

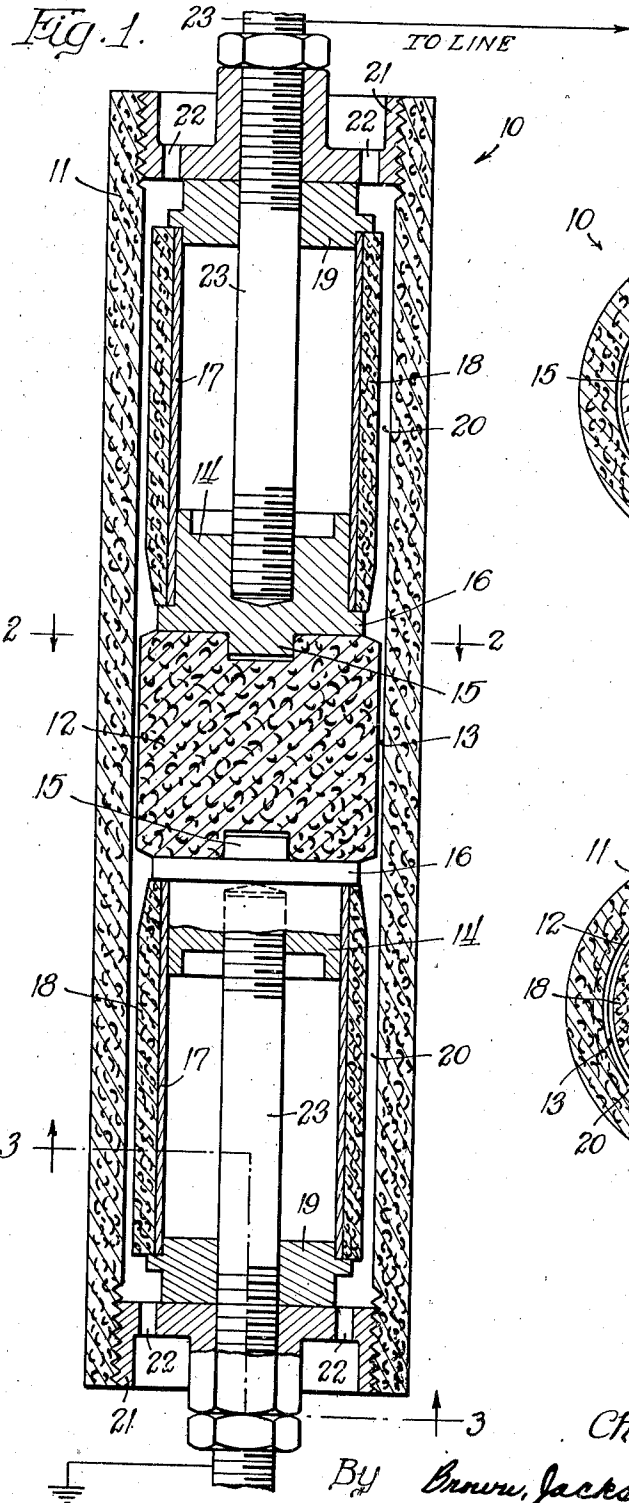
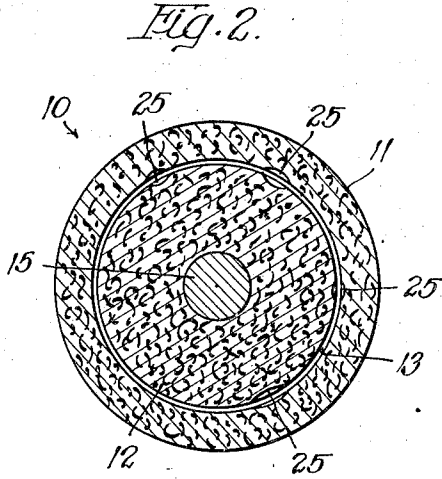
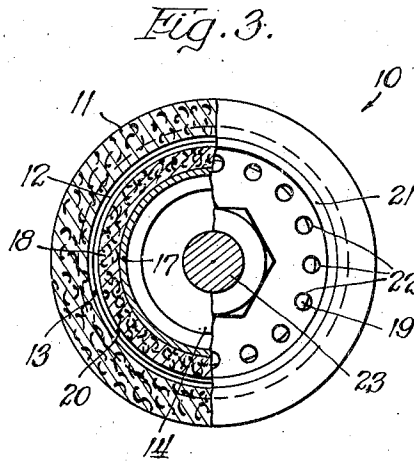
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C. L. STROUP

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CURRENT INTERRUPTING APPARATUS

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Inventor:
Charles L. Stroup.

