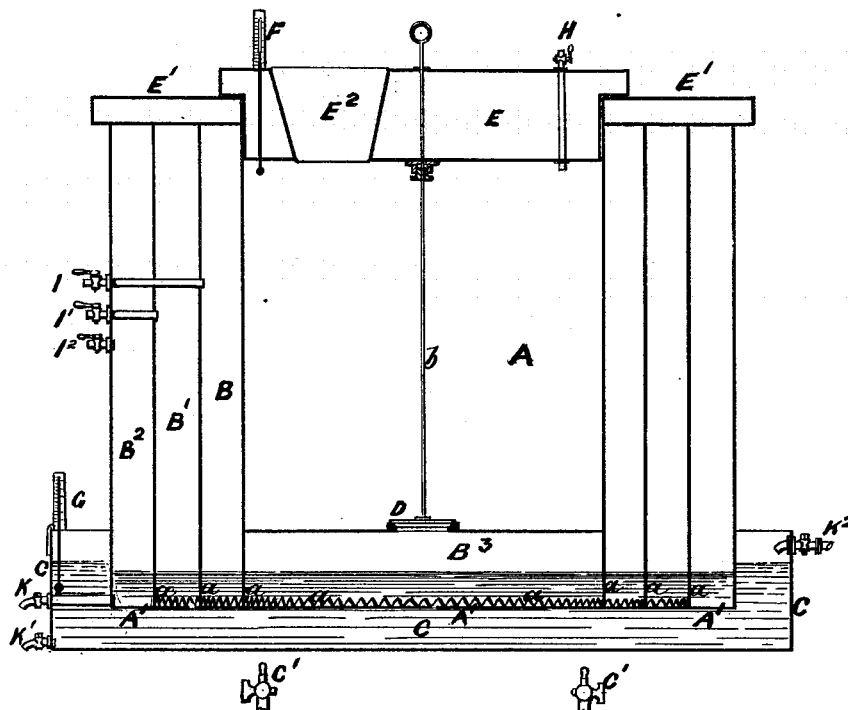


G. H. SMITH.
 Apparatus and Process of Fixing Colors.
 No. 221,428. Patented Nov. 11, 1879.



Witnesses
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UNITED STATES PATENT OFFICE.

GEORGE HAND SMITH, OF SOUTH KENSINGTON, COUNTY OF MIDDLESEX,
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IMPROVEMENT IN APPARATUS AND PROCESSES OF FIXING COLORS.

Specification forming part of Letters Patent No. **221,428**, dated November 11, 1879; application filed May 1, 1879; patented in England, March 29, 1878.

To all whom it may concern:

Be it known that I, GEORGE HAND SMITH, of South Kensington, in the county of Middlesex and Kingdom of England, doctor of medicine, have invented improvements in the application or production of colors, marks, or designs to or in materials or articles of mineral, animal, or vegetable substances, and the apparatus or means employed therein, of which the following is a specification.

My said invention relates, chiefly, to the sinking or fixing of colors and marks or designs in color in or upon and under the surface of mineral, animal, and vegetable materials, such, for example, as marble, stone, baked clay, bone, ivory, wood, wool, jute, and the like.

It consists in the impressing upon or painting in the usual manner of colors or marks or designs in colors upon the surface of the material or article to be treated, and then subjecting the same to the action of heat and vapor, as hereinafter described, whereby the color or design is caused to penetrate and be fixed upon and under the surface to an extent depending upon the duration and condition of the treatment. The surplus color, if any, is subsequently washed away or removed, leaving the design unaltered and fixed upon and in the object, article, or material operated upon.

It also consists in fixing the designs, marks, or colors by the aid of a corrosive agent applied before the article or material is acted upon by heat and vapor.

In carrying out the process of sinking or fixing the color or design, I employ apparatus such as is hereinafter described, or apparatus so constructed as to be capable of being used in a like manner to produce like results.

One form of the apparatus which I use (and which is illustrated in sectional elevation in the accompanying drawing) is constructed and arranged in the following manner:

A is an inner chamber or holder, constructed of galvanized iron or other suitable substance of a sufficient size for the materials or articles to be treated, which holder is surrounded by a series of chambers or heat-cells, B B' B², arranged the one outside the other, and com-

municating the one with the other by means of openings *a* in the lower parts of their sides, and those of the lower central chamber, B³, at their lower ends, as shown at *a*.

