

Nov. 23, 1954

R. G. SANDS
PROTECTIVE DEVICE

2,695,377

Original Filed April 6, 1950

2 Sheets-Sheet 1

FIG. 1

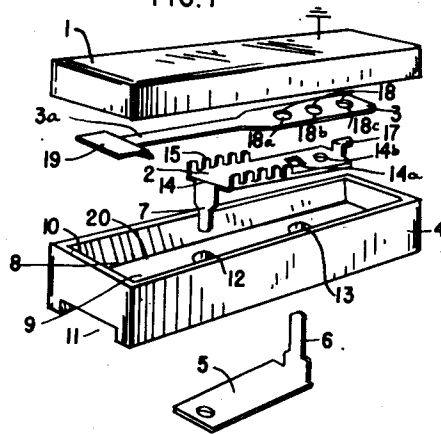


FIG. 2

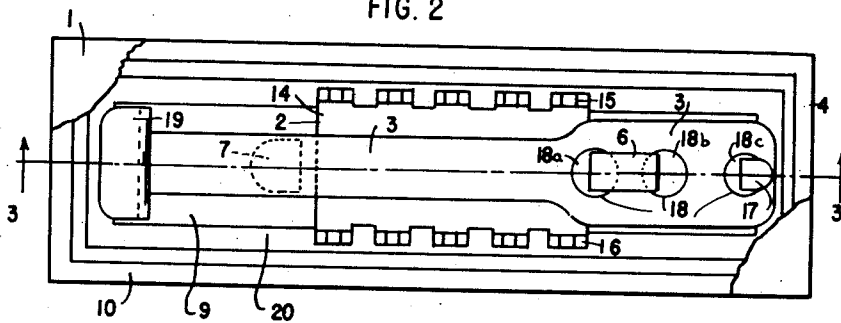
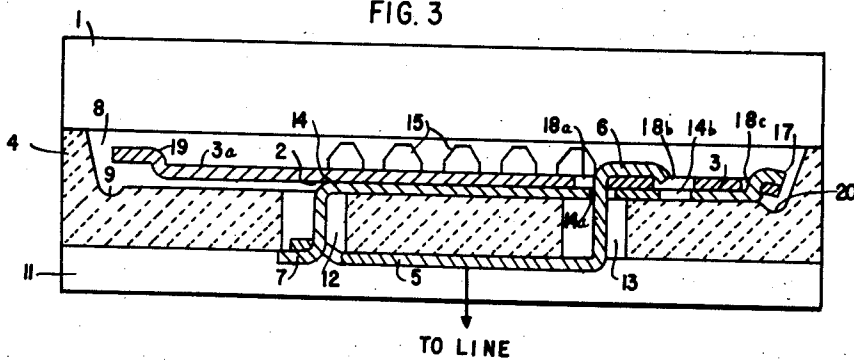


FIG. 3



TO LINE

INVENTOR.
ROY G. SANDS
BY *Walter DeWitt*

ATTY.

1

2,695,377

PROTECTIVE DEVICE

Roy G. Sands, Waukegan, Ill., assignor to Automatic Electric Laboratories, Inc., Chicago, Ill., a corporation of Delaware

Original application April 6, 1950, Serial No. 154,336.
Divided and this application June 6, 1952, Serial No. 292,091

1 Claim. (Cl. 317—66)

This invention relates in general to protective devices and more particularly to the thermal type of protective device for arresting abnormal voltages, lightning, and the like, likely to prove dangerous to life or destructive to property.

This application is a division of application Serial No. 154,336, filed April 6, 1950.

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

Another object of the invention is to provide an improved thermal abnormal voltage protector which is exceedingly simple in construction and compact in size.

A further object of the invention is to provide in an abnormal voltage protector including serrated discharge members, an improved thermal member which will not become inoperative due to a fusion therewith of a part or parts of the serrated discharge members.

Another object of the invention is the provision of improved arcing faces for the serrated discharge members of a predetermined arrangement and geometric shape.

Still another object of the invention is the provision of a new and extremely practical method of manufacturing the protective device in accordance with the above objects.

In keeping with the last mentioned object, an outstanding feature of the invention resides in the novel arrangement and method of assembling the various pieces making up the protector.

These and other objects and features will be more particularly pointed out and described in the ensuing specification and appended claims taken in conjunction with the accompanying drawings in which:

Fig. 1 is an exploded view of the protective device.

Fig. 2 is a plan view of the protective device.

Fig. 3 is a cross-sectional view of the device taken along the line 3—3 in Fig. 2.

Fig. 4 is a cross-sectional view of the apparatus used in the assembling of the device.

Fig. 5 is a cross-sectional view of the apparatus employed in setting the air gap between the serrated members and the ground element after the assembly step.

Fig. 6 is a cross-sectional view of a portion of the apparatus and work piece taken along line 5—5 in Fig. 5 during the actual setting.

In the preferred form of the protective device illustrated in the accompanying drawings, the abnormal voltage arrester construction contemplates the use in combination of a carbon block type ground element 1, serrated metallic discharge member 2, thermal bimetal member 3, refractory insulating member 4 and contact member 5.

The serrations of the serrated discharge member 2 are positioned by a novel arrangement and means in a definite and a predetermined spaced relationship with bimetal member 3 and both bimetal member and serrated member are positioned in spaced relationship with the ground element 1 by means of refractory insulating member 4, and held in place by the interlacing arrangement of integral projections on the serrated discharge member 2 and the contact member 5. These projections are in registry with apertures in the other members provided therefor.

In general, the contact member 5 is in electrical contact with a line or lead of the equipment that is desired

2

to be protected, so that the abnormal voltages then travel through the contact member 5 to the serrated discharge member 2 and the bimetal member 3 by way of the interlaced projections 6 and 7. These voltages, if sufficiently great to create a hazardous conduction will arc from the tip surface areas of the serrations to the ground element 1 which is, as its name implies, connected to ground. In this manner, abnormal voltages are dissipated, and in the event that these abnormal voltages are sustained, the heat created by the continued arcing causes the bimetal member 3 to flex into contact with the ground element 1, thereby providing a direct path of a fixed low resistance for said voltages to travel to ground. This path eventually shorts out the arcing, and as cooling down occurs, the bimetal member will return to its normal position. The bimetal member in this invention is so arranged with relation to the serrations that a high potential surge arcing between serrations and ground before the bimetal member has been heated sufficiently to flex, may cause one or more of the serrations to melt or fuse without disabling the bimetal member.

Electrical equipment is in this manner positively and quickly protected for the duration of the abnormal voltage, the protective device clearing itself from the circuit when the necessity for this protection has ceased. The construction and arrangement of the preferred embodiment illustrated will now be described in detail.

The refractory insulating member 4 is composed of a ceramic material which has been subjected to heat, a particular material meeting these requirements and which may be used is known as Steatite. However, other forms of compositions of insulating material may be employed as well.

Insulating member 4 is somewhat elongated and rectangular in shape. The upper portion is evenly recessed at 8 and the bottom of the recess is designated at 9 and the upper edges 10 are flat and parallel. In the under portion, a groove 11 runs longitudinally therethrough. In the bottom 9 of recess 8 and extending from bottom 9 to groove 11 are two holes 12 and 13.

Contact member 5 having a projection 6 extending upwardly from one end thereof and a hole in the other end thereof is placed in groove 11 with the projection 6 extending upwardly through the hole 13. On the flat bottom 9 of the recess 8 is placed the somewhat elongated serrated discharge member 2. The base 14 of the serrated discharge member 2 has two apertures 14a and 14b therein, one of which, 14a, is in registry with the hole 13. One end of the serrated discharge member 2 has thereon an upraised hook 17, while from the other end thereof extends downwardly a projection 7. Projection 7 is positioned downwardly through hole 12 and through the hole in contact member 5.

Along the lateral edges of discharge member 2, connected to and extending upwardly therefrom are two series of serrations such as 15 and 16. The tips of these serrations are flat, substantially square in shape and describe an area of a predetermined size.

The thermal bimetal member 3 is generally I-shaped, that is to say, the end portions are wider than the portion extending therebetween. One of the end portions has therein three holes 18a, 18b and 18c, the other end comprising a widened raised contact 19. One of the holes, 18c, is placed under the raised hook 17 so that the major portion of the bimetal member normally lies flat on base 14 of the discharge member 2, the narrow center portion lying between the upwardly extending serrations 15 and 16. The other two of the holes 18 are in registry with the two apertures in the base of the discharge member and the projection 6 of the contact member 5 extends upwardly through one of them, 18a.

Projection 6 extending upwardly through hole 13, aperture 14a and hole 18a is bent tightly over and then downwardly into hole 18b and 14b thereunder.

The other projection, 7, extending downwardly through hole 12 and the hole of contact member 5 is bent tightly under contact member 5 thereby firmly holding all of these members together.

The bimetal member 3 is so constructed, that is to say, by layering of the two metals of different thermal expansibility, so that heat will cause it to flex upwardly,

3

but as one end portion is securely held or clamped down to the refractory insulating member 4 by the bent over projections 6 and 7 and by hook 17, which is also pressed down, only the other end having the upraised wide contact 19 thereon can raise or flex upwardly when the bimetal member is heated.

The flat, substantially square tips of serrations 15 and 16 are in a plane parallel to the upper edges of the insulating member 4.

The ground element 1, which is preferably a substantially rectangular carbon block and of the same dimensions in length and width as the insulating member, is placed upon the upper edges 10 as shown in Fig. 3. In this position only a narrow air gap exists between the tips of serrations 15 and 16 and the under surface of ground element 1. This air gap is of a predetermined size and the method of setting will be described in detail hereinafter in conjunction with the method of manufacturing and assembling the device. The shape of these tips is substantially square, describing a definite predetermined area, and are so constructed that arcing therefrom will not deeply pit or dig craters as readily in the underside of ground element 1, because of the greater arcing surface provided. Greater efficiency in this manner has been obtained without an appreciable rise in resistance due to pitting and it has been observed that this is particularly true when the size of the tip is substantially .020 of an inch wide. Greater protection is afforded in that the resistance for which the air gap is originally set will not vary appreciably over a long period of continued use.

It will also be noted, particularly in the cross sectional view of Fig. 3, that the normal position of the bimetal member 3 lying flat on base 14 of discharge member 2 and between the serrations thereof is such that its free end with upraised, widened, contact 19 thereon is normally out of electrical contact with the under surface of ground element 1.

Therefore, looking again at this cross sectional view, it is seen that an abnormal potential on contact member 5 will be transmitted through the projections 6 and 7 to the discharge member 2 and the bimetal member 3 thereon, and that if this potential is above a predetermined value, it will complete a path to ground on ground element 1 from the nearest points thereto, namely by arcing from the square, flat tips of serrations 15 and 16. Any substantial abnormal voltage of this sort will seek to perpetuate this path and the arcing will cause sufficient heat to be generated very quickly to cause the bimetal discharge member 3 to flex upwardly so that contact 19 will then be in electrical contact with ground element 1. A fixed low resistance circuit is thereby traced from the abnormal potential on contact member 5 through the projections 6 and 7 to the base 14 of the discharge member 2 and thence to the bimetal member 3 and therethrough to contact 19 to ground element 1 and ground thereon. This latter low resistance path effectively short circuits the arcing paths previously described and as cooling occurs, bimetal member 3 will flex back to normal removing the short.

It will be seen, therefore, that the device will be good for a great many continued repetitions of this protective cycle. The method of manufacturing and assembling the protective device described hereinbefore is as follows.

After the various members have been initially placed together, that is to say, the projections 6 and 7 are interlaced through the various holes and apertures of the members, the tips of these projections are manually bent over a small bit so that all the members remain loosely fastened together. The loosely assembled device is now placed, contact member downward into a tool 21 which has been recessed at 22 to hold the ceramic insulating member 4 snugly therewithin.

Projecting upwardly from the bottom of one end of this recess 22 is an initial positioning pin 23 which is retractable into tool 21 under pressure because of spring 24 thereunder. This pin initially permits one end of the loosely assembled device to be slightly raised to accommodate the partially bent over end 7a of projection 7.

Tool 21 is held in place on a shoe 25 by pins 26 under the pressing head 27 of a spring pad press. Any form of pad pressure may be utilized in this assembly, however, the preferred embodiment illustrated exhibits a spring pad press under which high pressure may be achieved

4

without the shattering direct pressure of a punch press or the like.

A plunger 28 is fitted by means of a strong spring 29 into the pressing head 27. On the lower end of the plunger 28 is a plunger head 30. This plunger head 30 is positioned directly above the loosely assembled work piece positioned in tool 21. Extending downwardly from the plunger head 30 is a spring retractable plunger 31 with a holding and pressing member 32 at its lower extremity. This holding member is positioned above the portion of the work piece containing projection 7 and is sufficiently narrow to fit between serrations 15 and 16. Alongside plunger 31 and fitted into and extending downwardly from the plunger head 30 are two additional pressure applying tools 33 and 34. Tool 33 has a curved lower surface 33a which is positioned over projection 6. Tool 34 is similarly positioned over upraised hook 17. The whole pad press is arranged so that the pressing head, plunger head and associated tools may be lowered into an initially engaging position whereby the holding and pressing member 32 is above projection 7, the curved pressure applying tool 33 is resting upon partially bent over tip 6a of projection 6 and pressure applying tool 34 is upon tip 7a of hook 17.

