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LIGHTNING PROTECTOR

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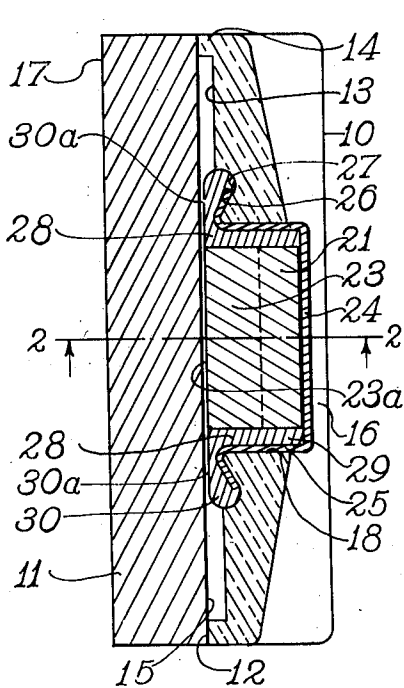


Fig. 1

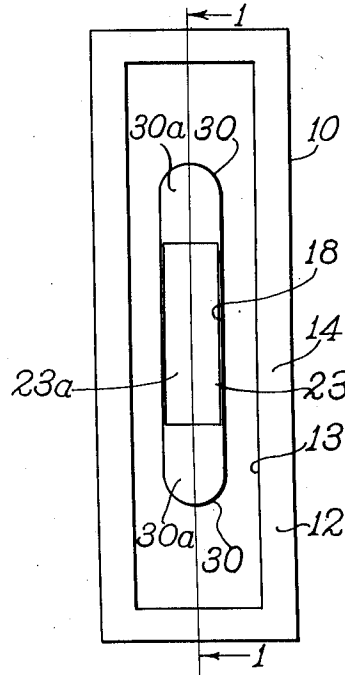


Fig. 3

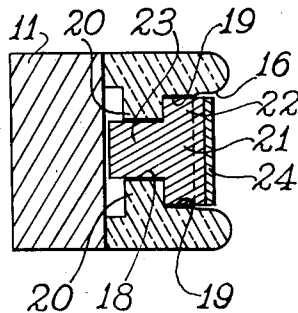


Fig. 2

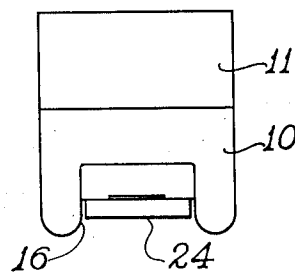


Fig. 4

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LIGHTNING PROTECTOR

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7 Claims. (Cl. 175—30)

The present invention relates to lightning protectors or arrestors of the thermal type and more particularly to improvements in lightning protectors of the general character of that disclosed and claimed in Roy G. Sands Patent No. 2,141,490, issued December 27, 1938.

A conventional lightning protector or arrester of the thermal type comprises two arcing electrodes formed of carbon and separated by an arcing-gap and a thermal element formed of a suitable fusible solder, the thermal element being arranged in a cavity provided in the face of one of the electrodes. During the operation of the lightning protector the heat produced, due to the presence of an electric arc between the electrodes, causes the thermal element to fuse and flow between the electrodes, thereby electrically to connect the electrodes in order to complete a resistance ground circuit including in series the two carbon electrodes.

While a thermal lightning protector of the type described is reasonably satisfactory in service, it is slower in operation than is desirable and operative to complete a relatively high resistance ground circuit, the resistance of the ground circuit being variably disposed within a considerable wide band of magnitudes.

Accordingly it is an object of the present invention to provide an improved thermal lightning protector which is positive and fast in operation and which is operative to complete a direct ground circuit of fixed low resistance.

Another object of the invention is to provide an improved thermal lightning protector which is of extremely simple and rugged construction and which is compact and economical to manufacture.

