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(54) Title of the Invention: **Machine and solar panel associated with machine**
Abstract Title: **Machine and solar panel associated with machine**

(57) A machine 100 includes a work implement for performing at least one machine operation and also includes at least one solar panel 126 mounted at a location that is exposed to sunlight. The at least one solar panel or photovoltaic (PV) panel is adapted to generate electric power based on exposure of the at least one solar panel to sunlight. The machine further includes a charge controller adapted to receive the electric power generated by the at least one solar panel. The charge controller is further adapted to direct the electric power received from the at least one solar or photovoltaic panel to at least one battery (fig 2, 120) and an auxiliary power port (fig 2, 116) provided in the machine. The machine may comprise a second battery. The solar panel may be removably mounted on the machine.

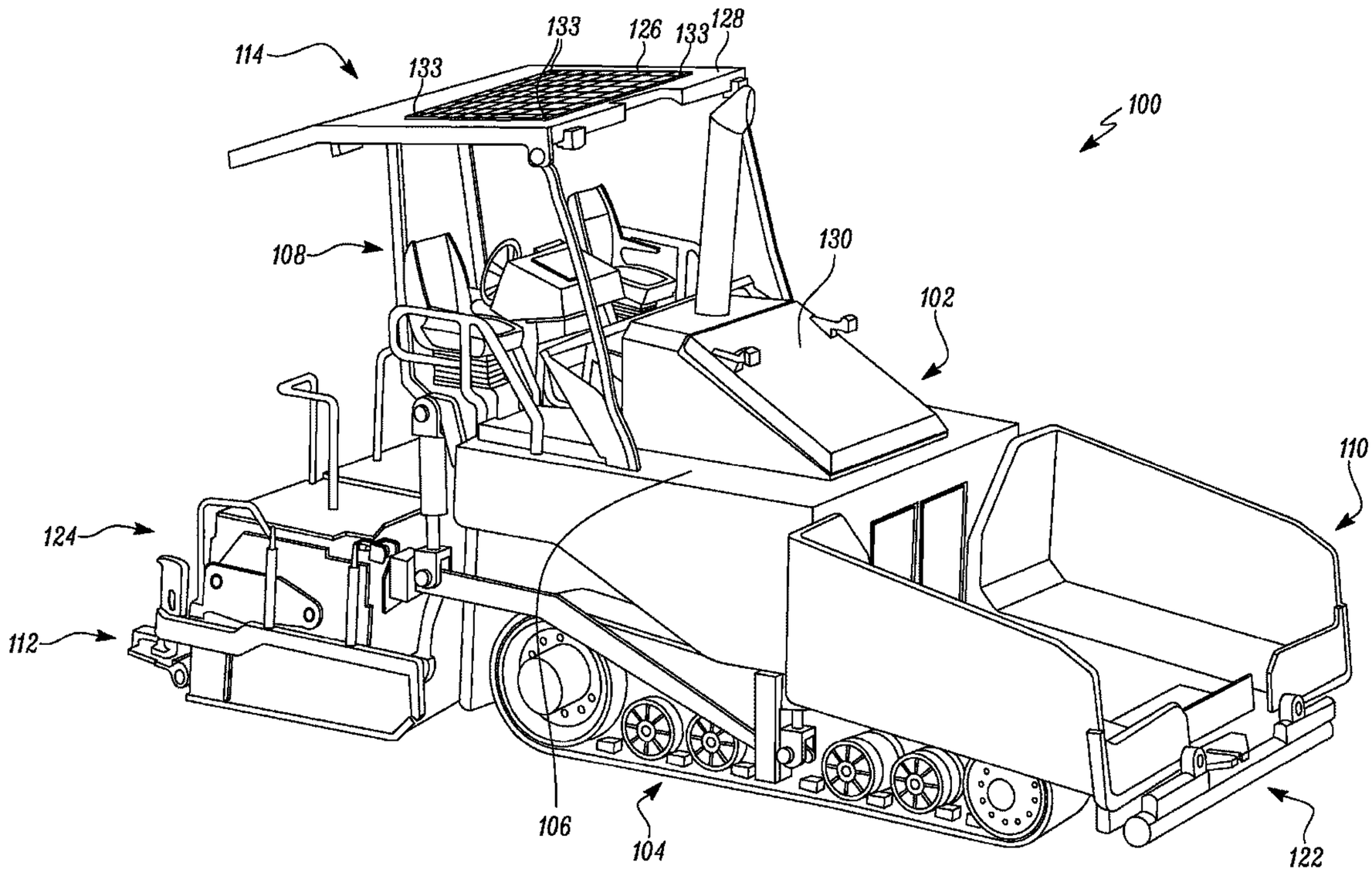

FIG. 1

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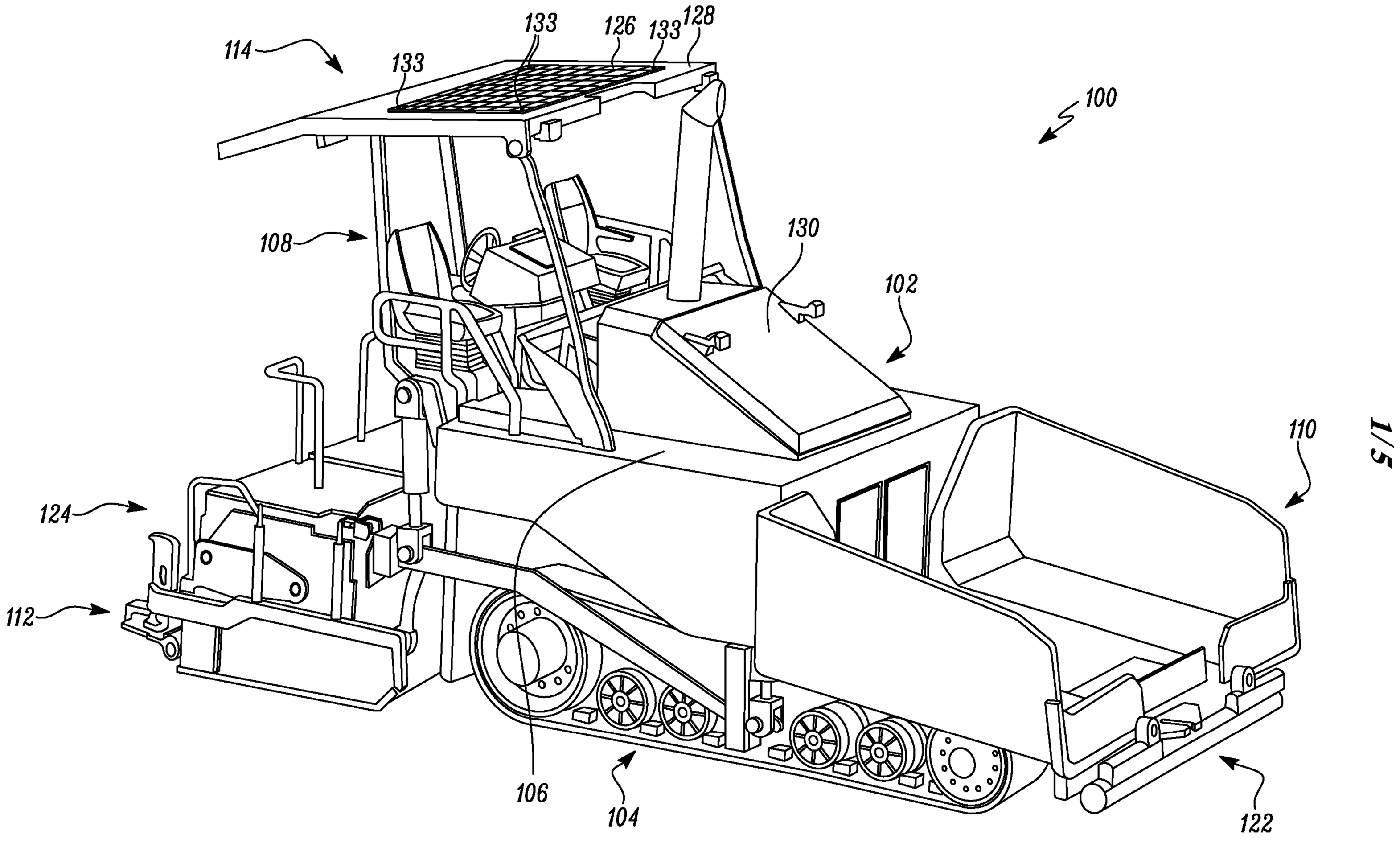

