United States Patent Application Publication	20250258047
Kind Code	A1
Publication Date	August 14, 2025
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LOAD SENSOR AND LOAD DETECTING DEVICE

Abstract

A load sensor includes: at least one first electrode; at least one second electrode disposed so as to cross the first electrode; a dielectric body present between the first electrode and the second electrode; a resistor array that has a plurality of resistors in series connection and in which both ends of the series connection are respectively connected to a power supply line on the side of a detection circuit and a ground line; and a connection part configured to connect, to the first electrode, one point out of the both ends of the resistor array and a connection position between the resistors adjacent to each other of the resistor array. Here, the point is set to a position corresponding to identification information of the load sensor.

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Family ID: **91195972**

Appl. No.: **19/188826**

Filed: **April 24, 2025**

Foreign Application Priority Data

JP	2022-187738	Nov. 24, 2022

Related U.S. Application Data

parent WO continuation PCT/JP2023/024095 20230628 PENDING child US 19188826

Publication Classification

Int. Cl.: **G01L1/14** (20060101)

U.S. Cl.:

CPC **G01L1/146** (20130101);

Background/Summary

CROSS REFERENCE TO RELATED APPLICATION [0001] This application is a continuation of International Application No. PCT/JP2023/024095 filed on Jun. 28, 2023, entitled "LOAD SENSOR AND LOAD DETECTING DEVICE", which claims priority under 35 U.S.C. Section 119 of Japanese Patent Application No. 2022-187738 filed on Nov. 24, 2022, entitled "LOAD SENSOR AND LOAD DETECTING DEVICE". The disclosures of the above applications are incorporated herein by reference.

BACKGROUND OF THE INVENTION
Field of the Invention
[0002] The present invention relates to a load sensor and a load detecting device that detect a load, based on capacitance.
Description of Related Art
[0003] Load sensors are widely used in the fields of industrial apparatuses, robots, vehicles, and the like. In recent years, in accordance with advancement of control technologies by computers and improvement of design, development of electronic apparatuses that use a variety of free-form surfaces such as those in human-form robots and interior equipment of automobiles is in progress. In association therewith, it is required to mount a high performance load sensor to each free-form surface.
[0004] Japanese Laid-Open Patent Publication No. 2021-113787 describes a load detecting device including: a load sensor in which a plurality of sensor parts are disposed so as to be arranged in a matrix shape in a measurement region; and a controller that controls the load sensor to measure a load. Based on change in voltage when a voltage has been applied to a sensor part serving as a measurement target, the controller detects capacitance in the sensor part and measures the load applied to the sensor part, from the detected capacitance.
[0005] Since a large number of load sensors having the above configuration are disposed, the load detection range can be significantly widened. However, in such a use form, if wrong arrangement or misconnection has occurred in any of the load sensors, or an operation error has occurred, it is extremely difficult to identify which load sensor is the target.
SUMMARY OF THE INVENTION
[0006] A first aspect of the present invention relates to a load sensor. A load sensor according to this aspect includes: at least one first electrode; at least one second electrode disposed so as to cross the first electrode; a dielectric body present between the first electrode and the second electrode; a resistor array that has a plurality of resistors in series connection and in which both ends of the series connection are respectively connected to a power supply line on a side of a detection circuit and a ground line; and a connection part configured to connect, to the first electrode, one point out of the both ends of the resistor array and a connection position between the resistors adjacent to each other of the resistor array. Here, the point is set to a position corresponding to identification information of the load sensor.
[0007] In the load sensor according to the present aspect, when the power supply voltage has been applied to the resistor array via the power supply line, a voltage according to the position of the point, i.e., the identification information, appears in the first electrode. Therefore, by detecting, on the detection circuit side, the voltage that appears in the first electrode when the power supply voltage has been applied to the resistor array, the identification information of the load sensor can

be acquired. Therefore, identification of the load sensor can be performed in a simple manner.
[0008] A second aspect of the present invention relates to a load detecting device. The load detecting device according to this aspect includes the load sensor according to the first aspect and the detection circuit.
[0009] Since the load detecting device according to the second aspect includes the load sensor according to the first aspect, effects similar to those in the first aspect can be exhibited.
[0010] The effects and the significance of the present invention will be further clarified by the description of the embodiments below. However, the embodiments below are merely examples for implementing the present invention. The present invention is not limited to the description of the embodiments below in any way.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0011] FIG. **1**A is a perspective view schematically showing a base member and electrically-conductive elastic bodies set on the upper face of the base member according to Embodiment 1;
[0012] FIG. **1**B is a perspective view schematically showing a state where conductor wires are set on the structure in FIG. **1**A according to Embodiment 1;
[0013] FIG. **2**A is a perspective view schematically showing a state where threads are set on the structure in FIG. **1**B according to Embodiment 1;
[0014] FIG. **2**B is a perspective view schematically showing a state where a base member is set on the structure in FIG. **2**A according to Embodiment 1;
[0015] FIG. **3**A and FIG. **3**B each schematically show a cross section of a load sensor according to Embodiment 1;
[0016] FIG. **4**A is a plan view schematically showing a configuration of the inside of the load sensor according to Embodiment 1;
[0017] FIG. **4**B is a plan view of the load sensor according to Embodiment 1;
[0018] FIG. **5** is a circuit diagram showing configurations of a detection circuit and the load sensor according to Embodiment 1;
[0019] FIG. **6**A schematically shows a configuration of a resistor array according to Embodiment 1;
[0020] FIG. **6**B schematically shows an example of a connection form of each wiring cable with respect to a resistor array according to Embodiment 1;
[0021] FIG. **7**A to FIG. **7**C each show an example of a method of assigning a numeral to a resistor array according to the connection form of a switch element with respect to five connection terminals of the resistor array according to Embodiment 1;
[0022] FIG. **8** shows a state of the detection circuit in an identification information reading mode according to Embodiment 1;
[0023] FIG. **9** shows a state of the detection circuit in a capacitance measurement mode according to Embodiment 1;
[0024] FIG. **10** is a block diagram showing a configuration of a load detecting device according to Embodiment 1;
[0025] FIG. **11** shows a configuration of management information retained in an operation terminal according to Embodiment 1;
[0026] FIG. **12** is a flowchart showing control performed during identification information reading according to Embodiment 1;
[0027] FIG. **13** is a flowchart showing a process performed when an error has occurred, according to Embodiment 1;
[0028] FIG. **14** is a circuit diagram showing configurations of the detection circuit and the load

sensor according to Embodiment 2;
[0029] FIG. **15** shows a state of the detection circuit in the identification information reading mode according to Embodiment 2; and
[0030] FIG. **16** shows a state of the detection circuit in the capacitance measurement mode according to Embodiment 2.
[0031] It is noted that the drawings are solely for description and do not limit the scope of the present invention in any way.

DETAILED DESCRIPTION

[0032] A load detecting device according to the present invention is applicable to a management system or the like that performs processing in accordance with an applied load. Examples of the management system include a stock management system, a driver monitoring system, a coaching management system, a security management system, and a caregiving/nursing management system.
[0033] In the stock management system, for example, by a load sensor provided to a stock shelf, the load of a placed commodity is detected, and the kinds of commodities and the number of commodities present on the stock shelf are detected. Accordingly, in a store, a factory, a warehouse, and the like, the commodities can be efficiently managed, and manpower saving can be realized. In addition, by a load sensor provided in a refrigerator, the load of food in the refrigerator is detected, and the kinds of the food and the quantity and amount of the food in the refrigerator are detected. Accordingly, a menu that uses food in a refrigerator can be automatically proposed.
[0034] In the driver monitoring system, by a load sensor provided to a steering device, the distribution of a load (e.g., gripping force, grip position, tread force) applied to the steering device by a driver is monitored, for example. In addition, by a load sensor provided to a vehicle-mounted seat, the distribution of a load (e.g., the position of the center of gravity) applied to the vehicle-mounted seat by the driver in a seated state is monitored. Accordingly, the driving state (sleepiness, mental state, and the like) of the driver can be fed back.
[0035] In the coaching management system, for example, by a load sensor provided to the bottom of a shoe, the load distribution at a sole is monitored. Accordingly, correction or guidance to an appropriate walking state or running state can be realized.
[0036] In the security management system, for example, by a load sensor provided to a floor, the load distribution is detected when a person passes, and the body weight, stride, passing speed, shoe sole pattern, and the like are detected. Accordingly, the person who has passed can be identified by checking these pieces of detection information against data.
[0037] In the caregiving/nursing management system, for example, by load sensors provided to bedclothes and a toilet seat, the distributions of loads applied by a human body to the bedclothes and the toilet seat are monitored. Accordingly, at the positions of the bedclothes and the toilet seat, what action the person is going to take is estimated, whereby tumbling or falling can be prevented.
[0038] The load detecting device of the embodiments below is applied to a management system as described above, for example. The load detecting device of the embodiments below includes: a load sensor for detecting a load; a detection circuit combined with the load sensor; and a control circuit that controls the detection circuit. The load sensor of the embodiments below is a capacitance-type load sensor. Such a load sensor may be referred to as a “capacitance-type pressure-sensitive sensor element”, a “capacitive pressure detection sensor element”, “a pressure-sensitive switch element”, or the like. The embodiments below are examples of embodiments of the present invention, and the present invention is not limited to the embodiments below in any way.
[0039] Hereinafter, embodiments of the present invention will be described with reference to the drawings. For convenience, X-, Y-, and Z-axes orthogonal to each other are indicated in the drawings. The Z-axis direction is the height direction of a load sensor **10**.

Embodiment 1

[0040] With reference to FIG. **1**A to FIG. **4**B, the load sensor **10** will be described.
[0041] FIG. **1**A is a perspective view schematically showing a base member **11** and electrically-

conductive elastic bodies **12** set on the upper face (the face on the Z-axis positive side) of the base member **11**.

[0042] The base member **11** is an insulative flat-plate-shaped member having elasticity. The base member **11** has a rectangular shape in a plan view. The thickness of the base member **11** is constant. The thickness of the base member **11** is 0.01 mm to 2 mm, for example. When the thickness of the base member **11** is small, the base member **11** may be referred to as a sheet member or a film member. The base member **11** is formed from a non-electrically-conductive resin material or a non-electrically-conductive rubber material.

