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(54) BONDING COVERING TO A SUPPORT

(71) We WEBER ET BROUTIN, a French Corporate body of "Le Closeau", Servon, 77170, Brie Comte Robert, Seine et Marne, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to a method of bonding a covering to a support.

The present invention is particularly, but not exclusively, suitable for attaching carpet, for example Turkey or Brussels carpet to a floor. Other applications of the present invention will be described later.

The present invention, the scope of which is defined in the appended claims, includes a method of bonding a covering to a support comprising the steps of,

introducing a layer between the support and the covering, said layer comprising a thermofusible adhesive and means for producing heat under the influence of an applied field, thereafter

positioning a field source over a region of an exposed surface of the covering thereby causing melting of the adhesive in the layer beneath the region such that when the field source is removed the adhesive forms a bond between the support and the covering beneath said region, and

moving the field source to position it over further regions of the exposed surface of the covering until substantially all of the covering is bonded to the support, the field being such that the covering is undamaged by it.

It will be appreciated that the above-defined method enables a covering to be bonded *in situ to a* support such as a wall or a floor of a building or a building panel or the like which is of such dimensions that it is not convenient to feed it through apparatus for bonding a covering thereto.

In order that the invention may be well understood some embodiments thereof will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a plan view of part of a layer comprising a sheet of thermofusible adhesive reinforced with a heating structure;

Figure 2 is a partial transverse section of the sheet shown in Figure 1, to a considerably larger scale;

Figure 3 is a perspective view of apparatus for bonding a carpet to a floor by means of sheets similar to those of Figure 1;

Figures 4a to *4c* are diagrams showing steps of the method of bonding the carpet of Figure 3 to the floor;

Figure 5 is a section of a carpet having an integral layer of adhesive containing heat producing means;

Figure 6 is a diagram of the circuits in the apparatus of Figure 3, and

Figures 7 and *8* show respectively in perspective and in plan elements of one portion of the apparatus of Figure 3.

The layer 1, shown in Figures 1 and 2, comprises a sheet of adhesive reinforced with a heating structure. The heating structure is here a sheet 1*a* having holes 2 which are located at the intersections of a chequer-work formed conventionally by two sets of parallel straight lines; in this example the diameters of the holes 2 may be of the order of 2 to 5 mm and the distance between the intersections of the chequer-work of the order of 7 to 15 mm.

The layer 1 has a very thin heating structure of "heart" 1*a* of aluminium (Figure 2), the thickness of which may be of the order of some hundredths of a millimetre. Each of the two faces of this heart 1*a* is provided with a pellicular coating 3 having a base of a glue which is a thermofusible adhesive of a type commonly called Hot-Melt, which melts under the action of heat at a temperature lying between 60 and 120°C, such glues being employed in known manner for various applications by hot gluing, especially the bonding in the factory of coverings in the form of sheets, foils or plates to suitable supports, in particular panels of various natures. The melting point of glues of this nature is not sufficiently high as to damage coverings currently employed and in particular carpet. The coatings 3 together form a sheet of thermofusible adhesive.

The layer 1 may readily be produced by the use of processes currently employed in the technical field of coating by means of conventional devices and machines.

The layer 1 may be delivered in the form either of strips of great length, packaged in rolls or in rectangular sheets the dimensions of the sides of which are of the order of a metre, these sheets being conveniently stacked on one another.

Figure 3 illustrates an apparatus consisting mainly of a power source in a cabinet 4*a* the dimensions (height, length, width) of which lie between about 2 to 6 decimetres, and of a frame or "shoe" 4*b* equipped with a handle, this shoe 4*b* being connected to the cabinet 4*a* by means of flexible conductors which comprise a flexible cable 4*c* including wires for conducting electricity.

This apparatus which will be described in greater detail later, comprises a power source or "generator" arranged inside the cabinet 4*a* and capable of being fed from a conventional distribution network of electrical energy of 50 Hertz, by means of a conductor cable 4*f*. The generator supplies alternating current at high frequency in order to excite an "oscillating circuit" which is carried by the shoe 4*b* (Figure 5), this circuit includes capacitors 5*c* and an induction coil 5*s* capable of generating a field of electromagnetic induction at "medium frequency".

It will be observed that this apparatus is standing on a support of cement 6 covered, for example, with a carpet 7 which may be connected to the floor by "continuous gluing" as is explained below. The cabinet 4*a* is provided with two feet and two wheels for moving it.