FIG. 1

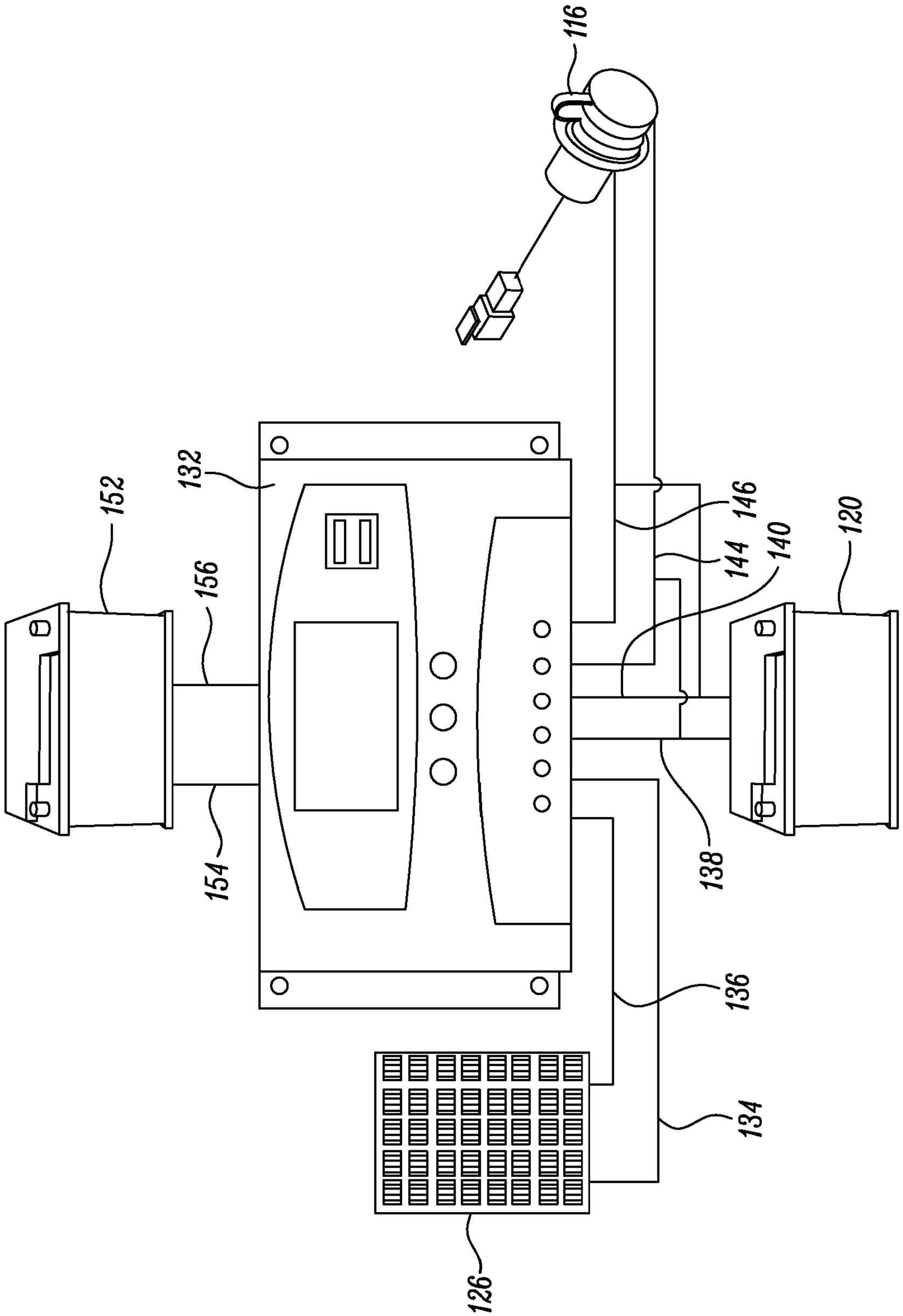

FIG. 2

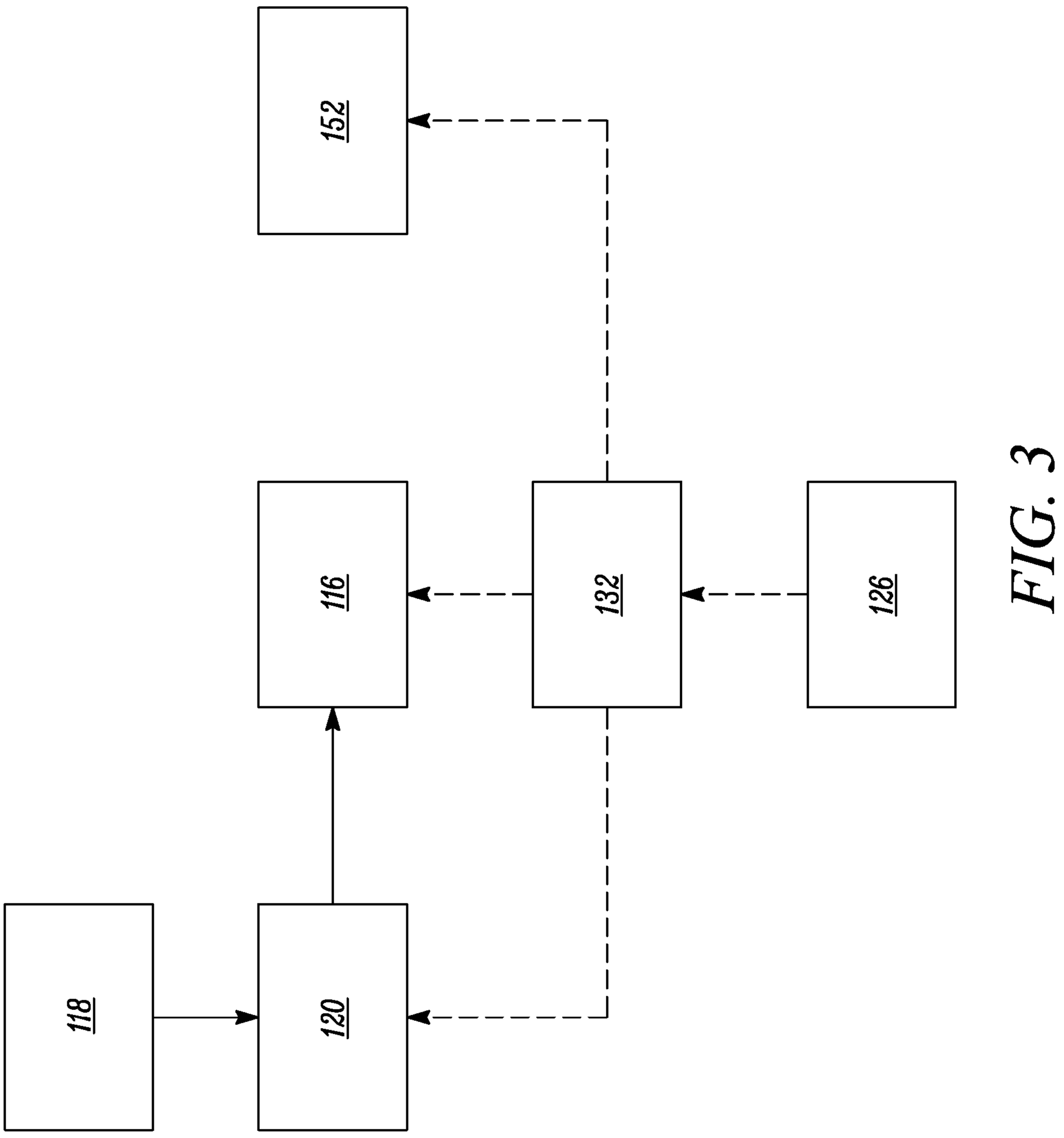

FIG. 3

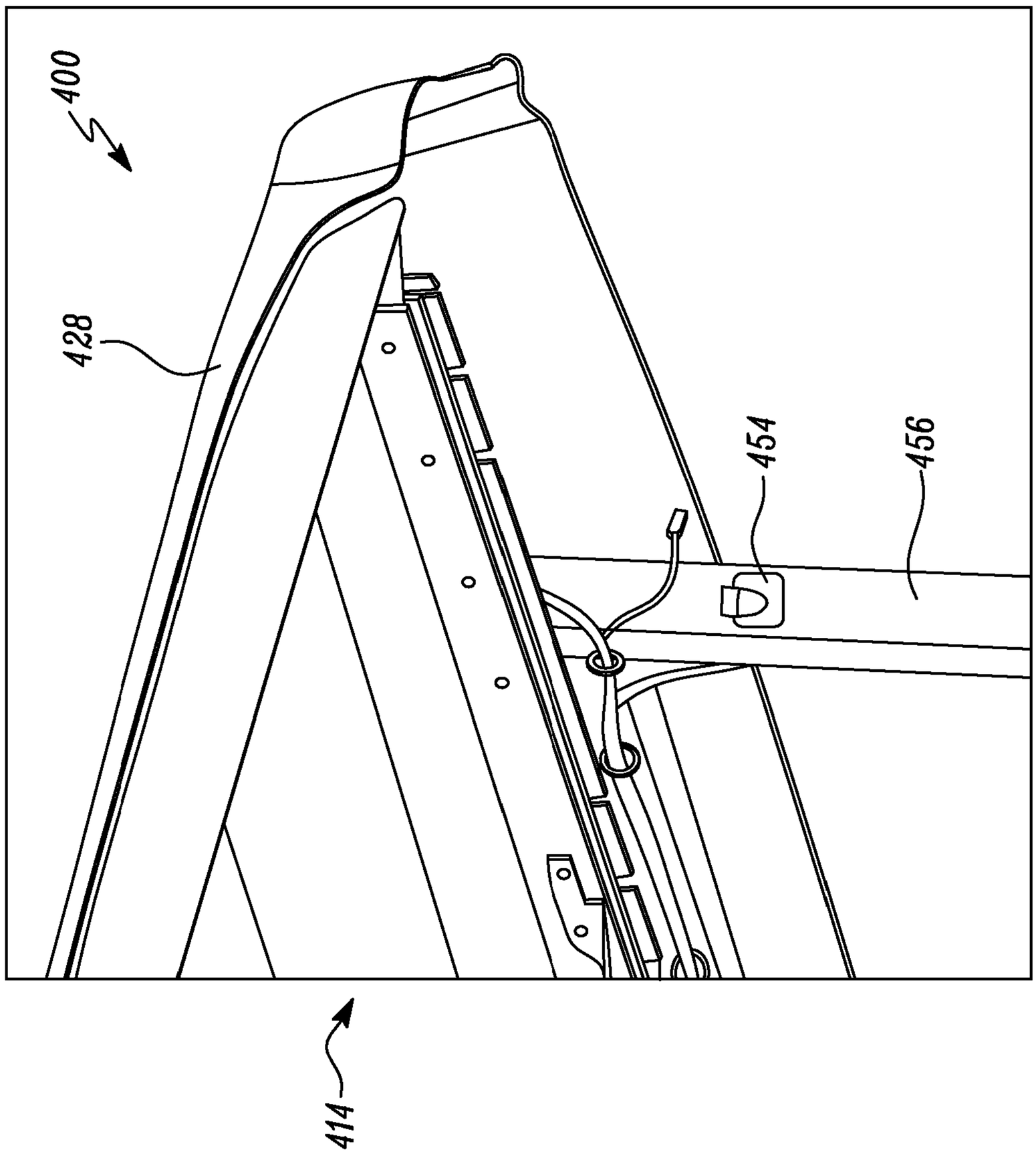

FIG. 4

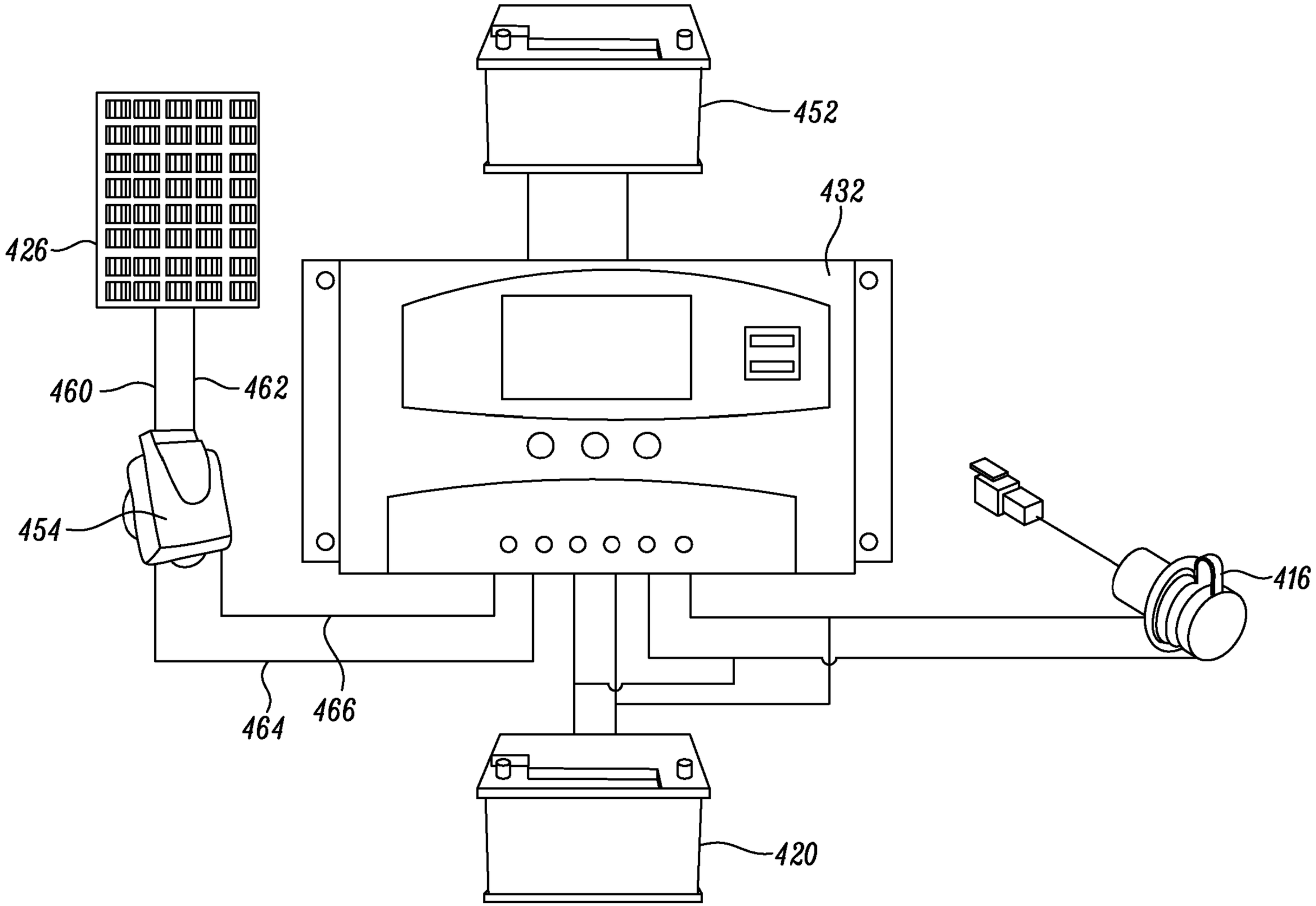

FIG. 5

MACHINE AND SOLAR PANEL ASSOCIATED WITH MACHINE

Technical Field

[0001] The present disclosure relates to a machine having a solar panel for harnessing solar energy.

Background

[0002] Usage of solar power as an alternate source of energy has increased over the years with newer technologies being developed to harness solar energy to produce electric power. Construction machines, such as pavers, cold planers, wheel loaders, and the like, generally operate during daylight hours and are fully exposed to sunlight during operation. Machines that are currently available in the market do not provide a means to harness the solar energy for generation of electric power. Further, machines do not include a provision to connect solar panels to harness solar energy to generate electric power.

[0003] U.S. Published Application Number 2006/0225781 describes a portable solar tarp or a field portable battery charger employing a solar tarp, utilizing flexible solar panels, solar fabric, or solar film. Around the perimeter of the solar tarp is a series of attachment points for straps. The attachment points can be grommets, loops, buckles, hooks, buttons, or grab loops and lines, and to which connected various straps (webbing, line, cord, or cable). The present invention further discloses a versatile, adjustable strapping system utilizing straps, buckles, and hooks. The present invention strapping system can attach almost any object to nearly any other object, such as back packs, luggage, vehicles, boats, permanent and portable shelters and buildings, mechanical equipment, and natural objects such as trees, rocks. The solar panel according to the present invention can have the