S. S. SONNEBORN.

MULTIPLE SECTION SUSPENSION INSULATOR.

APPLICATION FILED FEB. 10, 1917.

1,282,481.

Patented Oct. 22, 1918.

2 SHEETS—SHEET 1.

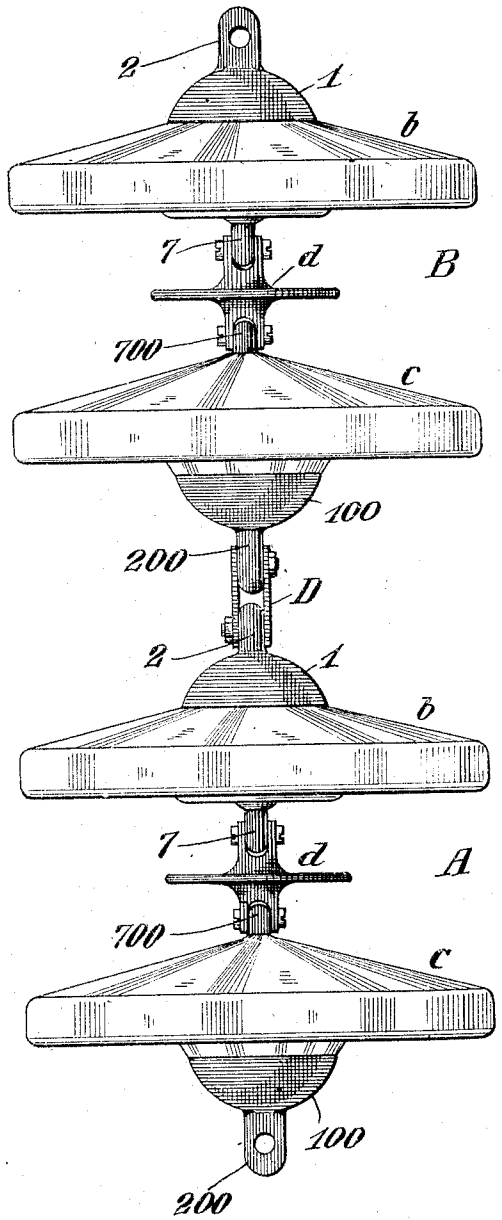


Fig. 1.

Fig. 4.

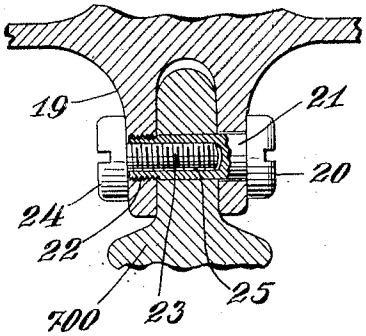
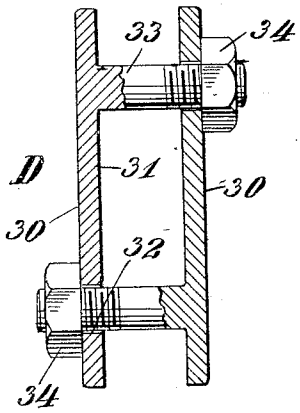


Fig. 3.



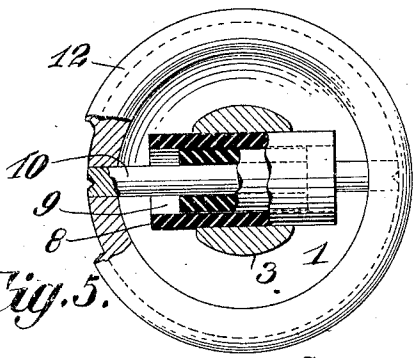


Fig. 5.

