A series connected gas tube protector having an internal fuse link attached between the protector electrode and the output. Normal line current passes through the electrode and fuse link, high voltage surges operate to ionize the protector gases and arc between the electrode and grounded tube case, and excessive line current opens the fuse link.

58 Claims, 2 Drawing Figures
FIG. 1

PRIOR ART

FIG. 2
1. Field of the Invention

The present invention relates generally to the field of electrical overload protective devices and more specifically to a new and improved gas tube protector device.

2. DESCRIPTION OF THE PRIOR ART

Prior to the present invention the gas tube protector has been known and used to protect both subscriber and central office equipment in modern telephone systems. A typical gas tube protector of the prior art is shown in the cross-section illustration of FIG. 1. The gas tube comprises an electrically conductive case containing first and second electrodes and an inert gas. It is a three terminal device with one terminal being coupled between the case and ground potential and the other two terminals passing through a gas tight seal and being coupled from the electrodes through so-called heat coil type of fuses to the tip and ring lines respectively of a protected station.

In the use of this parallel coupled type of gas tube protector a high voltage pulse, such as a lightning strike, will ionize the gas in the tube and arc from one or both electrodes to the grounded conductive tube case. Other types of overvoltages will burn out the external heat coil fuse link between the lines and the protector. With this type of arrangement it is assumed that the impedance presented to overvoltages between the gas tube protector and ground will be less than that presented by that portion of the lines and 30 the protector and the protected station. A recognized shortcoming of the prior art gas tube protector is that they may fail in an open circuited condition rather than short circuited. The single weakest point in such protectors is the gas tight joint between the seal and case. Even with extreme manufacturing care it is possible for the protector to lose its gas and thus lose the capacity to provide any protection against high voltage surges. A second deficiency of the prior art gas tube protectors arises in that an overvoltage sufficient to open the heat coil fuses will disconnect the protector from the protected station. A factor which compounds these problems is that with the parallel coupled arrangement there is no detectable effect upon the protected station; i.e. the subscriber station will continue to receive incoming signals and transmit outgoing signals in a normal manner even though it is completely unprotected from overvoltage conditions. It is thus necessary that each and every gas tube protector be inspected on a routine basis to assure that they continue to provide the necessary protection.

OBJECTS AND SUMMARY OF THE INVENTION

From the preceding discussion it will be understood that among the various objectives of the present invention are included the following:

- the provision of a new and improved gas tube protector;
- the provision of a device of the above-described character which is adapted for series connection;
- the provision of a device of the above-described character having an internal fuse link; and
- the provision of a device of the above-described character which fails safe in the event of a gas leak.

These and other objectives of the present invention are efficiently achieved by providing a gas filled, grounded tube case which contains a series connected electrode and fuse link and adapted for series connection to a protected station. The fuse link may be constructed such that normal signal currents will vaporize the link in the event that the gas is displaced by air.

The foregoing as well as other objects, features and advantages of the present invention will become more readily understood from the following detailed description taken in conjunction with the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic cross-section illustration of a three electrode parallel connected gas tube protector of the prior art; and FIG. 2 is a schematic cross-section view of an improved series connected gas tube protector constructed in accordance with the principles of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The prior art gas tube protector of FIG. 1, having been described hereinabove, attention is directed to FIG. 2. The improved gas tube protector of the present invention includes an electrically conductive tube case which is connected to ground potential via terminal. Disposed within the case are first and second electrodes having input leads and which pass through a gas tight input seal. The other ends of electrodes and are series connected to first and second fuse links respectively which are in turn connected by output leads and passing through a gas tight output seal to the protected station. As is conventional the case is filled with an inert gas such as argon at less than atmospheric pressure. The inert gas may be a mixture of such gases (e.g. argon-nitrogen) and traces of a radioactive element which serves to partially ionize the gas and stabilize its electrical characteristics.

