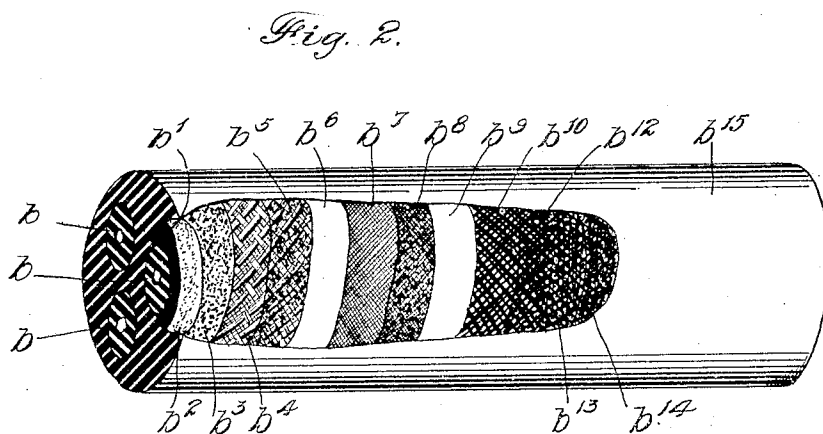


No. 809,313.

PATENTED JAN. 9, 1906.

A. M. LOUGEE.
PROTECTED CONDUCTOR.
APPLICATION FILED MAY 23, 1904.



Witnesses

John C. Porter.

A. M. Rice.

Inventor.

Amanda M. Lougee,

by Geo. S. Maxwell

Attorney.

UNITED STATES PATENT OFFICE.

AMANDA M. LOUGEE, OF BOSTON, MASSACHUSETTS.

PROTECTED CONDUCTOR.

No. 809,313

Specification of Letters Patent.

Patented Jan. 9, 1906

Application filed May 23, 1904. Serial No. 209,192.

To all whom it may concern:

Be it known that I, AMANDA M. LOUGEE, a citizen of the United States, and a resident of Boston, in the Commonwealth of Massachusetts, have invented an Improvement in Protected Conductors, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

For meeting all the requirements of use and doing away with a separate conduit not only must the article in question have high insulation, be fireproof, waterproof, nail-proof, flexible, durable, and not liable to change its character by age, but it must be small in size, moderate in cost, convenient to handle, and present a fair appearance.

The object of my present invention is to meet all these requirements and produce a wire or conductor which with slight changes is adapted for heavy service not only in building construction and aerial construction, but in the more exacting underground construction and in submarine cable-work.

The ordinary electrical wire commonly used in buildings, for example, is constructed as follows: The covering next to the wire is made up principally of shoddy rubber, which requires in its manipulation quite an amount of palm-oil or other lubricants for putting it into shape for sufficient pliability to permit its use in covering the conductor-wire. This mixture of shoddy rubber and oil having been applied to the wire, a covering of cotton-braid of one or two thicknesses is applied, said braid then being soaked in pitchy preparations to maintain it properly in place. The result is that when the wire and its covering is ready for the market it is a mass of inflammable material which whenever a short circuit takes place and the fuses fail to work is sure to ignite, and because of its extremely inflammable character the fire is carried through the iron conduit, thereby setting fire to the building or the electric car or to the underground structure, as the case may be. In connection with underground work the problem is still more difficult because of the destructive electrolysis, which is rapid in the presence of moisture and stray currents. The conductors commonly employed in underground work for light, heat, and power are composed of the current-carrying wires, surrounded with a large mass of paper saturated in oil in sufficient volume to carbonize, and then this inflammable mass is surrounded

by large quantities of jute closely compressed in proper shape and retained by a lead sheath, which is usually applied thereto under pressure, so as to prevent displacement of any portions of the cable and so as to keep out the moisture. Lead, however, being a metal most easily acted upon by electrical currents is quickly attacked by the stray electrical currents present in the ground and is frequently destroyed, especially adjacent to the manholes, where moisture is usually present.

The purpose of my invention is to provide a construction which is absolutely electrolysis-proof and yet is small in size, fireproof, flexible, and has all the other attributes above mentioned, the parts being so combined that without sacrificing strength, lightness, economy of production or convenience of use every one of the desirable features and requirements above mentioned is secured in one and the same article.

In carrying out my invention I first coat the electric wire with a compound having great strength and extremely high insulation, preferably increasing in fire-resisting qualities from the center outward, and surround this coating with a fireproof jacket permeated with a special compound for rendering it still further fireproof and impervious, and about this jacket I provide a plastic layer of fireproof and vulcanizable ingredients, in the outer surface of which is embedded a wire covering having a coating of special materials applied in such a manner as to become practically a part of said covering, the latter having successive applications thereof, and finally a second and in some instances a third covering of wire and coating serve to render the article adapted to the most exacting requirements of underground and other construction, the whole being vulcanized and rendered as nearly integral and homogeneous as possible.

