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Brown

[11] **3,840,781**

[45] **Oct. 8, 1974**

[54] **SMALL PLUG-TYPE SURGE PROTECTOR**

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[52] **U.S. Cl.** ..... **317/16,** 317/9 A, 317/50, 317/62

[51] **Int. Cl.** **H02h 9/04,** H02h 9/06

[58] **Field of Search** ..... 317/16, 40 A, 48, 50, 51, 317/61.5, 61, 68; 337/198, 201, 206, 269, 263, 266, 268, 270; 339/147 P, 256 SP, 258 S

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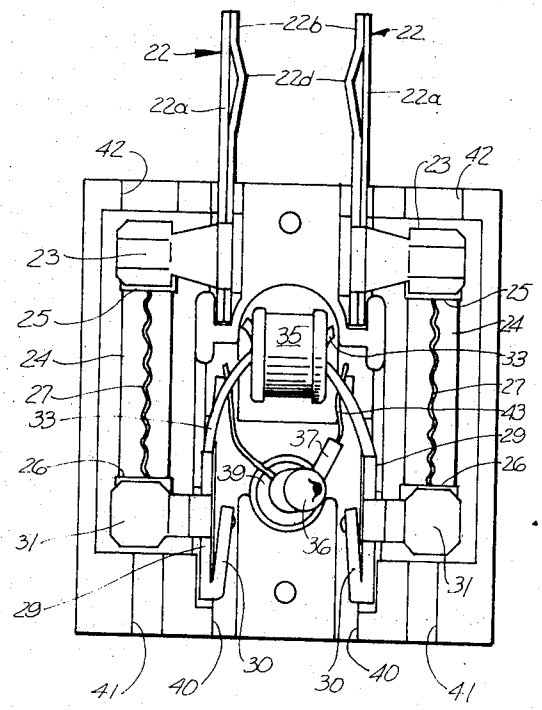
Primary Examiner—J. D. Miller
Assistant Examiner—Patrick R. Salce
Attorney, Agent, or Firm—Melville, Strasser, Foster & Hoffman

[57] **ABSTRACT**

A small, efficient and inexpensive surge protector to protect delicate, transistorized equipment such as TV sets and the like. The surge protector comprises a plug incorporating one or more fuses and a firing device including a circuit having a Siemens tube, or other non-polarized gas filled tube. The surge protector is plugged into a wall outlet and the line cord from the device to be protected is plugged into the female contacts at the opposite end of the protector. When a voltage surge enters the protector, it passes through the fuses and activates the gas filled firing device, causing a near short circuit across the female contacts, protecting the load and melting one or both of the fuse elements. A neon indicator is utilized so that it is always readily apparent whether or not the surge protector is in operative condition.

