(No Model.) 2 Sheets—Sheet 1.

D. J. CARTWRIGHT.

SAFETY FUSE FOR ELECTRICAL DEVICES.

No. 590,750. Patented Sept. 28, 1897.

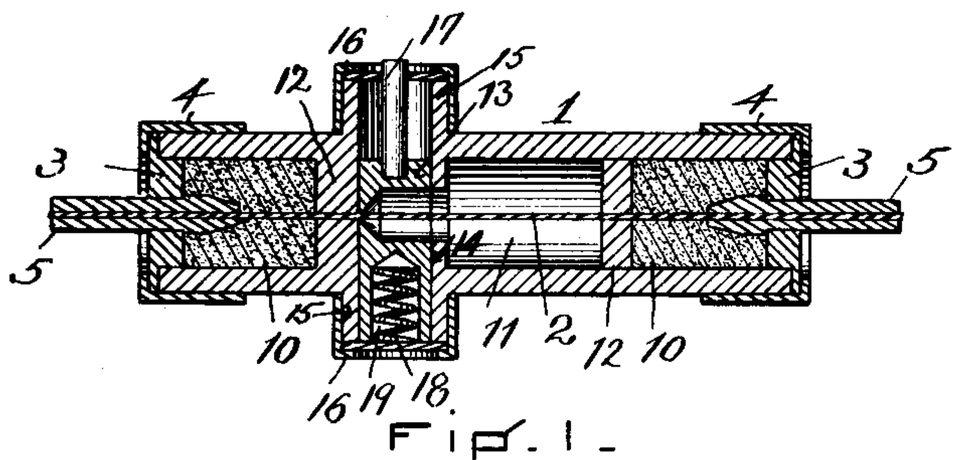

Fig. 1.

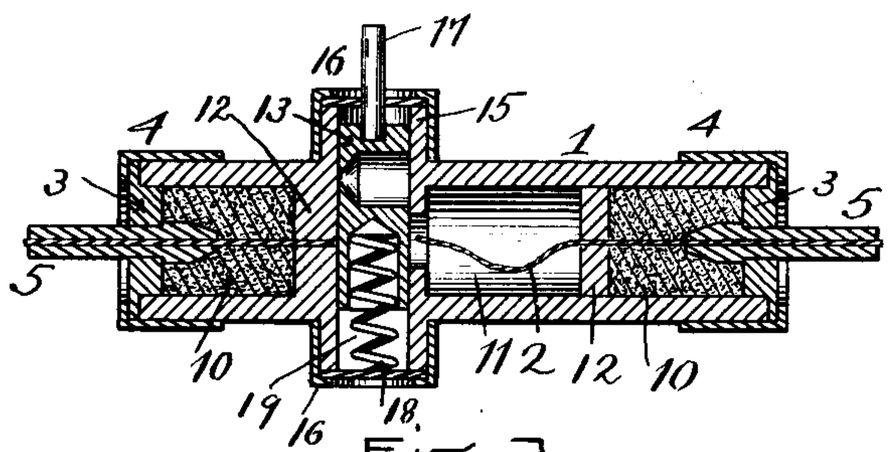

Fig. 2.

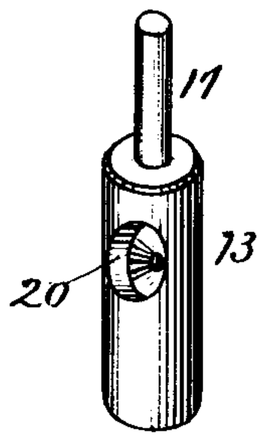

Fig. 3.

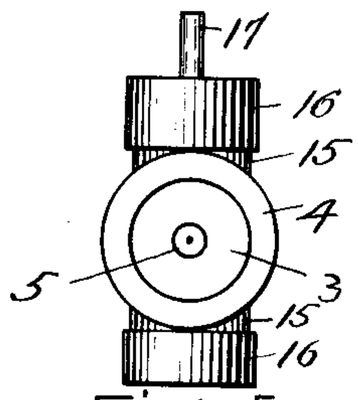

Fig. 5.

