



**Description****BACKGROUND OF THE INVENTION**

[0001] The present invention relates to a surge protective means for protecting an AC power supply from damaging surges and spikes.

[0002] In recent years, there are many precision products using advanced integrated circuitry of high technology being widely employed in homes, offices, and factories. Examples of these precision products are televisions, computers, VCR's, facsimile machines, etc. These precision products are highly sensitive to changes in current and voltage. Environmental hazards, such as atmospheric disturbances and lightning, which may cause surges, spikes, electro magnetic interference (EMI), or radio frequency interference (RFI) to damage the equipment and appliances, and even cause hazards to the users. Thus, it is a trend to develop means for protecting these equipment and appliances from such damaging surges and/or spikes.

[0003] A surge protector is usually mounted in a machine or equipment or on a plug thereof. However, an important element of the surge protector, that is, a surge absorber, has only limited times of service. That is, there is a relativity between an impulse current and an impulse width. This makes the surge absorber have an attenuated life. When such conventional surge protector is mounted in a circuitry, it shall lose its function to provide another protection against surge once it has achieved a first time surge protection.

[0004] It is therefore tried by the inventor to develop a modular surge protective means which is associated with a plug of an electric appliance or equipment and the plug is provided with an indicator to show whether the plug with the surge protective means still has the surge protection function, so that a consumer may timely replace a useless plug with a good one to effectively protect the electric appliance or equipment.

**SUMMARY OF THE INVENTION**

[0005] A primary object of the present invention is to provide a plug having a surge protective means mounted therein.

[0006] Another object of the present invention is to provide a plug having a replaceable surge protective means mounted therein, that is, to provide a replaceable surge protective plug.

[0007] A further object of the present invention is to provide a plug having a surge protective means on which a light-emitting diode (LED) is provided, such that the LED keeps lighting when the plug is in a normal service condition and the LED extinguishes when the plug is no longer workable in protection against surge. A consumer can determine whether a plug according to the present invention can still protect an electric appliance or equipment connected thereto by the on or off of

the LED on the plug.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0008]

Fig. 1 is a perspective of a plug having surge protective means according to the present invention;

Fig. 2 is a perspective of the plug of Fig. 1 but in an upside-down position;

Fig. 3 is a perspective of the plug of Fig. 2 with a bottom cover thereof disassembled from the plug; and

Fig. 4 is a circuit diagram of the plug according to the present invention.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

[0009] Please refer to Figs. 1 to 3. The present invention relates to a plug having a surge protective means. The plug mainly includes a main body 1, a conductor 2, and a set of pins 3. An LED 11 is provided on a top surface of the main body 1, and a bottom cover 12 forms a part of a bottom portion of the main body 1. The bottom cover 12 can be removed from the bottom portion of the main body 1 for access of three connection terminals 13, 14 and 15 by loosening screws 12a, 12b from the main body 1 as shown in Fig. 3.

[0010] A protective circuit is arranged inside the main body 1 and will be described in more details later. To the three connection terminals 13, 14 and 15, three lines L, N, and E of the conductor 2 are connected, respectively.

[0011] In a normal condition, the LED 11 lights when there is a current flowing through the plug, representing the plug is usable and needs not replacement. In the event the LED 11 extinguishes even there is a current passing the plug, it means the plug can no longer absorb any surge and needs replacement with a good one.

[0012] To replace the useless plug with a good one, first loosen the screws 12a, 12b and remove the bottom cover 12 from the main body 1 of the plug as shown in Fig. 3; detach the three lines L, N, and E from the connection terminals 13, 14 and 15 so that the main body 1 is detached from the conductor 2; and then, connect a new and good plug to the conductor 2 by connecting the lines L, N, and E to the terminals 13, 14 and 15, respectively, on the new main body 1 and close the bottom cover 12 to the main body 1.

[0013] Fig. 4 is a circuit diagram of an embodiment of the present invention. As shown, the terminals 13, 14 and 15 are connected with lines L, N, and E and the pins 3 are inserted into a power socket (not shown).

