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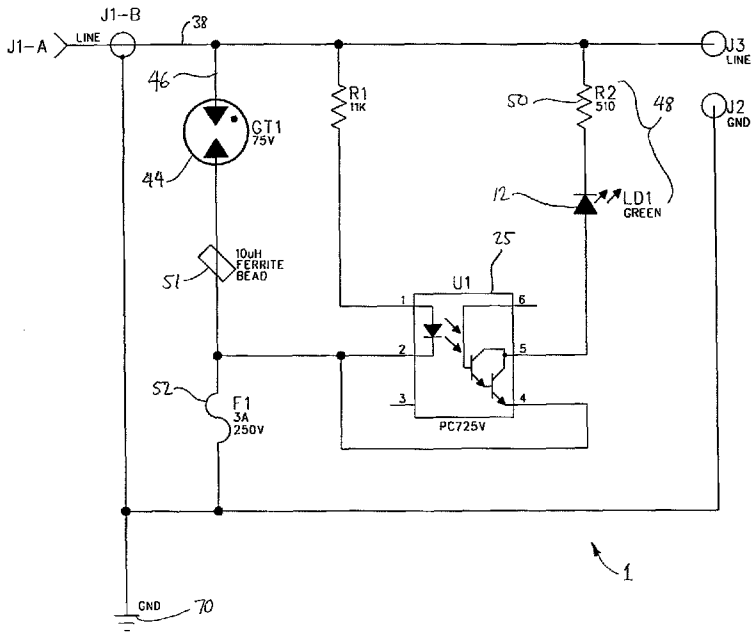
(54) **Title:** SURGE PROTECTION DEVICE FOR COAXIAL CABLE WITH DIAGNOSTIC CAPABILITIES



(57) **Abstract:** A surge protection circuit (1) utilizing direct current (DC) voltage on the information carrying coaxial cable (18) of a receiving device with a surge protection device (10) to suppress transient signal fluctuations over the coaxial cable and a diagnostic surge protection status indicator (12) with on/off configurations to indicate the status of operation of the surge protection device (10). The visual indicator may be a light emitting diode or some other indicator device that when energized indicates normal operation of the surge protection circuit (1).

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SURGE PROTECTION DEVICE FOR COAXIAL CABLE WITH DIAGNOSTIC CAPABILITIES

Technical Field

The present invention relates generally to surge protection devices and, more particularly, to a surge protection circuit with diagnostic status capability and method for use with coaxial cables.

Background Art

Surge protection circuits are known in the art to protect electronic equipment from voltage surges that impinge on wires transmitting power to the equipment. Devices known in the art such as televisions, computers, monitors and satellite-based receivers for satellite and cable television, however, receive information signals, such as audio signals, video signals, and other types of signals, that convey information, rather than power. Such information signals are typically conveyed using voltage, current or frequency modulation and, similar to wires transmitting power, are susceptible to voltage transient fluctuations, spikes, and/or surges that could damage sensitive electronic devices that receive the information signals.

Some devices receive information-based signals over dedicated information lines that do not transmit power. Such devices typically utilize standard construction coaxial cables for information-based signal transmission. Standard coaxial cables, designated RG6 or RG59, are constructed with a central conductor, an insulator that surrounds the central conductor, an outer conductor and an insulating outer sheath. For example, satellite television (Satellite TV) and cable television/community access television (CATV) systems typically use video signal processing devices, such as computers, set-top boxes, and video cassette recorders (VCRs), that use standard coaxial cables, coaxial cable connections, and coaxial cable jacks to connect to the Satellite TV or CATV system to receive information signals transmitted through the coaxial cables.

A need exists in the surge protection device art for a surge protection circuit to protect information signal line transmission, such as through coaxial cables, to provide

surge protection for devices that receive the type of information signals transmitted in Satellite TV and CATV systems.

Disclosure of Invention

The present invention is a surge protection device and method of use that utilizes direct current (DC) to provide power to a surge protection status indicator to protect devices that receive information signals transmitted on coaxial cables from being damaged by transient signal fluctuations, spikes and/or surges that would otherwise damage such receiving devices.