photovoltaic cells wired individually, or in a single line, because when parts of the photovoltaic system is subjected to shade, or if due to space constraint, parts of the photovoltaic system is covered or folded away, the remaining photovoltaic cells with useable energy are still able to function at peak capacity, since the covered cells will not become an energy drain upon the remaining cells. Further, the photovoltaic system is able to harness all available energy, regardless of the

required or desired voltage and/or amperage for the system, thus converting any and all available energy into a useable current to either recharge batteries, or power a load.

Summary of the Disclosure

[0004] In an aspect of the present disclosure, a machine is provided. The machine includes a work implement for performing one or more machine operations. The machine also includes a solar panel mounted at a location that is exposed to sunlight. The solar panel is adapted to generate electric power based on exposure of the solar panel to sunlight. The machine further includes a charge controller adapted to receive the electric power generated by the solar panel. The charge controller is further adapted to direct the electric power received from the solar panel to a battery and/or an auxiliary power port provided in the machine.

[0005] Other features and aspects of this disclosure will be apparent from the following description and the accompanying drawings.

Brief Description of the Drawings

[0006] FIG. 1 is a perspective view of a machine, according to an embodiment of the present disclosure;

[0007] FIG. 2 is a schematic view illustrating a solar panel and a charge controller associated with the machine of FIG. 1, according to an embodiment of the present disclosure;

[0008] FIG. 3 illustrates a schematic view of two different modes for providing electric power to a first battery, a second battery, and an auxiliary power port provided in the machine of FIG. 1;

