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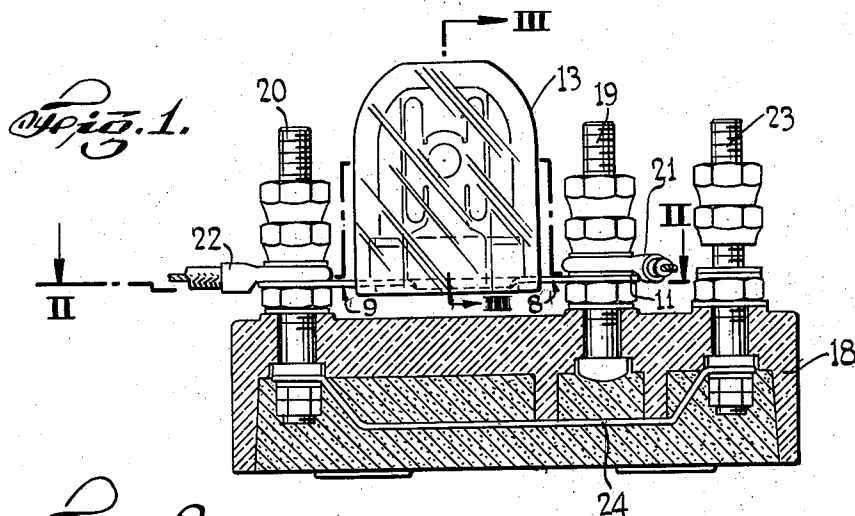
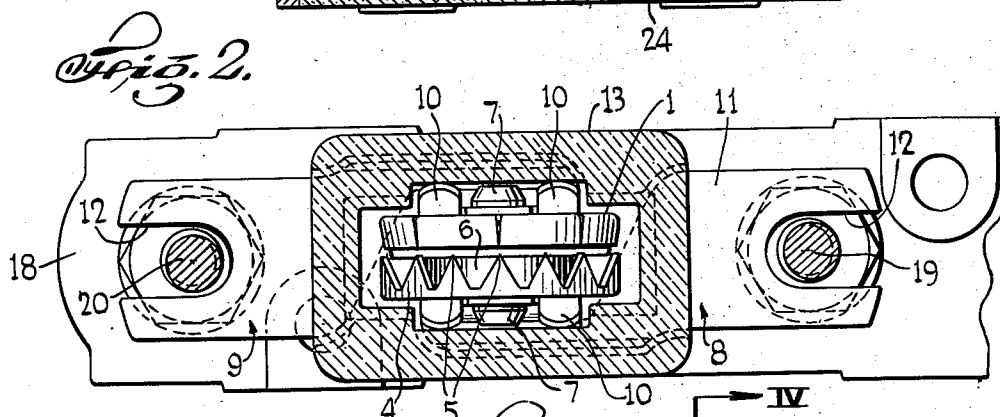
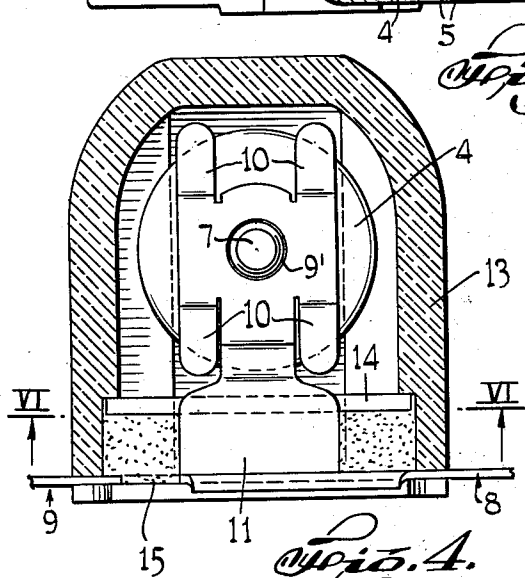
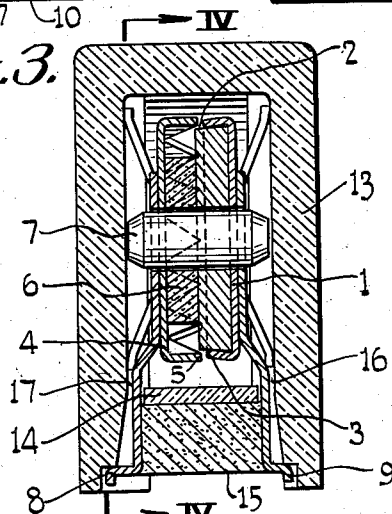
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2,297,323

LIGHTNING ARRESTER

Filed Sept. 27, 1940

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 5.

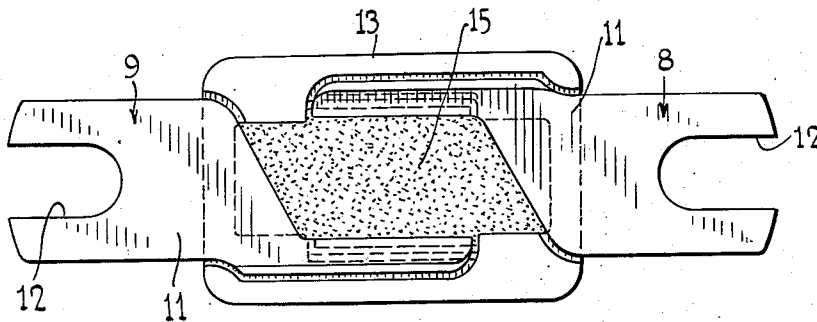


Fig. 6.

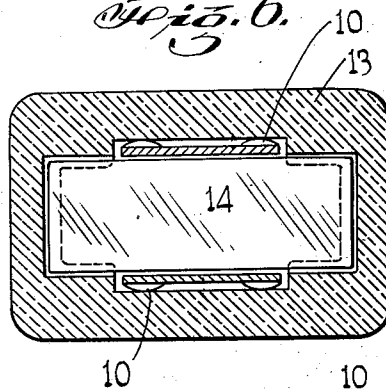


Fig. 7.

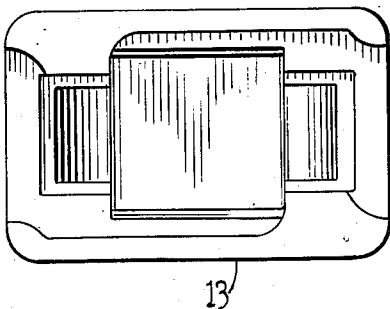
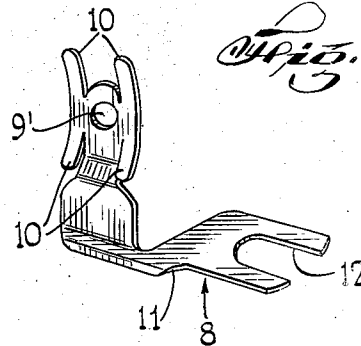


Fig. 8.



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2,297,323

LIGHTNING ARRESTER

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9 Claims. (Cl. 175—30)

This invention relates to lightning arresters.

A principal object of the invention is the production of a device of the type specified which is constructed on such principles that it may occupy the minimum of space and at the same time exhibit high efficiency.

A further object of this invention is to provide a device of the type specified which may be manufactured in such manner that it may be an inch or less in width and an inch and three-eighths or less in length and relatively short and of such efficiency that it will amply and properly protect, from damage by lightning, railroad signal apparatus connected to aerial conductors.

A further object of the invention is the production of a device of the type specified which is provided with discharge teeth of such acuteness that when a point thereof is melted the molten metal will tend to run back on the teeth.

A further object of the invention is the production of a device of the type specified which is constructed with a plurality of discharge teeth which are spaced apart such a distance that when the teeth are properly positioned facing a discharge surface, the arc on one tooth will not burn an adjacent tooth.

A further object of the invention is the production of a device of the type specified which is so constructed that when the discharge teeth thereof are properly positioned facing a discharge surface, an arc from one point will not ionize the gap between an adjacent point and the discharge surface thus causing that point to also discharge as the first mentioned point burns back increasing the gap and thereby the voltage across it and the two low resistance bodies.

A further object of the invention is the production of a device of the type specified in which the discharge points are sufficiently closely adjacent to a high resistance body in contact with a discharge plate as to start ionization of the air at a comparatively small voltage and yet, due to the high resistance body, obviate any danger of a complete short circuit.

A further object of the invention is the production of a device of the type specified in which the discharge points are sufficiently closely adjacent to a high resistance body in contact with a discharge plate as to start ionization of the air at a comparatively low voltage and yet, due to the high resistance body which serves no part in maintaining an established arc, provides the same arc extinguishing ability as though the high resistance body were not present.

Other objects and advantages of the invention will appear as the description of the particular physical embodiment selected to illustrate the invention progresses and the novel features will be particularly pointed out in the appended claims.

In describing the invention in detail and the

particular physical embodiment selected to illustrate the invention, reference will be had to the accompanying drawings and the several views thereon, in which like characters of reference designate like parts throughout the several views, and in which:

Figure 1 is a side elevational view of a device embodying the invention mounted on a terminal block which is shown in section; Fig. 2 is a cross-sectional view of the device, as shown by Fig. 1 in plan, on the plane indicated by the line II—II, viewed in the direction of the arrows at the ends of the line but with a portion of the end connection block broken away; Fig. 3 is a cross-sectional view of the device, as shown by Fig. 1, on the plane indicated by the line III—III, viewed in the direction of the arrows at the ends of the line; Fig. 4 is a cross-sectional view of the device, as shown by Fig. 3, on the plane indicated by the line IV—IV, viewed in the direction of the arrows at the ends of the line; Fig. 5 is a bottom plan view of the lightning arrester of applicants' invention as shown applied to a terminal block in Fig. 1; Fig. 6 is a cross-sectional view of the device as shown by Fig. 4 on the plane indicated by the line VI—VI, viewed in the direction of the arrows at the ends of the line; Fig. 7 is a bottom plan view of a cover used with applicants' device, as shown by Fig. 1; Fig. 8 is a perspective view of a metallic connector used in applicants' device, as shown by Fig. 1.

A lightning arrester embodying applicants' principle is preferably made in a form in which there is a complete circle of discharge points. It is not to be inferred that the principles may not be embodied in an arrester of non-circular form but the preferred construction which gives the maximum of discharge points in a minimum of space embodies the circular form.

Applicants' invention, in its preferred form, includes a cup 1 of low resistance material, preferably metal and preferably nickel-silver. This cup has an internal diameter such that it just receives a cylindrical prism 2 with a portion of the prism protruding beyond the free edge 3 of the cup. The cylindrical prism 2 is made of a high resistance material and preferably a highly refractive material such as carborundum or Everohn.

Juxtaposed to the metallic cup 1 is the metallic cup 4 which has the same internal diameter as the cup 1 and is made, preferably, of the same material but its free edge is formed into a series of teeth as 5. The ends of the points of these teeth are positioned substantially in the plane of the outer face of the high resistance body 2.

An insulating spacer 6 is provided. This spacer is shown as a disc and is made not only of insulating material but preferably of a re-

factory insulating material such as lava and is interposed between the metallic cup 4 and the high resistance body 2 so that the cups 1 and 4 can only approach each other to such an extent as to position the points of teeth of the cup 4 in the position hereinbefore stated.

The members 1, 2, 4 and 6 are each provided with an axial bore and within these bores is positioned a pin 7 which positions all of the parts as shown most clearly in Fig. 3. This pin 7 is made of an insulating material and preferably of lava.

In order to connect electrically to the cup bearing the discharge points 5 and to the cup 1, terminal connectors 8 and 9 are provided, shown in perspective in Fig. 8. Each of these terminal connectors is provided with a through bore 9' and with presser fingers 10 and with a tail 11 provided in any suitable or appropriate manner with convenient means for insertion under a bolt, as by a cut out portion 12. Each of these terminal connectors is identical in form but is reversely positioned when assembled, as shown in Fig. 3, as one tail extends outwardly in one direction and the other one extends outwardly in the opposite direction, as best shown in Fig. 1.

A cover in the form of a hollow prism 13 is provided and the parts 1, 2, 4 and 7 together with the terminal connectors are positioned within the prism by first placing the ends of the pin 7 within the bores 9 of the terminal connectors and then pushing the whole assembly into the hollow prism 13 so that the parts rest in the position as shown in Fig. 3, the fingers 10 pressing against the inside surface of the hollow prism on opposite sides thereof to hold all parts in position and without shifting.

After the parts are positioned as described, it is best to provide a closing plate 14, as best shown in Figs. 3 and 4 and to run in insulating compound 15 to seal although there is still left an opportunity for any gases generated within the hollow prism to escape along the channels 16 and 17.

The complete device is usually positioned on a connecting block 18, as shown in Fig. 1, the connector 9 being placed under the nuts of one post 19 and the connector 8 under the nuts of the other post 20. The post 19 is the post which is normally connected to ground by means of a conductor such as 21. The post 20 is assumed to connect with an aerial conductor by means of the eyelet 22 and post 20 is connected to post 23 by a conductor 24. The post 23 is connected in any suitable or appropriate manner with electrical apparatus.

The points of the teeth 5 are very closely adjacent the outside corner of the member 2 but are not in contact therewith although if they do actually get in contact with member 2 the circuit formed would be of such high resistance, due to the high resistance of the member 2, that no great harm would result. The teeth 5 are made quite acute, that is, the included angle of the teeth is not greater than 45 degrees. In the particular form now being built the angle is about 42 degrees and 30 minutes. Teeth formed with such a small included angle are quite essential because when the point of such a tooth is melted as by an electrical discharge, the slight amount of metal melted will tend to wet and flow back on the tooth itself without forming a pendant globule. However, if molten metal at the point of a tooth does form into a globule

it will increase the distance between the tooth and the member 2 rather than decrease it.

The teeth 5 are also spaced apart. In fact, in a preferred form of the invention actually built, the points of the teeth are spaced apart more than four times the distance between the ends of the teeth 5 and the free edge 3 of the cup 1 so that an arc formed between a tooth and the free edge 3 of the cup 1 will not jump to an adjacent tooth. Furthermore, an arc between one tooth and the free edge of the cup 1 will not burn an adjacent tooth. In an actual device, the cup 4 has been made 0.841 inch in internal diameter and the teeth on the free edge thereof have been made 0.125 inch at their base and 0.160 inch in length so that 16 of them were positioned around the free edge of the cup 4.

The teeth 5 are positioned almost touching the prism 2 so that a relatively low voltage lightning potential will cause a discharge across the exposed surface of 2 and will thus ionize the surrounding air so as to afford a lower resistance path and thus act to start the arc before a difference of potential applied across the cups has arisen to its full value.

It will be seen that under no contingency can the resistance of the path between cup 4 and cup 1 be substantially lowered because the breakdown voltage between 1 and 4 is determined by the closest tooth 5 and if that is partially destroyed then the breakdown voltage is determined by the next closest tooth and the destruction of tooth after tooth tends to increase the breakdown voltage rather than to decrease it and in the same way if a tooth becomes mutilated by reason of the point melting the breakdown voltage between that tooth and the cup is not decreased but increased.

Although applicants have particularly described the lightning arrester in a form in which the discharge takes place between the plate and a circle of points, it is to be understood that the principle in forming the teeth are no more applicable to the circular form than they are to a straight line form.

Although we have particularly described one particular physical embodiment of our invention and explained the operation, construction and principle thereof, nevertheless, we desire to have it understood that the form selected is merely illustrative, but does not exhaust the possible physical embodiments of the idea of means underlying our invention.

What we claim as new and desire to secure by Letters Patent of the United States, is:

1. A lightning arrester, including, in combination: a relatively high resistance body; a relatively low resistance body bearing against the high resistance body and extending partially thereacross; a second relatively low resistance body juxtaposed to the first mentioned relatively low resistance body and the relatively high resistance body and parallel thereto, the said second relatively low resistance body presenting a toothed edge, the points of the teeth being just out of contact with the relatively high resistance body and facing the first said low resistance body on the uncovered side of the high resistance body, the included angle at the point of each tooth being less than 45 degrees whereby when the point of a tooth is melted the molten metal will have a tendency to run back on the tooth without forming a substantial pendant globule and whereby the destruction of any number of teeth

cannot result in decreasing the resistance of the path between low resistance bodies or between the second mentioned low resistance body and the relatively high resistance body and whereby upon the application of a high difference of potential between the low resistance bodies, a path of lower resistance is created by an initial ionization of the air therebetween by a preliminary discharge along the surface of the relatively high resistance body, providing a low bolt breakdown, yet high arc extinguishing ability with obviation of a complete short circuit of the device should the air gap become closed.

