(No Model.)

W. W. AVERELL.

ASPHALTIC CONCRETE CONDUIT.

No. 293,214. Patented Feb. 12, 1884.

Fig. 1

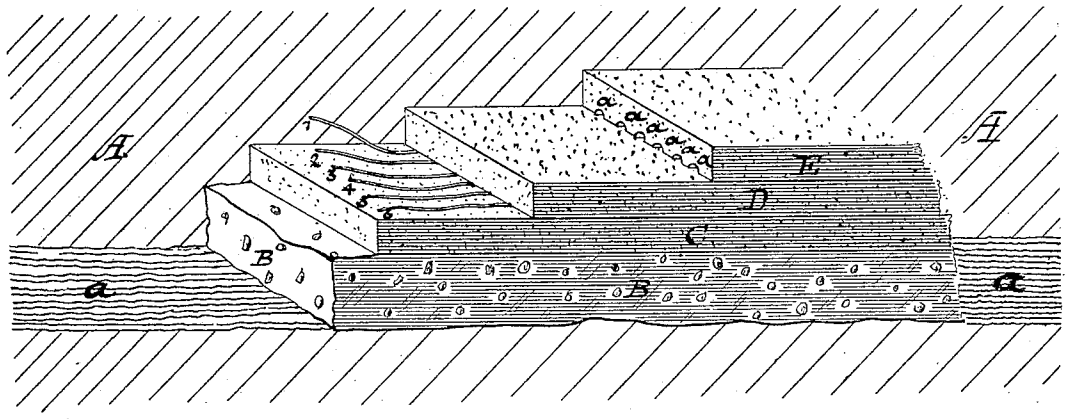


Fig. 2.

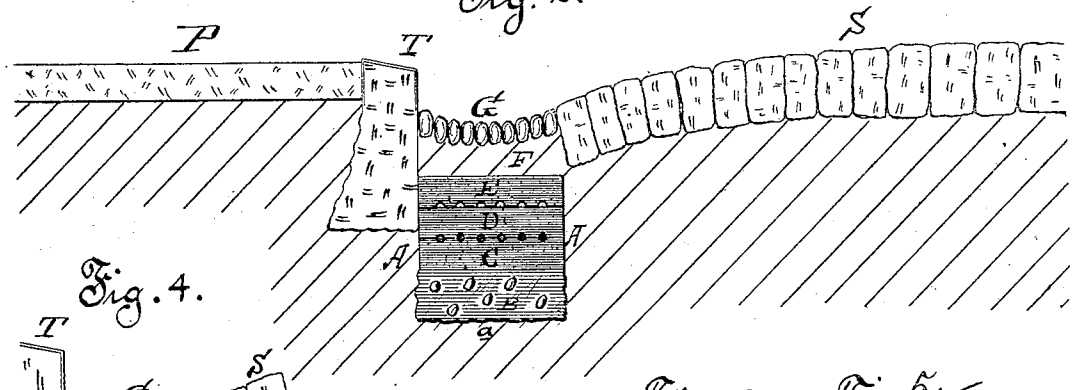


Fig. 4.

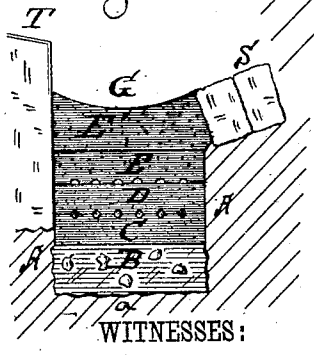


Fig. 3.

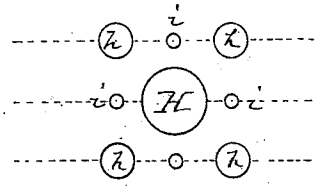
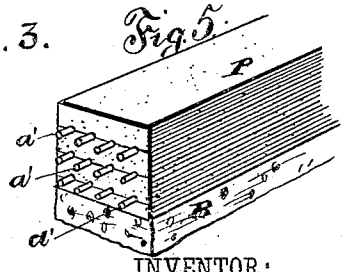


Fig. 5.



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WILLIAM W. AVERELL, OF BATH, NEW YORK.

ASPHALTIC-CONCRETE CONDUIT.

SPECIFICATION forming part of Letters Patent No. 293,214, dated February 12, 1884.

Application filed May 26, 1883. (No model.)