[0009] FIG. 4 is a perspective view of a portion of a machine having an electrical connector for connecting a solar panel, according to an embodiment of the present disclosure; and

[0010] FIG. 5 is a schematic view illustrating a solar panel and a charge controller associated with the machine of FIG. 4, according to an embodiment of the present disclosure.

Detailed Description

[0011] Reference numerals appearing in more than one figure indicate the same or corresponding parts in each of them. References to elements in the singular may also be construed to relate to the plural and vice-versa without limiting the scope of the disclosure to the exact number or type of such elements unless set forth explicitly in the appended claims.

[0012] Referring to FIG. 1, an exemplary machine 100 is illustrated. The machine 100 is embodied as a paving machine that may be used for laying asphalt on a work surface, such as a roadway. Although the machine 100 is depicted as an asphalt paving machine, it will be appreciated that the machine 100 may embody any other type of paving machine for laying any type of paving material to form a layer of the paving material on the work surface. For example, the machine 100 disclosed herein may be embodied for use as a concrete paving machine or a paving machine that can be used to lay other suitable aggregates known to persons skilled in the art. In alternative embodiments, the machine 100 may include a track type tractor, an excavator, a dozer, a harvester, a wheel loader, a cold planer, a backhoe loader, a skid steer loader, or any other type of machine known in the art. The machine 100 may perform one or more than one type of operations associated with an industry, such as mining, construction, farming, transportation, or any other industry known in the art.