[0043] The resin material used in the base member **11** is a resin material of at least one type selected from the group consisting of a styrene-based resin, a silicone-based resin (e.g., polydimethylpolysiloxane (PDMS)), an acrylic resin, a rotaxane-based resin, a urethane-based resin, and the like, for example. The rubber material used in the base member **11** is a rubber material of at least one type selected from the group consisting of silicone rubber, isoprene rubber, butadiene rubber, styrene-butadiene rubber, chloroprene rubber, nitrile rubber, polyisobutylene, ethylene-propylene rubber, chlorosulfonated polyethylene, acrylic rubber, fluororubber, epichlorohydrin rubber, urethane rubber, natural rubber, and the like, for example.

[0044] The electrically-conductive elastic bodies **12** are disposed on the upper face (the face on the Z-axis positive side) of the base member **11**. In FIG. **1**A, three electrically-conductive elastic bodies **12** are disposed on the upper face of the base member **11**. The electrically-conductive elastic bodies **12** are each an electrically-conductive member having elasticity. Each electrically-conductive elastic body **12** has a band-like shape that is long in the Y-axis direction. The three electrically-conductive elastic bodies **12** are disposed so as to be arranged with a predetermined interval therebetween in the X-axis direction. At an end portion on the Y-axis negative side of each electrically-conductive elastic body **12**, a wiring cable W**1** electrically connected to the electrically-conductive elastic body **12** is set. Each wiring cable W**1** extends in the Y-axis negative direction, then is bent in the X-axis negative direction, and extends to the vicinity of an end portion on the X-axis negative side of the base member **11**.

[0045] Each electrically-conductive elastic body **12** is formed on the upper face of the base member **11** by a printing method such as screen printing, gravure printing, flexographic printing, offset printing, or gravure offset printing. With these printing methods, the electrically-conductive elastic body **12** can be formed so as to have a thickness of about 0.001 mm to 0.5 mm on the upper face of the base member **11**.

[0046] Each electrically-conductive elastic body **12** is formed from a resin material and an electrically-conductive filler dispersed therein, or from a rubber material and an electrically-conductive filler dispersed therein.

[0047] Similar to the resin material used in the base member **11** described above, the resin material used in the electrically-conductive elastic body **12** is a resin material of at least one type selected from the group consisting of a styrene-based resin, a silicone-based resin (e.g., polydimethylpolysiloxane (PDMS)), an acrylic resin, a rotaxane-based resin, a urethane-based resin, and the like, for example.

[0048] Similar to the rubber material used in the base member **11** described above, the rubber material used in the electrically-conductive elastic body **12** is a rubber material of at least one type selected from the group consisting of silicone rubber, isoprene rubber, butadiene rubber, styrene-butadiene rubber, chloroprene rubber, nitrile rubber, polyisobutylene, ethylene-propylene rubber, chlorosulfonated polyethylene, acrylic rubber, fluororubber, epichlorohydrin rubber, urethane rubber, natural rubber, and the like, for example.

[0049] The electrically-conductive filler used in the electrically-conductive elastic body **12** is a material of at least one type selected from the group consisting of: metal materials such as Au (gold), Ag (silver), Cu (copper), C (carbon), ZnO (zinc oxide), In.sub.2O.sub.3 (indium oxide (III)), and SnO.sub.2 (tin oxide (IV)); electrically-conductive macromolecule materials such as

PEDOT: PSS (i.e., a complex composed of poly (3,4-ethylenedioxythiophene) (PEDOT) and polystyrene sulfonate (PSS)); and electrically-conductive fibers such as a metal-coated organic matter fiber and a metal wire (fiber state), for example.

[0050] FIG. **1**B is a perspective view schematically showing a state where conductor wires **13** are set on the structure in FIG. **1**A.

[0051] Each conductor wire **13** has a linear shape, and is disposed so as to be superposed on the upper faces of the electrically-conductive elastic bodies **12** shown in FIG. **1**A. In the present embodiment, three conductor wires **13** are disposed so as to be superposed on the upper faces of the three electrically-conductive elastic bodies **12**. The three conductor wires **13** are disposed so as to be arranged with a predetermined interval therebetween along the longitudinal direction (the Y-axis direction) of the electrically-conductive elastic bodies **12** so as to cross the electrically-conductive elastic bodies **12**. Each conductor wire **13** is disposed, extending in the X-axis direction, so as to extend across the three electrically-conductive elastic bodies **12**.

[0052] The conductor wire **13** is a covered copper wire, for

[0053] example. The conductor wire **13** is composed of an electrically-conductive member having a linear shape and a dielectric body formed on the surface of the electrically-conductive member. The configuration of the conductor wire **13** will be described later with reference to FIGS. **3**A, **3**B.

[0054] FIG. **2**A is a perspective view schematically showing a state where threads **14** are set on the structure in FIG. **1**B.

[0055] After the conductor wires **13** are disposed as shown in FIG. **1**B, each conductor wire **13** is connected to the base member **11** by threads **14** so as to be able to move in the longitudinal direction (the X-axis direction) of the conductor wire **13**. In the example shown in FIG. **2**A, twelve threads **14** connect the conductor wires **13** to the base member **11** at positions other than the positions where the electrically-conductive elastic bodies **12** and the conductor wires **13** overlap each other. Each thread **14** is implemented by a chemical fiber, a natural fiber, a mixed fiber of the chemical fiber and the natural fiber, or the like.

[0056] FIG. **2**B is a perspective view schematically showing a state where a base member **15** is set on the structure in FIG. **2**A.

[0057] The base member **15** is set from above (the Z-axis positive side) the structure shown in FIG. **2**A. The base member **15** is an insulative member. The material of the base member **15** is a resin material of at least one type selected from the group consisting of polyethylene terephthalate, polycarbonate, polyimide, and the like, for example. The base member **15** may be formed from the same material as that of the base member **11**.

[0058] The base member **15** has a flat-plate shape parallel to an X-Y plane. In a plan view, the base member **15** has a rectangular shape, and the width (the X-axis direction) thereof is smaller than that of the base member **11**. The width of the base member **15** in the Y-axis direction is the same as that of the base member **11**. The thickness in the Z-axis direction of the base member **15** is 0.01 mm to 2 mm, for example.

[0059] The outer peripheral four sides of the base member **15** are connected to the outer peripheral four sides of the base member **11** with a silicone rubber-based adhesive, a thread, or the like. Accordingly, the base member **15** is fixed to the base member **11**. Further, a circuit board **16** is set, from above, to an end portion on the X-axis negative side of the base member **11**, and the conductor wires **13** protruding in the X-axis positive and negative directions are cut. In this manner, the load sensor **10** is completed. The load sensor **10** is used in a state of having been flipped upside down from the state in FIG. **2**B.

[0060] FIG. **3**A and FIG. **3**B schematically show a cross section of the load sensor **10** along a plane parallel to a Y-Z plane at the center position in the X-axis direction of the electrically-conductive elastic body **12** of the load sensor **10**. FIG. **3**A shows a state where no load is applied, and FIG. **3**B shows a state where a load is applied.

[0061] As shown in FIGS. **3**A, **3**B, the conductor wire **13** is composed of an electrically-conductive

member **13***a* and a dielectric body **13***b* formed on the electrically-conductive member **13***a*. The electrically-conductive member **13***a* is a member that is electrically-conductive and that has a linear shape. The dielectric body **13***b* covers the surface of the electrically-conductive member **13***a*. The electrically-conductive member **13***a* is formed from copper, for example. The diameter of the electrically-conductive member **13***a* is about 60 μm, for example.
[0062] The dielectric body **13***b* has an electric insulation property, and is formed from a resin material, a ceramic material, a metal oxide material, or the like, for example. The material of the dielectric body **13***b* may be a resin material of at least one type selected from the group consisting of a polypropylene resin, a polyester resin (e.g., polyethylene terephthalate resin), a polyimide resin, a polyphenylene sulfide resin, a polyvinyl formal resin, a polyurethane resin, a polyamide imide resin, a polyamide resin, and the like. Alternatively, the material of the dielectric body **13***b* may be a metal oxide material of at least one type selected from the group consisting of Al.sub.2O.sub.3, Ta.sub.2O.sub.5, and the like.
[0063] As shown in FIG. **3**A, when no load is applied, the force applied between the electrically-conductive elastic body **12** and the conductor wire **13**, and the force applied between the base member **15** and the conductor wire **13** are approximately zero. From this state, as shown in FIG. **3**B, when a load is applied to the face on the Z-axis negative side of the base member **11**, the electrically-conductive elastic body **12** and the base member **11** are deformed by the conductor wire **13**.
[0064] As shown in FIG. **3**B, due to the application of a load, the conductor wire **13** is brought close to the electrically-conductive elastic body **12** so as to be wrapped by the electrically-conductive elastic body **12**. In association with this, the contact area between the conductor wire **13** and the electrically-conductive elastic body **12** increases. Accordingly, the capacitance between the electrically-conductive member **13***a* and the electrically-conductive elastic body **12** changes. The capacitance between the electrically-conductive member **13***a* and the electrically-conductive elastic body **12** is detected, whereby the load applied to this region is acquired.
[0065] FIG. **4**A is a plan view schematically showing a
[0066] configuration of the inside of the load sensor **10**. In FIG. **4**A, the threads **14** and the base member **15** are not shown for convenience.
[0067] As shown in FIG. **4**A, element parts A**11**, A**12**, A**13**, A**21**, A**22**, A**23**, A**31**, A**32**, A**33** in which capacitance changes in accordance with a load are formed at positions where the three electrically-conductive elastic bodies **12** and the three conductor wires **13** cross each other. Each element part includes an electrically-conductive elastic body **12** and a conductor wire **13** in the vicinity of the intersection between the electrically-conductive elastic body **12** and the conductor wire **13**.
[0068] In each element part, the conductor wire **13** forms one pole (e.g., positive pole) for capacitance, and the electrically-conductive elastic body **12** forms the other pole (e.g., negative pole) for capacitance. That is, the electrically-conductive member **13***a* (see FIGS. **3**A, **3**B) in the conductor wire **13** forms one electrode of the load sensor **10** (capacitance-type load sensor), the electrically-conductive elastic body **12** forms the other electrode of the load sensor **10** (capacitance-type load sensor), and the dielectric body **13***b* (see FIGS. **3**A, **3**B) included in the conductor wire **13** corresponds to the dielectric body that defines the capacitance in the load sensor **10** (capacitance-type load sensor).
[0069] When a load is applied in the Z-axis direction to each element part, the conductor wire **13** is wrapped by the electrically-conductive elastic body **12**. Accordingly, the contact area between the conductor wire **13** and the electrically-conductive elastic body **12** changes, and the capacitance between the conductor wire **13** and the electrically-conductive elastic body **12** changes. An end portion of each conductor wire **13** and an end portion of the wiring cable W**1** set to each electrically-conductive elastic body **12** are connected to a detection circuit **20** described later via the circuit board **16**.

