This invention relates to a series spark gap for lightning arresters.

This invention is an improvement over that shown in my prior Patent No. 2,891,193 of June 16, 1959, for Spark Gap Assembly, assigned to the same assignee as the present invention.

Objects are to provide a spark gap assembly construction in which the double the number of spark gaps are obtained without materially increasing the length of the assembly, in which a much better capacitance coupling between the gaps is obtained thereby providing a better voltage divider effect for the spark gap assembly, and securing a more uniform operation of the spark gap construction.

Further objects are to provide a spark gap assembly which ionizes less air to thereby avoid the danger of total flashover which has been a serious problem in high voltage lightning arresters.

Further objects are to provide a construction which is extremely simple, which may be very inexpensively manufactured, which has great mechanical strength, which is compact, and which may be readily assembled.

An embodiment of the invention is shown in the accompanying drawings in which:

FIGURE 1 is an elevation of the lightning arrester with the upper portion in section.

FIGURE 2 is an enlarged view of the spark gap assembly.

FIGURE 3 is a sectional view on the line 3—3 of FIGURE 1.

FIGURE 4 is a face view of one of the supporting insulating posts or bars.

FIGURE 5 is a side view of the structure shown in FIGURE 4.

Referring to the drawings, it will be seen that the spark gap assembly forming the subject matter of this invention is very much like the spark gap assembly shown in my above noted patent. This, however, is only in general appearance, as the actual mode of operation is quite different as will be seen as the description progresses.

Referring to FIGURE 1, it will be seen that the spark gap assembly is positioned between the valve material 1 and the upper terminal plate or member 2. This spark gap assembly is a unitary and firm structure as shown in FIGURE 2, and is provided with end terminals 3 and 4. The end terminal 3 is the bottom terminal and rests upon or contacts the valve material 1, and the upper terminal 4 is provided with spring arms 5 which contact the upper terminal 2 of the lightning arrester. The spark gap assembly has electrodes 6. The upper electrode is made a little longer than the others and is indicated by the reference character 6′.

The electrodes 6 are carried by means of the conducting plates 7 in exactly the same way as in my prior patent. These conducting plates are notched at their outer edges and receive the upright insulating structure which consists of a pair of upright bars 8 of insulating material. These bars or posts of insulating material are slotted on opposite sides at their outer edges as is clearly shown in FIGURES 4 and 5. The plates 7 receive the bars within notches 9 formed in the plates and the outer edges of the notches 9 fit within the slots 10 formed in the upright or insulating supporting bars or posts 8, see FIGURES 1, 4 and 5. These plates 7 serve therefore to carry the electrodes and securely position them as shown in FIGURES 1 and 2. The plates 7 which carry the electrodes act not only as supporting means for the electrodes, but also as baffles. The baffles divide the ionized air into separate sections and thus reduce the tendency to overall flashover.

An essential feature of this invention is the provision of intermediate metal plates 14 which are out of contact with the electrodes and are positioned directly between them as shown most clearly in FIGURE 2. These plates 14 may be like the plates 7 previously described, if so desired.

It will be seen that the plates 14, which are conducting members, have a very important role to play in the normal operation of the spark gap assembly. They serve to divide the assembly into sections so that there is a spark gap between each electrode and the adjacent plate thus substantially doubling the number of spark gaps without increasing the length of the spark gap assembly.

Advantage is taken of both the characteristics of the spark gaps in the form of points or tapered portions and the flat quench type spark gap. It will be seen that the balance between the effect of the pointed, or substantially pointed, electrodes and the flat plate type electrodes may be balanced so that the exact impulse ratio may be obtained. For example, if a lower breakdown voltage is desired, the effect of the pointed electrodes could be increased. On the other hand, if the breakdown voltage is desired to be very high the effect of the plate electrode could be increased. It will thus be seen that the impulse ratio can be easily controlled and can be adjusted or made any desired value.

Further, it is to be noted that the construction is such that the spark gap assembly will last a very long time without burning out any of the electrodes or adjacent parts. It should be noted that the spark formed between a pointed electrode and the plate does not occur at the same definite place at all times, but may wander or strike at different points on the plate and thus may be shifted on the adjacent electrode. In this way a substantially new arcing portion is obtained from time to time automatically and without thought on the part of the user.

It will be seen that a very simple structure has been provided which may be inexpensively made and easily assembled and which has characteristics as enumerated hereinabove which determine precisely the impulse ratio obtained from the spark gap assembly.