The surge protection device is comprised generally of a surge protection circuit and diagnostic surge protection status indicator circuit and fuse connected in series (collectively referred to as the "parallel surge protection circuit"). The surge protection circuit is comprised of a surge protection device, such as a gas tube, one or more resistors, a ferrite bead and a fuse. The diagnostic surge protection status indicator circuit is comprised of an opto-isolator, resistors and a status indicator such as a light emitting diode (LED). The surge protection circuit and surge protection status indicator circuit are connected between the center conductor and the shield of the coaxial cable and in parallel to the coaxial cable.

The parallel surge protection circuit has a first terminal connected to the coaxial cable that carries an information signal and a second terminal connected to the shield ground. An information signal is input on the coaxial cable from, for instance, a Satellite TV transmission system. The information signal travels the length of the coaxial cable to the receiving device such as a VCR. During normal, undisrupted transmission of the information signal, the indicator device of the diagnostic status indicator circuit is activated with, for instance, the LED is illuminated, to indicate that DC power is being supplied to the parallel surge protection circuit and the surge protection is functional.

If the information signal experiences transient signal fluctuation, however, the surge protection device, such as a gas tube, detects the spike in voltage in the coaxial cable which then draws the potentially damaging current from the coaxial cable and diverts it to the shield ground. If the magnitude of the surge is large enough, the induced current will cause the fuse to open thereby creating an open circuit at the fuse between the surge protection device and ground. Once the parallel surge protection

circuit is broken, the diagnostic indicator device, for instance a LED, is turned off indicating that the parallel surge protection circuit has suppressed a transitory spike or power surge in the coaxial cable and the fuse needs to be replaced to enable the circuit for a future transitory fluctuation in the information signal in the coaxial cable.

According to another aspect of the invention, a method is provided for suppressing surges along a non-AC transmitting conductor. The method of the present invention includes the steps of providing a surge protection circuit connected in parallel to a coaxial cable for information signal transmission wherein the diagnostic status indicator device is in the "on" configuration during normal, undisrupted information signal transmission. When the surge protection circuit detects a spike or surge in transmitted voltage, the surge protection device draws the potentially damaging power from the coaxial cable and diverts it to the shield ground which opens the circuit at the fuse and causes the diagnostic status indicator device to switch to the "off" configuration.

Brief Description of Drawings

For a better understanding of the invention, and to show how it may be carried into effect, reference is now made, purely by way of example, to the accompanying drawings in which like numerals designate corresponding elements or section thoughts and in which:

Figure 1 depicts a block diagram of a surge protection device connected to a coaxial cable that includes the diagnostic status indicator device as a light emitting diode.

Figure 2 depicts a schematic illustration of the parallel surge protection circuit comprised of the surge protection device circuit and in accordance with an embodiment of the invention.

Best Mode for Carrying Out the Invention

The surge protection circuit disclosed utilizes a DC voltage on a coaxial cable to provide power to a surge protection status indicator that is in parallel with the coaxial cable to indicate the operational status of the surge protection circuit. The surge protection circuit is adapted to provide surge protection for video devices and/or other devices that receive information signals over coaxial cables. The surge protection

circuit can divert signal surges such as transient signal fluctuations, spikes and/or surges, on coaxial cables to the shield ground which may prevent damage to the video devices coupled to receive signals on the coaxial cables.

Figure 1 depicts the surge protection device of the present invention which includes a cylindrical surge protection device 10 having input and output coaxial cables and diagnostic surge protection status indicator 12, in this case a LED, positioned thereon to indicate the status of operation of surge protection device 10. Accordingly, a user, by looking at the LED 12, can readily determine whether or not surge protection device 10 is working. LED 12 will be lit to indicate to a user that power is being provided to surge protection device 10 and surge protection is activated. Conversely, if LED 12 is not lit, a user is notified that no power is being provided to surge protection device 10.

In further reference to Figure 1, coaxial cables 18, 20 are standard coaxial cables, such as RG6 or RG59 having, for example, an inner or central conductor, an insulator surrounding the central conductor, an outer conductor, and an insulating sheath. The information signals are typically transmitted through inner conductor of the coaxial cable, with the outer conductor typically being connected to a ground. In disclosed surge protection device 10, voltage signals from coaxial cable 18 carry information signals in a modulated format that is used to power surge protection device 10 even though coaxial cable 18 is operating to convey information, not power, signals to video device 24.