By using a series of heat-cells the temperature in the holder is more easily regulated, as the exterior cells prevent any sudden reduction of temperature or condensation in the one immediately surrounding the holder, and also any considerable loss of heat thereby from radiation.

The sides of the holder and the heat-cells rest on a common bottom, A', above which is a stratum of water or other suitable liquid, into which they dip, and which is heated by an external water-bath, C, or other equivalent bath, which, in turn, may be heated outside by the flames of the gas-jets C', or by any other convenient means. The bottom of the holder A is arranged at a suitable height, so as to leave a space between it and the bottom A'. The liquid circulates freely through the openings or apertures *a* made in the lower parts of the sides of the heat-cells B B' B² and the central chamber, B³; but its height should be above the level of the openings or apertures *a*, thus cutting off the connection from one heat-cell to the other, and from the cell B to the central chamber, B³, so as to prevent, when required, intercommunication of vapor.

In the bottom of the holder is a valve, D, carried on a stem or spindle, *b*, which passes through the cover E of the holder A, and by the act of operating which the valve D may be raised, and the vapor arising from the liquid underneath from the central chamber, B³, may be allowed to enter the holder. The cover E, which is arranged to fit tightly, may be covered or lined with felt, or felt combined with vulcanized india-rubber, or, where high heats are used, non-conductors that are heat-resisting should be used, in order to prevent the radiation of heat. The heat-cells B B' B² are also provided with a hollow cover, E', which, in like manner, may be lined with felt covered with vulcanized india-rubber, or otherwise protected by non-conductors of heat, so as to prevent the radiation.

The holder A and the bath C are fitted with

thermometers F G, respectively, for the purpose of enabling the temperatures to be regulated; and cocks H I I' I² are provided, in connection with the holder A and heat-cells B B' B², respectively, for emission, when required, of surplus vapor or steam. A cock, K, is also provided, in order to enable the water or other liquid to be drawn off from the bottom, A', and the bath is also fitted with cocks K' K², through which, respectively, the water contained in the bath may be drawn off and water admitted, so as to enable the temperature to be rapidly regulated when required.

Instead of employing water, it may be sometimes found advantageous, having regard to the articles proposed to be treated, to employ alcohol or ammoniacal or other liquids, wholly or in part, instead of water. It will be obvious that in such cases the perforations made in the sides of the cells may be advantageously dispensed with.

In the place of the heat-cells B B' B², it may be found, in some cases, desirable to surround B² and the holder A with walls of material that will prevent the radiation of heat.

In order that my process may be understood, I will describe a mode of carrying it out that will be practically successful, although the degree of temperature, the forms of the apparatus, and other details may be varied. I find apparatus such as is hereinbefore described may be used with great success.

Materials or articles having upon their surfaces any required design formed by impressing thereon colors or pigments in any suitable manner are treated as hereinafter described, so as to permanently fix the designs in or upon the articles.

The materials or articles to be treated are placed in the holder A through the door E², with which the cover E is provided, and the door is then closed, the vapor-supply valve D being maintained in its seat so as to cut off all communication between the holder and the liquid for generating the vapor contained in the bottom A'. Heat is then applied to the bath C, and the temperature is raised quickly or slowly, according to the nature of the material or article to be treated. The temperature of the materials or articles contained in the holder will rise with less rapidity than that of the vapor surrounding them, and the liquid generating the vapor is again colder than the bath C.

When the materials or articles in the holder and the holder itself have both attained as nearly as possible the same temperature of about 100° Fahrenheit, (the vapor outside having a temperature slightly in excess of 100° Fahrenheit,) the valve D is raised or opened and vapor is allowed to enter the holder. The liquid in the bath C is then gradually heated up to, say, about 212° Fahrenheit, whereby a difference of temperature between the vapor in the holder and the objects contained therein is maintained, such difference increasing or decreasing in proportion to the rapidity or other-

wise of the ascent of the temperature, so that the condensation of vapor may be thus controlled at will. The temperature is then diminished, either quickly or slowly, by turning down the gas-jets C', and by allowing a flow of cold liquid into the bath C through the cock K², according to the nature of the material or articles under treatment, but still maintaining the relative difference of temperature in order to avoid a heavy condensation of vapor upon the said materials or articles.

The valve D may be wholly or partially closed before or during the lowering of the temperature.