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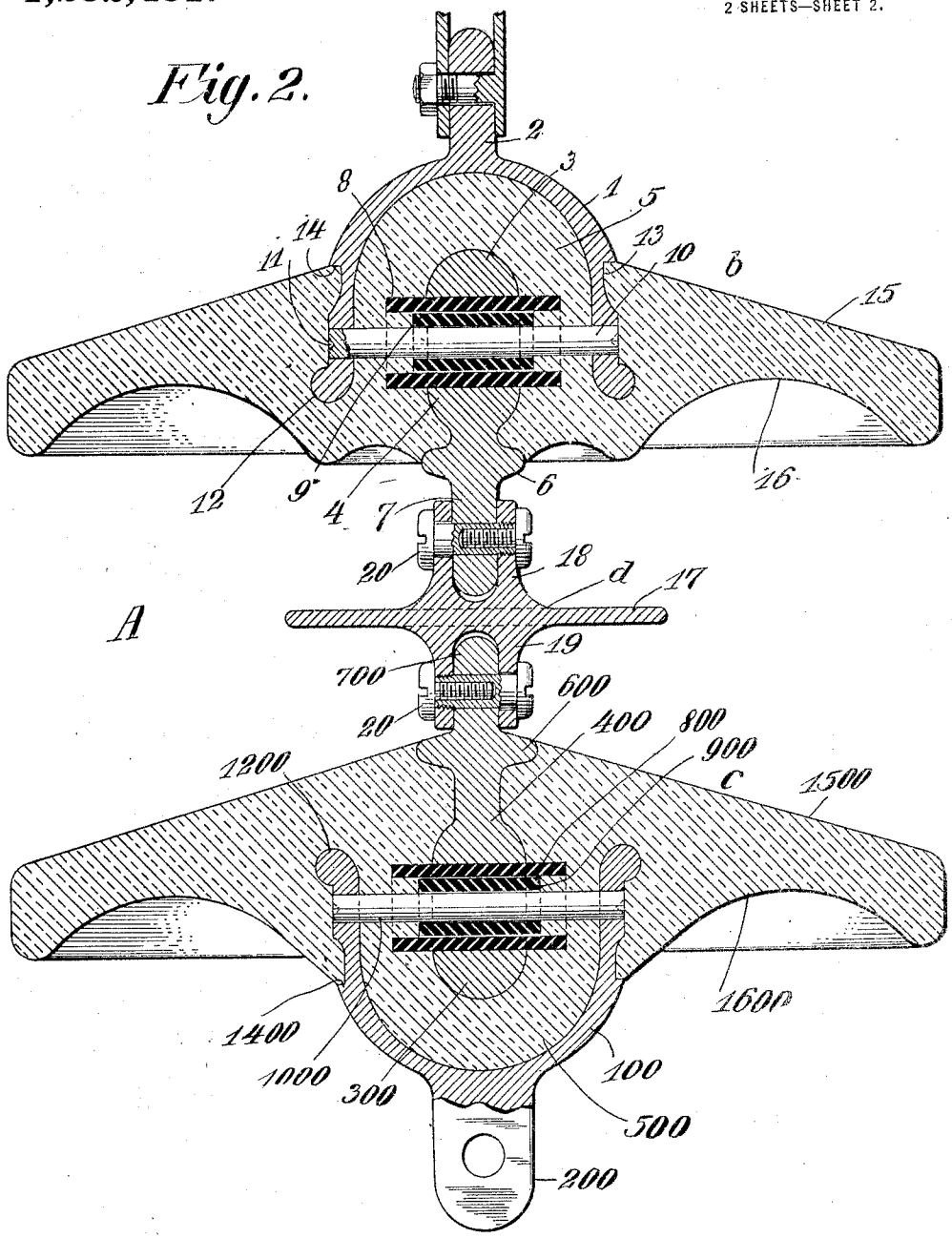
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2 SHEETS—SHEET 2.

Fig. 2.



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MULTIPLE-SECTION SUSPENSION-INSULATOR.

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Application filed February 10, 1917. Serial No. 147,734.

To all whom it may concern:

Be it known that I, SOL S. SONNEBORN, a citizen of the United States, and a resident of Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Multiple-Section Suspension-Insulators, set forth in the following specification.

This invention relates to insulators for high-potential transmission lines and particularly to insulators of the suspension type.

All practical problems in transmission line insulation involve a combination of effects resulting from the employment, through necessity, of at least two kinds of dielectric,—air and the solid insulating material employed for structural purposes. Unfortunately the air is not always dry and the insulator design must take into consideration protection against the precipitation of moisture in the form of rain. The protection against rain through the medium of petticoats to a large extent prevents designing an insulator in a manner to give greatest efficiency to the solid insulating material, were the air always dry. Nevertheless it is desirable that the insulating material be so formed that its contour lines correspond as nearly as practicable to the flow lines of dielectric stress. This is to give maximum efficiency to the air path over the surface of the insulating material.