In practice the gas tube protector of FIG. 2 will be inserted in series with the tip and ring lines and running to the protected station. In this arrangement the protector may be subjected to the three basic electrical conditions. In normal telephone operation conventional telephone line currents will pass through the electrodes and and fuse links and to the protected station. It will be apparent that the fuse links thus must be of such a construction that they will carry this normal current level so long as the protector is in satisfactory condition. The second condition is a very high voltage surge or pulse of short duration which occurs during a lightning strike. These voltage pulses ionize the gas within the tube case and arc from electrodes and or to the grounded case in the manner conventional with the gas tube protector. The third condition arises when excessive line current is placed on the lines due to a power cross or other types of overloads. Under this condition the excessive current will burn out the fuse links and and provide the necessary protection. Thus the improved gas tube protector of the present invention not only provides the protection from repeated high voltage surges that has made the prior art gas tube protector desirable, but also provides positive protection from current over-
loads without disconnecting the protector from the line.

Since it is not foreseeable that an absolutely reliable gas tight seal is likely to be available, the provision of a gas tube protector which fails safe in the event of a gas loss is desired. To this end it is preferred in the practice of the present invention that the fuse links 48 and 50 be fabricated much in the fashion of a light bulb filament; i.e. when in the original inert gas environment it will carry normal current levels, however, in an air environment these normal current levels are sufficient to vaporize the links. As an illustrative example, the fuse links may be made of 0.005 to 0.010 inch tungsten filament wire which will readily carry the normal 0.1 amp voice current in a telephone system as long as it is in an inert gas atmosphere but will vaporize at this current level in an ambient air environment. It will be seen that with this construction both the overvoltage condition and the gas leak condition will open the fuse links and provide the desired protection of the protected station. It will also be noted that an open fuse link will be evidenced by an interruption of service to the protected station, a condition that is readily brought to the attention of appropriate maintenance personnel without requiring that all protectors in the system be routinely inspected.

While the present invention has been described as a two line protector which is of particular utility in telephone systems, it will be understood that the principles of the invention are equally applicable to any number of lines. It will thus be seen that the Applicant has provided a new and improved gas tube protector whereby the objectives set forth herein above are efficiently met. Since certain changes in the above-described construction will occur to those skilled in the art without departure from the scope of the invention, it is intended that all matter set forth in the preceding description or shown in the appended drawings shall be interpreted as illustrative and not in a limiting sense.

Having described what is new and novel and desired to secure by Letters Patent, what is claimed is:

1. A protective device for use in combination with a circuit including a protected station, and a line subject to carrying normal electrical current levels, occasional excessive current levels, and occasional excessive voltage pulses, said protective device comprising an electrically conductive housing, means for coupling said housing to ground potential, an electrode disposed within and spaced apart from said housing, a fuse link disposed within said housing and connected to one end of said electrode, an ionizable inert gas substantially filling the space within said housing about said electrode and fuse link, means for connecting said electrode and fuse link in series with said line and said protected station, electrically insulative means for providing a substantially gas tight seal between said housing and said connecting means, said inert gas being responsive to the application of an excessive voltage pulse to said electrode to ionize and provide a conductive path between said electrode and said grounded housing, and said fuse link having an electrical current carrying capacity in the presence of said inert gas which is sufficient to carry said normal current level, and being responsive to the application of an excessive current level to melt and thereby open the circuit between said line and said protected station.

2. A device as recited in claim 1 wherein said fuse link current carrying capacity in air is insufficient to carry said normal current level such that in response to the application of said normal current level said fuse link vaporizes in air and thereby opens said circuit between said line and said protected station.

3. A device as recited in claim 1 wherein said inert gas is argon.

4. A device as recited in claim 3 further including nitrogen mixed with said argon.

5. A device as recited in claim 2 wherein said fuse link is formed of tungsten.

6. A device as recited in claim 2 wherein said protected station is a telephone instrument and said normal current level is no greater than one tenth ampere.