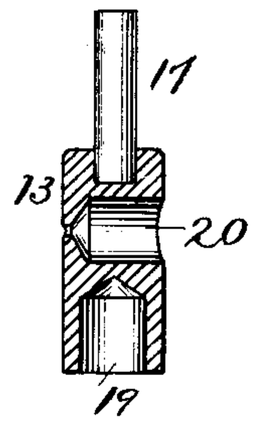

Fig. 4.

WITNESSES

George S. Lea

William H. Parry.

INVENTOR

David J. Cartwright

by his attorney

Alex. L. Hayes

(No Model.) 2 Sheets—Sheet 2.

D. J. CARTWRIGHT.

SAFETY FUSE FOR ELECTRICAL DEVICES.

No. 590,750. Patented Sept. 28, 1897.

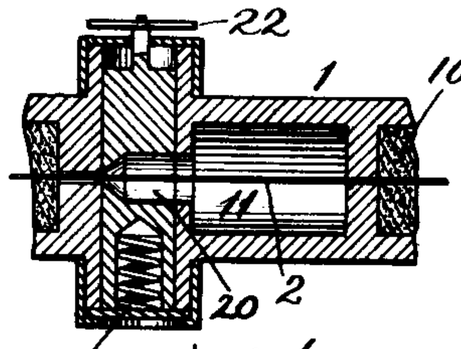

Fig. 6.

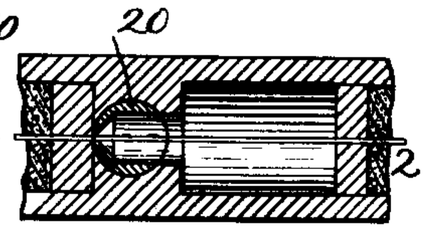

Fig. 7.

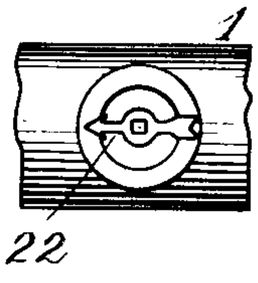

Fig. 8.

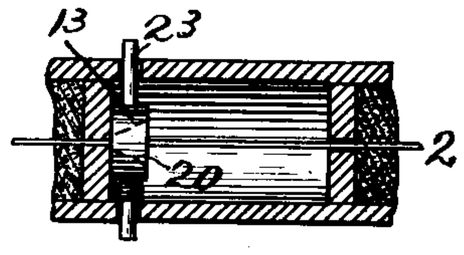

Fig. 9.

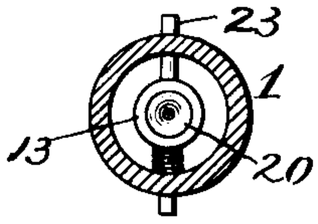

Fig. 10.

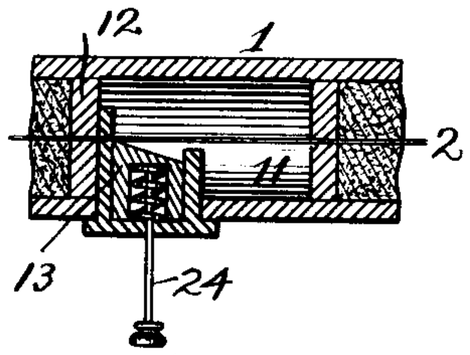

Fig. 11.

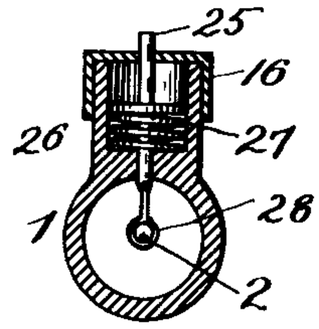

Fig. 12.