To all whom it may concern:

Be it known that I, W. W. AVERELL, of Bath, in the county of Steuben and State of New York, have invented a new and useful Improvement in Insulating Conduits and Compounds; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

A thoroughly-practicable system of conduits or pipes for an underground electric system should meet certain requirements. The material itself should be of high insulative capacity and of such character as to furnish all necessary protection to the wires without intervention of other protectors—such as metal pipes, &c. It should be easy of manufacture and manipulation, economical in first cost, and durable, so as to insure economy of maintenance and repair-account. Where roadways or streets are to be disturbed in its laying, it should be of such character as to create the least disturbance and obstruction during such laying. Where the top of the conduit or system of conduits is at or near the surface of the roadway, it should, if practicable, be of such material and manufacture as itself to form a good and enduring pavement. It should be so constructed as to be affected in the least possible degree by thermal or hygrometric changes.

The objects of my invention are to furnish a material for a system of underground conduits possessing these qualities in the highest degree, and to utilize the same in such a conduit or system of conduits. To accomplish this an asphaltic concrete—that is, a concrete consisting mainly of asphalt and silicious matters—is made, the proportions being determined as hereinafter set forth. As is well known, both natural asphalt (which herein may be taken as a type of similar hydrocarbons) and silica are good insulators, each, however, having properties which preclude its use alone for this purpose. Silicious particles need some binding agent to unite them in a firm homogeneous mass to prevent movement and saturation, which would reduce or destroy the insulative properties of the mass. Asphalt alone is too readily affected by thermal changes, becoming soft and malleable or hard and brittle with changes in temperature.

In view of these things my improvements may be said to consist, first, in combining them in such proportions as will furnish only enough asphalt to fill the voids or interstices of the silicious matter, and thereby render the combination of the two as near a perfect solid as it is possible to attain; and, second, in the utilization of the matter so prepared as the material from which conduits for underground use are to be made; and, third, in conduits or pipes or tubes for an underground system, laid as hereinafter set forth, from such material; and, fourth, to furnish a matrix holding and enduringly protecting tubes of other materials inclosing wires, when it is desired to use such tubes.

In carrying my invention into practice, what may be called the "voids" of the silicious matter to be used are first accurately ascertained. Suppose two degrees of fineness as regards size of such matter are used, (the same principles applying to any number of such degrees,) the first being sharp fresh-water gravel, well screened, and of a size not larger than a pigeon-egg, and the second ordinary fresh-water sand. There are in any given bulk of such material a number of interstices between the points of contact of the units of the mass, which, both hereinbefore and hereinafter, are called "voids." Starting, now, with a given bulk of the first element—viz., sharp fresh-water gravel, the percentage of these voids to the entire mass is ascertained in the usual manner by the quantity of water which it will hold, and an equal percentage of sharp fresh-water sand added. By such experiments the percentage of fine sand, which may be mixed with the coarser materials without increasing the bulk, may be ascertained for the several varieties used; but there will yet remain voids between the units of the mass. The percentage of these voids thus ascertained in volume gives the proportional measure of asphaltic cement (allowance being made for its shrinkage in cooling) which should be added to the silicious matter to form, as nearly as can be done by human agency, a perfect solid of high insulative capacity, thoroughly water-proof, durable, and not affected by thermal or hygrometric changes.

While the above gives a general description

of the method of manufacture of my improved asphaltic concrete, I have found it preferable in practice to make some modifications thereof. When the proportion of sand to be used is ascertained, (whether sand alone or in conjunction with the gravel mentioned,) I prefer to add to it five to ten per cent. of ground plaster or carbonate of lime of the amorphous kind, in order to partially fill the remaining voids and assist in the binding properties of the asphaltic cement by its affinities. In place of sand, a greater or less proportion of pulverized silicious stone or stone-dust may be used. I prefer, also, not to use the asphalt in its crude or natural state, but to subject it to the action of heat to such a degree that it will resist a high fire-test—say 200° Fahrenheit. This eliminates all foreign ingredients—water, &c.—and leaves the product a pure or sufficiently pure asphaltum. To this is then added, while hot, say from fifteen to twenty per cent. of what is known as the "residuum of petroleum"—that is, liquid bitumen—whose density is 14° to 18° Baumé, and which will resist a high fire-test. It follows, then, that while the asphaltic concrete to be used may be composed of silicious matters and asphaltic cement, whose relative proportions are to be ascertained as set forth, the preferable concrete is composed of fresh-water gravel not larger than a pigeon-egg, sharp fresh-water sand, amorphous carbonate of lime, asphalt, and petroleum residuum. The proportions, therefore, will of course vary according to the proportions of the materials in any particular location, but such proportions can be definitely ascertained by the process hereinbefore described. These materials are mixed together at a heat which ordinarily should not exceed the lowest degree at which asphaltic cement is maintained in a liquid condition, and the composition is laid or molded while hot, as hereinafter set forth. Thus prepared, proportioned, and mixed, a concrete is had which, when properly laid, renders the entire conduit a solid, so as to prevent the penetration of water, is of high insulative character, comparatively cheap, easy of use, and imperishable by any action of the elements.

