

July 19, 1966

R. F. BOGAERTS ETAL

3,262,018

FUSE PROTECTION SYSTEM WITH AN AUXILIARY HIGH CURRENT  
VOLTAGE SOURCE FOR SELECTIVE DISCONNECTION OF LOADS  
UNDER FAULT CONDITIONS  
Filed March 6, 1963

FIG. 1.

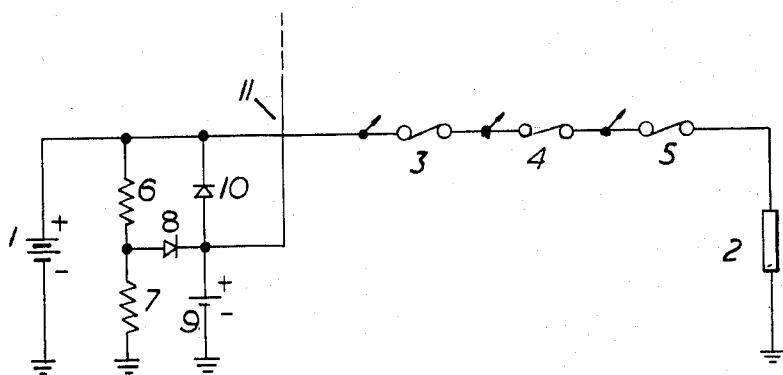
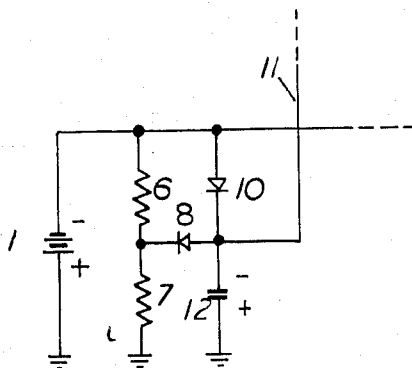


FIG. 2.



Inventors  
R. F. BOGAERTS-J. VANDERHEYDEN

By *Philip G. Weiss*  
Attorney

1

3,262,018

## FUSE PROTECTION SYSTEM WITH AN AUXILIARY HIGH CURRENT VOLTAGE SOURCE FOR SELECTIVE DISCONNECTION OF LOADS UNDER FAULT CONDITIONS

Renaat Frans Bogaerts and Joseph Marie Gerlachus Vanderheyden, Antwerp, Belgium, assignors to International Standard Electric Corporation, New York, N.Y., a corporation of Delaware

Filed Mar. 6, 1963, Ser. No. 263,185

Claims priority, application Netherlands, Mar. 21, 1962, 276,219

8 Claims. (Cl. 317-40)

The invention relates to power supply circuits and more particularly concerns overload protection circuits for power supply systems comprising one or more D.C. low current power sources each feeding one or more loads through one or more fuses.

In such systems it is generally desirable to have a series of fuses of the type in which when a fuse melts, an alarm circuit individual to the fuse is closed to permit the localization of the fault. So-called "grasshopper fuses" are well known and are widely used in such systems as telephone exchanges and the like. They are so constructed that the fuse element holds a leaf spring in a retracted position against its spring tension. When the fuse wire melts an electrical alarm circuit is closed by the released leaf spring. Such fuses require an appreciable current to operate and adequate fuses of this type with lower current ratings than those normally available in telephone exchanges of conventional type are not readily available. Yet in many instances, electronic devices are now being introduced in telecommunication systems as well, of course, as in other systems such as computers, etc. Such devices generally require additional power sources which have a voltage different from the conventional battery voltage used in the telephone exchanges, e.g. 48 volts, and which do not have to deliver a substantial current. Such auxiliary sources may have higher voltages, e.g. 100 volts or more for the operation of certain electronic tubes, or alternatively they may have much lower voltages, e.g. 12 volts when they serve to power transistor circuits.

In general, the capacity of the power source is solely based on normal on-load current consumption considerations. Such sources as described above are therefore designed with a current output which is not sufficient to permit protection by the usual grasshopper fuses. Ordinary fuses of lower current rating, associated with high impedance detecting devices which serve to identify a burned-out fuse such as by causing the release of a relay, normally operated as long as a voltage is developed across the high input impedance of the detector when the fuse is still in service are used. Such detecting devices for operating a relay are quite elaborate, bulky and expensive in comparison to the grasshopper fuses mentioned above. An additional and important drawback is that since the low current sources have a high internal resistance, too many of such high impedance detectors cannot be included in any one system.

In general, only one such high impedance detector is used per system to give a general alarm when an associated single main fuse is blown or preferably when the voltage drops below its normal level. At that time an alarm must be given and the fault must be localized. A system of cut-off jacks or U-links is used to isolate the faulty circuit from the rest of the network to restore the power source output voltage to its normal level.

