN_TEMP
23 SC_DETECT
24 12V/24V_OPTO_IN1
18 12V/24V_OPTO_IN2
32 MCU_24V_READ
34 MCU_BATT_A/B_VOLT
TP24
TP19
TP44
TP10
TP11
TP26 10K R 36
TP25 10K R 37
XGC_OUT_CURR 4
XGC_IN_TEMP 4
SC_DETECT 4
12V/24V_OPTO_IN1 4
12V/24V_OPTO_IN2 4
24V_READ 4
BATT_A/B_VOLT 4
3.3V
C11 104
VD D
AVD D
6
27
C12 104
AVSS
VSS
30
7
FROM FIG. 68A-5
68A-1
68A-2
68A-3
68A-4
68A-5
68A-6
68A-7

FIG. 68A-6

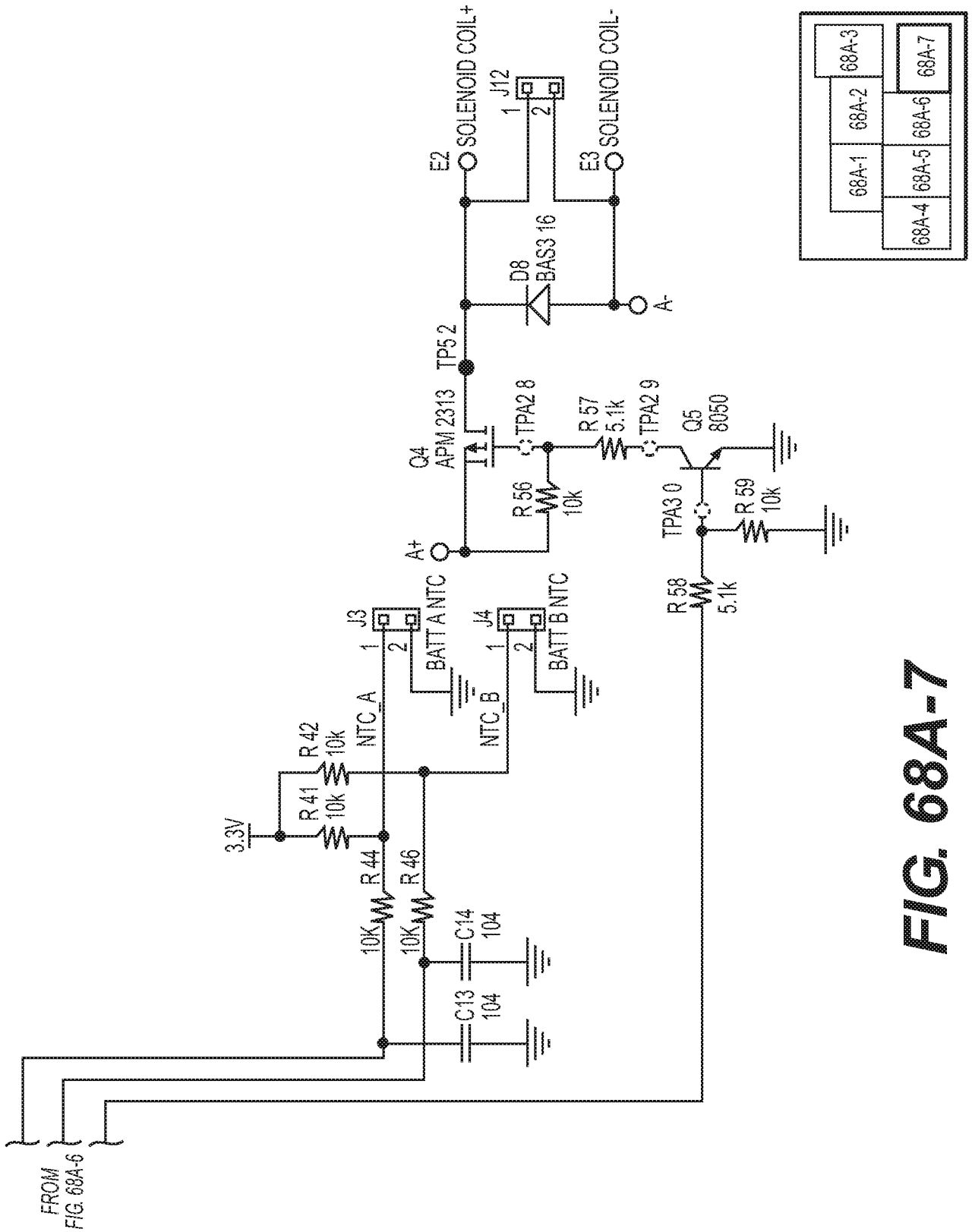

FROM FIG. 68A-6
3.3V
R 41 10k
R 42 10k
R 44 10K
R 46 10K
C13 104
C14 104
NTC_A
NTC_B
J3
J4
BATT A NTC
BATT B NTC
A+
Q4 APM 2313
TPA2 8
R 56 10k
R 57 5.1k
TPA2 9
Q5 8050
TPA3 0
R 59 10k
R 58 5.1k
TP5 2
D8 BAS3 16
A-
E2 SOLENOID COIL+
E3 SOLENOID COIL-
J12
68A-1
68A-2
68A-3
68A-4
68A-5
68A-6
68A-7

FIG. 68A-7

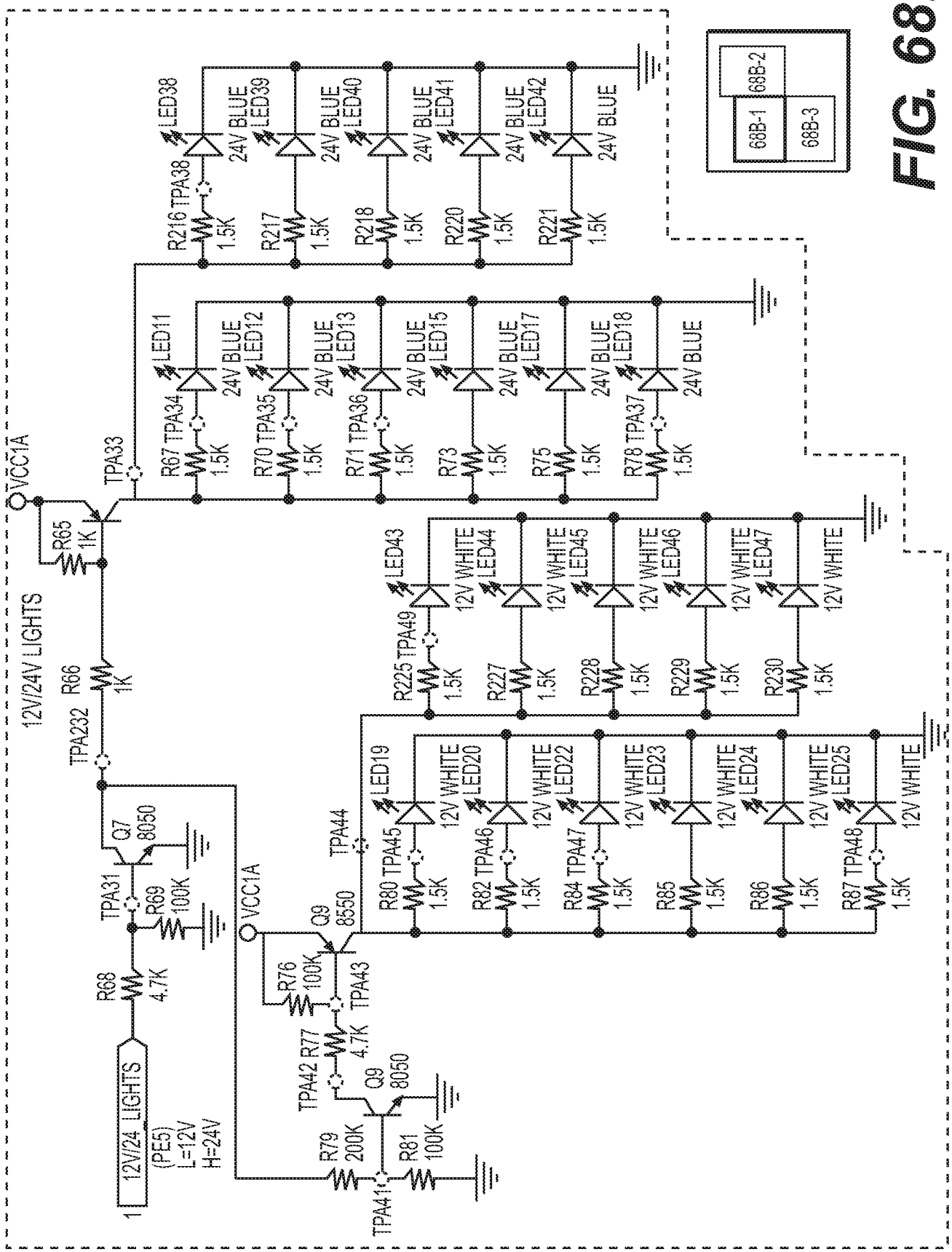

12V/24V LIGHTS
VCC1A
R65 1K
TPA33
R66 1K
TPA232
Q7 8050
TPA31
R69 100K
R68 4.7K
12V/24 LIGHTS (PE5) L=12V H=24V
VCC1A
Q9 8550
TPA44
R76 100K
TPA43
R77 4.7K
TPA42
Q9 8050
R79 200K
R81 100K
TPA41
LED38
LED39
LED40
LED41
LED42
24V BLUE
R216 TPA38
R217
R218
R220
R221
1.5K
LED11
LED12
LED13
LED15
LED17
LED18
R67 TPA34
R70 TPA35
R71 TPA36
R73
R75
R78 TPA37
LED43
LED44
LED45
LED46
LED47
12V WHITE
R225 TPA49
R227
R228
R229
R230
LED19
LED20
LED22
LED23
LED24
LED25
R80 TPA45
R82 TPA46
R84 TPA47
R85
R86
R87 TPA48
68B-1
68B-2
68B-3

FIG. 68B-1

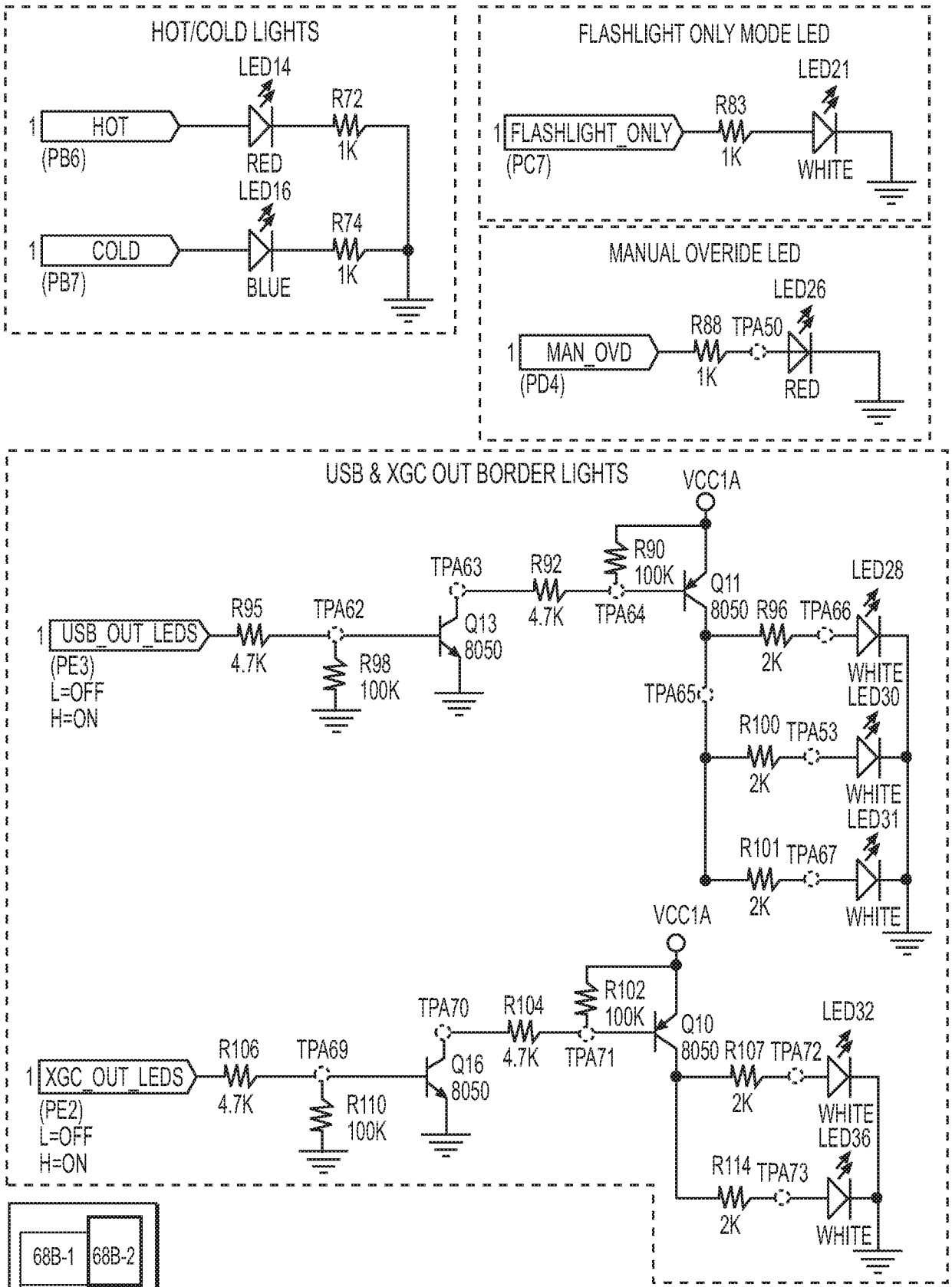

HOT/COLD LIGHTS
LED14
R72
1K
HOT
(PB6)
RED
LED16
R74
1K
COLD
(PB7)
BLUE
FLASHLIGHT ONLY MODE LED
LED21
R83
1K
FLASHLIGHT_ONLY
(PC7)
WHITE
MANUAL OVERIDE LED
LED26
R88
TPA50
1K
MAN_OVD
(PD4)
RED
USB & XGC OUT BORDER LIGHTS
VCC1A
R90
100K
TPA63
R92
4.7K
TPA64
Q11
8050
LED28
R95
TPA62
4.7K
USB_OUT_LEDS
(PE3)
L=OFF
H=ON
Q13
8050
R98
100K
R96
TPA66
2K
WHITE
LED30
TPA65
R100
TPA53
2K
WHITE
LED31
R101
TPA67
2K
WHITE
VCC1A
R102
100K
TPA70
R104
4.7K
TPA71
Q10
8050
LED32
R106
TPA69
4.7K
XGC_OUT_LEDS
(PE2)
L=OFF
H=ON
Q16
8050
R110
100K
R107
TPA72
2K
WHITE
LED36
R114
TPA73
2K
WHITE
68B-1
68B-2
68B-3