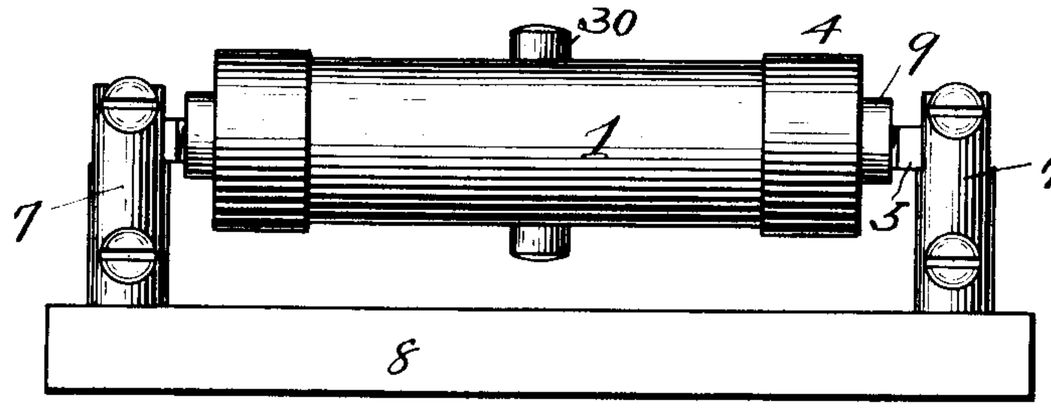

Fig. 13.

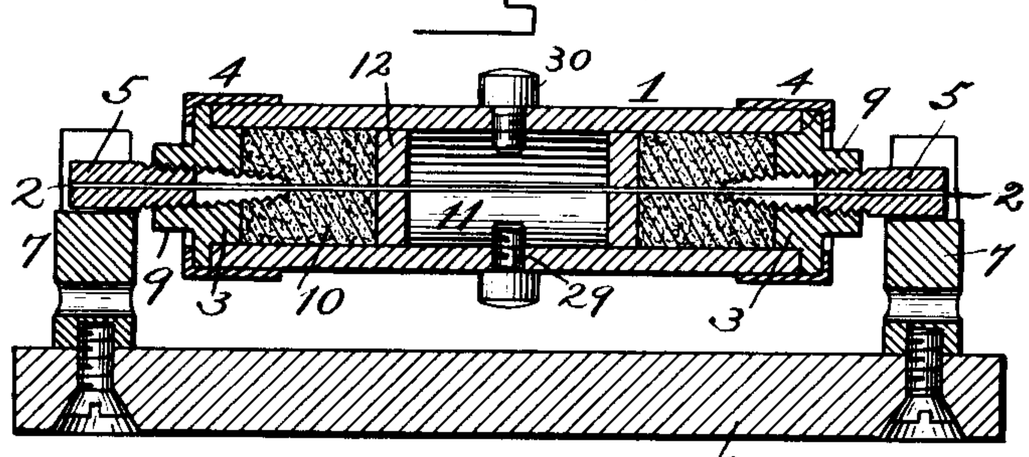

Fig. 14.

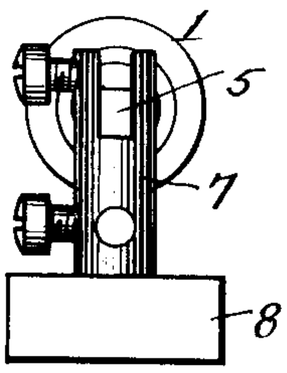

Fig. 15.

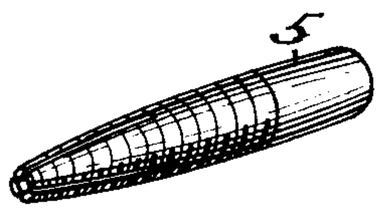

Fig. 16.

WITNESSES

George S. Lee.

William L. Parry.

INVENTOR

David J. Cartwright

by his attorneys

Alex. L. Hays & Co.

UNITED STATES PATENT OFFICE.

DAVID J. CARTWRIGHT, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO THE ELECTRICAL SAFETY COMPANY, OF SAME PLACE.

SAFETY-FUSE FOR ELECTRICAL DEVICES.

SPECIFICATION forming part of Letters Patent No. 590,750, dated September 28, 1897.

Application filed April 19, 1897. Serial No. 632,738. (No model.)

To all whom it may concern:

Be it known that I, DAVID J. CARTWRIGHT, of Boston, in the county of Suffolk and State of Massachusetts, have invented a new and useful Improvement in Safety-Fuses for Electrical Devices, of which the following, taken in connection with the accompanying drawings, is a specification.