This use of only one high impedance detector is clearly inadequate since an urgent alarm must be given during the time required to identify the faulty circuit. Otherwise, the source remains in a short-circuited condition with reduced power for the rest of the equipment. This

2

arrangement is very vulnerable to faults, since any single fault has immediate repercussions on the rest of the circuits and the fault can only be located and eliminated manually.

The specifications and quality control on such low power source systems may, of course, be of a high enough caliber to take such faulty conditions into account but obviously the cost of such systems will then increase.

A general object of the invention is to remedy the above drawbacks.

A specific object of the invention is to devise such a fuse arrangement that permits the use of fuses operated by a substantially higher current than that which is normally supplied by the sources to be protected with such fuses.

In accordance with a preferred embodiment of the invention, a fuse arrangement for low current power supply systems is characterized in that each such D.C. power source having a voltage whose absolute value is smaller than those of the other sources and able to supply a larger current than said other sources. A potentiometer is provided across at least one of said power sources with a tapping point connected to the additional power source through an additional uni-directional impedance. The additional uni-directional impedance is normally conductive in order to keep a steady potential across the additional power source, while at the same time all the individual uni-directional elements are non-conductive. When there is a predetermined decrease in the overall load impedance of any one of said power sources the corresponding individual uni-directional element becomes conductive to enable the additional power source to send an increased current through the load for a time period sufficient to melt a fuse included in the faulty circuit part of said load that is responsible for the lowering of the source voltage.

Another object of this invention is to provide a fault protection circuit having an additional high current power source. The additional power source may comprise a relatively high current battery maintained in a charged condition by current supplied through the additional uni-directional impedance means.

In another embodiment of the invention the additional power source may comprise a capacitor of relatively high value maintained in a charged condition by the current supplied through said additional uni-direction impedance means.

In this manner, the high current battery or the large capacitor does not deliver any current as long as the load conditions are normal. When the load is short-circuited the high current battery or, if the overload current increases fast enough, the large capacitor renders the rectifier associated with the faulty source conductive and supplies a higher current to the load. In this way, the various circuits constituting the load may be subdivided into various sections each having its own fuse of the grasshopper variety. The current ratings for such fuses will increase as the circuits are grouped in larger units towards the source. The grasshopper fuse associated with the faulty circuit will rapidly melt, interrupt the flow of current and give a non-urgent alarm identifying the faulty circuit, while the voltage of the overloaded supply source immediately returns to normal. Thus, in this manner, an efficient fault protection system for low current drain systems can be realized with simple and economic means.

The above and other objects of the invention, as well as the invention itself, will be better understood from the following description of a detailed preferred embodiment of the invention to be read in conjunction with the accompanying drawings wherein:

FIG. 1 represents a first embodiment of the invention using an additional high current power source with a

3

lower voltage than those of the power sources to be protected; and

FIG. 2 shows a modification of FIG. 1 in which the additional supply source is constituted by a large capacitor.

Referring to FIG. 1, a D.C. power source 1 has its negative pole grounded while its positive pole is applied to a load comprising a plurality of circuits of which only 2 is represented in FIG. 1. This connection between power source 1 and the load such as 2 is made through a series of fuses of the grasshopper variety such as 3, 4 and 5. Each of such fuses closes a contact upon being burned-out in order to give an alarm. As indicated by the multiplying arrows next to these fuses 3, 4 and 5, such fuses constitute a pyramid or tree arrangement leading to the various individual load circuits such as 2, and the fuse current ratings may be upgraded as one nears the source 1. For example, fuse 5 directly associated with circuit 2 may be a 1 ampere fuse, fuse 4 may be a 2 ampere fuse covering a whole rack of circuits such as 2, while fuse 3 may be a 4 ampere fuse covering a whole row of racks, and additional stages.

Across source 1, is branched a resistive potentiometer comprising the resistances 6 and 7 which are of relatively high value in order to limit the extra current consumption. Their junction point is connected to the anode of a rectifier 8 whose cathode is connected to the positive pole of an additional high current power source 9, whose negative pole is grounded. The positive pole of source 9 is connected to the positive pole of source 1 through rectifier 10 poled as shown and as indicated by the multiplying connection 11, this positive pole of source 9 may also be coupled through other individual rectifiers such as 10 to other sources such as source 1 each supplying a plurality of other circuits such as load circuit 2 through its own network of fuses such as fuses 3, 4 and 5. Thus, source 9 may be connected to a plurality of arrangements such as shown in FIG. 1 except that the potentiometer and rectifier arrangement 6, 7, and 8 is necessary between one of the sources such as source 1 and the common additional source 9, although, evidently the latter may be associated with more than one source such as 1 through circuits similar to that comprising the elements 6, 7 and 8.