FIG. 68B-2

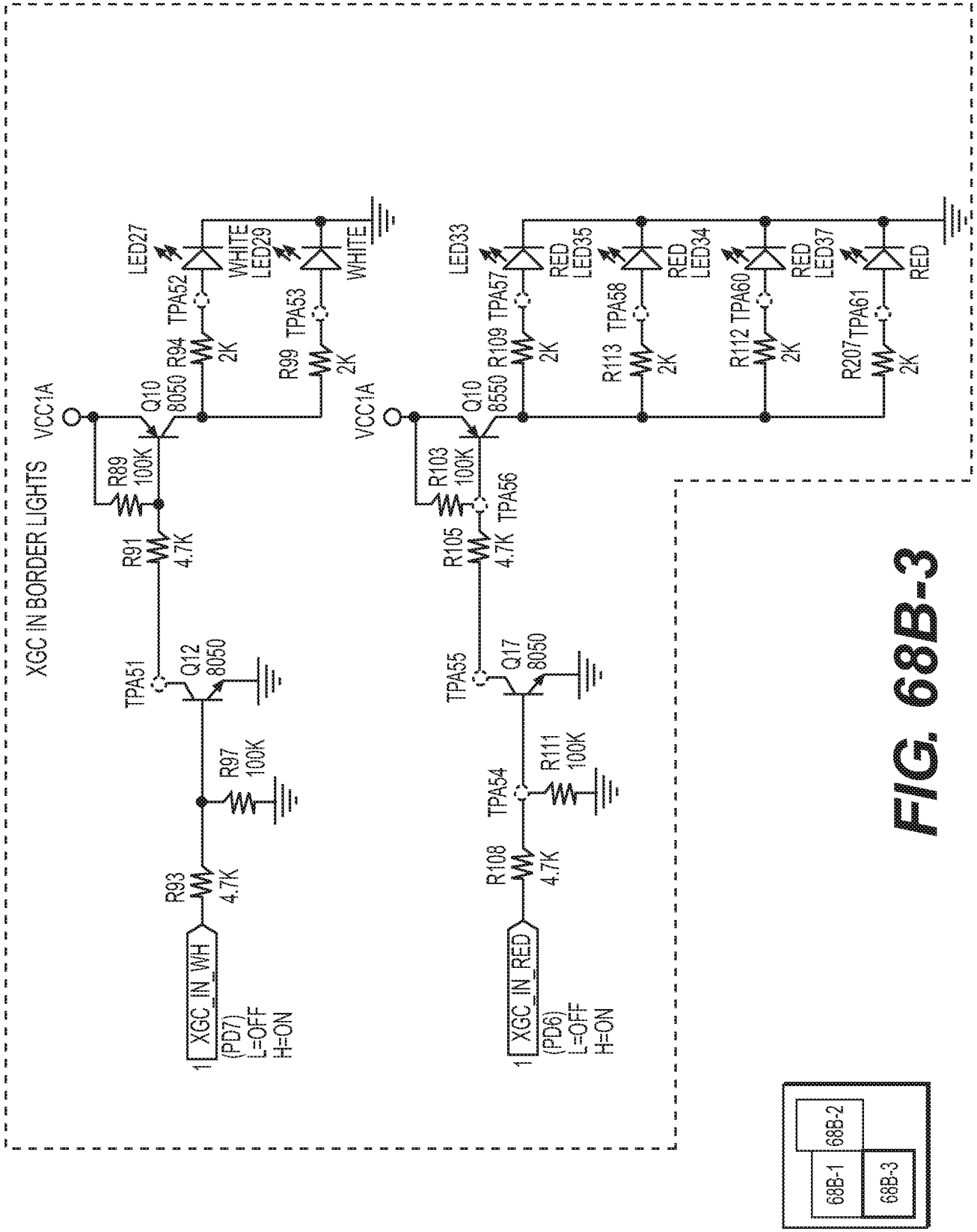

XGC IN BORDER LIGHTS
VCC1A
R89 100K
Q10 8050
R91 4.7K
TPA51
Q12 8050
R97 100K
R93 4.7K
XGC_IN_WH
(PD7)
L=OFF
H=ON
LED27
WHITE
TPA52
R94 2K
R99 TPA53 2K
WHITE
LED29
VCC1A
R103 100K
Q10 8550
R105 4.7K TPA56
TPA55
Q17 8050
R111 100K
R108 4.7K
TPA54
XGC_IN_RED
(PD6)
L=OFF
H=ON
LED33
RED
R109 TPA57
2K
LED35
R113 TPA58 2K
RED
LED34
R112 TPA60 2K
RED
LED37
R207 TPA61 2K
RED
68B-1
68B-2
68B-3

FIG. 68B-3

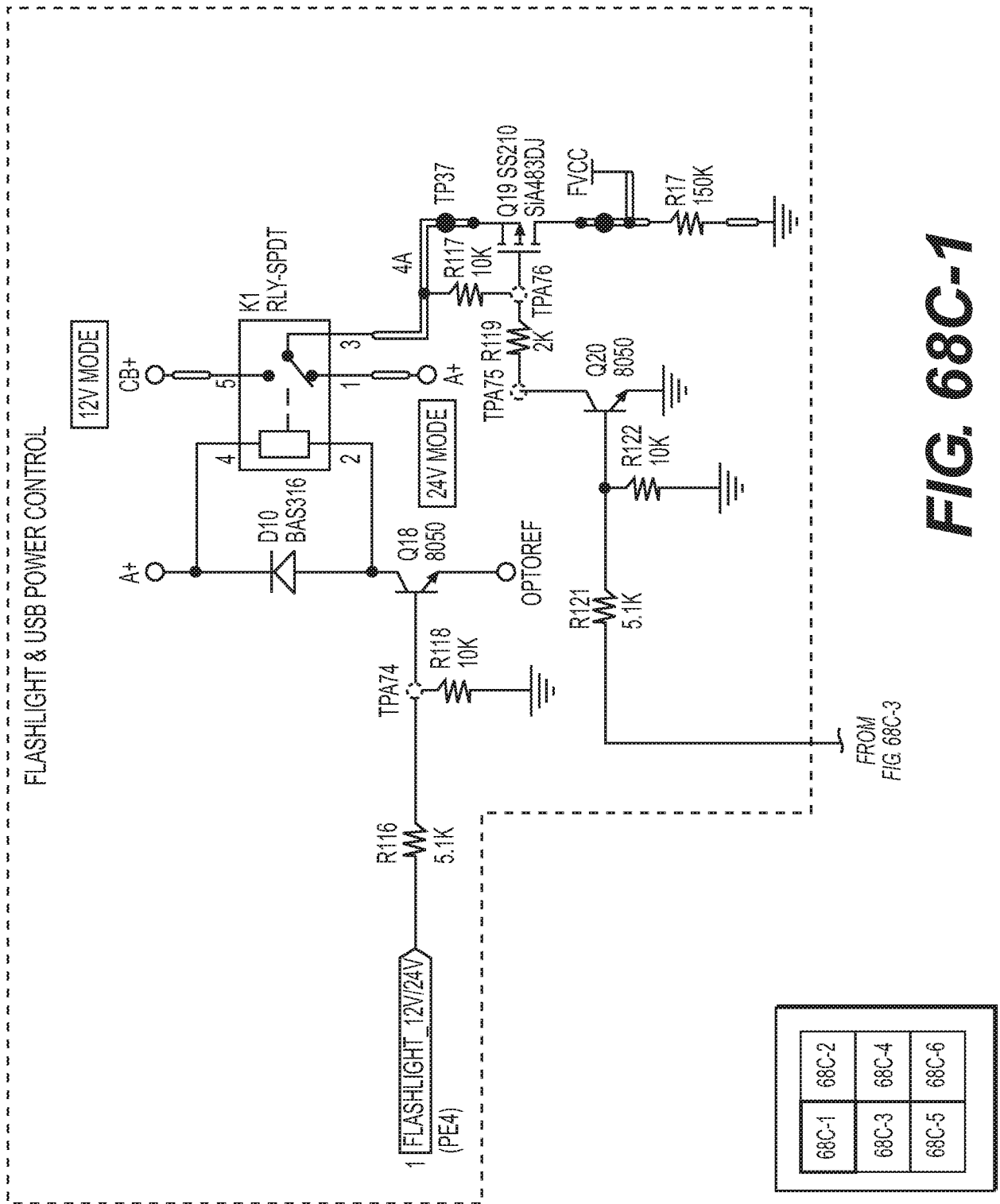

FLASHLIGHT & USB POWER CONTROL
12V MODE
24V MODE
CB+
A+
K1
RLY-SPDT
D10
BAS316
Q18
8050
OPTOREF
TPA74
R118
10K
R116
5.1K
FLASHLIGHT_12V/24V
(PE4)
TP37
4A
R117
10K
Q19 SS210
SIA483DJ
FVCC
R17
150K
TPA76
TPA75 R119
2K
Q20
8050
R122
10K
R121
5.1K
FROM
FIG. 68C-3
68C-1
68C-2
68C-3
68C-4
68C-5
68C-6

FIG. 68C-1

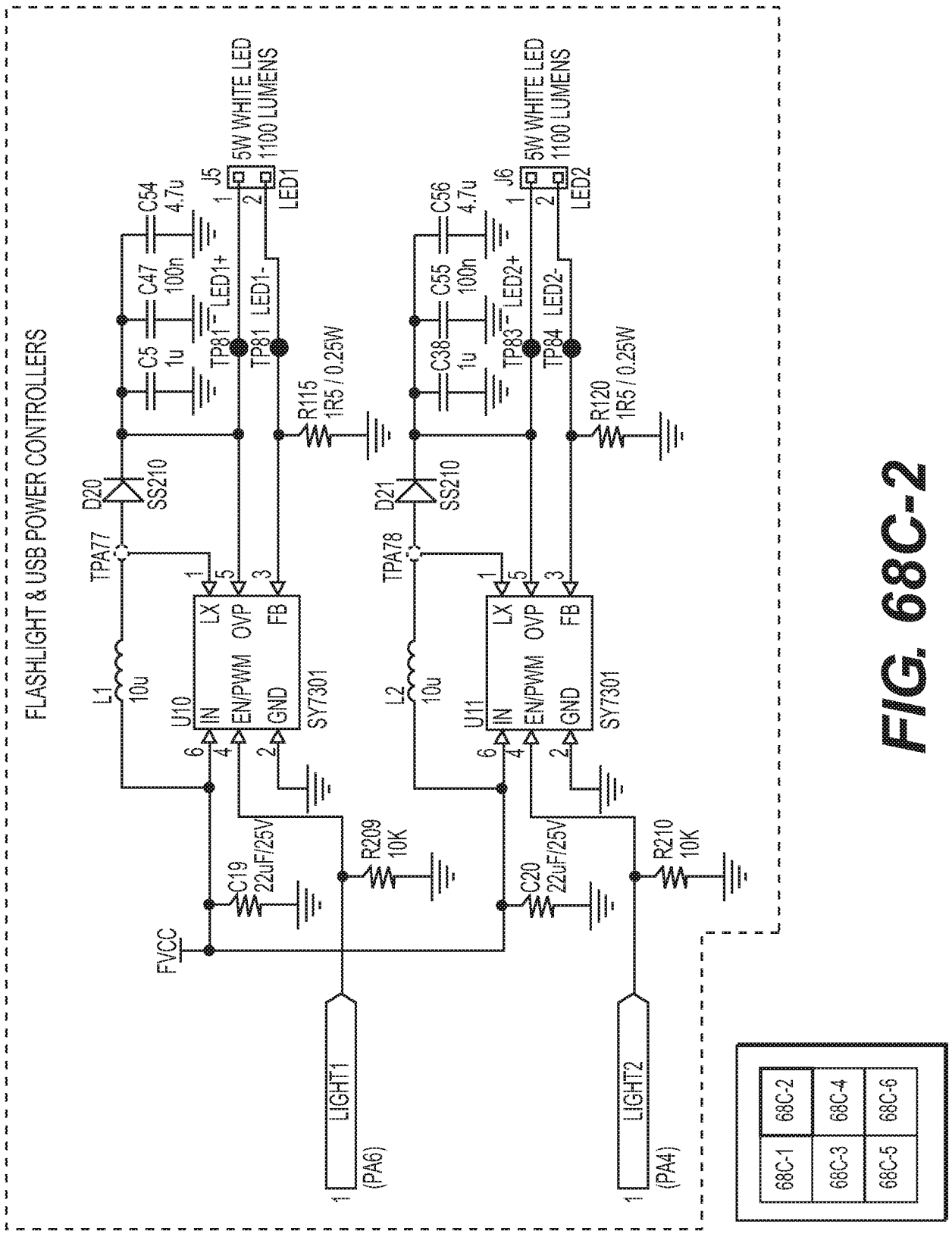

FLASHLIGHT & USB POWER CONTROLLERS
5W WHITE LED
1100 LUMENS
LED1
LED2
J5
J6
C54
4.7u
C47
100n
C5
1u
C56
C55
C38
TP81
TP83
LED1+
LED2+
LED1-
LED2-
TP84
R115
R120
1R5 / 0.25W
D20
D21
SS210
TPA77
TPA78
L1
L2
10u
U10
U11
IN
EN/PWM
GND
LX
OVP
FB
SY7301
C19
C20
22uF/25V
R209
R210
10K
FVCC
LIGHT1
LIGHT2
(PA6)
(PA4)
68C-1
68C-2
68C-3
68C-4
68C-5
68C-6

