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D. K. SLOSBERG ET AL

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CONDUCTIVE FLOOR COVERING

Filed Oct. 26, 1965

FIG. 1

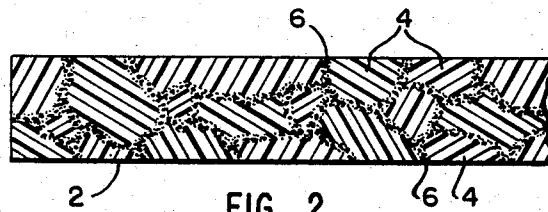
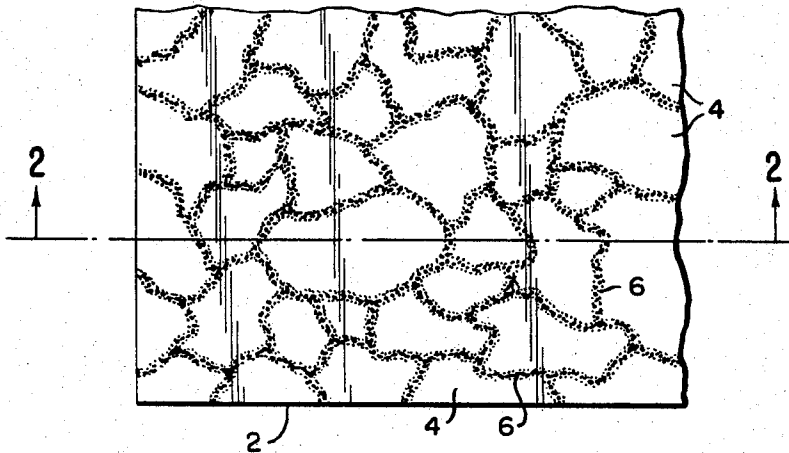


FIG. 2

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CONDUCTIVE FLOOR COVERING

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5 Claims. (Cl. 317-2)

ABSTRACT OF THE DISCLOSURE

The invention is a conductive plastic sheet having the appearance of terrazzo, in which the sheet is made of granules of vinyl resin fused together, the boundaries between the particles consisting of a thin layer of conductive plastic resin, with the result that the surface of the sheet shows only very thin veins extending through the sheet, these veins being interconnected. Thus, a substantially continuous, electrically-conductive network extends throughout the sheet.

This invention relates to conductive plastic sheet material, and more particularly to such material having an esthetically pleasing appearance in which the presence of the conductive material is minimized.

Conductive flooring materials have been made, either in sheet form or in tile form, comprising a plastic to which has been added a conductive material such as carbon black for the purpose of providing a path for electrical current in order to drain off any electrostatic charges that may have built up. Such materials are used, particularly in industrial plants, where explosive materials or gases are present, in order to minimize or eliminate completely the build-up of such charges. As an example of such material, a conductive vinyl tile is made by marbling a non-conductive vinyl base with a conductive mottle. The conductive mottle contains about 20% of conductive carbon black. The marbled material is then granulated to a 3/8 inch chip, and these chips are then consolidated by heat and pressure to form a slab which, with further treatment, will become the end product for use on floors as a covering.

The disadvantages of the above process and articles are that the making of the conductive mottle is not only a dirty operation due to the large amount of carbon black required, but, additionally, clean-out batches are required after each mottling operation, that is, after the addition of conductive mottle to the base compound. Furthermore, the conductivity of the finished material, either in sheet or tile form, may be variable and critical. (This is caused by varying degrees of milling or other high shear operations, which in turn, vary the degree of dispersion of the conductive carbon black particles throughout the flooring.) Therefore, a high percentage of rejects may occur due to non-uniform conductivity.

In addition to the above, the high level of conductive black pigment incorporated in the material reduces the value of reject and scrap material for reuse. Also, in the finished material the chips comprising the conductive mottle appear as relatively large black spots or areas on the surface, such an appearance not being desirable in many instances. A further requirement for such a floor covering is that the resistivity should fall within certain criteria, established by the Underwriters' Laboratories, Inc., namely, it should be less than 1,000,000 ohms as measured between two electrodes placed three feet apart at any points on the test panel laid in accordance with the Underwriters' Laboratories instructions; and more than 25,000 ohms as measured between a ground connection and an electrode at any point on the panel, and also as between electrodes

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placed three feet apart at any points on the surface of the sample.

