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HIGH TENSION INSTALLATION

Original Filed Oct. 20, 1921

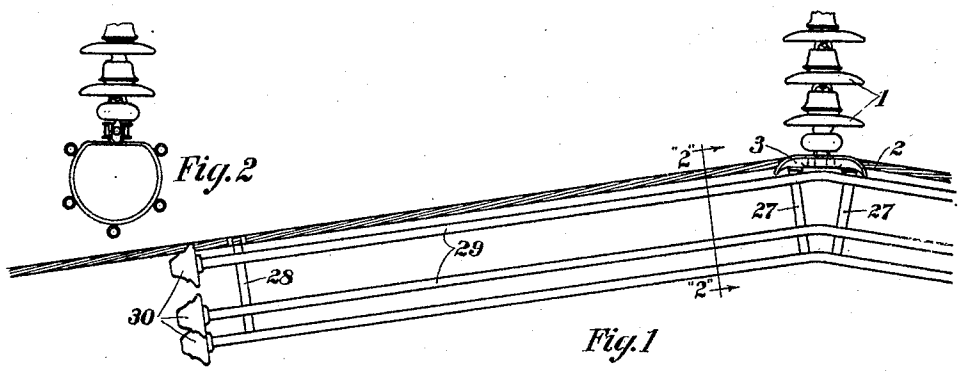


Fig. 1

Fig. 2

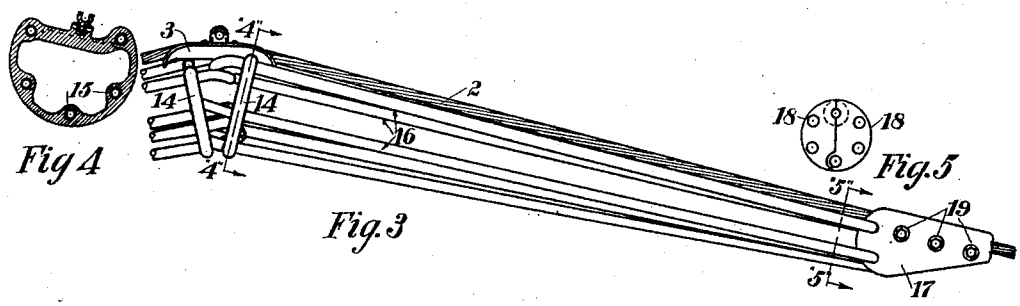


Fig. 4

Fig. 3

Fig. 5

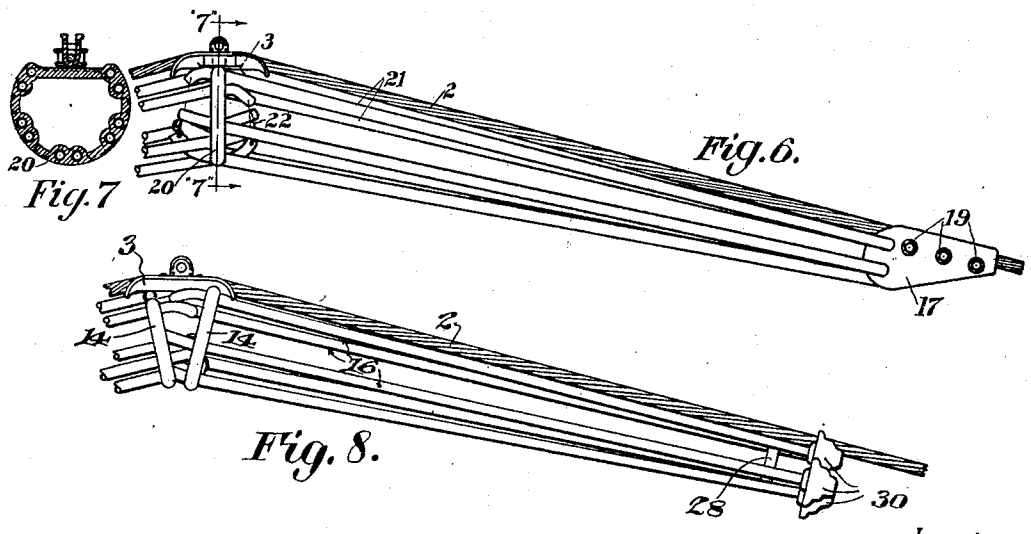


Fig. 7

Fig. 6.

