

Oct. 28, 1930.

E. LYNDON

1,779,610

FIRE DETECTING CABLE

Filed May 18, 1927

Fig. 1

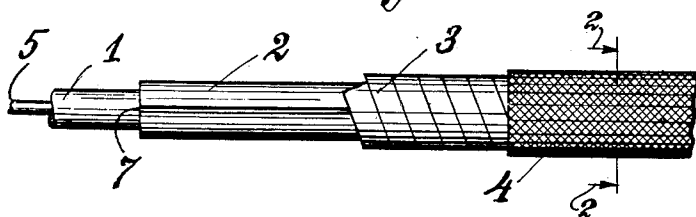


Fig. 2

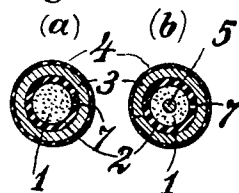


Fig. 3

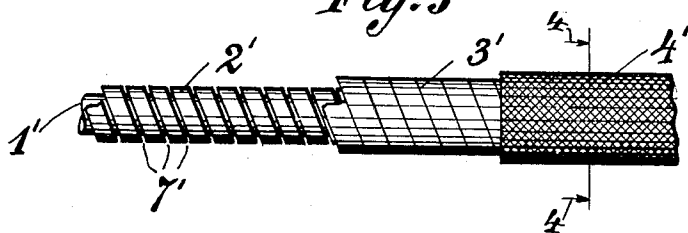


Fig. 4

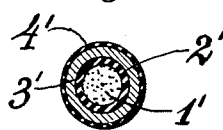


Fig. 5

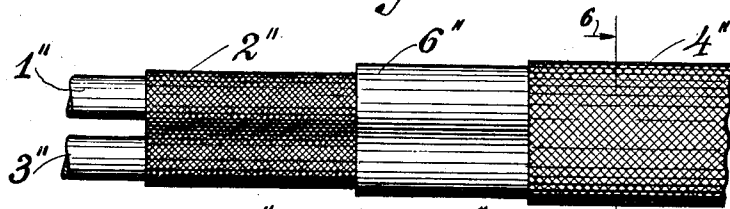


Fig. 6

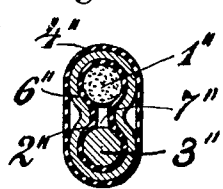


Fig. 5a

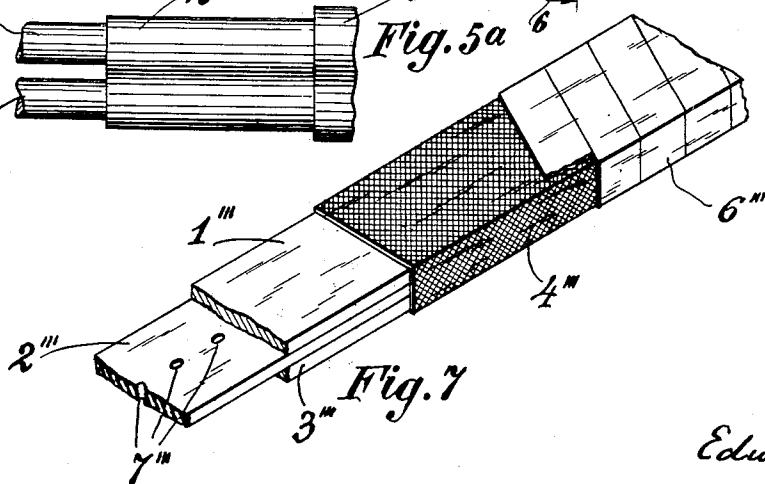
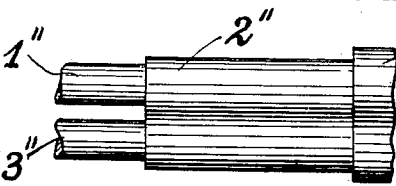


Fig. 7

Edward Lyndon
Inventor
By Alexander Chessin
his Attorney.

UNITED STATES PATENT OFFICE

EDWARD LYNDON, OF NEW YORK, N. Y.

FIRE-DETECTING CABLE

Application filed May 18, 1927. Serial No. 192,234.

My invention relates to electric cables adapted for use in detecting fires and in fire alarm signalling and is based on the closing of a circuit upon the rising of temperature in the vicinity of the cable.

Among the improvements of my device over existing devices of this character are its simplicity of structure and of operation, ease of manufacture, security against failure due to oxidation of the alloy or fusible metal forming one of its essential elements, and reliability of its action in general.