By *Brown, Jackson, Bottcher & Dickins*
Attys

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CURRENT INTERRUPTING APPARATUS

Charles L. Stroup, Oak Park, Ill.

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13 Claims. (Cl. 175—30)

My invention relates generally to electrical apparatus and it has particular relation to current interrupting apparatus such as lightning arresters, in which arc extinction is effected by means of a blast resulting from the creation of the arc and acting to blow out or cut off the arc.

An object of my invention is to provide for extinguishing an arc in a new and improved manner by directing across a section of its path a blast created as a result of the arc.

Another object of my invention is to provide for extinguishing an arc by placing a pair of electrodes at the open ends of a restricted arc passageway so that a blast created therein by an arc will extinguish the arc at either or both of the open ends.

Another object of my invention is to provide for extinguishing an arc by placing an electrode to the side of an arc passageway so that a blast created therein by an arc will cut off or blow out the arc where it changes direction toward the electrode.

Still another object of my invention is to provide for extinguishing an arc between a pair of electrodes by causing the arc to make a sharp change in direction from its main or general path, and cutting off the arc where it changes direction by a blast moving in a direction generally parallel to the main path of the arc.

Another important object of my invention is to prevent the puncture or bursting of a lightning arrester housing due to heavy electric arcs, by placing the electrodes of the arrester in from the sides of the housing.

Other objects of my invention will in part be obvious and in part appear hereinafter.

Accordingly, my invention is disclosed in the embodiment thereof shown in the accompanying drawing, and it comprises the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the application of which will be indicated in the appended claims.

While I have chosen to disclose my invention as employed in a lightning arrester, it will be apparent that it may also be employed for use in other types of current interrupter, such as fuses or circuit breakers.

For a more complete understanding of the nature and scope of my invention, reference may be had to the following detailed description, taken in conjunction with the accompanying drawing, in which:

Figure 1 is a vertical sectional view through a lightning arrester unit illustrating one working embodiment of my invention;

Figure 2 is a sectional view, taken on line 2—2 of Figure 1; and

Figure 3 is a view taken on line 3—3 of Figure 1.

Referring now to Figures 1, 2 and 3 of the drawing, a lightning arrester unit is indicated generally at 10, comprising a fiber tube or housing 11 with a fiber cylinder 12 fitting closely therein approximately midway between the open ends. Preferably, the cylinder 12 is of such size that it may be easily inserted into the tube 11 with substantially no play therebetween. The narrow clearance between the cylinder 12 and the inside of the casing 11 provides a restricted arc passage 13, the width of which is shown greatly exaggerated in the drawing for purposes of illustration.

The lightning arrester 10 shown in the drawing represents an actual working embodiment of my invention and is shown in approximately full scale dimensions in Figures 1, 2 and 3. The tube or casing 11 is 10 inches long with an outside diameter of 2½ inches. The cylinder 12 is 1¾ inches in height and has a diameter of 1½ inches. The width of the arc passageway 13, or the clearance between the cylinder 12 and inside of the casing 11, is approximately 3.0 thousandths of an inch in the working device shown.

A pair of disc-shaped electrodes 14 may be provided on opposite sides of the fiber cylinder 12, having bosses 15 fitting into recesses in the faces of the fiber cylinder 12 to maintain alignment. The electrodes 14 may be machined down so as to leave shoulders 16 at the faces abutting the cylinder 12. A pair of inner metal sleeves 17 and a pair of outer fiber sleeves 18 fit over the machined portion of the electrodes 14 and rest against the shoulders 16. It is not essential to the operation of the lightning arrester 10 that the sleeves 18 be formed of fiber. The ends of the metal sleeves 17 and fiber sleeves 18 may be closed by a pair of washers 19. The fiber sleeves 18 are of somewhat less diameter than the inside of the fiber tube 11, thereby providing a pair of relatively open annular spaces 20 coaxial with the periphery of the fiber cylinder 12. In the actual working embodiment above mentioned, the sleeves 18 are about 2⅞ inches long and have a diameter of 1½ inches. And the annular spaces 20 are about ⅛ inch in radial width.

