March 1, 1927. 1,619,640

W. W. SLOANE

EXPLOSIONPROOF FUSE

Filed June 24. 1920 2 Sheets-Sheet 1

Fig. 1

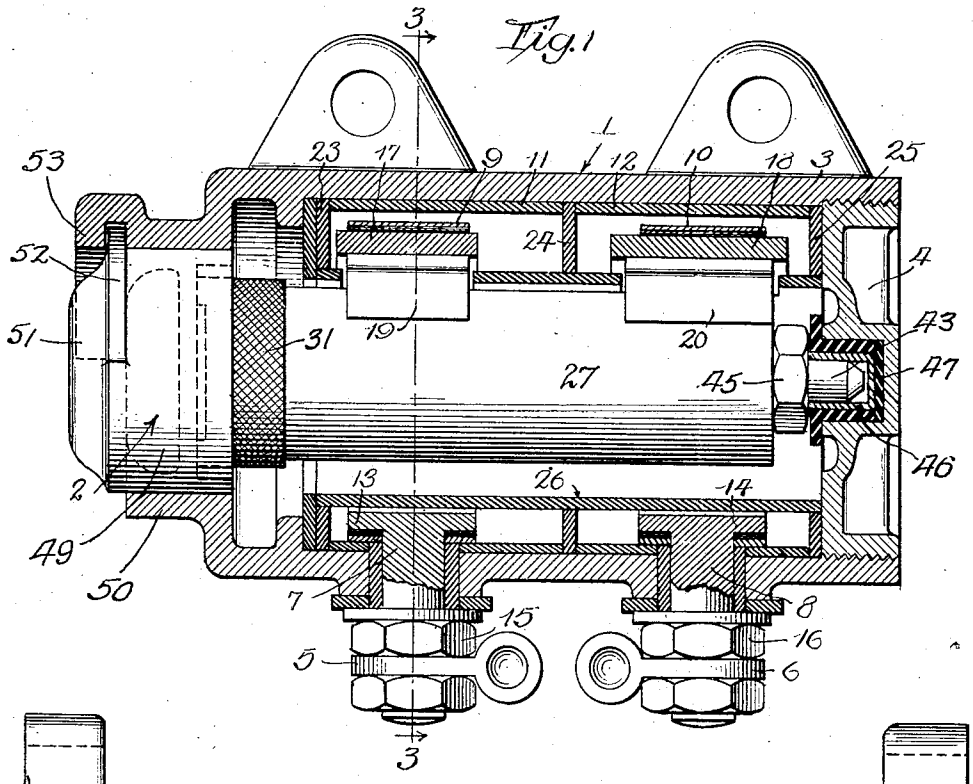


Fig. 2

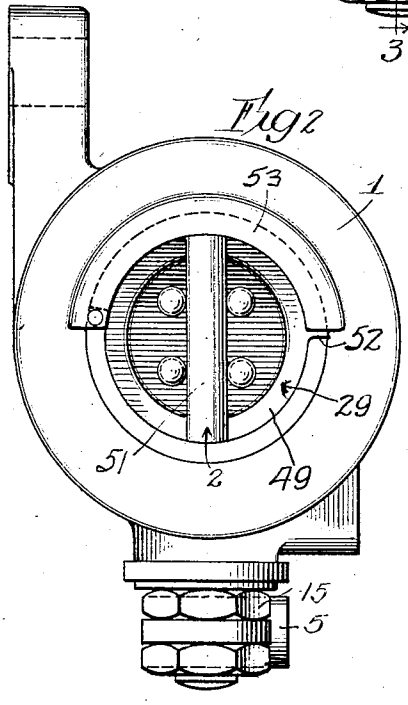
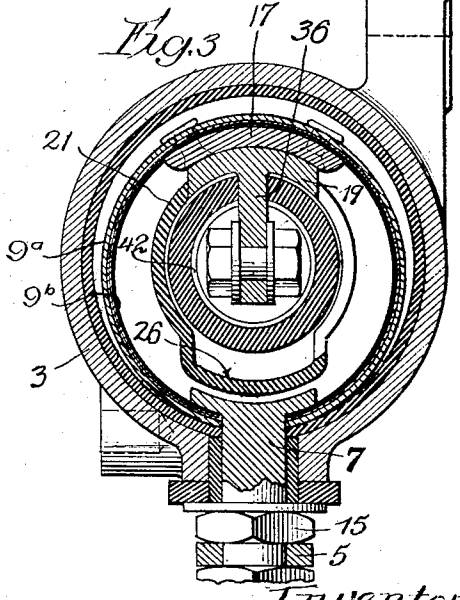