[0070] When a load is applied to the element part A**11**, the contact area between the electrically-conductive member **13***a* of the conductor wire **13** and the electrically-conductive elastic body **12** increases via the dielectric body **13***b* in the element part A**11**. In this case, when the capacitance between the electrically-conductive elastic body **12** on the most X-axis negative side and the conductor wire **13** on the most Y-axis positive side is detected, the load applied to the element part A**11** can be calculated. Similarly, in another element part as well, when the capacitance between the electrically-conductive elastic body **12** and the conductor wire **13** crossing each other in the other element part is detected, the load applied to the other element part can be calculated.
[0071] A wiring pattern is formed on the face on the Z-axis negative side of the circuit board **16**. In corresponding terminal regions on this wiring pattern, the three conductor wires **13** (the electrically-conductive members **13***a*) and the three wiring cables W**1** are respectively soldered. On the circuit board **16**, a connector (not shown) is disposed, and the wiring pattern is connected to this connector. Accordingly, the three conductor wires **13** (the electrically-conductive members **13***a*) and the three wiring cables W**1** are connected to corresponding terminals of the connector via the wiring pattern on the circuit board **16**. The connector is connected to the later-described detection circuit **20** via a cable. In this manner, the three conductor wires **13** (the electrically-conductive members **13***a*) and the three wiring cables W**1** are connected to the detection circuit **20**.
[0072] Further, resistor arrays **111** and switch elements **112** described later are mounted to the circuit board **16**. A wiring pattern for connecting these resistor arrays **111** and switch elements **112** to corresponding terminals of the connector is further disposed on the circuit board **16**. Accordingly, the resistor arrays **111** and the switch elements **112** are connected to the detection circuit **20**.
[0073] FIG. **4**B is a plan view showing a configuration of the load sensor **10**.
[0074] In FIG. **4**B, a state where the load sensor **10** has been flipped upside down is shown. That is, the upper face of the base member **11** being the load detection face is shown in FIG. **4**B.
[0075] As shown in FIG. **4**B, a label **16***a* and a storage medium **16***b* are attached to the region, in the upper face of the base member **11**, that corresponds to the circuit board **16**. Identification information of the load sensor **10** is printed on the label **16***a*, and identification information of the load sensor **10** is readably retained in the storage medium **16***b*. The storage medium **16***b* is a bar code or a QR code (registered trademark), for example. The storage medium **16***b* may be another readable medium such as an RFID tag.
[0076] The identification information is the manufacturing serial number of the load sensor **10**, for example. In this case, on the label **16***a*, a numeral indicating the manufacturing serial number of the load sensor **10** is shown, and this serial number is retained in the storage medium **16***b*. A user can grasp the identification information of the load sensor **10** from the indication on the label **16***a*. In addition, the user can manage the identification information of each load sensor **10** by reading the identification information from the storage medium **16***b* with a portable terminal, a bar code reader, or the like.
[0077] In the present embodiment, as described later, these pieces of identification information are also retained by the resistor array mounted on the circuit board **16**. The retaining method of the identification information by the resistor array and the reading method thereof will be described later with reference to FIG. **6**A to FIG. **9**.
[0078] FIG. **5** is a circuit diagram showing configurations of the detection circuit **20** and the load sensor **10**. In FIG. **5**, for convenience, as the configuration of the load detection region of the load sensor **10**, only the conductor wires **13** (the electrically-conductive members **13***a*, the dielectric bodies **13***b*) and the electrically-conductive elastic bodies **12** are shown, and each electrically-conductive elastic body **12** is shown in a linear shape.
[0079] As a configuration for measuring the capacitance in the load sensor **10**, the detection circuit **20** includes a switch **211**, a resistor **212**, an equipotential generator **213**, switches **214**, **215**, a resistor **216**, an output terminal **217**, a first switchover part **218**, and a second switchover part **219**.

The detection circuit **20** is a circuit for detecting the capacitance at a crossing position between the conductor wire **13** and the electrically-conductive elastic body **12** with respect to the load sensor **10**.
[0080] One terminal of the switch **211** is connected to a power supply line L**10** being at a power supply voltage Vcc, and the other terminal of the switch **211** is connected to the resistor **212**. The resistor **212** is disposed between the switch **211** and a plurality of the conductor wires **13**. A supply line L**11** is connected to the downstream side terminal of the resistor **212**.
[0081] The supply line L**11** is connected to the first switchover part **218**, the equipotential generator **213**, the resistor **216**, and the output terminal **217**. The output-side terminal of the equipotential generator **213** is connected to a supply line L**12**. The equipotential generator **213** is an operational amplifier, and the output-side terminal and the input-side negative terminal are connected to each other. The equipotential generator **213** generates a suppression voltage having the same potential as the potential (the potential on the downstream side of the resistor **212**) in the supply line L**11**.
[0082] The supply line L**12** is connected to the equipotential generator **213**, the first switchover part **218**, and the second switchover part **219**. The switch **214** is an electric element including a resistor component interposed between the supply line L**12** and a ground line L**13**. In FIG. **5**, for convenience, the switching function of the switch **214** is shown as a switch part **214***a*, and the resistor component of the switch **214** is shown as a resistor part **214***b*. When the switch part **214***a* is set to an ON-state, the supply line L**12** is connected to the ground line L**13** via the resistor part **214***b*.
[0083] The switch **215** is interposed between the supply line L**11** and the ground line L**13**. When the switch **215** is set to an ON-state, the supply line L**11** is connected to the ground line L**13** via the resistor **216**. The output terminal **217** is connected to an AD converter **40** (see FIG. **10**) described later.
[0084] The first switchover part **218** selectively connects either one of the supply line L**11** for supplying the potential on the downstream side of the resistor **212** and the supply line L**12** for supplying the suppression voltage, to the conductor wire **13**.
[0085] Specifically, the first switchover part **218** includes three multiplexers **218***a*. The output-side terminals of the three multiplexers **218***a* are connected, in a one-to-one relationship, to the three conductor wires **13** (the electrically-conductive members **13***a*), respectively. Each multiplexer **218***a* is provided with two input-side terminals. The supply line L**11** is connected to one input-side terminal, and to this input-side terminal, a voltage is applied from the power supply line L**10** via the resistor **212** and the supply line L**11**. The other input-side terminal of the multiplexer **218***a* is connected to the supply line L**12**, and to this input-side terminal, the suppression voltage is applied from the equipotential generator **213** via the supply line L**12**.
[0086] The second switchover part **219** selectively connects either one of the supply line L**12** for supplying the suppression voltage and the ground line L**13** connected to the ground, to each electrically-conductive elastic body **12**.
[0087] Specifically, the second switchover part **219** includes three multiplexers **219***a*. The output-side terminals of the three multiplexers **219***a* are connected, in a one-to-one relationship, to the three electrically-conductive elastic bodies **12**, respectively. Each multiplexer **219***a* is provided with two input-side terminals. The supply line L**12** is connected to one input-side terminal, and to this input-side terminal, the suppression voltage is applied from the equipotential generator **213** via the supply line L**12**. The other input-side terminal of the multiplexer **219***a* is connected to the ground line L**13**.
[0088] Switching of the switch **211**, the switch part **214***a*, the switch **215**, the multiplexers **218***a*, a**219***a*, and a switch **221** is controlled by a control circuit **30** as described later.
[0089] As a configuration for reading the identification information of the load sensor **10**, the detection circuit **20** includes the switch **221** and a resistor **222**. A wiring cable L**14** between the switch **221** and the resistor **222** is connected to one terminal of each of three resistor arrays **111**.