FIG. 68C-2

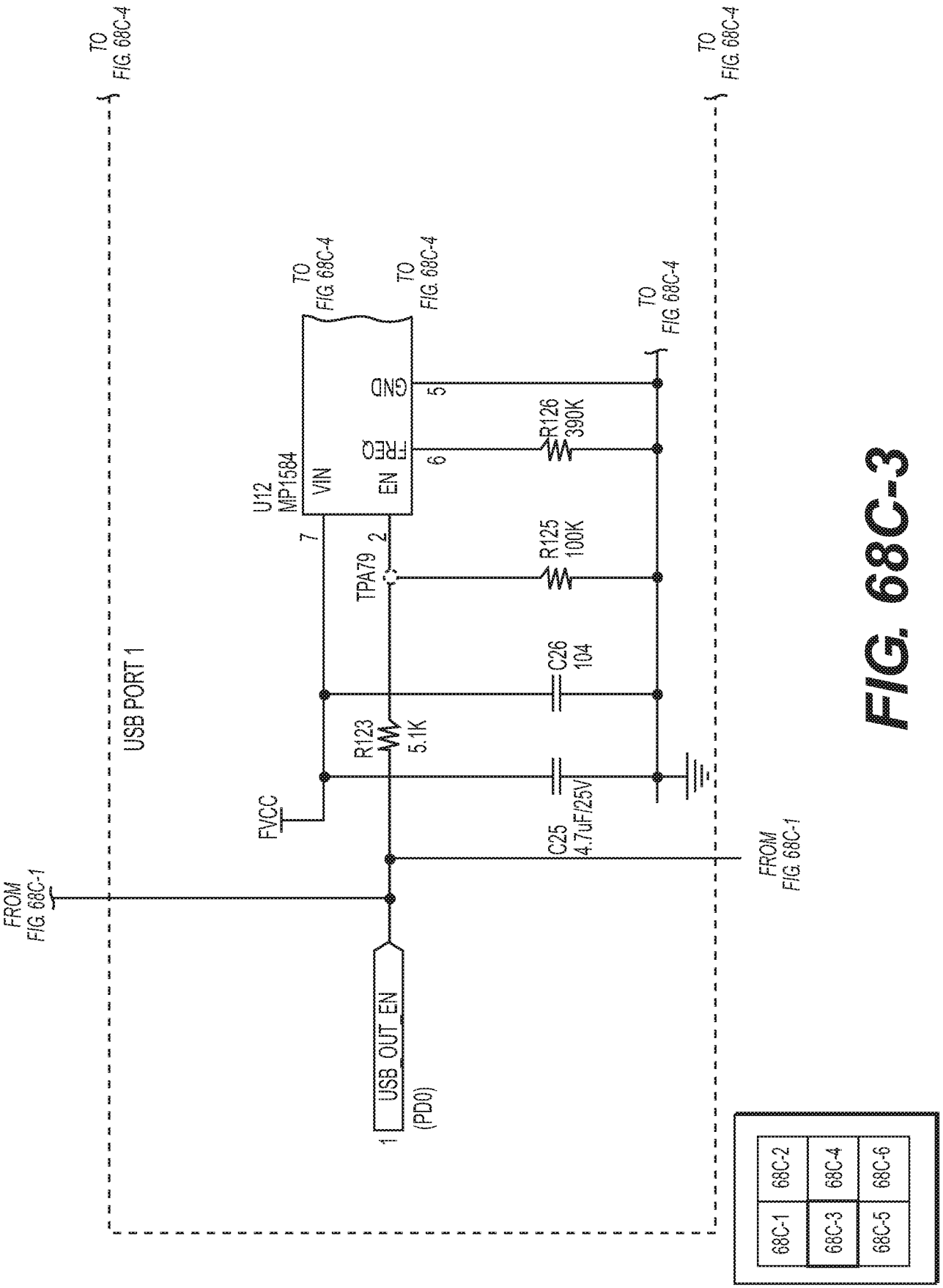

FROM FIG. 68C-1
USB PORT 1
TO FIG. 68C-4
USB_OUT_EN
(PD0)
1
FVCC
R123 5.1K
TPA79
2
C25 4.7uF/25V
C26 104
R125 100K
R126 390K
U12 MP1584
VIN
EN
FREQ
GND
7
6
5
68C-1
68C-2
68C-3
68C-4
68C-5
68C-6

FIG. 68C-3

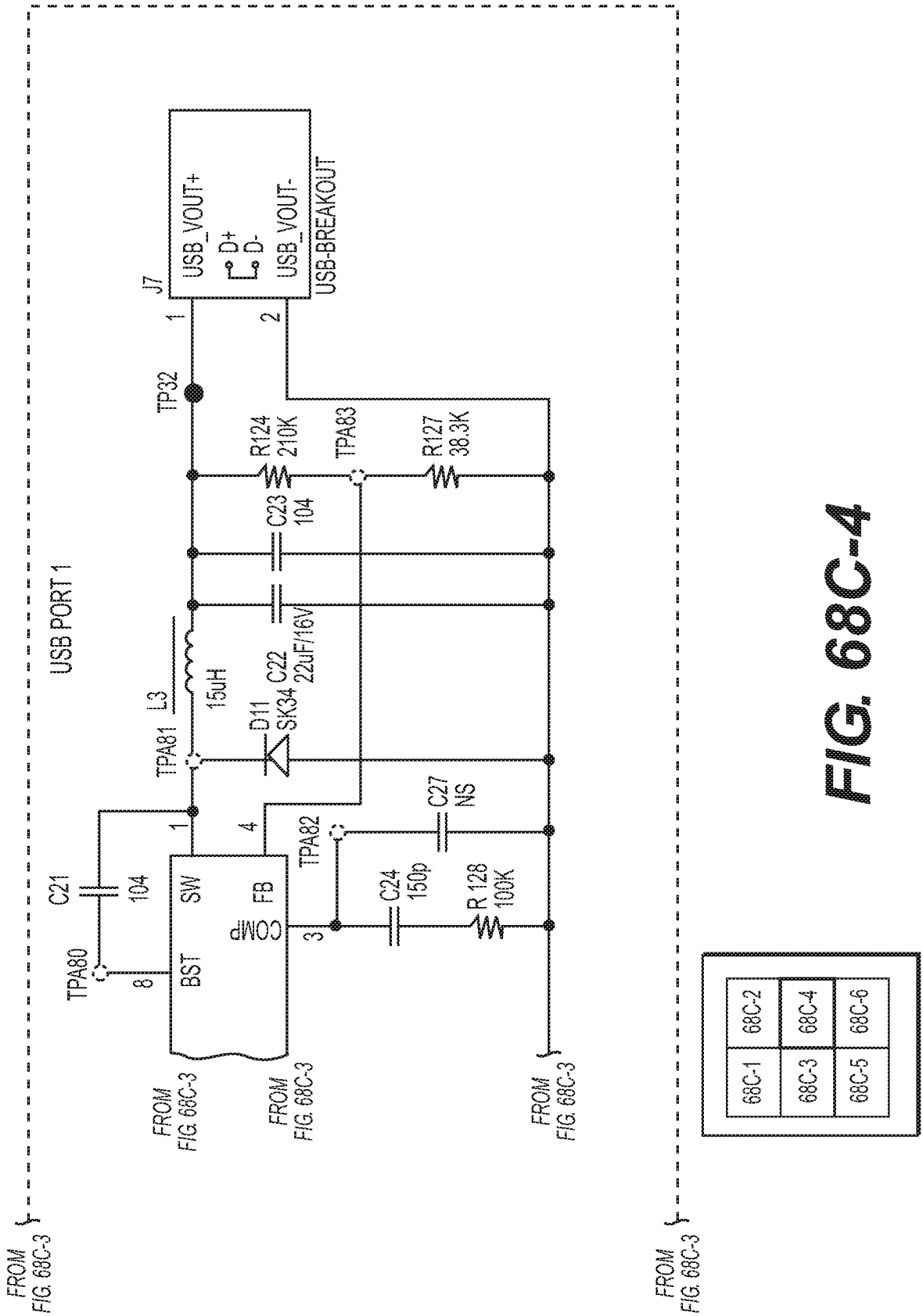

USB PORT 1
J7
USB_VOUT+
D+
D-
USB_VOUT-
USB-BREAKOUT
TP32
R124 210K
TPA83
R127 38.3K
C23 104
C22 22uF/16V
L3 15uH
TPA81
D11 SK34
C27 NS
TPA82
C24 150p
R 128 100K
C21 104
TPA80
BST
SW
FB
COMP
FROM FIG. 68C-3
FROM FIG. 68C-3
FROM FIG. 68C-3
FROM FIG. 68C-3
FROM FIG. 68C-3
68C-1
68C-2
68C-3
68C-4
68C-5
68C-6

FIG. 68C-4

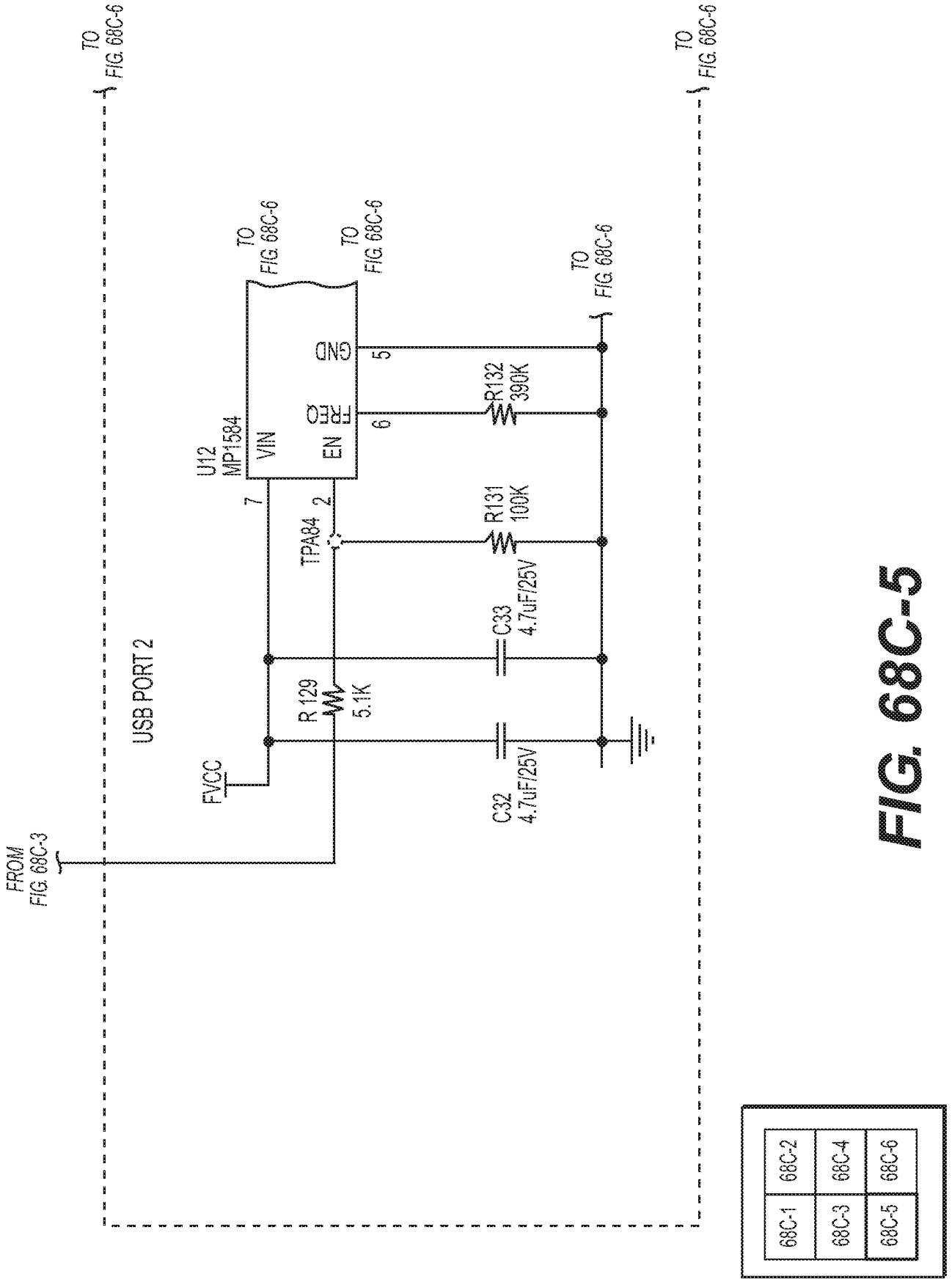

FROM FIG. 68C-3
TO FIG. 68C-6
USB PORT 2
FVCC
R 129 5.1K
TPA84
U12 MP1584
VIN
EN
FB
GND
7
2
6
5
C32 4.7uF/25V
C33 4.7uF/25V
R131 100K
R132 390K
68C-1
68C-2
68C-3
68C-4
68C-5
68C-6

