Dec. 25, 1962 M. LIPCSEY ETAL 3,070,528

DEHUMIDIFICATION AND DAMP-PROOFING OF STRUCTURES

Filed Feb. 27, 1961 3 Sheets-Sheet 1

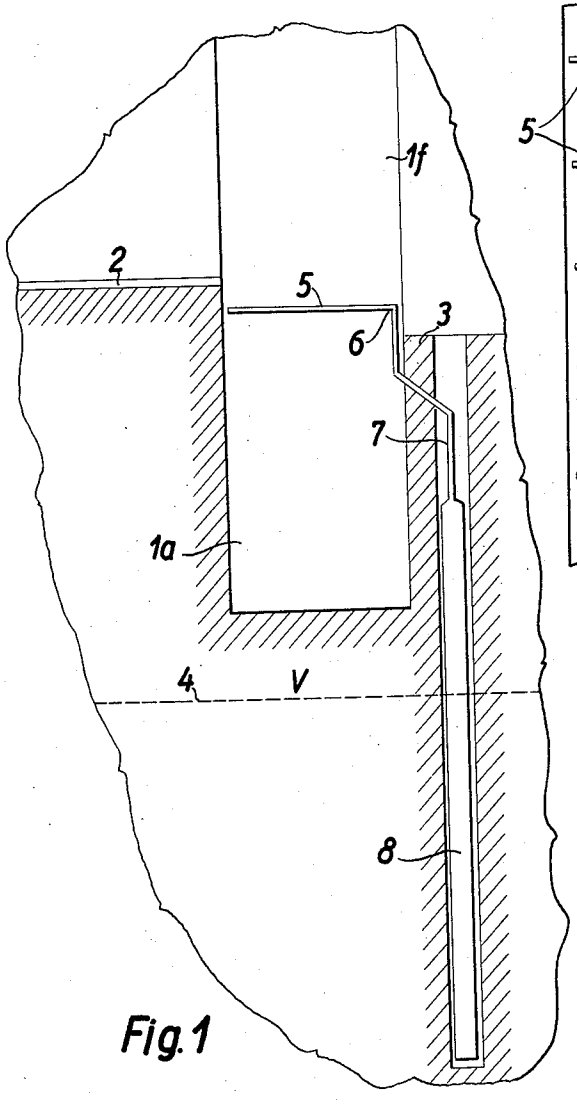


Fig. 1

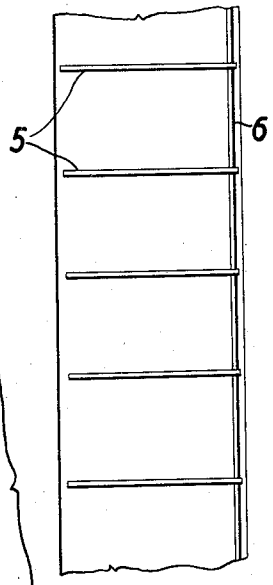


Fig. 2

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DEHUMIDIFICATION AND DAMP-PROOFING OF STRUCTURES

Filed Feb. 27, 1961 3 Sheets-Sheet 2

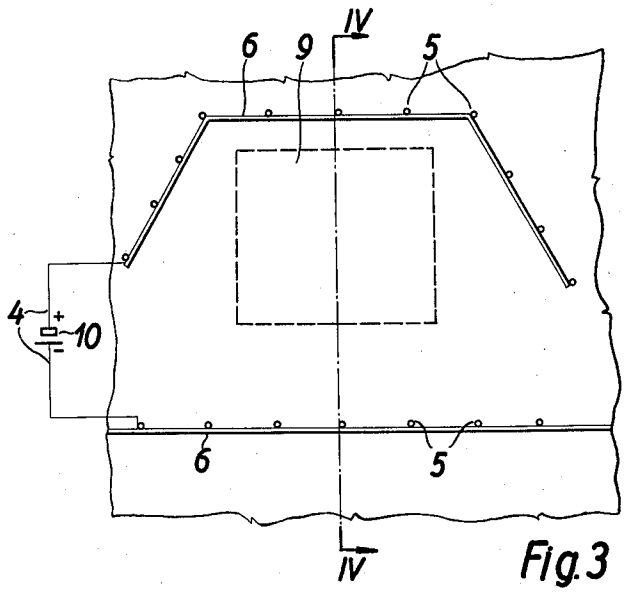


Fig. 3

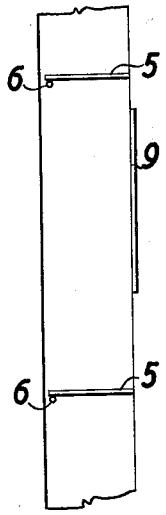


Fig. 4

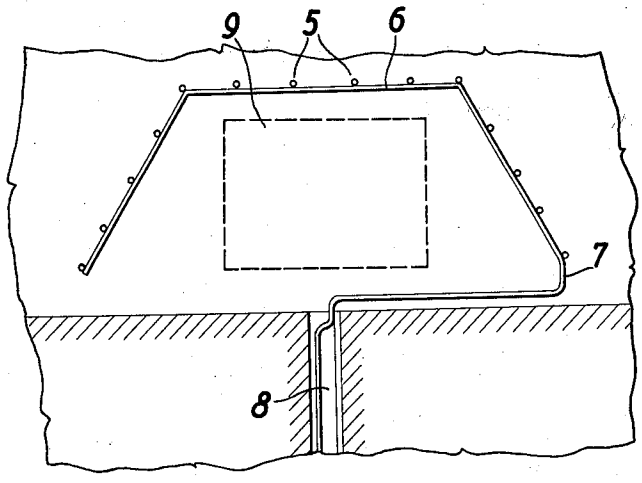


Fig. 5

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DEHUMIDIFICATION AND DAMP-PROOFING OF STRUCTURES

Filed Feb. 27, 1961 3 Sheets-Sheet 3

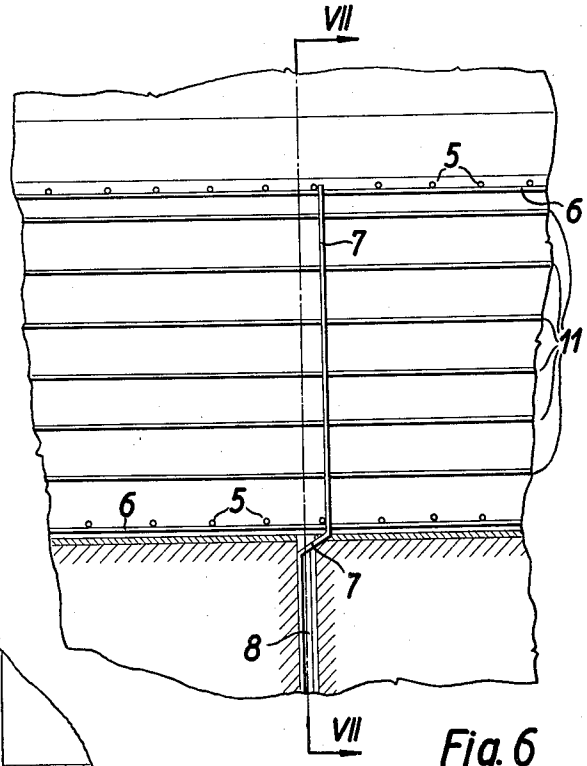


Fig. 6

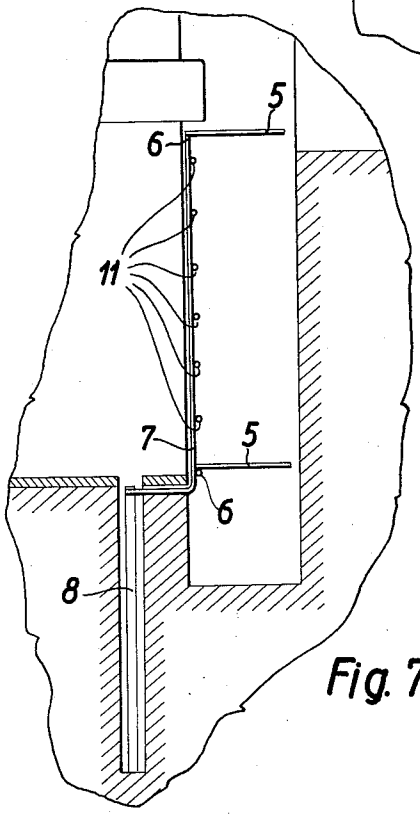


Fig. 7

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United States Patent Office

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3,070,528
DEHUMIDIFICATION AND DAMP-PROOFING OF STRUCTURES

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7 Claims. (Cl. 204—180)

The invention relates to a method of dehumidifying and damp-proofing hydrophilic structural portions of buildings, particularly brickwork. It is a more particular object of the invention to dry walls in buildings which have become damp by the absorption of moisture from the ground as a result of capillary action and effectively and permanently to prevent further absorptive action from taking place. In other words, the invention relates to a method of drying damp buildings and damp-proofing buildings which are in course of erection.

Various methods have been proposed for solving this problem. These include the subsequent insertion of horizontal courses of water-proofing felts, the drying of damp walls by ventilation, or the lowering of the ground-water level by the provision of seepage drain pipes. Each of these methods has grave defects. For instance, the subsequent insertion of bituminous water-proofing felts is possible only in ordinary brickwork walls but not in walls which are subject to pressure (party or buttress-type walls). Moreover, it is an expensive method to carry out. The drying of walls by ventilation is effective only in the case of damp but not in the case of wet walls. Moreover, the effect is not lasting and endures only so long as a covered space is actually open to the outside atmosphere. The employment of seepage drain pipes is limited to very small areas, i.e. on sloping ground, and the results are most unreliable.