This invention eliminates the need for making a conductive vinyl chip. It also eliminates the requirement of mottling or marbling the base compound. It presents a conductive plastic sheet material in which the conductive material is present in a form and location which is relatively unobvious, even on the finished floor surface, and the finished material has a relatively uniform conductivity from point to point thereon.

Among the several objects of the invention, therefore, may be noted the provision of a conductive sheet flooring material having a pleasing appearance; the provision of a material of the above class having a more uniform resistance and/or conductivity than previously known flooring materials; the provision of a plastic sheet material which can be readily used either in continuous sheet form or can be cut up into tiles; the provision of conductive floor material which meets the requirements of the Underwriters' Laboratories for such material; the provision of materials of the above classes which are cleaner and more economical to make; the provision of a method of making material of the above classes which eliminates the need of making a conductive vinyl chip, and of mottling or marbling a base compound; the provision of a method of making a conductive sheet material which provides a more uniform electrical conductivity through the finished sheet material; and the provision of a method of making a conductive material which is relatively simple and economical to practice. Other objects and advantages will be in part obvious and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, steps and sequence of steps, features of construction of the article, and arrangements of parts, all of which will be exemplified in the structure of the article and in the methods herein described, and the scope of the application which will be indicated in the appended claims.

In the accompanying drawing, in which is illustrated one embodiment of the invention:

FIG. 1 is a plan view of an embodiment of the invention, with the components thereof relatively enlarged in order to show detail with greater clarity; and

FIG. 2 is an edge view of the FIG. 1 embodiment, also with the components relatively enlarged for clarity.

Throughout the drawings, similar reference characters illustrate corresponding parts of the embodiment.

The sheet or tile material of this invention comprises a body 2 made from chips 4 of a plastic material such as vinyl polymer and a conductive material which comprises the boundary layers 6 between the chips 4. It will be noted that the boundary or inter-chip layers 6 appear as veins throughout the sheet material. In the finished material, as an example, the boundary layers 6 appear in most places as veins having a hairline thickness. These veins or boundary layers 6 extend throughout the sheet and are connected together. Since the width of the chips 4 is many times greater than the thickness of the veins 6, when one looks at the finished surface of the sheet 2, the chips appear separated and bounded by a very fine black line. Thus, when chips of different color are used, there are not present any relatively large blotches of black to spoil the effect.

As indicated, these veins, or inter-chip boundaries, are connected together throughout the whole of the sheet material, and thus in the material there is a continuous conductive path for the flow of electrical current there-through. Since the width of the boundary layers 6 does not vary greatly from place to place in the sheet, then between one place in the sheet and another there is gen-

erally present the same amount of conductive material with resultant uniform conductivity.

The boundary layer material itself comprises a resin such as a vinyl polymer having suitable additives, and also containing a conductive oil furnace carbon black dispersed in a vinyl plasticizer in paste form.

The method of preparing the sheet materials prior to pressing and heating to fuse the chips together, is basically to prepare the boundary layer material as a wet powder blend, and then tumble the vinyl chips together with the boundary material in, for example, an unheated ribbon mixer. After tumbling, the coated chips may be screened to remove excess fines, and thereafter the remainder of the material is formed at an elevated temperature and pressure into a fused vinyl slab. This slab may be used as is, or further processing may be carried out to improve the appearance, for example such as splitting, re-surfacing by polishers or pressers, back sanding to gage, and cutting into tile form. The heating and pressing processing is described in Patent No. 3,017,714, dated Jan. 23, 1962, the teachings of which patent are incorporated herein by reference.

The electrical resistance of the finished tile or floor material depends on the amount of boundary layer material present (hereinafter called the etch compound), and the level of the conductive material (carbon black) in the etch compound. The combination of the two variables can lead to an infinite number of formulations, and therefore, as a practical matter, there are certain considerations that should be observed.

The first of these is that the use of less than 2% by weight of the etch compound in the total tile leads to a discontinuous separation of the hairline veins which is neither esthetically pleasing nor reliable for conductivity.