After having suitably "prepared" the floor by, for example, trimming up with a smoothing coat in conventional fashion, sheets 1*b* identical in construction with the layer 1 described above is spread over it to form a layer thereon, taking care to arrange the separate lengths approximately edge to edge so as to cover the whole area of the floor (Figure 4*a*). The sheets 1*b* in this example are delivered in rolls. Then in a conventional fashion widths of carpet 7*a* are spread over the layer formed by sheets 1*b*, by arranging these widths edge to edge (Figure 4*b*). The layer formed by sheets 1*b* is thus introduced between the support 6 and the covering of carpet 7.

It is then sufficient (Figure 4*c*) to set the generator of the apparatus 4*a* working and then at a suitable speed (arrow f_1, Figure 4c) to move the shoe 4*b* over the carpet to ensure connection of it to the floor. Thus the field is applied to regions of the exposed surface of the carpet.

During the course of this movement the induction field provided by the induction coil 5*s* passes through the carpet 7 and induces "eddy currents" in the heart 1*a* which are sufficiently intense to ensure heating of the heart 1*a*, and thus melting of the glue in the layer beneath the region to which the field is applied. The speed of movement of the shoe 4*b* may be such that an induction coil 5*s* of length 3 to 4 decimetres sweeps approximately 1 m^2 of carpet per minute. The heart 1*a* thus constitutes means for producing heat under the influence of the field.

The shoe 4*b* is suitably loaded so that the pressure applied to the carpet by two skids with which the shoe is equipped transversely, brings about by degrees the bonding of the carpet 7 on to the heart 1*a* and simultaneously the bonding of the heart 1*a* on to the support 6.

A load of 10 to 20 kg on two skids of a total sliding area of about 150 cm^2 provides good results and bonding of the carpet 7 to the floor 6 occurs upon cooling, which is quick, of the glue in the coatings 3.

The foregoing description demonstrates that the induction field produced by the induction coil 5*s* of the shoe 4*b* located on the exposed surface of the carpet passes through this carpet without risk of damage, in order to reach the heart 1*a* which constitutes a heating structure which is remarkably effective for converting the induction field energy into heat. The small thickness of the heart 1*a* prevents undue dissipation of the heat generated, in spite of the good conductivity of the aluminium.

The holes 2 in the heart 1*a* are sufficiently small for the heat generated in the layer 1 to ensure melting of the glue in these holes 2 which promotes direct bonding between the carpet 7 and the floor 6.

An alternative layer having a heating structure which is a continuous sheet 1*a* of

aluminium, enables advantageous manufacture of composite products such as panels including a heart impervious to moisture and commonly called a "vapour-barrier". A layer of this kind has two adhesive faces and is well suited to industrial manufacture of panels in a factory using a generator of "HF" current which is substantially simpler than the apparatus shown in Figures 6 to 8 because of the static state of its self-induction.

A sheet of aluminium constitutes an excellent barrier to moisture if it does not exhibit the slightest hole (even of the order of one thousandth of a millimetre) and, for example, composite building panels have been proposed which include such a sheet caught in a sandwich between a plaster-base slab and a slab of expanded polystyrene.

Previously proposed methods of manufacture of such panels industrially involve first bonding the vapour-barrier sheet of aluminium by one of its faces to a slab of plaster and then bonding its other face to a slab of expanded polystyrene. Since the aluminium sheet must be thin in order not to be too costly, precautions must be taken during manufacture to prevent perforations of this vapour-barrier, which reduce or eliminate the sealing effect.

However, if the sheet of aluminium is coated with Hot-Melt glue on both surfaces (which would be possible on a sheet of thickness 1 mm if it were not too costly) the above disadvantages can be avoided because:

the coatings of glue 3 ensure a protection which is not negligible to a thin sheet of aluminium; and

the composite layer requires only a single operation in order to bond the slab of plaster to the slab of polystyrene, which avoids excessive handling and transfer during the course of which a layer 1 may be accidentally punctured.

This connection in a single operation is obviously less costly than conventional connection, as the natures of the two coatings 3 of glue may without particular difficulty be suited to the respective natures of the aluminium and the elements to be connected, for example, plaster and polystyrene.

The heating structure 1*a* in the sheet of glue exhibits sufficient mechanical strength to reinforce the layer 1 which facilitates the manufacture, handling, storage, conveyance and application of these layers. Hence a layer 1 of this kind is perfectly compatible with the most diverse covering applications. In certain cases the operations of lining a floor with sheets 1*b* of the layer 1 may be avoided by bonding a layer in the factory to the back of the widths of carpet or other covering 7.

Such an arrangement is well suited to the bonding of a covering to a vertical wall on site.