FIG. 68C-5

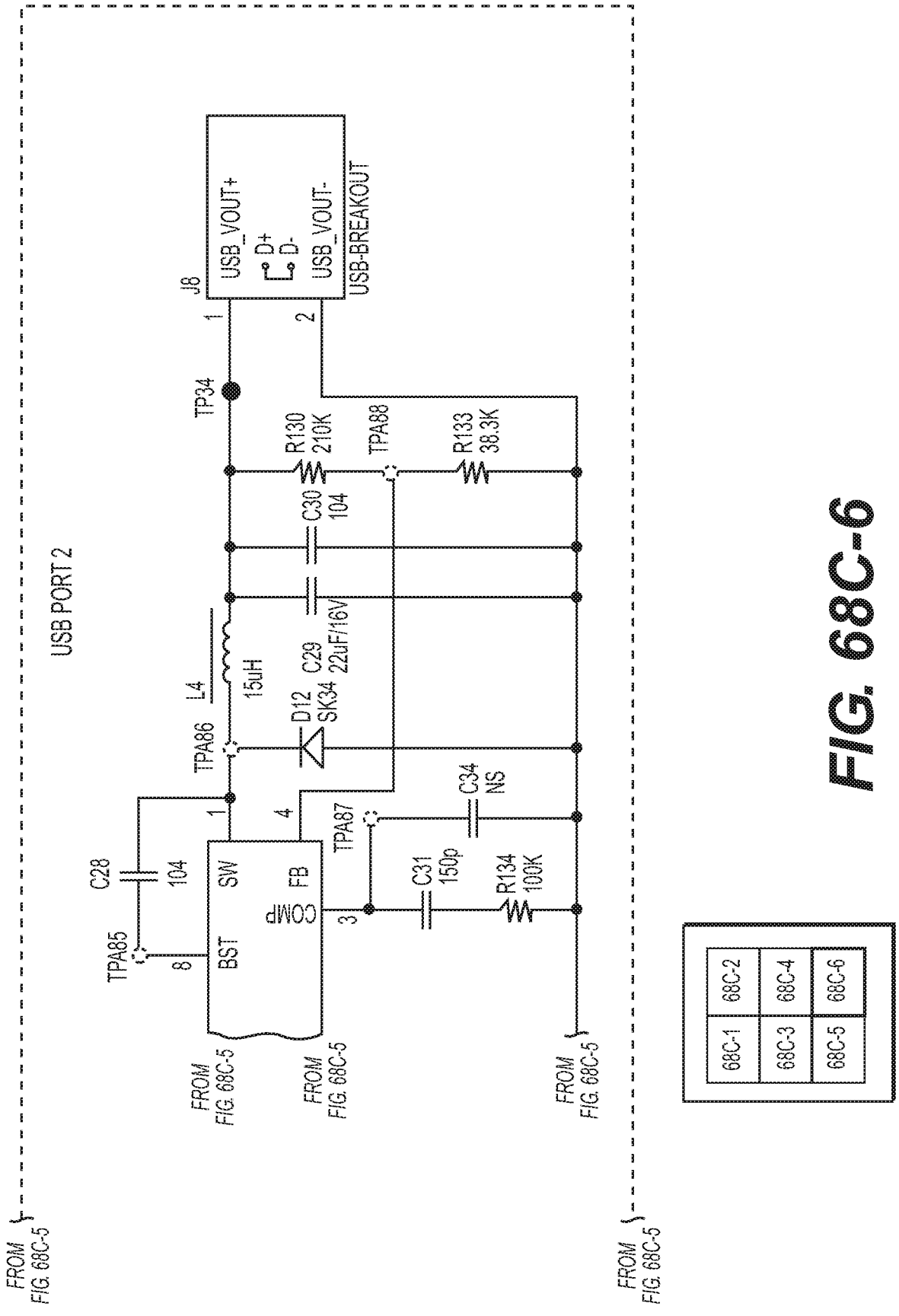

USB PORT 2
FROM FIG. 68C-5
FROM FIG. 68C-5
FROM FIG. 68C-5
FROM FIG. 68C-5
FROM FIG. 68C-5
J8
USB_VOUT+
D+
D-
USB_VOUT-
USB-BREAKOUT
TP34
R130 210K
TPA88
R133 38.3K
C30 104
C29 22uF/16V
L4
15uH
D12 SK34
TPA86
C34 NS
TPA87
C31 150p
R134 100K
C28 104
TPA85
BST
SW
FB
COMP
68C-1
68C-2
68C-3
68C-4
68C-5
68C-6

FIG. 68C-6

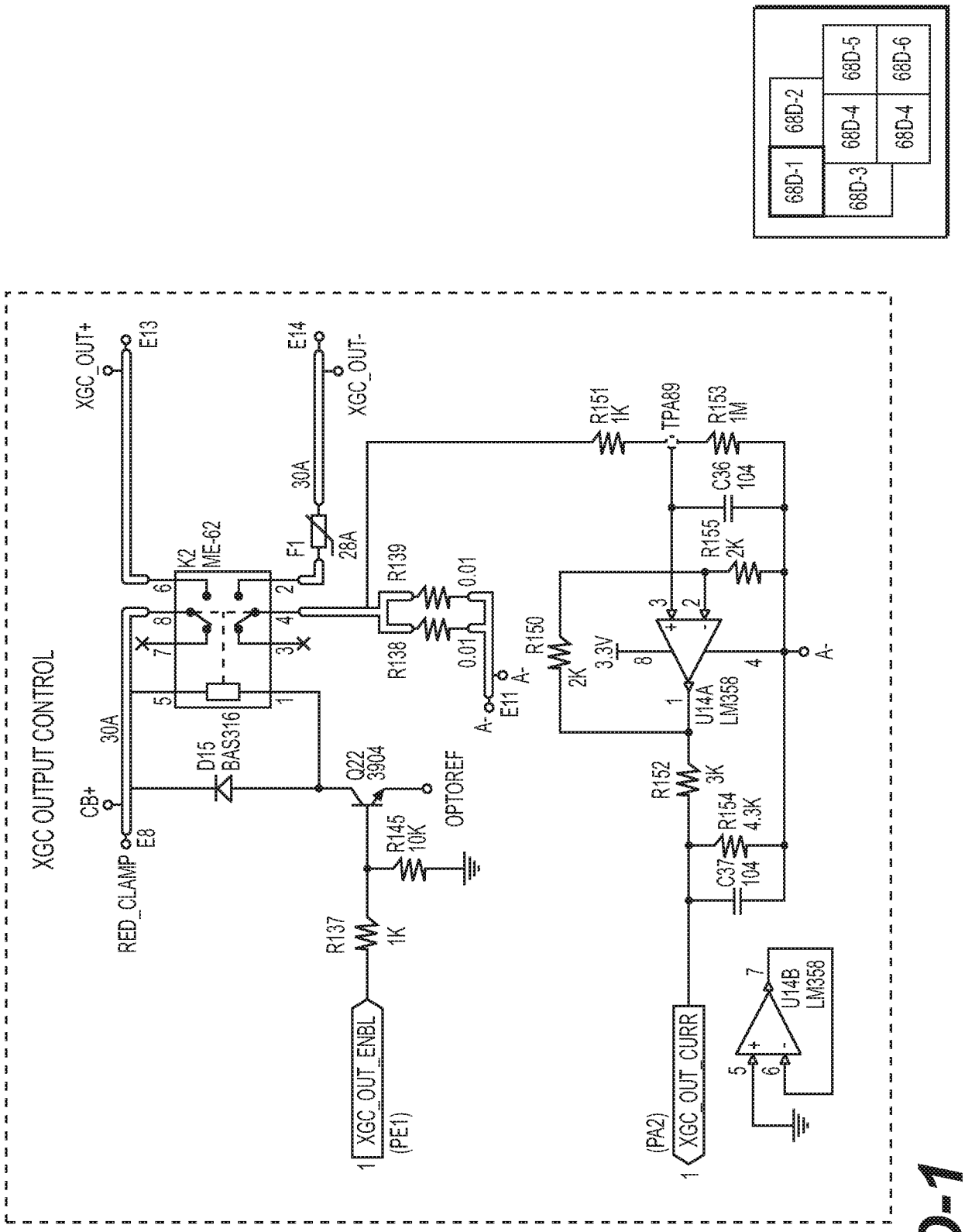

68D-1
68D-2
68D-3
68D-4
68D-5
68D-4
68D-6
XGC OUTPUT CONTROL
XGC_OUT+
E13
XGC_OUT-
E14
30A
F1
28A
K2
ME-62
D15
BAS316
Q22
3904
OPTOREF
R145
10K
R137
1K
XGC_OUT_ENBL
(PE1)
CB+
E8
RED_CLAMP
R139
R138
0.01
0.01
A-
E11
R150
2K
3.3V
R151
1K
TPA89
R153
1M
C36
104
R155
2K
U14A
LM358
R152
3K
R154
4.3K
C37
104
U14B
LM358
(PA2)
XGC_OUT_CURR

FIG. 68D-1

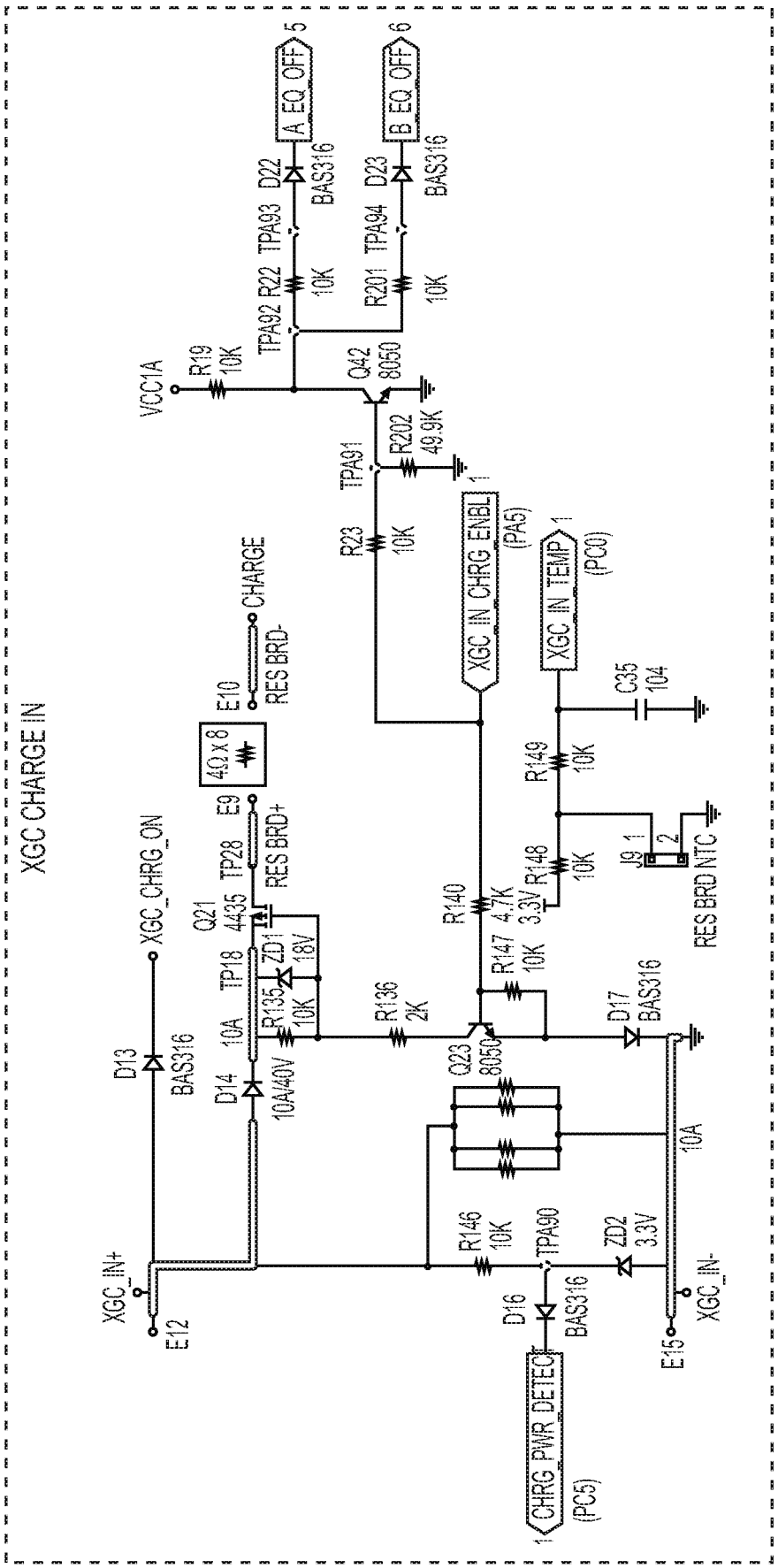

XGC CHARGE IN
XGC_CHRG_ON
XGC_IN+
XGC_IN-
E12
E15
D13
BAS316
D14
10A/440V
10A
TP18
Q21
4435
TP28
E9
RES BRD+
40.x 8
E10
RES BRD-
CHARGE
ZD1
18V
R135
10K
R136
2K
R140
4.7K
R147
10K
3.3V
R148
10K
R149
10K
J9
1
2
RES BRD NTC
C35
104
XGC_IN_TEMP
(PC0)
XGC_IN_CHRG_ENBL
(PA5)
R23
10K
TPA91
R202
49.9K
Q42
8050
R19
10K
VCC1A
TPA92
R22
10K
TPA93
D22
BAS316
A_EQ_OFF
R201
10K
TPA94
D23
BAS316
B_EQ_OFF
Q23
8050
D17
BAS316
R146
10K
TPA90
ZD2
3.3V
D16
BAS316
CHRG_PWR_DETECT
(PC5)
68D-1
68D-2
68D-3
68D-4
68D-5
68D-6
68D-4