12 Claims, 9 Drawing Figures



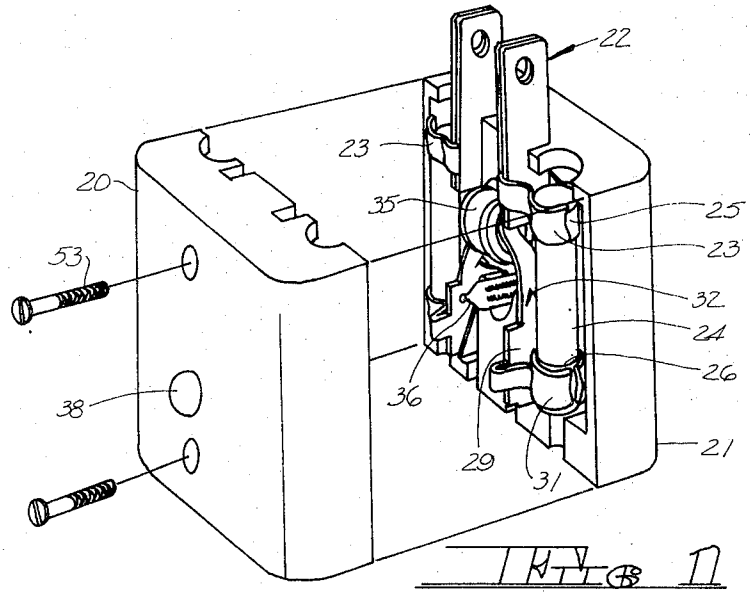


FIG 1

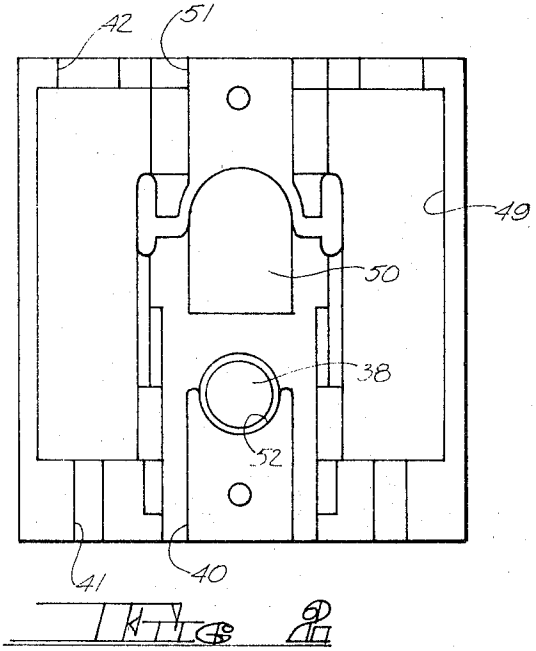


FIG 2

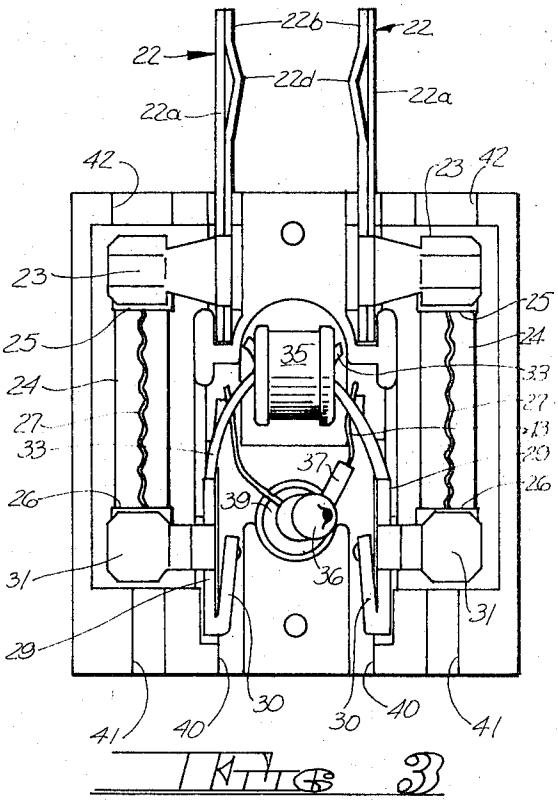


FIG 3

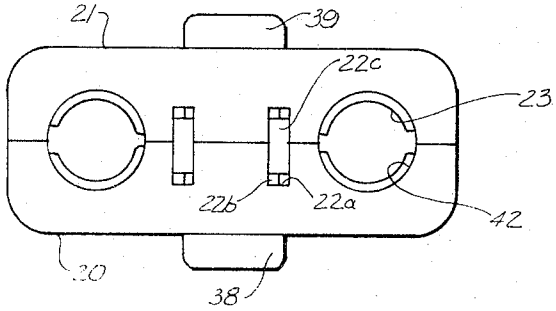


FIG. 4

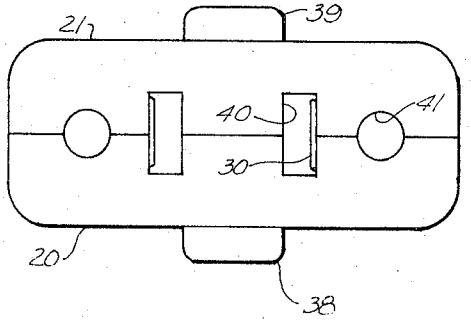


FIG. 5

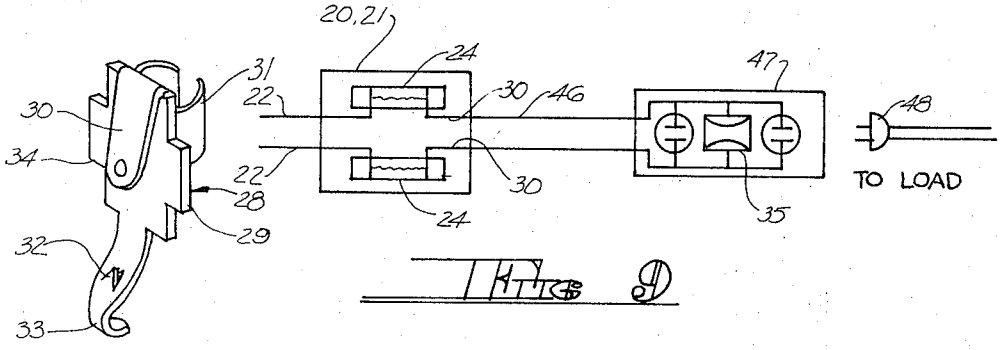


FIG. 9

FIG. 6

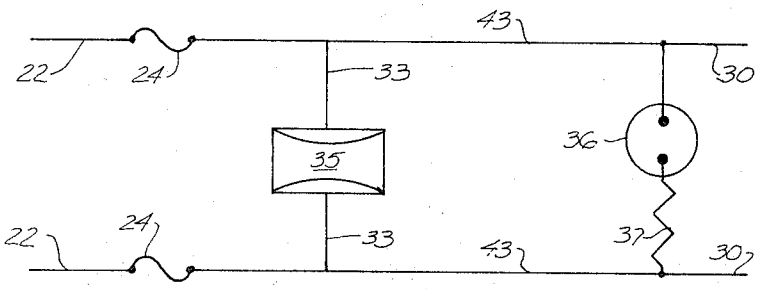


FIG. 7

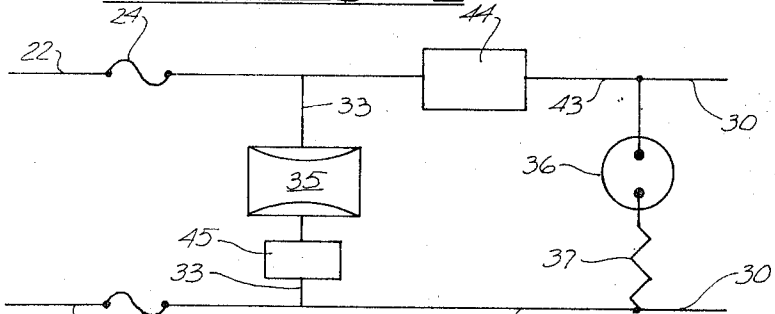


FIG. 8

SMALL PLUG-TYPE SURGE PROTECTOR

CROSS REFERENCE TO RELATED APPLICATION

This application, although neither a continuation-in-part application nor a divisional application, is closely related to application Ser. No. 335,021 in the name of the same inventor and filed Feb. 23, 1973; this latter application is a continuation-in-part of an earlier filed application in the name of the same inventor filed Jan. 3, 1972, and bearing Ser. No. 215,060, now United States Patent No. 3,723,820.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention has particular application in the protection of transistorized equipment found in homes, office buildings and the like wherein it is not important that the protector reset itself after having once performed its protecting function. Transistors are usually operated somewhere near their maximum voltage rating and, therefore, it is necessary that a surge device fire on spikes slightly higher than the normal line voltage. The peak voltage across a 120 volt line is approximately 168 volts so the plug protector should incorporate a firing device that operates at about 200 volts. The device is arranged to shunt a surge even though there is no current through the fuses. This permits a piece of equipment to be turned off and still protected, an important feature in view of the fact that many times TV sets, for example, are damaged by voltage spikes even though they are turned off.