In the operation of my device, an alloy of low fusibility, rendered plastic by the action of heat, is discharged under pressure through a duct which is very small as compared with the volume of the alloy for any definite length of the cable. As soon as the alloy is reduced to a plastic state by the action of heat, the pressure developed in the space within which it is confined forces the plastic mass through this duct into contact with one of the leads or conductors in the cable, thereby closing a circuit, the alloy constituting the other lead of this circuit.

Referring to the drawings, Figure 1 is one form of my invention, with sections of various elements uncovered to show the structure of the device; Figures 2, (a) and (b), are cross sections of the form of my invention shown in Figure 1, the figure (b) including a central core of hard metal and figure (a) having this central core omitted. Figure 3 is another form of my invention, and Figure 4 is a cross section of Figure 3 along the line 4—4. Still another form of my invention is shown in Figures 5 and 5', Figure 6 being a cross section of Figure 5 along the line 6—6; and in Figure 7 is shown a substantial modification of my invention, in perspective.

For the purpose of this application, it may be assumed that Figures 1 to 4 embody the preferred form of my invention. In these figures, 1 and 1' are cores of an alloy metal of low fusibility. This core of alloy may be solid, as shown in Figure 2 (a) and Figures 3, 4, or it may have a central core of hard metal, 5, as shown in Figures 1 and 2 (b). The alloy 1 or 1' is surrounded by an electric insulation in either the form 2 or 2'. In

the first case, the insulation 2 has a longitudinal slit 7 the entire length of the cable or of a fixed section thereof, in the second, the corresponding insulation 2' forms a spiral duct 7' serving the same purpose as the slit 7, as will be explained further below. The insulation 2 or 2' is permeable to heat but not to the alloy when fused. Around the insulation 2 or 2' is spirally wound a tape of hard metal, such as steel, for instance, forming a metal conductor 3 or 3' within which the electrically insulated core of alloy 1 or 1' is thus confined. This completes the cable as applicable for the purposes here intended, but I may cover it with a suitable electric insulation, 4 or 4', if so required, preferably of a loose fabric.

Generally, it is desirable to make the operation of the device subject only to a sustained action of heat, to avoid the frequent trouble of false alarms due to accidental rises of temperature in the vicinity of the cable or to effects of such a rise in temperature which is of but short duration. I may accomplish this result in two ways, either by making the mass of alloy per unit of cable length larger in proportion, so that it takes a longer time to heat the confined alloy to the necessary plastic stage, or by a proper selection of the material for the insulation 2, 2', which may be readily heat conductive or of slow heat conductivity. The latter method is, of course, preferable because of lower cost.

In the forms of my invention illustrated in Figures 1 to 4, the core of alloy 1 or 1' serves as one of the conductors of electric current, while the current in opposite direction has its path through the metal envelope 3 or 3'. The circuit remains open so long as the two conductors 1 and 3, or 1' and 3', are out of contact. When the temperature at any point along the cable rises high enough to cause the alloy core 1 or 1' to become plastic, the pressure developed in the confined space within the conductor 3 or 3' due to the expansion of the alloy will extrude the plastic mass through the duct 7 or 7' into contact with the conductor 3 or 3', closing the circuit. The closing of the circuit may be utilized in any one of the standard ways for the purpose of

setting an alarm to work or to otherwise signal the occurrence which usually denotes a fire in the vicinity of the cable.

In order to make the extrusion of the alloy effective to establish contact with the hard metal conductor 3 or 3', I prefer to make the volume of the duct, whether in the form of the slit 7 or the spiral 7', less, per unit of cable length, than the volumetric increase of the alloy when heated to a state of plasticity; or, I may make it substantially equal to this increase after allowing for the expansion of the conductor 3 or 3', so that the duct is entirely filled with the extruded metal. The effect of the pressure under which the metal is extruded is beneficial not only because of the assured full contact, but also because it eliminates the trouble which is likely to occur owing to the unavoidable oxidation of the surface of the alloy. Such oxidation is liable to take place whenever the cable has been exposed for any length of time because it is impossible to prevent the air from coming in contact with the surface of the alloy, especially if the steel bands 3, 3' are not overlapping. Some air must in the nature of things be enclosed in the cable in all cases, even if admission of further air could be prevented without actually sealing the cable along its entire length. If the alloy were allowed to merely flow without pressure, its oxidized surface would make the contact with the conductor 3 very uncertain, but when the plastic metal is forcibly extruded, the oxidized surface is broken up and clean parts of the alloy are discharged through the broken surface of oxidation, assuring a good electrical contact for the small current used in the application of such devices.

While I have illustrated a particular type of my invention in the two embodiments shown in Figures 1 to 4, it is to be understood that these illustrations do not preempt the many variations of which this particular type is capable, and that the two illustrations given are to be considered only as good examples of this type.