The resistor **222** is connected to each of three switch elements **112**. When the switch **221** is closed, the power supply voltage Vcc in the power supply line L**10** is applied to one terminal of each of the three resistor arrays **111** and the three switch elements **112**.
[0090] On the circuit board **16** shown in FIG. **2**B, the three resistor arrays **111** and the three switch elements **112** are mounted, as shown in FIG. **5**. Each resistor array **111** is configured by a plurality of resistors being in series connection. Here, four resistors are in series connection to form a resistor array **111**. The resistance values of these four resistors are the same. The three resistor arrays **111** have the same configuration.
[0091] The three switch elements **112** are disposed so as to correspond to the three resistor arrays **111** and the three conductor wires **13**, respectively. Each switch element **112** is interposed in a wiring cable that connects a corresponding resistor array **111** and a corresponding conductor wire **13** (the electrically-conductive member **13***a*), and switches the resistor array **111** and the conductor wire **13**, between connection and non-connection.
[0092] Each switch element **112**, when the power supply voltage Vcc is applied thereto via the resistor **222**, operates so as to connect a resistor array **111** and a conductor wire **13** to each other. That is, the switch element **112** is switched from a non-conductive state (open state) to a conductive state (closed state) by the power supply voltage Vcc being applied thereto via the resistor **222**.
[0093] Each switch element **112** is implemented by a switching
[0094] transistor, for example. In this case, to the base terminal of the switching transistor forming each switch element **112**, the power supply voltage Vcc is applied via the resistor **222**. The switch element **112** may be a switch element of another type, such as an electromagnetic switch element, that is switched from a non-conductive state (open state) to a conductive state (closed state) through application of the power supply voltage Vcc.
[0095] In each resistor array **111**, one terminal is connected to the wiring cable L**14** between the resistor **222** and the switch **221** on the detection circuit **20** side, and the other terminal is connected to the ground line L**13**. These connections are performed via the connector and the wiring pattern on the circuit board **16** and a cable connected to the connector, as described above.
[0096] One terminal T**1** of each of the three switch elements **112** is connected, via the wiring pattern on the circuit board **16**, to a corresponding one of terminal regions on the circuit board **16** to which the three conductor wires **13** (the electrically-conductive members **13***a*) are respectively soldered. Therefore, when the conductor wires **13** are soldered to these terminal regions, each conductor wire **13** and one terminal T**1** of a corresponding switch element **112** are connected to each other.
[0097] The other terminal T**2** of each switch element **112** is connected to one point out of both ends of a corresponding resistor array **111** and the connection positions between adjacent resistors of the resistor array **111**.
[0098] FIG. **6**A schematically shows a configuration of the resistor array **111**.
[0099] The resistor array **111** includes four resistors **111***a*, five connection terminals **111***b*, a power supply connection terminal **111***c*, and a ground connection terminal **111***d*. The five connection terminals **111***b* are each a terminal that is connected to the terminal T**2** of the switch element **112**. The five connection terminals **111***b* are each connected to one point out of both ends of the resistor array **111** and connection positions between adjacent resistors **111***a*. The power supply connection terminal **111***c* is a terminal to which the wiring cable connected between the switch **221** and the resistor **222** in FIG. **5** is connected. The ground connection terminal **111***d* is a terminal to which the wiring cable connected to the ground line L**13** is connected.
[0100] As shown in FIG. **6**B, the power supply connection terminal **111***c* is connected by solder to the wiring pattern, on the circuit board **16**, that is connected to the wiring cable L**14** between the switch **221** and the resistor **222** in FIG. **5**. The ground connection terminal **111***d* is connected by solder to the wiring pattern, on the circuit board **16**, that is connected to the ground line L**13** in FIG. **5**. In addition, to one of the five connection terminals **111***b*, the terminal on the resistor array

111 side of the switch element **112** is connected on the circuit board **16** by wire bonding or the like. The connection method is not limited to wire bonding and may be another method.

[0101] FIGS. **7**A to **7**C each show an example of a method of assigning a numeral to the resistor array **111** according to the connection form of the terminal T**2** of the switch element **112** with respect to the five connection terminals **111***b*.

[0102] Here, among the five connection terminals **111***b*, when the switch element **112** is connected to the first connection terminal **111***b* from the top, 0 is assigned, and when the switch element **112** is connected to the second, third, fourth, and fifth connection terminals **111***b* from the top, 1, 2, 3, and 4 are assigned, respectively. Therefore, five numerals of 0 to 4 are assigned to one resistor array **111**.

[0103] Here, when the power supply connection terminal **111***c* and the ground connection terminal **111***d* are connected to the power supply line L**10** and the ground line L**13**, respectively, a voltage obtained by dividing the power supply voltage Vcc by four resistors appears in the five connection terminals **111***b*. That is, in this case, in the first connection terminal **111***b* from the top, a voltage having the same magnitude as that of the power supply voltage Vcc occurs, and in the second, third, fourth, and fifth connection terminals **111***b* from the top, voltages of (3/4).Math.Vcc, (2/4).Math.Vcc, (1/4).Math.Vcc, and 0 V appear, respectively.

[0104] Therefore, in accordance with which of the five connection terminals **111***b* the terminal T**2** of the switch element **112** is connected to, the magnitude of the voltage applied from the resistor array **111** to the conductor wire **13** via the switch element **112** changes between Vcc, (3/4).Math.Vcc, (2/4).Math.Vcc, (1/4).Math.Vcc, and 0 V. Therefore, by detecting this voltage, which of the five connection terminals **111***b* the switch element **112** is connected to, i.e., the numeral assigned according to the connection form between the resistor array **111** and the terminal T**2** of the switch element **112**, can be detected.

[0105] With reference back to FIG. **5**, on the circuit board **16**, three sets of the resistor array **111** and the switch element **112** are disposed. As described above, it is possible to express five numerals of 0 to 4 by using one set of the resistor array **111** and the switch element **112**. Therefore, by using these three sets of the resistor array **111** and the switch element **112**, it is possible to express the number of kinds up to 5 to the third power using 3-digit numbers in base 5. Therefore, by setting the connection position between the resistor array **111** and the terminal T**2** of the switch element **112** in each of these sets to a position according to the identification information (e.g., manufacturing serial number) of the load sensor **10**, it is possible to cause these three sets of the resistor array **111** and the switch element **112** to retain the identification information of the load sensor **10**.

[0106] When the number of the resistors **111***a* included in one resistor array **111** is increased, the kinds of numerals that can be assigned to each digit can be increased. Accordingly, the kinds of identification information that can be expressed by the three resistor arrays **111** can be further increased. In addition, in the configuration in FIG. **5**, since three conductor wires **13** are disposed in the load sensor **10**, the number of disposed resistor arrays **111** is also three. However, when four or more conductor wires **13** are disposed in the load sensor **10**, four or more sets of the resistor array **111** and the switch element **112** can be disposed in the load sensor **10**. Accordingly, the number of digits that can be expressed by these sets can be increased, and the kinds of identification information that can be expressed by these sets can be further increased.

[0107] The method of assigning the numerals is not limited to the method shown in FIGS. **7**A to **7**C. For example, in the example in FIGS. **7**A to **7**C, when the terminal T**2** of the switch element **112** is connected to the first connection terminal **111***b* from the bottom, 0 may be assigned, and when the terminal T**2** of the switch element **112** is connected to the second, third, fourth, and fifth connection terminals **111***b* from the bottom, 1, 2, 3, and 4 may be assigned, respectively.

[0108] Next, control of the detection circuit **20** during identification information reading will be described.

[0109] FIG. **8** shows a state of the detection circuit **20** during reading of identification information (identification information reading mode). In FIG. **8**, for convenience, wiring cables and resistors related to identification information reading are indicated by thick lines.
[0110] During identification information reading, the switches **211**, **214**, **215** are opened, and the switch **221** is closed. By the switch **221** being closed, the power supply voltage Vcc is supplied to each of the three resistor arrays **111**. In addition, the power supply voltage Vcc is applied to each of the three switch elements **112** via the resistor **222**. Accordingly, each of the three switch elements **112** is switched to a conductive state.
[0111] When the three switch elements **112** have been switched to a conductive state in this manner, a voltage according to the connection form of the terminal T**2** of each switch element **112** to a corresponding resistor array **111**, i.e., which of the five connection terminals **111***b* in FIG. **6**A the terminal T**2** is connected to, is applied via each switch element **112** to a corresponding conductor wire **13**.
[0112] Here, in the state in FIG. **8**, among the three multiplexers **218***a* of the first switchover part **218**, only the multiplexer **218***a* in the uppermost row is connected to the supply line L**11**. Therefore, the voltage applied to the conductor wire **13** in the uppermost row via the resistor array **111** in the uppermost row and the switch element **112** in the uppermost row is supplied to the output terminal **217** via the supply line L**11**.
[0113] At this time, to the three electrically-conductive elastic bodies **12** crossing the conductor wire **13** in the uppermost row, the suppression voltage having the same potential as that in the supply line L**11** is being applied from the equipotential generator **213**, and thus, the element parts A**11** to A**13** are disabled in terms of circuitry. Therefore, the voltage from the resistor array **111** in the uppermost row is appropriately reflected in the output terminal **217**. Therefore, by the later-described control circuit **30** detecting the voltage at the output terminal **217**, the numeral assigned according to the connection form between the resistor array **111** in the uppermost row and the switch element **112** in the uppermost row is acquired.
[0114] Subsequently, when the multiplexer **218***a* in the uppermost row of the first switchover part **218** has been switched to the supply line L**12** side, the multiplexer **218***a* in the middle row is switched to the supply line L**11** side. Accordingly, the voltage applied to the conductor wire **13** in the middle row via the resistor array **111** in the middle row and the switch element **112** in the middle row is supplied to the output terminal **217** via the supply line L**11**. Therefore, by the later-described control circuit **30** detecting the voltage at the output terminal **217**, the numeral assigned according to the connection form between the resistor array **111** in the middle row and the switch element **112** in the middle row is acquired.
[0115] Subsequently, the multiplexer **218***a* in the middle row of the first switchover part **218** is switched to the supply line L**12** side and the multiplexer **218***a* in the lowermost row is switched to the supply line L**11** side. Accordingly, the voltage applied to the conductor wire **13** in the lowermost row via the resistor array **111** in the lowermost row and the switch element **112** in the lowermost row is supplied to the output terminal **217** via the supply line L**11**. Therefore, by the later-described control circuit detecting the voltage at the output terminal **217**, the numeral assigned according to the connection form between the resistor array **111** in the lowermost row and the switch element **112** in the lowermost row is acquired.
[0116] From the three numerals acquired in this manner, three-digit identification information associated with the load sensor **10** is acquired. Then, the identification information acquisition operation ends.
[0117] Next, control of the detection circuit **20** during load detection will be described.
[0118] For example, in the configuration in FIG. **5**, when a load in the element part A**11** is to be detected, the three multiplexers **218***a* included in the first switchover part **218** and the three multiplexers **219***a* included in the second switchover part **219** are set to the state shown in FIG. **5**. That is, the multiplexer **218***a* in the uppermost row connected to the conductor wire **13** (the

electrically-conductive member **13***a*) forming one electrode of the element part A**11** is connected to the supply line L**11**, and the multiplexer **219***a* in the leftmost row connected to the electrically-conductive elastic body **12** forming the other electrode of the element part A**11** is connected to the ground line L**13**. In addition, the switches **211**, **221**, **214**, **215** are set to an open state as in FIG. **5**. The three switch elements **112** are in a non-conductive state.

