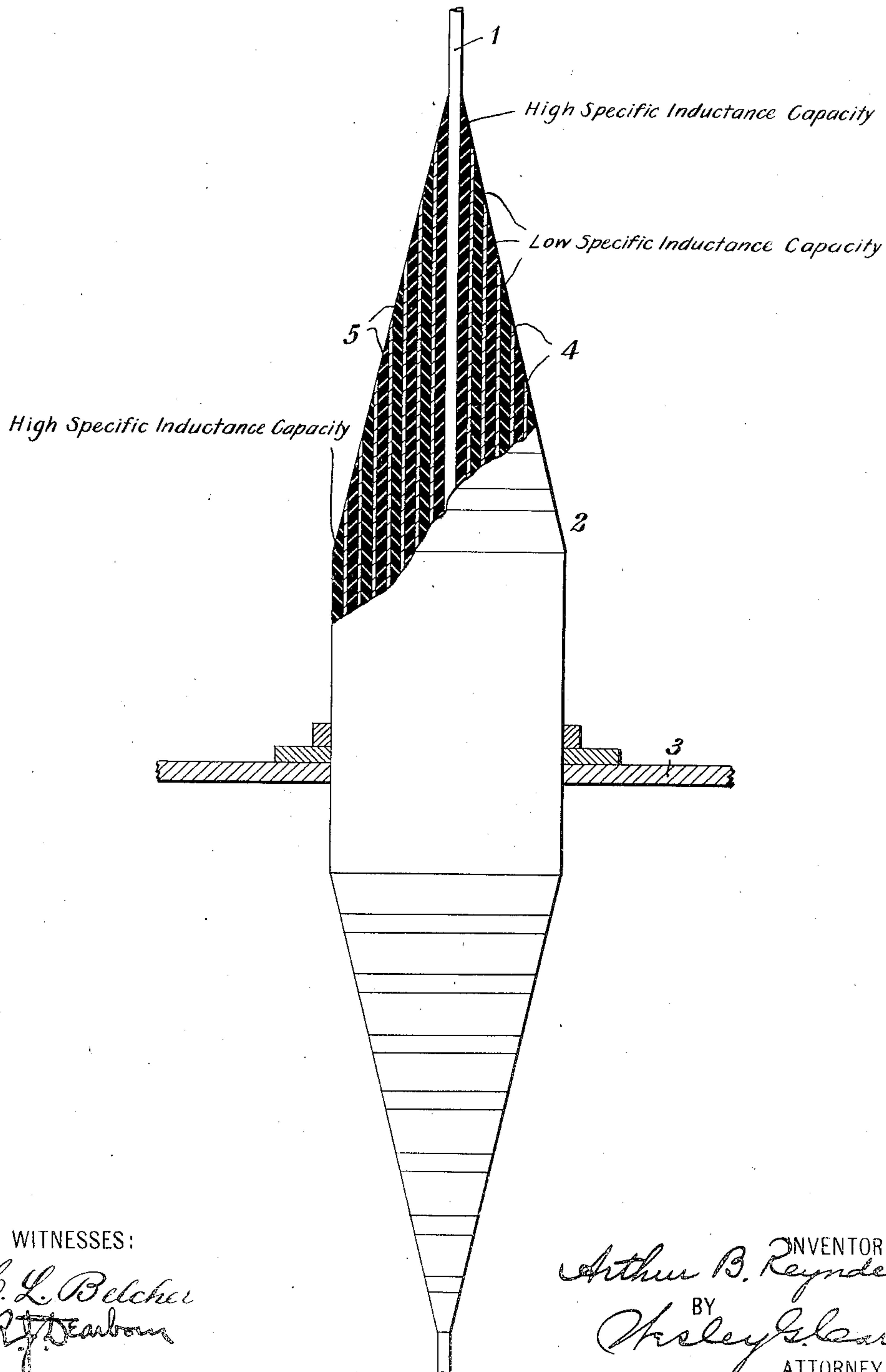


A. B. REYNDERS.  
INSULATING MATERIAL.  
APPLICATION FILED JULY 6, 1908.

952,467.

Patented Mar. 22, 1910.



WITNESSES:

C. L. Belcher  
R. J. Dearborn

INVENTOR  
Arthur B. Reynders  
BY  
Wesley S. Sears  
ATTORNEY



# UNITED STATES PATENT OFFICE.

ARTHUR B. REYNOLDERS, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, OF EAST PITTSBURG, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

## INSULATING MATERIAL.

952,467

Specification of Letters Patent. Patented Mar. 22, 1910.

Application filed July 6, 1908. Serial No. 442,195.

### *To all whom it may concern:*

Be it known that I, ARTHUR B. REYNOLDERS, a citizen of the United States, and a resident of Wilksburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Insulating Materials, of which the following is a specification.