The further details of my invention will be pointed out more fully in the course of the following description, reference being had to the accompanying drawings, in which I have shown preferred embodiments of the invention, the latter being further defined in the appended claims.

In the drawings, Figure 1 is a fragmentary view, inside elevation, showing a conductor constructed according to my invention and especially adapted for use in buildings and other places where the various qualities are called for in their highest efficiency, this figure

having portions broken away to show the internal construction. Fig. 2 is a view similar to Fig. 1, showing my invention applied to underground and other uses.

5 Referring to Fig. 1, where the invention in its simpler embodiment is shown, let a represent a copper wire or other electrical conductor. This is provided with a covering or coating a' , composed of rubber and fireproof
10 material, so as to combine the very best insulation with proper fireproofing to render flaming practically impossible. The fireproofing is not secured by applying an external coating, but is formed as a part of the
15 compound, the ingredients being mixed with the rubber or other highly-insulating material and applied so that the pure rubber comes adjacent to the wire and the fireproof ingredients increase in amount outwardly. This
20 compound may be composed of the ingredients set forth and referred to in my Patent No. 717,009 and may be applied in the manner therein mentioned. The covering a' is provided externally with one or more thin coat-
25 ings or dippings a'' of extremely fireproof compound, and then a covering a''' , of asbestos or woven fiber saturated with fireproof substance, preferably with sulfate of aluminium, is braided tightly in place. All the meshes
30 of this braided jacket a''' and the fiber itself are completely filled with a special fireproof insulating compound, so that it is permeated both inside and outside therewith. This compound is preferably composed of rubber, zinc,
35 sulfate of aluminium, and sulfur enough to vulcanize, although in the cheaper grades of conductor I employ instead thereof oxidized oils and hydrocarbons, sulfate of aluminium, and a suitable drier or some or all of the materials mentioned in my aforesaid patent. The
40 covering a''' is then dipped sufficiently to coat it, as indicated at a^1 , with a comparatively thin and vulcanizable coating of high fire resistance and flexible qualities, and then a considerable body a^5 of the special compound above
45 mentioned is applied, and while yet plastic a covering of wire a^6 is woven or braided thereon tightly, so as to embed itself in the coating a^5 . The wire covering a^6 having been tightly
50 and compactly applied, as stated, it is dipped in the fireproof compound above mentioned at a high heat, the result being that the coating becomes not merely applied thereto, as in the case of a paint, but most tenaciously united
55 therewith, and as the compound is more or less elastic it not only is incorporated with the separate strands of wire, but fills the interstices and unites with the plastic compound a^5 , so that the various layers of compound and wire are in no sense separate or properly
60 recognizable as distinct layers, but they are united in as nearly a homogeneous structure as it is possible to obtain. The dipping (meaning any method of application, especially im-
65 mersing) of the conductor as thus far con-

structed is repeated several times to get the desired thickness until a considerable body or coating a' is provided, and then while the latter is still somewhat plastic a second covering
of wire a^8 is tightly woven or braided in place,
70 being then dipped in a hot bath of the rubber and fireproof compound, as indicated at a^9 , so as to become as nearly as possible incorporated with the wire and also so as to unite with the coating a^7 and completely fill and solidify
75 the meshes and unevenness of the wire covering a^8 , especially on the outer surface thereof. Successive dippings, or it may be a thicker mass or bath of the compound, are then applied, as indicated at a^{10} , and on this coating
80 an outside covering of wire a^{12} is applied in the same manner as before stated. On this last-mentioned covering of wire a^{12} a heavy outside coating a^{13} is applied in successive hot
85 dippings until the desired thickness of outside covering is obtained.

Having built up the conductor as above explained, it is properly vulcanized as a whole, so that it all becomes to all intents and purposes a one-piece article and none of the
90 layers can be removed or separated either accidentally or intentionally from the rest of the structure.

For some uses one wire covering will be sufficient; but where great strength and extreme
95 safety are needed, as in the case of underground cables for light, heat, and power, it is preferable to employ the entire arrangement as above described. Where more than one
100 wire covering is employed, the outermost covering of compound will contain a larger proportion of the harder and more waxy ingredients.

