The object of the present invention is a lightning arrester provided with an ionization chamber designed so as to cause the efflux of electric charges due to surtension, that is to say to steep front waves and to the waves of great amplitude which occur in electric wiring systems. The apparatus is more specially intended for medium tension systems (a few thousand volts). Its functioning is based on the use of an ionization chamber which, in a manner, artificially creates a corona effect.

On the attached drawings three forms of embodiment of the lightning arrester, which forms the subject matter of the invention, have been shown in a diagrammatic form and solely as examples:

Figure 1 is the diagram of an existing device;
Figure 2 is the diagram of the new apparatus;
Figure 3 is a part section of an example of an embodiment of the apparatus;
Figure 4 is a larger scale sectional diagram showing the arrangement of the ionization chamber;
Figure 5 is a section of a different arrangement of the ionization chamber;
Figure 6 is another different embodiment of the ionization chamber and of its spark gap discharge device in section.

The existing device, shown in Figure 1, is constituted by an inductance 1 shunted by a resistance 2; one of the terminals of the inductance is grounded through a condenser 3; the other terminal of the said inductance is led to the lightning arrester device proper 4, which is grounded.

The new lightning arrester, which forms the subject matter of the invention is differentiated from existing devices by the fact that condenser 3 is shunted by an ionization chamber P which artificially creates a corona effect, and through this chamber the charge due to surtension will be dissipated. This arrangement is seen in Figure 2.

In the example of an embodiment shown in Figure 3, self inductance 1, mounted on suitable insulating supports 5 and 6, surrounds the tubular condenser 3, the metallic armature 1, cylindrical in shape, of which is separated by a tube, made of a dielectric substance 8, from metallic rod 9 which constitutes the second electrode grounded at 10. Resistance 2 is in the form of a crown fitted at the end of tube or electrode 1 and is connected to that terminal of self inductance 1 which leads to the output conductor 11. The opposite terminal of the self inductance is connected, through the input conductor 12, to electrode 1 and penetrates into the ionization chamber P shown to a larger scale in Figure 4.

The ionization chamber P is constituted by washers 13 made of a more or less resistant or semi-conductive substance (carborundum, for instance, in the case of glass, and aluminum for low tensions etc.), arranged in the tube 8 and kept apart from one another by insulating spacing rings 14. The inner surface of these inserted rings 14, which constitute the ionizing elements, is coated with a radioactive layer 15. The whole assembly, including washers 13, rings 14 and their layer of radioactive matter 15, is located in tube 8 and held between the metalic electrodes 7 and 9 of condenser 3, constituting the ionizing chamber which supplies the means of artificially causing a corona effect which makes it possible to dissipate the charges due to surtension.

In the example of an embodiment shown in Figure 5 the parts already described in the preceding figures, bear the same reference numbers as in those figures.

In this figure the self inductance has been designated by 1, the outer end inner electrodes of the tubular condenser by 7 and 9, these electrodes being separated by dielectric 8; the washers of the ionization chamber by 13, these washers being kept apart from one another by the inserted insulating rings 14, their inner surface being coated with a radioactive layer 15. The input collector, which connects the self inductance 1 to armature 7 of the condenser, has been designated by 12.

In this modified embodiment, the ionization chamber has been extended on the side opposite to armature 9 and in this extension has been located a spark gap discharge device which possesses an adjustable and automatically variable sparking distance, this spark gap discharge device being constituted by an electrode 16 fitted in the center of a flange 17 provided with holes 18 and by an electrode 19 screwed into a moveable disc 20 arranged as a valve resting on a seat 21. Seat 21 is separated from flange 17 by a spacing insulating sleeve 22 the inner surface of which is coated with radioactive substance 15. Disc 20 is pressed against seat 21 by a spiral spring 23 which bears on a flange 24 provided with holes 25, the center portion of this flange being designed to serve as a guide to electrode 18 the rear portion of which, in the form of a screw head 26, is located opposite the central hole 27 provided at the rear end of armature 7.
of the lightning arrester. Disc 21 is separated from the flange 24 by an insulating sleeve 28. The improved device, which can be applied to high tension wiring systems, functions as follows:

