No. 642,539. Patented Jan. 30, 1900.

A. THOMA.

METHOD OF LINING CONDUITS, PIPES, OR THE LIKE.

(Application filed Aug. 24, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

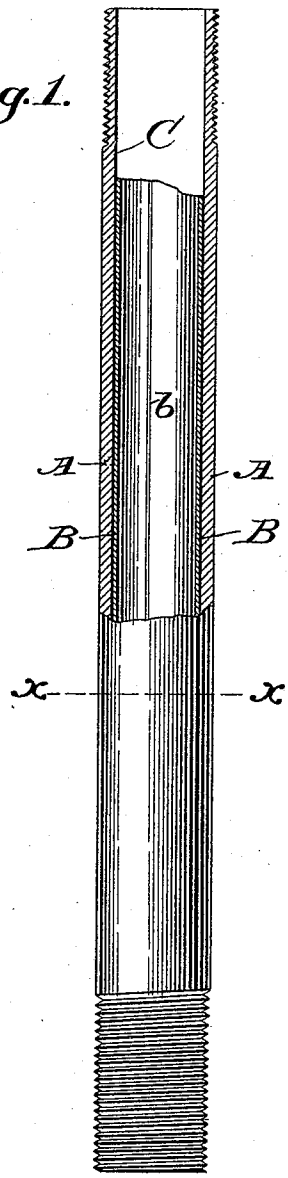
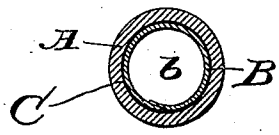


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

Fig. 3.

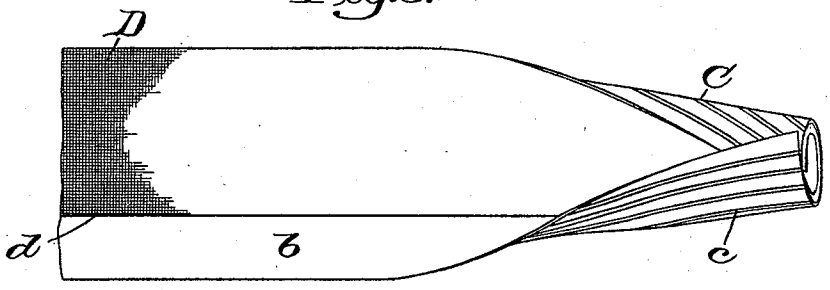


Fig. 3a.

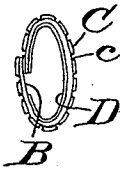


Fig. 4.

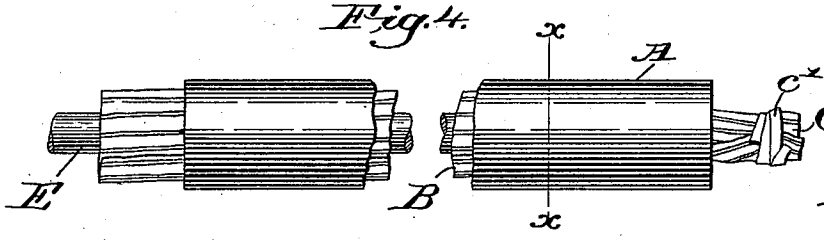


Fig. 4a.

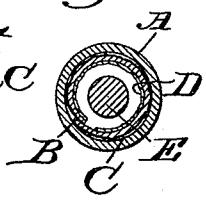


Fig. 5.

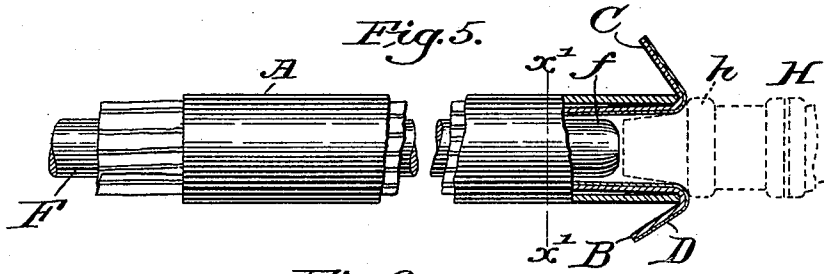


Fig. 5a.

