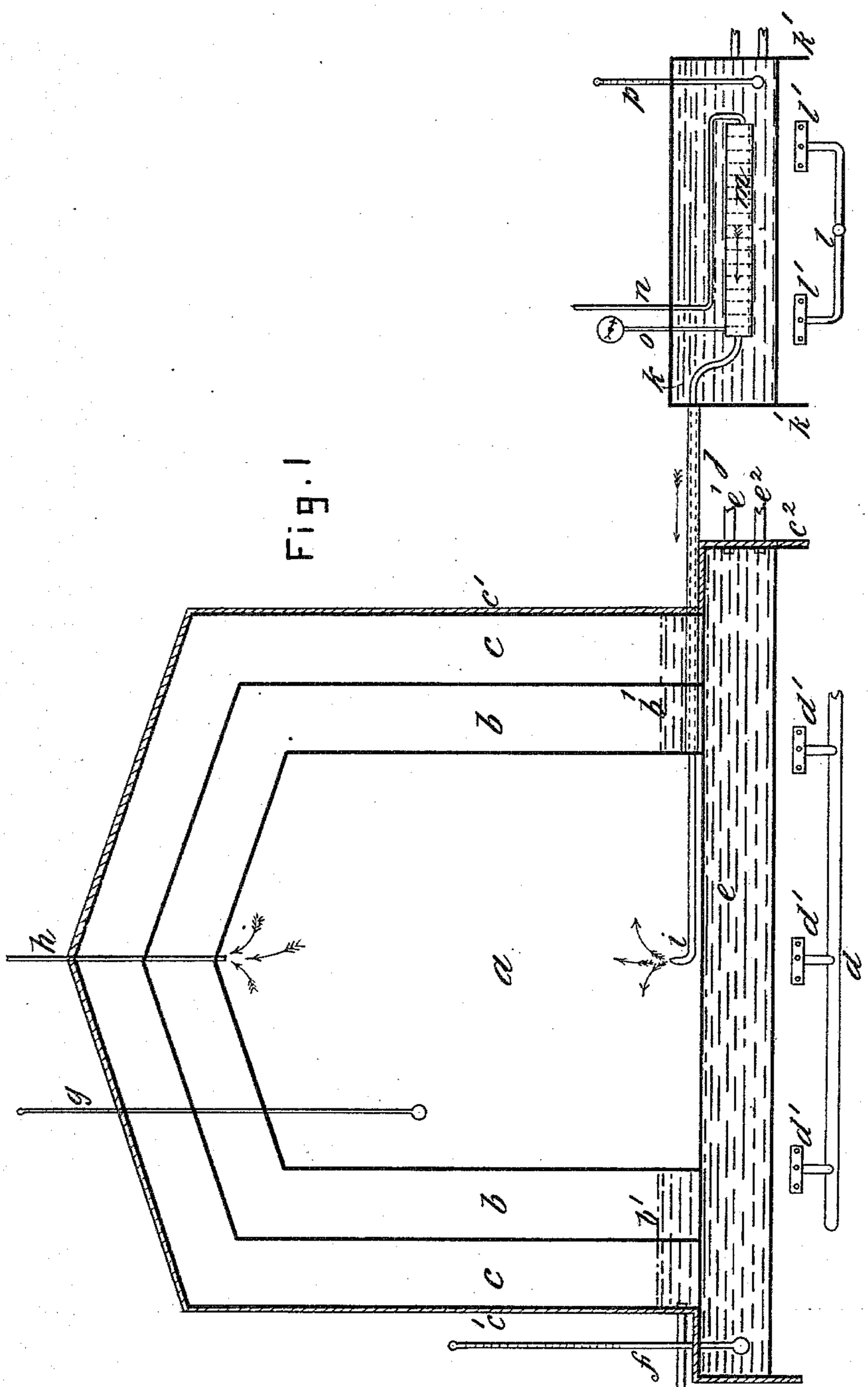
(No Model.) 2 Sheets—Sheet 1.

G. H. SMITH.

FIXING COLORS OR DESIGNS IN WOOD, MARBLE, &c.

No. 303,276. Patented Aug. 12, 1884.

