H. T. JUDSON.

PROCESS OF ORNAMENTATION.

APPLICATION FILED SEPT. 23, 1915.

1,235,037. Patented July 31, 1917.

Fig. 1.

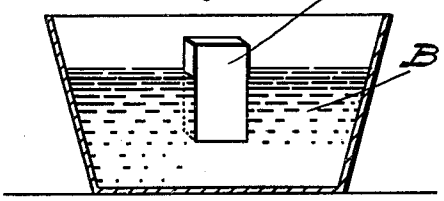


Fig. 2.



Fig. 3.

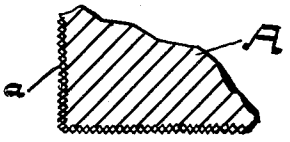


Fig. 4.

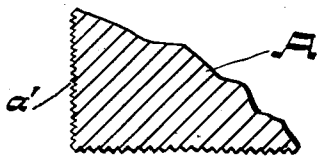


Fig. 5.

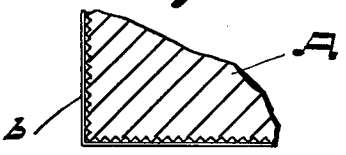


Fig. 6.

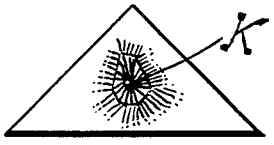


Fig. 7.

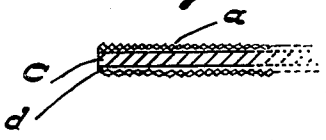
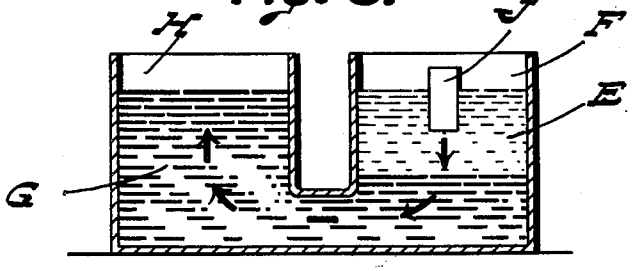


Fig. 8.



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UNITED STATES PATENT OFFICE.

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PROCESS OF ORNAMENTATION.

1,235,037. Specification of Letters Patent. Patented July 31, 1917.

Application filed September 23, 1915. Serial No. 52,286.

To all whom it may concern:

Be it known that I, HOWARD T. JUDSON, a citizen of the United States, residing at Leominster, in the county of Worcester and State of Massachusetts, have invented a new and useful Process of Ornamentation, of which the following is a specification.

This invention relates to a process of ornamenting, applicable either to the ornamentation of surfaces or to the ornamentation of the interior of solids of a transparent, or partially transparent character.

The invention relates to the production of a permanent ornamental configuration by the formation of crystals on, in, or partially in, the material that receives the ornamentation, and involves the production of such ornamentation in an exceedingly simple, inexpensive, expeditious and practical manner, and in a way which, in its broad aspects, is applicable to practically all kinds of solid substances. Although I have referred to it as a process of ornamentation, yet the invention is broader than that, as by it the surface of an article is changed so that it may have additional utility. For example, those materials made of pyroxylin dissolved in camphor or other solvent, generically termed "celluloids," may be provided with a surface which will readily take ink and constitute a good writing surface, irrespective of the ornamentation.

The invention is capable of being carried out in many ways, certain of which are shown in the accompanying drawings, in which—

Figure 1 is a sectional view showing a bath of liquid material in which a celluloid article is partially immersed and thus showing the first step of the process;

Fig. 2 is an elevation showing the same article after the crystallization has taken place;

Fig. 3 is a greatly magnified sectional view of the celluloid article showing the crystals thereon;

Fig. 4 is a similar view showing the same article after the crystals are removed;

Fig. 5 is a similar view showing an additional step that can be taken, namely, the covering of the celluloid with a protective coating;

Fig. 6 is a view showing the product of another way of carrying out the method in which the ornamentation is in the interior instead of on the surface;

Fig. 7 is a view similar to Fig. 4 showing the application of the invention to a sheet of paper; and

Fig. 8 is a sectional view showing another modification.

