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Patented Nov. 11, 1902.

A. M. LOUGEE.
METHOD OF MAKING ELECTRIC CONDUITS.

(Application filed Dec. 2, 1901.)

No Model.)

Fig. 1.

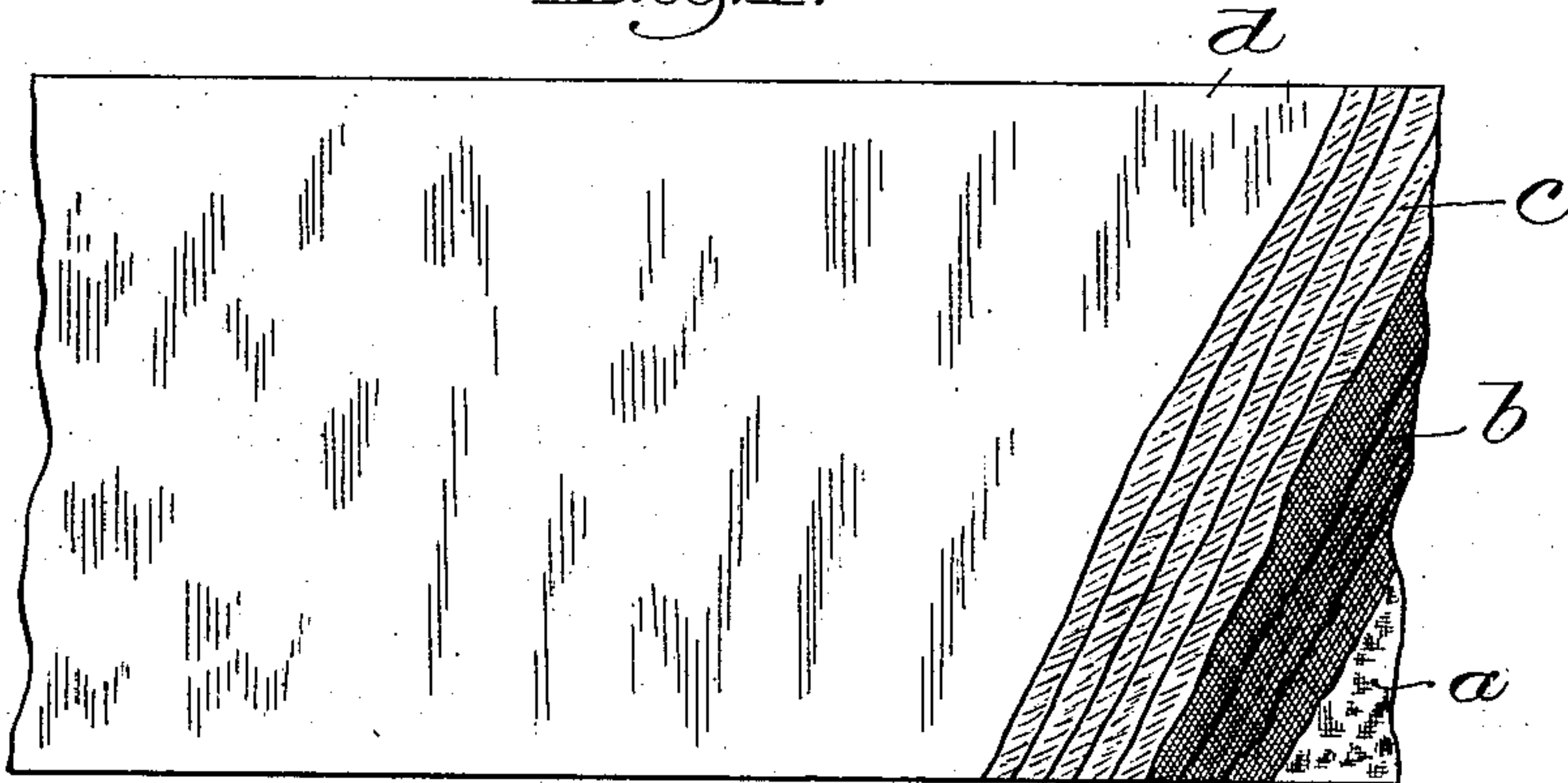


Fig. 2.