It has recently been discovered that the difference in electrical potential between subsoil and brickwork is a decisive factor in the absorption of moisture from the ground, the brickwork having a negative potential relative to the ground. In view of this phenomenon, which is accentuated by the capillary structure of hydrophilic brickwork, it has been proposed to eliminate the existing potential difference by artificially applying a positive electrical voltage to the brickwork. For this purpose electrodes, so-called probes, are inserted into the ground around the foot of the brickwork or into the brickwork itself and are connected with the positive pole of a source of potential.

Subsequently it was observed that for effective dehumidification it is not essential to provide a special source of potential, but that the desired effect can be achieved by grounding the probes through a common conductor. This process and the means adopted for carrying it out are described in Swiss Patent No. 261,908. In the course of testing this method we found that the desired dehumidification and damp-proofing effect was actually secured only in exceptional cases and that success appeared to be quite accidental. It was repeatedly found that despite the insertion of probes and despite the provision of satisfactory grounding the brickwork became even more damp than it had been before.

In seeking the reasons for this phenomenon it was found that the negative potential cannot be compensated by the applicating of a constant and steady positive potential which is independent of incidental conditions unless the eelctrical resistances of the several components constituting the natural damp-proofing circuit bear a given relationship to one another. It was ascertained that the desired dehumidifying effect was always achieved if the relative resistances conformed with the following relation:

$$r_1 \geqq r_2+r_3+r_4+r_5$$

wherein r_1 is the resistance in the direction of current flow of the brickwork which is to be protected, r_2 is the contact resistance between the electrodes and the brickwork, r_3 is the resistance of the several metallic conductors (electrodes, common conductor, earth conductor—generally a negligible resistance), r_4 is the contact resistance between the subsoil and the ground lead, and r_5 is the resistance of the portion of adjoining terrain completing the circuit betwen the ground and the footings of the brickwork.

The satisfaction of the relationship defined in this formula is all the more important because, in known arrangements, r_1 is usually smaller than the sum of all the other resistances taken together, and this is the salient reason explaining the failures which had been experienced.

In evaluating the electric circuit components according to the above-mentioned formula, r_1 is a given constant, r_3 has no significant influence, as previously mentioned, and r_5 cannot as a rule be arbitrarily chosen because it is desirable to place the ground lead as near to the brickwork as possible so that its position determines the resistance of the relevant portion of the soil. Consequently, the two remaining resistances r_2 and/or r_4 must be adjusted in such a way that the above formula will be satisfied. Primarily, r_4 will be modified to meet the specified needs.

In actual practice, r_1, r_3 and r_5 are ascertained by taking measurements in a manner known as such, and (r_2+r_4) is then calculated by means of the formula, one of these factors being adjusted as may be required. Normally, adjustment will call for a reduction in value of these resistances in conformity with what has already been said. The most obvious method of reducing r_4 is to employ two or more ground points instead of only one. Another possibility is to embed the ground lead in a material of known lower resistance than that of the soil environment. Coal dust is a suitable embedding material. Conveniently, the coal dust may be mixed with a few percent of bentonite, this being a very hygroscopic material which has a low electrical resistance when it has swelled.

If it is desired to reduce r_2, the holes for the reception therein of the electrodes are filled with lime mortar before the electrodes are inserted, this being a material which is useful for fixing the electrodes but its use for the contemplated purpose has not been previously proposed. Since the resistance of lime mortar is relatively high and somewhat uncertain, coal dust may be added thereto as well as preferably a little bentonite. The desired results are thus usually achieved, but if r_2 should still prove to be excessively high, then the spacing of the electrodes must be reduced.

The invention relates more particularly to drying out solid walls, solid wall portions, and cellar walls. In the latter case the interpretation of some of the resistance values may be slightly different from those given above. This point will be discussed in greater detail in the course of the following description of a number of illustrative examples.

The accompanying drawing shows four embodiments of the invention in the form of specific arrangements for applying the contemplated method. In the drawing:

FIG. 1 is a vertical section of the lower portion of a vertical foundation wall and its environment;

FIG. 2 is a plan view of electrodes and of a portion of their common interconnecting conductor;

FIG. 3 illustrates the damp-proofing of a particular portion of wall with the help of an artificial source of potential;

FIG. 4 is a section taken on the line IV—IV in FIG. 3;

FIG. 5 illustrates the damp-proofing of a particular portion of wall by the circulation of a natural current;

FIG. 6 illustrates the dehumidification of a cellar wall; and

FIG. 7 is a section taken on the line VII—VII in FIG. 6.