This invention relates to inclosed fuses, and has for its object, first, the production of a safety-fuse which when connected in a circuit can be handled or touched without the possibility of the person touching the device coming into contact with any part of the circuit; second, the production of a safety-fuse which can be used in places where there are inflammable or explosive gases or substances without the possibility of causing the ignition or explosion of these gases or substances; third, the determination at a definite part of the fuse-wire of the rupture of the same by the fusing effect of the heat produced by the increased current through the fuse-wire; fourth, the prevention of noise when the fuse-wire is ruptured by the effect of the increased current; fifth, the prevention of the formation of an arc at the point where the fuse-wire breaks; sixth, the absorption and distribution of the gases or other substances produced by the fusing of the fuse-wire, whereby the force of any explosive action attending this fusing is rendered harmless; seventh, the capability of removing from the inclosing tube or case the substances produced by the fusing of the fuse-wire; eighth, the regulation of the carrying capacity of the fuse-wire, whereby its rupture by the fusing effect of the increased current may be predetermined for any strength of current and for any period of time; ninth, the production of means for obtaining with an inclosed fuse-wire an indication that a rupture of the fuse-wire has occurred. I attain these results by the devices hereinafter fully described in this specification and illustrated in the accompanying drawings, and which devices embody the principle of my invention.

In the drawings, Figure 1 is a longitudinal sectional view of one form of these devices and shows the fuse-wire as unbroken and the covering device held in position by the fuse-wire. Fig. 2 is a similar longitudinal sectional view of the same device and shows the fuse-wire broken and the covering device moved to cover the perforation in the partition and to give an indication that a rupture of the fuse-wire has occurred. Fig. 3 is a detached view in elevation of the covering device used in this embodiment of the invention and shows the recess in the covering device. Fig. 4 is a detached sectional view of this covering device. Fig. 5 is an end view of the tube or case. Fig. 6 is a longitudinal sectional view of a part of another form of device embodying the principle of my invention and shows another form of covering device. Fig. 7 is a horizontal sectional view of that part of the device which contains the covering device. Fig. 8 is a plan view of the indicator operated by the covering device. Fig. 9 is a sectional longitudinal view of part of the device and shows another form of covering device. Fig. 10 is a front view of this covering device, showing its position when the fuse-wire is unbroken. Fig. 11 is a sectional longitudinal view of part of the device and shows still another form of covering device. Fig. 12 is a longitudinal sectional view of part of device and shows a means for giving an indication that the fuse-wire is broken. Fig. 13 is a longitudinal view in elevation of the tube or case and the means for supporting the same when in use. Fig. 14 is a longitudinal sectional view of an embodiment of the principle of my invention, in which embodiment the covering and indicating devices are not used. Fig. 15 is an end view of the same. Fig. 16 is a perspective view of a terminal.

In the several figures the same numerals refer to the same parts.

Referring to the drawings, 1 is a tube or case, and 2 is the fuse-wire passing through the same and which fuse-wire may be of the usual form or material or of any suitable form or material. This case may be cylindrical or rectangular or of any convenient form. It may be made of any suitable material, but if made of a conducting material its ends should be of an insulating material or insulation should be afforded for the terminals to which

the fuse-wire is attached. A convenient material for the tube or case is fiber. A convenient size for general purposes is about three inches in length by three-quarters of an inch in diameter, as shown in the drawings, but it may be of larger or of smaller dimensions as may be found desirable.

The ends of the tube or case are closed and a convenient means of accomplishing this result is by means of the end pieces 3, each of which may be held in position by an insulated ferrule 4 or in any other suitable manner. In each of the ends of the tube or case is inserted a piece of metal 5, round or square in section and in the form of a rod or strip or of any other convenient form. This piece may have in it a longitudinal perforation for the reception of the fuse-wire or the fuse-wire may be otherwise attached to the piece 3. This piece forms a suitable terminal for the fuse-wire by means of which connection of the fuse-wire is made with the conducting-wire of the circuit—as for example, by the insertion of these terminals in suitable sockets in the standards 7, supported upon a suitable base-plate 8, to which standards the conducting-wires are connected in any suitable manner. These standards are best made of sufficient height to prevent the possibility of contact of the conducting-wire with the tube or case.

A boss 9 of insulating material may be placed upon the end of the tube or case in order to prevent contact of the tube or case with the support for the conducting-wire.