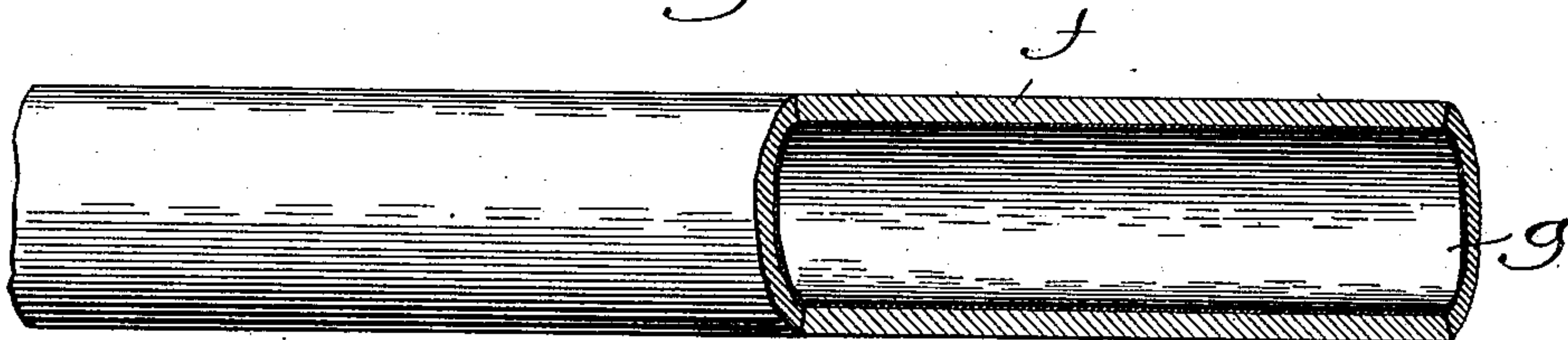


Fig. 3.



Fig. 4.

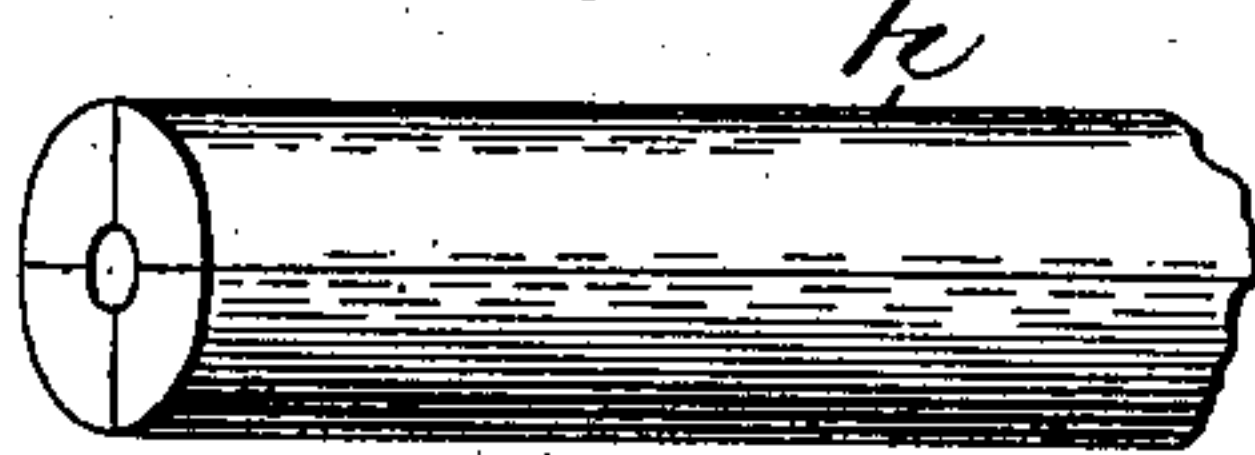


Fig. 5.



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METHOD OF MAKING ELECTRIC CONDUITS.

SPECIFICATION forming part of Letters Patent No. 713,122, dated November 11, 1902.

Application filed December 2, 1901. Serial No. 84,344. (No model.)

To all whom it may concern:

Be it known that I, AMANDA M. LOUGEE, a citizen of the United States, residing at Boston, county of Suffolk, State of Massachusetts, have invented an Improvement in Methods of Making Electric Conduits, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My present invention is a method of manufacturing electric conduits of the kind in which there is an outside armor provided with an interior lining or insulating member formed as nearly as possible integrally with said armor and preferably being capable of being made as nearly as possible like a coating—i. e., being so thin and occupying such intimate relation to the armor as to be more like a skin or coating of the armor than a separate tube secured thereto.