[0119] From this state, as shown in FIG. **9**, the switch **211** is closed for a certain period. Accordingly, the power supply voltage Vcc is applied to the element part A**11**, and in accordance with accumulation of electricity in the element part A**11**, the voltage at the output terminal **217** increases according to the time constant defined by the capacitance in the element part A**11** and the resistor **212**. As described above, the capacitance in the element part A**11** has a value according to the load being applied to the element part A**11**. Therefore, the voltage value at the output terminal **217** after elapse of a predetermined period after the switch **211** has been closed becomes a value according to the load being applied to the element part A**11**. From this voltage value, the load according to the capacitance in the element part A**11** is calculated.

[0120] In the state in FIG. **9**, since the switch **221** and the switch elements **112** are open, the three resistor arrays **111** are in a state (float state) of being disconnected from the detection circuit **20**. Therefore, the three resistor arrays **111** do not influence the voltage at the output terminal **217**. Therefore, from the voltage at the output terminal **217**, the capacitance and the load in the element part A**11** can be appropriately calculated.

[0121] Then, after the switch **211** has been closed for a certain period, the switch **211** is opened, and the switches **214**, **215** are closed. Accordingly, electric charge accumulated in the element part A**11** is discharged to the ground via the resistor **216** and the switch **215**. In addition, if electric charge is accumulated in other element parts, electric charge in these element parts is discharged to the ground via the switch **214**.

[0122] Then, after discharging has been performed, the switches **214**, **215** are opened together with the switch **211**. Then, the control is shifted to a step of performing load detection with respect to the element part A**12** adjacent on the right of the element part A**11**. In this step, in order to apply a voltage to this element part A**12**, among the three multiplexers **219***a* included in the second switchover part **219**, the center multiplexer **219***a* is connected to the ground line L**13** and the remaining two multiplexers **219***a* are connected to the supply line L**12**. The state of the three multiplexers **218***a* included in the first switchover part **218** is kept as is.

[0123] In this state, the switch **211** is closed for a certain period, and the power supply voltage Vcc is applied to the element part A**12**. Then, similar to the above, from the voltage value at the output terminal **217**, the load in this element part A**12** is calculated. Then, similar to the above, the switches **214**, **215** are closed and discharging is performed.

[0124] With respect to the other element parts as well, with the first switchover part **218** and the second switchover part **219** controlled, the voltage Vcc is applied to the detection target element part, and from the voltage value at the output terminal **217**, the load in the detection target element part is calculated. Then, when load detection has been performed with respect to all the element parts, the same control is performed from the element part A**11** and load detection with respect to each element part in the next routine is performed again.

[0125] FIG. **10** is a block diagram showing a configuration of a load detecting device **1**.

[0126] The load detecting device **1** includes the load sensor **10** and the detection circuit **20** described above, the control circuit **30**, and the AD converter **40**.

[0127] The control circuit **30** includes an arithmetic processing circuit such as a CPU (Central Processing Unit) and a memory, and controls each component according to a predetermined program. The control circuit **30** controls the detection circuit **20** as described above to calculate the load in each element part of the load sensor **10**. In addition, the control circuit **30** controls the detection circuit **20** as described above to acquire the identification information of the load sensor **10**. Further, the control circuit **30** transmits various information including a load detection result, to

an operation terminal **2** as appropriate.
[0128] The AD converter **40** converts the voltage outputted from the output terminal **217** in FIG. **5** to digital data, and outputs the digital data to the control circuit **30**.
[0129] The operation terminal **2** is a personal computer, for example. The operation terminal **2** is used for displaying information supplied from the control circuit **30** and for inputting information to the control circuit **30**. The operation terminal **2** has installed therein an application program for the load detection using the load detecting device **1**. By activating this application program, display of information regarding load detection and input of information are enabled. The operation terminal **2** is not limited to a personal computer and may be a dedicated terminal.
[0130] In FIG. **10**, one load detecting device **1** is connected to the operation terminal **2**, but a plurality of the load detecting devices **1** can be connected to the operation terminal **2**. In this case, the operation terminal **2** is used for inputting/outputting information with respect to each connected load detecting device **1**. These load detecting devices **1** and the operation terminal **2** form a load detection system.
[0131] The operation terminal **2** performs communication with a management server **3** via an external communication network. The management server **3** has stored therein management information of the load sensor **10** in association with the identification information (e.g., manufacturing serial number) of the load sensor **10**. The management server **3** is managed and operated by the manufacturer of the load sensor **10**, for example. A manager of the manufacturer causes the management server **3** to store characteristic data based on the individual difference of the load sensor **10**, in association with the above-described identification information assigned to the load sensor **10**, for example. This characteristic data includes data for correcting parameter values used when the capacitance and the load are calculated from the voltage outputted from the output terminal **217** in FIG. **9**. This data is set for each element part of the load sensor **10**.
[0132] When having acquired the identification information of the load sensor **10** through control described with reference to FIG. **8**, the control circuit **30** outputs the acquired identification information to the operation terminal **2**. In accordance with this, the operation terminal **2** accesses the management server **3** and acquires characteristic data corresponding to the identification information from the management server **3**. The acquisition of the characteristic data may be performed by using the identification information read from the storage medium **16***b* in FIG. **4**B.
[0133] The operation terminal **2** stores, into a storage thereof, the characteristic data acquired from the management server **3**, in association with the identification information, as shown in FIG. **11**. In the example in FIG. **11**, a plurality of the load detecting devices **1** are connected to the operation terminal **2**, and characteristic data of the load sensor **10** included in each load detecting device **1** is stored in association with the identification information of the load sensor **10**.
[0134] FIG. **12** is a flowchart showing control performed during identification information reading.
[0135] When the control mode has been set to the identification information reading mode (S**101**: YES), the control circuit **30** executes the identification information reading process described with reference to FIG. **8** (S**102**). Setting of the reading mode is performed upon receiving an identification information reading instruction from the operation terminal **2**. For example, in accordance with activation of the load detection system shown in FIG. **10**, the operation terminal **2** transmits the identification information reading instruction to each load detecting device **1**. Accordingly, the control circuit **30** of each load detecting device **1** sets the control mode to the identification information reading mode.
[0136] Next, the control circuit **30** confirms whether or not the read identification information is registered in the operation terminal **2** (S**103**). Here, the control circuit **30** transmits the read identification information to the operation terminal **2**, to confirm the presence or absence of registration of the identification information.
[0137] The operation terminal **2** determines whether or not the received identification information is included in the management information in FIG. **11**. When the received identification

information is included in the management information, the operation terminal **2** transmits, to the control circuit **30**, a notification indicating that the registration has been made and characteristic data associated with the identification information.

[0138] On the other hand, when the received identification information is not included in the management information, the operation terminal **2** initially accesses the management server **3**, and performs a process of acquiring characteristic data corresponding to the identification information, from the management server **3**. In response to this, when having received the characteristic data from the management server **3**, the operation terminal **2** transmits, together with the received characteristic data, a notification indicating that the registration has been made, to the control circuit **30**. At this time, the control circuit **30** stores, into a storage thereof, the received characteristic data, in association with the identification information. On the other hand, when the characteristic data corresponding to the identification information has not been able to be received from the management server **3**, a notification indicating that the identification information is not registered is transmitted to the control circuit **30**.

[0139] When having received, from the operation terminal **2**, a notification indicating that the identification information is registered, the control circuit **30** sets the determination in step S**103** to YES, performs initial setting on parameter values used when calculating the capacitance and the load in each element part, with characteristic data received together with the notification (S**104**), and shifts the mode to a measurement mode for load (S**105**). Then, the control circuit **30** ends the process in FIG. **12**.

[0140] On the other hand, when having received, from the operation terminal **2**, a notification indicating that the identification information is not registered, the control circuit **30** sets the determination in step S**103** to NO, sets an unhandled flag indicating that the characteristic data is not registered with respect to the load sensor **10** (S**106**), and stops the load measurement using the load sensor **10** (S**107**). In this case, on the operation terminal **2**, a notification indicating that there is an error in the load sensor **10** is displayed together with the identification information thereof. Then, the control circuit **30** ends the process in FIG. **12**.

[0141] FIG. **13** is a flowchart showing a process performed when an error has occurred.

[0142] When an error has occurred in the load sensor **10** (S**201**), the control circuit **30** extracts, from the storage thereof, the identification information of the load sensor **10** (S**202**).

[0143] Here, in step S**201**, it is determined that an error has occurred, when the voltage has not been appropriately outputted from the output terminal **217** during measurement of the capacitance with respect to a predetermined element part due to short circuit between the conductor wire **13** and the electrically-conductive elastic body **12** or breakage of the conductor wire or a wiring cable, for example. In step S**202**, the identification information read in step S**102** in FIG. **12** is extracted from the storage. That is, when shifting to the measurement mode in step $**105**, the control circuit **30** stores, into the storage thereof, the identification information read in step S**102**. In step S**202**, this identification information is extracted from the storage.

[0144] The control circuit **30** transmits, to the operation terminal **2**, a notification indicating that an error has occurred, together with the extracted identification information (S**203**), and stops the load measurement process (S**204**). Then, the control circuit **30** ends the process in FIG. **13**.

[0145] When having received an error notification in step S**203**, the operation terminal **2** displays, on a display thereof, an error announcement screen including an error message and the identification information received together with this error notification. At this time, the operation terminal **2** may further output, from a speaker thereof, an alert sound or a message voice indicating that an error has occurred.

[0146] The user grasps the fact that an error has occurred in any of the load detecting devices **1**, with reference to the error announcement screen displayed on the display. At this time, by checking the identification information of the load sensor **10** included in the error announcement screen against the identification information on the label **16***a* (see FIG. **4**B) attached to each load sensor

10 in use, the user can identify the load sensor **10** in which the error has occurred from among the load sensors **10** in use. Thus, the user can smoothly advance the subsequent measure such as replacing the load sensor **10** in which the error has occurred with a new load sensor **10**.

Effects of Embodiment 1

[0147] According to the present embodiment, the following effects are exhibited.