The inner ends of the terminals project into the adjacent filling and act to conduct heat away from the fuse-wire at that part of the same so as to prevent the possibility of the fuse-wire fusing near the end of the case. These inner ends of the terminals are preferably tapered and split, as shown in Fig. 16, and the perforation for the insertion of the terminal in the end of the tube or case is preferably tapered, as shown in Fig. 12, so that after the terminal is inserted its inner end will be compressed to firmly bind the fuse-wire and insure good contact with the same.

Each end of the case is filled with some material different from the fuse-wire and acting to conduct away from that part of the fuse-wire which passes through this filling the heat produced by the passage of the current through the fuse-wire.

I can use several substances for the filling 10—as for example, asbestos, plaster-of-paris, oil, or paraffin—and I do not confine myself to any particular substance, provided it is different from the fuse-wire and acts to conduct heat away from the same, but I prefer asbestos, and a convenient manner for using this material is by winding a strip of sheet-asbestos around a part of the fuse-wire until such a thickness of covering is secured that when the asbestos-covered wire is inserted into the tube or case the asbestos will be packed or firmly held in the end of the tube or case.

Asbestos is insulating, is non-inflammable, is sufficiently heat-conducting to conduct some of the heat away from this part of the fuse-wire, which is in contact with the asbestos, and by its porous nature it acts to absorb and hold the gases and other substances produced by the fusing and combustion of the fuse-wire by the heat produced by an increased current passing through the fuse-wire, and by its elasticity it yields to the pressure of the gases, and thus, in connection with the absorption of the gases and other substances produced by the fusing and combustion of the fuse-wire, tends to prevent harmful results from any explosive action when this fusing and combustion takes place. It is also coherent and can be packed around the fuse-wire, so as to enable a definite air-space to be formed in the inclosing tube or case without the use of partitions or of a drum.

Between each of the filled ends of the tube or case is a space 11, through which the fuse-wire passes, and in order to insure the rupture of a fuse-wire of the same conductivity by any predetermined strength of current and after the passage of a current for any predetermined time this space must be of definite dimensions, as any variation in the dimensions of this space will effect the carrying capacity of the fuse-wire to the point of rupture by an increased current, and it is important in safety-fuses for electrical circuits that the carrying capacity of the safety-fuse should be accurately known.

If the filling material is capable of being compacted into each end of the tube or case, the definition with accuracy of the space 11, between the fillings 9, can be effected without a partition, but as some of the materials which may be used for filling must be otherwise retained in the end of the tube or case I may place between the filling and the space 11 a transverse inflexible partition 12, perforated for the passage of the fuse-wire, but I prefer to use partitions with any material, as these partitions act to confine the force of the explosion to the heated-air space and to direct through the perforation in each partition the heated air, gases, or other substances generated when the fuse-wire melts, and thus to cause the blowing out of any arc which may be formed. The proper insulation of the fuse-wire in this partition is obtained either by making this partition of an insulating material or in any other suitable manner.

The partitions may be separable from the case, and they fit air-tight within the same, and may be held in position in any suitable manner and be adjustable, thus permitting a variation in the length of the air-space for the purpose of changing the carrying capacity of the fuse-wire.

As the fuse-wire in the space 11 is out of

contact with any heat-conducting material rupture of the fuse-wire by the heat produced by the increased current passing through the fuse-wire will take place at the part of the fuse-wire in the space 11 instead of at any other part of the fuse-wire, and the gases or other materials produced by this fusing of the fuse-wire will be mainly formed in this space 11. For the further purpose of preventing the passage of an arc from this space through the perforation in the partition when the fuse-wire is ruptured in this space 11 I may use a device which is normally held in position by the fuse-wire when this fuse-wire is unbroken against a force acting to move this device, which device automatically covers the perforation in the partition when the fuse-wire is ruptured, as in Letters Patent No. 441,933, granted to me December 2, 1890, and in this part of the tube or case I place the means whereby an indication may be given that the rupture of the fuse-wire has occurred. The means for giving this indication may form a part of the covering device and may be operated thereby, or it may be an independent device, and I may dispense with either or both of these devices.

Various devices may be adopted for both purposes.