While the coarser silicious material has been spoken of as not larger than a pigeon's egg, it is to be understood that, when desirable—as, for instance, where tubes or wires are to be laid quite close together—the maximum size of the coarser material is to be proportionately diminished.

In utilizing this concrete for the purpose of an underground electric system, a ditch is dug in any portion of the roadway—say upon either or each side or in the center—of a size sufficient to contain the finished prism of wires. Upon the bottom of this ditch is laid a foundation of ordinary good hydraulic concrete composed of broken rock, gravel, &c., and hydraulic cement, to form a firm unyielding base for the layers of insulating asphaltic concrete, to be thereafter laid thereon. Upon such, or upon any other suitable base, is placed a layer of the asphaltic concrete before noted, which is tamped and rammed while hot. Upon such layer wires, either naked or insulated, or tubes for the reception of wires, are placed. If wires are used, they may be placed thereon from reels which run above the ditch, and are so arranged as to lay or reel off the wires parallel to each other. If tubes for the reception of wires are to be used, they may be metal, or wooden or paper tubes of proper size, laid thereon parallel to each other; or tubes or conduits may be formed by laying upon this (or any other layer) mandrels or formers. A second layer of the asphaltic concrete is then placed thereon, rammed and tamped. If wires or formed tubes are used, they are then *in situ*.

If the tubes are to be formed of the material, they are formed by the consolidation of the material around the mandrels or formers referred to, which are withdrawn after the hardening or settling of this second or other layer, leaving a conduit formed of the concrete itself.

In forming tubes around mandrels or formers, the latter, in order that they may be easily withdrawn after the hardening of the concrete around them, may be oiled or coated with paraffine; or, preferably, a tube of paper is formed on the mandrel or former by winding thereon a sufficient quantity of stiff paper, which may itself have been coated or treated with asphalt; or a formed tube of paper may be slid upon the mandrel and then left in position in the prism on withdrawal of the mandrel. If such tubes are used, they may be of the kind whose manufacture has lately been proposed—viz., formed directly from paper-pulp under pressure, or they may be tubes formed by wrapping asphaltized or bituminized paper around a former, as was patented by Jaloureau May 24, 1859, No. 24,125. Upon and around such a tube the asphaltic concrete will pack firmly and readily, clinging closely thereto. The interior mandrel or former is then withdrawn, leaving a conduit or pipe of the asphaltic concrete lined with paper. Additional layers are then formed, if necessary, in the same manner, the result eventually being a prism of solid asphaltic concrete containing the desired number of wires, or tubes for the reception of such wires, either singly or in cables. This asphaltic-concrete prism inclosing the wires is itself of high insulative capacity, economical in first cost, durable, water-repellent, and of itself a good roadway-surface. It need not be laid deep, as it will not be affected by thermal or hygrometric changes, and where desired the top layer may itself form the gutter for the roadway, or a portion of the roadway itself.

In laying such a conduit or system it is of course to be understood that it may be laid in sections, the sections breaking joint with each other, but the sections of such layer being so laid as to form a continuous homogeneous layer, and the layers united by a flushing of

hot asphalt, so as to form a solid continuous homogeneous prism inclosing the wires, or the tubes for the wires, and possessing the qualities before mentioned.

In the drawings are given typical illustrations of the utilization of this concrete. Figure 1 shows a perspective of a prism in a ditch containing wires and tubes; Fig. 2, a section thereof laid at the curb or edge of a roadway, while Fig. 3 is a diagram showing larger and smaller tubes inclosed in such a prism, and Fig. 4 is the same as Fig. 2, except that the top layer is finished off as part of the roadway, while Fig. 5 shows in perspective a section of completed prism having tubes embedded therein.