Fig. 8.

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UNITED STATES PATENT OFFICE

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HIGH TENSION INSTALLATION

Original application filed October 20, 1921, Serial No. 508,933, and in Switzerland April 20, 1922. Divided and this application filed March 26, 1928. Serial No. 264,906.

This invention relates to installations for high electrical potentials, such as high tension transmission lines, wireless apparatus, and other constructions, and has for its object the provision of mechanism of the class named which shall be of improved construction and operation and which shall reduce the tendency to discharge of various characters from the highly charged conductors through the control of the electrostatic flux in the medium surrounding such conductors.

The invention is exemplified in the combination and arrangement of parts shown in the accompanying drawing and described in the following specification, and it is more particularly pointed out in the appended claims.

This is a division of application, Serial No. 508,933, filed October 20, 1921, which has resulted in Patent 1,664,100, issued March 27, 1928.

In the drawing—

Fig. 1 is an elevation of an installation embodying one form of the present invention.

Fig. 2 is a section on line 2—2 of Fig. 1.

Fig. 3 is an elevation of an installation showing another modification.

Fig. 4 is a section on line 4—4 of Fig. 3.

Fig. 5 is a section on line 5—5 of Fig. 3.

Fig. 6 is a view similar to Fig. 3 showing another form of the invention.

Fig. 7 is a section on line 7—7 of Fig. 6.

Fig. 8 is a view similar to Fig. 1 showing a different modification of the invention.

In high tension insulators for transmission and radio work as customarily used, a six or eight section suspension insulator will ordinarily withstand a greater voltage at a high frequency without danger of arcing than will the conductor on which the voltage is impressed, unless the conductor is of abnormally large size. It is, of course, not economical to use a conductor which is so large that the first cost and interest on the investment will be excessive, therefore abnormally large conductors are not feasible. Even if there were sufficient power to warrant a very large conductor for transmitting power at a high voltage, the line reactance due to the large current necessary for economy would be too great to permit of a size sufficiently large to prevent arcing of the conductor in the vicinity of the supporting tower where the electrostatic field is strong. Spreading or splitting the conductor into several parts so as to increase the effective diameter would be of material benefit, but this is open to serious mechanical objections when carried out throughout the line or in the vicinity of the tower.

The insulators or portion of insulators next the transmission lines carry higher electrostatic stress than those farther from the line due to what may be termed the leakage of electrostatic flux to ground from different members in the series. The use of a very large conductor in the vicinity of the insulator tends to prevent or make up for this loss of electrostatic flux, thereby greatly improving the stress distribution or gradient for the insulating member or members. The gradient or stress distribution in the series may be improved by horns or flux controls, as shown in my previous application, Serial No. 476,179, filed June 19, 1921, which has resulted in Patent 1,552,664, issued Sept. 8, 1925 or by a large ring or shield. Where a ring or shield is used to control the flux, this ring or shield may lower the flashover owing to its projecting into a strong field on the tower side so that it may more than offset the advantage of an improved gradient in the insulator.

An eight or ten section insulator of good design will usually withstand a higher voltage than that which will start an arc from the conductor to the tower, a distance of from five to ten feet, depending upon electrical conditions, although the length of the insulator may be only half this value. From this it will be seen that using a long string of insulators may be of little benefit in providing a larger factor of safety, as an arc may start from the conductor to the tower. This invention is designed to prevent this arcing from conductor to tower by raising the voltage to which arcing or pluming will occur and at the same time reduce the danger of arcing of the insulator string by improving the distribution of stress in same.

