June 22, 1954 C. F. CARLSON 2,681,473

MANUFACTURE OF PLAQUES AND THE LIKE

Filed Dec. 30, 1948

Fig. 1.

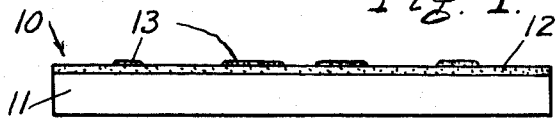


Fig. 3.

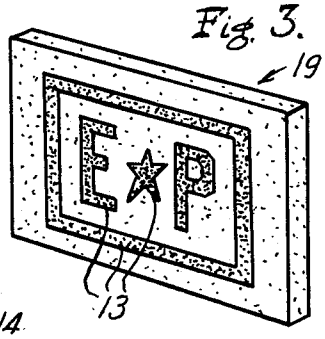


Fig. 2.

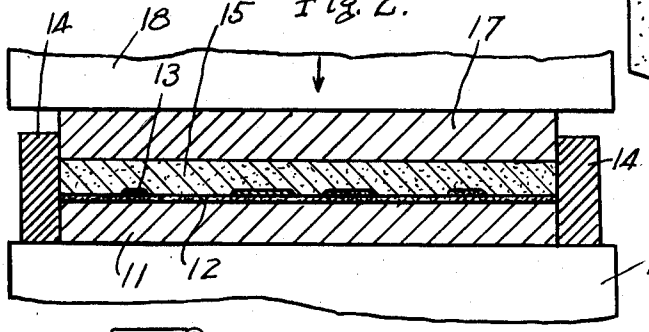


Fig. 4.

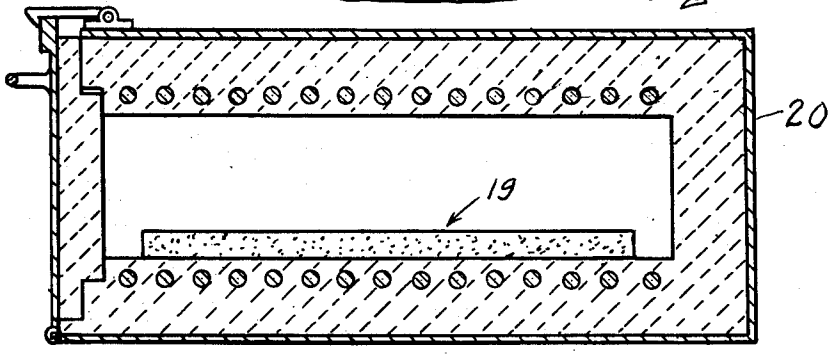


Fig. 5.

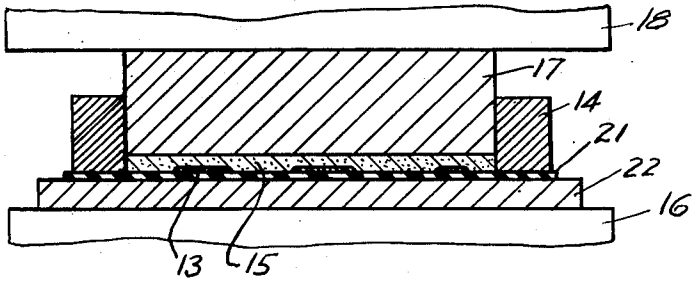
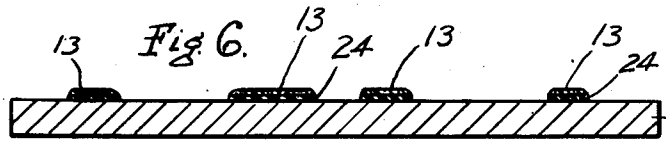


Fig. 6.



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MANUFACTURE OF PLAQUES AND THE LIKE

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6 Claims. (Cl. 18—61)

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This invention relates to the manufacture of plaques, nameplates and the like.

An object of the invention is to improve the methods of making plaques, nameplates, ornamental objects, plates and sheets, permanent photographs and other intelligence-bearing objects, plates or sheets.

A further object is to provide an improved plaque, nameplate, ornamental object, plate or sheet and the like.

Other objects of the invention will be apparent from the following description and accompanying drawings taken in connection with the appended claims.

Figure 1 is an edge view of an electrophotographic plate carrying a powder image electrostatically held thereon;

Figure 2 illustrates a step in a method of the present invention in which a backing material in powder or granular form is consolidated with the powder image in a press, the electrophotographic plate and the press plates being shown in section;

Figure 3 shows a completed plaque or nameplate;

Figure 4 illustrates a step in a modified method of practicing the present invention;

Figure 5 shows a step in another modified method; and

Figure 6 shows a plate suitable for use with a further modified method.