FIG. 68D-2

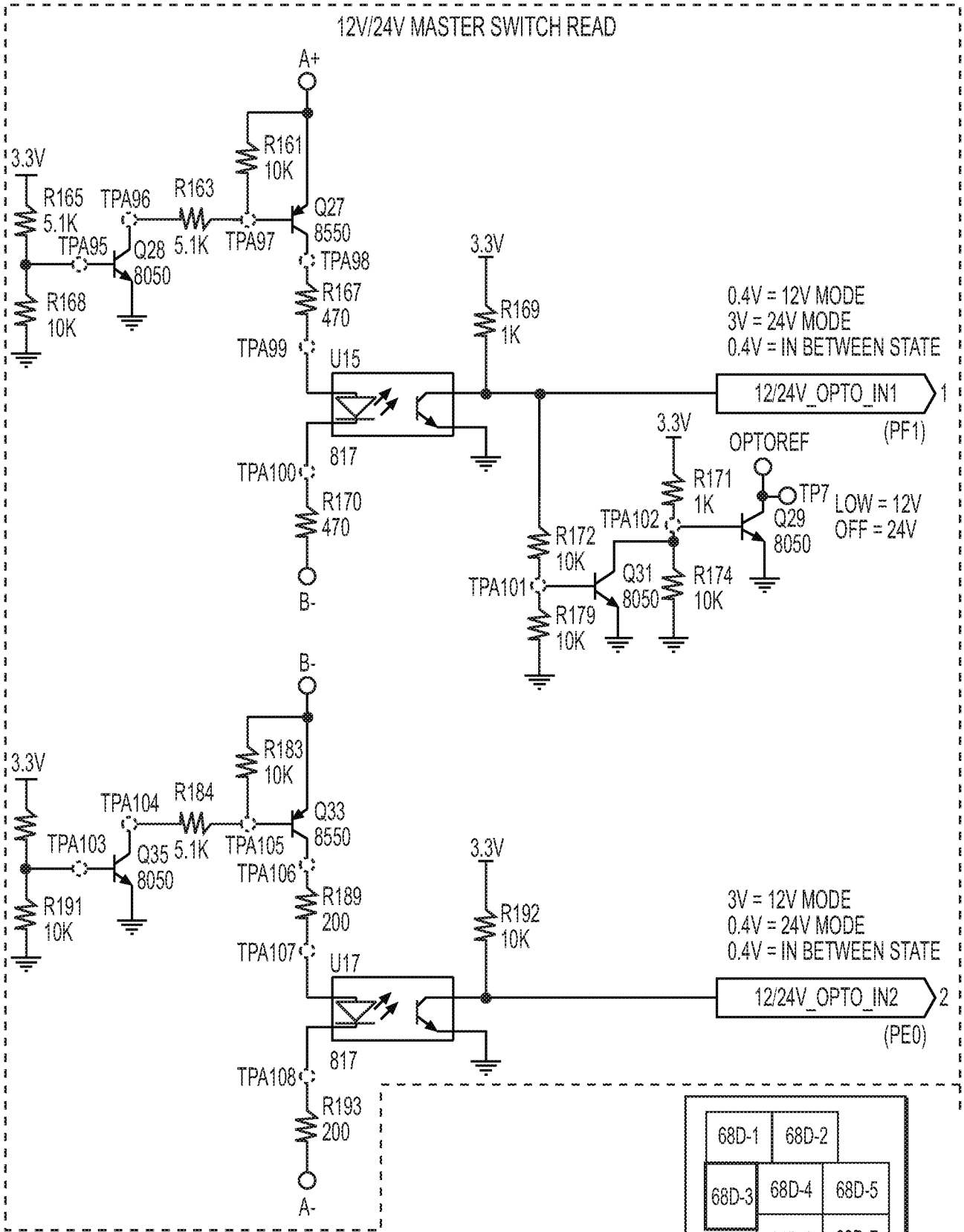

12V/24V MASTER SWITCH READ
A+
3.3V
R161
10K
R165
5.1K
TPA96
R163
Q27
8550
TPA95
Q28
8050
5.1K
TPA97
TPA98
R168
10K
R167
470
TPA99
U15
3.3V
R169
1K
0.4V = 12V MODE
3V = 24V MODE
0.4V = IN BETWEEN STATE
12/24V_OPTO_IN1
1
(PF1)
817
TPA100
R170
470
B-
3.3V
OPTOREF
R171
1K
TP7
LOW = 12V
OFF = 24V
TPA102
Q29
8050
R172
10K
Q31
8050
R174
10K
TPA101
R179
10K
B-
3.3V
R183
10K
TPA104
R184
Q33
8550
TPA103
Q35
8050
5.1K
TPA105
TPA106
R191
10K
R189
200
3.3V
R192
10K
3V = 12V MODE
0.4V = 24V MODE
0.4V = IN BETWEEN STATE
TPA107
U17
12/24V_OPTO_IN2
2
(PE0)
817
TPA108
R193
200
A-
68D-1
68D-2
68D-3
68D-4
68D-5
68D-6
68D-7

FIG. 68D-3

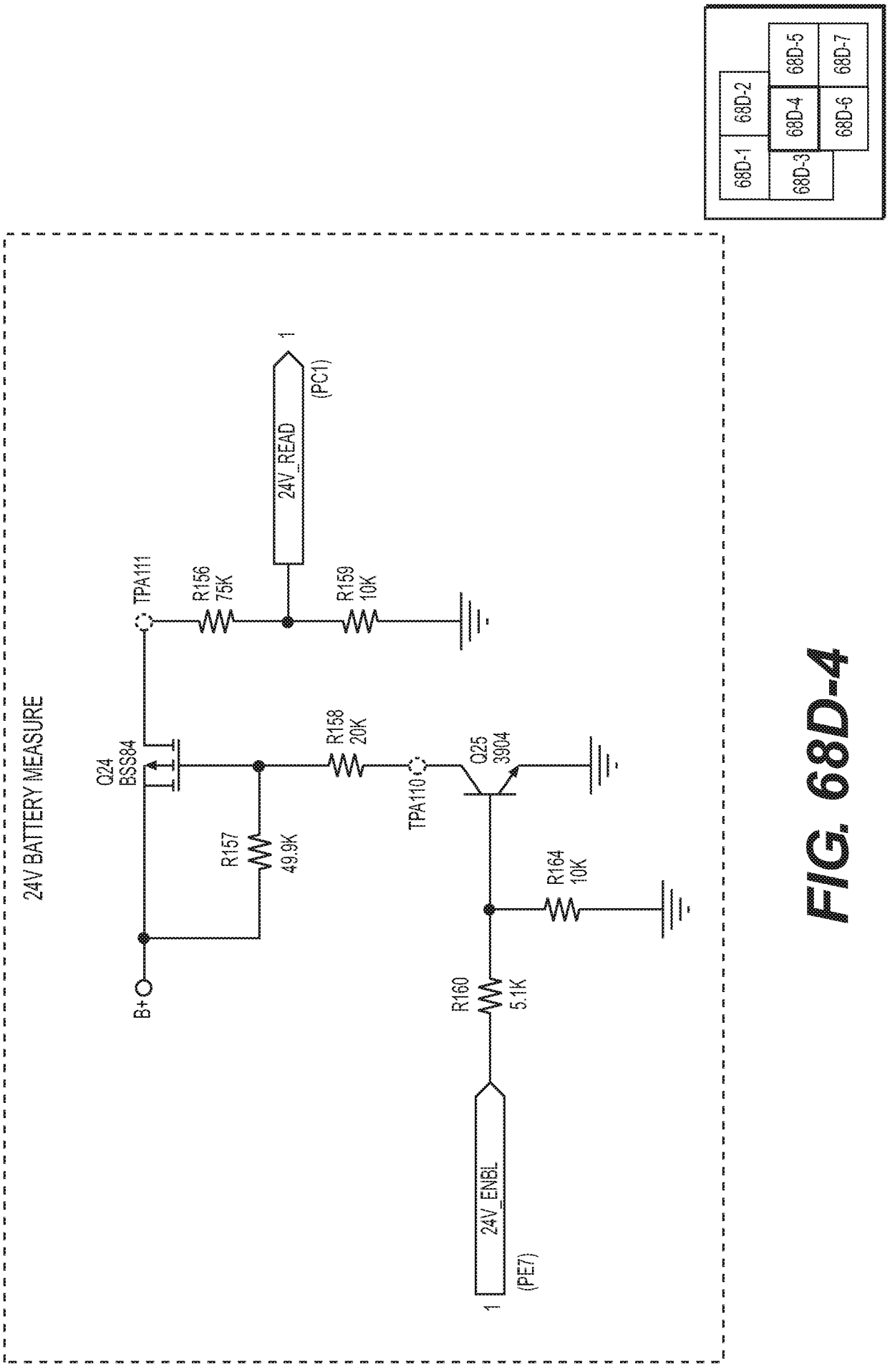

68D-1
68D-2
68D-3
68D-4
68D-5
68D-6
68D-7
24V BATTERY MEASURE
B+
Q24
BSS84
TPA111
R156
75K
R157
49.9K
R158
20K
TPA110
Q25
3904
R159
10K
R160
5.1K
R164
10K
24V_READ
(PC1)
24V_ENBL
(PE7)
1
1

FIG. 68D-4

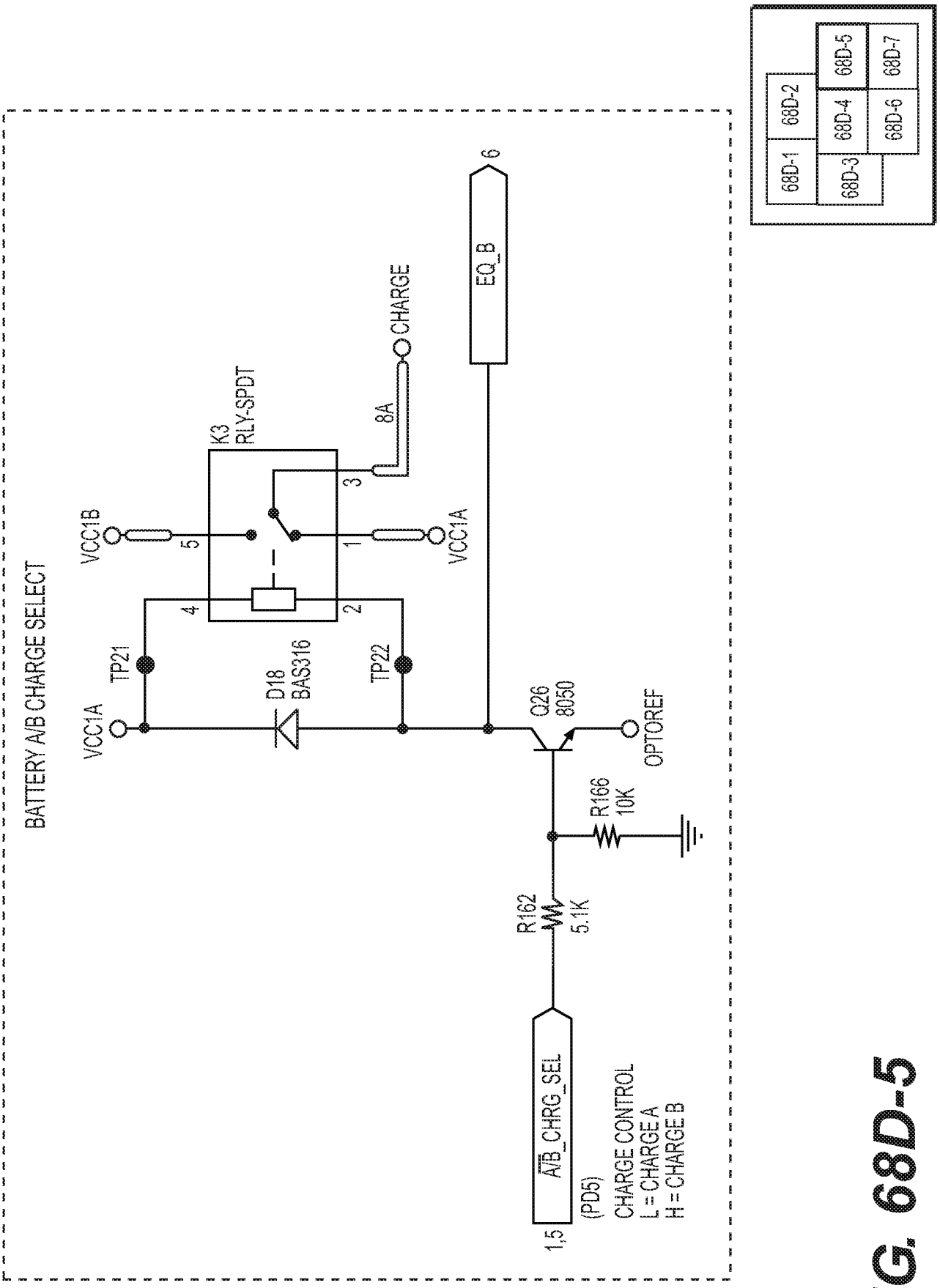

BATTERY A/B CHARGE SELECT
VCC1A
TP21
D18
BAS316
TP22
VCC1B
K3
RLY-SPDT
5
4
3
2
1
8A
CHARGE
VCC1A
EQ_B
6
Q26
8050
OPTOREF
R166
10K
R162
5.1K
A/B_CHRG_SEL
1,5
(PD5)
CHARGE CONTROL
L = CHARGE A
H = CHARGE B
68D-1
68D-2
68D-3
68D-4
68D-5
68D-6
68D-7