In Figs. 1 and 2 I have shown the device for covering the perforation in the partition through which the fuse-wire passes as consisting of a block 13, of an insulating material perforated for the passage of the fuse-wire and held in position by the fuse-wire when the latter is intact and moving transversely to the tube or case 1 in substantial contact with or adjacent to the inside surface of the partition in a tube formed by the partition, a collar 14 on the inside of the tube or case, and a rim 15, each around opposite openings in the tube or case 1 on opposite sides of the same. The ends of the transverse tube are each preferably covered with a cap 16, and one or both ends of these caps may be removable in order that the block 13 can be removed from the tube or case and thus permit the removal from the space 11 of substances produced by the fusing of the fuse-wire. On one end of the block 13 is a rod or projection 17, which passes through the cap 16 and when the fuse is unbroken is substantially normal to the outer surface of this cap. On the other end of the block 13 a suitable spring is arranged, which acts when the block 13 is permitted to move by the breaking of the fuse-wire to move this block, so that it covers the perforation in the partition and also causes the projection from the surface of the cap 16 of the rod or other device or attached to the block 13, thus affording a visual indication that a rupture of the fuse-wire has occurred.

Instead of the rod 17 I can use any other suitable device.

I have shown a helical spring 18 in a socket 19 in the block 13, but it is obvious that other forms or arrangements of springs may be used or any other means for moving the block 13 on the release of the same.

A longitudinal recess 20, surrounding the fuse-wire, is preferably formed in the block 13, open toward the space 11 and tapering toward the adjacent partition 10. The effect of this recess is to bring upon that part of the fuse-wire which is near the perforation in the partition the pressure of the spring which moves the block 13, and thus cause a tendency of the fuse-wire to first rupture at that point when the fuse-wire is softened by the heat of the increased current. This recess also acts to receive the gases produced when the fuse-wire is fused, so that the block will have a tendency to be moved by the expansive force of these gases.

The movement of the covering device produced when the block is released by the rupture of the fuse-wire may be made to open or close an electric circuit for the purpose of operating electric magnetic devices for giving a visual or an audible indication, or both, that a rupture of the fuse-wire has occurred, or it may be made to operate or release other mechanism for the same purpose.

I have shown only one covering device, but two or more may be used.

Instead of a perforation, a transverse slot may be used for the passage of the fuse-wire through the covering-block.

In the covering device shown in Figs. 6 and 7 the block 13 rotates in the transverse tube, this rotation being effected by a suitable spring 21 or by any other suitable means when the fuse-wire breaks. The visual indication may be given by the movement of an index 22 on the outside of the tube or case and attached to the block. The recess 20 acts to locate the point of rupture of the fuse-wire near the perforation in the partition.

In the device shown in Figs. 9 and 10 the transverse tube is dispensed with and on each end of the covering-block 13 is a rod 23, which passes transversely through the tube or case.

In the covering device shown in Fig. 11 the fuse-wire rests upon the end of the block 13, and this block is beveled off toward the partition. The withdrawal of a rod 24, attached to the block 13, and normally projecting through the side of the tube or case, affords a visual indication that rupture of the fuse-wire has occurred, and this rod may be made to effect the operation of an electromagnetic device or other mechanism for giving a visual or an audible indication, or both, that rupture of the fuse-wire has occurred. A visual or an audible indication, or both, of this fact may be afforded by the device shown in Fig 12, for which device a rod 25, moving by the force of a spring 26, in a case 27, attached to the outside of the tube or case, is provided with a loop or hook 28, through which loop or hook the fuse-wire passes, and when the fuse-

wire is intact the rod 25 is prevented from moving, but when the fuse-wire is ruptured the spring 26 is allowed to act to move the rod.

Other forms of devices operating to afford a visual or audible indication of the rupture of the wire may be used.

In the device shown in Figs. 13 and 14 the covering and indicating devices are not used.

For the purpose of removing the material produced in the fusion of the fuse-wire perforations 29 may be formed in the space 11 of the tube or case, normally closed by any suitable means—as, for example, by the screws 30.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. The combination, substantially as set forth, of an air-tight tube or case inclosing the entire fusible metal and tightly closed at each end by inflexible material, a coherent filling at each end of the tube or case of a different material from the fuse-wire and acting to conduct away from that part of the fuse-wire which passes through the filling the heat produced by the passage of the current through the fuse-wire at that part and to absorb the gases and other substances generated when the fuse-wire melts, a definite air-space between the fillings; and a fuse-wire passing through the fillings and the air-space.

