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(54) **Electrical protection device.**

(57) A protection device for electrical circuits comprises a frangible container (10) over which an electrical circuit path (14) extends and a substance in the container having a characteristic such that upon occurrence of a condition, such as a low temperature, the substance expands and fractures the container (10) thereby breaking the circuit path (14).

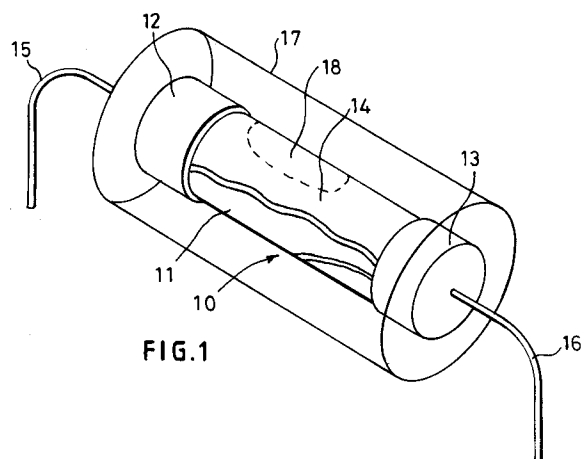


FIG.1

This invention relates to electrical protection devices and in particular to devices which render electrical circuits inoperative upon the occurrence of predetermined conditions.

It is known to protect electrical circuits from predetermined overload conditions by the provision of a fusible link which breaks upon the occurrence of excessive flow of electrical current through the fusible link.

According to one aspect of the invention an electrical protection device comprises a frangible container; an electrical circuit path extending over a wall of the container; and a substance in said container having a characteristic such that the substance expands to an extent sufficient to fracture the wall of the container upon occurrence of a predetermined condition.

According to another aspect of the invention a franking machine includes electronic circuits operable to carry out accounting functions in relation to value used in franking mail items and including a sensing circuit including an electrical protection device as hereinbefore defined; said electronic circuits being inoperative if the sensing circuit is open due to exposure of the electrical protection device to a temperature at which the wall of the container fractures.

An embodiment of the invention will now be described by way of example with reference to the drawings in which:-

Figure 1 is a view of a protection device in accordance with the invention, and

Figure 2 is a block diagram of electronic circuits of a franking machine.

Referring to Figure 1 of the drawings, a protection device comprises a frangible container 10 formed of a cylindrical tube 11, for example of glass closed at both ends by metal end caps 12, 13 secured to the cylindrical tube. An electrically conductive coating 14 is deposited on the outer surface of the cylindrical wall of the tube and the coating provides a low resistance electrical path interconnecting the end caps 12, 13. Wire leads 15, 16 are electrically connected to the end caps 12, 13 to enable the protection device to be connected in an electrical circuit. A substance is contained in the cylindrical tube 11, the substance having a property of expanding at a predetermined temperature range to an extent sufficient to cause fracture of the cylindrical tube. Water changes from liquid to solid phase at 0°C and as the temperature decreases from normal ambient temperature to a temperature below 0°C the water not only becomes frozen and solid but also expands. This expansion is sufficient to fracture the cylindrical tube and thereby breaks the electrical path provided between the metal end caps by the electrically conductive coating 14. By suitable choice of substance contained in the cylindrical tube, the tube may be caused to fracture at a chosen predetermined temperature range. For example the tube may contain water to which additives have been add-

ed to lower the freezing point of the mixture, such additives may include substances used as anti-freeze additives. Substances other than water may be used, such substances being either in a liquid or gel state at normal ambient temperatures and undergoing an expansion sufficient at a chosen temperature range to fracture the cylindrical tube 11.

If desired instead of, or addition to the conductive coating 14, a coating of electrically conductive material may be applied to the inner surface of the cylindrical tube 11. It will be appreciated that the coating 14 and any coating applied to the inner surface of the cylindrical tube may extend over the entire outer and inner surfaces respectively or over only a part of those surfaces provided that an electrically conductive path connecting the end caps 12, 13 is formed by one or both coatings.

In order to prevent fracture of the cylindrical tube as a result of expansion of the substance contained therein due to rise of temperature above normal ambient temperature, the tube is not wholly filled with the substance. A small predetermined space 18, indicated by dotted line, is left and this may be occupied by air or if desired by gas. Accordingly expansion of the substance due to temperature rise over a predetermined range will be accommodated by compression of the air or gas in the space. Thus the cylindrical tube would not fracture when the ambient temperature is within a normal range of temperatures. If desired the space unfilled with the substance may be of a volume predetermined such that expansion of the substance due to excessive rise in ambient temperature is sufficient to fracture the cylindrical tube. Typically the cylindrical tube may be caused to fracture at temperatures outside the range -40°C to +70°C but it will be appreciated that by protection devices operating as hereinbefore described may be constructed such as to operate for at other temperatures or temperature ranges.

