(No Model.)

S. F. SHELBOURNE.

METHOD OF AND APPARATUS FOR INSULATING ELECTRIC CABLES.

No. 297,181. Patented Apr. 22, 1884.

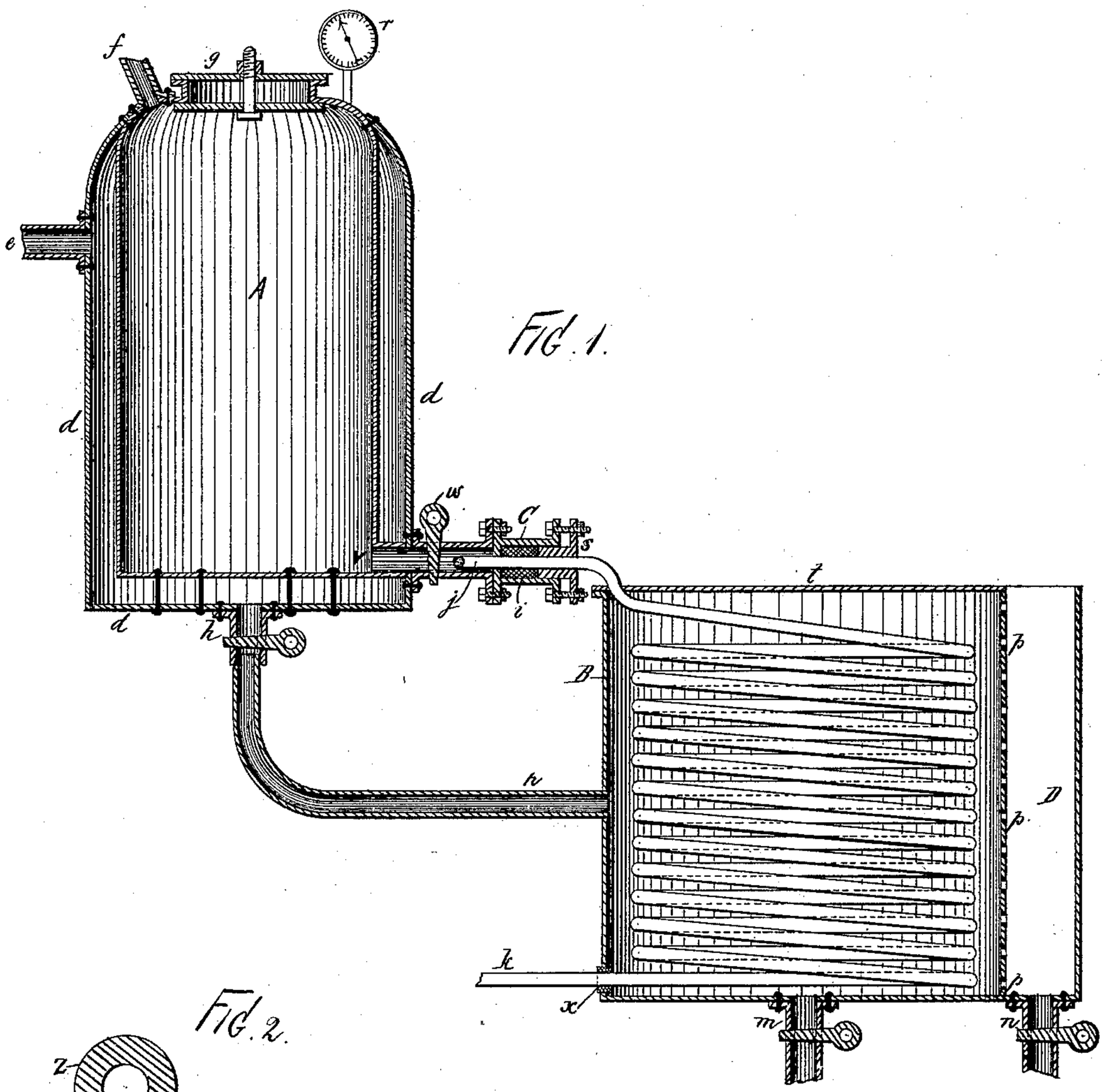

FIG. 1.