2. The combination, substantially as set forth, of an air-tight tube or case inclosing the entire fusible metal and tightly closed at each end by inflexible material, a filling of asbestos at each end of the tube or case, a definite air-space between the fillings, and a fuse-wire passing through the fillings and the air-space.

3. The combination, substantially as set forth, of an air-tight tube or case inclosing the entire fusible metal tightly closed at each end by inflexible material, transverse inflexible partitions dividing the tube or case into sections of a definite length and perforated solely where the fuse-wire passes through the partition, a fuse-wire passing through the tube or case and partitions, a filling at each end of the tube or case of a different material from the fuse-wire and acting to conduct away from that part of the fuse-wire which passes through the filling the heat produced by the passage of the current through the fuse-wire at that part and to absorb the gases and other substances generated when the fuse-wire melts, and a definite air-space between the end sections.

4. The combination, substantially as set forth, of an air-tight tube or case inclosing the entire fusible metal and tightly closed at each end by inflexible material, transverse, inflexible movable partitions dividing the tube or case into sections of a definite length and perforated solely where the fuse-wire passes through the partition, a fuse-wire passing through the tube or case and partitions, a filling at each end of the tube or case of different material from the fuse-wire and acting to conduct away from that part of the fuse-wire which passes through the filling the heat produced by the passage of the current through the fuse-wire at that part and to absorb the gases and other substances generated when the fuse-wire melts, and a definite air-space between the end sections.

5. The combination, substantially as set forth, of a tube or case, a fuse-wire passing through said tube or case, a rod extending transversely through the case and normally held by said fuse-wire when said fuse-wire is unbroken and a spring acting when the fuse-wire is broken to cause the projection of the rod.

6. The combination, substantially as set forth, of a tube or case, a fuse-wire passing through said tube or case, a transverse partition in said tube or case through which partition the fuse-wire passes, a movable device normally held in position by the fuse-wire when said fuse-wire is unbroken, means acting when the fuse-wire is broken to move the device to cover the perforation in the partition through which the fuse-wire passes, and means operated by the movement of the covering device to give an indication that the fuse-wire is broken.

7. The combination, substantially as set forth, of a tube or case, a fuse-wire passing through said tube or case, a transverse partition in said tube or case through which partition the fuse-wire passes, a movable device adjacent to the inner surface of the partition and through which device the fuse-wire passes and normally held in position by the fuse-wire when said fuse-wire is unbroken, and moving when the wire is broken adjacent to the inner surface of the partition to cover the perforation in the partition through which the fuse-wire passes, a perforated recess in this device tapered toward the partition and surrounding the fuse-wire.

8. The combination, substantially as set forth, of a tube or case, a fuse-wire passing through said tube or case, a transverse partition in said tube or case through which partition the fuse-wire passes, a block of insulated material perforated for the passage of the fuse-wire and adjacent to the inside surface of the partition and transversely movable, a covered transverse tube for the movement of said block, a spring acting to move said block transversely when the wire is broken in the space adjacent to the inner surface of the partition, and a device attached to the block and projecting from the tube or case, when the block moves on the rupture of the fuse-wire.

9. The combination, substantially as set forth, with an air-tight tube or case inclosing the entire fusible metal and tightly closed at

each end by an inflexible material, an insulated metallic terminal for the fuse-wire and projecting respectively from each end of the tube or case and extending within the same, supports for the terminals, means for preventing the contact of the case with the supports, ferrules or caps on each end of the tube or case and insulated from the adjacent terminals.

10. The combination, substantially as set forth, with an air-tight tube or case inclosing the entire fusible metal and tightly closed at each end by an inflexible material, an insulated metallic terminal for the fuse-wire and projecting respectively from each end of the tube or case and extending within the same, supports for the terminals, an insulating-boss on the outside of each end of the tube or case for preventing the contact of the case with the supports, ferrules or caps on each end of the case and insulated from the adjacent terminals.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this 16th day of April, A. D. 1897.

DAVID J. CARTWRIGHT.

Witnesses:

EMERY GROVER,

A. D. KINGSBURY