[0148] As shown in FIG. **1**A to FIG. **4**B, FIG. **5**, and FIGS. **6**A, **6**B, the load sensor **10** includes: at least one electrically-conductive member **13***a* (first electrode); at least one electrically-conductive elastic body **12** (second electrode) disposed so as to cross the electrically-conductive member **13***a* (first electrode); the dielectric body **13***b* present between the electrically-conductive member **13***a* (first electrode) and the electrically-conductive elastic body **12** (second electrode); the resistor array **111** that has a plurality of resistors **111***a* in series connection and in which both ends of the series connection are respectively connected to the power supply line L**10** on the detection circuit **20** side and the ground line L**13**; and the wiring pattern (connection part) on the circuit board **16** and the switch element **112** (connection part) that connect, to the electrically-conductive member **13***a* (first electrode), one point (connection terminal **111***b*) out of both ends of the resistor array **111** and the connection position between the resistors **111***a* adjacent to each other. Here, the above point of the resistor array **111** to which the switch element **112** is connected is set to a position corresponding to the identification information of the load sensor **10**.

[0149] With this configuration, as described with reference to FIG. **8**, when the power supply voltage Vcc has been applied to the resistor array **111** via the power supply line L**10**, a voltage according to the position of the point, i.e., the identification information, appears in the electrically-conductive member **13***a* (first electrode). Therefore, by detecting, on the detection circuit **20** side, the voltage that appears in the electrically-conductive member **13***a* (first electrode) when the power supply voltage Vcc has been applied to the resistor array **111**, the identification information of the load sensor **10** can be acquired. Therefore, identification of the load sensor **10** can be performed in a simple manner.

[0150] As shown in FIG. **5**, the switch element **112** that switches the connection position (point) of the resistor array **111** and the conductor wire **13** (the electrically-conductive member **13***a*: first electrode), between connection and non-connection is disposed. Therefore, as shown in FIG. **9**, by opening the switch element **112** when the capacitance in an element part is to be measured, the resistor array **111** can be disconnected from the conductor wire **13** (the electrically-conductive member **13***a*: first electrode). Therefore, in measurement of the capacitance in the element part, occurrence of influence of the resistor array **111** on the voltage that is outputted from the output terminal **217** can be appropriately prevented.

[0151] As shown in FIG. **5**, the detection circuit **20** includes the switch **221** that switches the power supply line L**10** and the wiring cable L**14** connected to both of the resistor array **111** and the switch element **112**, between connection and non-connection. When the switch **221** has been closed, and accordingly, the power supply line L**10** has been connected to the wiring cable L**14** and the power supply voltage Vcc has been applied, the switch element **112** operates so as to connect the connection position (point) of the resistor array **111** and the conductor wire **13** (the electrically-conductive member **13***a*: first electrode) to each other. With this configuration, without providing a configuration for switching the switch element **112** on the load sensor **10** side, the switch element **112** can be set to a conductive state merely by applying the power supply voltage Vcc from the detection circuit **20** side to the switch element **112**. Therefore, the configuration of the load sensor **10** can be simplified.

[0152] As shown in FIG. **1**A to FIG. **4**B and FIG. **5**, the load sensor **10** includes a plurality of the electrically-conductive members **13***a* (first electrodes), and includes a set of the resistor array **111** and the switch element **112** (connection part) for each of the electrically-conductive members **13***a* (first electrode). Thus, since a plurality of sets of the resistor array **111** and the switch element **112** are included, the number of digits (combinations of numbers) of the identification information can

be increased. Therefore, the kinds of the identification information that can be set can be increased.
[0153] As shown in FIG. **1**A to FIG. **4**B, the load sensor **10** includes a plurality of the electrically-conductive elastic bodies **12** (second electrodes), and crossing positions between a plurality of the first electrodes and a plurality of the second electrodes are disposed in a matrix shape. With this configuration, the number of the crossing positions (element parts) can be increased, and the distribution of the load can be measured in a wider area.
[0154] As shown in FIG. **4**B, a representation (the label **16***a*) indicating the identification information is attached to a surface of the load sensor **10**. Therefore, by referring to this representation (the label **16***a*), the user can smoothly and accurately grasp where the load sensor **10** corresponding to the identification information read from the resistor array **111** is. Thus, for example, when an error has occurred, the user can smoothly identify the load sensor **10** in which the error has occurred, and can smoothly carry out replacement work, etc. of the load sensor **10**.
[0155] As shown in FIG. **4**B, the storage medium **16***b* from which the identification information is readable is attached to a surface of the load sensor **10**. Therefore, as described above, by reading the identification information from the storage medium **16***b* with a portable terminal, a bar code reader, or the like, the user can manage the identification information of each load sensor **10**. For example, the user can manage the arrangement layout of the load sensors **10**, and can smoothly confirm erroneous arrangement, missing arrangement, or the like of each load sensor **10**.
[0156] As described with reference to FIG. **9**, in the capacitance measurement mode, the detection circuit **20** applies the power supply voltage Vcc to the electrically-conductive member **13***a* (first electrode) and outputs, to the output terminal **217**, a voltage of the electrically-conductive member **13***a* (first electrode) that changes in accordance with the capacitance at the crossing position between the electrically-conductive member **13***a* (first electrode) and the electrically-conductive elastic body **12** (second electrode). As described with reference to FIG. **8**, in the identification information reading mode, the detection circuit **20** applies the power supply voltage Vcc to the resistor array **111** and outputs the voltage appearing at the connection position (point) of the switch element **112** with respect to the resistor array **111**, to the output terminal **217** via the electrically-conductive member **13***a* (first electrode). Therefore, the output terminal **217** can be used in common for measurement of the capacitance and reading of the identification information. Therefore, the detection circuit **20** can be simplified.
[0157] As shown in FIG. **10**, the load detecting device **1** includes the control circuit **30** that detects, in the capacitance measurement mode, capacitance at the crossing position between the electrically-conductive member **13***a* (first electrode) and the electrically-conductive elastic body **12** (second electrode) from the voltage outputted from the output terminal **217**, and that acquires, in the identification information reading mode, the identification information of the load sensor **10** from the voltage outputted from the output terminal **217**. Accordingly, from the voltages outputted from the common output terminal **217**, the load at the crossing position (element part) and the identification information of the load sensor **10** can be respectively acquired.
Embodiment 2
[0158] FIG. **14** is a circuit diagram showing configurations of the detection circuit **20** and the load sensor **10** according to Embodiment 2.
[0159] Similar to FIG. **5**, in FIG. **14**, for convenience, as the configuration of the load detection region of the load sensor **10**, only the conductor wires **13** and the electrically-conductive elastic bodies **12** are shown, and each electrically-conductive elastic body **12** is shown in a linear shape.
[0160] As compared with FIG. **5**, in FIG. **14**, the switch elements **112** and the resistor **222** are omitted. The three resistor arrays **111** are directly connected to the three conductor wires **13** (the electrically-conductive members **13***a*) by wiring cables L**15**, L**16**, L**17**. This connection is performed on the circuit board **16**. On the detection circuit **20** side, a third switchover part **223** and a multiplexer **224** are added. The other configuration is the same as the configuration in FIG. **5**.
[0161] In the configuration in FIG. **14** as well, as in the case of FIG. **5**, depending on which of the

five connection terminals **111***b* in FIG. **7**A the wiring cable L**15**, L**16**, L**17** is connected to, the identification information (e.g., manufacturing serial number) of the load sensor **10** is retained in the resistor array **111**.

[0162] FIG. **15** shows a state of the detection circuit **20** during reading of identification information (identification information reading mode). In FIG. **15**, for convenience, wiring cables and resistors related to identification information reading are indicated by thick lines.

[0163] During identification information reading, the switches **211**, **214**, **215** are opened. The multiplexer **224** is connected to the ground line L**13** side. In this state, by the switch **221** being closed, the power supply voltage Vcc is supplied to each of the three resistor arrays **111**. Accordingly, a voltage according to the connection form of each of the wiring cables L**15** to L**17** to a corresponding resistor array **111**, i.e., which of the five connection terminals **111***b* in FIG. **6**A the wiring cable L**15** to L**17** is connected, is applied to a corresponding conductor wire **13** (the electrically-conductive member **13***a*).

[0164] Here, in the state in FIG. **15**, among the three multiplexers **218***a* of the first switchover part **218**, only the multiplexer **218***a* in the uppermost row is connected to the supply line L**11**. Therefore, the voltage applied to the conductor wire **13** in the uppermost row from the resistor array **111** in the uppermost row is supplied to the output terminal **217** via the supply line L**11**.

[0165] At this time, to the three electrically-conductive elastic bodies **12** crossing the conductor wire **13** in the uppermost row, the suppression voltage having the same potential as that in the supply line L**11** is being applied from the equipotential generator **213**, and thus, the element parts A**11** to A**13** are disabled in terms of circuitry. Therefore, the voltage from the resistor array **111** in the uppermost row is appropriately reflected in the output terminal **217**. Therefore, by the above-described control circuit **30** detecting the voltage at the output terminal **217**, the numeral assigned according to the connection form between the resistor array **111** in the uppermost row and the wiring cable L**15** is acquired.

[0166] From the state in FIG. **15**, the first switchover part **218** is set such that only the conductor wire **13** in the middle row is connected to the supply line L**11**, whereby the voltage applied from the resistor array **111** in the middle row to the conductor wire **13** is supplied to the output terminal **217** via the supply line L**11**. By the control circuit **30** detecting the voltage at the output terminal **217** at this time, the numeral assigned according to the connection form between the resistor array **111** in the middle row and the wiring cable L**16** is acquired.

[0167] From the state in FIG. **15**, the first switchover part **218** is set such that only the conductor wire **13** in the lowermost row is connected to the supply line L**11**, whereby the voltage applied from the resistor array **111** in the lowermost row to the conductor wire **13** is supplied to the output terminal **217** via the supply line L**11**. By the control circuit **30** detecting the voltage at the output terminal **217** at this time, the numeral assigned according to the connection form between the resistor array **111** in the lowermost row and the wiring cable L**17** is acquired.

[0168] From the three numerals acquired in this manner, three-digit identification information associated with the load sensor **10** is acquired. Then, the identification information acquisition operation ends.

[0169] FIG. **16** shows a state of the detection circuit **20** during capacitance measurement (capacitance measurement mode). Here, the element part A**11** is the measurement target. In FIG. **16**, for convenience, wiring cables and resistors related to capacitance measurement are indicated by thick lines.