It will be appreciated that it is undesirable to have water or other electrically conductive liquids present in electrical circuits. Accordingly in order to prevent the material initially contained in the cylindrical tube from becoming freely released from the protection device upon fracture of the tube, the tube is housed in an outer container 17. The cylindrical tube may be supported in the outer container by the electrical connection leads or the outer container may be formed with recesses to receive the end caps. The space between the cylindrical tube and the outer casing may be empty, i.e. filled with air, or may be wholly or partially filled with a substance which remains fluid at the temperature range at which the material within the cylindrical tube freezes and expands provided that the substance does not significantly impede fracture of the cylindrical tube. The substance may be a liquid or in the form of a gel. If desired the outer container 17 may be formed of resilient material to ensure that

the outer container 17 does not fracture as a result of fracture of the cylindrical tube 11.

Protection devices constructed and arranged to operate as hereinbefore described may be used in electrical or electronic equipment where operation or storage of the equipment at low temperatures may result in malfunctioning of the equipment. An example of such equipment is franking machines in which accounting for use of postage value and control of the machine to print franking impressions is carried out by means of electronic circuits. As is well known in the art of franking machines, the accounting circuits are required at all times to maintain an accurate accounting record of postage value used in franking mail items and, where the franking machine is operated in a prepayment mode, to maintain an accurate accounting record of credit value remaining available for use in franking mail items, the credit value being decremented in accordance with use of value in franking. A block circuit diagram of a franking machine is shown in Figure 2. The franking machine includes a microprocessor 20 operable under the control of software routines stored in read only memory (ROM) 21 to carry out accounting and control functions of the franking machine. A keyboard 22 enables input by a user of control signals to the microprocessor to cause the microprocessor to carry out a selected operation, for example franking a mail item or recrediting the franking machine with an amount of credit. The keyboard also enables input by the user of data, for example a value of a postage charge with which a mail item is to be franked by the machine. A display device 23 is operated by the microprocessor to display to the user an echo of data input by means of the keyboard and status information and other information to assist the user in use of the franking machine. Non-volatile memories 24, 25 are provided to store accounting data relating to credit entered into the machine and usage of the machine in franking mail items. As is well known the memories 24, 25 usually include a number of registers. For example a descending credit register to store a value of credit available for use in franking of mail items, an ascending register to store an accumulated value of postage charges applied to mail items, an items count register to store the number of mail items franked and a high items count register to store the number of mail items franked with a postage charge greater than a predetermined value. Commonly, postal authorities permit franking machines to be operated in a so-called prepayment mode in which a value of credit is purchased from the postal authority and this value of credit is entered into the descending register of the franking machine. Thereafter the franking machine is operable for use in franking mail items until such time as the credit is exhausted or has decreased to a predetermined low value. Accordingly as a part of each franking routine carried out by the microprocessor, the microprocessor carries out a

check to determine that there is a sufficient value of credit registered in the descending register to enable the currently required franking operation to be performed. If the credit is sufficient the franking operation continues and the mail item is printed, by means of a printer 26 controlled by the microprocessor, with a franking impression including the value of postage charge. If the credit value is determined to be insufficient, the franking machine is rendered inoperative for further franking until such time as the descending register has been recharged with credit purchased from the postal authority. Other postal authorities permit franking machines to be used in a so-called post-payment mode in which the franking machine does not store a value of credit and periodically the postal authority inspects the franking machine to determine the value of postage charge which has been applied to mail items and then charges the user in accordance with that determined value.

In order to ensure integrity of the accounting data, each register is provided in duplicate in each of the memories 24, 25 and in each franking operation the microprocessor carries out a check to determine if the accounting data stored in each replication of each register is identical. If identity is not found, the franking machine is rendered inoperative until any fault has been diagnosed and corrected by an authorised service engineer.

Because the accounting records maintained by the accounting circuits relate to revenue for the postage postal authority and to expenditure by a user of the franking machine, measures are taken to protect the integrity and security of the information in the accounting records. One such measure comprises housing all circuits critical to maintenance of the accounting records and circuits for operation of the printer in a secure housing 27 to prevent tampering with the electronic circuits of the machine which may be attempted if fraudulent operation of the machine were intended.

If the electronic circuits are subjected to extreme low temperatures it is possible that the accounting information may be corrupted or totally lost. A protection device 28 as described hereinbefore may be connected in an electrical path 29 of the franking machine such that the franking machine is rendered inoperative if the path is broken. The path 29 may be a power supply path from a power source 30. Alternatively or in addition a protection device 31 as hereinbefore described may be connected in an electrical path 32 of a circuit 33 tested periodically by a microprocessor of the electronic circuit for continuity. If the path is a power supply path, fracture of the protection device due to extreme low temperature would prevent operation of the franking machine. If the path is a circuit tested periodically for continuity, in the event of the path being broken the franking machine may be partially operable to perform functions unrelated to

accounting or to franking operations. For example the franking machine may display information on a display device thereof indicating to the user that the machine requires a service call by an authorised engineer to put the machine back into service.