Good results have been obtained by producing in the factory by bonding on to the back of the covering (for example, widths of carpet 7 m) a layer having a base of a mixture of Hot-Melt glue and heat producing means which are thin particles of aluminium 1*p* (Figure 5), the proportion of the latter in this mixture being suited to the formation of a core providing heating results similar to those mentioned above.

Satisfactory results have likewise been obtained with layers of mixtures in suitable proportions of Hot-Melt glue and graphite powder exhibiting a grain size adequate for the satisfactory formation of a heater core.

It is also possible to manufacture industrially from a mixture of Hot-Melt glue and *ad hoc* particles (aluminium, graphite) a flexible layer in the form of strip by means of calendering machines usually employed for the manufacture of sheets of plastics such as sheets of polyethylene.

Such layers would be suitable for applications similar to those of the layer 1 as Figure 1, but they would be less advantageous than those integral with the covering, especially because of the small thickness that such a layer can exhibit. Tests have confirmed that satisfactory bonding is obtained for amounts of glue not exceeding 100 to 400 grammes per m^2 distributed over the two faces of a heating structure.

It is advantageous to produce a layer of adhesive and heat producing particles, integral with the back of the covering, because of economical factory production as well as appreciable convenience in handling, conveyance and storage of this composite product ready for laying, thus avoiding the operation of applying the layer to the support separately on site as already mentioned with reference to Figure 4*a*.

It is of course possible where there is sufficient demand to attach all the described embodiments of the layer to coverings in the factory in order to provide the advantages already mentioned.

Finally it is possible and it may be advantageous

to prepare in the general form of a powder a suitable mixture of Hot-Melt glue in the ground state and of heater particles,

to spread this mixture over a floor, for example, by sprinkling to form a thin layer,

to spread carpet or other covering over this layer and then to operate as has been explained above with reference to Figure 4*c* for bonding the carpet to the floor.

One might equally well employ in the same way as granules, heater particles coated with

a skin of Hot-Melt glue in order to obtain a similar result.

This method enables various contingencies arising during work on a site to be satisfied, for example, unforseen replacements or adjustments of certain portions of covering on a support.

In all cases for all these variants of the heat producing means (sheets, lattice or network, particles of metal or graphite .....) and coverings applied to floors or other supports of large area (walls, building partitions .....), the convenience of application of the covering on to a support which may be very large is essentially due to the ease of handling of the shoe 4*b*, as the "supply generator", being relatively bulky, may be "relegated" successively to portions of floor suitable for free manoeuvres of this shoe 4*b*.

The shoe 4*b* only comprises elements which are not very bulky (induction coil and capacitors), which allows of very diverse manoeuvres both over a floor and over vertical walls such as walls or partitions, as the handle of the shoe may be replaced by one or two hand-holds suitable for application to vertical surfaces.

Finally if the field from the shoe is applied through carpets which have already been bonded to a floor by the described method sufficient heat will be produced in the heating structure 1*a* to bring about melting of the glue in the layer so that the carpet may be removed progressively by degrees without damage either to the carpet or to its support.

It is true that operations which are the reverse of operations of connection or erection of the most varied elements have always enabled dismounting the latter but these dismountings are often more costly than the corresponding erection, however, in this case the shoe 4*b* enables un-laying which is at least as quick and advantageous as an equivalent laying of a covering.

The shoe 4*b* (Figures 7 and 8) includes a frame 8 in the form of a case the bottom of which is integral with two straight profiled skids 8*p* of insulating and heat-resistant material, for example, a material having a base of fibres in synthetic resin of urea formaldehyde type.

These two skids 8*p* the length of which is of the order of 30 to 50 cm are suitably attached underneath the bottom of this case 8, and are arranged in parallel in order to leave between them a gap of about 10 to 15 cm.

A unit of three plane rectangular turns resulting from bending at right angles a tube 5 of pure copper of about 6 mm diameter to constitute an induction coil 5*s* is attached by means of crosspieces of insulating material 5*t* to the lower portion of the case 8, and is arranged in a plane parallel with the plane determined by the sliding faces of the skids 8*p* at a distance of the order of 1 cm from this plane.

Means (not shown) may be provided on the case 8 for providing adjustment of the relative positions of the skids 8*p* and the induction coil 5*s*, in order to take account of the thickness and the nature of the covering being used.

The ends of the tube 5 are connected in a dismountable fashion to other tubes welded to bars 9 arranged in parallel with one another in order to enable the mounting of the connection terminals of two capacitors 5*c*. The latter tubes may be connected to rubber pipes 9*t* in order to constitute a conventional cooling circuit by a flow of water. The bars 9 are attached to the case 8 by crossbars or feet of insulating material 9*p* and are connected by flexible conductor wires 9*c* to the aforesaid circuit in the cabinet 4*a*.