Fig. 3



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EXPLOSIONPROOF FUSE

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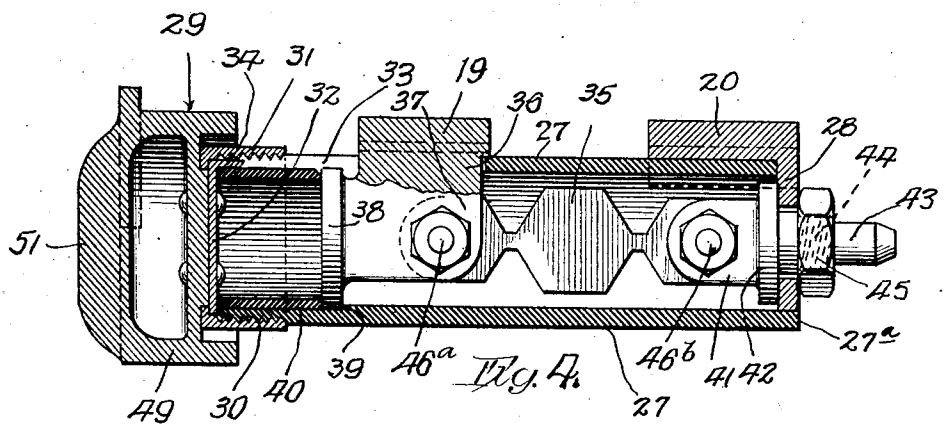

Fig. 4.

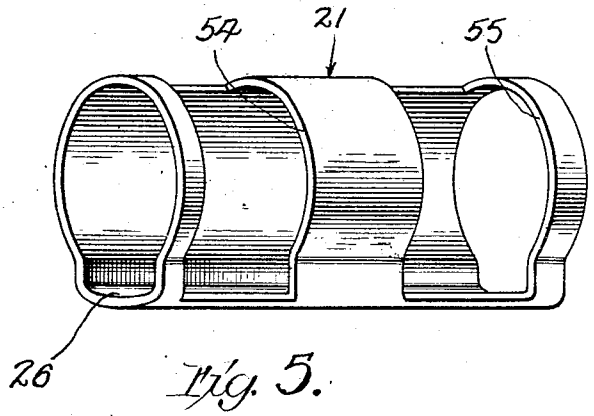

Fig. 5.

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UNITED STATES PATENT OFFICE.

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EXPLOSIONPROOF FUSE.

Application filed June 24, 1920. Serial No. 391,393.

This invention relates to improvements in explosion-proof electrical fuses or cutouts, and has for its principal object to provide a safety fuse for use in gaseous mines, or under similar conditions in which explosions may be caused by the arcing of exposed fuse connections.

To this end, I provide an improved construction comprising a renewable fuse element and a casing therefor, in which the fuse is enclosed in the casing, and cannot be removed therefrom without first breaking the electric circuit.

A further object of this invention is to provide a construction in which it is practically impossible to insert a substitute for the fuse element between the fuse connections.

Further objects will appear from the following description, reference being had to the accompanying drawings, in which Figure 1 is a vertical cross-section of my improved device, showing the fuse element in locked position in the casing.

Figure 2 is an end view of the casing.

Figure 3 is a vertical cross-section of the casing and fuse element taken on line 3—3 of Figure 1.

Figure 4 is a vertical cross-section of the fuse element, removed from the casing.

Figure 5 is a detail.

Referring now to the details of the construction, my device comprises two main elements, namely; an outer casing 1, and a removable fuse element 2 adapted to be inserted at one end of the casing 1, and locked therein, so as to provide a practically air-tight enclosure.