Owing to the comparatively small diameter of the conductor and the comparatively short distance to the tower, there is a very strong field about the conductor in the vicinity of the tower so that by increasing the effective diameter of the conductor by means of a properly formed shield or screen running along or adjacent to the conductor, the stress in the air is lowered and the corona point or voltage necessary to start a plume or arc may be greatly raised and the danger of pluming or arcing to ground under high frequency disturbances may be greatly reduced or eliminated.

There are two classes of discharge into the air from insulators or high voltage conductors. One class affects the performance of transmission lines very seriously due to the arcing to ground at voltages much lower than would be indicated by the voltage which can be carried at normal frequency. Where a discharge from a conductor into the air is in the nature of a small streamer, the resistance of the streamer will be greatly reduced by increasing the current in the same. As this current may be regarded as a charging current the air acting as a dielectric in a condenser and a streamer as one of the conducting plates, it will be seen that by increasing the frequency the current in the streamer will be increased accordingly. Since, however, increasing the current in the streamer greatly reduces its resistance, the voltage drop along the streamer will be less, consequently the high stress of the conductor will be carried out further from the conductor. This will cause a further breakdown of the air, permitting an increase in the electrostatic capacity of the condenser which affects the current and resistance of the streamer acting as one of the electrodes of the condenser. This further increase in current again reduces the resistance so that an accumulated effect is produced which is very serious when a high frequency is impressed upon the line or insulator. This may be better understood when we consider that doubling the current in the streamer may cut its resistance in half.

From this it will be seen that while the resistance in a streamer might be excessively high at a normal frequency of twenty-five or sixty cycles, the same length of streamer would have almost a negligible resistance if the frequency is increased several thousand times, which might easily occur on the transmission line. This increase in frequency over the normal frequency may come from a number of different causes, such as lightning and arcing ground, the effect of corona on the line in producing a harmonic, the harmonics produced by connected apparatus, or other causes. A discharge then which will cascade because of the accumulative effect of current, either due to the reaching of a sufficiently high voltage, or partially due to the increased current from an increased frequency, or a combination of both, may cause serious arcing or at least arcing to ground at voltages much lower than would otherwise be the case.

A small diameter of conductor, as was pointed out, permits a highly concentrated field which tends to produce streamers at comparatively low voltages. These streamers may exist at or even below the normal transmitting frequency. While there may be no trouble from the same other than the loss of power at normal frequency, an increase in frequency, particularly when attended by an increase in voltage, may permit of growth of a streamer resulting in an arc to ground, as previously explained. Where the size of the conductor is increased, the concentration of the field is reduced, and even though a streamer starts, the accumulative effect will not be so great and a much higher voltage and frequency may be impressed without producing a plume or arc which will go to ground under a disturbance, permitting the energy of the line to follow.

In Fig. 1 is shown a suspension string of insulators 1 supporting a conductor 2 by means of a saddle 3. The effective diameter of the conductor in the vicinity of the insulator and tower is increased by means of a metallic cage formed of open-work structure extending along the conductor 2. A pair of rings 27 is supported from the saddle 3 adjacent the insulator string and similar rings 28 are connected to the conductor 2 at points spaced from the insulator string. A series of pipes 29 is welded or otherwise secured to the periphery of the rings 27 and 28 and extend along the conductor forming a cylindrical cage therewith.

In order to prevent arcing from the ends of the pipes 29, an insulator 30 may be placed over the end of each of these pipes. It will be seen that this cage greatly increases the effective diameter of the conductor so that a much higher voltage must be impressed to cause a sufficient concentration of stress in the air to start a streamer than in the case of a bare conductor of a relatively small diameter.