The plug-type surge protector of this invention may be used to protect color TV sets, CATV equipment using transistors, heavier equipment such as room air conditioners, and similar items. The equipment to be protected will determine the amperage of the fuses incorporated into the plug along with the non-polarized gas filled firing tube device. If a color TV set, for example, is to be protected, fuses of the five ampere, fast blow type would be used; if heavier equipment such as a room air conditioner is to be protected, fuses with a higher amperage rating would be necessary because of the heavier current involved.

2. Description of the Prior Art

A rather extensive patentability and validity search was conducted on this plug-type surge protector. Some 45 patents were developed. Additionally, other patents of some interest are of record in the said application and said patent earlier mentioned. Although the purpose of the search was to develop the most pertinent prior art to the invention disclosed and claimed herein, no assertion is made that the best art was actually found. It is believed that the following patents are the more pertinent: 1,942,178, Machenheimer; 2,244,044, Bishop; 2,404,407, Seurynik; 2,742,545, Sundt; 2,786,112, Pempey; 2,910,625, Carpenter; 3,047,695, Borys; 3,184,569, McLaren; 3,187,224, Le Massena; 3,323,017, Powell et al; 3,368,110, Taylor, 3,369,153, Arnold et al; 3,386,004, Dwyer; 3,452,252, Mapham; 3,659,252, Brown; and 3,660,719 Grenier.

Patent Nos. 3,368,110 and 3,660,719 appear to be the closest, although others of the patents do disclose various forms of fused plugs.

With reference to Patent No. 3,368,110 Taylor, it is known that voltage surges sometimes reach 2,600 volts across a 120 volt power line. It is necessary, therefore,

for a surge protective device to be able to withstand such high voltage spikes and have sufficient current carrying capacity to melt the protective fuse elements placed ahead of the "firing" device. In order to protect a device which draws only a nominal current, such as a color TV set, Taylor's safety adapter would need diodes capable of withstanding 3,000 volts and a 1 cycle current of approximately 5 amperes. Diodes of this type are rather expensive. Furthermore, diodes will not react to a surge as fast as the non-polarized gas filled tubes incorporated in the instant plug-type surge protector. It does not appear that the Taylor safety adapter could be an effective surge protector capable of protecting delicate, transistorized equipment and it would be expensive to manufacture.

The device of Grenier, 3,660,719, is evidently designed to protect equipment less sensitive to voltage surges than transistorized CATV and TV equipment. This patent discloses the use of a ballast resistor in series with a gas filled, spark gap device. It evidently counts on being able to reset itself because no fuse is employed and the ballast is used to quench the arc across the gas filled device. The ballast resistor is in series in the firing circuit and will slow down the firing time of the circuit to the extent that a damaging pulse could pass on by the shunting device.

SUMMARY OF THE INVENTION

The small plug-type surge protector comprises a body housing tubular fuses, fuse holders, male contacts, a gas filled firing device, a neon indicator light, and a female electrical contact. This latter contact is itself a fuse holder, a female electrical contact, a Siemens tube holder, a neon pilot light connector and a means for positioning it within the housing.

The male elements at one end of the plug surge protector are plugged into a wall outlet and the line cord from the device to be protected is plugged into the female contacts at the opposite end of the protector. The various members are so arranged that current normally passes through the fuses to the device to be protected. The non-polarized gas filled firing tube is placed directly across the line, between the device to be protected and the fuses, with nothing to delay the firing time except the tube itself. The time lag in the thermal fuses has nothing to do with the speed with which the surge is shunted; but rather the speed is dependent solely upon the speed with which the gas filled device fires.

The neon pilot light indicates the condition of the surge protector. If the light is on, the fuses are intact and the device is operable. When the device fires on a surge, one or both of the fuses are blown. The plug is such that these fuses are readily replaceable by pushing them out through appropriate holes at the male end of the device. If the gas filled tube is damaged, the replaced fuses will blow, indicating this fact. A firing device, however, can itself be easily replaced by lifting out the old one and pushing a new one into the place provided. The female contact clip is reversible so that only one type need be made.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view showing the plug-type surge protector.

FIG. 2 is a plan view of the interior of one-half of the plug assembly.

FIG. 3 is a plan view of the other half of the plug assembly.