[0013] The machine 100 includes a tractor 102 that propels the machine 100 on the work surface. In the present embodiment, the tractor 102 is a track type tractor including a pair of ground engaging members 104 for providing traction between the tractor 102 and the work surface. The pair of ground engaging members 104 are embodied as tracks. Alternatively, it can be contemplated to embody the set of ground engaging members 104 in the form of wheels. In another example, the tractor 102 may also include a combination of tracks and wheels for providing traction between the tractor 102 and the work surface.

[0014] The machine 100 also includes a power source (not shown) that provides power to the machine 100 for operational and mobility requirements. The power source may be disposed in an enclosure 130 formed in the tractor 102. In an example, the power source may include an engine. The engine may embody an

internal combustion engine, such as a diesel engine, a gasoline engine, a gaseous fuel-electric powered engine, or any other combustion engine.

[0015] Further, the machine 100 includes a frame 106. The frame 106 is adapted to support various components of the machine 100 including, but not limited to, an operator station 108, a hopper 110, and a work implement 112. An operator of the machine 100 may be present at the operator station 108 for operating the machine 100. The operator station 108 is covered by a canopy 114. The canopy 114 defines a roof 128 of the machine 100. The operator station 108 includes control levers and switches for the operator to control various parameters of a paving operation associated with the machine 100. Further, the operator station 108 includes an auxiliary power port 116 (shown in FIG. 2). The auxiliary power port 116 allows charging of various portable electronic devices, such as, tablets, mobile phones, display devices, portable speakers, and the like. When the machine 100 is an operating state, the auxiliary power port 116 may receive electric power supply from a first battery 120 (shown in FIG. 2) of the machine 100. In some examples, the auxiliary power port 116 may also receive power from a second battery 152 (shown in FIG. 2). The first battery 120 and the second battery 152 will be explained later in this section with reference to FIG. 2.

[0016] Further, the hopper 110 is coupled to the frame 106 adjacent to a front end 122 of the tractor 102. The hopper 110 may receive the paving material from another machine (not shown), for example, a truck. The hopper 110 may include a conveyor (not shown) for transferring the paving material to a rear end 124 of the tractor 102. An auger (not shown) may also be installed at the rear end 124 of the tractor 102 to evenly distribute the paving material in front of the work implement 112.

[0017] The work implement 112 is disposed at the rear end 124 of the tractor 102. The work implement 112 performs one or more machine operations. In the illustrated example, the work implement 112 is embodied as a screed that spreads and compacts the paving material deposited on the work surface. Specifically, a screed plate (not shown) of the work implement 112 contacts the paving material deposited on the work surface to level the deposited paving material with respect to the work surface. Alternatively, the work implement 112

may perform other machine operations, such as, levelling, compacting, digging, scarifying of ground surfaces, without any limitations. Accordingly, the work implement 112 may include a bucket, a blade, a milling drum, and the like that is used to perform one or more machine operations.

[0018] Further, the machine 100 includes one or more solar panels 126. The solar panel 126 is mounted at a location that is exposed to sunlight. The machine 100 illustrated herein includes a single solar panel 126 mounted on the roof 128 of the operator station 108. Alternatively, the machine 100 may include multiple solar panels disposed at various locations of the machine 100, such as, the hopper 110, the work implement 112, the enclosure 130, and the like. The solar panel 126 is adapted to generate electric power based on exposure of the solar panel 126 to sunlight. For this purpose, the solar panel 126 may include a number of solar modules (not shown). The solar modules may in turn include a number of solar cells (not shown). It should be noted that a configuration of the solar modules may be varied to achieve desired voltage and/or wattage. In one example, the solar panel 126 may generate and output electric power having a nominal voltage of 12 Volts. In another example, the solar panel 126 may generate and output electric power having a nominal voltage of 24 Volts or 48 Volts, without any limitations.

[0019] The solar panel 126 may be connected to the roof 128 of the machine 100 using mechanical fasteners 133. For example, the solar panel 126 may be connected to the roof 128 using bolts or screws. In another example, adhesives or a mounting structure (not shown) may be used to connect the solar panel 126 to the roof 128. Further, the solar panel 126 may be connected to the roof 128 using other joining techniques such as, welding, brazing, soldering, and the like.

[0020] As shown in FIG. 2, the machine 100 includes batteries 120, 152. More particularly, the machine 100 includes the first battery 120 and the second battery 152. It should be noted that the machine 100 may include additional batteries other than those mentioned herein. In an example, the first battery 120 may be supported by a chassis of the tractor 102. The first battery 120 is embodied as a main battery that powers one or more electric components of the machine 100. More particularly, the first battery 120 provides electric power supply to one or

more electrical components of the machine 100. When the machine 100 is in operation, the first battery 120 may be charged by an alternator 118 (shown in FIG. 3) of the machine 100. It should be noted that specifications of the first battery 120 may vary as per electric requirements of the machine 100. Accordingly, the first battery 120 may include a 12 Volts battery, a 24 Volts battery, a 48 Volts battery, and the like.

[0021] Further, the machine 100 includes the second battery 152. The second battery 152 is embodied as an auxiliary battery that stores electric power therein. In the illustrated example, the second battery 152 is a solar battery. The second battery 152 receives the electric power generated by the solar panel 126. The second battery 152 can be used as a back-up battery when the solar panel 126 is generating an excess amount of the electric power. Further, at night-time or on cloudy days when there is little or no output from the solar panel 126, the electric power stored in the second battery 152 may be used to provide electric power to one or more machine components when the machine 100 is in the off state.

[0022] The second battery 152 may embody any battery that is compatible with the solar panel 126 and can be charged by the electric power generated by the solar panel 126. The second battery 152 may be mounted at any suitable location on the machine 100. In one example, the second battery 152 may be mounted in the tractor 102. For example, the second battery 152 may be mounted behind a cover within the chassis of the tractor 102. Further, the location of the second battery 152 is dependent upon a type of the machine 100 with which the second battery 152 is associated and the location may vary for different machines.