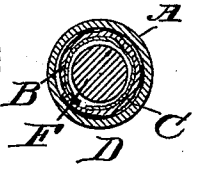


Fig. 6.

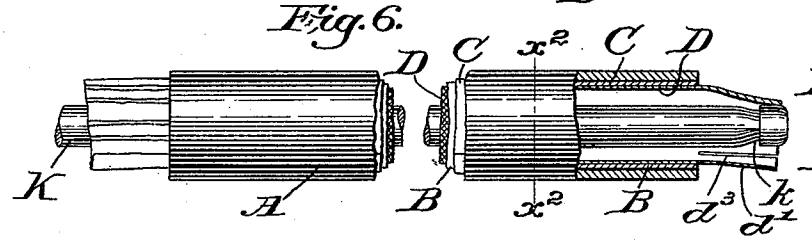


Fig. 6a.

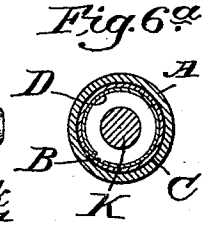


Fig. 7.

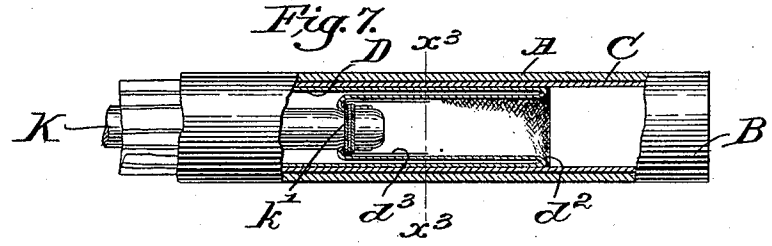
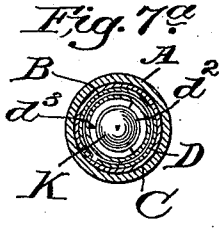


Fig. 7a.



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UNITED STATES PATENT OFFICE.

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METHOD OF LINING CONDUITS, PIPES, OR THE LIKE.

SPECIFICATION forming part of Letters Patent No. 642,539, dated January 30, 1900.

Application filed August 24, 1899. Serial No. 728,391. (No model.)

To all whom it may concern:

Be it known that I, ANDREW THOMA, of Cambridge, county of Middlesex, State of Massachusetts, have invented an Improvement in Methods of Lining Conduits, Pipes, or the Like, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention relates to methods for providing conduits, pipes, or similar articles with linings.

In lining conduits it is frequently necessary to make use of a lining material which is highly flexible and often tender and easy to rupture, and as manipulation of a highly-flexible insulating member within ten, fifteen, or twenty foot lengths of pipe of small diameter is almost impracticable by ordinary methods, especially if coated thoroughly with a cementitious substance of suitable adhesive qualities, I have devised a support by means of which the introduction of the flexible material can be accomplished with facility and which is withdrawn after assemblage of the members of the conduit, the conduit as such forming the subject of a separate application, Serial No. 725,537, filed July 29, 1899.

The various features of my invention will be fully illustrated and described hereinafter and set forth in the claims.

In the drawings, Figure 1 is a view in side elevation of a short length of conduit in the construction of which my invention has been utilized, Fig. 2 being a view in transverse section of the same. Figs. 3 to 7, inclusive, illustrate the various aspects of the lining material in its preparation for, insertion within, and application to the armor member. Fig. 3 is a view of a portion of lining material in course of preparation for insertion, Fig. 3^a being a view in end elevation of the same. Fig. 4 is a view in side elevation of an armor member, showing the lining after insertion, the members being broken away for the sake of clearness, and Fig. 4^a being a sectional view on the line $x\ x$, Fig. 4, looking from right to left. Fig. 5 is a view similar to Fig. 4 preparatory to introducing the blast for applying the lining, Fig. 5^a being a cross-sectional view on the line $x'\ x'$, Fig. 5. Fig. 6 is a view similar to Figs. 4 and 5 after the lining has been applied and preparatory to withdrawal of the supporting-ply, Fig. 6^a being a cross-sectional view on the line $x^2\ x^2$, Fig. 6, looking from right to left. Fig. 7 is a view, partly in longitudinal section and partly in elevation, illustrating the act of withdrawing the supporting-ply, Fig. 7^a being a cross-sectional view on the line $x^3\ x^3$ looking from right to left.