FIG. 4 is a top plan view of the plug when assembled.

FIG. 5 is a bottom plan view of the plug when assembled.

FIG. 6 is a perspective view of the all-purpose female electrical contact.

FIG. 7 is a diagrammatic view of a circuit which may be incorporated in the plug-type surge protector.

FIG. 8 is a diagrammatic view of another circuit which may be incorporated in the protector.

FIG. 9 is a schematic view of a modification of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIGS. 1 through 5 the small plug-type surge protector is comprised of a pair of housing members 20 and 21. The various members included within the protector are shown as located within member 21 while member 20 is provided with suitable cavities to accommodate such members. It will be apparent that it would be possible to reverse these members.

As a matter of fact these members 20 and 21, before the insertion of the working elements, are identical.

Noting that throughout the description of this invention like numerals will be used to identify like parts, each of the male contacts 22 comprises a pair of elongated strips 22*a* and 22*b*, joined at their outer ends as at 22*c*, and having a bulge 22*d* to insure good electrical connection when the members 22 are inserted within the usual wall outlet found in homes, office buildings and the like. Extending from that end of the member 22 located within the plug is a clip extension 23 adapted to receive and have electrical contact with a tubular fuse 24. The fuse 24 has caps 25 and 26 adjacent its ends and connected between these caps is the fuse element 27. When the fuse 24 is in the position shown in FIG. 3, the cap 25 will be in electrical contact with the extension 23 of the male element 22. The members 22 and 23 may be separate elements suitably welded or otherwise held together in electrical contact or the member 23 may be integral with one of the members 22*a* or 22*b*; other arrangements may readily occur to those skilled in the art.

A pair of female contacts generally indicated at 28 is incorporated in that end of the plug which is opposite that in which the male elements 22 are located. These female contacts are shown in FIG. 3 and one of them is shown in perspective in FIG. 6. The female contact 28 is reversable so that only one type need be made. The female member 28 comprises a body strip 29 having a female contact member 30, a fuse holding clip 31, a pilot light connector 32, a Siemens tube holder 33, and shoulders 34 for positioning it within the housing 21.

The extended portions 33 of the female contact 28 serve to make electrical contact with the Siemens tube 35 and to clamp it in position within the housing members 20, 21. A neon pilot light 36 is connected across the members 33. Preferably a suitable resistance 37 is incorporated in the circuit which includes the pilot light 36. Reflectors 38 and 39 are provided in the members 20 and 21 so that the presence of the pilot light 36 may be observed from either side of the plug.

In use the plug will be plugged into the usual wall outlet by means of the male elements 22*a*, 22*b* the ends of which may be joined as at 22*c*, see FIG. 4. The device to be protected is then plugged into the surge protector, the prongs of the plug which is connected to the device being inserted through the openings 40 so as to contact the female electrical contacts 30. The surge protector, at the end adjacent the female contacts, is provided with small openings 41 through which a suitable instrument may be passed in order to push a spent fuse 24 out of the protector, that end of the protector adjacent the male elements 22 being provided with openings 42 through which such fuse may pass. A new fuse may then be inserted through such opening 42 into the clip elements 23 and 31 which are in electrical contact with the male prongs 22 and female connectors 30 respectively. Circuit elements 43 connect the pilot light 36 across the extended portions 33 of the female contact member 28, 30 and are hooked onto the ears 32 provided in such portions 33.

In FIG. 7 the basic wiring diagram of the surge protector is diagrammatically illustrated, the various reference numerals of the electrical contacts described in connection with the protector of FIG. 3 being used to designate the corresponding parts in FIG. 7. Thus, current from the wall outlet will pass through the male contacts 22, through the fuses 24, through the female contact elements 33 and the gas filled tube 35, and through the female connector portions 30, the pilot light 36 and its resistor 37 being connected across this circuit by the conductors 43.

It is conceivable that the surge protector of FIGS. 1 through 7 could be modified as diagrammatically illustrated in FIG. 8 by incorporating therein a suitable choke 44 and an additional resistor 45 for the Siemens tube 35. This in effect would result in a circuit arrangement for the surge protector like that claimed and disclosed in the said closely related application. The use of the choke 44 promotes the fast firing of the tube 35.