The present invention contemplates an electrostatic method of making plaques, nameplates, plates or sheets carrying ornamental designs, data, trade marks, words, numerals, pictorial photographs and the like as well as objects of more complicated configuration carrying such designs or data. In its preferred embodiment an electrostatic charge pattern is first produced on a surface, the pattern corresponding to the desired pattern or design which is to appear on the finished plaque or nameplate. A powder of the desired color and composition is then deposited on the charge pattern to produce a powder pattern. A second powder of different color or composition is then deposited over the surface to cover the first powder as well as the areas not occupied by the first powder. The two powder layers are then consolidated by pressure, heat or chemical action or a combination of these steps to form the completed plaque or the object .

Referring to the drawings, an electrostatic charge image is first produced on an insulating surface. One method of producing such an image is the photographic method described in Carlson

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Patent 2,297,691, relating to Electrophotography issued October 6, 1942. As described therein a layer of photoconductive insulating material preferably in contact with a conductive backing is photographically exposed while under the influence of a strong electric field through the layer. Thus, in one method of procedure, the surface of the layer is first given a uniform electric charge by friction or other methods and then exposed to light to discharge portions of the charge leaving an electrostatic latent image. The image is then developed by depositing a finely-divided material or powder on the surface. The powder adheres to the charged areas but not to the background.

Figure 1 is a side view of an electrophotographic plate 10, comprising a metal backing 11, and a coating 12 of photoconductive insulating material on one face of the backing. After charging, exposure and development, the plate carries a powder image 13 adhering by electrostatic attraction to its surface.

According to the present invention powder 13 may be a metal powder such as copper or bronze, silver, gold, or any one of a variety of other metals or alloys, or a ceramic powder such as porcelain or porcelain glaze, clay or powdered glass, the ceramic powder carrying a suitable pigment or coloring material embodied therein if desired, such as the colors that are used for colored glazes and the materials used to produce colored glass. The powder may also be an inorganic cementing material such as plaster of Paris of natural color or colored with a water insoluble dye or carrying a colored pigment.

The powder may also comprise one of the molding resins or plastics in finely-divided form such as cellulose acetate, methyl methacrylate, polystyrene or uncured phenol formaldehyde, or urea resins suitably colored.

While the electrostatic charge pattern on which the powder is deposited may be produced photographically as described in connection with Figure 1, it may also be produced by other methods as by discharging high voltage electricity from a pointed conductor on to an insulating surface. The pattern can also be produced on the surface by drawing a rounded metal point or the point of a rounded glass rod over the surface to create frictional charge in any pattern described by the stylus point.

Having produced a powder pattern by depositing a selected powder on the charge image, blowing away or otherwise removing any excess powder not adhering to the surface by the electrostatic attraction, the surface including the pow-

der image is next covered with a second powder of similar or different composition than the first powder but of a different color or color value so as to have a contrasting appearance. Thus, where a silver pattern is used for the image the backing powder may be formed of copper. Where the image is formed of red ceramic powder the backing can be formed of white or non-colored ceramic powder; similarly for plaster of Paris and the plastic molding materials.

In order to produce a uniform backing layer of the selected powder the plate 10, carrying the image, is enclosed in a metal frame or border 14, Figure 2, which fits closely against the edge of the plate after which a layer 15 of the backing powder is sifted or sprinkled onto the top surface of the plate over image 13. When the desired quantity of powder is deposited on layer 15 the two layers 13 and 15 are consolidated by pressure, heat, chemical action or the like to complete the plaque or plate.

Figure 2 illustrates one method, in which plate 10 is laid on the base 16 of a hydraulic press and a pressure plate 17 is laid on layer 15, after it has been smoothed, and the pressure head 18 of the press is brought down to apply the desired consolidating pressure. In order to avoid damage to layer 12 of the electrophotographic plate, and hence preserve it for future use, it is generally desirable to use the minimum pressure necessary to consolidate the layers and permit their removal from the plate 10 as a unitary layer. With metal and ceramic powders it may be desirable to incorporate a molding aid in the powder of layer 15, and in some cases also in layer 13, to facilitate molding. Thus 0.5% of camphor, zinc stearate, paraffin, or other heat volatile material may be mixed with the powder. After pressing, the pressed plaque is carefully removed from the plate 10 and frame 14. Figure 3 shows a completed plaque 19 comprising the powder image 13 embedded in and consolidated with the pressed layer 15 of backing powder material.