2. A lightning arrester, including, in combination: a relatively high resistance body; a relatively low resistance body bearing against the high resistance body and extending partially thereacross; a second relatively low resistance body juxtaposed to the first mentioned relatively low resistance body and the relatively high resistance body and parallel thereto, the said second relatively low resistance body presenting a toothed edge, the points of the teeth being just out of contact with the relatively high resistance body and facing the first said low resistance body on the uncovered side of the high resistance body, the included angle at the point of each tooth being less than 45 degrees whereby when the point of a tooth is melted the molten metal will have a tendency to run back on the tooth without forming a substantial pendant globule and whereby the destruction of any number of teeth cannot result in decreasing the resistance of the path between low resistance bodies or between the second mentioned low resistance body and the relatively high resistance body and whereby upon the application of a high difference of potential between the low resistance bodies, a path of lower resistance is created by an initial ionization of the air therebetween by a preliminary discharge along the surface of the relatively high resistance body, the said teeth being spaced apart a distance sufficient to prevent arcing at one tooth point from ionizing the gap of an adjacent tooth, allowing it also to discharge and thereby damaging more than one tooth in case of an extra heavy discharge.

3. A discharge plate for an arrester formed of relatively high conducting material in the form of a cylindrical cup, the free edge of which is formed into a plurality of substantially equally spaced teeth, each tooth formed with an included angle of less than 45 degrees.

4. A discharge plate for an arrester formed of relatively high conducting material in the form of a cylindrical cup, the free edge of which is formed into a plurality of substantially equally spaced teeth, each tooth formed with an included angle of such acuteness that upon the point of the tooth being melted the molten metal will all run back on the tooth.

5. A discharge plate for an arrester formed of relatively high conducting material in the form of a cylindrical cup, the free edge of which is formed into a plurality of substantially equally spaced teeth and the point of the teeth spaced apart more than four times the distance at which the ends of the points are adapted to be spaced from and to cooperate with a discharge body of high conductivity.

6. A lightning arrester, including in combination: a cylindrical prism of relatively high resistance material; a cylindrical cup of relatively low resistance material, said cup of an internal

diameter substantially equal to the external diameter of the prism and said cup receiving said prism with a portion of the prism protruding therefrom, a second cylindrical cup of low resistance material, said second cup of an internal diameter substantially equal to that of the first cup and the free edge of said second cup toothed, means for positioning said cups on an axis passing through the central portion of the bases thereof with the teeth of the second cup presented toward the first cup and the points thereof in substantially the plane of the outer base of the protruding prism.

7. A lightning arrester, including, in combination: a cylindrical prism of relatively high resistance formed with a through axial bore, a cylindrical cup of relatively low resistance material formed with an axial bore in its base, said cup of an internal diameter substantially equal to the external diameter of the prism, and said cup receiving said prism with a portion of the prism protruding therefrom, a second cylindrical cup of low resistance material, said second cup of an internal diameter substantially equal to that of the first cup, the free edge of the second cup toothed and an axial bore in the base thereof, a spacer of insulating material formed with an axial bore, and a pin of insulating material passing through the axial bore of each of the said cups and prisms, the spacer being of such thickness and so placed that the points of the teeth of the toothed cup are positioned substantially in the plane of the outer base of the high resistance prism.

8. A lightning arrester, including, in combination: a cylindrical prism of relatively high resistance formed with a through axial bore, a cylindrical cup of relatively low resistance material formed with an axial bore in its base, said cup of an internal diameter substantially equal to the external diameter of the prism, and said cup receiving said prism with a portion of the prism protruding therefrom, a second cylindrical cup of low resistance material, said second cup of an internal diameter substantially equal to that of the first cup, the free edge of the second cup toothed and an axial bore in the base thereof, a spacer of insulating material formed with an axial bore, and a pin of insulating material passing through the axial bore of each of the said cups and prisms, the spacer being of such thickness and so placed that the points of the teeth of the toothed cup are positioned substantially in the plane of the outer base of the high resistance prism, and means for electrically connecting to each cup.

9. A lightning arrester connector including, in combination: a hollow substantially right prism; two metallic connectors formed of sheet metal, each provided with a bore, one connector positioned on one side of the inside of the hollow prism and the other on the opposite side of the inside of the hollow prism; each connector formed with a connecting tail extending one in one direction from the hollow prism and the other in the opposite direction; an insulating pin having its ends seated, one in one connector and one in the other, said pin adapted to support a discharge element between and in contact with said connector.

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