A further object of the invention is to provide in a lightning protector including a supporting block and an arcing electrode, an improved thermal element which is utilized to position the electrode with respect to the supporting block and which is operative to complete an electrical connection in multiple with the electrode.

A further object of the invention is to provide in a lightning protector including an electrode and a thermal element, an improved arcing face comprising substantially contiguous coplanar surfaces provided on the electrode and the thermal element.

In general, the objects, as set forth above, are attained in accordance with the present invention by providing a lightning protector of the thermal type comprising a refractory insulating block formed of porcelain and having an

opening therein, a carbon electrode having a shank extending through the opening in the block and a head, means including a substantially U-shaped metallic terminal clip engaging the head of the electrode and provided with spaced-apart legs disposed in the opening in the block and secured thereto for clamping the head of the electrode in place on the block, and means including two fusible metallic elements disposed between the shank of the electrode and the legs of the terminal clip in engagement therewith for positioning the shank of the electrode in the opening in the block. The shank of the electrode and the elements are disposed in good heat conducting relationship and are provided with substantially contiguous coplanar surfaces constituting a common arcing face adapted to be displaced by an arcing-gap from an associated grounding conductor, wherein each of the elements is so constructed and arranged that, upon fusing, two multiple connections are established thereby between the terminal clip and the associated grounding conductor, one of the connections including the electrode and the other of the connections excluding the electrode.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawing in which Figure 1 is a longitudinal sectional view of a lightning protector embodying the features of the present invention; Fig. 2 is a lateral sectional view of the lightning protector taken along the line 2—2 in Fig. 1; Fig. 3 is a front view of a supporting block incorporated in the lightning protector; and Fig. 4 is an end elevational view of the lightning protector.

Referring now more particularly to Figs. 1 to 4, inclusive, of the drawing, there is illustrated a thermal lightning protector or arrester which is adapted to be removably supported within an enclosing casing of the combination lightning protector and fuse type, such as the porcelain casing shown in the previously mentioned Sands patent. The construction and arrangement of the enclosing casing forms no part of the present invention and is not illustrated in the interest of brevity.

The lightning protector illustrated comprises a supporting block 10 formed of refractory insulating material such as porcelain and a ground-

ing block 11 formed of conductive material such as brass or carbon. Preferably, the grounding block 11 is formed of a brass comprising approximately 62% Cu, 35% Zn and 3% Pb, as such brass resists both swelling and pitting to a considerable degree. More particularly, the supporting block 10 is provided with a flat rectangular face 12 having a recess or depression 13 therein bounded by a ledge 14; while the grounding block 11 is provided with a flat rectangular face 15 matching the face 12 of the supporting block 10. Also a recess or groove 16 is provided in the side of the supporting block 10 opposite the face 12 thereof which is adapted to receive a contact spring; while the grounding block 11 is provided with a flat side 17 opposite the face 15 thereof which is adapted to be engaged by a contact terminal. Preferably, the face 12 of the supporting block 10 and the face 15 of the grounding block 11 are retained in snug engagement due to the resiliency of the contact spring adapted to be received in the recess 16 provided in the supporting block 10, the faces 12 and 15 being ground flat to insure an accurate matching fit therebetween.

A centrally disposed rectangular opening 13 is provided in the supporting block 10 adjacent two spaced-apart counter recesses 19 formed in the bottom of the recess 16 provided in the supporting block 10, whereby two spaced-apart shoulders 20 are formed on the supporting block 10 disposed between the depression 13 and the recess 16 provided in the supporting block 10. Further the lightning protector comprises an electrode 21 formed of a conductive material such as carbon, the electrode 21 being substantially T-shaped in lateral cross-section and comprising a head 22 and a shank 23. The electrode 21 is carried by the supporting block 10, the shank 23 thereof being substantially rectangular and extending through the opening 13 provided in the supporting block 10 and the head 22 thereof being substantially rectangular and disposed in the counter recesses 19 provided in the supporting block 10. The head 22 of the electrode 21 is securely clamped in place within the counter recesses 19 provided in the supporting block 10 and in engagement with the shoulders 20 formed on the supporting block 10 by an arrangement comprising a terminal clip 24 formed of a metallic conductive material such as a suitable nickel-silver alloy. Preferably, the terminal clip 24 is substantially U-shaped comprising two spaced-apart legs 25 disposed in the opening 13 provided in the supporting block 10. Each of the legs 25 is provided with an outwardly projecting tab 26 disposed in a counter depression 27 formed in the bottom of the depression 13 provided in the supporting block 10. Preferably, the terminal clip 24 has some resiliency, thereby to cause a clamping force to be exerted between the head 22 of the electrode 21 and the tabs 26 disposed in the counter depressions 27 provided in the supporting block 10.

Finally the lightning protector comprises two substantially identical L-shaped thermal elements 28 formed of a suitable metallic conductive material. Each of the thermal elements 28 includes a stem 29 disposed between one end of the electrode 21 and one of the legs 25 carried by the terminal clip 24 and an arm 30 disposed within the counter depression 27 formed in the supporting block 10. Preferably, each of the thermal elements 28 is formed of a suitable soft solder having a low melting point of the order of 80 to 125° C. Accordingly the electrode 21,

the terminal clip 24 and the thermal elements 28 are arranged in mutually contacting and conductive relationship; and the shank 23 of the electrode 21 and the stems 29 of the thermal elements 28 are disposed in good heat conducting relationship. Moreover, the arrangement of the stems 29 of the thermal elements 28 between the opposite ends of the electrode 21 and the legs 25 of the terminal clip 24 positively positions the shank 23 of the electrode 21 in the opening 13 provided in the supporting block 10 and prevents movement of the electrode 21 with respect to the supporting block 10.

The shank 23 of the electrode 21 and the arms 30 of the thermal elements 28 are provided with substantially contiguous coplanar surfaces 23a and 30a constituting a common arcing face disposed in spaced parallel relationship with respect to the face 15 of the grounding block 11. Preferably, the common arcing face formed on the electrode 21 and the thermal elements 28 is ground flat to insure that the plane of this common arcing face is disposed substantially parallel to the plane of the face 15 of the grounding conductor 11.

In assembling the lightning protector the shank 23 of the preformed electrode 21 is first arranged in the opening 13 provided in the preformed supporting block 10. The legs 25 of the terminal clip 24 are then inserted into the opening 13 provided in the supporting block 10; and the tabs 26 provided on the outer ends of the legs 25 of the terminal clip 24 are then bent downwardly into engagement with the walls of the counter depressions 27 provided in the supporting block 10, thereby to cause the terminal clip 24 to clamp the head 22 of the electrode 21 on the supporting block 10. Molten solder is then poured between the opposite ends of the electrode 21 and the legs 25 of the terminal clip 24, thereby to fill the space therebetween and to fill the counter depressions 27 provided in the supporting block 10, whereupon the thermal elements 28 are formed. Subsequently, the end of the shank 23 of the electrode 21 and the arms 30 of the thermal elements 28 are ground to provide the substantially contiguous coplanar surfaces 23a and 30a, thereby to provide the common arcing face formed on the electrode 21 and the thermal elements 28. Finally, the face 12 of the supporting block 10 is positioned in engagement with the face 15 of the grounding block 11 in order to provide an assembly which is then positioned and supported in place in a suitable enclosing casing of the combination lightning protector and fuse type. More particularly, a contact terminal in the enclosing casing engages the flat side 17 of the grounding block 11; and a resilient contact spring in the enclosing casing engages the terminal clip 24; thereby to provide a circuit between ground and a conductor to be protected including the lightning protector and a fuse in the enclosing casing.

During the operation of the lightning protector a lightning or voltage surge upon the line to be protected causes an arc discharge between the face 15 of the grounding block 11 and the common arcing face provided on the electrode 21 and the thermal elements 28, whereby the excess voltage on the conductor to be protected is discharged to ground. Ordinarily, repeated voltage surges upon the line to be protected may cause repeated arc discharges between the face 15 of the grounding block 11 and the common arcing face provided on the electrode 21 and the

thermal elements 28 without causing either the thermal elements 28 to fuse or the fuse included in this series circuit to be blown. However, in the event an arc discharge persists for a predetermined time interval between the face 15 of the grounding block 11 and the common arcing face formed on the electrode 21 and the thermal elements 28, due, for example, to the presence of a cross between the line to be protected and a low voltage power line, one or both of the thermal elements 28 are fused due to the heat produced by the arc discharge. More particularly, the thermal elements 28 are heated directly by the arc discharge between the face 15 of the grounding block 11 and the common arcing face formed on the electrode 21 and the thermal elements 28 and heated indirectly due to the consequent heating of the electrode 21.

Upon fusing, the configurations of the thermal elements 28 are ruptured whereupon the solder, of which the thermal elements are formed, flows into engagement with the face 15 of the grounding block 11 and between the face 15 of the grounding block 11 and the surface 23a provided on the end of the shank 23 of the electrode 21, thereby to establish two multiple connections between the terminal clip 24 and the grounding block 11. One of these multiple connections extends directly from the grounding block 11 by way of the thermal elements 28 to the terminal clip 24 excluding the electrode 21; while the other of these connections extends from the grounding block 11 by way of the solder disposed between the face 15 of the grounding block 11 and the surface 23a provided on the end of the shank 23 of the electrode 21 and the electrode 21 to the terminal clip 24. Accordingly, the lightning protector is operative to complete a direct low resistance connection between the grounding block 11 and the terminal clip 24, thereby positively to cause the fuse serially included in the grounding circuit to be blown.

It is noted that the lightning protector is extremely fast to operate due to the fact that the arc discharge between the face 15 of the grounding block 11 and the common arcing face formed on the electrode 21 and the thermal elements 28 causes heat to be produced directly in the thermal elements 28 and to the fact that the thermal elements 28 are arranged in good heat conducting relationship with respect to the electrode 21. Also due to this fast operation of the thermal elements 28, the principal bodies thereof are not fused incident to operation, thereby rendering it possible for the lightning protector to be used repeatedly. More particularly, after the lightning protector has operated in the manner previously explained, it may be reconditioned for further use merely by removing the supporting block 10 and the elements carried thereby from the enclosing casing and regrinding the common arcing face formed on the electrode 21 and the thermal elements 28, whereupon the supporting block 10 and the elements carried thereby may be reassembled in the enclosing casing in cooperation with the grounding block 11 in the manner previously explained.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A lightning protector comprising a refractory insulating block having an opening therein, a conductive electrode having a shank extending through the opening in said block and a head, means including a conductive terminal secured to said block and engaging the head of said electrode for clamping the head of said electrode in place on said block, and means including a fusible conductive element extending into the opening in said block and engaging the shank of said electrode and said terminal for positioning the shank of said electrode in the opening in said block, whereby the shank of said electrode and said element are disposed in good heat conducting relationship, the shank of said electrode and said element being provided with substantially contiguous coplanar surfaces constituting a common arcing face adapted to be displaced by an arcing-gap from an associated grounding conductor, said element being so constructed and arranged that upon fusing two multiple connections are established thereby between said terminal and the associated grounding conductor, one of said connections including said electrode and the other of said connections excluding said electrode.

2. A lightning protector comprising a refractory insulating block having an opening therein, a conductive electrode having a shank extending through the opening in said block and a head, means including a conductive terminal secured to said block and engaging the head of said electrode for clamping the head of said electrode in place on said block, and means including a fusible conductive element extending into the opening in said block and engaging the shank of said electrode and said terminal for positioning the shank of said electrode in the opening in said block, whereby the shank of said electrode and said element are disposed in good heat conducting relationship, the shank of said electrode and said element being provided with substantially contiguous coplanar surfaces constituting a common arcing face adapted to be displaced by an arcing-gap from an associated grounding conductor, said element being so constructed and arranged that upon fusing a direct low-resistance connection independent of said electrode is established thereby between said terminal and the associated grounding conductor.

