

UNITED STATES PATENT OFFICE.

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METHOD OF FILLING POROUS MATERIAL WITH LIQUID.

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Specification of Letters Patent.

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No Drawing.

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To all whom it may concern:

Be it known that we, CHARLES W. DAVIS, residing at Edgeworth, county of Allegheny, and State of Pennsylvania, and WILLIAM S. BROWN, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, both citizens of the United States, have invented or discovered certain new and useful Improvements in Methods of Filling Porous Material with Liquid, of which improvements the following is a specification.

Our invention relates to improvements in method of filling fibrous substances with liquid. While not limited to any particular field of use, we have found our improved method applicable in the making of electrical cables, and particularly in the filling of paper insulation with oil or insulating compound or substance heavier than oil.

It is usual in cable-making to envelop the conductor in a layer of wrapped-on paper insulation, and then to immerse the thus far completed cable in a bath of the material with which the insulation is to be filled. The filling then follows, being effected by absorption. If the filling material be normally viscous, it is usual to heat it until it becomes fluid. It is common practice to prepare the porous body for absorption by carefully drying it; it is common to effect immersion of the body in the impregnation material in approximate vacuum; and it is also common, at the conclusion of the immersion operation, to apply pressure to the bath while the article under treatment is still immersed,—these various measures being resorted to singly or conjointly, in order to cause the filling material to penetrate the layers of paper and to fill the interstices and capillary spaces as completely as possible. Perfect filling has been practically unattainable.

We have, through careful experiment and observation, discovered that when, in the progress of such methods of filling as are indicated above, pressure is relieved (and particularly when suddenly relieved), the submerged body, though theretofore quiet, will give off bubbles, and this in very remarkable degree; and we have further discovered that, if the pressure be alternately reduced and increased and then reduced again, this giving-off of bubbles will be still more pronounced. This effect is conditioned upon drop in pressure, and will occur whether the drop be

from atmospheric pressure, or from some point of sub-atmospheric pressure, or from a point of pressure higher than atmospheric, to a lower point.

We do not undertake to say, why it is that such repeated decreases of pressure effect the result. Undoubtedly the effect is in some degree comparable to a "shaking out" of the bubbles, but that is not the whole story; for, even when the decrease of pressure is effected gradually, additional bubbles are released on the second decrease, even though at the end of the period of first decrease the giving off of bubbles had ceased. The accession of pressure after the first decrease and then a second decrease are instrumental in doing something worth the doing. The discovery that a gain of importance is achieved by this sequence of manipulation is a discovery contrary to expectation.

From this discovery we proceed to our invention; it consists (in simplest terms) in reducing the pressure upon the bath while the filling operation is in progress. Diminution of pressure releases bubbles of air, etc. Alternate (and preferably sudden) decreases in pressure followed by increase, and this alternation repeated again and again, if desired, will effect a filling more complete (and, consequently, a finished article in this respect more perfect) than otherwise is obtainable.

In laboratory experiment such a sudden drop of pressure as is alluded to above may be obtained by using a vacuum pump of large capacity as compared with the space to be evacuated in the impregnation tank. Commercially, such relative sizes would ordinarily not be realized; instead, an intermediate vessel of large capacity as compared with that of the impregnating tank may be used. A three-way valve should be so situated as to first connect the impregnating tank with the intermediate tank previously evacuated, and then to connect the impregnating tank with the pump.

We preferably proceed, taking the usual measures, and adding to them those in which our invention resides: The paper-wrapped conductor is carefully dried; it is introduced into a suitable container and a substantial vacuum produced within; the filling material (also carefully dried beforehand) is allowed to flow in and to submerge the

paper-enveloped conductor. If the filler is normally viscid, the operation proceeds at an elevated temperature. Incident to the ensuing absorption operation, those fluctuations of pressure in which resides our invention are resorted to, with pauses in the succession of steps, extending, it may be, over hours. The operation is concluded at atmospheric temperature and pressure.

10 We have found that when the absorbing operation is conducted at elevated temperature (whether to render more fluid and more readily absorbable a heavy absorbent, or for other reason), we may, after the operation is otherwise completed, advantageously maintain a condition of diminished pressure until cooling has been effected, and then allow the pressure to increase to atmospheric.

20 It is not requisite that before submergence pressure be reduced; it is permissible, in the practice of our invention, and may under particular conditions or for reasons having no bearing upon the present elucidation, be found desirable to effect submergence of the porous insulation in the bath of oil or compound while atmospheric pressure is maintained, or even under pressure in excess of atmospheric.

30 It will be understood that, in the ensuing claims "sub-atmospheric pressure" is inclusive of a vacuum, to the extent that a vacuum is or may be attainable under conditions of industrial operation.

35 The method manifestly is applicable to the filling of fibrous material with liquid, whatever be the particular substances, and

regardless of the intended use of the article treated.

We claim as our invention:

1. The method herein described of filling fibrous material with fluid, which consists in immersing the one in the other, and, as absorption progresses, subjecting the bath to repeated sudden drops in pressure, whereby entangled gaseous bubbles are released and escape from the fibrous material.

2. The method herein described of filling fibrous material with fluid, which consists in immersing the one in the other, and, as absorption progresses, subjecting the bath to repeated drops in pressure, with alternate accession of pressure between, whereby entangled gaseous bubbles are released and escape from the fibrous material.

3. In the manufacture of electric cables, the method herein described of filling with insulating compound a body of paper insulation wrapped upon a conductor, which consists in immersing in a bath of the compound the conductor with its envelop of wrapped-on paper, and, as absorption progresses, subjecting the bath to repeated drops in pressure, with alternate accession of pressure between, whereby entangled gaseous bubbles are released and escape from the fibrous material.

In testimony whereof we have hereunto set our hands.

CHARLES W. DAVIS.
WILLIAM S. BROWN.

Witnesses:

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