FIG. 68D-5

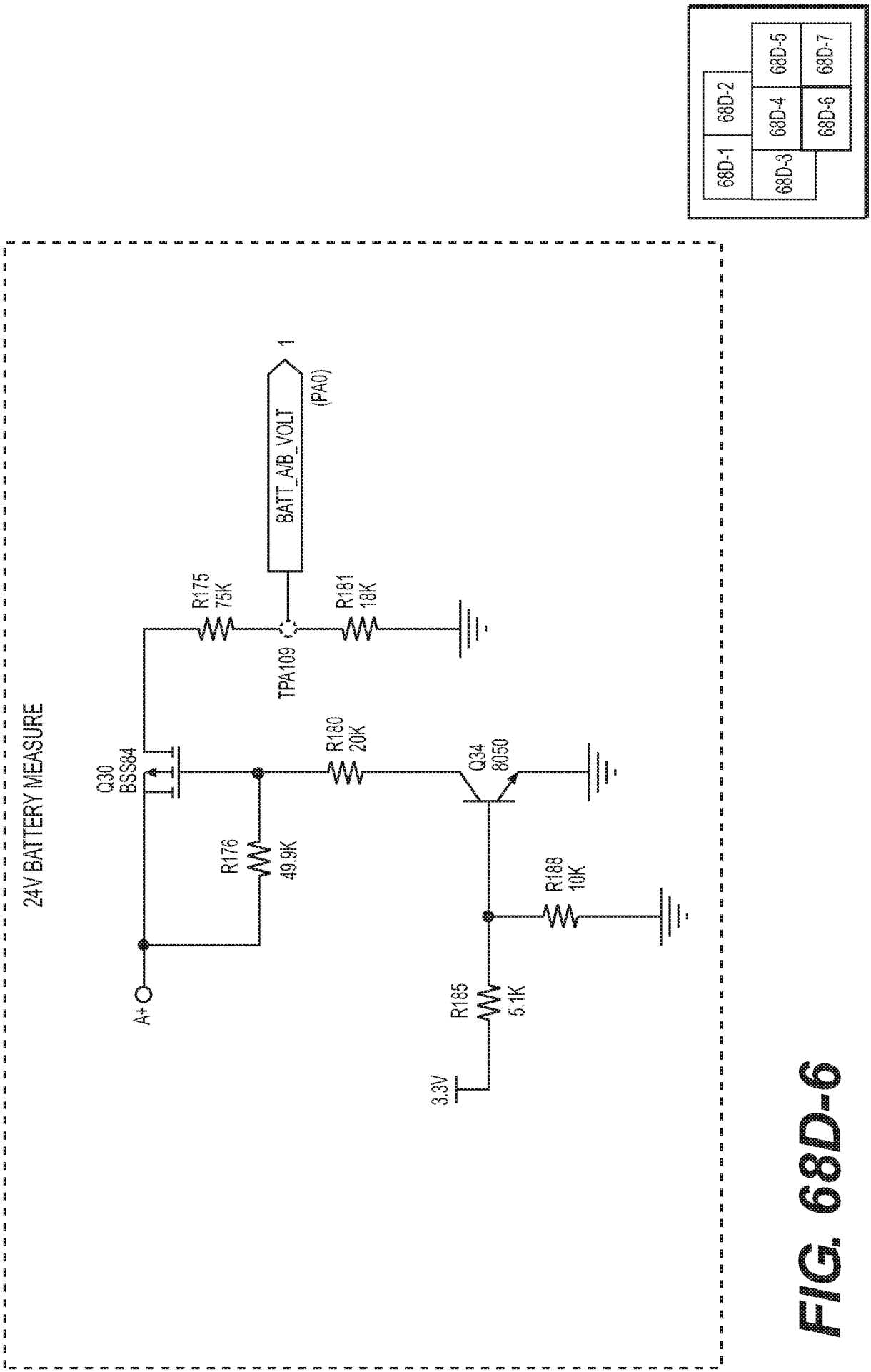

68D-1
68D-2
68D-3
68D-4
68D-5
68D-6
68D-7
24V BATTERY MEASURE
BATT_A/B_VOLT
(PA0)
1
R175
75K
R161
18K
TPA109
R180
20K
Q34
8050
Q30
BSS84
R176
49.9K
R188
10K
A+
R185
5.1K
3.3V

FIG. 68D-6

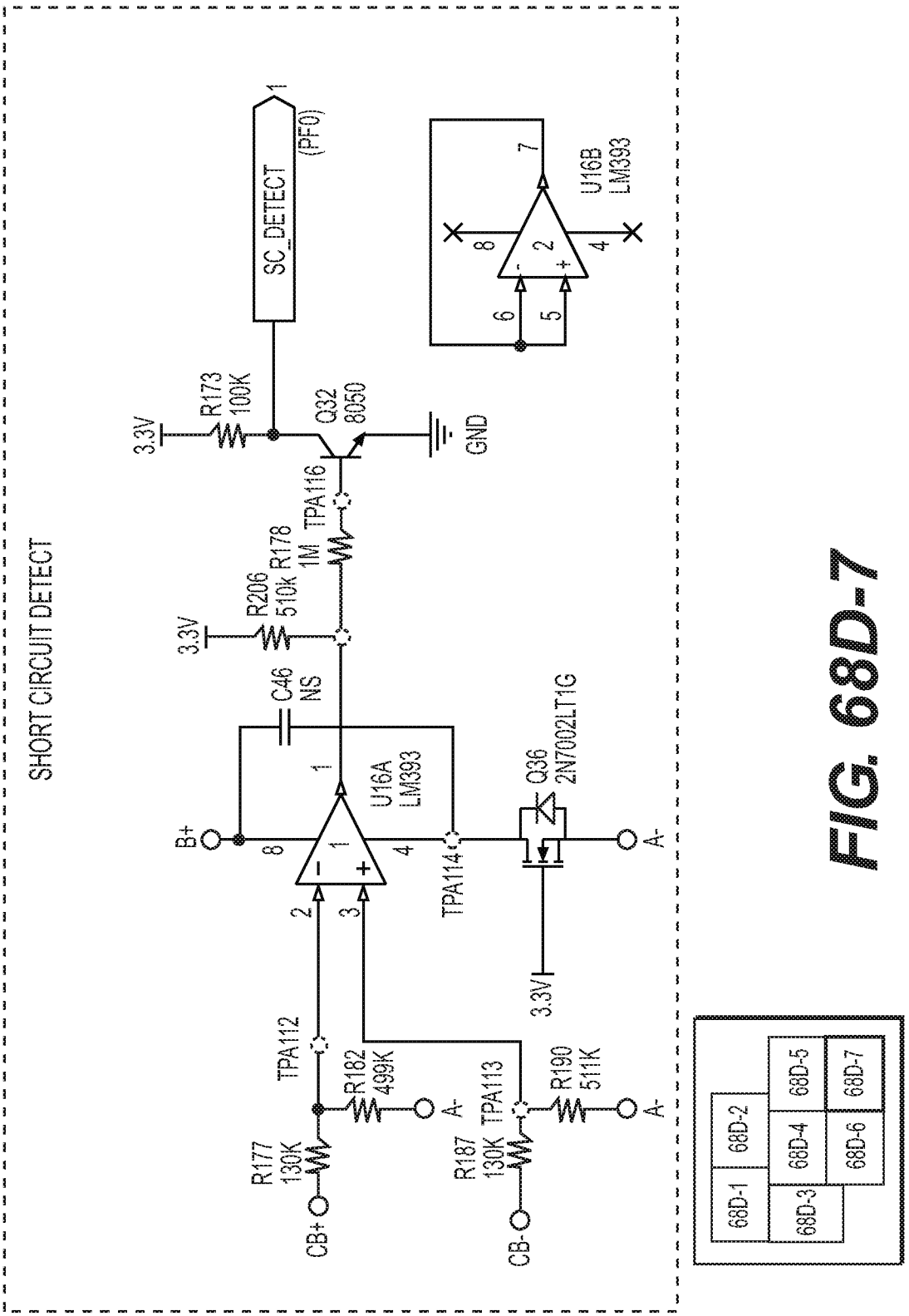
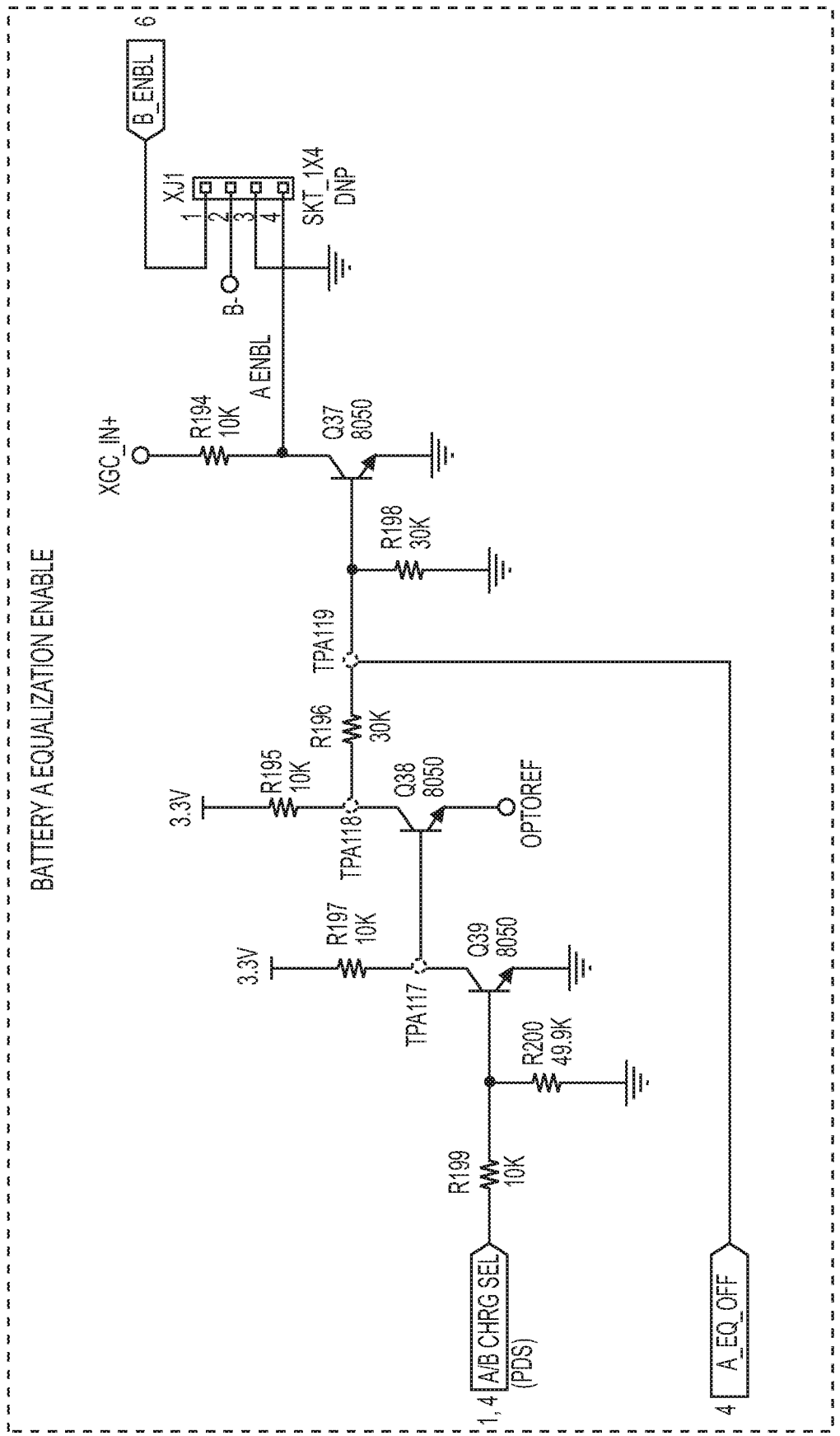

SHORT CIRCUIT DETECT
SC_DETECT
(PF0)
U16B
LM393
R173
100K
3.3V
Q32
8050
GND
TPA116
R178
1M
R206
510k
C46
NS
U16A
LM393
B+
A-
TPA114
Q36
2N7002LT1G
TPA112
R182
499K
TPA113
R190
511K
R177
130K
R187
130K
CB+
CB-
68D-1
68D-2
68D-3
68D-4
68D-5
68D-6
68D-7

FIG. 68D-7


BATTERY A EQUALIZATION ENABLE
B_ENBL
6
XJ1
1
2
3
4
SKT_1X4
DNP
B-
A ENBL
XGC_IN+
R194
10K
Q37
8050
R198
30K
TPA119
R196
30K
R195
10K
3.3V
Q38
8050
OPTOREF
TPA118
R197
10K
3.3V
Q39
8050
TPA117
R200
49.9K
R199
10K
1, 4
A/B CHRG SEL
(PDS)
4
A_EQ_OFF