By making the conductor guard or cage of open construction, the concentration of drip water is eliminated and the cost of the guard kept down. The concentration of drip water, if permitted, would tend to form a conducting path which would start a plume and lower the flash-over, particularly where the cage or guard has a large projecting surface which accumulates and concentrates considerable drip water. The use of the conductor cage or guard permits higher operating voltages and frequency without arcing from insulators, conductors and fittings for a given tower clearance.

Where it is desired to raise the voltage of a line after an installation is made, it frequently occurs that there is not sufficient clearance to permit an insulator of sufficient size to prevent arcing. It will be seen that the conductor guard or cage is of particular advantage in a case of this kind as it permits an increase in the voltage without danger of arcing such as would occur in ordinary construction due not only to high pluming voltage of the conductor but also to the greater efficiency of the insulator permitting a shorter insulator with greater clearance.

In Fig. 3 a pair of brackets 14 are suspended from the saddle 3 and these brackets are provided with openings 15 as shown in Fig. 4. Rods or hollow pipes 16 are suspended in the openings 15 and extend along the conductor 2, the rods or pipes 16 with the conductor 2 forming a cage of approximately cylindrical shape. The outer ends of the pipes 16 are supported by a fitting 17 comprising a pair of clamp blocks 18 held together by bolts 19. The blocks 18 are clamped over the conductor 2 and are provided with openings in which the pipes 16 are secured in any suitable manner.

The construction shown in Fig. 6 is somewhat similar to that shown in Fig. 3 except that in Fig. 6 a single supporting bracket 20 is suspended from the saddle 3, the bracket being provided with a series of openings for receiving the pipes 21 extended in both directions from the insulator string. The outer ends of the pipes are supported from the conductor by a fitting similar to that shown in Fig. 3. In the construction shown in both Figs. 3 and 6 the ends of the pipes are turned inwardly to prevent danger of arcing from their ends. A wire or other suitable holding device may be threaded through the ends of the pipes as shown at 22 to hold the bent ends in their inwardly turned position.

In the modification shown in Fig. 8, the rods 16 are supported adjacent the insulator in a manner similar to that shown in Fig. 4 but the ends of the rods are provided with insulators 30 similar to those shown in Fig. 1.

I claim:—

1. The combination with a conductor of an insulating support for said conductor, a plurality of bars disposed along said conductor and extending a short distance at opposite sides of said support, spaced brackets for holding said bars and conductor in spaced relation to one another and means at the ends of said bars for minimizing electrical discharge therefrom.

2. The combination with a conductor of an insulating support for said conductor, a pair of brackets connected with said conductor in spaced relation to each other adjacent said support, a plurality of bars of conducting material mounted on said brackets in spaced relation to one another and to said conductor, said conductor being extended away from said support beyond the ends of said bars and means on the ends of said bars for minimizing electrical discharge from said bars.

3. The combination with a conductor of an insulating support for said conductor, a bar of conducting material extending along said conductor adjacent said support and electrically connected with said conductor and terminating at a point short of the end of said conductor and an insulator disposed upon and enclosing the end of said bar.

4. The combination with a conductor of an insulating support for said conductor, a plurality of bars arranged in spaced relation to one another and to said conductor and extending longitudinally of said conductor adjacent said support, said bars being terminated at opposite sides of said support while said conductor extends beyond the ends of said bars and coverings of dielectric material disposed over the ends of said bars.

5. The combination with a conductor of a bar extending longitudinally of said conductor and electrically connected therewith and terminating at a point between the ends of said conductor, the end of said bar being turned inwardly toward the center of the electrostatic field set up by said bar and said conductor to prevent electrical discharge from said end.

6. The combination with a conductor of a metal ring disposed adjacent said conductor in a plane transverse thereto, a plurality of metal bars carried by said ring and extending longitudinally of said conductor, the ends of said bars being turned inwardly toward the interior of said ring to prevent electrical discharge therefrom.

In testimony whereof I have signed my name to this specification this 24th day of March, A. D. 1928.

ARTHUR O. AUSTIN.