[0023] The machine 100 also includes a charge controller 132. The charge controller 132 is coupled with the solar panel 126. The charge controller 132 receives the electric power generated by the solar panel 126. The charge controller 132 further directs the electric power received from the solar panel 126 to the batteries 120, 152 and/or the auxiliary power port 116 provided in the machine 100. The charge controller 132 is used to regulate an output voltage from the solar panel 126. For example, during peak hours of sunlight, the charge controller 132 may provide overload protection by reducing the output voltage from the solar panel 126. Further, the charge controller 132 restricts a return flow of electric power

towards the solar panel 126 in an absence of sunlight. In an example, the charge controller 132 may also prevent overcharging of components connected therewith.

[0024] A specification of the charge controller 132 may depend on specifications of the solar panel 126, the first battery 120, and the second battery 152. Accordingly, the charge controller 132 may output a voltage of 12 Volts, 24 Volts, or 48 Volts. The charge controller 132 may embody a Maximum Power Point Tracking (MPPT) solar charge controller or a Pulse Width Modulated (PWM) solar charge controller, without any limitations. The solar panel 126 is coupled to the charge controller 132 using wires 134, 136, more particularly, negative and positive wires 134, 136 of the solar panel 126 is connected to negative and positive input terminals (not shown) of the charge controller 132.

[0025] Further, the electric power from the charge controller 132 may be directed to the batteries 120, 152 and/or the auxiliary power port 116 provided at the operator station 108. The first battery 120 is coupled to the charge controller 132 using wires 138, 140, more particularly, negative and positive wires 138, 140 of the first battery 120 may be connected to negative and positive output terminals (not shown) of the charge controller 132. Further, the second battery 152 is coupled to the charge controller 132 using wires 154, 156, more particularly, negative and positive wires 154, 156 of the second battery 152 is connected to negative and positive output terminals (not shown) of the charge controller 132.

[0026] In an example, the charge controller 132 includes means to gauge an electric charge present in the first battery 120 and the second battery 152. Accordingly, when the charge controller 132 detects that the electric charge in the first battery 120 and /or the second battery 152 is below a predetermined threshold value, the charge controller 132 directs the electric power generated by the solar panel 126 towards the first battery 120 and/or the second battery 152. However, when the electric charge of the first battery 120 and/or the second battery 152 is above the predetermined threshold value, the charge controller 132 restricts the supply of electric power to the first battery 120 and/or the second battery 152 in order to prevent overcharging of the first battery 120 and/or the second battery 152. Further, the charge controller 132 is connected to the auxiliary power port 116 using negative and positive wires 144, 146. More particularly, the negative and

positive wires 144, 146 may be connected to negative and positive output terminals (not shown) of the charge controller 132 to establish connection between the charge controller 132 and the auxiliary power port 116.

[0027] FIG. 3 illustrates an exemplary diagram depicting flow of electric power to the first battery 120, the second battery 152, and the auxiliary power port 116. When the machine is in the operating state, electric power supply to the first battery 120 and the auxiliary power port 116 is designated by solid lines. Further, electric power supply to the first battery 120, the auxiliary power port 116, and the second battery 152 supplied by the solar panel 126 is designated by dotted lines. As illustrated, when the machine 100 is in the operating state, the first battery 120 is charged based on the electric power supplied by the alternator 118. Further, supplementary electric power is provided to the first battery 120 by the solar panel 126. However, when the machine 100 is in the off state, the solar panel 126 may continue to trickle charge the first battery 120. Thus, the electric components of the machine 100 may be operated when the machine 100 is in the off state and the first battery 120 is not being charged by the alternator 118.

[0028] Further, when the machine 100 is in the operating state, the auxiliary power port 116 may receive the electric power from the first battery 120. Moreover, supplementary electric power is provided to the auxiliary power port 116 by the solar panel 126. However, when the machine 100 is in the off state, the electric power generated by the solar panel 126 is used to supply electric power to the auxiliary power port 116. Thus, portable electronic devices may be charged using the auxiliary power port 116 when the machine 100 is in the off state. The electric power generated by the solar panel 126 is also used to charge the second battery 152. Further, any additional electric power that remains after charging the first battery 120 and supplying electric power to the auxiliary power port 116 may be used to charge the second battery 152.

[0029] FIGS. 4 and 5 illustrate another embodiment of the present disclosure. FIG. 4 illustrates a portion of a machine 400 that is similar to the machine 100 described in reference to FIG. 1. The machine 400 includes a work implement (not shown), a canopy 414, and a roof 428 similar to the work implement 112, the canopy 114, and the roof 128 of the machine 100. In the

illustrated embodiment, the machine 400 includes an electrical connector 454. The electrical connector 454 is connectible to the solar panel 426. The electrical connector 454 is provided proximate to an operator station (not shown) of the machine 400 so that the electrical connector 454 is accessible by an operator of the machine 400. As illustrated, the electrical connector 454 is provided in a mounting rod 456 that holds the canopy 414 in place. Alternatively, the electrical connector 454 may be provided at another suitable location, without any limitations. In an example, the electrical connector 454 may embody a bulk-head connector including a negative terminal (not shown) and a positive terminal (not shown).

[0030] As shown in FIG. 5, the machine 400 includes the solar panel 426. The solar panel 426 is adapted to generate electric power based on exposure of the solar panel 426 to sunlight. In the illustrated embodiment, the solar panel 426 is a portable solar panel which can be removably mounted on the machine 400. Further, the solar panel 426 is mounted at a location on the machine 400 that is exposed to sunlight. For example, the solar panel 426 may be connected to the roof 428 or another portion of the canopy 414 of the machine 400 using mechanical fasteners, such as bolts or screws, or adhesives. In other examples, the machine 400 may include a mount or other means that allows mounting of the solar panel 426 such that the solar panel 426 is exposed to sunlight. In an example, the mount or other means for holding the solar panel 426 may be provided at the roof 428 or another portion of the canopy 414 of the of the machine 400. Components and arrangement of the solar panel 426 are similar to components and arrangement of the solar panel 126 described in relation to FIG. 2. It should be noted that specifications of the solar panel 426 may vary as per a type of the machine 400 and specifications of a first battery 420 and an auxiliary power port 416 of the machine 400.