The outer casing 1 comprises a cylindrical body 3, preferably of metal, enclosed at one end by a threaded plug 4 and at the opposite end by the fuse element 2 already referred to. A pair of metallic connecting members 9 and 10 are separated from each other in the casing, and encircle the chamber adjacent the outer wall 3 of the casing, but are insulated therefrom by means of suitable insulation pieces 11 and 12, respectively. Connecting members 9 and 10 each comprise a spring member 9^a, and a contiguous conducting member, or "shunt" 9^b. The spring member 9^a is preferably of phosphor bronze, or other material suitable for use as a spring, while the conducting member, or "shunt" 9^b, is preferably made up of a plurality of thin copper plates, of high relative conductivity, so as to carry most of the current. This arrangement is provided so that the tensional properties of the spring member 9^a are not affected by heating. As shown in Figure 3, the connecting members 9 and 10 are preferably constructed in the form of rings, and arranged eccentric with respect to the casing. They are connected to the outside terminals 5 and 6 by means of studs 7 and 8, having heads 13 and 14. The studs are inserted thru suitable holes in the rings 9 and 10, and secure the said connecting rings by threaded nuts 15 and 16 on the terminals. Contact shoes 17 and 18 are attached to the upper portions of the rings 9 and 10 respectively, and are adapted to provide contact with corresponding contact members 19 and 20 carried by the fuse element 2.

Inside of the ring-shaped connectors 9 and 10 is inserted an insulating member 21 which extends practically the entire length of the casing, and is held in place by insulating disks 23, 24 and 25 supported by the casing wall 3. Said insulating member (shown in detail in Figure 5) is so proportioned in cross-section as to receive the fuse element 2 therein, and includes a depending wall portion 26 extending the full length thereof, which receives the contact members 19 and 20 of said fuse element when the fuse element is inserted in its inverted position, as will hereinafter be more fully described.

Referring now particularly to the fuse element 2, I prefer to utilize a so-called "removable link" fuse in connection with my device, details of which are shown in Figure 4. The inner contact member 20 of the fuse element extends laterally from the inner end of an insulator tube 27, and preferably has a circular portion 28 enclosing one end of said tube. An end portion 27^a of the tube extends flush with the outer face of the disk 28 excepting adjacent the contact member, for a purpose which will hereinafter be described. The opposite, or outer end of the tube 27 is detachably connected to a cap member 29, preferably having threaded engagement 30 in a collar 31 which is rotatably mounted at the inner face of the cap member 29 and secured thereto by means of a plate 32. The collar 31 is knurled as shown in Figure 1 so that the tube may be readily screwed and unscrewed by hand, to assemble

or disassemble the fuse element. A slot 33 extends longitudinally from the outer end of the tube 27, toward the center thereof. The disk 32 is provided with a lip 34 which fits in this slot and holds the insulating tube in proper relation to the plug 29 when the fuse element is assembled. Contact member 19 of the fuse has a constricted portion 36, adapted to extend thru the slot 33 and connecting with a fuse terminal member 37. Said terminal member has a collar 38 which fits against a shoulder 39 on the inner face of the insulating tube 27, and is held thereagainst by a spacing collar 40 which abuts the inner end of the disk 32 when the fuse element is assembled. The opposite terminal for the fuse link comprises a terminal piece 41 having an enlarged flange 42, and a spindle 43 which extends thru the end disk 28 on the inner end of the fuse element. The spindle 43 has a threaded portion 44 adjacent the outer face of the end disk 28, and is provided with a nut 45 which clamps the terminal member to said disk. The fuse link 35 is detachably connected between the link terminals 37 and 41 in any suitable manner, as for instance by bolts 56, 56.

The end of the spindle is adapted to fit in a recessed bushing 46, formed in the plug 4, but insulated therefrom by insulating bushing 47.

The outer end of the fuse element comprises the plug 29 having an annular body portion 49 adapted to fit tightly in the neck 50 of the casing, and has a long bearing surface therein, so as to provide an "explosion-proof" joint, in which any flame from an arc, or an explosion caused thereby, within the casing, cannot reach the outer air. The fuse element 2 is provided with a handle 51, and is adapted to be locked in the casing by means of a segmental flange 52 which is adapted to engage a corresponding lip 53 on the casing.