In a perfectly designed insulator of single section construction the cost is approximately proportional to the cube of the electric stress for which the insulator is designed. It has been found, however, that by constructing an insulator out of a number of sections in series, theoretically at least the cost can be made approximately proportional directly to the voltage instead of to the cube of the voltage. There are certain practical difficulties, however, which make it impracticable indefinitely to employ insulator sections in series so that each added section will give its pro rata increase in potential increase. This is due to the fact that under normal operating conditions there is practically no leakage current over the surfaces of the insulators and the potential to which each insulator section is therefore subjected is dependent upon the charging currents of the various condensers produced by the connection of sections in series. The insulator section nearest to the transmission line, when all insulator sections are identical, must sustain the maximum voltage, and that nearest the tower arm or ground is required to sustain the least. Therefore, for equal distribution of voltage between the various insulator sections, grading must be resorted to. Grading is not to be favored on account of the fact that so many various styles of insulator sections would be required, thus doing away with interchangeability of parts. Heretofore, when interchangeability of parts has been adhered to, the maximum electric stress to which the lowest insulator section in a series was to be subjected determined the size of all the insulator sections and, obviously, every insulator section above the lowest became inefficient or more costly than was necessary to withstand strain to which it would be subjected.

One object of the present invention is to divide as equally as possible the largest amount of electric stress between the two lowest insulator sections in a series and so on between each superposed couple or pair of insulator sections. A further object of the invention is to design the insulator sections with a view to the capability of coupling in pairs so that a symmetrical disposition of the conducting parts of each pair will result and the relative shaping and disposition of the conducting parts and of the solid insulating material so that the contour lines of the insulating material will conform as nearly as possible to the flow lines of electro-static stress while, at the same time, protection against rain and consequent surface leakage will be provided. A still further object in connection with the symmetrical positioning of the conducting parts in a pair of insulator sections is the creation of a condenser arrangement capable of equalizing the electric stress as nearly as practicable between two insulators so that the maximum size for the insulator section in accordance with this invention may be made much smaller and cheaper than has heretofore been possible.

Further objects of the invention are to provide accessory parts tending to correlate and simplify the combining of insulator sections in accordance with this invention.

The above and further elements of the invention will better be understood from the accompanying claims and the following specification which is drawn in connection with an illustrative embodiment of the in-

vention shown merely for purposes of illustration in the accompanying drawings which form a part hereof and in which like characters designate corresponding parts in the several figures.

In the drawings Figure 1 is a front elevation of a suspension insulator comprising two units each of two insulator sections each; Fig. 2 is a vertical section of the lower insulator unit of Fig. 1 but drawn to an enlarged scale; Fig. 3 is a detail enlarged sectional elevation of the coupling for use between insulator units; Fig. 4 is a detail vertical section with parts broken away showing a coupling pin or bolt; and Fig. 5 is a top plan view with parts broken away and shown in section of one of the cup-shaped metallic members of the insulator construction.

In the insulator illustrated the unit A comprises two similar yet radically different individual sections *b* and *c*. The insulator section *b* comprises an inverted metallic cup 1 providing a suitable terminal which may be in the form of the perforated lug 2. The cup 1 is a uniform body of revolution. Axially positioned within the metallic cup 1 but depending downwardly is the terminal 3 of substantially eye-bolt construction, but having its eye-portion 4 so shaped and positioned relatively to the interior surface of the cup 1 that the bounding surfaces of the intermediate insulating material 5 conforms substantially to the flow lines of dielectric stress. This is approximated in the mechanical construction by having the boundaries of the eye-portion parallel to the inner surface of the cup 1. (See Figs. 2 and 5). The stem of the eye-bolt 4 is preferably enlarged into a collar 6 the contour lines of which are free from sharp angles and below which is formed any suitable connector such as the perforated lug 7.

The eye-portion 4 of the bolt 3 is fitted with overlapping cylinders 8 and 9 of some insulating material of high dielectric strength such, for example, as mica-board. The tie-bolt 10 passes through the inner insulating bushing 9 and engages the walls of the cup 1 in suitable perforations where it may be fixed in position in any suitable manner, as by center punches 11 in the ends. In assembling the structure the cup and the eye-bolt are preferably mechanically united first, and the insulating material 5 is thereafter molded about the previously assembled parts. It is preferable that the cup 1 be formed with a beading 12 about its terminal edge and with an undercut portion 13 providing a ledge 14. The insulating material molded about the metallic parts is preferably formed into a petticoat 15 which terminates under the ledge 14 against the cup 1 and flares outwardly to form the usual rain-shedding surface, its under portion 16 being corrugated to increase the leakage surface. Electrose is a suitable material.