[0014] The plug of the present invention provides its

protective function against surge because of an important element, a varistor or MOV, included in the circuit. The varistor is a surge absorber formed from a non-linear voltage coupling variable resistor. Briefly speaking, impedances at two ends of this element vary with different voltages between two ends of the element. When a surge of high voltage across two ends of the element exists, the impedance of the element shall instantaneously drop from a high impedance to a low impedance within a response time less than 10 nanoseconds (ns), making the element instantaneously change from an approximate insulator to an approximate good conductor. This high voltage and low impedance shall cause a large part of current to flow through this element as an bypass, so that energy of the surge is absorbed by the element and transformed into heat energy which dissipates into the air. The voltage is then recovered to a tolerable level to protect the electric appliance or equipment from the damaging surge.

**[0015]** As can be seen from Fig. 4, three varistors (MOV's) 16, 17, and 18 are separately connected between each of the three electrodes L, N, and E (ground) and the pins 3 to serve as the surge protective means. When a surge or spike enters into any one of the electrodes L, N, and E, it will be absorbed by the MOV connected to that electrode. However, in view that an MOV has a life which is subject to the relativity between the impulse current and the impulse width and therefore has limited times of service, a thermal fuse 19 is additionally provided to the electrode L in the plug of the present invention. Moreover, the fuse 19 is enveloped by the MOV's 16, 17, and 18 to achieve a temperature coupling condition. When a small surge current exists, the MOV's 16, 17, and 18 may absorb the full surge energy and may endure more than once similar surge without a temperature raise high enough to burn out the fuse 19. The appliance or equipment connected to the plug can still be supplied with normal power and the LED 11 on the plug keeps lighting. On the contrary, when a large surge current exists, although the MOV's 16, 17, and 18 can still absorb the surge energy, they shall have largely reduced service time or even be used for once only. Thereafter, the plug shall lose its function of absorbing any subsequent surge. The plug of the present invention, due to the provision of the thermal fuse 19 which may be burned out by the high temperature caused by the large amount of surge energy absorbed by the MOV's 16, 17, and 18, may still protect the electric appliance or equipment connected thereto from the next surge when the MOV's 16, 17, and 18 are no longer workable, because the burned-out fuse 19 has successfully disconnected the power supply. At this point, the LED 11 extinguishes, indicating a new and good protective module, that is, a main body 1, must be used to replace the old one.

**[0016]** As to any spark at contacts due to plugging in or pulling out a plug as well as any RFI that do not reach a level for the MOV's to absorb them, they will be prop-

erly suppressed by a parallelly connected metallized polyester capacitor 110 between the electrodes L and N.

**[0017]** In brief, the present invention provides a surge protective plug for protecting the electric appliance or equipment connected thereto from damaging by a surge. The plug has an LED 11 which indicates the plug has the surge protection function if the LED lights, and not if the LED extinguishes. Moreover, a consumer may easily replace a useless plug with a new and good one when necessary.

## Claims

1. A replaceable surge protective plug, comprising a main body, a protective circuit arranged in said main body, and a conductor connected to said main body;

said main body including a removably attached bottom cover forming a part of a bottom portion of said main body and a set of pins projecting from said bottom portion of said main body for inserting into a power socket;

said protective circuit including a surge protective circuit and an LED circuit, three connection terminals being provided in said main body below said bottom cover for easily access when said bottom cover is removed; and

said conductor including three connecting lines L, N, and E separately connected at one end to said three connection terminals of said protective circuit below said bottom cover of said main body; whereby when said connecting lines L, N, and E are detached from said connection terminals, said main body of said surge protective plug can be replaced with a new and good one to ensure an electric appliance connected to said plug to be protected from damaging surge.

2. A replaceable surge protective plug as claimed in claim 1, wherein said main body is provided with a light-emitting diode (LED) controlled by said LED circuit to indicate whether said plug is in a surge protection state.