The operation of my device is as follows: The fuse element 2 is inserted in the casing with the contact members 19 and 20 in their inverted, or downward position, so as to register with the insulating tube 21 and the downwardly extending portion 26 thereof, hereinbefore described. When the fuse element is inserted to its farthest limit, the pin 43 seats in the recess 46. The entire fuse element is then turned a half turn by means of the handle 51 so that the locking flange 52 on the fuse element engages with the lip 53 to lock the fuse element firmly in place, as shown in Figure 1. As the fuse element is thus rotated, the contact members 19 and 20 are also removed from the inverted, or downward position. Two segmental slots 54 and 55 (shown in Figure 5) are provided in the insulating tube 21, with which the contact members 19 and 20 are adapted to register, so that they may be turned from their inverted, or downward position to a second position indicated in Figure 1, where they engage with the contact shoes 17 and 18, respectively. In this position, therefore, the fuse element is locked in the casing and the circuit thru the fuse is closed. It will now be clear that in order to unlock the fuse element and casing, it is necessary to reverse the above described action, by rotating the fuse element so as to move the contact members 19 and 20 out of engagement with their respective contact shoes 17 and 18, before the locking flange 52 can be unlocked, and the fuse element withdrawn from the casing.

I prefer to make the slot 54 and contact member 19 somewhat shorter than the contact member 20, so that the latter cannot be accidently engaged with the contact shoe 17. Otherwise, if it were possible to insert the fuse element part way into the casing, and then rotate it to contact the member 20 and shoe 17, a short-circuit might be formed thru the fuse and contact member 19 to the casing 3. The possibility of such a short-circuit is eliminated, however, by constructing the shoes and slots of different lengths, as described.

I provide another safety feature in the construction of the inner end of the fuse element, in which the insulation 27^a extends flush with the end portion 28 of the contact member 20, as already described. I have found that it is possible to insert the fuse element at such an angle that the forward edge 27^a of the fuse element may extend thru the slot 54 and engage with the contact shoe 17. As this forward edge 27^a is insulated however, the possibility of short-circuit from this cause is eliminated.

A further feature of my invention is a construction which makes it practically impossible for a careless operator to insert a substitute for the fuse element so as to close the circuit within the casing while the casing is unlocked. It is well known to those familiar with the operation of safety devices of this character, that in spite of all warnings as to the danger of overloading a circuit, and of explosions caused by open fuse contacts, yet a large proportion of operators will ignore all provisions for their own welfare by attempting to contrive some method of defeating the purpose of the safety device. One of the common practices is to connect the ordinary fuse terminals with fuse wire, and in fact common wire, and many other articles, are used for this purpose. It will be seen, however, that with my improved construction, it is practically impossible to reach the contact shoes 17 and 18 for the purpose of connecting these terminals with any substitute for the fuse element in the manner above suggested. While it may be possible to insert fuse wire or other substitute for the fuse link 35, yet when this is done, the entire

fuse element 2 must be inserted and locked before proper contact of the fuse device can be made.

Having described my invention what I claim as new and desire to cover by Letters Patent, is:

1. In a device of the class described, a casing, a removable fuse element having a portion thereof adapted to form a closure for said casing, electrical contacts for said fuse element within said casing, contact members associated with said fuse element adapted to engage said contacts, and means independent of said contacts for locking said closure in all positions of engagement between said contacts and contact members.

2. In a device of the class described, a casing, a removable fuse element having a portion thereof adapted to form a closure for said casing, electrical contacts within said casing, contact members on said fuse element adapted to engage the first named contacts, and means independent of said contacts permitting insertion and removal of said fuse element only when said fuse contact members are out of engagement with said contacts.

3. In a device of the class described, a cylindrical casing, a rotatable fuse element having an annular portion thereof adapted to form a closure for said casing, electrical contacts for said fuse element within said casing, means permitting longitudinal movement of said fuse element within said casing when said fuse contacts are out of longitudinal alignment with said casing contacts, and means permitting rotation of said fuse element in said casing only when said annular portion is in fully closed position in said casing.

4. In a device of the class described, a casing, a removable fuse element having a portion thereof adapted to form a closure for said casing, a pair of contacts for said fuse element in said casing, contact members on said fuse element, means permitting insertion and removal of said fuse element in one position with said fuse contact members removed from said casing contacts; means affording movement of said fuse element in a second position with said fuse contact members in engagement with said casing contacts, and means operable to lock said closure against longitudinal movement, in a position intermediate the two first mentioned positions of said fuse element.

5. In a device of the class described, a casing, a rotatable fuse element having an annular portion thereof adapted to form a closure for said casing, and having a pair of laterally extending contact members, a pair of contacts in said casing for said fuse contact members, said casing having a passageway affording entrance of the fuse element in an axial direction with the respective fuse and casing contacts maintained at a distance from each other, and means whereby the fuse element may be rotated to engage the respective fuse and casing contacts only when said fuse element is in closed position in said casing.