In accordance with my invention the flexible material with which the conduit or similar article is to be lined is provided with a supporting-ply and thus supported is presented for assemblage with the conduit, the supporting-ply being removed thereafter. While the supporting-ply may surround the lining material and act merely as a jacket to protect it until safely within the conduit, I prefer to apply the lining material to the supporting-ply in the form of a coating, then introduce the supporting-ply within, and with the lining material presented toward the inner walls of the conduit, dilating the material against the walls and then removing the ply, leaving the lining in place.

The supporting-ply may be composed of paper, light cotton fabric, or other suitable material, and an economical method of preparation is to coat a web of the fabric of several feet in width and many yards in length with the mixed ingredients of the flexible insulating material, thereafter cutting or tearing the web up into the widths and lengths proper for individual supporting-plies, according to the length and diameter of the armor member to be treated. The ply, with its coating of lining material, is then inserted in cylindrical form within the armor-tube, coated side out, and dilated by any suitable means—as, for example, a free blast of air—as disclosed and claimed in my application, Serial No. 697,833, filed November 30, 1898, introduced within the ply and acting progressively upon it through the pipe to force the coating of lining material into intimate contact with the inner walls of the armor-tube throughout.

The introduction of water, naphtha, or other suitable solvent, according to the nature of the lining material and supporting-ply, respectively, will aid in freeing the ply from

the lining material, and the ply in any event is removed from the conduit, leaving the lining material in place. Preferably the ply will be slightly longer than the length of conduit to be treated, and the removal of the ply may be effected by the use of a rod passing through the conduit and to which is tied the projecting end of the ply, and the latter withdrawn through the conduit, turning inside out, or by other suitable means.

If the lining material has a longitudinal lap-joint, it will aid removal of the ply to strip a narrow portion of the supporting fabric from the edge of the lining material before introduction of the latter into the conduit, and no portion of the supporting-ply will then be caught between the lapping edges of the lining.

The application of the lining material to the walls of the conduit will preferably be accomplished in the presence of heat sufficient to soften the cementitious substance employed to effect the adhesive union of the lining to the armor, whether said cementitious substance be included in the composition of the lining material or preferably applied thereto before its introduction within the armor or applied to the inner walls of the latter or to both lining and walls.

In the drawings the armor member is designated by the reference-letter A, the insulating member by the reference-letter B, and the cementitious substance by the reference-letter C.

In the construction of the lining material selected as a convenient form for illustration in Fig. 3, B designates the strip of highly-flexible lining material after it has been separated into strip form from the sheet, as already described, with a supporting-ply D of suitable material, as a textile fabric, still covering a portion of its inner face, a narrow portion of said fabric having been removed by tearing along the line *d*, leaving the uncovered selvage-like portion *b*.

C designates the layer of cementitious substance preferably grooved, as at *c*, to facilitate bending about a longitudinal axis.

To prepare the lining material for inserting within the armor member, a slight quantity of suitable cement is preferably applied along the uncovered portion *b*. The opposite edge of the lining-strip is doubled over along its entire length, and the uncovered portion *b* is then doubled over also upon and into contact with the former, the initial stage of the doubling being shown at the right-hand end of Fig. 3 to illustrate the relative position of the edges, which will also be seen in Fig. 3ª.

A suitable rod may be inserted within the blank of lining material, and by a suitable binding or other connection, as that illustrated at *c'*, provision will be made for introducing the blank of lining material into the armor member, in the instance illustrated by thrusting upon the rod E. I do not limit myself to the use of such a rod, since other suitable means for introducing the blank of lining material within the conduit may be utilized, as found desirable.