This invention depends upon taking advantage of the well known laws of crystallization. I have discovered that if a solid article is coated in any way with a solution of crystallizable substance or substances in a solvent which itself is capable of attacking the original substance so as to dissolve or soften the surface thereof, or if the solid article is coated with a crystallizable substance which itself is capable of softening the surface, and then the crystallizable substance or substances are allowed to crystallize, either by the evaporation of the solvent or in any other way, the crystals will form practically in the surface of the original substance and will constitute a surface ornamentation therefor. This, as above described, constitutes one species of this invention, but it can be carried further. For example, the crystals can be dissolved away from the surface in which they are embedded and it will be found that an ornamental and durable surface will be left, due to the imprints of the crystals, which does not depend upon the adhesion of any crystals or other foreign substance to the principal substance. This can be treated in other ways as will appear. This process, however, does not depend on the exact procedure just above specified, for the same principle can be applied in widely different ways. For example, the crystallizable substance can be mixed with the main substance in a liquid or a plastic state and the crystals formed within the body of the latter upon solidifying. Furthermore, it is not necessary to have the crystallizable substance originally

suspended or held in the solution for it can be suspended in a molten or plastic medium, it can be applied in a molten or liquid state, it can be deposited from its gaseous state, or it can be applied by making use of the laws of chemical combination.

With these general statements, indicating in some degree the scope of the invention, I will proceed to describe a specific procedure by which the process can be carried out and which also constitutes the preferred embodiment of the invention at the present time.

Referring to the first five figures of the drawings, A (Fig. 1) represents an article of transparent celluloid, which may have been cut, molded, or otherwise shaped and colored, if desired. I have shown a bath B consisting of commercial wood alcohol having urea dissolved in it. The commercial wood alcohol is capable of softening the surface of the celluloid by application thereto for a short period of time. The solution and article to be ornamented can be brought into contact by immersion, flooding, spraying, sprinkling, pouring, or in any other manner.

In the embodiment of the invention illustrated in Fig. 1, the celluloid article A is plunged into the bath of crystallizable substance and its solvent and left there a length of time, which is determined by the kind and character of ornamentation desired, and also the strength of the solution. A practical solution to be used is two parts of urea dissolved in nine parts of wood alcohol by weight, but of course the proportions can be varied within wide limits. With this solution I keep the celluloid in contact with the liquid for a period of time, varying from a few seconds up to three minutes or more. This can be done at ordinary temperatures, but I find that the temperature affects the time required to produce a certain result—the higher the temperature, the shorter the time necessary.

During the contact, the wood alcohol penetrates beyond or within the surface of the celluloid, carrying with it the crystallizable substance into the softened outer portion of the celluloid. I have found that in order to produce certain effects, it is advantageous to include in this solution a certain amount of celluloid or other thickening material, this of course being dissolved in the wood alcohol with the other substance. This causes a larger amount of the solution to adhere to the celluloid articles after they are removed from the bath.

The celluloid is then removed from the solution and the crystals are produced in various ways, as for example, by the evaporation of the solvent, by the lowering of the temperature, by the application of a substance which precipitates or causes the crystals to form or by any two or all three means, or by the absorption of the solvent into another medium in which the crystallizable substance is not readily soluble. I find that benzol causes the crystals to form from this solution. Also the solvent can be absorbed by chloroform or castor oil. This does away with the difficulty due to atmospheric moisture. I prefer simply to evaporate the solvent from the surface of the celluloid. I find that if the article is chilled, small crystals *a* are formed, starting at many points near together and extending out to meet those from the neighboring points. The effect is substantially as indicated in Fig. 2, but in this particular case the crystalline lines or rays are shorter and perhaps more uniform. I find also that a strong current of air or of other gas will produce a similar effect. On the other hand, if I keep the article warm and allow the evaporation to proceed more slowly by excluding currents of air, or allow the evaporation to proceed in an atmosphere somewhat charged with the vapor of the solvent (wood alcohol) crystals will start from fewer points, that is, from points farther apart. Consequently the crystal needle must extend a greater distance before meeting with other crystals and thus a different effect is produced.