Figure 2 depicts a schematic illustration of a parallel surge protection circuit 1 that includes coaxial cable 18 on which the information signal is input through coaxial cable connector 14 to signal line 38 that conveys the information signal input on coaxial cable 18 to output coaxial cable 20 with cable connector 16 that transmits information signal to receiving device 24.

As further depicted in Figure 2, the preferred embodiment of parallel surge protection circuit 1 is comprised first of the surge protection circuit that includes surge protection device 10, here depicted as a gas tube 44 which receives the information signal conveyed by signal line 38 transmitted by at least one tap line 46, one or more resistors, a ferrite bead 51 and resistor 52 which leads to the shield ground 70. Parallel surge protection circuit 1 is further comprised of the diagnostic surge protection status indicator circuit 48 that includes resistor 50, diagnostic surge protection status indicator

LED 12 and opto-isolator 25 to provide electronic isolation for LED 12 from coaxial cables 18, 20.

During normal, non-surge transmission of information signals on coaxial cables 18, 20, LED 12 is powered by DC current and lit indicating the parallel surge protection circuit is closed and ready to draw voltage from input coaxial cable 18 in response to transient signal fluctuations, spikes and/or surges. Upon transmission of such transient signal fluctuation into input coaxial cable 18, surge protection device 10 detects the signal fluctuation, draws the potentially damaging voltage from input coaxial cable 18 and diverts it to the shielded ground to protect information signal receiving device 24. Diversion of the potentially damaging voltage to the shielded ground breaks the circuit at fuse 52 and, thereafter, DC voltage to LED 12 is terminated and LED 12 stops glowing to indicate that parallel surge protection circuit 1 has suppressed a transient signal fluctuation, the circuit is open and fuse 52 needs to be replaced to close the circuit to be re-engaged to suppress future transient signal fluctuation in the system.

As further depicted in Figure 2, device 24 receives information signals over coaxial cables 18, 20 where device 24 may be a computer, set-top boxes or VCR for processing. Operating power for device 24 is not provided by coaxial cables 18, 20.

In a further embodiment, surge protection device 10 may be a gas tube (as depicted in Figure 2) or some other such protection device including a silicon avalanche diode (SAD). Parallel surge protection circuit 1 may also include a current limiting device connected in series with the diagnostic surge protection status indicator, such as LED 12 in Figure 2, and/or a resistor in series with surge protection device 10, such as gas tube 12 in Figure 2.

In another embodiment of the present invention, coaxial cable 18 receives information signals from a Satellite TV system, such as a digital satellite system (DSS)-based receiver connected to an antenna and/or a satellite dish, or cable television/community access television (CATV) as input information signals. In this embodiment, device 24 is a video signal processing device, such as a television or set-top box, that receives and processes the input information signals to generate corresponding TV images from selected channels.

Figure 2 depicts a schematic in which the information signal input on coaxial cable 18 has a direct current (DC) voltage component, such as an offset voltage, and parallel surge protection circuit 1 uses this DC voltage as a power source for surge

protection status indicator circuit and surge protection status indicator device such as LED 12 to indicate activated surge protection. For example, DSS satellite receivers may provide a DC signal of about 5 volts of DC (VDC) in addition to the information signal. In an alternative embodiment, the information signal may not include a DC voltage component. Instead, surge protection device 10 can include a rectifier to tap the information signal and generate DC voltage from the information signal. In a further alternative embodiment, parallel surge protection circuit 1 can include a separate power source or a connection to an external power source. Surge protection circuit 10 and/or indicator circuit 48 may require a minimum operating voltage of about 5 VDC that may also be supplied by a step up transformer or rectifiers that generate such a DC voltage.

Referring further to Figure 2, gas tube 44 labeled GT1 has a 75 V rating and is connected by tap line 46 to signal line 38 to suppress surges in power signals transmitted along the coaxial signal line. Gas tube 44 can be any device, such as the PTX series of gas-tube surge protection devices commercially available from "NEXTEK, INC." of Westford, Massachusetts. In alternative embodiments, a capacitor, a diode, or other surge protection device may be used instead of, or in addition to, gas tube 44 to perform surge protection.