Fig. 1



Witnesses
D. A. Lowe
E. H. Eakle

Inventor,
George Hand Smith
by John J. Halsted & Son
his Attys

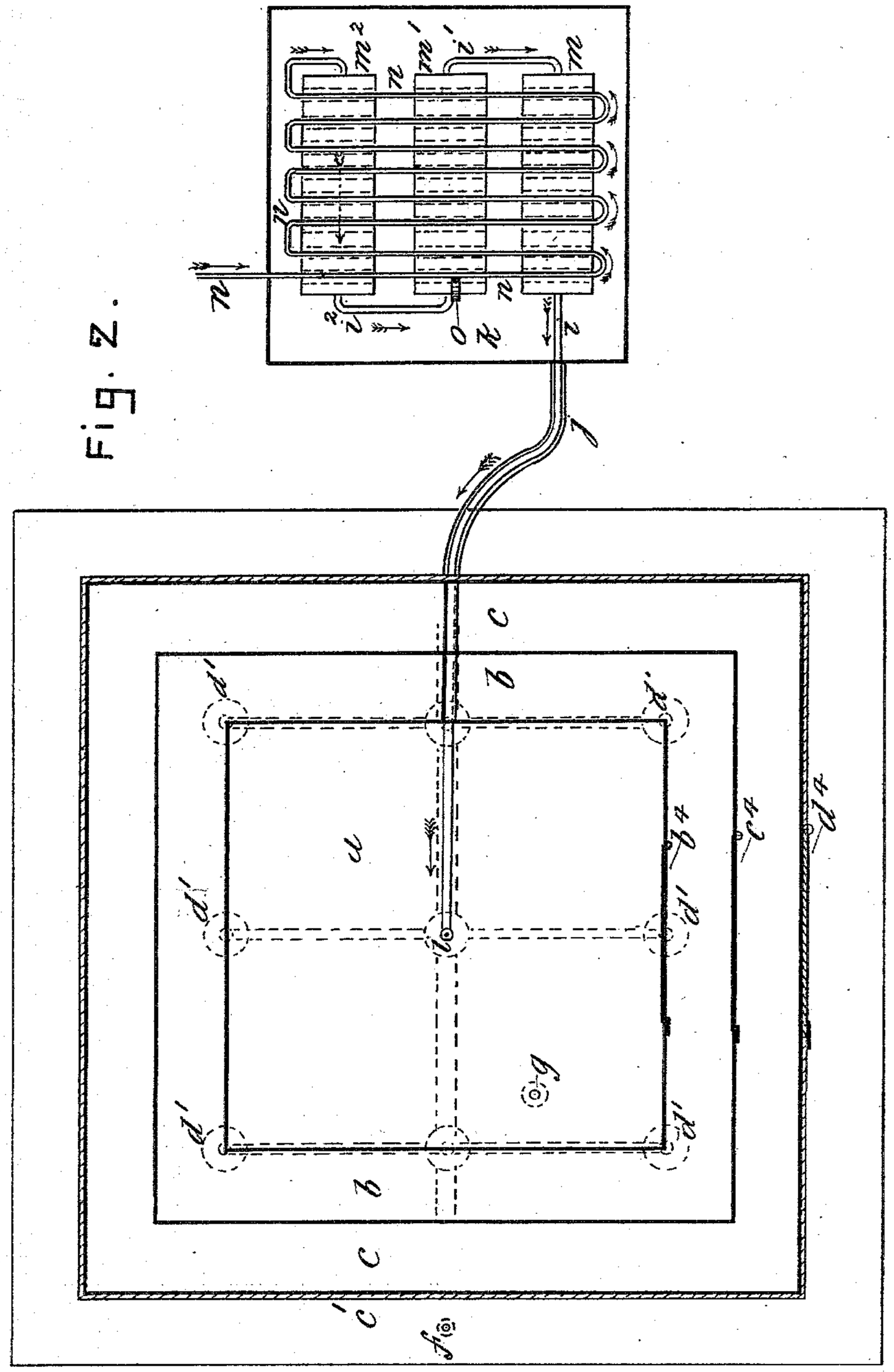
(No Model.) 2 Sheets—Sheet 2.

G. H. SMITH.

FIXING COLORS OR DESIGNS IN WOOD, MARBLE, &c.

No. 303,276. Patented Aug. 12, 1884.

Fig. 2.



Attest:
D. Rowe
E. H. Eakle

George Hand-Smith. Inventor:
by John J. Halsted & Son
his Attys

UNITED STATES PATENT OFFICE.

GEORGE HAND SMITH, OF LONDON, COUNTY OF MIDDLESEX, ENGLAND.

FIXING COLORS OR DESIGNS IN WOOD, MARBLE, &c.

SPECIFICATION forming part of Letters Patent No. 303,276, dated August 12, 1884.

Application filed October 4, 1883. (No model.)