The blank of lining material having been introduced within the armor member, the rod E may then be withdrawn and the lining material applied to the inner walls of the armor members—as, for example, by the use of a blast of air through a nozzle or other suitable device H, in connection with a source of fluid-pressure, preferably air under pressure. A convenient form of nozzle will be found to take the form illustrated, wherein the nose is slightly tapering to facilitate its insertion within the lining-blank, while a shoulder *h* will serve to hold the ends of the lining material C in place by crowding it against the armor member. To facilitate the introduction of the nozzle, the portion of the lining projecting beyond the end of the armor member after its introduction therewithin may be split, as indicated at d^3, Fig. 6. If found desirable, a suitable mandrel-like deflecting member F may be introduced within the lining member and in the path of the blast to insure proper presentation of the latter to the inner walls of the lining material, and, if desired, this deflecting member may have its forward end chamfered to a suitable degree, as indicated at *f*. After the lining has been applied to the inner walls of the armor member, when it will take somewhat the appearance illustrated in Fig. 6, the supporting-ply may be removed, and to facilitate such removal I prefer to apply a suitable solvent to free the fabric or other supporting-ply from the lining material proper, and while this solvent may be applied in greater quantity throughout the interior of the conduit I have found that with the materials described in my specification and the use of a fabric it will be sufficient to apply a small quantity of naphtha or the like to the projecting ends of the blank of lining material. The projecting portion of lining material proper may then be stripped away from the fabric, leaving the latter projecting, as indicated at *d'* at the right-hand end of Fig. 6. This fabric may then be easily withdrawn—as, for example, by tying it, as at *k'*, to the end of the member K, introduced within the conduit, and then pulling out the member K, as shown in Fig. 7, doubling the fabric upon itself, and the fabric will be found to part readily from the lining material, leaving the latter in place, supported by the cementitious substance C between it and the inner walls of the armor member.

In the conduit constructed according to my invention and illustrated it will be noted that the perfect nature of the union between the members provides for the support of the insulating member wholly from the inner walls of the armor member, so that the thickness of the insulating member is not such as either to reduce the effective diameter of the conduit or to interfere with its flexibility. Indeed, the completed conduit may be bent cold with perfect impunity, affording a dis-

tinct advance over conduits as constructed in accordance with the present state of the art.

Having described my invention thus fully, I wish it understood that I do not limit myself to the exact details of construction or to the materials illustrated and described, nor in general otherwise than as set forth in the claims.

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

1. The novel step in methods of applying lining material to conduit, which consists in providing said material with a supporting-ply, presenting said material, thus supported, for assemblage with said conduit, and thereafter removing said supporting-ply.

2. The novel step in methods of applying highly-flexible lining material to conduits, which consists in introducing said lining material upon a supporting-ply within said conduit, dilating said ply to apply said lining material to the inner walls of said conduit, and removing said supporting-ply.

3. The novel method of lining armored insulating-conduits which consists in coating a supporting-ply with insulating material, introducing said supporting-ply within, and with said material presented toward the inner walls of, said armor, dilating said material against said walls, and removing said supporting-ply.

4. The novel method of lining conduit, which consists in introducing lining material within said conduit upon a supporting-ply, dilating said ply by a free blast acting progressively upon said ply to apply said lining material to the inner walls of said conduit, and thereafter removing said ply.

5. The novel method of lining armored insulating-conduit which consists in applying lining material to the inner walls of said conduit in the form of a coating upon a supporting-ply, applying thereafter a solvent to free said ply, and removing the latter, leaving said lining in place.

6. The novel method of lining armored insulating-conduits which consists in coating a fabric with a flexible insulating compound; providing said material with a cementitious substance; applying said material, thus supported, to the inner walls of said armor; applying a suitable solvent to free said fabric; and removing the latter; leaving said lining material in adhesive union with said walls and free to flex with said armor, when bent, without impairment of said union or of the insulating properties of said lining.

7. The novel step in methods of applying lining material to conduits, which consists in providing said material with a supporting-ply, presenting said material, thus supported, for assemblage with said conduit, applying said material, attaching said ply to a stripping member, and by means of the latter withdrawing said ply, doubling it upon itself and stripping it from said material.

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

ANDREW THOMA.

Witnesses:

ALEXANDER C. PROUDFIT,

FREDERICK L. EMERY.