This construction is particularly adapted
105 for building construction, simply being applied directly in place either inside or outside of the walls without the necessity of being drawn into an iron conduit. When several coverings of wire are used, I prefer to have
110 the first covering a^6 woven more coarsely or loosely, so that it will permit the outside and inside layers of compound to unite more directly and firmly with each other, and I prefer to have the layer a^8 composed of fine wire,
115 so that the strands may rest as snugly and tightly against each other as possible. I also prefer to employ different kinds of metal for these successive layers of wire—as, for instance, the outside layer a^{12} may be composed of
120 steel wire for giving great strength, and various other kinds of metal—such as copper, aluminium, iron, and brass—may be employed in the other layers as may be required for giving increased flexibility or lightness or for decreasing the expense, &c.
125

In applying my invention to the construction of heavy multiconductor underground
cables, as indicated in Fig. 2, I follow the same
general plan of construction. Having first
constructed the individual conductors as above
130

explained, I mount them in proper relation to each other, as indicated at b , Fig. 2, where three are shown, and surround them with a proper amount of compound b' , the same as above described in connection with the layer a' , this compound having adjacent the center of the cable and about the individual conductors extremely high insulation and increasing in fireproof ingredients as it recedes toward the circumference, the outside thereof at b^2 having a relatively thin layer of the most highly fireproof character. It will be understood that the compound can be varied to suit different requirements simply by increasing or decreasing the proportion of fireproof ingredients with relation to the insulating ingredients and vulcanizing ingredients, &c., as is more fully stated in my patent above mentioned and the others therein referred to.

About the layer b^2 I apply a heavy layer of thick compound b^3 , over which is woven a loose jacket of wire b^4 , and to this covering is applied under heat a series of thin coatings, as indicated at b^5 , and then a coating of thick compound b^6 for receiving a fine tightly-braided jacket b^7 , which again is coated under heat, as indicated at b^8 , and a thick coating b^9 is next applied to receive a wire jacket b^{10} . The jacket b^{10} is composed of quite coarse wire having great strength for withstanding strains in all directions, and to this outside wire covering are applied under heat successive coatings b^{12} b^{13} b^{14} sufficient to render the wire covering b^{10} impervious to moisture and absolutely current-proof—*i. e.*, so that electrolysis cannot take place. Then a final outside heavy layer b^{15} of my special compound is applied, and the whole cable is vulcanized.

One object of incorporating a vulcanizing agent throughout the compound or successive layers and then vulcanizing them all is to reinforce the strong points or advantages of each layer by those of the other layers in such an intimate and direct manner that no possible cleavage or natural disruption can take place, but all the advantages conspire together in accomplishing the desired unitary result.

As already stated, a fibrous covering may be used for some purposes in place of the asbestos jacket. So for some purposes I apply some of the layers—as, for instance, it may be one of the layers a^2 or a part of one of the layers a^5 , a^7 , and a^{10} , (usually the outside surface of these latter heavier layers)—in the form of a more or less heavily coated tape-like winding or layer.

In the case of aerial conductors I omit the asbestos, and so likewise in the case of submarine protection, where the rust-proof and waterproof ingredients predominate and fireproofing on the exterior is unnecessary.

I have endeavored to employ ingredients which can be purchased at low cost in the market and so to combine said ingredients as to produce a permanently-flexible and easily-

handled small, durable, and permanent cable. My invention resides in so combining the right articles in the order specified as to enable me to secure a cable of neat appearance which notwithstanding its small size, flexibility, and inexpensive construction is proof against fire, water, electrolysis, and ordinary puncturing or abrasion by nails and the like. Above all, however, the most important advantage is that by my invention I avoid the dangers of electrolysis without, however, introducing any weakness or diminishing in any degree the fireproof, waterproof, and insulating and impervious character of the cable or conductor.

The parts and compounds are so arranged, manipulated, and treated that all is accomplished in one homogeneous structure adapted to general use.

Moisture has no effect on my conductor or cable, as it is not an air-drying construction, but is chemically and mechanically built up into permanent integral condition in such a manner that it maintains substantially the same character throughout long use.

Heretofore insulation is what has been aimed at mainly so far as the conductor has been concerned, and a separate outside conduit has been relied upon for the fireproofing thereof, and one serious difficulty thereof has been the liability of the conductor to abrade by the fin or bur left at the end of the pipe or conduit or by the scale which is sometimes left inside the iron pipe, which catch the cotton covering of the wire and pull off the insulation. By my invention all the desirable qualities of strength, insulation, fireproofing, &c., of the conduit conductor system are obtained in one and the same piece without any of the disadvantages, and, moreover, my article is permanently flexible and electrolysis-proof.

Besides the uses above explained my invention is especially adapted to aerial use, and it is not subject to deterioration by the action of the elements and is well adapted to withstand the abrasion of trees, which, taken in connection with the sudden changes of temperature and humidity, have heretofore proved so destructive in connection with the use of telephone and telegraph wires. It is also well adapted for submarine use, as it is not affected by salt water, not liable to rust, and the coatings cannot be separated.