There has always been great difficulty in obtaining a substantial insulating member properly united to the armor; and accordingly my present invention has for one object the provision of a method whereby the resulting conduit has its insulating member or interior lining and the armor or outside covering practically integral at all points, this result being obtained, moreover, without the sacrifice of any of the desirable qualities essential to a superior conduit, but, on the contrary, my method includes certain steps which produce a much more efficient conduit in respect to flexibility, insulation, durability, adaptability to all positions and kinds or usage and manipulation, besides other features, such as fire-resisting capacity, all as will more fully be set forth in the course of the following description.

My invention in its broader aspects includes the application to or between the adjacent surfaces of the armor and lining proper of proper materials for producing a practically integral chemical union of the two when subjected to heat, and, stated more specifically, my invention comprises, in connection with the foregoing, certain steps of manufacture which give a hard or relatively hard exposed

inner surface of great insulating and fireproof qualities with an intermediate softer layer capable of great flexibility.

For the purpose of a clear understanding of my method I have illustrated in accompanying drawings the steps thereof as taken by me in the manufacture of one form of armored conduit.

Figure 1 is a fragmentary plan view of a sheet properly prepared prior to being formed for insertion in the armor. Figs. 2 and 3 are plan views, partly in section, showing an armor in the process of being provided with the insulating-lining. Fig. 4 is a perspective view of a mandrel which may be employed. Fig. 5 is a longitudinal sectional view showing a further step in the process.

In carrying out my method I do not intend to limit myself to any set way of making a conduit; but for purposes of illustration herein I refer to that method in which the various layers which constitute the lining of the conduit are prepared in sheet form before they are formed into tubular shape for insertion within the armor.

Bearing in mind that one of my purposes is to obtain an exposed inner surface which shall be fireproof and also of higher insulating qualities than heretofore, and yet that this must be obtained without sacrificing the pliability and strength of the conduit, I first spread upon a suitable base or support *a*, such as cotton fabric, (reference may be had to my Patent No. 642,539, dated January 30, 1900,) a thin layer of asbestos, mica, or other fire-resisting material, as will be more fully defined later on, contained in a vulcanizing-vehicle or binding agent, preferably rubber or the like, containing sulfur, antimony, or other vulcanizing ingredients well known to the trade. This layer is made of a serviceable thickness, and as it is extremely fireproof and contains its own hardening agents (when subsequently vulcanized) it may be much thinner than has heretofore been possible. This layer constitutes also a virtual protector for the next layer or layers to be described. On this first layer (and it will be understood that it may consist of as many

coats of the material as required to form the thickness desired) I spread a layer of pliable material, such as rubber or the like, this layer being preferably composed of a number of
 5 coats of rubber, and preferably the amount of sulfur or other vulcanizing agent is used in diminishing quantities in the successive coats from the first coat of the fireproof layer to the last coat of the pliable layer, the result
 10 being that when vulcanized the hardest finish is given to the exposed surface and the increasing pliability results between said surface and the adhesive or binding parts next to the armor.

15 Having prepared the sheet composed of its successive layers, as above stated, I provide the inside of the armor-tube with a special cementitious coating and also preferably place a similar coating on the last layer of
 20 the insulating-sheet, then dry said cementitious coatings. I dry the armor with heat, so as to expel all moisture possible and render the cementing solution as dry and permanent in position as possible, that when subse-
 25 quently the lining is inserted and heat applied, as will be presently explained, there may be no possibility of the union being rendered imperfect by reason of gases, bubbles, or other imperfections due to the presence of
 30 moisture or volatile ingredients, and also that the layer of cementitious material may remain uniform and not be dislodged or wiped off by the sliding action thereon of the insulating layer as the latter is inserted within
 35 the armor-tube.

One of the important features of my conduit resides in having the lining and armor joined together as nearly integral as possible, this union being much more perfect than by
 40 any simple cementing. I accomplish this and I also accomplish a second exceedingly desirable result—namely, the making of the insulating-lining of any extreme thinness desired, as already mentioned, and that with-
 45 out sacrificing any of the insulating or fireproof qualities—by vulcanizing the lining directly to the armor, the latter being preferably iron. I accomplish this, moreover, in such a manner that the lining is not stuck to
 50 the armor, but is chemically united—that is to say, I do not depend upon a line of adhesion, such as would exist between two pieces glued or stuck together by a regular compound, such as has heretofore been employed; but I use
 55 such substances and in such a manner that the lining and armor constitute practically one piece, the substance used consisting, preferably, of the fundamental ingredients of the lining material itself, so that after the sub-
 60 sequent vulcanizing step in the process there is really no third material between the lining and the armor; but the adhesive layer originally applied has disappeared as such and has actually become a part of the armor
 65 and lining. The cementitious substance or coating is composed of some fluid solvent—such as naphtha, benzol, &c., bisulfid of car-

bon being preferably added and used therewith as the vehicle—as this solvent facilitates the disintegrating of or perfect forma- 70
 tion of a solution of rubber, sulfur, and litharge, (it being understood by those skilled in the art that the usual ingredients of rubber compounds may be used, including a drier and vulcanizing agency,) the bisulfid of car- 75
 bon changing the nature of the ingredients to such a state as to produce a freely-flowing fluid capable of being freely run through any pipe, however small, thereby leaving a com- 80
 plete coating thereof, and yet a thin coating. I have found that this solvent will contain in solution a very large percentage of sulfur.