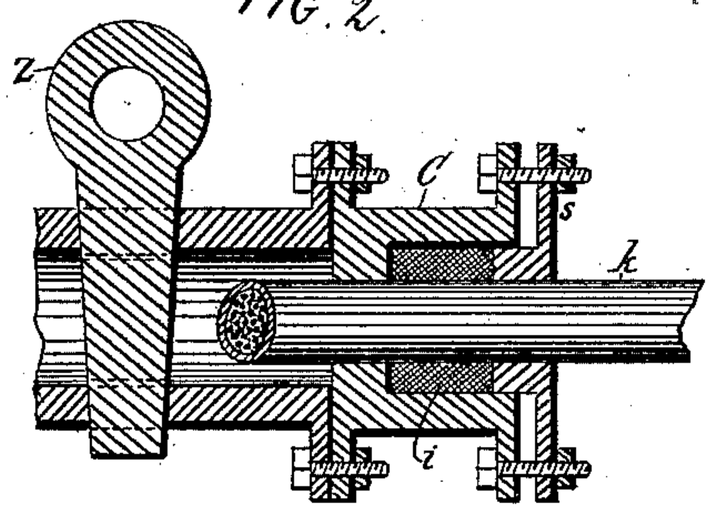

FIG. 2.

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UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR INSULATING ELECTRIC CABLES.

SPECIFICATION forming part of Letters Patent No. 297,181, dated April 22, 1884.

Application filed September 8, 1883. (No model.)

To all whom it may concern:

Be it known that I, SIDNEY F. SHELBOURNE, a citizen of the United States, residing in the city of New York, and State of New York, have invented a new and useful method of insulating electric cables when inclosed in metal tubes, and also apparatus for accomplishing the same; and I do hereby declare that the following is a clear and exact description of the invention.

My invention relates to that class of electric cables which have, for their exterior inclosure and protection, a tube of metal, usually being of lead. While the combined tube and inclosed electric conductors are usually called "the cable," in this specification, for the purpose of clearness of description, the assembled and fiber-covered conductors will alone be called "the cable," and their metal surrounding "the tube." Cables of this class are usually prepared for use by filling the interior of the tube with paraffine, asphalt, or resinous compounds while in a melted state, depending upon the melted material at the same time to saturate the fiber covering the assembled wires within. Hitherto this has been done in a very imperfect manner, by reason of two facts, first, the tube being long and the vacant spaces within to be filled being minute, it has been found impossible to get a proper saturation of the fibers covering the wires. The reason is that air particles persistently adhere to and are confined within the fibers, and necessarily exclude the melted insulating material; second, the insulating material filling the tubes only when melted, and therefore expanded, on cooling and becoming solid has a much greater ratio of contraction than the metal tube, and consequently air-bubbles and open spaces are found within the tube when the insulation is finished and the cable is presented for use. It has been sought to obviate the last of the difficulties mentioned by charging the melted insulating material with gas—usually carbonic acid—with the expectation that this, reaching the minute particles of the insulating compound, would prevent their exhibition of contraction and keep them distributed uniformly throughout the tube. It will be seen, however, that this is but an aggravation of the difficulty, for while this may prevent any flaws or air-places of notable size, it is but a deception of the naked eye, and does not satisfy the rational conditions required, for, since two bodies cannot occupy the same space at the same time, the carbonic acid charged into the melted material is but adding the spaces required by itself to those of the air particles already within the tube, in giving that material, when cold, a greatly-increased porosity; and as carbonic acid is readily absorbed by water wherever moisture has a chance to get into the tube, it will absorb the carbonic acid and occupy its spaces, and thus deteriorate the insulation. I entirely obviate both of the difficulties presented, in the manner which I shall now proceed to describe.

I first exhaust the air from the tube while it is attached to the charging-vessel, and while heated nearly to the temperature of the charging material. Then the insulating material is allowed to pass in the tube to fill the vacuum, allowing sufficient time for it to permeate the fibers about the wires to the remote end of the tube. When this is accomplished, the tube is cooled in progression of its length, beginning with its end remote from the charging-vessel, while a strong air-pressure, as much as the tube will bear, is kept up in the charging-vessel over the melted material, and of course extends within the tube to every portion of the material not yet passed into the solid state. As the material becomes cold first next to the lead of the tube, it contracts first outwardly toward the tube and tends to leave a hollow in the center, which is still liquid, but which is prevented by the pressure upon the liquid portions in the uncooled tube immediately adjacent, and thus as the cooling proceeds along the tube the whole interior becomes solidly filled with the insulating material. The apparatus by which this is accomplished is illustrated in the drawings, in which—

Figure 1 is a sectional elevation of the main portions thereof, while Fig. 2 shows the construction of the parts by which the tube is held air-tight at its ends while the vacuum is being produced and the charging with the insulation completed.

