March 22, 1938. E. F. BOOTHE 2,111,745

SECONDARY FUSE

Filed Dec. 14, 1936

Fig. 1

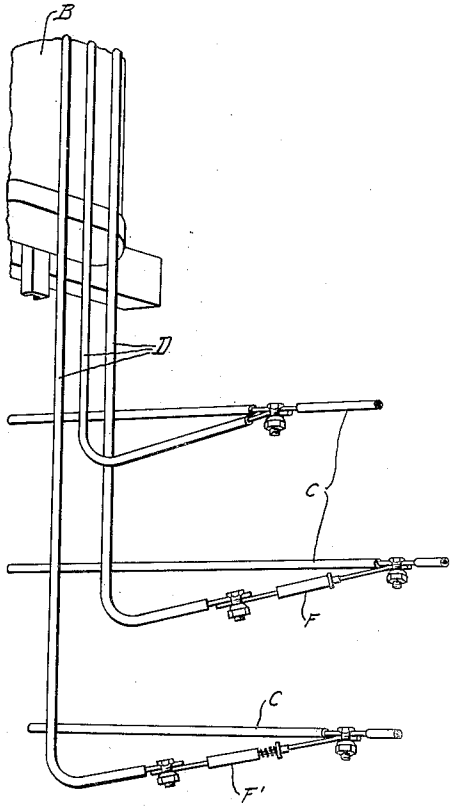


Fig. 2

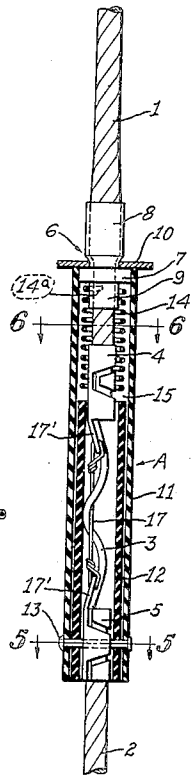


Fig. 3

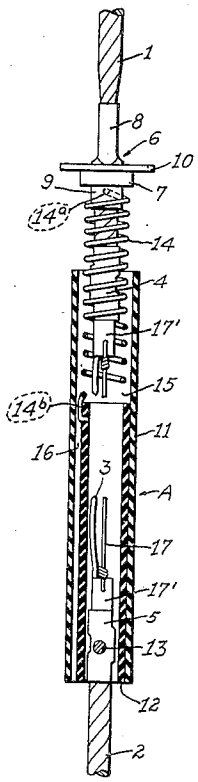


Fig. 4

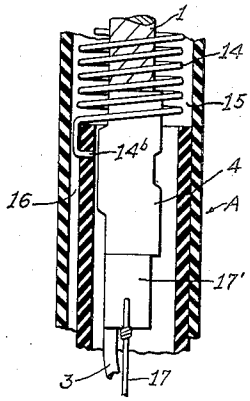


Fig. 5

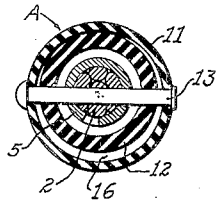
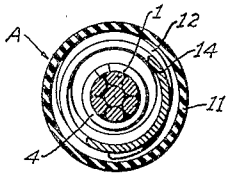


Fig. 6



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SECONDARY FUSE

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Application December 14, 1936, Serial No. 115,652

9 Claims. (Cl. 200—117)

This invention relates generally to secondary fuses and more specifically to a fuse of this type which includes expansible spring means adapted on rupture of the fusible link of the fuse to quickly separate the ruptured ends of said fusible link so as to extinguish the arc, the predominant object of the invention being to provide a fuse of this improved construction and arrangement which in addition to performing its intended function in an improved and highly efficient manner indicates, by the positions of certain of its parts whether or not the fuse has been blown.

As is generally known by persons familiar with the distribution of electrical energy practically every system of overhead secondary in urban districts consists of a network or grid, minus the actual interconnections between individual transformer sections. In general the gaps between transformer sections consist of strain insulators inserted in the outer wires of the three-wire secondary, the neutral of the secondary usually being carried through as a solid interconnected and grounded grid throughout, the area served, thus assuring maximum protection which follows the paralleling of all protecting grounds on the low voltage main. In order to establish in such a system an interconnected low voltage overhead network it is only necessary to bridge these secondary gaps and ordinarily this is accomplished through the use of secondary fuses. These secondary fuses may be bridged across strain insulators between transformer sections, or one of said secondary fuses may be arranged in each live leg of each transformer secondary. Also in some cases a combination of these two methods is employed. Additionally in most cases secondary fuses are inserted in service taps which supply unusually heavy service and those installed in conduits extended down a pole and leading underground to a consumer's premises.