When supertension occurs this causes the striking of an arc which jumps between electrode 19 (connected to the input conductor 12 through disc 20, spring 25, flange 54 and conducting sleeve 45) to electrode 18; this discharge being aided by the ionization of the spark gap discharge chamber, which ionization is determined by the radioactive substance 16 which coats the spacing sleeve 22; from electrode 16, discharge continues towards armature 9 through the ionization chamber (described in Figures 1 to 4) constituted by washers 13 and inserted rings 14. The deflagration which occurs at the moment of the discharge causes a sudden expansion of the air confined in the space contained in the ionizing chamber and its extension. As this space is closed by disc 20; this disc is driven back violently together with electrode 19. The sparking distance separating the electrodes 16 and 18 is thus increased causes the extinction of the arc the quenching of which is aided by the air eddy in the ionizing chamber. At the same moment said arc is extinguished when electrode 19 returns to its original position together with disc 20 which seals the ionizing chamber anew and the apparatus is ready to function again. The initial sparking distance between electrodes 16 and 18 may be adjusted by screwing the latter electrode more or less in to disc 20.

In the example of an embodiment illustrated in Figure 6, the parts already described have been indicated by the same reference numbers as before; the inductance has been indicated by 1, the outer and inner armatures of the tubular condenser by 7 and 9, these armatures being separated by dielectric 8. The input conductor which connects the inductance 1 to electrode 7 of the condenser has likewise been designated as well and the movable disc which forms the valve and rests on seating 21, by 20.

In this modification of the embodiment, the ionization chamber is constituted by metallic washers 31 strung over an insulating tube 32 and separated from one another by insulating washers 33, 34; each of these insulating washers presents an annular groove lined with radioactive substance 35. The end washers 36 are thicker than washers 31 and constitute cheeks tightened between conducting parts 37 and 38, the latter being solid with armature 9 of the condenser. In the axial hole of tube 32 is a rod 39 connected with armature 9 of the condenser and conductive (through an antenna effect) to ionization in the ionization chamber. The rod 39, combined with the ionization chamber, has the effect of considerably augmenting the conductivity of the air or of the ionization gas in the vicinity of the electrodes, and as a consequence to lower the sparkling potential and to facilitate the passage of the sparks.

The ions emitted by the radioactive salts thus become movable armatures of a condenser of which the rod 39 is the other armature, while the insulating piece supporting the spacing members on which are coated the radioactive salts, forms the dielectric for the condenser.

Conducting part 37, provided with holes 40, is connected by means of an annular piece 41 to a ring 42 acting as a spark gap discharge electrode. The movable equipment of the variable sparking distance spark gap discharge device is constituted by a rod 43 provided with a screw thread and terminated by a slotted head 26 which is accessible through port 27 provided in the outer electrode 7 of the condenser. The threaded rod 43, which may be more or less screwed into disc 20 acting as a valve, is terminated, on the side towards ring 42, by a disc 44 acting as an electrode, in front of which disc is an insulating screen 45 fixedly secured on aforementioned rod 43. Screen 45 cooperates with an insulating diaphragm 46 (at the moment when the spark gap discharge device movable portion moves backwards) to diaphragm the ionized space separating disc 44 from ring 42 when the apparatus functions owing to a discharge. On the other hand, screen 45 constitutes a baffle and increases the sparking distance which separates electrodes 46 and 42, when the moving equipment of the spark gap moves backwards. On the rear of the valve-disc 20 is a resistant sleeve 47 separated from threaded rod 43 by an insulating tube 48. Threaded rod 43 which can slide (by its smooth portion in front of screw head 26) in guiding part 24, 25 bears a contacting disc 49 upon which spring 23 acts. When the apparatus is idle and is not functioning, the small contacting ring 50 perforated with holes 51 and connected, by means of connecting piece 52, to the input condutor 12 and the outer electrode 7.

Parts 42, 46, 21, 50, 24 and the left hand end of electrode 7 are separated from one another by insulating sleeves 33, 34, 35.

The improved device which, by suitable adjustment can be applied to wiring systems of very different tensions, functions as follows:

When supertension occurs an arc is struck, jumping between electrode 44 (connected with the input conductor 12 by threaded rod 43, ring 50 and conductor 52) and electrode 42. The striking of this arc is aided by the ionization caused by the radioactive material of the spark gap chamber; from electrode 42 the discharge spreads towards armature 9, through part 31, the new ionization chamber (consisting of washers 31 and the insert parts 33 and 34) and part 38. The deflagration which occurs at the moment of discharge causes the sudden expansion of the air confined in the space enclosed in the ionization chamber and the spark gap chamber, this space being sealed by disc 20; this disc is then violently driven backwards and draws along the whole of the moving equipment of the spark gap discharge device (threaded rod 43, electrode 44, screen 45, resistance 47 and disc 49), which equipment, through disc 48, compresses spring 23 resting against guide piece 24. The exploding distance which separates electrodes 44 and 42 increases at the same time as the space which separates them is diaphragmed by screen 43 and diaphragm 46, which causes the extinction of the arc, the quenching of which is aided by the air vortex in the ionization chamber. This extinction is further aided by the bringing into circuit of resistant sleeve 47 which comes to a stop bearing against conducting crown ring 50 thus increasing the damping of the circuit which goes from the input conductor 12 to the spark gap discharge electrode 44. At the same time as the extinction of the arc occurs, electrode 44 returns to its original position as well as the whole of the movable equipment to which it is fixedly secured; the closing disc again seals the ioniza.
tion chamber and the spark gap chamber and the apparatus is ready to function anew.

The different forms of embodiment described above are supplied only as indications, the details of construction may be modified without departing from the subject matter of the invention.

1. A condenser comprising two concentric cylindrical armatures separated by a tube of a dielectrical substance, said tube containing an ionization chamber connected, on the one hand, to the outer armature and, on the other hand, to the spark gap chamber and the apparatus is ready to function anew. The different forms of ionization chamber, one of the two electrodes of said discharge device being integral with a movable sealing disc normally closing the ionization chamber, which disc is adapted to be moved from its normal rest position by the air expanding under the electric discharge so as to increase the distance between said electrodes when said discharge occurs.

2. A device according to claim 1, comprising a supplementary, adjustable and automatically variable sparking distance discharge device fitted in an extension of the ionization chamber, one of the electrodes of said discharge device being controllably threaded into the approximate center of a movable valve-shaped disc; a seat for said disc, and a spring urging said disc against said seat, said electrode being adjusted in spaced relationship to the other electrode according to the voltage of the system to be protected. A device according to said condenser, a damping resistance movable with said movable electrode, a check crown ring between which and the valve-shaped disc the resistance is inserted at the end of the functioning stroke of the movable valve-shaped disc, an insulated disclike screen placed in front of the disclike electrode, and a stationary diaphragm with which said screen is adapted to cooperate to break the arc when the movable disc is driven backwards by an electrical discharge.

6. In a lightning arrester, a condenser ionizing structure, the said condenser comprising two concentric cylindrical electrodes, a tube of dielectrical material separating said electrodes, and an ionization chamber, the said ionization chamber being contained in said tube, and comprising a series of semi-conductive elements, inserted rings of insulating material separating said elements, a layer of radio-active substance covering said rings, the end elements being electrically connected respectively to the inner and outer electrodes of the condenser.

7. In a lightning arrester, a condenser ionizing structure, the said condenser comprising two concentric cylindrical electrodes, a tube of dieelectrical material separating said electrodes, and an ionization chamber, the said ionization chamber being contained in said tube, and comprising a series of semi-conductive elements, inserted rings of insulating material separating said elements, a layer of radio-active substance covering said rings, the end elements being electrically connected respectively to the inner and outer electrodes of the condenser, a supplementary, adjustable and automatically variable spark-gap discharge device fitted in an extension of the ionization chamber, one of the electrodes of said discharge device comprising a spring-pressed disc mounted on a rod, a movable valve-shaped disc into the approximate center of which the rod of the spring-pressed disc is adjustably threaded, a seat against which the valve-shaped disc is thereby urged, said electrode being adjusted in spaced relationship to the other electrode according to the voltage of the system to be protected and said electrode being connected at rest to the input electrode of the condenser, a damping resistance movable with said movable electrode, a check crown ring between which and the valve-shaped disc the resistance is inserted at the end of the functioning stroke of the movable valve-shaped disc, a rod containing the disclike electrode, said resistance consisting of semi-conductive substance entirely insulated from said rod, and adapted to connect, at the end of the back stroke of said electrode, the valve-shaped disc to said check crown, an insulated disclike screen disposed in front of the disclike electrode, and a stationary diaphragm with which said screen cooperates to break the arc when the movable disc is driven backwards by an electrical discharge.
8. In a lightning arrester, a condenser-ionizing structure, the condenser comprising two concentric cylindrical electrodes, a tube of dielectric material separating said electrodes, the ionizing portion of said structure comprising an ionization chamber contained in said tube and comprising a series of washers of more or less resistance, inserted rings of insulating material separating said washers from each other, and a layer of radioactive substance covering said rings, the end washers being connected respectively to the inner and outer electrodes of the condenser.

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