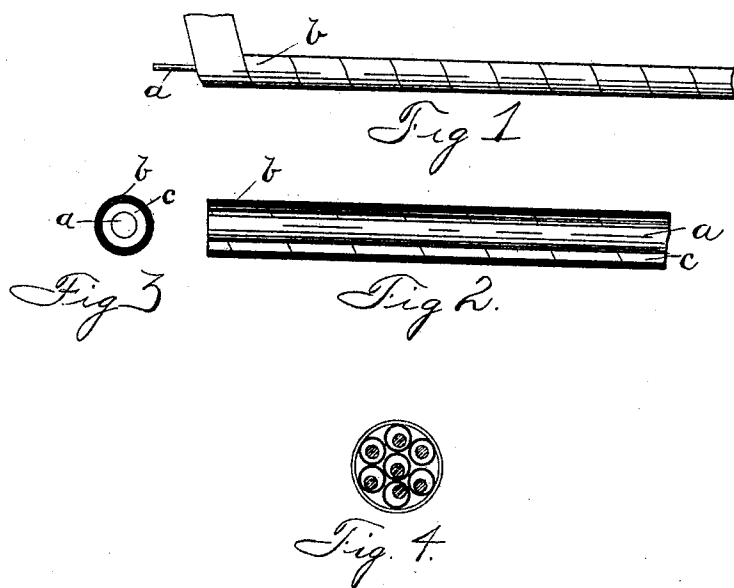


(No Model.)

T. N. HALLANGER.  
INSULATED ELECTRIC CONDUCTOR.

No. 544,531.

Patented Aug. 13, 1895.



Witnesses.  
W. Clyde Jones.  
George L. Cragg.

Inventor.  
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# UNITED STATES PATENT OFFICE

TOBIAS N. HALLANGER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE.

## INSULATED ELECTRIC CONDUCTOR.

SPECIFICATION forming part of Letters Patent No. 544,531, dated August 13, 1895.

Application filed February 18, 1893. Serial No. 462,813. (No model.)

*To all whom it may concern:*

Be it known that I, TOBIAS N. HALLANGER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Insulated Electric Conductors, (Case No. 2,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to insulated electric conductors for electric cables. Its object is to produce an insulation that shall at the same time offer a maximum electrical resistance and a minimum inductive capacity.

It is desirable in an insulation to secure both a high electrical resistance and a low inductive capacity, and that insulation will be the most efficient which combines in its properties both a maximum electrical resistance and a minimum inductive capacity. Such an insulation is not only desirable, but essential to the proper grouping of electrical conductors in cables where the conductors must necessarily occupy contiguous positions, and the consequent mutual induction is an important factor for consideration. Most materials which possess solidity and high electrical resistance unfortunately do not possess a low inductive capacity, so that by providing a sufficient thickness of such material around the conductor almost perfect current-insulation may be secured, but inductive troubles will still exist. It is a well-known fact that dry air, of all the known substances, possesses a maximum electrical resistance and a minimum inductive capacity, so that the ideal insulation would be that in which the conductor is surrounded by no other substance than dry air. Appreciating this fact, many forms of insulation have been produced in which air chambers or interstices are left in the insulation for the retention of air, thus decreasing the inductive capacity. It is to secure the maximum effect of an air-insulation that my invention is adapted.

My invention consists in a conductor wound with fibrous insulating material formed into a tube whose inner diameter is materially greater than the diameter of the conductor,

thus leaving an air-space between the conductor and the protecting sheath.

My invention will be more readily understood by reference to the accompanying drawings, in which—

Figure 1 shows a conductor spirally wound with tape in accordance with my invention. Fig. 2 is a sectional view through the axis of a conductor so wound. Fig. 3 is an end view thereof. Fig. 4 is a sectional view of a cable composed of wires insulated in accordance with my invention.

Like letters refer to like parts in the several figures.

The conductor *a* which is to be insulated is loosely surrounded by an insulating covering *b*, whereby an air-space *c* is left between the conductor and the inclosing sheath.

I have described a method of winding insulating tape upon a conductor, so that an air-space may be left around the same, in my application for Letters Patent filed November 14, 1891, Serial No. 411,848, and therefore do not deem it necessary to enter into detail upon the method of forming such a product.

In the application above referred to the method consists in positively winding insulating-tape about the conductor, so as to form a tube or protecting sheath of insulating material about the conductor, and having an inside diameter materially greater than the diameter of the conductor insulated. It is evident, however, that such a tube may be formed about a conductor in a variety of ways, and I do not wish to limit myself to a tube or sheath of insulating material formed precisely in the manner shown in said application.

Instead of one enveloping-tube another may be wound concentric with the first, with an air-space between it and the first tube, or, in fact, any number of tubes may be thus placed about a conductor. The tubes may be formed of any of the well-known fibrous insulating substances, as paper, cotton, &c.

Any number of conductors thus insulated may be united to form a cable in which the conductors will be separated by air-spaces, and the mutual inductive effect of the conductors greatly diminished. By changing the ratio between the diameter of the conductor

and the internal diameter of the inclosing tube the inductive effect between the conductors may be reduced indefinitely.

Having described my invention, what I  
5 claim as new, and desire to secure by Letters Patent, is—

As a new article of manufacture, a cable  
composed of conductors twisted or bunched  
together, each of said conductors being sur-  
10 rounded by a tube of insulating material hav-  
ing an inside diameter considerably greater  
than the diameter of the conductor to thereby  
leave an air space about the conductor, said

tubes being formed of tape wound spirally  
about the conductors with the edges abutting 15  
or overlapping to form a tube surrounding  
the conductor, air spaces being thus provided  
between the several conductors formed into  
a cable to decrease the inductive capacity,  
substantially as described. 20

In witness whereof I hereunto subscribe my  
name this 7th day of January, A. D. 1893.

TOBIAS N. HALLANGER.

Witnesses:

HARRIET G. TEMPLETON,  
W. CLYDE JONES.