A pair of end plugs 21 may be screwed into the ends of the fiber tube 11, having a plurality

of apertures 22 for outlet or discharge of blast gases from within the lightning arrester unit 10. In order to connect the lightning arrester unit 10 in electrical relationship between line and ground, a pair of terminals 23 in the form of bolts may be screwed centrally through the plugs 21 and into threaded recesses in the electrodes 14, as shown. An air gap, such as a sphere gap or a horn gap, should be provided in the line connection, according to standard practice, in order to prevent subjecting the lightning arrester unit 10 to continuous line voltage, with resultant leakage current and to avoid the voltage hazard of a live piece of equipment.

Several different insulation materials other than hard fiber may be used for the casing 11, cylinder 12, and the sleeves 18. Any material which evolves arc extinguishing gases under the heat of an electric arc may have the necessary arc extinguishing properties. Certain woods, vegetable fiber, impregnated paper, and chemical compounds give off arc extinguishing gases. Wood, fiber, paper and the like yield gases by destructive distillation. These gases probably comprise both water vapor and lower hydrocarbons. Chemicals, such as boric acid, yield water vapor by having water of crystallization driven off by the heat of the arc.

The operation of the lightning arrester unit 10 may be explained as follows: The height of the fiber cylinder 12 and corresponding distance between the electrodes 14 largely determines the discharge rating or capacity of the lightning arrester unit 10. When the voltage impressed on the lightning arrester unit 10 exceeds its discharge rating, an arc will be established between the electrodes 14. Such an arc will be formed between opposite points of the peripheries of the shoulders 16 through the narrow or restricted space between the fiber cylinder 12 and the inside of the tube 11. It will be noted that the main path of such an arc is parallel with the axis of the tube 11, but that the arc must turn in at each end to reach the opposing points on the shoulders 16. Having the shoulders 16 thus inset a short way from the periphery of the faces of the cylinder 12 serves to aid in the extinguishment of an arc. Gases will be driven off from the cylinder 12 and tube 11 by the arc flowing therebetween to create a blast which moves with tremendous velocity out the opposite ends of the narrow space between the cylinder 12 and the inside of the tube 11, into the relatively open annular spaces 20. It will be seen that this blast moves in a direction generally normal to the portions of the arc which turn in to reach the shoulders 16. Such a transverse blast either cuts off the turned-in or normal portions of the arc immediately at the edges of the cylinder 12, or forces the arc in loop form up into the open annular spaces 20, where its extinguishment is aided by the gases evolved from the fiber sleeves 18 and the tube 11. The end plugs 21 are spaced sufficiently far from the electrodes 14 so that there is no possibility of the arc restriking or being extended therebetween, or, if necessary, the plugs 21 may be made of insulating material.

An arc established between opposing points on the shoulders 16 will burn opposing groove or furrows into the fiber cylinder 12 and fiber tube 11, as indicated at 25 in Figure 2 of the drawing. The thickness of the grooves 25 is greatly exaggerated in Figure 2 for purposes of illustration.

An arc will not usually be reestablished between the same pair of opposing points on the shoulders 16 of the electrodes 14.

A very important feature of my invention is in having the shoulders 16 of the electrodes 14 spaced from the inside of the casing or tube 11, so as to leave expansion spaces therebetween. It has been found that on placing electrodes against an arrester housing, heavy arcs will puncture and burst the housing. My improved lightning arrester is capable of withstanding a number of heavy current arc discharges without failure by reason of the housing being punctured or broken adjacent to the electrodes.

Since certain changes can be made in the foregoing construction, and different embodiments of the invention may be made without departing from the scope thereof, it is intended that all matters shown in the accompanying drawing or described hereinbefore shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In a circuit interrupting device, in combination, a fiber housing, an imperforate fiber plug fitting closely within said fiber housing, and a pair of electrodes disposed at opposite ends of said fiber plug between which an arc may be formed along the juxtaposed surfaces of said housing and plug, said electrodes being laterally spaced from the discharge path of gases from said juxtaposed surfaces so that the arc established therebetween must make at least two changes in direction.