In most cases it is desirable to improve the bonding by the application of heat. If plastic molding powders are used, and in some cases when metals having a low sintering temperature are used, heating is preferably combined with the pressing operation by heating platens 16 and 18 of the press and maintaining pressure on the powder layers for a sufficient period to enable them to become heated to the preferred molding temperature.

Figure 4 illustrates a furnacing step which may be used supplemental to the pressing step. In this instance the plaque 19, which has been pressed, with or without the application of heat during pressing, is placed in electric furnace 20 and heated to sintering or fritting temperature, after which it is allowed to cool.

When water setting powders are used for layers 13 and 15, they are consolidated by hydration. Thus, when plaster of Paris is used, the upper surface of layer 15 is smoothed off and a quantity of water is carefully poured onto the upper surface of layer 15 in such a manner as to permit it to penetrate layers 15 and 13. The layer is then permitted to stand until hardened.

Figure 5 illustrates a modified pressing arrangement in which the powder image 13 is held on an insulating sheet 21 such as paper, cellophane, vinyl resin, cellulose acetate, ethyl methacrylate, phenol-formaldehyde resin, glass or other insulating material by electrostatic attraction.

According to one of the above-described methods of forming the image the sheet is first cleared of any resident electrostatic charges by passing it through a gas flame or by wiping the surface with a clean damp cloth or sponge. A metal or glass stylus is then used to draw or write on the surface to create an electrostatic pattern or image and powder is then deposited to form powder image 13.

Another method comprises forming a powder image on a first surface by any method, such as by the electrophotographic method of the aforementioned Carlson patent. Sheet 21 is then laid over the powder image. It is then charged by passing a row of electrically charged needles over the back of the sheet at a slight spacing from the sheet and discharging a corona discharge onto the sheet. This results in transferring the powder image to the surface of sheet 21 where it is electrostatically held.

Sheet 21, carrying powder image 13, is laid face up on a metal plate 22 and metal frame 14 is set on the sheet. Powder layer 15 is next sprinkled onto the sheet over image 13 and the layers are consolidated between press platens 16 and 18, using pressure plate 17 over layer 15. If a subsequent sintering or fritting step is used, sheet 21 may be allowed to adhere to the plaque surface when the plaque is placed in the furnace, it being burned off during furnacing.

Figure 6 shows a plate useful for producing several plaques of similar design. A smooth metal base plate 23 is provided with an image 24 of insulating material bonded thereto. This may be applied by a printing process or by fusing a resin powder image onto the plate. This plate can be used repeatedly in making plaques by the following method:

The surfaces of image areas 24 are electrically charged by frictionally rubbing the surface of the plate with a clean brush or cloth or by passing the plate under a row of corona discharge needles. Powder is then deposited on the surface where it will adhere to the charged insulating areas to produce powder image 13. The layer of backing powder is then deposited and the two layers consolidated in the manner previously described.

In Figure 6, layer 24 is shown substantially raised above the surface of plate 23 for convenience of illustration. In practice the thickness of layer 24 may be so small that plate 23 and layer 24 present a substantially smooth face on which the powder is deposited.

An advantage of the method of the present invention resides in its simplicity and convenience of operation and in its accuracy in rendering fine detail. Due to the electrostatic adhesion of the powder image to the insulating surface during the deposition of the backing powder it is not dislodged or the image distorted. No mechanical means are required to hold the powder image, such as dies or forms to keep the powder in place. When the electrophotographic method is used it is possible to copy any desired design or photograph, the pressed plaque being obtained in a few minutes or less.

Different powders which may be used for producing layer 13 adhere to the electrostatic image with varying degrees of adhesion, apparently due to their surface electrostatic or tribo-electric properties. In order to insure good adhesion in all cases it is desirable, with some of the powders, to coat each powder particle with a thin layer of another material of the desired properties.

An extremely thin layer only a few molecules in thickness is sufficient. One method of applying such a coating comprises washing the powder in a dilute solution of a coating material. Thus, a metal or ceramic powder may be washed in a solution of 0.1 to 0.5 of 1% of an asphaltum, such as Egyptian asphalt, Utah gilsonite or manjak in naphtha or another volatile solvent. Excess liquid is drained off and the powder is continuously tumbled until dry. A solution of 0.5 of 1% of zein in a mixture of 80% alcohol and 20% water may also be used. Resins such as rosins, copal and ethyl cellulose in volatile solvents are also satisfactory. Many metals and most ceramic and synthetic resin powders may be used without this pre-treatment.