[0170] As shown in FIG. **16**, the three multiplexers **218***a* included in the first switchover part **218** and the three multiplexers **219***a* included in the second switchover part **219** are set to the state in FIG. **5**. That is, the multiplexer **218***a* in the uppermost row connected to the conductor wire **13** (the electrically-conductive member **13***a*) forming one electrode of the element part A**11** is connected to the supply line L**11**, and the multiplexer **219***a* in the leftmost row connected to the electrically-conductive elastic body **12** forming the other electrode of the element part A**11** is connected to the ground line L**13**. The switches **211**, **221**, **214**, **215** are set to an open state as in FIG. **5**.

[0171] As for the third switchover part **223**, only a switch **223***a* in the uppermost row is opened and the remaining two switches **223***a* are closed. The multiplexer **224** is connected to the supply line L**12**.

[0172] In this state, the switch **211** is closed for a certain period. Accordingly, the power supply voltage Vcc is applied to the element part A**11**, and in accordance with accumulation of electricity in the element part A**11**, the voltage at the output terminal **217** increases according to the time constant defined by the capacitance in the element part A**11** and the resistor **212**. As described above, the capacitance in the element part A**11** has a value according to the load being applied to the element part A**11**. Therefore, the voltage value at the output terminal **217** after elapse of a predetermined period after the switch **211** has been closed becomes a value according to the load being applied to the element part A**11**. From this voltage value, the above-described control circuit **30** calculates the load according to the capacitance in the element part A**11**.

[0173] In the state in FIG. **16**, since the multiplexer **224** is connected to the supply line L**12**, the same potential as that in the supply line L**11** is applied to both ends of the resistor array **111** in the uppermost row. Therefore, the resistor array **111** in the uppermost row is disabled. Since the switches **223***a* in the middle row and the lowermost row of the third switchover part **223** are closed, the same potential as that in the supply line L**11** is applied to both ends and the connection positions of the resistor arrays **111** in the middle row and the lowermost row. Therefore, the resistor arrays **111** in the middle row and the lowermost row are also disabled.

[0174] Thus, since all of the three resistor arrays **111** are disabled, these three resistor arrays **111** do not influence the voltage at the output terminal **217**. Therefore, from the voltage at the output terminal **217**, the capacitance and the load in the element part A**11** can be appropriately calculated.

[0175] When the capacitance measurement with respect to the element part A**11** has ended, the switch **211** is opened, the switches **214**, **215** are closed, and discharging is performed, as in Embodiment 1 above. Then, with respect to the other element parts as well, with the first switchover part **218**, the second switchover part **219**, and the third switchover part **223** similarly controlled, the power supply voltage Vcc is applied to the detection target element part, and from the voltage value at the output terminal **217**, the load in the detection target element part is calculated. Then, when load detection has been performed with respect to all the element parts, the same control is performed from the element part A**11** and load detection in each element part in the next routine is performed again.

[0176] The processes in FIG. **12** and FIG. **13** can be performed in the same manner also in the configuration in Embodiment 2.

Effects of Embodiment 2

[0177] In Embodiment 2 as well, effects similar to those in Embodiment 1 can be exhibited.

[0178] In the configuration in Embodiment 2, since the connection terminal **111***b* (point) of the resistor array **111** and the conductor wire **13** (the electrically-conductive member **13***a*: first electrode) are directly connected to each other by the wiring cables L**15** to L**17**, the switch element **112** can be omitted as compared with the configuration in Embodiment 1. Therefore, the configuration of the load sensor **10** can be more simplified.

Modification

[0179] In the embodiments above, the detection circuit **20** is connected to the load sensor **10** such that the electrically-conductive member **13***a* serves as the positive electrode of the element part and the electrically-conductive elastic body **12** serves as the negative electrode of the element part. However, the detection circuit **20** may be connected to the load sensor **10** such that the electrically-conductive member **13***a* serves as the negative electrode of the element part and the electrically-conductive elastic body **12** serves as the positive electrode of the element part. In this case, the electrically-conductive elastic body **12** corresponds to "first electrode" described in the claims, and the electrically-conductive member **13***a* corresponds to "second electrode" described in the claims.

[0180] In the embodiments above, as shown in FIG. **4**B, both of the label **16***a* and the storage medium **16***b* are disposed on the surface of the load sensor **10**, but either one of them may be omitted. However, in order to allow the user to easily grasp the identification information of each load sensor **10** visually and to smoothly compare the grasped identification information with the identification information acquired from the resistor array **111**, it is preferable that at least the representation of the identification information by means of the label **16***a* or the like is provided.
[0181] The method of providing the representation indicating the identification information on the surface of the load sensor **10** is not limited to the method of attaching the label **16***a* to the surface of the load sensor **10** as in Embodiments 1, 2 above. For example, the identification information may be directly printed on the surface of the load sensor **10**, or the identification information may be written by hand on the surface of the load sensor **10**.
[0182] The method of measuring the capacitance in each element part is not limited to the method described in Embodiments 1, 2 above. For example, the voltage outputted from the output terminal **217** in the period from when a voltage has been applied to the element part until this voltage becomes stable may be accumulated, to calculate the electric charge amount accumulated in the element part, and from the calculated electric charge amount, the capacitance in the element part may be calculated.
[0183] The element parts need not necessarily be disposed in a matrix shape. For example, a configuration in which a plurality of conductor wires **13** and one electrically-conductive elastic body **12** are caused to cross each other, whereby element parts are arranged only in one column, may be adopted. In addition, the number of element parts need not necessarily be plural, and may be one. In this case, if the number of resistors in the resistor array **111** is increased, the kinds of identification information can be increased.
[0184] In addition, the resistor arrays **111** need not necessarily be disposed in association with all of the conductor wires **13** (the electrically-conductive members **13***a*). For example, when a large number of conductor wires **13** (the electrically-conductive members **13***a*) are disposed, the resistor arrays **111** may be associated with conductor wires **13** (the electrically-conductive members **13***a*) in the number necessary for realizing the required number of kinds of identification information.
[0185] In Embodiments 1, 2 above, one conductor wire **13** is assigned to one element part. However, a plurality of conductor wires **13** may be assigned to one element part. For example, in the configuration in FIG. **4**A, with respect to the region of the element parts A**11** to A**13**, two conductor wires **13** may be disposed so as to be arranged in the Y-axis direction. In each of the region of the element parts A**21** to A**23** and the region of the element parts A**31** to A**33** as well, two conductor wires **13** may be disposed so as to be arranged in the Y-axis direction. In this case, the two conductor wires **13** disposed in each of the region of the element parts A**11** to A**13**, the region of the element parts A**21** to A**23**, and the region of the element parts A**31** to A**33** have end portions on the X-axis positive side connected to each other, or connected to each other in the circuit board **16** or in the detection circuit **20**. When a plurality of conductor wires **13** are assigned to one element part like this, change in the contact area between the dielectric body **13***b* and the electrically-conductive elastic body **12** with respect to a load becomes large, and thus, load detection sensitivity can be enhanced.
[0186] When a plurality of conductor wires **13** are assigned to one element part like this, the total number of the conductor wires **13** that are disposed increases, and thus, the number of the resistor arrays **111** that can be disposed also increases. Therefore, the digit number of the identification information of the load sensor **10** can be increased, and the kinds of the identification information can be increased. In this case, the detection circuit **20** may be configured so as to: during capacitance measurement, connect a plurality of conductor wires **13** assigned to one element part to each other and connect the resultant conductor wire **13** to the output terminal **217**; and during identification information reading, individually connect the plurality of conductor wires **13** assigned to one element part, to the output terminal **217**. Accordingly, measurement of capacitance

in each element part and reading of identification information at each resistor array **111** can be smoothly performed.

[0187] The configuration of the detection circuit **20** is not limited to the configuration shown in FIG. **5** or FIG. **14**. As long as the capacitance in the element part can be measured and the identification information retained in the resistor array **111** can be acquired, the configuration of the detection circuit **20** can be changed as appropriate.

[0188] In Embodiments 1, 2 above, the first switchover part **218** and the second switchover part **219** are implemented by the multiplexers **218***a*, **219***a*. However, the first switchover part **218** and the second switchover part **219** may be implemented by a switching circuit other than a multiplexer.

[0189] The control performed by the control circuit **30** is not limited to the control in FIGS. **12**, **13** shown in Embodiment 1 above, and can be changed as appropriate.

[0190] The voltage applied to the power supply connection terminal **111***c* of the resistor array **111** and the voltage applied to the conductor wire **13** via the supply line L**11** may be different from each other.

[0191] In the embodiments above, the conductor wire **13** is implemented by a covered copper wire, but not limited thereto, may be composed of a linear-shaped electrically-conductive member formed from a substance other than copper and a dielectric body covering the electrically-conductive member. The electrically-conductive member may be implemented by a twisted wire. In the embodiments above, the conductor wire **13** extends in a straight-line shape, but the conductor wire **13** may meander in the Y-axis direction.

[0192] In the embodiments above, the electrically-conductive elastic bodies **12** are provided only on the face on the Z-axis positive side of the base member **11**. However, electrically-conductive elastic bodies may be provided also on the face on the Z-axis negative side of the base member **15**. In this case, the electrically-conductive elastic bodies on the base member **15** side are configured similarly to the electrically-conductive elastic bodies **12** on the base member **11** side, and are disposed so as to overlap the electrically-conductive elastic bodies **12** so as to sandwich the conductor wires **13** therebetween in a plan view. Then, the wiring cables drawn from the electrically-conductive elastic bodies on the base member **15** side are connected to the wiring cables W**1** drawn from the electrically-conductive elastic bodies **12** opposed in the Z-axis direction. When the electrically-conductive elastic bodies are provided above and below the conductor wires **13** in this manner, change in the capacitance in each element part becomes approximately twice correspondingly to the upper and lower electrically-conductive elastic bodies. Therefore, the detection sensitivity of the load applied to the element part can be enhanced.