The circuit in cabinet 4*a* (Figure 6) comprises

a source of continuous current 10 connected by conductor wires 4*f* to a conventional alternating current network at 50 Hz. This source is shunted by a decoupling capacitor 11 for feeding in series:

an induction coil 12*s*, shunted by a diode 12*d*,

a switching device 13 (for example, a transistor) for supplying a "chopped current",

a pilot device 14 intended for receiving information for controlling the operation of the device 13 suitably.

This circuit which is described in detail in French Patent Specification No. 2,316,787 can supply to the oscillating circuit 5*c*, 5*s* of the shoe a current of, for example, an effective intensity of 30 amperes at a crest voltage of 120 volts at a frequency of 30 kHz, the induction coil 5*s* having three turns of a length of about 40 to 50 cm and a width of about 10 cm.

The source 10 is fed at a voltage of about 70 volts at 50 Hz, for example, by means of an "explosion proof" transformer (not shown) which may be independent of the cabinet 4*a* for ease of movement of the latter.

The rubber tubes 9*t* of the water cooling circuit and the conductor wires 9*c* may be grouped together to form a flexible cable 4*c* which provides remote feeding of the shoe 4*b* without danger to a user. The inevitable energy losses due to the nature of the circuit in the cabinet 4*a*, are still acceptable for lengths of 15 to 20 meters of this cable.

Finally, concerning the glue used in the layer 1, it may be pointed out that conventional operations (grinding, screening, mixing .....) applied to the amounts of products specified in the tables below have provided satisfactory results.

A- Products	Known under the brand	Amount in kg
Ethylene vinyl acetate :	Ultrathèse USI 61 204 :	35
Microcrystalline wax :	Victory Amber:	18
Colophony :	Sicasso :	35
α pinene resin :	Dercolyte A 10 :	7
Silica :	Latexyl S :	5

This "glue" has been applied by hot coating (90 to 100°C) to heating structures

a) Aluminium sheet (ALBAL brand, reference 623) perforated with holes 5mm in diameter at the rate of 30% of the area.

b) Steel wire gauze : 1 mm mesh, wire 0.3 mm in diameter, or

c) Aluminium sheet (ALBAL brand, reference 623, without perforations), weight of glue employed 300 to 400 gr/m^2.

B- To the mixture of the five products specified above there may be added heat producing means in the form of:

d) Discs of 5 mm diameter of aluminium "confetti" (resulting from the perforation of sheets, specificed under a)) 20 to 30 kg, or

e) Graphite powder exhibiting a "grain size" lying between 90 and 110. 1/1000 mm 30 kg.

These mixtures d), e) have been applied hot (temperature lying between 90 and 100°C) to the backs of carpet elements at the rate of 400 gr/m^2.

It will be appreciated that there has been described a method of bonding a covering to a support which requires little skill in the operator and can conveniently be effected on site. The described method also causes no permanent damage to the covering and since the process is reversible the covering may be removed and applied elsewhere. The present method also avoids the disadvantages of using solvent glues, which include the variable and restricted gumming time as well as hazards associated with the use of often volatile, inflammable and toxic solvents.

WHAT WE CLAIM IS:-

1. A method of bonding a covering to a support comprising the steps of,

introducing a layer between the support and the covering, said layer comprising a thermofusible adhesive and means for producing heat under the influence of an applied field, thereafter

positioning a field source over a region of an exposed surface of the covering thereby causing melting of the adhesive in the layer beneath the region such that when the field source is removed the adhesive forms a bond between the support and the covering beneath said region, and

moving the field source to position it over further regions of the exposed surface of the covering until substantially all of the covering is bonded to the support, the field being such that the covering is undamaged by it.

2. A method as claimed in claim 1, wherein the heat producing means comprises a heating structure, the layer comprising a sheet of thermofusible adhesive reinforced with the heating structure, the stop of introducing the layer comprising the steps of applying the sheet to the support, and applying the covering to the sheet.

3. A method as claimed in claim 1, wherein the heat producing means comprises particles, the step of introducing the layer comprising steps of sprinkling a mixture of heat producing particles and thermofusible adhesive granules over the support, and applying the covering to the layer so formed.

4. A method as claimed in claim 1, wherein the heat producing means reinforce a sheet of thermofusible adhesive, the step of introducing the layer comprising the steps of bonding the layer to the covering and applying the covering integral with the layer to the support.

5. A method as claimed in claim 2, wherein the heating structure comprises a continuous sheet of aluminium substantially impervious to moisture coated on both surfaces with thermofusible adhesive, the layer having dimensions at least equal to those of the support.