Having prepared the armor and lining as stated, the lining is properly inserted in the armor and is then forced radially outward at 85
 all points into direct contact with the armor by any suitable means, as by a sectional mandrel, whereupon it is subjected to a vulcanizing heat sufficient to melt the cementitious layer or layers and perform the vulcanizing 90
 step of the process, which completes the perfect union of the lining and armor. Finally, the fabric foundation is withdrawn in any suitable way.

It will be understood that the degree of pli- 95
 ability depends upon the degree of vulcanization and upon the composition of the lining material—as, for example, the more fire-resisting substance (such as asbestos, mica, and the like) that is used the greater will be 100
 the hardness of the lining, and if for certain purposes the asbestos is incorporated more or less throughout all the layers of the lining the result is that there will be very little pli- 105
 ability. This brings me to a further step in my process, this step being employed according to whether I am producing a conduit of little pliability or not. I may also remark that this step is of service when I am making a conduit in which the lining is composed of 110
 vulcanite or other substance which after vulcanization or formation is not pliable. The step referred to consists of withdrawing from the conduit the mandrel before vulcanization or when the vulcanization has proceeded part 115
 way only and then subjecting the conduit to such bending and shaping as may be required to have it conform to its eventual installation shape, this bending taking place while the lin- 120
 ing material is still in a plastic state and then, having properly shaped the conduit, the vulcanization is completed.

For some purposes I find it desirable to replace the mandrel with some supporting medium for retaining the fresh or the partially- 125
 vulcanized lining pressed tightly against the armor, and I accomplish this by compressing within the partially-vulcanized conduit such materials as whiting, soapstone, powdered mica, &c., which, while serving to sustain the 130
 lining against the armor during the bending strain and final vulcanization, yet permit the conduit to be bent as required.

It will be understood that I have described

the order in which I prefer to assemble and form the parts of the lining; but I wish it understood that unless otherwise specified in the claims I do not limit myself thereto, as
5 other means of applying the materials and layers within the conduit may be resorted to.

The result of the successive steps which constitute my method, as above explained, is that the armor and lining constitute practically one piece, and the lining may be, if desired, as thin as a mere skin and yet possess all the requisite flexibility and fireproof qualities desired. The inner or exposed surface against which the wires contact is hard and
15 fireproof, thereby being practically indestructible and also minimizing the danger from friction as the wires are being hauled through the conduit, and between that and the iron of the armor is a soft and flexible or
20 pliable layer, which is joined to the armor by perfect vulcanization, the vulcanizing, however, preferably not extending into a soft layer, but the sulfur or other vulcanizing agent being practically taken up by the extremely-susceptible cementitious layer and
25 by the iron, for which it has an affinity.

Another advantage resulting from my method is that the lining is so directly joined to the iron and is of such a resulting nature
30 that it will not tear or become injured by the rough cutting to which electric conduits of this kind are apt to be subjected by ordinary workmen.

It is unnecessary to explain to those skilled in the art the very great advantage resulting from my method of having the lining held absolutely to the armor at every point, so that when the conduit is bent there is no possibility of the two separating, but the adhesion and stability of the lining and armor are
40 practically perfect.

By my process I am enabled to provide an interior surface of highly-insulating ingredients which are not in themselves flexible, but
45 are so combined as to afford a flexible layer, the conduit being capable of any degree of flexibility desired simply by varying the extent of softer material beneath the harder inner surface and the armor.

The insulating and fire-resisting or hardening substances may be asbestos or asbestos and mica, magnesium, lime, slate, talc, soapstone, infusorial earth, or any prepared mass or mixture of fireproof material or earthy substance, these giving not only fire-resisting
55 qualities, but providing a sleek hard top finish as well.