In FIGS. 1 and 2 the portion of wall which is to be dried is marked 1*f*, 1*a* is the footing of the wall, 2 is the floor in the interior, 3 is the outside ground level and 4 is the ground-water level. At the junction of the two wall portions 1*f* and 1*a*, or in the vicinity thereof, holes are drilled at given intervals into the wall from its outside face. The holes are filled with lime mortar containing coal dust and bentonite, and an iron rod 5 is inserted into each hole. The iron rods together form an electrode system. According to the invention the holes are drilled nearly through the wall, into close proximity with its inside face, in order to ensure that the dehumidifying effect involves the entire cross section. The external ends of rods 5 are interconnected by a common conductor 6 which is grounded at 8 by a conductor 7. For the reception of the common conductor 6, a groove is formed from hole to hole in the wall. When this work has been completed the external face of the wall is finished in such a way that the entire conductor system except the ground lead 7 will be concealed.

A natural electrical circuit is thus formed which is constituted as follows: subsoil—ground lead 7—common conductor 6—iron rods 5—footing 1*a*—subsoil. The presence of this circuit prevents moisture from rising from the soil beyond the horizontal plane defined by the bank of rods 5 in footing 1*a*, provided the resistances of the several circuit portions actually satisfy the relationship defined by the aforesaid formula. The upper portion 1*f* of the wall will therefore dry out, and no more water will be drawn up and make the wall damp again.

If it is desired to damp-proof solid wall portions or limited portions of wall, for instance for the purpose of protecting existing frescoes or the like, the wall portion 9 which is to be thus dehumidified or protected is completely surrounded by banks of electrodes formed by iron rods 5 (FIGS. 3 and 4) connected by a common conductor 6 with a source of potential 10. Should no artificial source be available or should its provision prove uneconomical, the relevant wall portions, particularly those of ground-floor rooms, may be dehumidified by the creation of a natural circuit as previously described, in which case only one row of electrodes would be required (FIG. 5).

When portions of a wall are thus to be dehumidified by an arrangement according to FIGS. 3 and 4, the terms in the aforesaid formula would have the following meaning: r_1 is the resistance of the wall portion between the electrode banks, r_4 is the contact resistance of the bottom row of electrodes, and r_5 is zero.

For dehumidifying and damp-proofing a cellar wall, the plaster must first be removed from the inside of the wall, and holes for the reception of the electrodes 5 are then drilled into the top and bottom of the wall (as shown in FIGS. 6 and 7). For protecting the wall on the sides an electrode mesh of wires 11 is provided at a depth of 2–4 cm. inside the wall on each side of the electrode banks. A number of grounds 8 connected by ground leads 7 to a common conductor 6 and the assembly of electrodes are provided near the outside of the cellar-wall footing. When the electrodes have been laid, the inside of the wall can be finished. In this arrangement r_1 in the side insulation is the resistance between the electrode mesh and the outside surface of the wall.

What we claim is:

1. In the method of limiting the penetration of moisture from surrounding terrain into a porous wall of a structure by bridging a portion of said wall with an electric circuit, the improvement which comprises lowering the contact resistance between said circuit and said wall by imbedding a conductor of said circuit in said wall with interposition of a solid comminuted conductive agent until the overall circuit resistance outside said portion is at most equal to the resistance of said wall portion.

2. In the method of limiting the penetration of moisture from surrounding terrain into a porous wall of a structure by bridging a portion of said wall with an electric circuit, the improvement which comprises lowering the contact resistance between said circuit and said wall by imbedding a conductor of said circuit in said wall with interposition of a solid comminuted nonmetallic conductive agent until the overall circuit resistance outside said portion is at most equal to the resistance of said wall portion.

3. The improvement as defined in claim 2 wherein said conductive agent is coal dust.

4. The improvement as defined in claim 3 wherein said coal dust is imbedded in lime mortar.

5. The improvement as defined in claim 4 wherein bentonite is admixed with the coal dust in said lime mortar.

6. In the method of limiting the penetration of moisture from surrounding terrain into a porous wall by bridging a portion of said wall and an adjoining portion of said terrain with an electric circuit forming respective junctions with said portions, the improvement which comprises lowering the contact resistance at least at one of said junctions by imbedding a conductor of said circuit in the corresponding portion with interposition of a solid comminuted conductive agent until the overall circuit resistance outside said portion is at most equal to the resistance of said wall portion.

7. In the method of limiting the penetration of moisture from surrounding terrain into a porous wall of a structure by bridging a portion of said wall and an adjoining portion of said terrain with an electric circuit forming respective junctions with said portions, the improvement which comprises lowering the contact resistance at least at one of said junctions by imbedding a conductor of said circuit in the corresponding portion with interposition of a solid comminuted nonmetallic conductive agent until the overall circuit resistance outside said portion is at most equal to the resistance of said wall portion.

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