The central core 5 in Figures 1 and 2 (b) has only the purpose of strengthening the core of the alloy 1, although it may have the additional advantage of reducing the cost of the cable.

Passing now to the other embodiments of my invention, the one illustrated in Figures 5 and 6 shows an arrangement of two parallel and separate cores, one, 1'' of a metal alloy of low fusibility, and a second one, 3'' of a hard metal, preferably copper. In this case, the current is made to flow in one direction through the core of alloy 1'' and in the opposite direction through the core of copper 3'', these two cores constituting the two leads or conductors of the circuit. They are held out of contact with one another by the envelope of hard metal, 6'', which may be a spirally

wound steel band or of any other suitable structure, pressed in midway between the two conductors 1'' and 3'' along the entire length of the cable to form a gorge 7''. An electric insulation, 2'', surrounds the two conductors 1'' and 3'' and separates them from the envelope 6''. This insulation 2'' is permeable to heat but not to the fused alloy. The cable may be covered with an electric insulation 4'' if so desired. The gorge 7'' functions in this case as the open duct between the two conductors. The insulation 2'' may be an impregnated fabric, or, as shown in Figure 5^a, made of a non-porous material.

In the embodiment of my invention illustrated in Figure 7, the tubular members of the previously considered types are replaced by flat bands. The metal band of an easily fusible alloy, 1''', and the band of hard metal, preferably copper, 3''', are held out of contact with one another by the band of insulating material 2'''. Perforations 7''' along the entire length of the cable serve as the duct through which the fused alloy is extruded to establish contact with the conductor 3'''. An insulation 4''' surrounds the three bands 1''', 2''' and 3''', and may be a fabric impregnated with a suitable substance which makes it impermeable to the fused alloy but permeable to heat. An envelope of hard metal, 6''', shown in Figure 7 as a spirally wound band of steel, confines the alloy as it expands under the action of heat.

It should be noted that the duct in all the embodiments of my invention, as illustrated, is entirely open and unobstructed, all the way from the fusible metal 1 (or 1', 1'', 1''') to the conductor 3 (or 3', 3'', 3'''). It has been customary in devices of this character to cause the fused alloy to penetrate a permeable insulation, usually a loose fabric, which is entirely avoided in my arrangement. I find that such an obstruction in the path of the fused alloy is detrimental in that the contact is never assured in such cases because of the interfering fabric and because the contact is of the needle form, i. e. the actual area of contact is only a fraction of the necessary contact area, so that too much resistance is offered to the passage of the small current used in the application of such devices. In the arrangement as here shown the contact is always perfect and of sufficient area to permit the small current to pass from one conductor to the other and thus insure the closing of the circuit.

Having fully described my invention, I claim:

1. In an electric cable, a conductor of hard metal, a second conductor of an easily fusible alloy, and impermeable means surrounding said second conductor for holding said two conductors out of contact at normal temperatures having an open duct from one of said

conductors to the other, said alloy being adapted to be extruded through said duct and establish contact with said hard metal conductor when heated to a plastic state.

2. In an electric cable, a conductor of hard metal, a second conductor of an easily fusible metal, and impermeable means surrounding said second conductor for holding said conductor out of contact at normal temperatures having an open duct from one of said conductors to the other, the volume of said duct for any given length of said cable being less than the volumetric increase of said easily fusible metal for the same length of cable when heated to a predetermined temperature.

3. In a cable, a conductor of hard metal, a second conductor of an alloy of low fusibility parallel thereto, and impermeable means confining said second conductor and holding said two conductors out of contact at normal temperatures provided with an open duct from one of said conductors to the other, said alloy being adapted to be extruded through said duct and make contact with said hard metal conductor when heated to a predetermined temperature.

4. In a cable, a conductor of hard metal, a second conductor of an easily fusible metal parallel thereto, impermeable means confining said second conductor and holding said conductors out of contact at normal temperatures provided with an open duct from one of said conductors to the other within said means, the volume of said duct for any given length of cable being less than the volumetric increase of said easily fusible metal for the same length of cable when heated to a plastic state, and an insulation for said cable.

5. In an electric cable, a conductor of hard metal, a second conductor of an easily fusible metal confined within said hard metal conductor, and an impermeable electrical insulation therebetween having an open duct between said conductors, said easily fusible metal being adapted to be extruded through said open duct and establish contact with said hard metal conductor when said cable is heated to a temperature sufficient to render said easily fusible metal plastic.

6. In an electric cable, a conductor of hard metal, a second conductor of an easily fusible metal confined within said hard metal conductor, and an impermeable electric insulation around said second conductor provided with a duct between said two conductors, said easily fusible metal being adapted to be extruded through said duct and establish contact with said hard metal conductor when said cable is heated to a predetermined temperature.