Resistor 50 can have a value of 6.8 k ohms and may be used as a current limiter, and LED 12 in series with resistor 50, is connected in parallel with gas tube 44.

This parallel configuration may be connected in series with fuse 52 such as a TR250-145 fuse. In an alternative embodiment, a circuit breaker or other current limiting device may be used instead of fuse 52 to create an open circuit between gas tube 44 (in parallel with LED 12 and resistor 50) and ground 70.

The information signal, which includes or is otherwise the source of the DC voltage, is fed to surge protection circuit 10 which performs the desired surge protection. In an alternative embodiment, the information signal may also be fed to indicator circuit 48 together with the DC voltage to cause LED 12 to light by a path to ground 70 which is provided through unbroken fuse 52. Glowing LED 12 indicates that surge protection device 10 is receiving power and surge protection operations are activated.

Industrial Applicability

The present invention is applicable to information-based signal transmission systems, and particularly to satellite television and cable television/community access television (CATV) systems. The parallel surge protection circuit herein disclosed is simple to implement, inexpensive to manufacture and modular in design for easy connection to coaxial cables for information signal transmission to existing video devices without having to replace or disassemble the coaxial cable connections or the receiving device. The parallel surge protection circuit is also compatible with connectors that are standard in the industry such as coaxial cable jacks and industry-accepted coaxial cables.

While the invention has been described in terms of specific embodiments, it is evident in view of the foregoing description that numerous alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, the invention is intended to encompass all such alternatives, modifications and variations which fall within the scope and spirit of the invention and the following claims.

The foregoing broadly outlines the preferred features of the present invention so that those skilled in the art may better understand the detailed description of the invention that follows. Additional features of the invention will be described hereinafter that form the subject of the claims of the invention. Those skilled in the art should appreciate that they can readily use the disclose conception and specific embodiment as a basis for designing or modifying other structures for carrying out the same purposes of the present invention and that such other structures do not depart from the spirit and scope of the invention in its broadest form.

We claim:

Claims

1. A surge protection circuit connected in parallel to a conductor for carrying an information signal, the circuit comprising:

a surge protection device;

one or more current limiting devices;

a ferrite bead;

an opto-isolator; and

a diagnostic status indicator device;

wherein the parallel surge protection circuit has a first terminal connected to said conductor for carrying an information signal and a second terminal connected to ground.

2. A surge protection circuit according to claim 1, wherein said diagnostic status indicator device is one of at least a light emitting diode LED and an audio device and a pulse/vibration device that when energized indicates normal operation of the surge protection circuit.

3. A surge protection circuit according to claim 1, wherein said surge protection device is one or a combination of a gas tube and a silicon avalanche diode and a capacitor.

4. A surge protection circuit according to claim 1, wherein a current limiting device is connected in series within the parallel circuit.

5. A surge protection circuit according to claim 1, wherein the first terminal and the second terminal are configured for connection respectively to a central conductor and an outer conductor of a coaxial cable.

6. A surge protection circuit according to claim 5, wherein

an input coaxial cable jack and an output coaxial cable jack each having a central connector and an outer connector,

said conductor for carrying an information signal connects the central connector of the input jack with the central connector of the output jack, and

the outer connector of each of the input jack and the output jack is connected to ground.

7. A surge protection circuit according to claim 1, further comprising

the information signal is input from one of at least a satellite television transmitter system and cable television/community access television transmitter system.

8. A surge protection circuit according to claim 1, further comprising

a receiving device of said information signal, wherein the receiving is one of at least a television and a set-top box and a video cassette recording device and a computer.

9. A surge protection circuit according to claim 1, further comprising

an information signal having a direct current voltage component to power the surge protection circuit.

10. A surge protection circuit according to claim 1, further comprising

one or a combination of at least a rectifier and a step up transformer and an external power source to power the surge protection circuit.

11. A surge protection circuit according to claim 1, further comprising

a current limiter comprised of one or a combination of a fuse and a resistor and a circuit breaker.