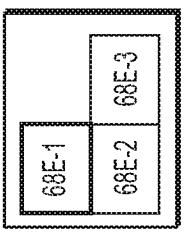

68E-1
68E-2
68E-3

FIG. 68E-1

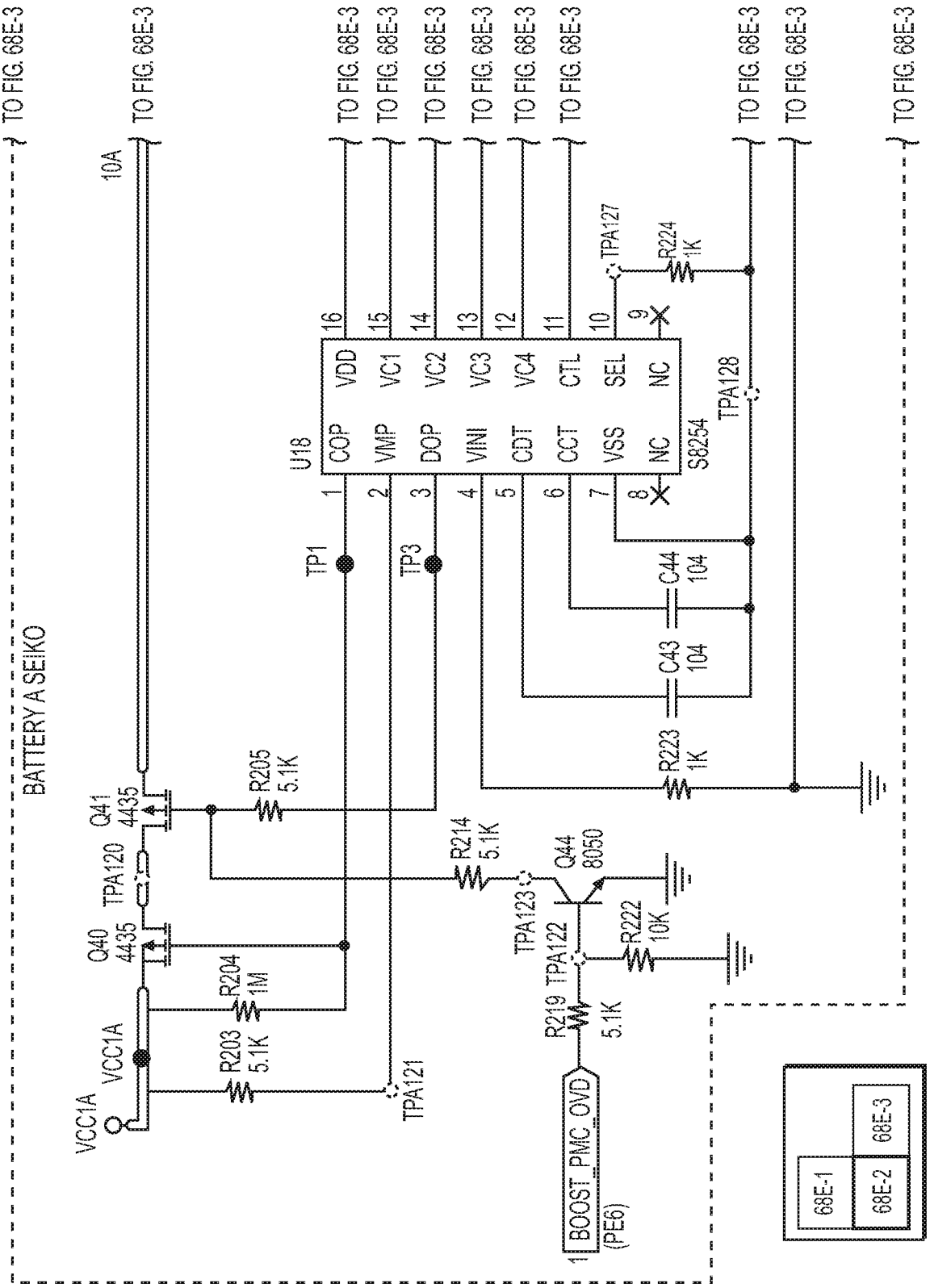

BATTERY A SEIKO
TO FIG. 68E-3
10A
U18
COP
VMP
DOP
VINI
CDT
CCT
VSS
NC
VDD
VC1
VC2
VC3
VC4
CTL
SEL
NC
S8254
TP1
TP3
TPA121
TPA120
TPA122
TPA123
TPA127
TPA128
Q40 4435
Q41 4435
Q44 8050
R203 5.1K
R204 1M
R205 5.1K
R214 5.1K
R219 5.1K
R222 10K
R223 1K
R224 1K
C43 104
C44 104
VCC1A
BOOST_PMC_OVD (PE6)
68E-1
68E-2
68E-3

FIG. 68E-2

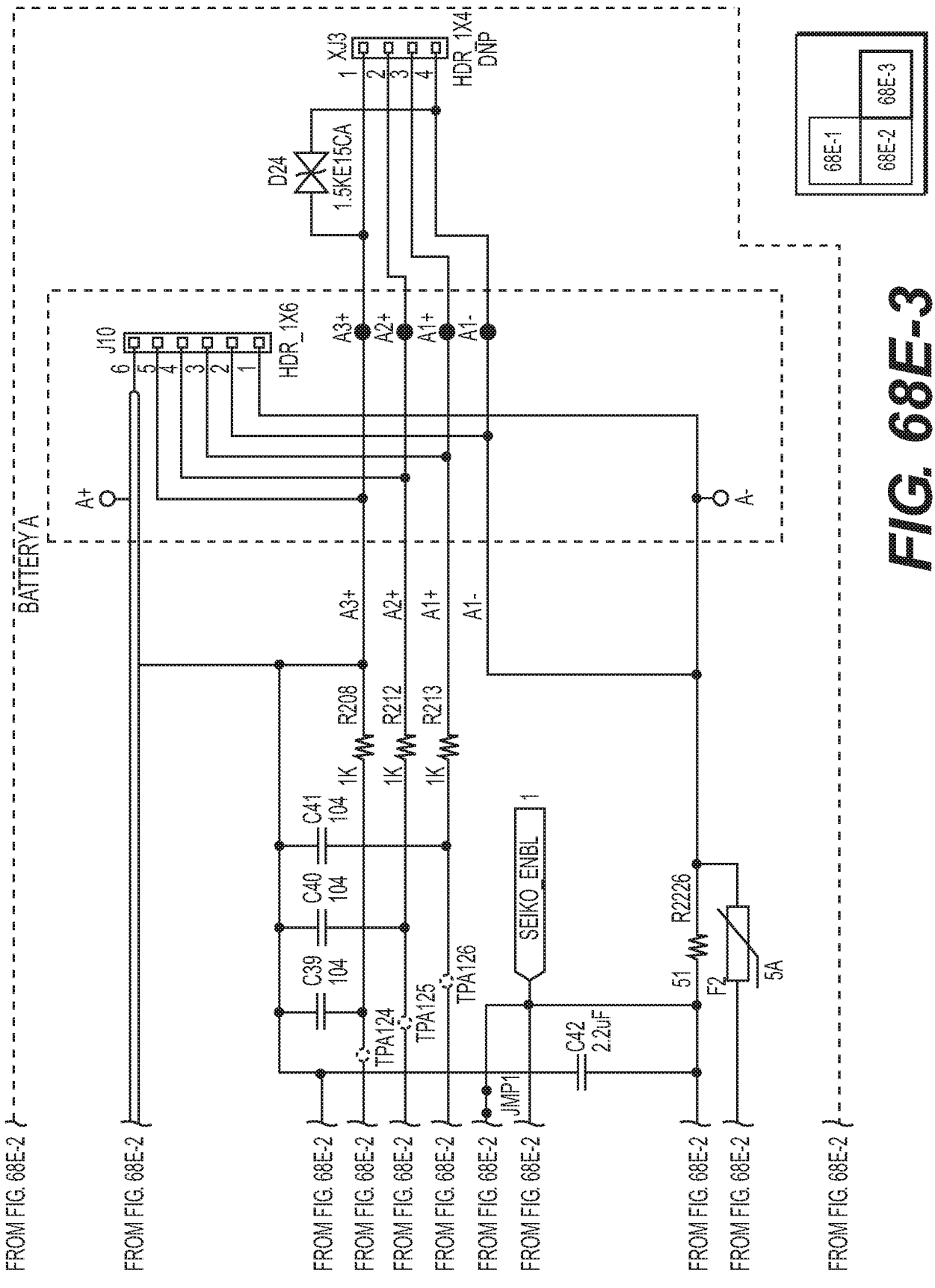

FROM FIG. 68E-2
FROM FIG. 68E-2
FROM FIG. 68E-2
FROM FIG. 68E-2
FROM FIG. 68E-2
FROM FIG. 68E-2
FROM FIG. 68E-2
FROM FIG. 68E-2
FROM FIG. 68E-2
FROM FIG. 68E-2
BATTERY A
A+
A-
J10
HDR_1X6
6
5
4
3
2
1
XJ3
HDR_1X4
DNP
D24
1.5KE15CA
A3+
A2+
A1+
A1-
R208
R212
R213
1K
C41
104
C40
104
C39
104
TPA124
TPA125
TPA126
SEIKO ENBL
JMP1
C42
2.2uF
R2226
51
F2
5A
68E-1
68E-2
68E-3

FIG. 68E-3

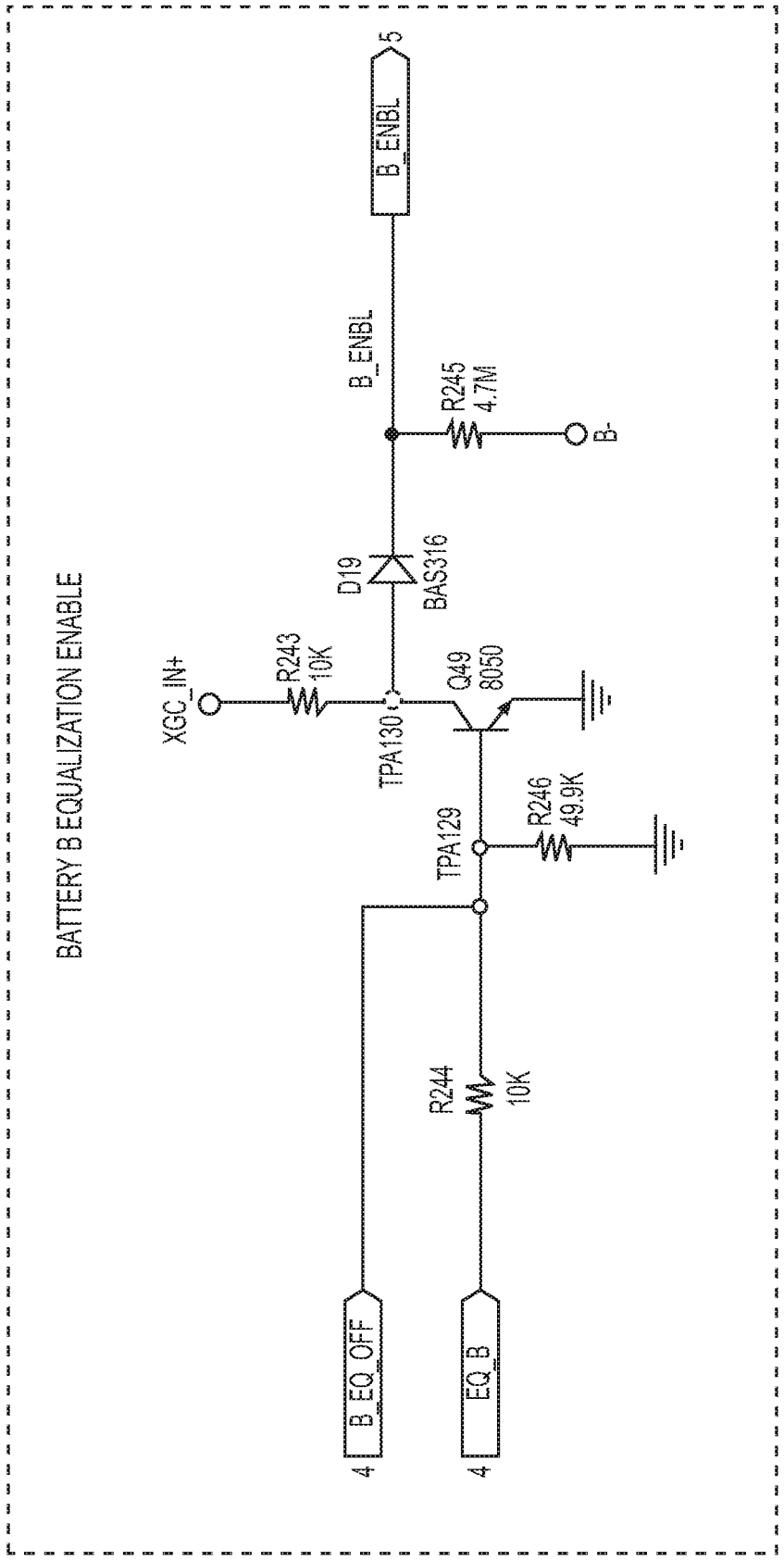

BATTERY B EQUALIZATION ENABLE
XGC_IN+
R243
10K
TPA130
D19
BAS316
B_ENBL
5
B_ENBL
R245
4.7M
B-
Q49
8050
TPA129
R246
49.9K
R244
10K
4
B_EQ_OFF
4
EQ_B
68F-1
68F-2
68F-3

FIG. 68F-1

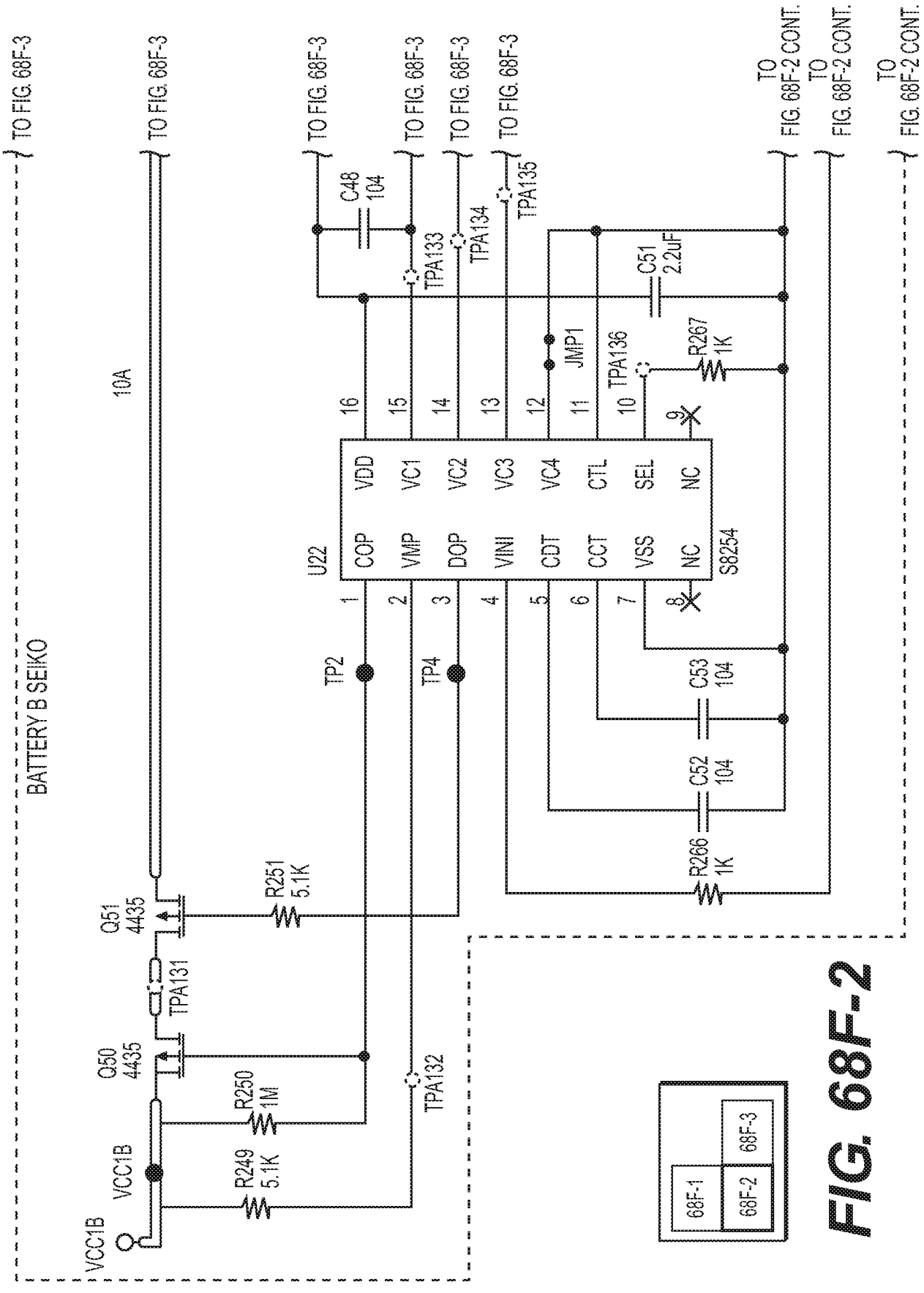

BATTERY B SEIKO
VCC1B
VCC1B
10A
Q50
4435
Q51
4435
R249
5.1K
R250
1M
R251
5.1K
TPA131
TPA132
TP2
TP4
U22
COP
VMP
DOP
VINI
CDT
CCT
VSS
NC
S8254
VDD
VC1
VC2
VC3
VC4
CTL
SEL
NC
C48
104
TPA133
TPA134
TPA135
JMP1
TPA136
C51
2.2UF
R267
1K
C53
104
C52
104
R266
1K
TO FIG. 68F-3
TO FIG. 68F-2 CONT.
68F-1
68F-2
68F-3