A represents the side, and *a* the bottom, of a ditch whose width is that desired for the ultimate prism of concrete. Upon the bottom of this ditch should be laid a foundation, B, of hydraulic concrete, to afford a firm unyielding bed for the asphaltic concrete. Upon this base B is laid the first layer, C, of the asphaltic concrete, made as described. It is laid hot, and rammed and tamped solid before cooling. Preferably, while yet somewhat plastic, wires, as 1 2 3 4 5 6, are laid thereon, parallel to each other. These wires may be cables containing many wires, or single wires having an insulating and protecting covering; or they may be naked wires. They may be easily laid in parallel lines by being unwound from a reel on a carriage whose wheels straddle the ditch, the reel having as many compartments and rolls of wire as there are wires to be laid. Upon this first layer, C, is now laid and tamped into place a second layer, D, upon the surface of which tubes *a a* are laid or formed, and of any suitable configuration in cross-section.

It is of course to be understood that tubes or wires may be placed or formed between any layers, or that both may be between the same layers, the arrangements shown in the drawings being merely typical.

If *a a* are tubes laid to be embedded, they may be of any desired material. If they are tubes to be formed, or formed and lined—say with paper—mandrels or formers are laid in proper position on D, which may have around them a wrapping of paper or paper tubes, as hereinbefore set forth. In Fig. 5 a part of a completed prism, P, upon a base, B, and having tubes *a' a'* laid therein *in situ*, is shown. The paper tubes thus formed *in situ* are rendered continuous by lapping or passing the end of each one over the end of the one in place, like a stove-pipe.

It is of course to be understood that I make no claim to the invention of any of the forms of paper tubes hereinbefore referred to, nor to the combination with a concrete tube of a waterproofed-paper lining; but I do lay claim to the combination, with the particular asphaltic-concrete prism which I have invented, of a paper tube or wrapping used primarily to permit the easy withdrawal of the mandrel, and as a substitute for or equivalent of a coating of oil or paraffine upon the mandrel for the same purpose.

Secured in position, a third layer, E, is placed upon D and thoroughly tamped. This process is repeated until the desired number of layers has been built up. The layers are preferably laid in sections, the sections of the various layers breaking joint. The joints of the various sections and the lines of unison of the layers with each other are made firm and solid by flushing the exposed joints, ends, or surfaces with hot liquid asphalt just prior to the addition of the material forming the next section or layer. The result is a prism of asphaltic concrete, of itself an exceedingly good insulator, thoroughly water-proof, practically indestructible by natural causes, and economical in material and labor.

The prism may of course be placed in any portion of the roadway. In cities, especially, the more desirable location seems to be at the edge of the roadway and next the curb, as shown in Figs. 2 and 4, where S is the roadway; P, the pavement; T, the curb, the prism being buried underneath the gutter G.

In Fig. 4 a top layer, E, is shown as forming the surface of the prism and finished off from the gutter, for which, from its solidity, durability, and water-proof nature, it is well adapted. In fact, a top or finishing layer of the prism may well be used as a part of the roadway, wherever located.

In Fig. 3 is shown an arrangement typical of the many modifications, as to size and distribution, of pipes which may be made, there being a very large tube, H, for large cables, several smaller ones, *h*, for smaller cables or collection of wires, and small pipes *v v* for one or two wires or small cables.

The prisms herein represented may be considered main prisms, or conduits from which branches may be laid at suitable or desirable points, and wires or tubes led off therein from the main prism or conduit.

If desired, "man-holes" may be made at intervals, one end of each of two sections of conduits entering therein, so as to afford means for ready inspection of the conduits and contents.

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

1. The method of forming an insulating concrete, consisting in first ascertaining the voids or interstices of the silicious materials used, and then adding such a percentage of the binding agent thereto, substantially as set forth.

2. The insulating-concrete hereinbefore described, consisting of silicious matter, asphaltum, and petroleum residuum, combined in the proportions ascertained or determined by the measurement of the interstices or voids, as set forth, and substantially as described.

3. An insulating asphaltic-concrete conduit formed of silicious materials and tempered as-

phalt, the percentage of the latter being equal to the ascertained voids of the silicious material, and containing wires laid *in situ*, substantially as set forth.

4. An insulating asphaltic-concrete conduit formed of silicious materials and tempered asphalt, the percentage of the latter being equal to the ascertained voids of the silicious material, and containing tubes laid *in situ*, substantially as set forth.

5. An insulating asphaltic-concrete conduit formed of silicious materials and tempered asphalt, combined in the proportions set forth, and having its top finished off to form part of the street or roadway, substantially as set forth.

6. An insulating asphaltic-concrete conduit formed of silicious materials and tempered asphalt, combined in the proportions set forth, and containing pipes or tubes laid and lined with paper *in situ*, substantially as set forth.

This specification signed and witnessed this 18th day of May, 1883.

WM. W. AVERELL.

Witnesses:
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