The electrical protection devices 28, 31 for the franking machine are located within the secure housing 27 of the machine thereby preventing replacement of the device 28, 31 by any person other than a person authorised by the postal authority to have access to the interior of the secure housing. Thus a broken protection device would provide a warning to the appropriate authorities that it is possible that tampering with the machine has occurred in an attempt to obtain or corrupt secure information held in the electronic circuits of the machine.

Claims

1. An electrical protection device characterised by a frangible container (10); an electrical circuit path (14) extending over a wall of the container (10); and a substance in said container having a characteristic such that the substance expands to an extent sufficient to fracture the wall (11) of the container (10) upon occurrence of a predetermined condition.
2. An electrical protection device as claimed in claim 1 wherein the substance expands to an extent sufficient to fracture the wall (11) of the container (10) at a predetermined low temperature.
3. An electrical protection device as claimed in claim 1 or 2 wherein the substance comprises water with additives effective to lower the freezing point thereof to a predetermined low temperature.
4. An electrical protection device as claimed in any preceding claim wherein the container (10) has a predetermined air or gas space (18) so that expansion of the substance due to temperatures within a predetermined range is ineffective to fracture the wall (11) of the container (10).
5. An electrical protection device as claimed in claim 4 wherein the air or gas space (18) is of predetermined volume such that expansion of the substance due to temperatures above the predetermined range is effective to fracture the wall (11) of the container (10).
6. An electrical protection device as claimed in any preceding claim wherein the wall (11) of the container (10) comprises a cylindrical tube (11); and including first and second electrically conductive

end caps (12,13) secured to opposite ends of the cylindrical tube (11); and an electrically conductive coating (14) on said cylindrical tube (11) extending between said first and second end caps (12,13) to provide an electrically conductive path interconnecting said first and second end caps (12,13).

7. An electrical protection device as claimed in any preceding claim wherein the container (10) is housed in an outer housing (17) effective to retain the substance after fracture of the container (10).
8. An electrical protection device as claimed in claim 7 wherein the outer housing is resilient.
9. A franking machine including electronic circuits (20) operable to carry out accounting functions in relation to value used in franking mail items and characterised by a circuit path (29;32) including an electrical protection device (28;31) as claimed in any preceding claim, said electronic circuits (20) being inoperative if the circuit path (32) is open due to exposure of the electrical protection device (31) to a temperature at which the wall of the container (10) fractures.