6. In a device of the class described, a casing, a rotatable fuse element adapted to be inserted in said casing to form a closure therefor, said fuse element having a pair of laterally extending contact members and a lock, contacts in said casing for said fuse contact members, said casing having a passageway affording entrance of the fuse element in an axial direction with the respective fuse and casing contacts removed from each other, and means independent of said contacts whereby the fuse element may be rotated to lock said fuse element against axial movement, and to engage the respective fuse and casing contacts, said fuse element being locked at all times that said fuse and casing contacts are engaged.

7. In a device of the class described, a casing, a fuse element having an end portion thereof adapted to form a closure for said casing and provided with laterally extending contact members, electrical contacts in said casing, insulating means in said casing having a passageway affording entrance of said fuse element with said fuse contact members maintained out of registering position with said casing contacts, said insulating means also permitting rotation of said fuse contacts into and out of engagement with said casing contacts when said casing is fully closed by said fuse element.

8. In a device of the class described, a casing, a fuse element having an end portion thereof adapted to form a closure for said casing and provided with laterally extending contact members, electrical contacts in said casing, insulating means in said casing having a passageway affording entrance of said fuse element with said fuse contact members maintained out of registering position with said casing contacts, said insulating means also permitting rotation of said fuse contacts into and out of engagement with the casing contacts when said casing is closed by said end portion of the fuse element, and means independent of said contacts for locking said fuse element against endwise movement in said casing when the respective fuse and casing contacts are engaged with each other.

9. In a device of the class described, a casing having electrical contacts therein, a fuse element having longitudinally spaced, laterally extending contact members, insulating means in said casing having a longitudinal passage permitting endwise entrance of said fuse element when the fuse contacts are out of registering position with respect

to said casing contacts, said insulating means also having a pair of slots affording rotation of said contacts into and out of engagement with the casing contacts, the inner fuse contact member being of larger proportions than the outer slot.

10. In a device of the class described, a casing having electrical contacts therein, a fuse element having laterally extending contact members, insulating means in said casing having a longitudinal passage permitting endwise entrance of said fuse element when the fuse contacts are out of registering position with respect to said casing contacts, said insulating means also having a pair of slots affording rotation of said contacts into and out of engagement with the casing contacts, and guiding means coacting between the inner end of said fuse element and the casing.

11. In a device of the class described, a casing, a pair of electrical contacts in said casing, spring devices securing said electrical contacts to the casing, a fuse element having laterally extending contact members, insulating means in said casing having a passage permitting entrance of said fuse element when the fuse contacts are out of registering position with respect to said casing contacts, and means affording rotation of said fuse contacts into and out of engagement with the casing contacts.

12. In a device of the class described, a casing, a pair of electrical contacts in said casing, spring devices securing said electrical contacts to the casing, conductor pieces associated with said spring devices, a fuse element having laterally extending contact members, insulating means in said casing having a longitudinal passage affording endwise entrance of said fuse element when the fuse contacts are out of registering position with respect to said casing contacts, and means affording rotation of said fuse contacts into and out of engagement with the casing contacts.

13. In a device of the class described, a casing, a removable fuse element comprising an annular end portion adapted to form a closure for said casing, and a detachable body portion having an insulating cover, a pair of laterally disposed contact members extending therethru, and a fusible piece connecting said contact members, said contact members being adapted to engage with contact members in said casing when the fuse element is in closed position.

14. In a device of the class described, a casing, a removable fuse element comprising an annular end portion adapted to form a closure for said casing, and a detachable body portion extending axially from said end portion having an insulating cover, a pair of laterally disposed contact members extending therethru, and a fusible piece connecting said contact, said contact members being adapted to engage with contact members in said casing when the fuse element is in closed position.

15. In a device of the class described, a casing, a removable fuse element comprising an annular end portion adapted to form a closure for said casing, and a detachable body portion having an insulating cover, a pair of laterally disposed contact members extending therethru, a fusible piece connecting said contact members, said contact members being adapted to engage with contact members in said casing when the fuse element is in closed position, and guiding means coacting between the inner end of said fuse element and said casing.

Signed at Chicago, Illinois, this 22nd day of June, A. D., 1920.

WILLIAM W. SLOANE.