In my present method the vulcanized conduit has rubber directly joined to rubber in the successive coatings, which results in an integral tube instead of having rubber united to the armor by an intermediate layer of some sort—as, for example, by a layer of asphalt, the latter making a poor joint, whereas in my
65 present conduit there is really no joint, inasmuch as the vulcanizing step of the process

makes the mass homogeneous. Also by having all the vulcanizing take place inside the armor after the entire conduit has been assembled there is a perfect union of the lining
70 material at the seam.

The required thickness of lining is made up by successive coatings, as stated, formed of material giving both pliability and strength.

I wish it understood that while I prefer to
75 employ all the steps of my method as above explained, thereby obtaining a conduit having all the advantages specified, yet I do not intend to restrict myself thereto, as certain of the steps may be employed without the
80 others, with a corresponding degree of resulting advantage. For instance, if the soft intermediate layer is omitted the remaining steps of the process will yet produce a superior conduit of a more rigid character, (which,
85 indeed, can be made absolutely rigid by employing a vulcanite or celluloid composition,) and also if the fireproof flexible lining should be secured in the armor by any of the old methods the resulting product would yet be
90 superior in respect to its fireproofing and flexibility.

Other advantages and capabilities than those enumerated are also within my invention, and accordingly I wish it understood
95 that I am not otherwise limited than as expressed in the claims.

In the drawings I have illustrated a groundwork or foundation of fabric *a*, on which is spread a layer *b* of fireproof composition in
100 as many coats as desired, three being indicated, and on this is a layer of the sulfur material *c*, preferably also applied in a plurality of coats and covered with a cementitious layer *d*, the armor *f* having also an interior cementitious coating *g*.
105

A preferred form of mandrel *h*, having a split formation for purposes of expansion, may be employed for forcing the lining out against the interior of the armor and holding
110 it there during vulcanization.

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

1. The herein-described method of making
115 insulating-conduit, consisting in applying to the interior of the armor a cementitious coating, containing vulcanizing ingredients, forming a lining provided on its outer surface with vulcanizing material, inserting the said lining within the armor and applying vulcanizing heat to the whole, thereby incorporating the said vulcanizing material in the conduit.
120

2. The herein-described method of making insulating-conduit, consisting in applying to
125 the interior of the armor a cementitious coating, containing vulcanizing ingredients, forming a lining, coating the said lining with a cementitious material containing vulcanizing ingredients, inserting the said lining thus
130 dusted within the armor, applying vulcanizing heat to the whole.

3. The herein-described method of making insulating-conduit, consisting in applying to the interior of the armor a cementitious coating, containing vulcanizing ingredients drying said coating, forming a lining, inserting the said lining within the armor and applying vulcanizing heat to the whole, thereby incorporating the said vulcanizing material in the conduit.

4. The herein-described method of making insulating-conduit, consisting in forming a lining of successive layers of rubber or like substance, containing vulcanizing ingredients in successively smaller percentages, introducing said lining within an armor, with the layer or layers containing the less amount of vulcanizing ingredients between the armor and the interior of the conduit, providing a cementitious agency for uniting the lining to the armor, and applying vulcanizing heat to the whole.

5. The herein-described method of making insulating-conduit, consisting in forming a layer composed of fire-resisting and vulcanizable ingredients, forming a layer thereon containing rubber or the like and vulcanizing ingredients, introducing the same in an armor, providing between said armor and lining a uniting substance, and subjecting the whole to a vulcanizing heat.

6. The herein-described method of making insulating-conduit, consisting in providing an armor, forming a lining material having a vulcanizable surface next to said armor, providing between said armor and lining a vulcanizing substance containing bisulfid of

carbon, and subjecting the whole to a vulcanizing heat.

7. The herein-described method of making insulating-conduit, consisting in coating the interior of the armor with a cementitious solution containing bisulfid of carbon, drying the same, forming a lining material having its surface next to said armor containing a vulcanizable layer, inserting said lining in the armor against said coating, and applying vulcanizing heat to the whole.

8. The herein-described method of making insulating-conduit, consisting in providing within an armor a vulcanizable lining, maintaining said lining in intimate contact with the inner surface of the armor, applying vulcanizing heat to said armor and lining, and while the lining is still plastic under the vulcanizing heat bending and shaping the armor and lining as desired.

9. The herein-described method of making insulating-conduit, consisting in providing within an armor a vulcanizable lining, filling the armor with a powdered mass capable of withstanding a vulcanizing heat, applying a vulcanizing heat for vulcanizing the lining in and to the armor, and bending or shaping the armor and lining while still plastic and containing said powdered mass.

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

AMANDA M. LOUGEE.

Witnesses:

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M. E. CAHILL.