The differential action thus set up may be repeated any required number of times, and when the operation (the duration of which will depend upon the depth of penetration required for the design upon the articles) is completed the design will be found to have been fixed upon or sunk into the substance of the material or article under treatment. The surplus color, if any, is then removed, leaving the design clearly defined and the luster of the material treated wholly unimpaired.

The indications for the degrees of temperature and for the general conduct of the operation hereinbefore given are more particularly suitable where designs with clearly-defined and sharp outlines are required. Where these results are not required—as, for example, in sinking color without a defined design—the difference of temperature between the materials or articles and the surrounding vapor may be greater, and the temperature may be raised more rapidly. The precise general conditions suitable to each case are easily ascertained by experience in working my invention.

When, from the nature of the materials under treatment, it is required to operate at a more elevated temperature than 212° Fahrenheit, the apparatus is so constructed as to be steam-tight and to sustain the pressure to which it may have to be subjected.

If desired, the pressure may be varied while the temperature remains constant; or the pressure and temperature may be varied simultaneously. In either case the desired regulated condensation is obtained.

In the treatment of stone—such, for example, as marble—I use metallic or other colors which do not injure the composition of the stone.

When applying my said invention to the production of marks, patterns, devices, or designs in or upon metals, glass, or other materials, I proceed as follows: I place the design upon the article of metal, glass, or other material, with any suitable agent corrosive to the same—such, for example, as acids or corrosive salts—which may, after application, be rendered sufficiently dry, either alone or by the addition of any suitable powder which will give the requisite dryness, and I then introduce the article into the holder A and operate in the manner hereinbefore described, the apparatus being heated

until the materials or articles in the holder and the holder itself have both attained a temperature of, say, 100° Fahrenheit, (while the vapor outside has a temperature slightly in excess of 100° Fahrenheit.) The valve D is then opened for the admission of the vapor into the holder A, whereby action upon the design is set up, after which the temperature of the liquid in the bath is raised to, say, 212° Fahrenheit, the temperature of the holder and of the material or article contained within the same being maintained slightly below that of the vapor, and the temperature is then again diminished, as before described. The differential action is, if necessary, repeated one or more times, the operation being continued until the design (the original character or qualities of which remain unimpaired) has sufficiently penetrated into the materials or articles under treatment.

If desired, in place of the design being imprinted, it may be cut out of asbestos or other suitable cloth or fabric which may be capable of absorbing and retaining the said corrosive acids or salts, the said design being then applied to the metal, glass, or other material; or the metallic or other surface may be covered with a thin layer of varnish capable of resisting the corrosive action, as in etching, and the design is then cut through the layer with a point, in the usual manner, and the corrosive substance is then applied. The article or material is then subjected to the action of the apparatus in the manner hereinbefore described.

Having now described and particularly ascertained the nature of my said invention and the manner in which the same is or may be used or carried into effect, I would observe, in conclusion, that what I consider to be novel and original, and therefore claim, is—

1. The process of fixing colors, marks, or designs upon various substances by heating the substance, having the color, mark, or design impressed, painted, or placed upon it, subjecting it to the action of vapor of a higher tem-

perature, and maintaining and regulating the difference in temperature to cause the fixing of the applied colors, marks, or designs without spreading, substantially as described.

2. In the process of fixing colors, marks, or designs upon various substances hereinbefore described, the method of maintaining and regulating the temperature of the vapor at a degree higher than that of the article upon which the color is to be fixed by gradually raising the temperature after application, substantially as set forth.

3. The process of fixing designs upon metals, glass, and other materials by the aid of a corrosive agent, the same consisting in placing the design upon the article with a suitable agent corrosive of the same, and then heating the article and subjecting it to the action of vapor of a higher temperature, substantially as described.

4. An apparatus for use in fixing or sinking colors or designs upon materials, consisting of an inner chamber or holder surrounded on the sides by heat-cells, a central liquid-chamber adapted to be put in communication with the holder through a suitable valve, and means for raising the temperature of the liquid in the said central chamber, substantially as described.

5. An apparatus composed of a series of concentric heat-cells, an inner chamber or holder, and a central liquid-chamber beneath said holder, and a bath, the said heat-cells and central chamber communicating with each other through apertures in their sides at the bottom, substantially as set forth.

In witness whereof I have signed my name to this specification in the presence of two subscribing witnesses.

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