[0031] The solar panel 426 is plugged into the electrical connector 454 for directing the electric power generated by the solar panel 426 towards the first battery 420, a second battery 452, and/or the auxiliary power port 416 provided in the machine 400. It should be noted that the first battery 420, the second battery 452, and the auxiliary power port 416 are similar to the first battery 120, the second battery 152, and the auxiliary power port 116 described in relation to FIG. 2. The

solar panel 426 may include an adapter (not shown) provided at one end of negative and positive wires 460, 462 that are connected to the solar panel 426. The adapter may allow connection of the solar panel 426 with the electrical connector 454 provided on the machine 400. More particularly, the negative and positive terminals of the electrical connector 454 connect with negative and positive terminals of the adapter for passage of electric power generated by the solar panel 426 towards a charge controller 432.

[0032] The charge controller 432 is similar to the charge controller 132 described in relation to FIG. 2. The charge controller 432 is connected with the electrical connector 454 via negative and positive wires 464, 466. The charge controller 432 receives the electric power generated by the solar panel 426. Further, the charge controller 432 directs the electric power received from the solar panel 426 to the battery 420, 452 and/or the auxiliary power port 416 provided in the machine 400.

[0033] It is to be understood that individual features shown or described for one embodiment may be combined with individual features shown or described for another embodiment. The above described implementation does not in any way limit the scope of the present disclosure. Therefore, it is to be understood although some features are shown or described to illustrate the use of the present disclosure in the context of functional segments, such features may be omitted from the scope of the present disclosure without departing from the spirit of the present disclosure as defined in the appended claims.

Industrial Applicability

[0034] The present disclosure relates to the machine 100, 400 having one or more solar panels 126, 426 that generate electric power when exposed to sunlight. The present disclosure provides a simple and easy to implement solution of generating electric power using solar energy. Further, the solar panels 126, 426 allow tapping of solar energy that is generally available in ample at locations where the machines 100, 400 operate. As the machine 100, 400 includes fewer components for generating electric power using solar energy, the present disclosure provides a cost effective solution of generating electric power. The solar panel

126, 526 and the charge controller 132, 432 can be easily retrofitted on existing machines without modifying hardware associated with the machines.

[0035] The present disclosure provides a means to charge the first battery 120, 420 or other personal electronic devices even when the machine 100, 400 is in the off state. Further, the present disclosure allows charging of portable electronic devices through the auxiliary power port 116, 416 thereby reducing dependency on the battery-power or engine-generated power for charging such electronic devices.

[0036] In an embodiment, the machine 100 may include the solar panel 126 that is connected to a location on the machine 100 that is exposed to sunlight. Alternatively, the machine 400 may include an integrated electrical connector 454 that allows the operator of the machine 400 to simply plug-in the portable solar panel 426 for charging the first battery 420 or other personal electronic devices when the machine 400 is in the off state. It should be noted that the portable solar panel 426 may be connected to the roof 428 or another portion of the canopy 414 of the machine 400 using mechanical fasteners or adhesives. Further, the machine 400 may include the mount that allows easy attachment and detachment of the portable solar panel 426. Moreover, the portable solar panel 426 and its associated components may be easily retrofitted on any existing machine.

[0037] Further, the charge controller 132, 432 associated with the machine 100, 400 may include means to guard the first battery 120, 420, the second battery 152, 452, and the portable devices connected to the auxiliary power port 116, 416 against high electric voltage supply and/or overcharging. Thus, any possibility of damage to the first battery 120, 420, the second battery 152, 452, and the portable devices connected to the auxiliary power port 116, 416 may be eliminated.

Claims

What is claimed is:

1. A machine comprising:

a work implement adapted to perform at least one machine operation;

at least one solar panel mounted at a location that is exposed to sunlight, wherein the at least one solar panel is adapted to generate electric power based on exposure of the at least one solar panel to sunlight; and

a charge controller adapted to receive the electric power generated by the at least one solar panel, wherein the charge controller is further adapted to direct the electric power received from the at least one solar panel to at least one battery and an auxiliary power port provided in the machine.

2. The machine of claim 1 further comprising an electrical connector provided on the machine, wherein the electrical connector is connectible to the at least one solar panel.

3. The machine of claim1, wherein the at least one solar panel is a portable solar panel which can be removably mounted on the machine.

4. The machine of claim1 further comprising a first battery and a second battery.

Intellectual Property Office

Application No:	GB1916179.3	**Examiner:**	Jonathan Huws
Claims searched:	1-4	**Date of search:**	27 March 2020

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-4	JP2007284874 A TAKEUCHI MFG See figures and abstract
X	1-4	CN202750469 U WUXI TONGCHUN NEW ENERGY TECH See figures and abstract
X	1-4	CN205661399 U STATE GRID SHANDONG ELECTRIC POWER CO YANGGU COUNTY POWER SUPPLY CO See figure and abstract
X	1-4	CN206172918 U SHENG HONGJUN See figures and abstract
X	1-4	CN108419502 A NINGBO DAYE GARDEN MACHINERY CO LTD See figures and abstract
X	1-4	CN209082407 U SHANDONG MINGTIAN ENV SERVICES CO LTD See figures and abstract

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X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

H02J

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
H02J	0007/35	01/01/2006