7. In a cable, a conductor of a metal having a comparatively high fusing point, a second conductor of an easily fusible metal confined within said first mentioned conductor, and a core of hard metal in said second con-

ductor, an impermeable electric insulation around said second conductor provided with a duct between said two conductors, said easily fusible metal being adapted to be extruded through said duct and establish contact with said first mentioned conductor when said cable is heated to a temperature sufficient to render said easily fusible metal plastic.

8. In an electric cable, a core of easily fusible metal, an impermeable electric insulation around said core, and a steel band spirally wound around said insulation, said insulation having a duct between said core and said steel band, and said easily fusible metal being adapted to be extruded through said duct and establish contact with said steel band when said cable is heated to a predetermined temperature.

9. In an electric cable, a core of easily fusible metal, an electric insulation around said core having a slit along the entire length of said cable, and a steel band spirally wound around said insulation, said easily fusible metal being adapted to be extruded through said slit and establish contact with said steel band when said cable is heated to a predetermined temperature.

10. In an electric cable, a conductor of hard metal, a second conductor of an easily fusible metal confined within said hard metal conductor, and an impermeable electrical insulation between said conductors having a duct from one of said conductors to the other, the volume of said duct for any given length of said cable being less than the volumetric increase of said easily fusible metal for the same length of cable when said cable is heated to a predetermined temperature.

11. In an electric cable, a conductor of hard metal, a second conductor confined within said hard metal conductor made of an easily fusible metal and having a central reinforcing core of hard metal, and a non-permeable, heat conducting insulation between said conductors having a duct from one of said conductors to the other, the volume of said duct per unit of cable length being less than the volumetric increase in said easily fusible metal when said cable is heated to a predetermined temperature.

12. In an electric cable, a conductor of hard metal, a second conductor of an easily fusible metal therewithin, a non-permeable, and heat conducting electric insulation between said conductors having a duct from one of said conductors to the other, said easily fusible metal being adapted to be extruded through said duct and establish contact with said hard metal conductor when said cable is heated to a predetermined temperature.

13. The combination with a conductor of hard metal, of a second conductor of an easily fusible metal confined therewithin, a non-permeable, and heat conducting insula-

- tion between said conductors having a longitudinal slit the entire length of said conductors, the volume of said slit for any given length of said conductors being less than the volumetric increase of said easily fusible metal for the same length of the conductors when said easily fusible metal is heated to a predetermined temperature.
14. In combination, a wire of an easily fusible alloy, a non-permeable, heat conducting insulation around said wire having a longitudinal slit the entire length of said wire, and a steel band spirally wound around said insulation.
15. In combination, a wire of an easily fusible metal, a non-permeable, heat conducting insulation around said wire, and a tubing of hard metal around said insulation, said insulation having an opening the entire length of said wire between said wire and said tubing.
16. In combination, a tubular conductor of hard metal, a conductor comprising an easily fusible metal therewithin, and a non-permeable, heat conducting insulation between said conductors having a duct between said conductors the entire length thereof.
17. The combination with a conductor of hard metal, of a second conductor comprising an easily fusible metal and confined within said hard metal conductor, and a non-permeable, heat conducting insulation between said conductors having a duct from one of said conductors to the other, the volume of said duct for any given length of said conductors being less than or substantially equal to the volumetric increase of said easily fusible metal for the same length of the conductors when heated to a predetermined temperature, allowing for the expansion of said hard metal conductor.
18. In an electric cable, a conductor of hard metal, a second conductor of an easily fusible metal, and impermeable means for holding said conductors out of contact at normal temperatures, which means is adapted to confine said second conductor and is provided with an open duct between said conductors, said easily fusible metal being adapted to be extruded through said duct and establish contact with said hard metal conductor when heated to a predetermined temperature.
19. In an electric cable, a conductor of hard metal, a second conductor of an easily fusible metal, and impermeable electrical insulation therebetween having an open duct from one of said conductors to the other, said conductor of hard metal being adapted to confine said second conductor, and said easily fusible metal being adapted to be extruded through said duct and establish contact with said hard metal conductor when heated to a predetermined temperature.
20. In combination, a wire of an easily fusible alloy, a non-permeable, heat conducting insulation around said wire having a longitudinal slit the entire stretch of a fixed length thereof, and a metal sheath around said insulation.
21. In combination, a wire of an easily fusible metal, a non-permeable, heat conducting insulation around said wire, and a sheath of hard metal around said insulation, said insulation having a duct the entire stretch of a fixed length of said wire between said wire and said sheath.
- EDWARD LYNDON.