My invention relates to insulators for high potential electrical circuits, and it has for its object to provide an insulating body in which the strains will be prevented from concentration upon or adjacent to outer surfaces, but will be equally distributed throughout the thickness of the body.

The invention consists in constructing an insulator of alternate layers of suitable insulating and conducting materials, a series of condensers being thereby provided between the external surfaces of the insulator, whereby the total strain to which the insulator is subjected is distributed throughout the thickness of the insulating material. Insulation of this general type has been used in the prior art and is known as condenser type insulation. When this insulation is utilized for bushings or sleeves for the electrical separation of conducting leads from the inclosing casings or tanks in which transformers and other electrical apparatus are contained, it has been found desirable to taper the ends of the cylindrical bushing, in order to increase the surface or creepage distance between the conducting cylinders which constitute the condenser plates. The capacity of concentric cylinders is dependent upon the distance between them, which is equal to the difference between their radii, the specific inductive capacity of the insulation between them and the areas of their adjacent surfaces. For high voltage work, it is, of course, desirable to reduce the size and the cost of the insulating bushings as far as it is possible to do so, and it has been found that these conditions can be best fulfilled by making the areas of the conducting cylinders which constitute the condenser plates, equal, and also by keeping the distances between the plates substantially equal but if it is attempted to construct a bushing which preferably fulfils the aforesaid conditions, it is found that the difference in the lengths of the successive outer cylinders is very slight while the difference between the

lengths of the successive inner cylinders is considerable, so that the taper at the ends of the complete bushing is constantly varying and the surface distance between adjacent conducting plates near the outer surface is very short.

According to my present invention, I have overcome these difficulties by constructing a bushing having uniformly tapered ends and conducting cylinders which are equally spaced apart and by compensating for the inequality in the areas of the several plates, so as to maintain the ideal condition of a series of condensers having equal capacities by introducing insulating material between the intermediate conducting cylinders which has a lower specific inductive capacity than that which separates the successive inner and the successive outer cylinders.

The single figure of the accompanying drawing is a view, partially in elevation and partially in section, of an insulating bushing that embodies my invention.

In the drawing, a rod or bar 1, of any suitable conducting material, which may constitute a circuit lead, is provided with an insulating bushing 2, by which it is insulated from a metal casing or supporting bracket 3.

The insulating bushing 2 is preferably constructed as set forth in Patent No. 858,385, granted July 2, 1907, to the Westinghouse Electric & Manufacturing Company as assignee of Emil Haefely, sheets 4 of tinfoil or other suitable conducting material being interposed at convenient or desirable intervals between the convolutions of insulating material during the construction of the bushing. The metallic sheets 4 form with each other and the conductor 1 a series of condensers in which the strains upon the insulation are proportional to the differences of potential between the sheets. The insulating properties of the material used in the construction of the bushing vary between its inner and outer walls, that having the best specific inductive capacity such as sheet mica being disposed adjacent to the walls and that having the lower specific inductive capacity such as cotton cloth or paper being disposed between conducting cylinders which are in the middle of the insulating body. By this means, the strains to which the insulating bushing is subjected



are uniformly distributed throughout its thickness, which is reduced to a minimum, and at the same time an equal surface distance or creepage distance is maintained between the ends of the conducting cylinders.

It will be readily understood, by those skilled in the art, that the utilization of poorer grades of insulating material for a material part of the construction of the insulating bushes considerably reduces the total expense involved in its manufacture.

I claim as my invention:

1. An insulating structure, comprising alternate layers of insulating material and conducting material which constitute a series of condensers, the insulating layers being graded as to specific inductive capacity in accordance with their distances from the surfaces of the structure.

2. An insulating structure comprising a plurality of alternate layers of conducting material and insulating material, the specific inductive capacity of the intermediate insulating layer or layers being less than that of the outside and inside insulating layers of the structure.

3. An insulating bushing comprising a plurality of concentric conducting cylinders and a plurality of insulating cylinders, which alternate in position with said conducting cylinders, the specific inductive

capacity of the outer and inner insulating cylinders being different from the specific inductive capacity of the intermediate insulating cylinder or cylinders.

4. An insulating bushing comprising a plurality of concentric conducting cylinders and a plurality of insulating cylinders which alternate in position with said conducting cylinders, the specific inductive capacity of the outside and inside insulating cylinders being relatively high, and the specific inductive capacity of the intermediate insulating cylinders being relatively low.

5. An insulating bushing having tapered ends and comprising a plurality of concentric cylinders of conducting material separated by insulation and constituting a series of condensers, the insulation between the intermediate cylinders being of lower specific inductive capacity than the insulation between the cylinders near the inner and outer surfaces of the bushing, whereby an equality in capacity of the condensers is effected.

In testimony whereof, I have hereunto subscribed my name this 13th day of June, 1908.

ARTHUR B. REYNDEERS.

Witnesses:

O. C. EDWARDS,  
BIRNEY HINES.