FIG. 68F-2

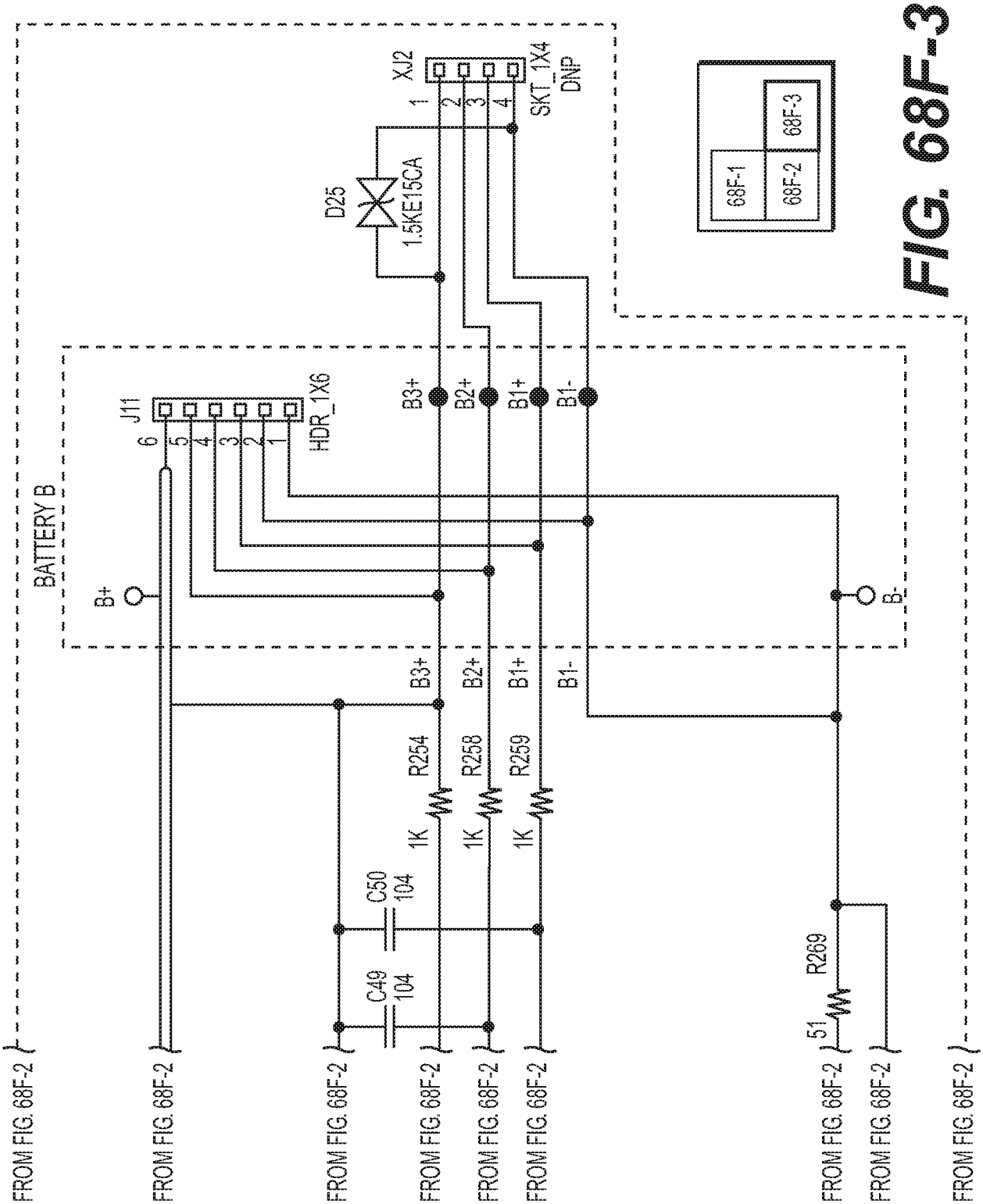

FROM FIG. 68F-2
BATTERY B
B+
B-
J11
HDR_1X6
XJ2
SKT_1X4
DNP
D25
1.5KE15CA
B3+
B2+
B1+
B1-
R254
R258
R259
R269
1K
51
C50
104
C49
104
68F-1
68F-2
68F-3

FIG. 68F-3

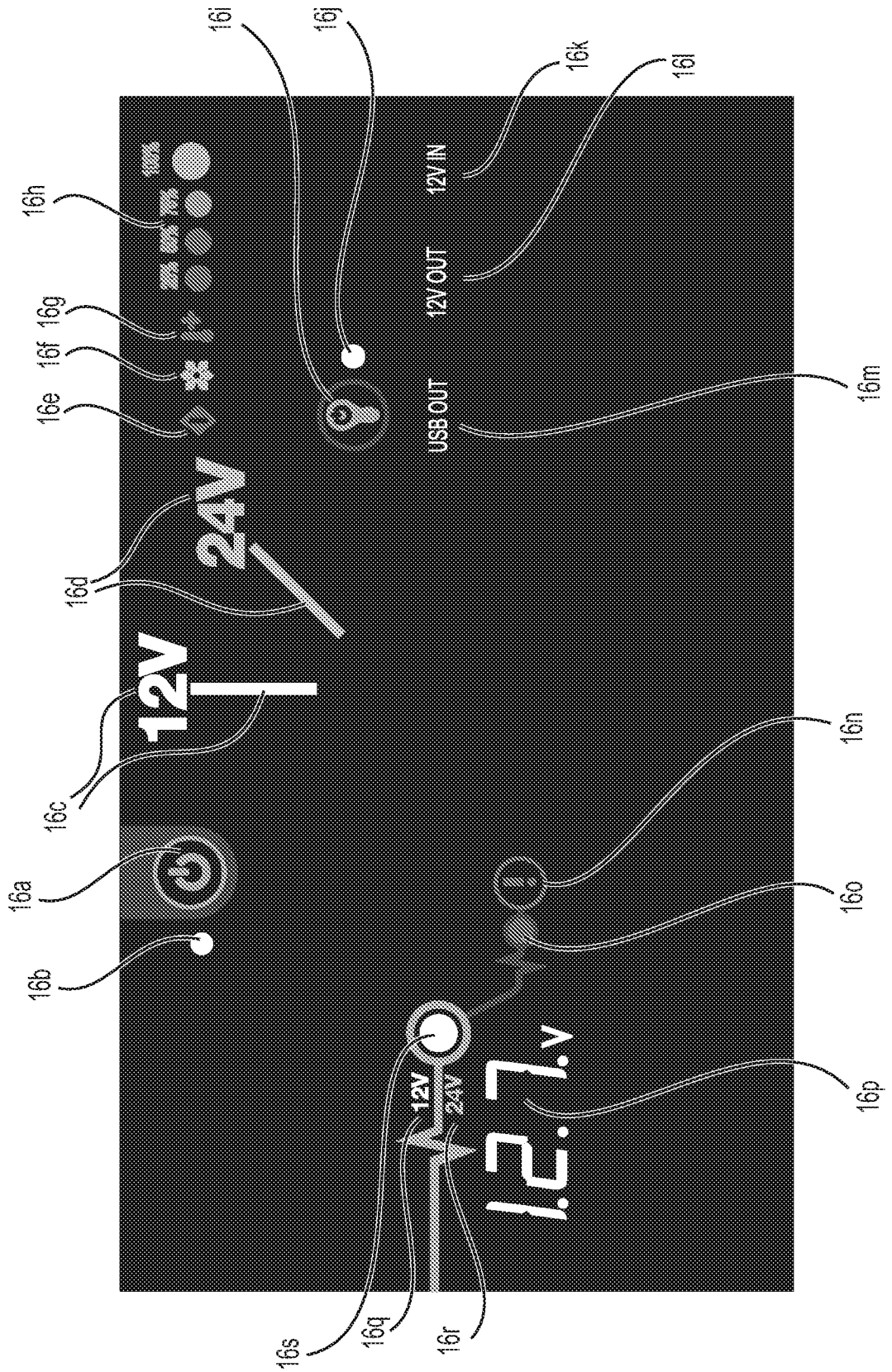

16i
16j
16k
16l
16h
16g
16f
16e
16d
16c
16a
16b
16m
16n
16o
16p
16q
16r
16s
12V IN
12V OUT
USB OUT
12V
24V
12V
24V
12.7v

FIG. 69

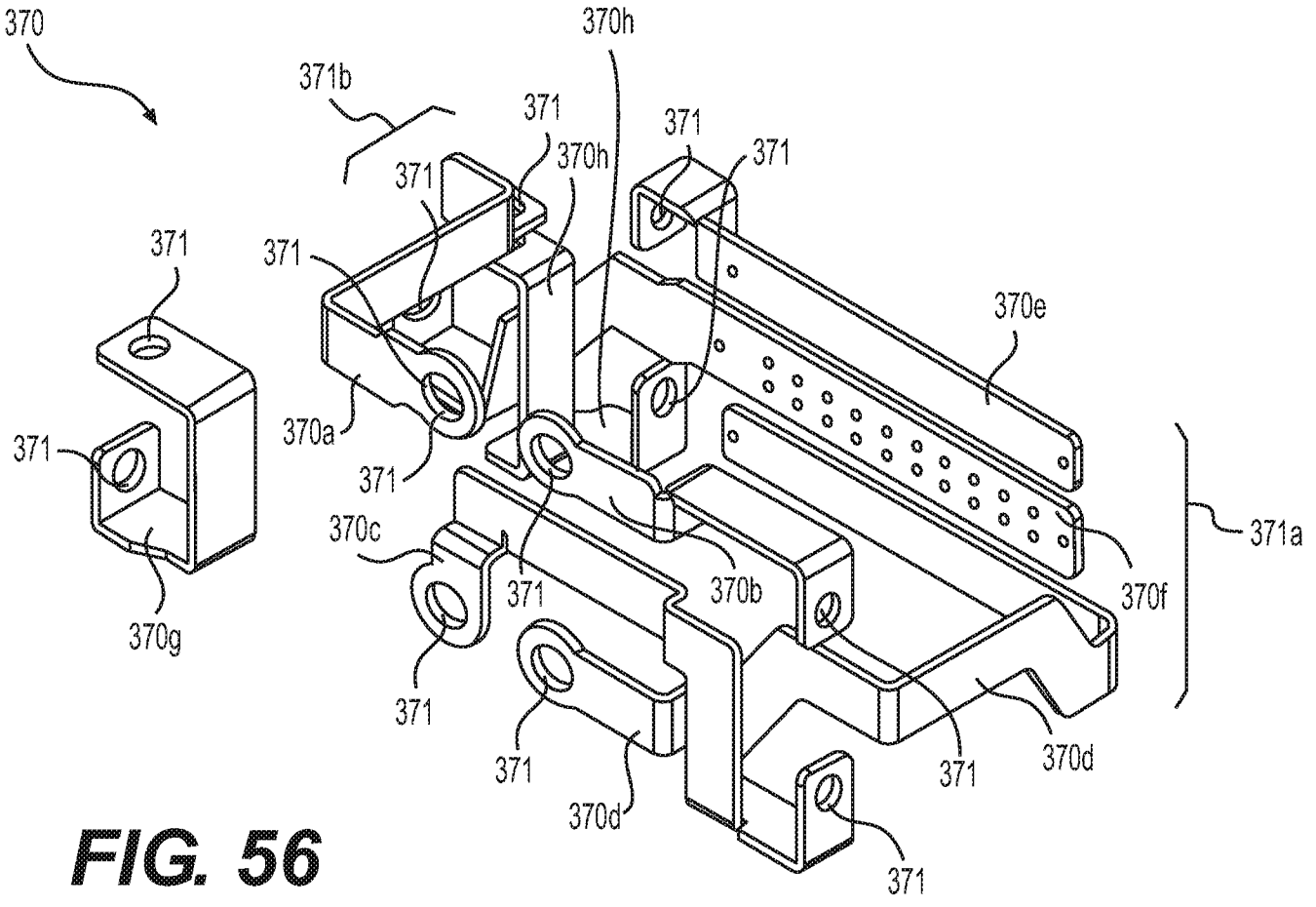

370
371b
371
370h
371
371
370h
371
371
371
371
370e
370a
371
371
370c
371
370b
370f
371a
370g
371
371
371
370d
371
370d
371

FIG. 56