Normally, the source 9 is maintained in the charged condition by the supply of energy from source 1 through the conductive rectifier 8. Since the voltage of source 9 is lower than that of source 1, rectifier 10 is normally blocked. If a short-circuit develops in one of the circuits such as load circuit 2, branched on any source such as 1, it would result in a lowering of the impedance of that circuit, in an increased current and in a decrease of the potential at the cathode of rectifier 10. The latter will become conductive when the potential goes down to about the potential present at the positive pole of source 9. The higher current available from source 9 through the conductive rectifier 10 would result in a sufficiently increased current through circuit 2 to melt fuse 5 and disconnect the circuit from the rest of the equipment. At the same time the fuse would give an alarm identifying the faulty circuit. Thus, as soon as a fault has lowered the potential of a source such as source 1 down to the lower value supplied by source 9, the faulty circuit is automatically put out of action and is identified despite the fact that source 1 is unable to supply sufficient current to melt the fuse.

It is clear that though positive supplies have been indicated in FIG. 1, the arrangement is evidently applicable with negative supplies having their positive poles grounded, provided the polarities of the rectifiers 8 and 10 are reversed so that the anode of 8 and the cathode of 10 would now be connected to the negative ungrounded pole of 9.

The high current power source 9 may also be replaced by a large capacitor. FIG. 2 shows this modification with the capacitor connected to the rectifiers 8 and 10

4

and assuming in this case that the positive poles of the sources are grounded. With this arrangement the capacitor 12 will normally be charged to a negative voltage by source 1 through the conductive rectifier 8 and it will also supply the relatively high current necessary to blow the fuses such as fuse 5 (FIG. 1). However, such an arrangement with a capacitor can only be effective if the short-circuit occurs over a short time period. A very gradual overload would lead to a prolonged state of affairs with the rectifier 10 just conductive and the capacitor 12 charged from source 1 through the arrangement 6, 7 and 8 at a rate which would be insufficient to compensate for the gradual discharge of capacitor 12 through rectifier 10. Insufficient current, therefore, would be delivered to the faulty circuit 2 with the result that the fuse 5 could not be burned-out. Nevertheless, the arrangement would be able to cover all sudden overloads and non-instantaneous increase of current above the rated value could be detected by a voltage detector (not shown) branched across the source to be protected.

Thus, low current D.C. sources which are often of vital importance to a system may be adequately protected by simple arrangement at little extra cost. The supervisory device may be used in common for various such low current sources which are usually specified as a function of their normal loads. Moreover, as a short-circuit affects only the local circuit, a non-urgent alarm is adequate.

While the principles of the invention have been described above in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention.

We claim:

1. A power supply system comprising a low current power source, at least one load circuit supplied by said low current power source, fuse means in said load circuit, said fuse means requiring more current to operate than is supplied by said low current source, a high current power source normally not connected to said load circuit, means responsive to an overload condition at said load circuit for connecting said high current power source to said fuse to operate said fuse to remove said overloaded circuit from said system, and means for charging said high current source from said low current source when said high current source potential falls below a predetermined value.

2. A power supply system comprising a plurality of first power means for individually supplying a first electric current at a first voltage to a plurality of load circuits associated with each of said first power means, fuse means individual to each of said load circuits, said fuse means requiring more current to operate than is supplied by said first power means, auxiliary power means common to said plurality of first power means, said auxiliary power means operating at a second voltage that is less than said first voltage and capable of supplying a second electric current that is larger than said first electric current, and first connecting means individual to each of said first power means operated responsive to a decrease in said first voltage to the value of said second voltage to connect said common auxiliary power means to said load circuits associated with said first power means, for a time sufficient to melt the fuse individual to an overloaded circuit.

3. The power supply system of claim 2 and second connecting means individual to each first power means for connecting to said common auxiliary power means to keep a steady potential across said auxiliary power means.

4. In the power supply system of claim 3 wherein said first connecting means comprises first uni-directional impedance means.

5. In the power supply system of claim 4 wherein said second connecting means comprises potentiometer

5

means bridging said first power means and second unidirectional impedance means connected to be normally conductive from a tapping point on said potentiometer to said auxiliary power means.

6. In the power supply system of claim 5 wherein said auxiliary power means comprises a high current battery maintained in a charged condition by current supplied through said second unidirectional impedance means.

7. In the power supply system of claim 5 wherein said auxiliary power means comprises a capacitor maintained in a charged condition by current supplied through said second unidirectional impedance means.

8. In the power supply system of claim 2 and second connecting means individual to at least one of said first

5

10

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6

power means for connecting said first power means to said common auxiliary power means to keep a steady potential across said auxiliary power means.

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STEPHEN W. CAPELLI, *Primary Examiner.*

R. V. LUPO, *Assistant Examiner.*