To all whom it may concern:

Be it known that I, GEORGE HAND SMITH, of Rochester, in the county of Monroe and State of New York, a citizen of the United States of America, temporarily residing at London, in the county of Middlesex, England, doctor of medicine, have invented certain new and useful Improvements in Sinking or Fixing Colors, Marks, or Designs into or on Marble, Wood, Ivory, and other Materials, and in apparatus employed therein; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to means of causing or inducing the sinking or fixing of colors or substances adapted to produce colors into or on marble, wood, ivory, and other materials, into which colors or coloring material can be sunk, either when applied first on the surface in lines, shades, or washes, or in other suitable manner.

Colors or coloring material are applied to the object to be treated according to my invention either by printing, painting, dipping, or in other suitable manner. That object is subjected, in the manner hereinafter described, to the action of heat and atmospheric air, to which sufficient moisture has been imparted; or, in place of atmospheric air so charged, other gases or vapors may be employed, as will be hereinafter explained. By this treatment with heat and an atmosphere highly charged with moisture or vapor, the color, marks or other designs upon the object is caused to penetrate into or under the surface of the object, and into the solid to a greater or less extent, dependent in great measure upon the duration of the treatment and the conditions under which it is applied. Any surplus coloring-matter which may be left on the surface of the object and not enter into the substance of the object may, if desired, be removed by abrasion or otherwise, leaving the subjacent color or marking constituting the design indelibly fixed and unaltered in itself. So also may portions of the substance of the object be abraded without interfering with the design.

In operation I place the objects to be treated (having already applied to them the colors or coloring-matters, designs, or markings) in a suitable chamber of copper or galvanized iron or other material adapted to the purpose, and of sufficiently strong construction, which chamber is accessible for placing, removing, and replacing the objects through suitable tightly closing or fitting doors. This chamber is surrounded on all its sides and upper part by a cell or cells, formed by surrounding inclosing walls and roofs of similar material to that of the chamber they inclose, with space between each for air and heated vapor or other gas to maintain uniformity of heat in the operating-receptacle, and I have found it conducive to good results to form each surrounding case or layer of air-space of uniform dimensions. The outer wall of all I construct strongly, and I incase it with wood or other suitable material, and to further aid the retention of heat I lag or stuff the intervening space between the coating and the outermost chamber-wall with suitable lagging, as hair-flock or other matters possessing such like properties. The bottoms of the chambers surrounding the innermost or operating chamber or receptacle for the objects are all formed by a tray or plate, down to which the walls of these cells or chambers reach and rest upon or, it may be, nearly reach to it; but where these walls rest on this bottom plate openings through their lower parts are left, so that liquid which is contained in that plate or tray, while sealing off the vapor of one cell from the next cell, may communicate throughout those chamber-bottoms freely; but the bottom of the operating chamber is formed above the liquid-surface. This tray or plate and the liquid supported by it is heated by a water bath beneath it, and this water bath is in turn heated by means of gas-jets disposed beneath it at suitable distances apart and in series or otherwise, controlled by a valve or valves or regulators, which may be arranged to operate automatically upon a determined amount of heat being developed or temperature reached in the water bath or operating-chamber. The wall which is outermost may be so continued down and over water-bath and tray as to inclose them. By these means the heat is in turn imparted by the gas-burners to the water-bath, thence to the tray of liquid; thence to the air-cells or surrounding chambers, and by

them to the inner and operating chamber or receptacle, by which also great uniformity of heat is secured with great economy, owing to loss by radiation being prevented, thus affording facility for the maintenance of a constant given temperature for a period adapted to the end in view.

In some cases I arrange the walls of the air-cells with doors or openings capable of swinging on hinges, or otherwise leaving accessible the receptacle for the objects to be treated, and through these openings that receptacle can be withdrawn by running it out on rails upon wheels attached to the lower or other part of such receptacle, the portions of the rails between the inner and outermost cell-walls being removable at will; or this chamber may be a fixture, and in either case it is accessible for charging and discharging by suitable tightly-closing doors. One great advantage attendant on the use of a removable receptacle is the facility for opening it away from the air-chambers, and without the danger of the moisture of the air therein condensing upon and injuring the designs or colors. The receptacle being charged, closed, replaced within the heat or air cells, and those cell-doors also closed tightly, communication to such receptacle is made by means of a suitable metal or other pipe regulated by a stop-cock or regulator of supply with another chamber or vessel, which may be made of copper or other suitable material, and of size adapted to the circumstances, but conveniently and generally formed long, narrow, and of moderate depth, inclosed perfectly on all sides, and provided with another pipe entering at the other or reverse end to the pipe connected to the operating-receptacle, or so arranged as to give the proper traverse of the air or other fluid through the saturator for effecting the desired saturation thereof with the contained liquid. In this vessel or saturator at short intervals are disposed a series of porous diaphragms or surfaces of cotton cloth or other porous absorbent material adapted to facilitate saturation of the atmosphere or fluid passing therethrough with the liquid supplied to such vessel and distributed by those surfaces. Proper distension of those surfaces is maintained by their being secured around the sides of the vessels and by dipping into the liquid to insure not only their being moistened by capillary attraction, but also that the passing air or fluid shall be saturated to the desired extent with such liquid as is driven into the vessel by one pipe or pipes, and passes out to the receptacle by the other or others. The amount of such moisture imparted to that air or fluid will, however, be mainly governed by and increase in ratio with the increase of temperature imparted to the saturating-box and its contents. To effect regulation of this temperature of this box or vessel, I find it convenient to locate it in the tray already mentioned and beneath the surface of the contained water therein, the outer or other heat-cell inclosing the whole; or a modification of these arrangements of saturating means may be employed.