The second is that the use of more than 20% of the etch compound in the finished floor material gives the later a terrazzo appearance; that is, chips suspended in a black matrix closely resembling the appearance of cement terrazzo flooring. While this is not in itself unpleasing, the object of this invention is to provide the more esthetically pleasing hairline separation of the chips.

A third consideration is that an excessively high level of carbon black can result in tile or floor material which will give streaking and smearing problems particularly in the subsequent processing operations such as splitting, sanding, etc., and quite possibly in use.

The fourth consideration is that material should be produced which falls within the electrical resistivity limits established by the Underwriters' Laboratories requirements.

In regard to the latter, if the etch compound is not to exceed 20% maximum of the total weight of the flooring, then the carbon in the boundary layer material should be greater than approximately 2.5%. On the other hand, if the etch compound level in the finished flooring has a lower limit of 2% by total weight, then the carbon black in the etch compound should be greater than 25%.

For the resistance of the material to be more than 25,000 ohms (and thus satisfy the minimum resistance requirement of the Underwriters' Laboratories), then for an etch compound level of 20% maximum, the carbon black therein should be less than 5% by weight; and if the etch compound level is at a 2% minimum by weight, then the carbon black therein should be greater than 50%. As noted above, an excessively high level of carbon black can result in streaking and smearing problems. Therefore, while it is theoretically possible to go as high as 50% by weight of the carbon black in the etch compound, nevertheless for practical reasons, it is preferred not to exceed approximately 13%. If the carbon black in the etch compound is established at approximately 13%, then the range thereof in the finished product will be approximately 3.7% to 8% by weight in order to fall within the prescribed limits of 1 million ohms maximum resistance and 25,000 ohms minimum resistance, respec-

tive. On the other hand, if a minimum level of 2% carbon black were to be established in the etch compound, then the range of the etch compound in the flooring itself would be from 25% to 50% by weight in order to fall within the Underwriter's Laboratories limits. This would produce, however, the above mentioned terrazzo appearance, which is not the fundamental purpose of this invention.

As an example of a coating compound for the boundary layer 6 the following composition will be found to be satisfactory and to provide the objects and advantages indicated above.

Material:	Parts
Polyvinyl chloride (specific viscosity) 0.4% in nitrobenzene at 25% C.	100
Di normal octyl, normal decyl adipate	20
Epoxidized soya oil	10
Barium cadmium liquid stabilizer	3
40% conductive oil furnace carbon black dispersed in vinyl plasticizer (paste form)	63
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The above mixture is prepared by thinning the conductive black paste with the liquid components listed, in a planetary type mixer at room temperature, for example, in a Hobart mixer. The polyvinyl chloride resin is added gradually to form a wet powder blend.

As indicated above, the coating of the vinyl chips with this conductive powder blend may be done by tumbling the wet powder blend with the proper proportion of vinyl chips in an unheated ribbon mixture. Thereafter, the total mix, after screening if desired, is formed at elevated temperatures and pressures into a fused vinyl slab. A suitable pressure is approximately 1500 pounds per square inch at a temperature of about 320° F. for five to seven minutes for a sheet of ½ inch thickness. The molding conditions may vary, depending on the compounds used, in heat from 250° F. to 350° F., and in pressure from about 50 pounds per square inch to about 3000 pounds per square inch. The processing of said patent then may be used to finish the material to final thickness and polish.

The specific example given above as a coating compound is coated on the vinyl chips by tumbling approximately 5 pounds of the powder blend with 100 pounds of vinyl chips in an unheated ribbon mixer. If it is desired to change the conductivity of the sheet material, then either more or less of the wet powder blend can be tumbled with the proper proportions of vinyl chips. As so prepared, the resistance of the finished tile will be approximately 70,000 to 80,000 ohms.

It will be noted that less of the conductive material is used than in former materials, and that tumbling for coating the vinyl chips prior to heating and pressing together is done with a wet powder blend. This leads to a cleaner operation than hitherto known, and any resulting scrap material (because of lower carbon black content) has a higher value as scrap.

The conductivity of the vinyl material is reproducible and subject to much less variation than formally known materials, since no intensive mixing operations are involved.