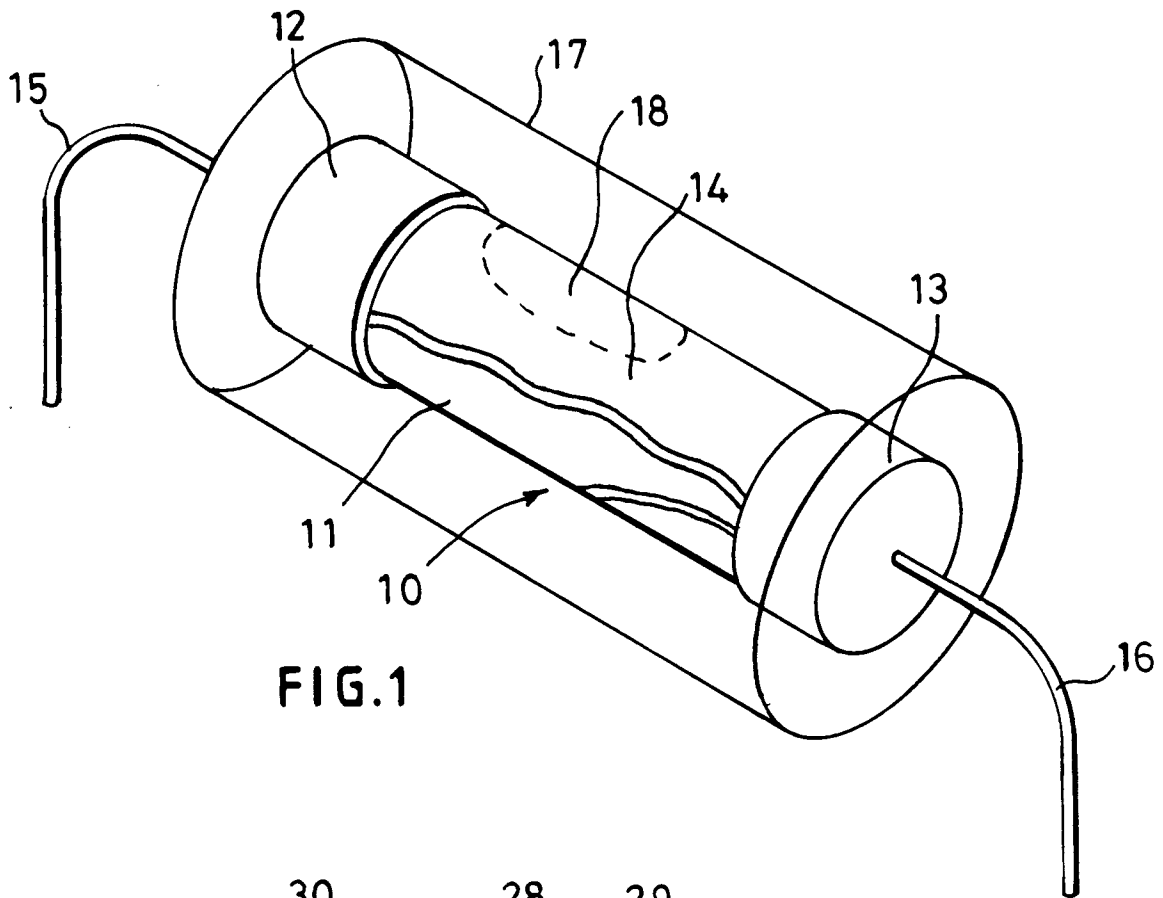


FIG. 1

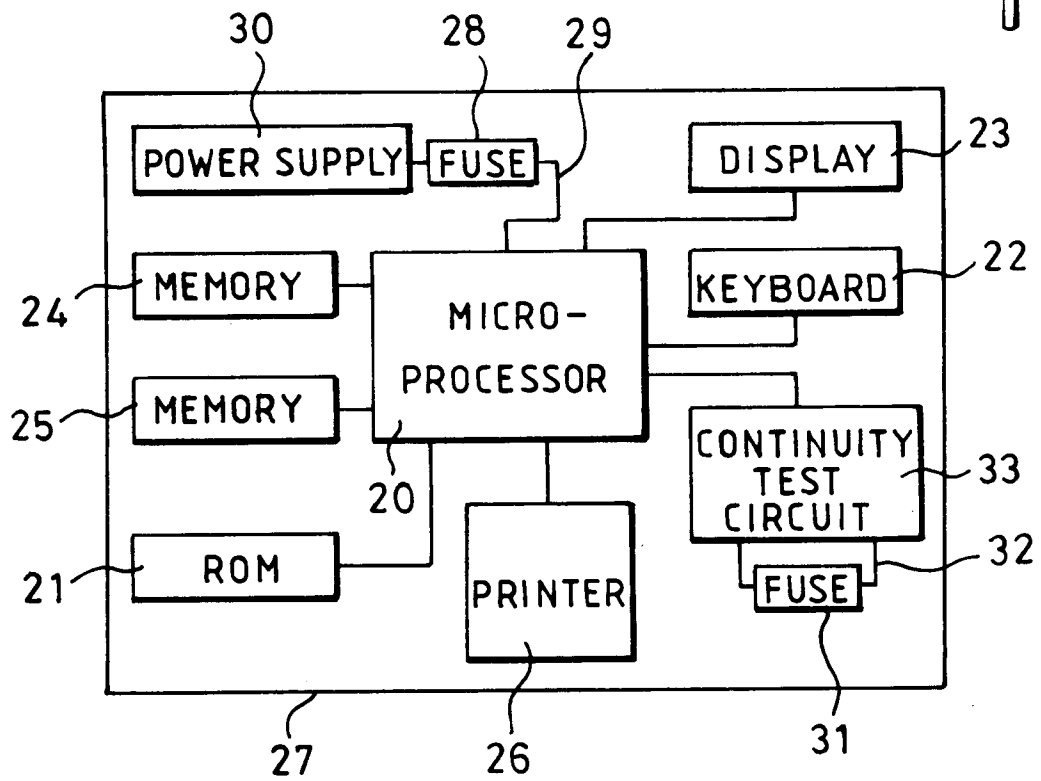


FIG. 2



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 95300561.8
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 6)
A	<u>US - A - 5 274 525</u> (GERMAIN LE MEUR) * Totality * --	1	H 02 H 5/04 G 07 B 17/04
A	<u>US - A - 4 262 274</u> (B.L. HOWE) * Totality * --		
A	<u>US - A - 4 423 402</u> (T.M. JACKSON) * Totality * ----		
			TECHNICAL FIELDS SEARCHED (Int. Cl. 6) G 07 B 17/00 H 01 H 37/00 H 02 H 5/00
The present search report has been drawn up for all claims			
Place of search VIENNA	Date of completion of the search 17-03-1995	Examiner ERBER	
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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