2. In a circuit interrupting device, in combination, a fiber housing, a fiber plug fitting closely within said fiber housing, the space between the wall of said fiber plug and the inside of said fiber housing providing a restricted arc passageway open at the ends, a pair of electrodes disposed at the opposite ends of said fiber plug, said electrodes being laterally spaced from the discharge path of gases from said restricted arc passageway so that an arc established between said electrodes must make at least two changes in direction therebetween, and said arc established between said electrodes being extinguished by a blast shooting out the open ends of said restricted arc passageway and cutting off said arc where it turns at the open ends of said restricted arc passageway to meet said laterally spaced electrodes, said blast being created by gas evolution from said fiber housing and said fiber plug defining said restricted arc passageway.

3. A lightning arrester comprising, in combination, a fiber tube, a relatively short fiber block fitting closely within said fiber tube and leaving a narrow space therebetween, a pair of electrodes disposed against the opposite ends of said fiber block, the peripheries of said electrodes lying within the peripheries of the opposite ends of said fiber block, a pair of fiber sleeves extending outwardly from said pair of electrodes, the periphery of said fiber sleeves being substantially less than the internal periphery of said fiber tube so as to provide relatively wide annular spaces therebetween, means for closing the ends of said fiber tube having apertures therein for gas outlet, and terminal means individual to each of said electrodes.

4. A lightning arrester comprising, in combination, a fiber tube, a relatively short fiber block fitting closely within said fiber tube and leaving a narrow space therebetween, a pair of electrodes

disposed against the opposite ends of said fiber block, the peripheries of said electrodes lying within the peripheries of the opposite ends of said fiber block, a pair of fiber sleeves extending outwardly from said pair of electrodes, the periphery of said fiber sleeves being substantially less than the internal periphery of said fiber tube so as to provide relatively wide annular spaces therebetween, means for closing the ends of said fiber tube having apertures therein for gas outlet, and terminal means individual to each of said electrodes, said narrow space between the inside of said fiber tube and the outside of said fiber block forming a restricted arc passageway opening at its ends into said relatively wide annular spaces formed by said fiber sleeves and the outer portions of said fiber tube.

5. A lightning arrester comprising, in combination, a cylindrical fiber tube, a relatively short fiber cylinder fitting closely within said cylindrical fiber tube and substantially midway between the ends thereof, a pair of disc-shaped electrodes fitting against the end faces of said short fiber cylinder, the lateral edges of said electrodes lying a short distance in from the peripheries of the end faces of said short fiber cylinder, a pair of cylindrical fiber sleeves fitting on said electrodes and extending outwardly therefrom toward the ends of said cylindrical fiber tube, said cylindrical fiber sleeves being substantially less in diameter than the inside of said cylindrical fiber tube so as to leave relatively wide annular spaces therebetween, a pair of plugs closing the outer ends of said cylindrical fiber tube and having a plurality of apertures therein for blast discharge, and a pair of terminal posts extending outwardly from said electrodes through the ends of said cylindrical fiber tube, the narrow space between the outside of said short fiber cylinder and the inside of said cylindrical fiber tube providing a restricted arc passageway for an arc established between said electrodes, the spacing of the lateral edges of said electrodes in from the peripheries of the end faces of said short fiber cylinder causing such an arc at its outer ends to take paths substantially normal to the axis of said cylindrical fiber tube whereby a blast created in said restricted arc passageway shoots out of the opposite ends thereof into said relatively wide annular spaces in a direction parallel to the axis of said cylindrical tube to cut off said arc at said sections of its path normal thereto.

6. A circuit interrupting device comprising, in combination, a pair of electrodes in spaced end to end relation between which an arc may be formed, means providing a restricted arc passageway between said spaced electrodes in material adapted to evolve an arc extinguishing medium due to the heat of the arc, at least one end of said arc passageway being open and the electrode thereat being spaced laterally from the discharge path of said medium out of said arc passageway whereby the arc established between said electrodes is required to follow a path transverse to the path of said medium as it is discharged from said open end and is extended and extinguished thereby, conductor means extending from the electrode at said open end of said passageway, and insulating means surrounding said conductor means for a substantial distance from the electrode from which it extends.

7. A circuit interrupting device comprising, in combination, a pair of electrodes in spaced end to end relation between which an arc may be formed, and means providing a restricted arc

passageway between said spaced electrodes in material adapted to evolve an arc extinguishing medium due to the heat of the arc, both ends of said arc passageway being open and the electrodes thereat being spaced laterally from the discharge path of said medium out of said arc passageway whereby the arc established between said electrodes is required to follow paths transverse to the path of said medium as it is discharged from said open ends and is extended and extinguished thereby.

8. A circuit interrupting device comprising, in combination, a pair of electrodes in spaced end to end relation between which an arc may be formed, means providing a restricted arc passageway between said spaced electrodes in material adapted to evolve an arc extinguishing medium due to the heat of the arc, both ends of said arc passageway being open and the electrodes thereat being spaced laterally from the discharge path of said medium out of said arc passageway whereby the arc established between said electrodes is required to follow paths transverse to the path of said medium as it is discharged from said open ends and is extended and extinguished thereby, conductor means extending endwise from each of said electrodes, and insulating means surrounding each conductor means for a substantial distance from the electrode from which it extends.

9. A circuit interrupting device comprising, in combination, a relatively long tubular housing of insulating material, a pair of electrodes disposed within said housing relatively far from its ends and in relatively close spaced relation with respect to each other between which an arc may be drawn, conductor means extending from each electrode endwise out of its end of said housing, and means providing a restricted arc passageway between said spaced electrodes in material adapted to evolve an arc extinguishing medium due to the heat of the arc, both ends of said arc passageway being open and the electrodes thereat being spaced laterally from the discharge path of said medium out of said arc passageway whereby the arc established between said electrodes is required to follow paths transverse to the path of said medium as it is discharged from said open ends and is extended and extinguished thereby.

10. In a circuit interrupting device, in combination, a relatively long tubular housing, a relatively short imperforate plug fitting closely within said tubular housing intermediate its ends, said housing and plug being formed of insulating material capable of evolving an arc extinguishing medium due to the heat of an arc, electrodes at the ends of said imperforate plug between which an arc may be formed along the juxtaposed surfaces of said housing and plug, a conductor rod extending axially from each electrode out of its end of said housing, and a sleeve of insulating material extending outwardly from each electrode and spaced from the inner surface of said housing to provide therebetween a gas expansion space.

11. In a circuit interrupting device, in combination, a relatively long tubular housing, a relatively short imperforate plug fitting closely within said tubular housing intermediate its ends, said housing and plug being formed of insulating material capable of evolving an arc extinguishing medium due to the heat of an arc, electrodes at the ends of said imperforate plug between which an arc may be formed along the juxtaposed surfaces of said housing and plug, a conductor rod

extending axially from each electrode out of its end of said housing, and a sleeve of insulating material extending outwardly from each electrode and spaced from the inner surface of said housing to provide therebetween a gas expansion space, the gas expansion space at each end of said housing being vented to the atmosphere through a plurality of apertures.

12. In a lightning arrester, in combination a tubular housing, a plug within said tubular housing spaced a substantial distance from at least one end thereof, said housing and plug being formed of insulating material capable of evolving an arc extinguishing medium due to the heat of an arc, electrodes at the ends of said plug between which an arc may be formed along the juxtaposed surfaces of said housing and plug, a conductor rod extending axially out of said one end of said housing from the adjacent electrode therein, a sleeve of insulating material extending from abutting relation with said adjacent electrode and spaced from the inner surface of said housing to provide therebetween a gas expansion space, and clamp means at said one end of said housing abutting the adjacent end of said

sleeve and cooperating with said conductor rod to hold said sleeve in a predetermined position in said housing.

13. In a circuit interrupting device, in combination, a relatively long tubular housing, a relatively short plug within said tubular housing intermediate its ends, said housing and plug being formed of insulating material capable of evolving an arc extinguishing medium due to the heat of an arc, electrodes at the ends of said plug between which an arc may be formed along the juxtaposed surfaces of said housing and plug, a conductor rod extending axially from each electrode out of its end of said housing, a sleeve of insulating material extending outwardly from abutting relation with each electrode and spaced from the inner surface of said housing to provide therebetween a gas expansion space, the outer end of each sleeve being spaced inwardly from the adjacent end of said housing, and clamp means threaded interiorly of each end of said housing including means abutting the adjacent end of the sleeve therein for holding the various parts in position in said housing.

CHARLES L. STROUP.