The air supplied for passage through the saturator to the operating-receptacle may be obtained from a suitable storage-reservoir, gasometer, or other containing means, or be forced in by pump, bellows, or otherwise, as may be most convenient, with provision for adequate regulation by devices adapted to the purpose and well understood, and such air or other gaseous fluid is generally heated before being passed into the saturator. The receptacle being *in situ* and heated, as already described, the action takes place on the contained objects as follows: Upon the heated air in such receptacle reaching the desired temperature—say 140° Fahrenheit—the cock giving communication by means of the pipe to the saturator is opened, and the saturated air or fluid flows in under pressure from such separator, and at a temperature somewhat in excess of the receptacle and its contents, in consequence of the saturator-vessel being heated accordingly. The desired pressure of air or other gaseous fluid supplied should be maintained uniform.

It will be found in practice that the amount of moisture absorbed by the air or fluid forced through the saturator will be dependent on the temperature, the velocity of flow, and other conditions more or less conducive to the desired saturation. The pipe or pipes for the supply of the saturated air to the receptacle are provided with suitable orifices or other means of distribution either by subdivision or otherwise, and this saturated air, on entering the receptacle being released from pressure, expands, and consequent lowering of the temperature ensues, causing the temperature therein to assume the conditions favorable to action upon the colors of the designs or upon the coloring-matter to form such design or markings, causing their penetration or sinking into the solid of the objects in a remarkable manner. Experience easily determines the particular conditions of pressure, degree of temperature, and length of time for exposure desirable for the different substances treated. The surplus expanded air or other fluid resulting in the chamber or receptacle passes out by a pipe or channel provided with a valve or regulator adapted to control its scope.

In place of employing gas as the heating agent for the heating of the apparatus, I sometimes employ other heating agency—such as fire-heat—directly or through the medium of hot air or water, or otherwise.

Colors I have found to give good results in the production of designs in marble are obtained by heating coal-tar with one of the known volatile solvents—such as benzole—to separate the insoluble matter, and then evaporating the solvent more or less, according to circumstances of shade required, or the basic

salts of iron produced by partial precipitation with carbonates or oxides of the alkaline metals.

When producing designs in ivory, I have found ordinary aniline colors give good results. When simply coloring marble, I also find sulphate of iron to be a useful coloring material.

The herein-described process may be effected in a chamber or holder surrounded with non-conducting casing or walls other than air-cells such as described—such, for instance, as wooden or metal casing, lagged with non-conducting matters, adapted to maintain uniformity of the interior heated temperature. I obtain these results by the use of apparatus illustrated in the accompanying drawings, in which—

Figure 1 is a vertical section of the apparatus, only such details as are of the most ordinary and well-known construction and use in manner common with such details or subsidiary appliances being omitted, to avoid complication of the drawings. Fig. 2 is a horizontal section of the apparatus shown by Fig. 1.

Similar letters refer to similar parts in each view.

The goods or objects of marble, ivory, bone, wood, or other materials, hereinafter shortly referred to as the objects, are placed in the operating-receptacle *a* by being conveyed thereto through doors b^4 c^4 d^4, which, respectively, are formed in the walls of the chambers or surrounding heat-retaining cells *b* and *c*, which cells surround and retain heat to the receptacle *a* on all sides except the bottom thereof.