In addition to the examples contained in the preceding description the following are specific examples of the process:

Example 1

Gold powder is passed through a 300 mesh sieve and is then washed with a solution of 0.2 of 1% of rosin in acetone. Anthracene-coated electrophotographic plate **10** is electrostatically charged by passing it under a row of corona discharge needles. It is then exposed in a camera or by contact printing to a positive image such as a photograph, line drawing or printed text. The gold powder is then sifted over the surface and the excess gently blown away to leave the electrostatically adhering gold powder image. The plate is enclosed in frame **14** and a layer of 300 mesh silver powder sprinkled over the entire surface to a depth of 20 mils. Polished steel plate **17** is laid over the loose powder layer and the layers are consolidated in the press at a pressure of 10 tons per square inch. The anthracene coating of plate **10** and the considated powder become bonded together to some extent during pressing. The assembly is then placed in an oven which is slowly heated. When a temperature of about 140° C. is reached the anthracene layer begins to sublime and is soon entirely dispersed leaving the plaque loosely resting on plate **11**. Plate **11** can now be removed and the plaque is placed in furnace **20** and sintered to insure the bond. A temperature of 700° to 900° in a hydrogen furnace for a few minutes is generally satisfactory. After cooling and polishing the metal photograph or nameplate is ready for use.

Example 2

An electrostatic design is formed on a thin sheet of polystyrene by marking it with a rounded end of a metal or glass rod. The surface is dusted with a finely powdered colored commercial glaze to develop the charge pattern, the excess powder being blown off. A white glaze, or one of contrasting color, is then sprinkled over the entire surface. A tablet of worked and wedged damp clay is carefully laid on the powder layer and then pressed down onto the powder. The assembly is dried and placed in the kiln for firing.

Example 3

An electrostatic pattern on an electrophotographic plate, or on the plate **23** shown in Figure 6, or formed on an insulating sheet as described in Example 2 is developed with finely divided colored cellulose acetate (or ethyl cellulose) powder, then the powder is transferred to a transparent cellulose acetate (or ethyl cellulose)

film by placing the film over the powder pattern and passing a row of corona discharge needles over the back of the film to charge it. The film is then placed in the bottom of a recess in a plastic molding die and cellulose acetate (or ethyl cellulose) powder of contrasting color is sprinkled over its surface to a depth of ¼ inch or so. A piston is then brought down and the die heated to the molding temperature to consolidate the sheet with both powder layers.

Example 4

A dyed hard wax powder, such as cerese wax or hard paraffin, issued to develop the image and uncolored wax used for the backing powder, the procedure being similar to Example 3. The cellulose sheet may be peeled off after molding.

With wax powders, certain thermoplastic resins, easily sintered metals, and certain glasses or glazes, it is sometimes possible to consolidate the powders by heat alone, the loose powder layers being placed in an oven or furnace without pressing.

In some cases it is also possible to place a solid backing plate against the upper powder layer and consolidate the plate with the powder. Thus, in Example 2, enamel powders can be used and a metal plate, carrying foundation coats of "gray" and "white," is pressed against the composite powder layer. The enamel is then baked or fired onto the plate.

Designs in multiple colors can be produced by transferring several powder images of different colors to the same backing sheet.

Within limits the designs can be applied by the methods described herein to the production of irregular or non-plane objects, such as ornamental dinner plates.

It is also possible to combine powder layers of very different composition. Thus a silver powder design can be consolidated with a backing layer of ceramic powder, steatite, or an enamel and fired. This affords a convenient method of making a plate carrying "printed" electric circuits, the fired silver lines serving as electrical conductors.

The process is versatile, and requires a minimum of equipment since no dies pattern are required to form the designs. The strong electrostatic adhesion of the powder image to the supporting sheet retains the image intact during application of the backing powder layer.

While the present invention, as to its objects and advantages, has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. The method of making plaques and the like, which comprises forming a pattern of a first powder on a surface, transferring said powder pattern to an electrically charged sheet, depositing a second powder on said sheet over said first powder and consolidating said powders.

2. The method of making plaques and the like as claimed in claim 1, in which said powders are consolidated by pressure.

3. The method of making plaques and the like as claimed in claim 1, in which said powders are consolidated by heat.

4. The method of making plaques and the like as claimed in claim 1, in which said powders are consolidated by pressure and heat.

5. The method of making plaques and the like

as claimed in claim 1, in which said powders are composed substantially, of water-setting material and are consolidated by wetting with water.

6. The method of making plaques and the like as claimed in claim 1, in which said powders are composed substantially of plaster of Paris and are consolidated by wetting with water.

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