[0193] In the embodiments above, the dielectric body **13***b* is formed on the electrically-conductive member **13***a* so as to cover the outer periphery of the electrically-conductive member **13***a*. However, instead of this, the dielectric body **13***b* may be formed on the upper face of the electrically-conductive elastic body **12**. In this case, in accordance with application of a load, the electrically-conductive member **13***a* sinks in and is wrapped by the dielectric body **13***b* and the electrically-conductive elastic body **12**, and the contact area between the electrically-conductive member **13***a* and the electrically-conductive elastic body **12** changes. Accordingly, similar to the embodiments above, the load applied to each element part can be detected.

[0194] In the embodiments above, each element part is formed by the electrically-conductive elastic body **12** and the conductor wire **13** crossing each other. However, the configuration of the element part is not limited thereto. For example, the element part may be formed by a hemisphere-shaped electrically-conductive elastic body and a flat-plate-shaped electrode sandwiching a dielectric body. In this case, the dielectric body may be formed on the surface of the electrode opposing the electrically-conductive elastic body, or may be formed on the surface of the hemisphere-shaped electrically-conductive elastic body.

[0195] In addition to the above, various modifications can be made as appropriate to the embodiments of the present invention without departing from the scope of the technical idea defined by the claims.

Additional Note

[0196] The following technologies are disclosed by the description of the embodiments above.

Technology 1

[0197] A load sensor comprising: [0198] at least one first electrode; [0199] at least one second electrode disposed so as to cross the first electrode; [0200] a dielectric body present between the first electrode and the second electrode; [0201] a resistor array that has a plurality of resistors in series connection and in which both ends of the series connection are respectively connected to a power supply line on a side of a detection circuit and a ground line; and [0202] a connection part configured to connect, to the first electrode, one point out of the both ends of the resistor array and a connection position between the resistors adjacent to each other of the resistor array, wherein [0203] the point is set to a position corresponding to identification information of the load sensor.

[0204] According to this technology, when the power supply voltage has been applied to the resistor array via the power supply line, a voltage according to the position of the point, i.e., the identification information, appears in the first electrode. Therefore, by detecting, on the detection circuit side, the voltage that appears in the first electrode when the power supply voltage has been applied to the resistor array, the identification information of the load sensor can be acquired. Therefore, identification of the load sensor can be performed in a simple manner.

Technology 2

[0205] The load sensor according to technology 1, wherein [0206] the connection part comprises a switch element configured to switch the point and the first electrode, between connection and non-connection.

[0207] According to this technology, by opening the switch element when the capacitance in an element part is to be measured, the resistor array can be disconnected from the first electrode. Therefore, in measurement of the capacitance in the element part, occurrence of influence of the resistor array on the voltage that is outputted from the output terminal can be appropriately prevented.

Technology 3

[0208] The load sensor according to technology 2, wherein [0209] the detection circuit comprises a configuration configured to switch the power supply line and a wiring cable connected to both of the resistor array and the switch element, between connection and non-connection, and [0210] when the power supply line has been connected to the wiring cable and a power supply voltage has been applied, the switch element operates so as to connect the point and the first electrode to each other.

[0211] According to this technology, without providing a configuration for switching the switch element on the load sensor side, the switch element can be set to a conductive state by merely applying the power supply voltage from the detection circuit side to the switch element. Therefore, the configuration of the load sensor can be simplified.

Technology 4

[0212] The load sensor according to technology 1, wherein [0213] the connection part is a wiring cable that directly connects the point and the first electrode to each other.

[0214] According to this technology, the switch element can be omitted. Therefore, the configuration of the load sensor can be more simplified.

Technology 5

[0215] The load sensor according to any one of technologies 1 to 4, [0216] comprising a plurality of the first electrodes, and [0217] comprising a set of the resistor array and the connection part for each of the first electrodes.

[0218] According to this technology, since a plurality of sets of the resistor array and the switch element can be disposed, the combinations of numbers of pieces of the identification information

can be increased. Therefore, the kinds of the identification information that can be set can be increased.
Technology 6
[0219] The load sensor according to technology 5, comprising [0220] a plurality of the second electrodes, wherein [0221] crossing positions between a plurality of the first electrodes and a plurality of the second electrodes are disposed in a matrix shape.
[0222] According to this technology, the number of the crossing positions can be increased, and the distribution of the load can be measured in a wider area.
Technology 7
[0223] The load sensor according to any one of technologies 1 to 6, wherein [0224] a representation indicating the identification information is attached to a surface of the load sensor.
[0225] According to this technology, by referring to this representation, the user can smoothly and accurately grasp where the load sensor corresponding to the identification information read from the resistor array is. Thus, for example, when an error has occurred, the user can smoothly identify the load sensor in which the error has occurred, and can smoothly carry out replacement work, etc. of the load sensor.
Technology 8
[0226] The load sensor according to any one of technologies 1 to 7, wherein [0227] a storage medium from which the identification information is readable is attached to a surface of the load sensor.
[0228] According to this technology, by reading the identification information from the storage medium with a reading device, the user can manage the identification information of each load sensor. For example, the user can manage the arrangement layout of the load sensors, and can smoothly confirm erroneous arrangement, missing arrangement, or the like of each load sensor.
Technology 9
[0229] A load detecting device comprising: [0230] the load sensor according to any one of technologies 1 to 8; and [0231] the detection circuit.
[0232] According to this technology, since the load sensor according to any one of technologies 1 to 8 is included, effects similar to those in technologies 1 to 8 can be exhibited.
Technology 10
[0233] The load detecting device according to technology 9, wherein [0234] the detection circuit [0235] in a capacitance measurement mode, applies a power supply voltage to the first electrode and outputs, to an output terminal, a voltage of the first electrode that changes in accordance with capacitance at a crossing position between the first electrode and the second electrode, and [0236] in an identification information reading mode, applies a power supply voltage to the resistor array and outputs a voltage appearing at the point, to the output terminal via the first electrode.
[0237] According to this technology, the output terminal can be used in common for measurement of the capacitance and reading of the identification information. Therefore, the detection circuit can be simplified.
Technology 11
[0238] The load detecting device according to technology 10, comprising [0239] a control circuit configured to [0240] detect, in the capacitance measurement mode, capacitance at the crossing position from a voltage outputted from the output terminal, and [0241] acquire, in the identification information reading mode, the identification information from a voltage outputted from the output terminal.
[0242] According to this technology, from the voltages outputted from the common output terminal, the load at the crossing position and the identification information of the load sensor can be respectively acquired.

Claims

1. A load sensor comprising: at least one first electrode; at least one second electrode disposed so as to cross the first electrode; a dielectric body present between the first electrode and the second electrode; a resistor array that has a plurality of resistors in series connection and in which both ends of the series connection are respectively connected to a power supply line on a side of a detection circuit and a ground line; and a connection part configured to connect, to the first electrode, one point out of the both ends of the resistor array and a connection position between the resistors adjacent to each other of the resistor array, wherein the point is set to a position corresponding to identification information of the load sensor.
2. The load sensor according to claim 1, wherein the connection part comprises a switch element configured to switch the point and the first electrode, between connection and non-connection.
3. The load sensor according to claim 2, wherein the detection circuit comprises a configuration configured to switch the power supply line and a wiring cable connected to both of the resistor array and the switch element, between connection and non-connection, and when the power supply line has been connected to the wiring cable and a power supply voltage has been applied, the switch element operates so as to connect the point and the first electrode to each other.
4. The load sensor according to claim 1, wherein the connection part is a wiring cable that directly connects the point and the first electrode to each other.
5. The load sensor according to claim 1, comprising a plurality of the first electrodes, and comprising a set of the resistor array and the connection part for each of the first electrodes.
6. The load sensor according to claim 5, comprising a plurality of the second electrodes, wherein crossing positions between a plurality of the first electrodes and a plurality of the second electrodes are disposed in a matrix shape.
7. The load sensor according to claim 1, wherein a representation indicating the identification information is attached to a surface of the load sensor.
8. The load sensor according to claim 1, wherein a storage medium from which the identification information is readable is attached to a surface of the load sensor.
9. A load detecting device comprising; a load sensor; and a detection circuit, wherein the load sensor includes at least one first electrode, at least one second electrode disposed so as to cross the first electrode, a dielectric body present between the first electrode and the second electrode, a resistor array that has a plurality of resistors in series connection and in which both ends of the series connection are respectively connected to a power supply line on a side of the detection circuit and a ground line, and a connection part configured to connect, to the first electrode, one point out of the both ends of the resistor array and a connection position between the resistors adjacent to each other of the resistor array, and the point is set to a position corresponding to identification information of the load sensor.
10. The load detecting device according to claim 9, wherein the detection circuit in a capacitance measurement mode, applies a power supply voltage to the first electrode and outputs, to an output terminal, a voltage of the first electrode that changes in accordance with capacitance at a crossing position between the first electrode and the second electrode, and in an identification information reading mode, applies a power supply voltage to the resistor array and outputs a voltage appearing at the point, to the output terminal via the first electrode.
11. The load detecting device according to claim 10, comprising a control circuit configured to detect, in the capacitance measurement mode, capacitance at the crossing position from a voltage outputted from the output terminal, and acquire, in the identification information reading mode, the identification information from a voltage outputted from the output terminal.
12. The load detecting device according to claim 9, wherein the connection part comprises a switch element configured to switch the point and the first electrode, between connection and non-

connection.

13. The load detecting device according to claim 12, wherein the detection circuit comprises a configuration configured to switch the power supply line and a wiring cable connected to both of the resistor array and the switch element, between connection and non-connection, and when the power supply line has been connected to the wiring cable and a power supply voltage has been applied, the switch element operates so as to connect the point and the first electrode to each other.

14. The load detecting device according to claim 9, wherein the connection part is a wiring cable that directly connects the point and the first electrode to each other.

15. The load detecting device according to claim 9, comprising a plurality of the first electrodes, and comprising a set of the resistor array and the connection part for each of the first electrodes.

16. The load detecting device according to claim 15, comprising a plurality of the second electrodes, wherein crossing positions between a plurality of the first electrodes and a plurality of the second electrodes are disposed in a matrix shape.

17. The load detecting device according to claim 9, wherein a representation indicating the identification information is attached to a surface of the load sensor.

18. The load detecting device according to claim 9, wherein a storage medium from which the identification information is readable is attached to a surface of the load sensor.