Because of a demand for a secondary fuse which is capable of performing its intended function in a highly efficient manner I have devised the improved fuse structure disclosed herein, the predominant feature of which is that an expansible coil spring is incorporated in the fuse structure in such manner that the ruptured ends of the fusible element of the fuse are quickly pulled apart when the fusible element blows. Also because of the use of this coil spring a part of the fuse strcture and a part of the coil spring are moved to such outwardly extended positions when the fuse blows as to readily indicate to a person inspecting the fuse structure that the fusible element thereof has been ruptured.

Fig. 1 is a view illustrating one manner of use of the improved secondary fuse.

Fig. 2 is a sectional-elevation of the improved secondary fuse showing same in an unblown condition.

Fig. 3 is a view similar to Fig. 2, but showing the fuse illustrated therein in a blown condition.

Fig. 4 is an enlarged fragmentary sectional view of a portion of the improved fuse.

Fig. 5 is an enlarged cross-section on line 5—5 of Fig. 2.

Fig. 6 is an enlarged cross-section on line 6—6 of Fig. 2.

In the drawing, wherein is shown for the purpose of illustration, merely, one embodiment of the invention, A designates the improved secondary fuse generally. The fuse A comprises a pair of cables 1 and 2 which serve as fuse terminals, said cables being spaced apart at their adjacent inner ends to provide a gap as shown to the best advantage in Fig. 2. When the improved secondary fuse is in its normal unblown condition as shown in Fig. 2, the spaced apart inner end portions of the cables 1 and 2 are joined by a fusible element 3 which is provided at its opposite ends with clamping means 4 and 5 adapted to be securely clamped or crimped to said end portions of the cables so as to mechanically and electrically connect the cables together. The clamping means 4 and 5 comprise each a piece of bendable metal having portions adapted to be bent into embracing relation with respect to the associated cable as shown in Figs. 2, 5, and 6, and the fusible element 3 is soldered or otherwise secured at its opposite ends to said clamping means.

Secured to the cable 1 is a tube retaining element 6 which comprises an intermediate annular flange 7 from which is extended outwardly a sleeve portion 8 the metal of which is thin enough to be pliable. Extended in the opposite direction from the intermediate flange 7 is a collar 9 which is of less diameter than said intermediate flange. Also the tube retaining element 6 includes a centrally apertured disk 10, the reduced inner portion of the sleeve portion 8 being extended through the aperture of the disk and the portion of the disk surrounding the aperture being confined between the larger portion of the sleeve portion and the intermediate flange 7. The tube retaining element 6 is provided with an opening formed entirely therethrough and the cable 1 is extended through said opening, said tube retaining element being secured to said cable by having the sleeve 8 crimped into tight frictional engagement therewith.

The improved secondary fuse includes a tube 11 formed of Bakelite or other suitable weather-resisting material which at one of its ends contacts with the disk 10 and embraces the intermediate annular flange 7 of the tube retaining element, the inner face of said tube 11 at said end thereof being in close contact with the peripheral face of said intermediate annular flange. Arranged within the tube 11 is a second tube 12 which is formed of horn fibre or other suitable material characterized by the ability to give off a gas in the presence of an electric arc that tends to extinguish said electric arc. The tubes 11 and 12 terminate in alinement at one end of the combined tube structure as shown in Figs. 2 and 3 and at this end of said tube structure the tubes are secured together and to the cable 2 by a pin 13 which extends through apertures formed through the walls of the tubes 11 and 12 and through apertures formed through the clamping means 5 and the cable 2.

Arranged in embracing relation with respect to the inner portion of the cable 1 is a coil spring 14. One end of the coil spring 14 is attached to the tube retaining element 6 by having an end portion 14*a* thereof extended into an opening formed in the collar 9 of said tube retaining element, and the opposite end of said coil spring is attached to the inner tube 12 by having an end portion 14*b* of the coil spring inserted in an aperture formed in the wall of said inner tube. By referring to Figs. 2, 3, and 4 it will be noted that the inner tube 12 is of less length than the outer tube 11 to provide a space 15 in which the coil spring 14 is located. Also the relative diameters of the tubes 11 and 12 are such that a space 16 is present at one side of the tube structure between the walls of said tubes which permits a portion of the coil spring adjacent to the portion 14*b* thereof to extend between said walls of the tubes 11 and 12.