A further modification of the invention is diagrammatically illustrated in FIG. 9 wherein like reference numerals have been employed to represent parts and elements like those described in connection with the embodiments of FIGS. 1 through 7 and FIG. 8. In this modification a receptacle 47 into which the load may be plugged is connected by an extension cord 46 to the female elements 30 of the surge protector 20, 21. The Siemens tube, or other non-polarized gas filled tube, is again indicated at 35 but in this modification it is incorporated within the receptacle 47. Electrically the setup of FIG. 9 is the equivalent of that of FIGS. 3 and 7. The firing device 35 has simply been moved from the plug 20, 21 to the receptacle 47. The plug 48 from the load to be protected is plugged into the receptacle 47 rather than directly into the surge protector 20, 21.

The various elements of which the surge protector is comprised have been shown as incorporated in plug member 21 in FIG. 1. Plug member 20, therefore, will be provided with corresponding cavities to receive these various elements. Thus, as shown in FIG. 2, the member 20 will have cavities 49 to receive the fuses 24, a cavity 50 to receive the Siemens tube 35, cavities 51 for the male prongs 22, and a cavity 52 to receive the reflector 38. The member 21 has corresponding cavi-

ties. The member **20** is also provided with openings **42** through which the fuses **24** may pass and with the punch holes **41** by means of which the fuses may be ejected through the openings **42.** The halves **20** and **21** of the surge protector may be joined by suitable fasteners **53** as best seen in FIG. **1.** As earlier indicated, these halves **20** and **21** may be molded identical to one another and the remaining elements then placed in either half whereafter the halves are joined.

The use of the Siemens tube **35,** or other nonpolarized gas filled tube, is important to the operability of the surge protector for the reason that fuses are not fast enough to protect delicate equipment. Furthermore, fuses, or other similar thermal devices, will not always give good protection against voltage surges, they not being fast enough for this purpose, although they usually will provide adequate protection against increases in current. The surge protector of this invention is essentially a voltage device, not a current device.

Referring again to FIG. **7,** two fuses **24** are used to protect the input circuit. This is especially useful in a non-polarized circuit (a circuit in which the line of highest or lowest potential isn't known) such as an A.C. circuit which is known as a floating ground. The Siemens tube being nonpolarized will fire in either direction so it doesn't matter which way it is plugged into the outlet. This is considered better than using a three-prong plug and socket because it is possible for the three-wire outlets to be improperly wired. The device shown in FIGS. **3** and **7** will fire on a surge regardless of polarity in the wiring circuit. Whenever a surge comes over the power line, it passes through the fuses and then is shunted to ground or the line of lowest potential, at which time the Siemens tube is virtually short circuited and the excessive current blows one or both of the fuses. The neon pilot light **36,** with its associated resistor **37,** is used to indicate that the device is in operable condition; if a fuse is blown, the pilot light won't burn.

The plug-type surge protector of this invention is indeed small and compact. In practice it has been incorporated in a plug which is 1 ½ in. wide, 1 ⅝ in. long and ⅝ in. thick. It is relatively inexpensive and easily and quickly assembled through the use of only a pair of pliers and a screwdriver. It has been used to protect TV sets and some CATV equipment using transistors. None of the equipment connected to this surge protector has been damaged although like equipment operating nearby without surge protection has been badly damaged. The combination of, and arrangement of, the various parts and elements to make a small, efficient and inexpensive surge protector to protect delicate, transistorized equipment is an important part of this invention.

The use of the Siemens tube or other non-polarized gas filled tube is considered important. Laboratory tests have shown that these gas filled devices will fire within two nanoseconds from the time the pulse is applied. Such speed would allow an electrical pulse to travel a distance of less than two feet during the transition time, thus preventing a pulse of any consequence from reaching a protected device. Another feature of these gas filled tubes is that, although they are small in size, they will withstand a peak discharge current of 25 amperes for one one-hundredth of a second, 500 amperes for one millisecond and 5000 amperes for one microsecond. Another desirable feature is that they normally deteriorate in the fail-safe direction.