6. A method as claimed in any one of claims 1 to 5, wherein the applied field is produced from an oscillating circuit close to the region of application, the oscillating circuit being powered remotely from a source connected to the circuit by means of flexible conductors.

7. A method as claimed in claim 6, wherein the step of applying the field source to further regions comprises sliding a frame carrying said oscillating circuit on skids over the exposed surface of the covering.

8. A method of bonding a covering to a support substantially as herein described with reference to the accompanying drawings.

9. A covering and a support bonded by a method as claimed in any one of the preceding claims.

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Sheet 1

FIG.1

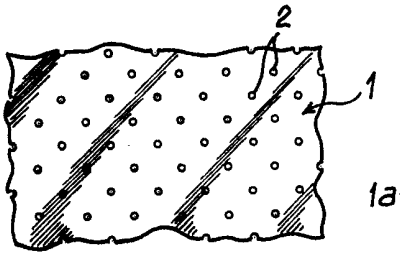


FIG.2

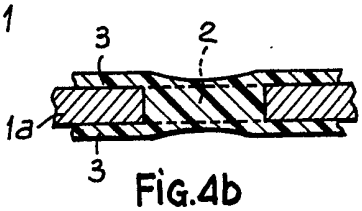


FIG.4a

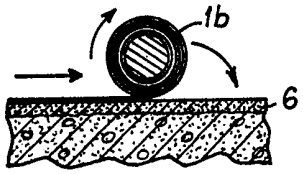


FIG.4b

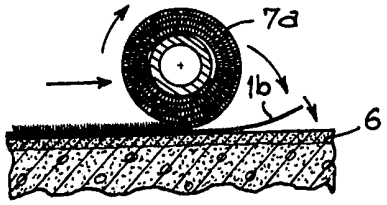


FIG.5

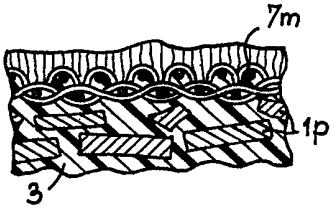


FIG.4c

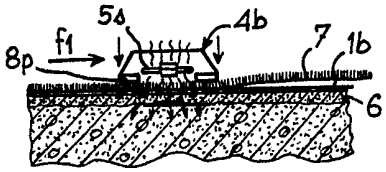


FIG.3

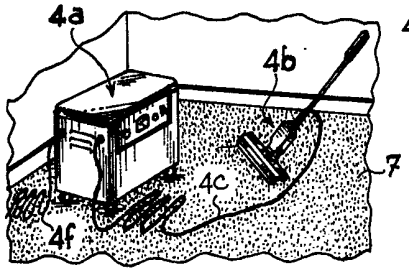
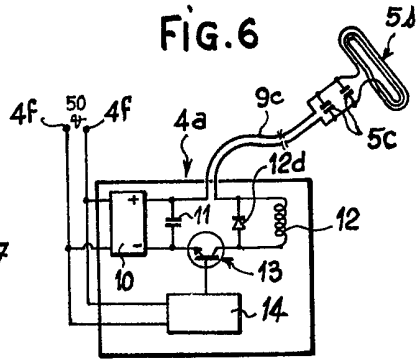


FIG.6



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Sheet 2

FIG.7

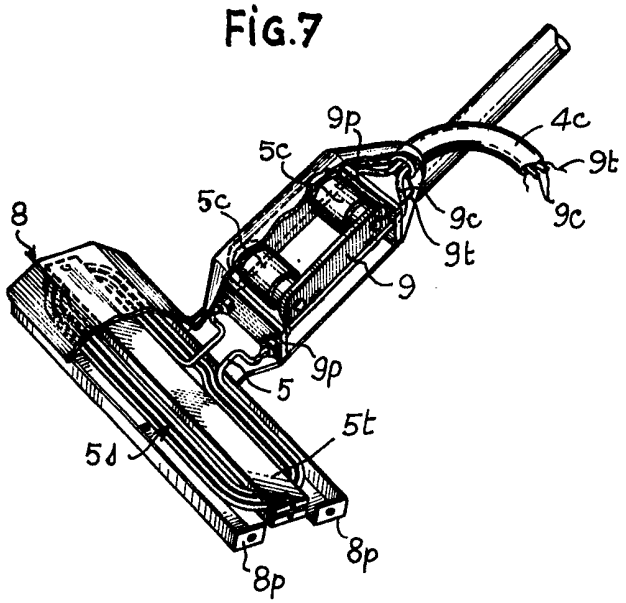

FIG.8