It will be understood that I am not limited to all the details of construction above set forth and also that my invention is capable of uses besides those explained, and I wish it understood that in some instances I may omit certain details of construction, as will appear more formally in the appended claims. In the claims I use the word "woven" to mean any method of producing the layer, whether strictly woven, or braided, knitted, or so forth. In some of the claims I have referred to the wire covering as having the adjacent compound

"incorporated therewith," and by this phrase I mean to restrict the claim to having the compound applied to the wire under heat, as above explained, as I have found that this method
 5 produces results not obtained otherwise. By the term "conductor-wire" or "conductor" in the claims I mean to include any conducting means, whether consisting of an individual strand or a plurality of strands or wires, as
 10 commonly found in individual conductors or in cables and the like as used for light, heat, power, telephonic and other purposes.

For enabling my invention to be more clearly apprehended I have described the same both
 15 with reference to the combination of parts and the process employed, the latter, however, being more fully described and claimed in my concurrent application, Serial No. 209,191.

Having described my invention, what I
 20 claim as new, and desire to secure by Letters Patent of the United States, is—

1. As an article of manufacture, a protected conductor, comprising an inner conductor-wire, an enveloping compound of insulating
 25 and fireproof ingredients having an increasing quantity of the latter on its outer side, a covering of fireproof fabric surrounding said compound and permeated on both sides with fireproof materials, a woven-wire jacket tightly
 30 embedded in the fireproof materials on the outer side of said fabric covering, and a coating of fireproof compound inclosing said wire jacket, the whole containing vulcanizing ingredients and being vulcanized together as a
 35 one-piece article.

2. As an article of manufacture, an inner conductor-wire, an enveloping vulcanizable compound containing a maximum quantity of insulating ingredients adjacent the wire, and
 40 an increasing quantity of fireproofing ingredients toward its outer side, a coarse-mesh woven-wire jacket filled and permeated on both sides with a vulcanizable compound containing fireproofing and insulating ingredi-
 45 ents, and a superimposed fine-mesh woven-wire jacket, permeated on both sides with a vulcanizable compound containing fireproofing, insulating and waterproofing ingredients, the whole being vulcanized together as a one-piece
 50 article.

3. As an article of manufacture, an inner conductor-wire, an enveloping vulcanizable compound of insulating and fireproofing ingredients, a tightly-woven wire jacket, hav-
 55 ing a vulcanizable, fireproofing and insulating compound incorporated therewith on both sides and permeating the meshes thereof, and a thick external coating, having a large number of layers of vulcanizable, permanently-

flexible compound, containing ingredients as
 60 described for rendering the same moisture-proof, electrolysis-proof and fireproof, and the whole being vulcanized together as a one-piece article.

4. As an article of manufacture, a cable,
 65 containing a plurality of individual conductor-wires, each embedded in a compound containing substantially pure insulating material adjacent the wire and an increasing proportion
 70 of vulcanizable and fireproofing ingredients externally thereof, all of said wires thus covered being together inclosed in a similar enveloping compound, and a plurality of woven-wire jackets separated from each other, and
 75 each embedded in and permeated by, a vulcanizable compound containing insulating and fireproofing ingredients, the inner jacket having coarse-mesh and fine wire and the outer jacket having coarse wire tightly woven, and an outside covering of thick, vulcanizable,
 80 fireproof, waterproof and insulating compound, the whole being vulcanized together, and permanently flexible.

5. As an article of manufacture, a cable,
 85 containing a plurality of individual conductor-wires permanently insulated from each other, and an enveloping compound of vulcanizable, insulating, fireproofing ingredients, a coarse-mesh fine-wire jacket, tightly inclosing said
 90 compound, a thin coating of similar compound incorporated therewith as stated, a thick coating of similar compound, containing an increased quantity of fireproofing ingredients, inclosing the same, a close-woven fine-wire
 95 jacket thereon, a further covering of similar compound similarly arranged, a close-woven coarse-wire jacket, and a thick coating of similar compound enveloping the whole, all being vulcanized together as a one-piece article.

6. As an article of manufacture, a protected
 100 conductor, comprising an inner conductor-wire, an enveloping compound of insulating and fireproofing ingredients, and a plurality of woven-wire jackets separated from each other by vulcanizable, fireproof insulating
 105 compound, and also permeated with said compound, the whole being vulcanized together and permanently flexible, the wire of the outer jacket having great tensile strength and hardness, and the wire of the inner jacket being
 110 lighter and more flexible.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

AMANDA M. LOUGEE.

Witnesses:

GEO. H. MAXWELL,
 MARY L. SWAIN.