The chamber or receptacle *a* may be formed of copper, galvanized iron, or other material adapted to the purpose. Within these cells *b* and *c* is retained air or gas with moisture or vapor, so that uniformity of heat to the receptacle *a* is maintained during the operation. Beneath the chamber or receptacle *a* is a water bath, *e*, which bath is heated by a series of gas-jets, *d'*, supplied by pipes *d*, and these pipes are provided with suitable valves and pressure-regulators and indicators of the ordinary and well-known construction, and therefore not necessary to be shown. The water-bath *e* is provided with a thermometer, *f*, to indicate its variations of temperature. The temperature of the receptacle *a* in a similar way may be read off from a thermometer, *g*.

i is a pipe having a small contracted outlet-orifice at its point of delivery into the receptacle *a*, and this pipe *i* delivers air charged with sufficient moisture and under pressure into the receptacle *a*, so that expansion shall ensue, producing the proper condition of atmosphere in that receptacle *a* best adapted to effect the desired operation on the objects therein. The surplus expanded air can escape by the outlet-pipe *h*. The arrows show the direction of the flow of the moisture-laden air through the parts of the apparatus.

In order to insure the sufficient saturation of the air discharged into the receptacle by the pipe *i*, the air conveyed thereto is first treated in another portion of the apparatus to which that pipe *i* is in connection, and which portion I call the "saturator." The air to be charged with moisture enters the saturator-chambers $m^2 m' m$ in turn from a pipe, *n*, which receives its supply from any suitable constant source of supply. It may be a pump or gasometer-formed reservoir. The chambers m^2, m', and *m* are also connected by other connecting-pipes, i^2 and i'. The water *k* incases the saturator *m* and its supply-pipes *n*, and this water bath is heated by the gas-jets l', supplied by the pipe *l*. The curtains k' to these burners l' and the like curtains to the burners d' serve to detain the heated air.

b^2 is a pipe of supply for liquid to b', and e' is a pipe for supply of liquid to *e*. e^2 is the draw off. The pipe *n* is made to follow a serpentine course through the water bath *k* before entering the saturator-chambers m^2 m' m, in order to warm the air and increase its capacity for taking up moisture. The dotted lines in the saturator-chambers *m* indicate a series of porous diaphragms or surfaces of porous absorbent material—such as cotton-cloth—adapted to draw up moisture to such chambers m^2, m', and *m*, and deliver such moisture to the passing air, and sufficiently saturate it.

o is a gage or indicator of pressure within the chambers m m' m^2.

p is a thermometer to the water bath *k*.

j is a casing to the pipe *i*.

In place of the heating of both the baths *e* and *k* being effected by gas, other suitable modes of heating commonly known may be employed.

The operation with the apparatus is as follows: The receptacle *a* being filled with objects or goods, and heated by the water bath *e*, aided by the cells *b c* and casing *c'*, to the desired heat read off from the thermometers *f g*, and adjusted upon comparison thereof to, say, 140° Fahrenheit, a cock giving communication by means of the pipe *i* to the saturator is opened, and saturated air flows in under pressure from the saturator *m* at a temperature adjusted at a slight excess over that of the receptacle and its contents, and expansion of that air, on release from pressure, results, with consequent fall of temperature, producing the state of atmosphere most suitable to the penetrative action on the colors of the objects, and this condition is then steadily maintained until the treatment is complete.

I wish it distinctly understood that I do not steam or bake the colors into substances under pressure. Steaming would cause the colors to run and blur the design, and baking would dry the limited moisture required and stop the action.

I claim—

1. The described process of fixing colors or designs on marble, wood, ivory, or other materials, which consists in first applying the color or design on the surface of the material, and then causing it to penetrate or sink through or below said surface by heating it in-

a closed chamber, and then treating it while heated with atmospheric air or other gas or vapor under pressure, and charged with moisture and at a temperature slightly above that of the material, whereby undue deposition of moisture on the articles under treatment is prevented.

2. In apparatus for use in sinking or fixing colors, marks, or designs into or on marble and other materials by the action of heat and atmospheric air or its equivalent, as herein explained, the combination of an operating-receptacle, *a*, with heat-retaining cells thereto, water bath *e*, and its heating appliances, escape-pipe *h* for surplus air, air-supply pipe *i*, water bath *k*, with its heating appliances, saturators m^2 m' m, and heating-pipe *n*, with regulating and indicating devices, substantially as herein described, and shown by the drawings.

3. The combination of the air-saturating apparatus and heating devices *k*, *l*, *l'*, *m*, *m'*, m^2, and *n* with the connections with the heated receptacle *a*, as and for the purpose specified.

In testimony whereof I affix my signature in the presence of two witnesses.

GEORGE HAND SMITH.

Witnesses:
ALFRED DONNISON,
JOHN ALFRED DONNISON.