12. A method for suppressing transient signal fluctuations along a conductor transmitting information signals, comprising the steps of:

providing a surge protection circuit that includes a diagnostic status indicator device;

coupling in series said diagnostic status indicator device and a surge protection device to create a parallel surge protection circuit;

connecting a first terminal of the parallel surge protection circuit to said conductor transmitting information signals; and

connecting a second terminal of the parallel surge protection circuit to ground.

13. A method according to claim 12, wherein said diagnostic status indicator device is one of at least a light emitting diode LED and an audio device and a pulse/vibration device that when energized indicates normal operation of said surge protection circuit, and further comprising the step of energizing said diagnostic status indicator device to indicate normal operation of said surge protection circuit.

14. A method according to claim 12, wherein said surge protection device includes at least one of a gas tube and a silicon avalanche diode.

15. A method according to claim 12, further comprising the step of connecting a current limiting device in series with said parallel circuit.

16. A method according to claim 12, wherein said step of connecting the first terminal comprises connecting the first terminal to a central conductor of a coaxial cable, and said step of connecting the second terminal comprises connecting the second terminal to an outer conductor of the coaxial cable.

17. A method according to claim 12, further comprising the steps of:

providing an input coaxial cable jack and an output coaxial cable jack each having a central connector and an outer connector;

connecting said non-power carrying conductor to the central connector of the input jack and to the central connector of the output jack; and

connecting the outer connector of each of the input jack and the output jack to ground.

18. A method according to claim 12, further comprising the step of

providing an information signal that has a direct current voltage component to power said surge protection circuit.

19. A method according to claim 12, further comprising the step of

providing a surge protection circuit that has one of at least a rectifier or a step up transformer or an external power source to power the surge protection circuit.