In the normal unblown condition of the improved secondary fuse the coil spring is compressed as shown in Fig. 2 and to retain said coil spring in such condition and eliminate imposition of mechanical strain created by the contracted coil spring on the fusible element 3 a strain wire 17 is provided. The strain wire is suitably secured at its opposite ends to extensions 17′ of the clamping means 4 and 5 and is of sufficient strength to hold the coil spring in its retracted condition.

When in the use of the improved secondary fuse abnormal passage of current therethrough occurs, the fusible element 3 is ruptured and the resultant electric arc immediately severs the strain wire 17. This frees the contracted coil spring 14 from restraint and said coil spring expands quickly and forcibly to the position shown in Fig. 3 thereby drawing the ruptured ends of the fusible element and the strain wire apart to extinguish the electric arc, such extinguishment of the electric arc being aided by a gas formed when the inner horn fibre tube 12 is subjected to the heat of the electric arc. It is to be noted that the opposite ends of the coil spring are attached to the cable 1 through the tube retaining element 6 and to the cable 2 through the inner tube 12, hence the separated parts of the fuse structure do not fly entirely apart when the fuse blows but are held together in a separated condition by the coil spring. Also when the improved fuse has been blown a part of the coil spring and the tube retaining element are projected a considerable distance beyond the adjacent end of the tube 11 to provide a visual indication that the fuse has blown.

In Fig. 1 I illustrate a typical installation involving the use of secondary fuses of the type disclosed herein. In this view B designates a transformer supported by a suitable element such as a crossarm of a pole, which transformer is electrically connected to power lines C by a transformer secondary D. The installation illustrated includes secondary fuses F and F′ in the live legs of the transformer secondary, the secondary fuse F′ being illustrated in the blown condition.

I claim:—

1. A secondary fuse comprising terminal cables spaced apart at their inner adjacent ends to provide a gap, a fusible element bridging said gap and electrically connected at its opposite ends to said terminal cables, an expansible coil spring arranged in a contracted condition and adapted on rupture of said fusible element to expand and draw the ruptured ends of said fusible element apart, and a tube enclosing said fusible element, said coil spring and inner portions of said terminal cables when the fuse is in an unblown condition, said coil spring being maintained in a position where a portion thereof is extended from an end of said tube when the fusible element has been ruptured so as to indicate the blown condition of the fuse.

2. A secondary fuse comprising terminal cables spaced apart at their inner adjacent ends to provide a gap, a fusible element bridging said gap and electrically connected at its opposite ends to said terminal cables, a strain wire connected to and extended between the inner adjacent ends of said terminal cables, an expansible coil spring arranged in a contracted condition and adapted on rupture of said fusible element to expand and draw the ruptured ends of said fusible element apart, and a tube surrounding said fusible element, said coil spring and inner portions of said terminal cables, said coil spring being maintained in a position where a portion thereof is extended from an end of said tube when the fusible element has been ruptured so as to indicate the blown condition of the fuse.

3. A secondary fuse comprising terminal cables spaced apart at their inner adjacent ends to provide a gap, a fusible element bridging said gap and electrically connected at its opposite ends to said terminal cables, a strain wire connected to and extended between the inner adjacent ends of said terminal cables, an expansible coil spring arranged in a contracted condition and adapted on rupture of said fusible element to expand and draw the ruptured ends of said fusible element apart, a tube surrounding said fusible element and said coil spring, a tube retaining element mounted on one of said terminal cables and adapted to engage an end of said tube, and means for attaching the opposite end of the tube to the other of said terminal cables, said coil spring being maintained in a position where a portion thereof is extended from an end of said tube when the fusible element has been ruptured so as to indicate the blown condition of the fuse.

4. A secondary fuse comprising terminal cables spaced apart at their inner adjacent ends to provide a gap, a fusible element bridging said gap and electrically connected at its opposite ends to said terminal cables, a strain wire connected to and extended between the inner adjacent ends of said terminal cables, an expansible coil spring arranged in a contracted condition and adapted

on rupture of said fusible element to expand and draw the ruptured ends of said fusible element apart, a tube surrounding said fusible element and said coil spring, a tube retaining element mounted on one of said terminal cables and adapted to releasably engage an end of said tube, and means for attaching the opposite end of the tube to the other of said terminal cables, said coil spring being maintained in a position where a portion thereof is extended from an end of said tube when the fusible element has been ruptured so as to indicate the blown condition of the fuse.