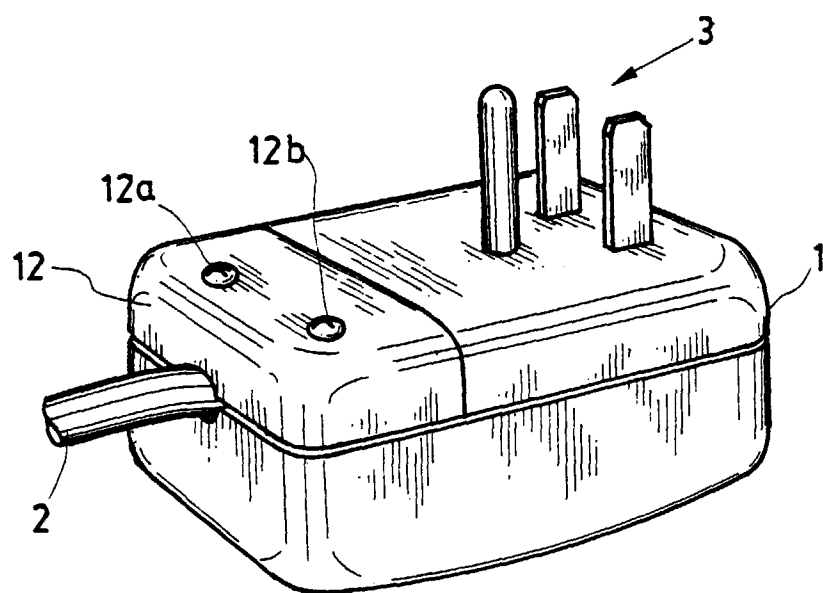
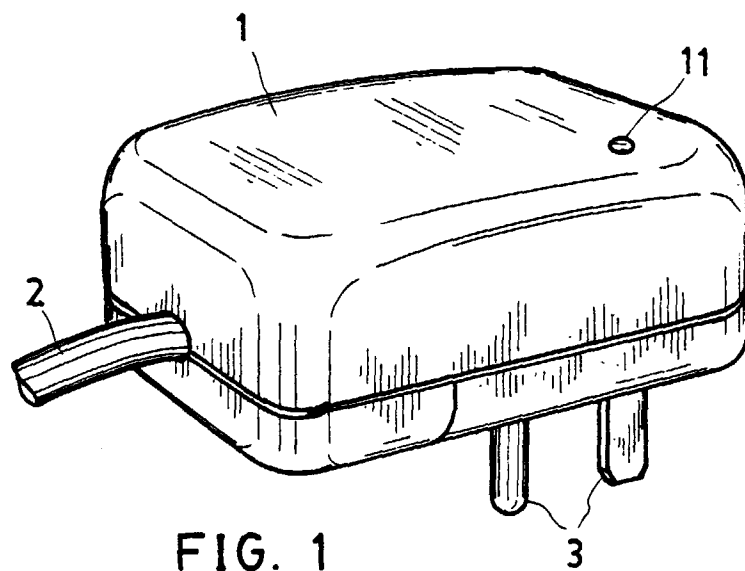