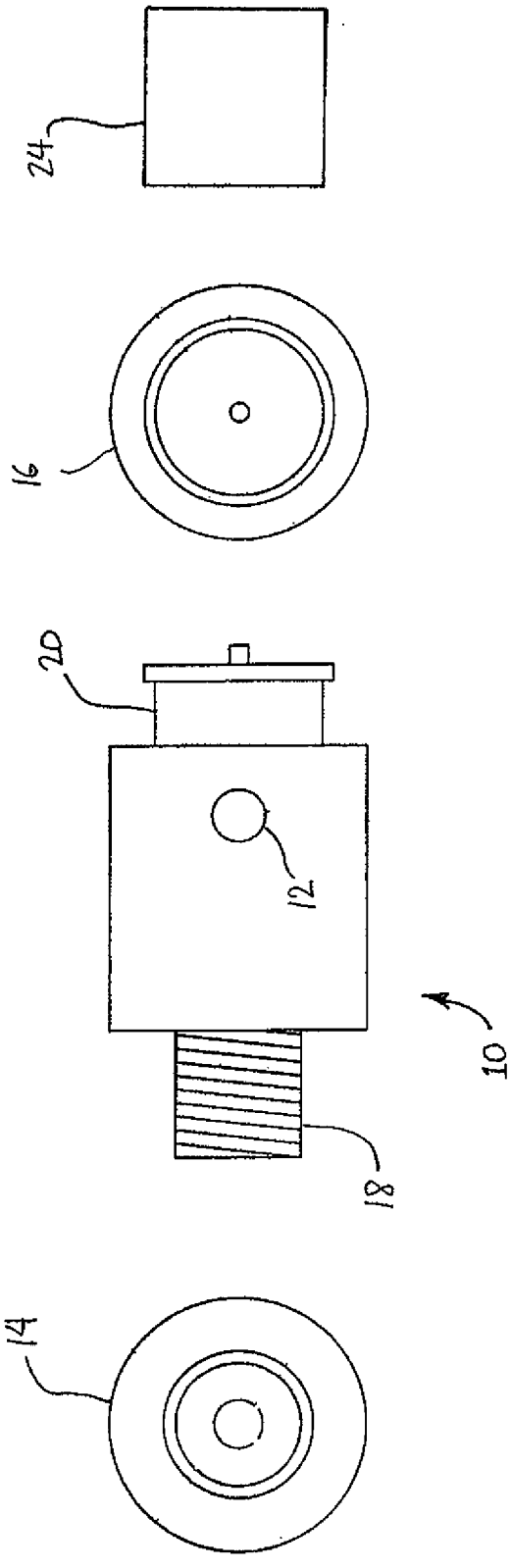

FIG. 1

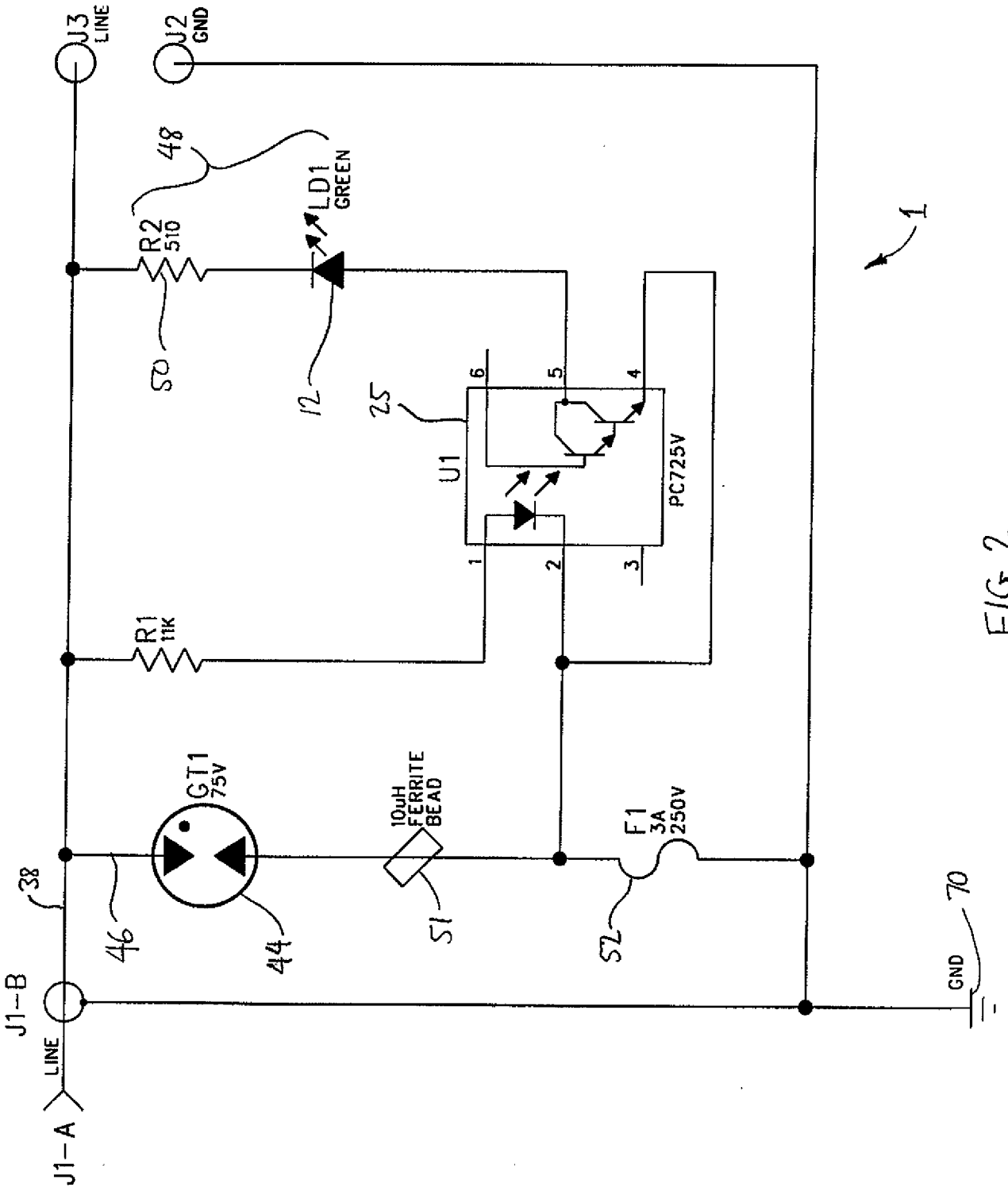
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FIG. 2