5. A secondary fuse comprising terminal cables spaced apart at their inner adjacent ends to provide a gap, a fusible element bridging said gap and electrically connected at its opposite ends to said terminal cables, an expansible coil spring arranged in a contracted condition and adapted on rupture of said fusible element to expand and draw the ruptured ends of said fusible element apart, an outer tube surrounding said fusible element and said coil spring, and an inner tube within said outer tube which surrounds said fusible element, said inner tube being formed of material characterized by the ability to give off a gas when subjected to the heat of an electric arc which tends to extinguish said electric arc, said coil spring being maintained in a position where a portion thereof is extended from an end of said outer tube when the fusible element is ruptured so as to indicate the blown condition of the fuse.

6. A secondary fuse comprising terminal cables spaced apart at their inner adjacent ends to provire a gap, a fusible element bridging said gap and electrically connected at its opposite ends to said terminal cables, a strain wire connected to and extended between the inner adjacent ends of said terminal cables, an expansible coil spring arranged in a contracted condition and adapted on rupture of said fusible element to expand and draw the ruptured ends of said fusible element apart, an outer tube surrounding said fusible element and said coil spring, and an inner tube within said outer tube which surrounds said fusible element, said inner tube being formed of material characterized by the ability to give off a gas when subjected to the heat of an electric arc which tends to extinguish said electric arc, said coil spring being maintained in a position where a portion thereof is extended from an end of said outer tube when the fusible element is ruptured so as to indicate the blown condition of the fuse.

7. A secondary fuse comprising terminal cables spaced apart at their inner adjacent ends to provide a gap, a fusible element bridging said gap and electrically connected at its opposite ends to said terminal cables, a strain wire connected to and extended between the inner adjacent ends of said terminal cables, an expansible coil spring arranged in a contracted condition and adapted on rupture of said fusible element to expand and draw the ruptured ends of said fusible element apart, an outer tube surrounding said fusible element and said coil spring, and an inner tube within said outer tube which surrounds said fusible element, said inner tube being formed of material characterized by the ability to give off a gas when subjected to the heat of an electric arc which tends to extinguish said electric arc, said coil spring being connected at one of its ends to one of said terminal cables and at its opposite end to said inner tube whereby it is maintained in a position where a portion thereof is extended from an end of said outer tube when the fusible element is ruptured so as to indicate the blown condition of the fuse.

8. A secondary fuse comprising terminal cables spaced apart at their inner adjacent ends to provide a gap, a fusible element bridging said gap and electrically connected at its opposite ends to said terminal cables, a strain wire connected to and extended between the inner adjacent ends of said terminal cables, an expansible coil spring arranged in a contracted condition and adapted on rupture of said fusible element to expand and draw the ruptured ends of said fusible element apart, an outer tube surrounding said fusible element and said coil spring, a tube retaining element mounted on one of said terminal cables and adapted to engage an end of said outer tube, an inner tube located within said outer tube and characterized by the ability to give off a gas when subjected to the heat of an electric arc which tends to extinguish said electric arc, said coil spring being connected at one of its ends to said tube retaining element and at its opposite end to said inner tube whereby it is maintained in a position where a portion thereof is extended from an end of said outer tube when the fusible element is ruptured so as to indicate the blown condition of the fuse, and means for attaching the outer and inner tubes to the terminal cable opposite to the terminal cable on which said tube retaining element is mounted.

9. A secondary fuse comprising terminal cables spaced apart at their inner adjacent ends to provide a gap, a fusible element bridging said gap and electrically connected at its opposite ends to said terminal cables, a strain wire connected to and extended between the inner adjacent ends of said terminal cables, an expansible coil spring arranged in a contracted condition and adapted on rupture of said fusible element to expand and draw the ruptured ends of said fusible element apart, an outer tube surrounding said fusible element and said coil spring, a tube retaining element mounted on one of said terminal cables and adapted to releasably engage an end of said outer tube, an inner tube located within said outer tube and characterized by the ability to give off a gas when subjected to the heat of an electric arc which tends to extinguish said electric arc, said coil spring being connected at one of its ends to said tube retaining element and at its opposite end to said inner tube whereby it is maintained in a position where a portion thereof is extended from an end of said outer tube when the fusible element is ruptured so as to indicate the blown condition of the fuse, and means for attaching the outer and inner tubes to the terminal cable opposite to the terminal cable on which said tube retaining element is mounted.

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