FIG. 2

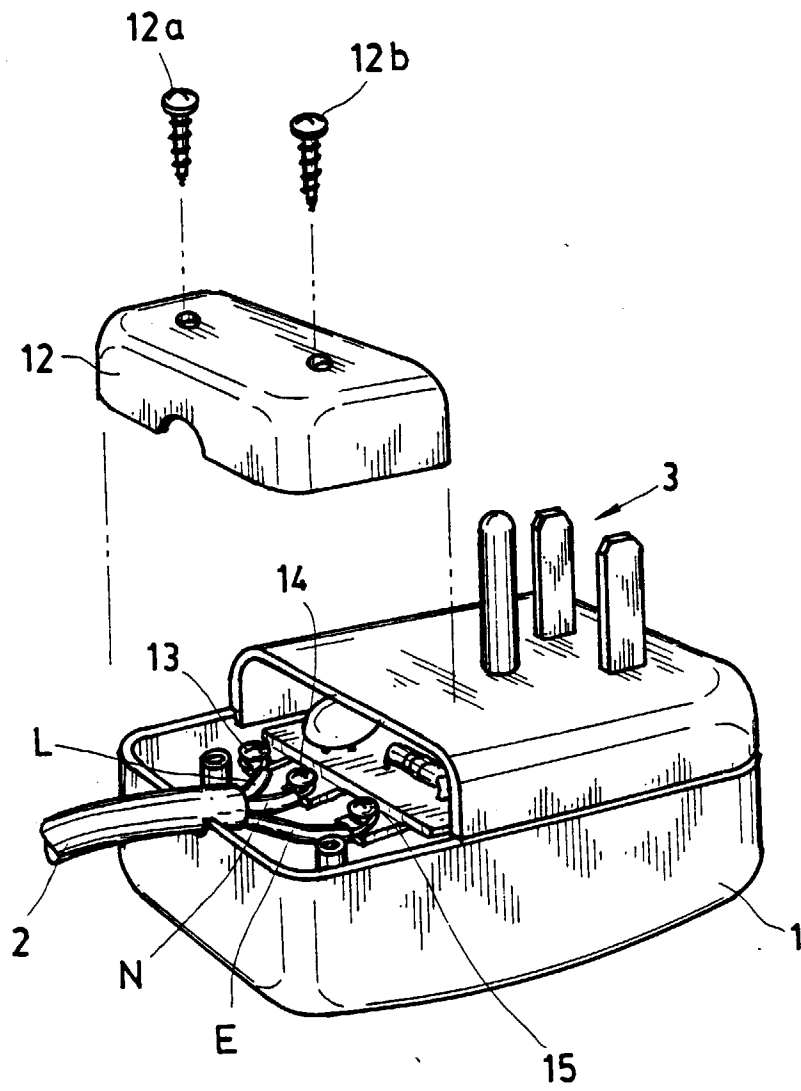


FIG. 3

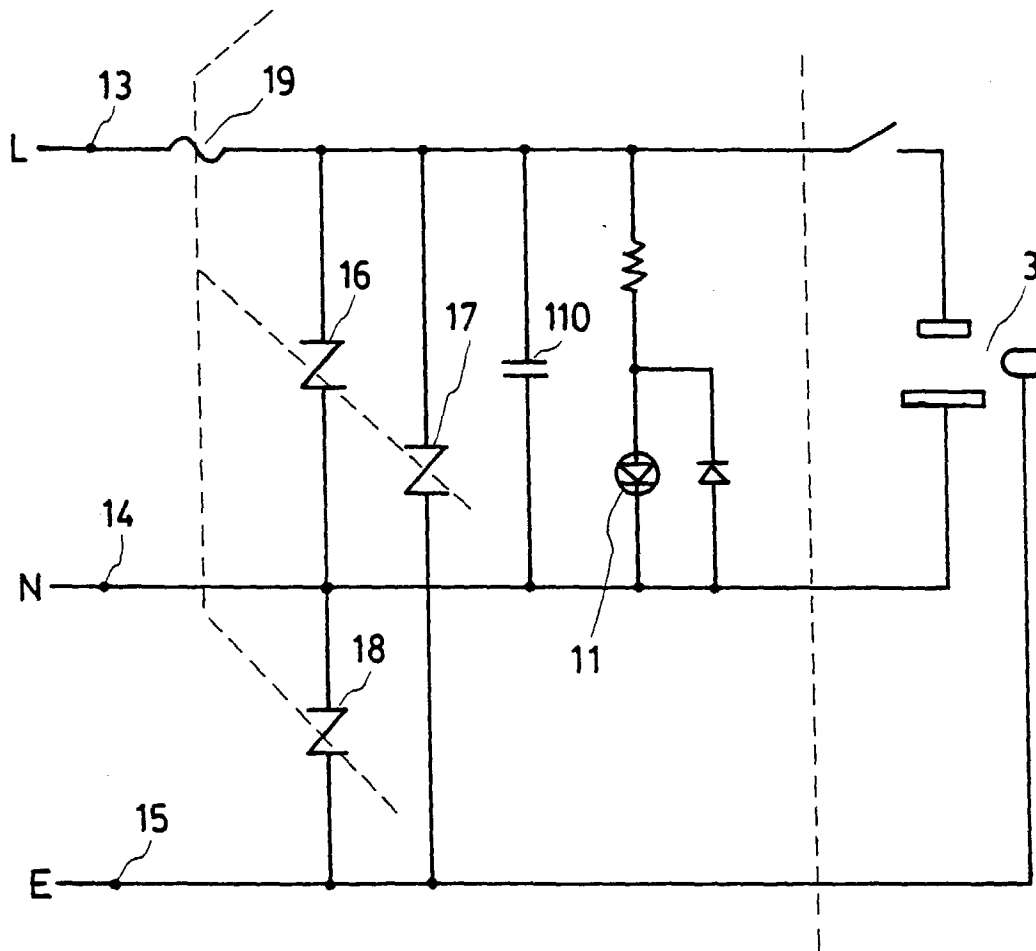


FIG. 4