It will be noted further that the spark gaps themselves are relatively short and that they therefore ionize less air than longer spark gaps. Consequently there is less air ionized and there is less chance for a total flashover to occur.

Another advantage is that the spark gap assembly has not only double the number of gaps but also the capacitance coupling between gaps is increased and a better voltage divider effect is produced.

Although the invention has been described in considerable detail it is to be understood that the description is intended to be illustrative and not limiting as the invention is to be limited only as claimed.

1. In an insulating housing having an axial bore, an open spark gap assembly within said bore comprising a plurality of superimposed conducting plates, the peripheral edges of said plates being spaced radially from the surface of said housing defining said bore, insulating support members maintaining said conducting plates in spaced relation to each other, alternate conducting plates having centrally disposed electrodes protruding from opposite sides thereof and the conducting plates between said alter-
3,106,662

nate plates being flat and spaced from said electrodes on said alternate plates and forming spark gaps therewith, said alternate plates having flat annular portions encircling the electrodes thereon defining auxiliary arcing surfaces and said plates preventing movement of ionized gases parallel to the axis of said bore, said support members engaging said plates at only spaced apart portions of the periphery thereof and permitting radially outward movement of ionized gases and cooling and deionization thereof by the gas between said spark gap assembly and said surface defining said bore, said electrodes having arcing surfaces comprising a relatively flat portion defining the minimum dimension of said spark gap formed with said adjacent flat conducting plate and extending radially outward therefrom in a surface divergent relative to said adjacent flat conducting plate.

2. In an insulating housing having an axial bore, an open spark gap assembly within said bore and spaced radially from the inner surface of said housing defining said bore, said spark gap assembly including a plurality of superimposed conducting plates the margins of which are spaced radially from said inner surface, a pair of insulating support members engaging diametrically opposed portions of said plates and maintaining said plates in spaced relation to each other, each of said support members having a plurality of spaced apart slots adapted to receive said plates, alternate conducting plates having centrally disposed electrodes protruding from opposite sides thereof and the conducting plates between said alternate plates being flat and spaced from the electrodes on said alternate plates and forming spark gaps therewith, said alternate conducting plates having flat annular portions surrounding the electrodes thereon and defining auxiliary arcing surfaces and said plates preventing movement of ionized gases parallel to the axis of said bore, said slots engaging diametrically opposed portions of the periphery of said plate and permitting movement of ionized gases radially outward from said electrodes and cooling and deionization thereof by the gases between said spark gap assembly and said inner surface of said housing defining said bore.

3. A series spark gap assembly for a lightning arrester comprising a plurality of superimposed conducting plates, a pair of insulating support members engaging diametrically opposed portions of said plates and maintaining said plates in spaced relation to each other, each of said support members having a plurality of spaced apart slots adapted to receive said plates, alternate conducting plates having centrally disposed electrodes protruding from opposite sides thereof and the conducting plates between said alternate plates being flat and spaced from the electrodes thereon defining auxiliary arcing surfaces and said plates preventing movement of ionized gases parallel to the axis of said bore, said alternate conducting plates having flat annular portions surrounding the electrodes thereon and defining auxiliary arcing surfaces and said plates preventing movement of ionized gases radially outward from said electrodes and cooling and deionization thereof by the gases between said spark gap assembly and said inner surface of said housing defining said bore.

4. A series spark gap assembly for a lightning arrester comprising a plurality of conducting plates on certain of which electrodes are centrally disposed, insulating support members maintaining said conducting plates and said electrodes in spaced relation to each other to provide spark gaps, at least one additional flat conducting baffle plate disposed between adjacent electrodes and being out of contact with either adjacent electrode, said conducting plates acting as baffles preventing movement of ionized gases in a direction transverse to said plates and said certain conducting plates having annular flat portions surrounding the electrodes thereon and defining auxiliary arcing surfaces, insulating support members engaging said conducting plates at only spaced intervals to provide a relatively open spark gap assembly permitting the hot ionizing gases formed in the vicinity of the electrodes to move outwardly parallel to the conducting plates and be cooled and deionized by the surrounding air.

References Cited in the file of this patent

UNITED STATES PATENTS

2,623,197 Kalb ---------------- Dec. 23, 1952
2,891,193 Cunningham ---------------- June 16, 1959