A further important feature of this invention is the construction of the female contact generally indicated at **28** and best seen in FIG. **6.** The multiple purposes served by this contact in part at least makes possible a surge protector resulting in such a small, convenient package.

It is believed that the foregoing description is complete. It will be apparent to those skilled in the art, however, that modifications may be made therein without departing from the scope and spirit thereof. It is to be understood that while the invention has been described in terms of particular elements and structures, such are not to constitute a limitation on the invention except insofar as they are specifically set forth in the subjoined claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A small plug-type surge protector adapted for easy assembly and repair comprising:

a. a housing;

b. first and second male contacts mounted in said housing in parallel spaced relationship, with the ends thereof extending through first and second perforations in a first end of said housing and adapted to be plugged into a wall outlet;

c. first and second female contacts mounted in said housing in parallel spaced relationship and in alignment with a pair of first and second perforations in a second end of said housing;

d. said first male contact and said first female contact each having a spring clip adapted to receive and frictionally engage a first tubular-type fuse;

e. said spring clips being so configured that said first fuse may be axially shifted into and out of engagement therewith through a third perforation in said first housing end;

f. means electrically connecting said second male and female contacts;

g. each of said female contacts having, in electrical contact therewith, a laterally extending spring arm, said spring arms extending toward each other; and

h. a firing device comprising a non-polarized gas filled tube frictionally engaged between and in electrical contact with said spring arms;

whereby, when said surge protector is plugged into a wall outlet and when a load to be protected from voltage surges is plugged into said female contacts of said surge protector, a voltage surge will cause said firing device to fire and blow said first fuse before said surge reaches said load.

2. The surge protector of claim **1** including a pilot light connected across said female contacts, whereby said pilot light is on whenever said male contacts are engaged within a wall outlet and said fuse is in operative condition.

3. The surge protector of claim **2** including a resistor in series with said pilot light.

4. The surge protector of claim **2** in which each of said female contacts has a connecting means to which said pilot light is connected.

5. The surge protector of claim **1** in which

a. said second male contact and said second female contact each have a spring clip adapted to receive

and frictionally engage a second tubular-type fuse;

b. said spring clips being so configured that said second fuse may be axially shifted into and out of engagement therewith through a fourth perforation in said first housing end; and

c. said means electrically connecting said second male and female contacts comprising said second tubular fuse.

6. The surge protector of claim **5** including a pilot light and a resistor for said pilot light connected across said female elements so that said pilot light is on whenever said male contacts are engaged within a wall outlet and said fuses are in operative condition.

7. The surge protector of claim **6** in which said housing is comprised of a pair of identical halves, each half having cavities to receive said male contacts, said female contacts, said spring clips, said fuses, said firing device, said pilot light and said resistor; and means to hold said halves together.

8. The surge protector of claim **1** in which said housing is comprised of two identical halves, each half having cavities to receive said male contacts, said female contacts, said fuse, and said firing device.

9. The surge protector of claim **1** in which said firing device is a Siemens tube.

10. An element for use in a surge protector of the type set forth in claim **1**, said element comprising a body to be received in a suitable housing, a female contact extending from said body, a spring clip extending from said body and adapted to slidably receive a fuse, an extension on said body adapted to engage a firing device, and a connecting means on said extension for engaging a pilot light lead.

11. The surge protector of claim **1** in which said first fuse may be axially shifted out of engagement with said spring clips through said third perforation in said first housing end by passing an instrument through a third perforation in said second housing end so as to push said first fuse through said first perforation in said first housing end, said third perforation in said second housing end being in axial alignment with said third perforation in said first housing end.

12. The surge protector of claim **5** including third and fourth perforations in said second housing end coaxially aligned with said third and fourth perforations in said first housing end whereby said first fuse may be shifted out of engagement with its spring clips and through said third perforation in said first housing end by insertion of an elongated tool into said third perforation in said second housing end and similarly said second fuse may be shifted out of engagement with its spring clips and through said fourth perforation in said first housing end by insertion of said tool in said fourth perforation in said second housing end.

* * * * *