3. A lightning protector comprising a refractory insulating block having an opening therein, an electrode formed of good heat and electric conductive material and having a shank extending through the opening in said block and a head, means including a terminal formed of good electric conductive material and secured to said block and engaging the head of said electrode for clamping the head of said electrode in place on said block, and means including an element formed of relatively low temperature fusible and good heat conductive material and disposed in the opening in said block and engaging the shank of said electrode for positioning the shank of said electrode in the opening in said block, whereby the shank of said electrode and said element are disposed in good heat conducting relationship, the shank of said electrode being provided with an arcing face adapted to be displaced by an arcing-gap from an associated grounding conductor, said element being so constructed and arranged that incident to operation of said lightning protector said element is fused and flows between said electrode and the associated grounding conductor, thereby to establish an electric connection therebetween.

4. A lightning protector comprising a refractory insulating block having an opening therein, an electrode formed of good heat and electric conductive material and extending through the opening in said block, a terminal formed of good electric conductive material and secured to said block and engaging said electrode, and means including an element formed of relatively low temperature fusible and good heat conductive material and disposed in the opening in said block and engaging said electrode for positioning said electrode in the opening in said block, whereby said electrode and said element are disposed in good heat conducting relationship, said electrode being provided with an arcing face adapted to be displaced by an arcing-gap from an associated grounding conductor, said element being so constructed and arranged that incident to operation of said lightning protector said element is fused and flows between said electrode and the associated grounding conductor, thereby to establish an electric connection therebetween.

5. A lightning protector comprising a refractory insulating block having an opening therein, a conductive electrode extending through the opening in said block, a conductive terminal secured to said block and engaging said electrode, and means including a fusible conductive element extending into the opening in said block and engaging said electrode and said terminal for positioning said electrode in the opening in said block, whereby said electrode and said element are disposed in good heat conducting relationship, said electrode and said element being provided with substantially contiguous coplanar surfaces constituting a common arcing face adapted to be displaced by an arcing-gap from an associated grounding conductor, said element being so constructed and arranged that upon fusing two multiple connections are established thereby between said terminal and the associated grounding conductor, one of said connections including said electrode and the other of said connections excluding said electrode.

6. A lightning protector comprising a refrac-

tory insulating block having an opening therein, a conductive electrode extending through the opening in said block, a conductive terminal secured to said block and engaging said electrode, and means including a fusible conductive element extending into the opening in said block and engaging said electrode and said terminal for positioning said electrode in the opening in said block, whereby said electrode and said element are disposed in good heat conducting relationship, said electrode being provided with an arcing face adapted to be displaced by an arcing-gap from an associated grounding conductor, said element being so constructed and arranged that upon fusing a direct low-resistance connection independent of said electrode is established thereby between said terminal and the associated grounding conductor.

7. A lightning protector comprising a refractory insulating block having an opening therein, a carbon electrode having a shank extending through the opening in said block and a head, means including a substantially U-shaped metallic terminal clip engaging the head of said electrode and provided with spaced-apart legs disposed in the opening in said block and secured thereto for clamping the head of said electrode in place on said block, and means including two fusible metallic elements disposed between the shank of said electrode and the legs of said terminal clip in engagement therewith for positioning the shank of said electrode in the opening in said block, whereby the shank of said electrode and said elements are disposed in good heat conducting relationship, the shank of said electrode and said elements being provided with substantially contiguous coplanar surfaces constituting a common arcing face adapted to be displaced by an arcing-gap from an associated grounding conductor, each of said elements being so constructed and arranged that upon fusing a direct low-resistance connection independent of said electrode is established thereby between said terminal and the associated grounding conductor.

ROY G. SANDS.