The coating material is sufficiently compatible with the ingredients of plastic chips so that a bond therebetween sufficient to make the sheet entirely integral, will occur under molding conditions of heat and pressure. Compositions containing polyvinyl chloride or copolymers containing vinyl chloride have been discovered to be extremely effective for use as such coatings for the plastic chips.

Auxiliary agents may be included in the coating composition, for example, a plasticizer may be used such as dialkyl phthalates in which the alkyl esterifying radical contains 4 to 10 carbon atoms; esters of dicarboxylic acid such as azelaic acid, sebacic acid, adipic acid, or the like; the hydrocarbon esters of phosphoric acid; and the epoxy

polymers such as epoxidized soybean oil. Specifically, exemplary of the plasticizers are butyl benzyl phthalate, butyl octyl phthalate, di-isodecyl phthalate, tri-cresyl phosphate, and tri-octyl phosphate.

In order to prevent adverse reactions such as oxidation from taking place, the coating compositions may also contain stabilizers, as for example, the barium, zinc, lead, tin and cadmium salts of fatty acids containing 6 to 24 carbon atoms; di-butyl tin dilaurate; tin mercaptides and dibasic lead phosphite.

A lubricant may be used in the coating material, such as paraffin wax, stearic acid, stearates of lead, calcium zinc and aluminum, coal tar resins, wood resin derivatives and others.

The coating of the plastic chips, according to the present invention comprises polyvinyl chloride or copolymers containing vinyl chloride plus the conductive additive material. The presence of the vinyl chloride in the copolymer renders the composition compatible with the vinyl plastic chips.

Mention has been made that the coating of the vinyl chips is done by a wet powder blend. One specific means of preparing the wet powder blend and thereafter applying it to the vinyl chips has been mentioned. Other methods of preparing the coating material and applying it to the vinyl chips can be utilized, and several of these are mentioned in Patent No. 3,017,714. If the use of a dry coating compound is desired, rather than a wet blend, a dry blending method can be used.

In view of the above it will be seen that the several objects of the invention are achieved and other advantageous results attained.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, nor to the methods described, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

As many changes could be made in the above constructions and methods without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense, and it is also intended that the appended claims shall cover all such equivalent variations as come within the true spirit and scope of the invention.

Having thus described our invention, what we claim

as new and desire to secure by Letters Patent of the United States is:

1. A conductive plastic sheet comprising a plurality of individual chips of plastic bonded together with a conductive material being present solely in the inter-chip boundaries, said boundaries being interconnected throughout said sheet to form a substantially continuous path for the passage of electrical current in said sheet.

2. A conductive plastic sheet comprising a plurality of individual chips of plastic bonded together, the inter-chip boundaries consisting, at least in part, of carbon black said boundaries forming a network of veins throughout the sheet and being interconnected substantially throughout the sheet to form a continuous path for the passage of electrical current in the sheet.

3. A conductive plastic sheet comprising a plurality of individual chips of vinyl polymer, a layer of conductive resin covering at least a portion of the surface of each of said chips, said layer being a polyvinyl chloride polymer and containing carbon black as a conductive medium, and said chips with their coating being bonded together under heat and pressure with said coating constituting the boundaries between each chip and said boundaries forming an electrically conductive network throughout the sheet.

4. The sheet of claim 3 in which said conductive resin ranges by weight from 2% to 20% of the plastic sheet and the carbon black in said conductive resin is proportioned with respect to the total weight of the sheet to provide an electrical resistance falling between twenty-five thousand ohms and one million ohms along a path between two electrodes spaced three feet apart on the surface of the sheet.

5. The sheet of claim 4 in which said conductive resin is approximately 5% by weight of said sheet, and said sheet, and said carbon black is approximately 13% by weight of the conductive resin.

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DARRELL L. CLAY, *Primary Examiner*.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,386,001

May 28, 1968

David K. Slosberg et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 71, "a" should read -- at --; same Column 3, line 75 and Column 4, line 1, "respective", each occurrence, should read -- respectively --. Column 5, line 39, "empolyed" should read -- employed --. Column 6, line 15, "the" should read -- said --; lines 35 and 36, cancel "and said sheet,".

Signed and sealed this 4th day of November 1969.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents