

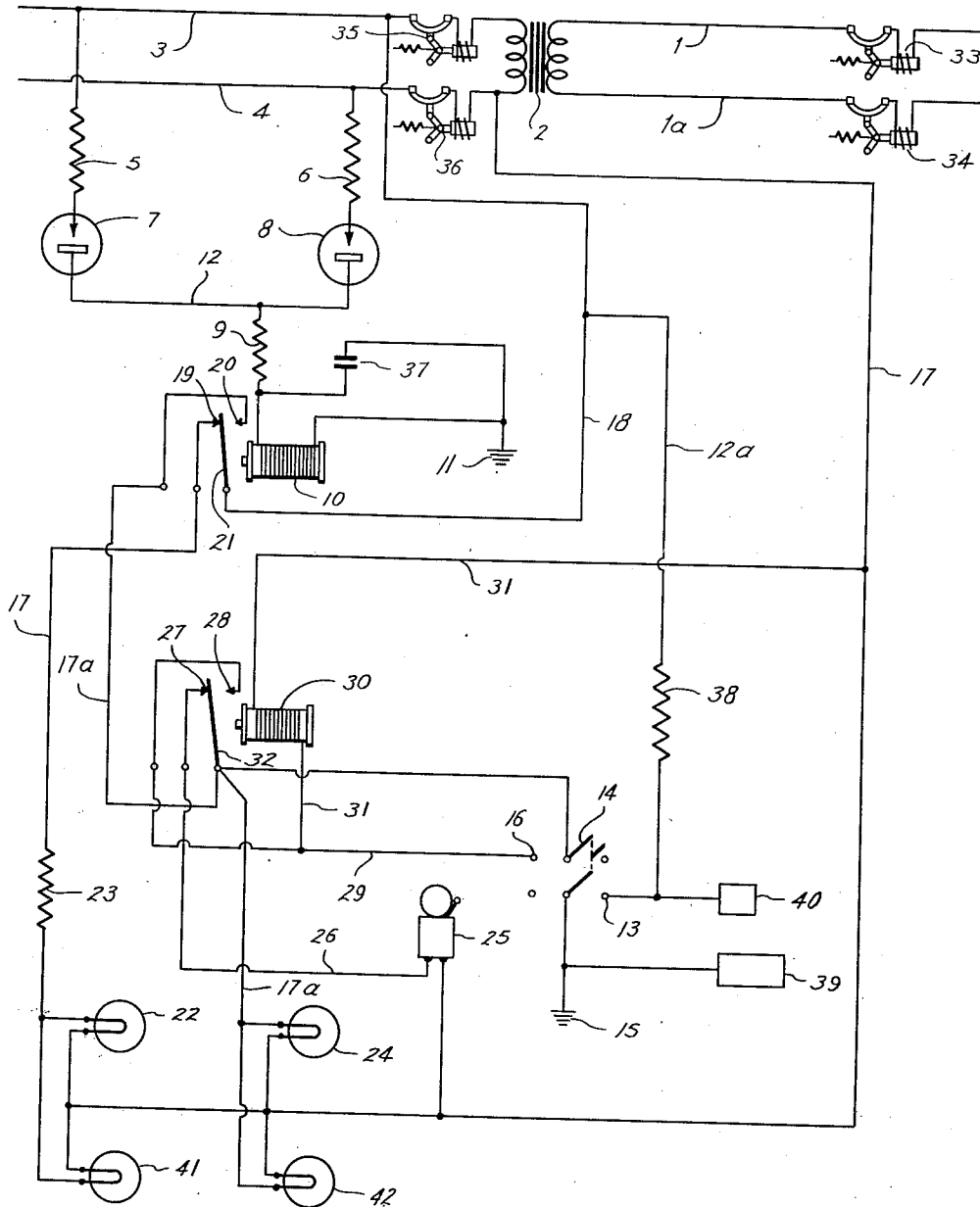
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CONDUCTIVITY TESTING SYSTEM

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1

2,816,264

CONDUCTIVITY TESTING SYSTEM

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4 Claims. (Cl. 324—62)

This invention relates to an electrical ground detector.

This application is a division of the co-pending application Serial Number 134,399, entitled "Electrical Ground Detector," filed December 22, 1949, now Patent No. 2,660,717.

A general object of the invention is to provide a safety ground detector which will indicate the grounding of an electrical current.

Another object of the invention is to provide a sensitive detector of the character described which will eliminate the accumulation of negative and positive static electricity on ungrounded conductors, which prevents the possibility of the danger of explosions due to static discharges in hazardous places such as hospital operating rooms, chemical and petroleum refineries and similar places where explosive gases are present.

Still another object of the invention is to provide a means of testing the conductivity of all persons before entering operating rooms in hospitals to equalize electrostatic potential before entering anesthetized locations and locations where combustible gases are stored or handled, a visible green signal light outside of the operating room indicating such persons are conductive to the flooring and a red signal light outside of operating rooms indicating that the conductivity of the individual is unsafe or a dangerous risk as an electro-static charge carrier; while one or more special electrodes, near the operating room or storage rooms located outside of the dangerous area, will be used in testing the degree of conductivity of hospital personnel and others desirous of entering said location.

Other objects and advantages will be apparent from the following specifications which is illustrated by the accompanying drawing, wherein the figure is a diagrammatic view of the detector.

Referring more particularly to the drawing the numerals 1, 1a are the electrical conductors leading from the source of energy.

A transformer, as 2, must be employed to deliver the electrical current from conductors 1, 1a to the electrical conductors 3, 4 which lead to the equipment to be used in a hospital operating room or in an industrial plant.

The ground detector is connected into the circuit through the ungrounded conductors 3, 4. As shown, there are suitable resistor units 5, 6 connected into the respective conductors 3, 4 and also connected with the corresponding rectifiers 7 and 8.

Current may then flow through resistor 9 to relay 10 and thence to ground 11. The rectifiers 7, 8 produce direct current rectified impulses to actuate relay 10. These rectifiers are connected into a common point by an electrical conductor 12 so that current can flow through these blocking rectifier elements toward the common point only. Conductor 12a connects with conductor 18 and conductor 3 and leads to resistor 38 thence through the resistor to the fixed contact 13 and hand electrode 40. There is also a moveable contact 14 which, when closed with contact 13, will form a circuit from

2

conductor 3 through conductors 18, conductor 12a, resistor 38, ground 15, ground 11, relay 10, resistor 9 and conductor 12 back to conductor 4. This, in turn, energizes relay 10. The purpose is to test the light signals and the audible signal.

There is also a fixed contact 16, and the moveable contact 14 may be closed with this fixed contact 16.

The moveable contact, as shown, is of the self-centering type and may be moved into closed position with either contact 13 or 16.

There are the electrical conductors 17, 18 which lead from the respective conductors 3 and 4. The conductor 17 terminates in a fixed contact 19, and opposing this fixed contact 19 there is a fixed contact 20.

The conductor 18 terminates in a moveable contact 21 which may be closed with either of the contacts 19 or 20.

The relay 10 is positioned to actuate the moveable contact 21, and when it is energized, as above explained, it will move contact 21 from contact 19 into closed position with contact 20.

Incorporated into conductor 17 there is a light globe 22, in the present instance green, and also, preferably, a resistor 23. The resistor 23 is provided to reduce the voltage applied to the filaments of lights 22 and 41 and increase the life of the filaments. Of course, other types of electrical signals may be employed. When the contacts 19, 21 are closed, the signals 22 and 41 will be energized. When contacts 14, 13 are closed and relay 10 energized and contact 21 moved from contact 19 and closed with contact 20, as above explained, the signals 22 and 41 will be extinguished, or rendered inactive.

Leading from contact 20 and connected into conductor 17 there is an electrical conductor 17a, and in this conductor there are light globes 24 and 42, in the present instance red and green, or other selected electrical signals. These signals will be energized when contacts 21, 20 are closed and signals 22 and 41 extinguished.

An audible signal may also be provided to take the place of, or to operate in conjunction with, the signal 24. In the present illustration, this is shown as an alarm bell 25, which is in an electrical conductor 26 leading from conductor 17 and terminating in a fixed contact 27 which opposes and is spaced from a fixed contact 28. An electrical conductor 29 connects contacts 16 and 28.

There is a relay 30 in the electrical conductor 31, which conductor leads from conductor 17 to conductor 29, and when contacts 20, 21 are closed the current flows from conductor 17a to contact 32, which is in contact with contact point 27 and thence through conductor 26 to operate signal 25. This contact 32 is moveable and is connected into conductor 17a so as to electrically connect the conductors 26, 29 alternatively with conductor 17a. When contacts 14 and 16 are closed, the relay 30 then becomes energized and closes contacts 32, 28, thus de-energizing signal 25, and upon closing switch 14 with contact point 13, signal 24 is energized and signal 22 de-energized.

The signals 24, 25 remain active until the movable contact 14, which is self-centering, assumes its normal, open position. Upon contact 14 moving to open position, the contact between the movable contact 32 and the fixed contact 27 will be broken and the contacts 32 and 28 will be closed, thereby silencing the signal 25.

As before stated, the movable contact 14 is self-centering, and, therefore, to close contacts 14, 13 or 14, 16 it is necessary to move said movable contact 14 in an appropriate direction. In accordance with the illustration, when the movable contact 14 is moved to the right the signals 24, 25 and 42 may be tested, since they become energized upon closing of the switches 14, 13. When

3

this contact is broken, the signals 24, 25 and 42 become inoperative and the signals 22 and 41 are re-energized.

The conductors 1, 1a are provided with over-current protecting devices 33, 34 which are provided to protect the primary circuit of the isolation transformer 2 from over-current supply, and incorporated into the secondary conductors 3, 4 there are over-current protecting devices 35, 36 to similarly protect the secondary winding. These over-current protecting devices may be ordinary fuse plugs, if desired, or similar devices.

During the normal operation of the protected equipment the green light 22 will be illuminated or be active, and it may be here stated that the switches 21, 32 are normally in the position indicated in the drawing, that is, connected with the respective contacts 19, 27, and so maintained by the customary spring or similar device for such purpose.

When a pulsating, direct current passes through the body of one or more persons from the line 3 or 4, such persons will be protected against electric shock through the resistor 9 and the relay winding 10, to the ground as the circuit will pass only sufficient current to actuate said relay and give warning signals, this current being not more than 400 microamperes.

Should an accidental ground occur on conductor 3 or 4, current will pass through resistor 9 and relay 10 to ground 11, and the current from ground 11 will pass back to conductor 3 or 4, whichever one becomes grounded. This will operate relay 10, and switch 21 will be moved into contact with contact 20, and the green light 22 will be extinguished and current will be conducted through 17a to illuminate the red light 24 and, the switch 32 still being closed with point 27, current will also flow through the conductor 26 to render the signal 25 active. There is a condenser 37 for the purpose of eliminating the alternating current component of the pulsating direct current connected across the winding of relay 10.

There is a resistor 38 placed in conductor 12a to limit the flow of current to the contact 13 and hand electrode 40 to protect the excessive or dangerous flow of current from the contact point 13 to ground 15 through the switch 14 when closed in the event lines 3 or 4 should become permanently grounded. The hand electrode 40 and foot electrode 39, located outside the operating room, are for the purpose of making a momentary test of the conductivity of personnel before entering the operating room. A red light 41 indicating danger, signifies no current is flowing through the body from hand electrode 40 to foot electrode 39. When current flows through the body from electrode 40 to 39, a circuit is established from the common point between rectifiers 7 and 8, through the resistance 9, the relay 10, ground 11, ground 15, foot electrode 39 through the body to hand electrode 40, through resistance 38 and conductor 12a to conductor 13 and ungrounded conductor 3. Establishment of this circuit causes energization of the relay 10, which de-energizes the red light 41 and energizes the green light 42, and the alarm signal 25, thus indicating current is flowing through the body from hand electrode 40 to foot electrode 39. It also enables the electro-static potential which may accumulate on the body of a person to flow to the grounded terrazzo floor in the operating room through the conductive soles of shoes required by hospital personnel and surgeons to equalize the electro-static potential that may form on the body which would prevent the possibility of forming a spark or arc which could ignite explosive, anesthetic gases.

In order to silence the audible signal 25, the operator may throw switch 14 into contact with contact 16 which will energize relay 30, thus throwing the switch 32 into contact with point 28 thereby silencing the signal. The switch 14, being a self-centering switch, will immediately move to open position, and points 32 and 28 will remain in contact due to the holding coil action of the relay

4

30. This indicates that a conductor 3 or 4 is grounded, and this defect should be removed by the electrician, and when removed the current flowing to the ground 11 is stopped, and the relay 10 is de-energized, and thereupon switch 21 will move into contact with point 19, and the green light 22 and red light 41 are illuminated. At the same time, current through conductor 29, 31 is broken, and the relay 30 is de-energized, and switch 32 moves to normal position in contact with contact point 27. It may be here stated that direct current may be used, and the circuits may be single- or multi-phase alternating current circuits.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth, together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

The invention having been described, what is claimed is:

1. A system for testing the conductivity of a person comprising an isolation transformer, a plurality of ungrounded conductors connected to the secondary of the transformer, blocking rectifier elements so connected between each of said conductors and a common point that current can flow through said elements toward the common point only, said common point being connected to ground through a resistance, a relay coil connected between said common point and said ground and in series with said resistance, an electrode connected through another resistance to one of said ungrounded conductors, and another electrode connected to ground, each of said resistances being sufficiently high to limit current passing through a person, who may be across said electrodes, to an amount insufficient to cause bodily discomfort, and signal means controlled by the relay coil for indicating the flow of current through such a person.

2. A system for testing a circuit and the conductivity of a person comprising an isolation transformer, a plurality of ungrounded conductors connected to the secondary of the transformer, blocking rectifier elements so connected between each of said conductors and a common point that current can flow through said elements toward the common point only, said common point being connected to ground through a resistance, signal means controlled by current flowing through the common point to ground, an electrode connected through another resistance to one of said ungrounded conductors, and another electrode connected to ground, each of said resistances being sufficiently high to limit current passing through a person, who may be across said electrodes, to an amount insufficient to cause bodily discomfort.

3. The assembly of claim 2 in combination with means for selectively passing a current through said common point for testing the operation of said signal means.

4. A system for testing the conductivity of a person comprising an isolation transformer circuit including a pair of ungrounded conductors, a relay winding connected between one of said conductors and ground, a resistor connected between said one conductor and said relay winding and being sufficiently high to protect a person against discomforting shock, a grounded electrode, another electrode connected to the other of said ungrounded conductors through another resistor also sufficiently high to protect a person against shock, said electrodes being spaced apart to provide a space for a person to stand on one electrode while contacting the other electrode, signal means controlled by said relay winding for indicating a conductive coupling between the electrodes,

and means for selectively passing a current through said
signal means for testing the operation of said signal means.

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