Referring to the details of the drawings, A, Fig. 1, is a boiler, of any convenient size, with a steam-jacket, *d d*, air-tight cover *g*, steam-inlet *e*, air-inlet *f*, outlet for the steam *h*, and outlet *v*, for the insulating material. In

the same figure, B represents an ordinary metal tank, with removable cover *t*, and receiving the steam-pipe *h*. It has also fitted to one side of it, and of identical height, a small chamber, D, with which it communicates through perforations in its side, some of which are represented at *p p p*. There is fitted to the bottom of B a water-inlet pipe, *m*, while under D there is fitted a water-outlet pipe, *n*. The tank B holds the coiled cable-tube *j k*, the end *j* passing within the stuffing-box C, attached to the outlet of the boiler A, while the end *k* is held in a similar stuffing-box, (shown at C, Fig. 2.) This stuffing-box is fitted to a pipe communicating with an air-pump of usual construction, and not shown in the drawings, which in turn also communicates with the air-pipe *f*, Fig. 1, fitted to the boiler A. The soft-rubber plug *x*, Fig. 1, prevents the steam or water from escaping from the tank B around the cable-tube *k*. A pressure-gage, *r*, is applied to the boiler A, to determine the air-pressure upon the melted insulating material within the cable-tube while cooling from the remote end.

The operation of the apparatus is as follows: The boiler A is filled, or nearly so, with the insulating material, which is heated and liquefied by steam in the jacket *d d*. This steam is allowed to escape through *h* to B, and heats at the same time the cable-coil, which is connected at its end *j* with A, through the stuffing-box C, and at its end *k* with the air-pump, through the similar box C, Fig. 2. A soft-rubber ring, *i*, in each of these boxes, compressed by the caps *s s*, pinches around the ends of the tube and prevents the passage of air around them. When the cable-coil is well heated and the material in A properly liquefied, the air-pump is put in operation, with the valve *w*, Fig. 1, closed, and the valve *z*, Fig. 2, open. The air is therefore exhausted from the entire length of the cable-tube. The valve *w* is then opened while the air-pump is still in operation, and the insulating material rushes into the cable-tube until it reaches the end *k*. An instant preceding this the valve *z* has been closed. The connection between the air-pump and the pipe *f* is now opened, and air-pressure begins to accumulate in A above the insulating material, to force it downward into the cable-tube. After a few moments, cold water is let into B, through the pipe *m*, which, escaping by the lower outlets *p*, is discharged from D through the pipe *n*. The orifices *p p p* have small disks, which are made to fall over them to stop the flow of water through each of them in succession, beginning with the lower ones. It has not been deemed necessary to show these disks in the figure. As these orifices are stopped from below upward, the cold water rises in B, gradually cooling the cable-coil by slow progression along its length upward, while at the same time the strong pressure in A keeps the liquid portion of the insulating material close above the solidifying portion and supplies the place of the shrinkage as it proceeds in the cooling.

The packing-boxes C are made of different sizes, to fit on the same flange-face, so as to take in cable-coils of varying sizes.

What is claimed as new is—

1. The process, substantially as herein described, of obtaining a complete saturation and solid insulation within the fibers covering conductors or electric cables drawn into metal tubes, consisting in first removing the air particles from such fibers, simultaneously applying heat thereto; then saturating such fibers and filling the same and the inclosing-tube with melted insulating material; then gradually cooling said tube, commencing at the end remote from the supply of insulating material, the liquid portion of such material being kept under pressure within the tube, to supply the place of shrinkage on cooling.

2. An apparatus for insulating electric cables, consisting in the combination of a steam-jacketed insulation-holder, with stuffing-box outlet, a heating and cooling tank or chamber for containing the cable-inclosing tube, connected with the steam-space of the insulation-holder, and fitted with a regulated water inflow and outflow, together with an air-pump, with stuffing-box attached to remote end of such cable-containing tube, substantially as and for the purpose set forth.

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