The lower insulating section *c* of the unit A is substantially a symmetrical reproduction of the section *b*. In this construction the eye-bolt 300 is axially positioned within the upright cup-shaped terminal 100 but extends upwardly instead of downwardly. The petticoat 1500 terminates against the beading 600 on its top surface, and against the ledge 1400 on its lower face. In other words, the parts for the lower section, characterized by the same numbers as characterize the similar parts in section *c* with the addition of two additional ciphers, are in all respects the same as those for the top section *b*, except that the idea of symmetry is carried out for the metallic or terminal parts. It is preferred that the top and bottom sections *b* and *c* of insulator unit A be connected by a flexible coupling *d*, preferably of a type to increase the electro-static capacity. Such a coupling is illustrated, comprising a central disk-shaped portion 17, which extends outwardly about the axis. The disk portion 17 is provided with top and bottom connecting lugs 18 and 19, which may be connected with the lugs 7 and 700 through the medium of bolts 20, it being preferred that the type of bolt illustrated be employed. This bolt comprises a major portion 21 having external threads 22 and an internally threaded bore 23. It also comprises a locking bolt 24 having external threads 25, fitting into the threaded bore 23.

In the insulator construction illustrated, instead of having the terminal of an eye-bolt adapted to connect with the line wire, the present invention contemplates connecting the line wire to the cup-shaped terminal 100, so that the first insulator unit connected to the line, provides within itself two condensers in series, that is, the condenser provided between the cup 100 and the bolt 400, and the condenser between the bolt 4 and the cup 1 and, in addition, a condenser in parallel to the two in series, namely, the condenser provided between the plate 100 and the plate 1. Another advantage is the uniform distribution of electrostatic stress as it is taken directly from the line wire. This is provided by the cup 100.

In Fig. 1 two exactly similar insulator units A and B are shown connected in series, the coupling between each unit being preferably accomplished by the special yoke D. This yoke or coupling D comprises two exactly identical sections 30, each of which consists of an elongated metal strap 31 having near one end a perforation 32 and near the other end a laterally extending threaded stem 33, symmetrically positioned relatively to the perforation 32. The stem of one portion 30 is thrust through the perforation of the opposite portion, whereupon nuts 34

complete the assemblement. The advantage of this structure is that there is no necessity of keeping in stock individually dissimilar mating parts, one of each of which is required to make a couple to complete the whole. All that is necessary in this instance is to keep in stock a number of identical parts, any two of which make a couple and complete a yoke.

The purpose of the conducting disk 17 between insulator sections may be considered as two-fold. It serves to distribute the dielectric stress more uniformly and also is a protection in the case of flash-over, tending to prevent local disruption of the insulator at the mechanical surface of demarcation between dielectric and conducting material.

What is claimed and what is desired to be secured by United States Letters Patent is:

1. A high potential chain insulator for sustaining and insulating a conductor from an anchorage between which conductor and anchorage there is adapted to exist a high potential difference comprising one or more insulation units, each said unit comprising two insulator-sections having each two separated metal parts one of which is laterally extensive and a body of insulation between each of said two separated metal parts, all said metal parts of each said unit being substantially symmetrical about a plane central to said unit and at right angles to the axis of said chain, whereby plural insulation plus more uniform distribution of electrostatic stresses is obtained for each said unit.

2. A sectional high-potential insulator-structure of the strain type comprising laterally extensive substantially symmetrically shaped and positioned metal end members; a metallic tension means extending axially between said end members and having a disk-like metal portion intermediate its ends; and insulation interposed between the ends of said tension means and said end members, all whereby electrostatic stresses are favorably distributed.

3. A high-potential insulator of the suspension type comprising at the bottom an upwardly concave metallic cup provided with means for conductively connecting and securing a line-conductor; an upwardly extending bolt for attachment to an anchorage; and a body of insulating material insulating said bolt from said cup and providing an upper water-shed, all whereby the necessary metal parts are positioned to give more favorable distribution of electrostatic stresses originating from a nether positioned conductor.

4. In a high potential insulator in combination two separated insulator sections having metal terminal parts, all of which are relatively substantially symmetrically shaped and positioned; and a conducting plate electrically connected with a terminal part of each of said sections and positioned between said sections and located in a plane substantially at right angles to the axis of each said section.

5. A capacity increasing coupling for suspension insulator sections comprising in a unitary structure a central disk of conducting material and metallic attaching lugs centrally positioned on opposite sides of said disk.

6. In high-potential insulators an inverted metallic cup; a similar upright metallic cup beneath said inverted metallic cup; a metallic tension structure substantially symmetrically positioned between the concavities of said cups; and a body of insulating material located between each said cup and the respective ends of said tension structure.

In witness whereof I have signed my name to this specification, this 26th day of Jan., 1917.

SOL S. SONNEBORN.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."