It will be noted that a gap 35 exists between the plunger head and the pressing head. The pressing head is now made to descend whereby the heavy spring 29 is caused to exert a spring pressure on plunger head 30. Plunger head 30 in turn directs the spring pressure to the three pressure applying members extending therefrom. In this manner, spring pad pressure, to an extent of 350 pounds per square inch, is applied to the various projections and the hook 17. Tip 7a of projection 7 is bent tightly under contact member 5. Hook 17 is bent tightly down upon the bimetal member and tip 6a, because of curve 33a in tool 33, is bent over bimetal member 3 and downwardly into holes 18b and 14b.

Because of the novel manner in which the interlacing of the various metallic members of the protective device has been arranged, along with the differing resiliences of the metals, in conjunction with the spring pad pressure, the device can be secured tightly together under this very high pressure without causing the fragile ceramic insulating member 4 to break. It is readily understood that position pin 23 recedes into the tool 21 during the pressing. The device in this single operation is now assembled.

The next step is to adjust or form the air gap between the tips of the serrations and the upper edge 10 of the insulating member, edge 10 corresponding with the lower surface of the ground element 1. This is accomplished by placing the now assembled member, serrations downward, onto another tool 35, the upper surface 36 of which is raised in the center to engage the serrations, the raised portion lying between the walls describing recess 8 of the insulating member. The surface 36 is raised above tool 35 a predetermined distance corresponding to the air gap which is to be set. Along either side of the upraised surface 36 of tool 35 are two holding projections 37 and 38 which lie along the outside of the serrations to maintain them in longitudinal alignment.

Additional grooves 20 in the bottom 9 of recess 8 of the insulating member 4, beneath the serrations have been provided. A pressing head 39 having a spring padded plunger 40 therewithin and a pressing rod 41 extending downwardly therefrom is positioned above the bottom of contact member 5 which now faces upward, since the assembly is lying on tool 35 in an inverted position. A universal joint arrangement 42 is placed above and resting on the contact member 5. It is guided by pins 42a seated in tool 35. The pressing head 39 and plunger rod 41 are brought down to engage the well known ball bearing 43 of the universal joint arrangement.

In this position the final forming step is accomplished by causing the pressing head 39 to press downward in turn causing spring 44 to exert pressure through plunger head 40 and rod 41, universal joint arrangement 42 and through to the work piece.

In this operation a uniform pressure of 200 pounds per square inch may be attained over the entire serration surfaces. The downwardly exerted pressure will cause the serrations to recede upwardly into the grooves 20 in block 4 as shown by bends 15a and 16a in the partial cross section of Fig. 6. The pressure is released and the

5

work piece removed complete but for placing a carbon block ground element upon the edges 10 of the insulating member.

It will be seen therefore, that the device was first assembled loosely, then through the cooperation of the differing resiliences of the interlaced metallic members and the spring padded pressure of the pressing head, the device was tightly secured together. Then the assembled device is placed in another tool and spring pad pressure again applied to force the serrations into the recesses 20 in the insulating member provided therefor to establish a predetermined air gap between the tips of the serrations and the plane of the upper edges 10 of the insulating member.

This method is extremely accurate, practical and simple, with substantially no breakage occurring, and production cost by this improved method can be reduced substantially.

Having described my invention in detail what I desire to be protected by the issuance of Letters Patent of the United States is:

A device for protecting electrical equipment from abnormal voltages comprising, in combination, a metallic serrated discharge member having a base with a plurality of oppositely positioned serrations extending upwardly from said base, each of said serrations comprising a tooth portion on the top and a depressed portion on the bottom integrally formed with said base of said discharge member; an insulating member having a recess, a flat bottom portion forming the greater portion of the base portion of said recess, a groove in said flat bottom portion, a carbon block positioned over said recess, means for se-

6

curing said discharge member in said recess with said base of said discharge member positioned on said flat bottom portion of said insulating member and with said depressed portion depressed into said groove to form a pre-determined air gap between the teeth of said discharge member and said carbon block, the size of said air gap being dependent upon the amount of depression of said depressed portion within said groove; a bi-metal member having two end portions and a narrow center portion therebetween, means connecting said discharge member to said bi-metal member at one of said end portions with said narrow center portion spaced from said serrations of said discharge member a distance greater than said pre-determined air gap, said narrow center portions being flexible when heated to move the other of said end portions to engage said carbon block in the event of sustained high voltage arcing in said air gap, said narrow center portion and said serrations being in such spaced relationship as to always prevent contact between said narrow center portion and said serrations, even if said serrations should partially melt and flow towards said narrow center portion as a result of a sustained high voltage arc.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,656,076	Sands	Jan. 10, 1928
2,141,490	Sands	Dec. 27, 1938
2,574,888	Riebe	Nov. 13, 1951