I have found that I can start the crystals at any point or line by touching the surface at that point or along the line, by directing a jet of compressed air on the point, and in other ways, for example a stone, or brilliant, previously set in the celluloid will spontaneously form a starting point for the crystals which will arrange themselves as rays around it. Thus by various means it is possible to control the markings and produce them as desired. If the surface is touched at a point the crystals will start out in all directions from that point, but if a line is drawn the crystals will form approximately perpendicular to the line. Thus it is possible to draw or stamp a pattern in points or in lines upon the surface and have the crystals fill in the pattern.

Although the starting points of the crystals can be controlled and their limits and directions also, yet it is not necessary to provide any such control, and in any event, the formation of the crystals is self-arranging after they are started and until they are stopped. I find also that the presence of much moisture in the air or in the gas surrounding the evaporating solution will have a material effect upon the appearance of the crystals. As this effect is generally detrimental, I prefer to carry out the evaporation in a substantially dry atmosphere. For this purpose I prefer to remove the

moisture by condensing it or by absorbing it in desiccating substances. For the production of certain effects I use in mixture with the urea solution, substances that retard the evaporation or that hinder the mixture of moisture with the solution, as for example, amyl acetate.

It will be noted that the article as so far described, is provided on its surface with crystals *a* of urea. This may end the process if desired and the article can be used in this state. However, I prefer to remove these crystals entirely from the surface, preferably by dissolving them in water and rinsing. Then after drying, the article (Fig. 4), instead of having projecting crystals lying along its surface, has a number of markings *a'* in the form of cells, grooves, channels, furrows, etc., constituting the exact imprints of the surfaces of the crystals. As compared with a surface formed of actual crystals, these imprints are, of course, more permanent as they cannot be removed by any solvent that does not dissolve or soften the surface of the material on which the ornamentation is placed and there is no danger of their mechanical disengagement. This surface constitutes a good writing and printing surface. These markings can be filled with some contrasting substance if desired, as water glass, colored or not, thus modifying the appearance.

For many articles the process can be stopped here, as a permanent ornamentation is provided by this means. However, for some uses I apply a coating of viscous varnish or similar transparent, or substantially transparent, coating which assists in preserving the ornamental surface. This coating can also be applied directly over the crystals *a* if the article is to be used without removing them.

In this connection a modification of the method may be mentioned. According to this modification, after the crystals are formed, time is allowed for further evaporation of the solvent and then a coating of thin lacquer or other material, so composed that it will not dissolve away the crystals, is applied. I have used one having only from two to ten per cent. of solid material and the rest volatile. After this thin coating has dried to a sufficiently firm condition, I dissolve away the crystals by a prolonged application of water. Of course in this case it is necessary to have the water reach the crystals through the surface of the lacquer. The lacquer after drying is either sufficiently porous to allow the water to penetrate or else the high points of the crystals come through the surface. Sometimes I also heat the article while using the water to hasten the dissolution of the crystals and obtain the desired appearance. Furthermore, the crystals can be wholly or partially removed or changed in form or composition by the application of solvent material or by heat or by application of a substance which effects decomposition or chemical change in the substance of the crystals or by any means or combination of means. After the crystals are wholly or partially removed the cells, grooves, channels or furrows can be filled or partially filled with another substance or with other substances than that of the crystals.

In the above description, I have referred to the ornamentation of a substance, as celluloid, which will itself be capable of being softened or slightly dissolved by the solvent of the crystallizable substance, but that is not necessary for the process can be carried out on such inert materials as paper, wood, metal, stone, clay, plaster, cement, fabrics, etc. For this purpose the sheet C (Fig. 7) to be treated may be first coated with a lacquer or varnish *d* of such character that it will be penetrated or softened by the solvent which is to be used, or by the crystallizable substance, or the mixture of the two. In other words, any material such as described in connection with the first example above given. A varnish made of celluloid, in solution is an example of a suitable material. After applying the varnish to the article to be ornamented, as for example a sheet of paper, I allow it to dry and I then have a material which, although having a basis of paper, is capable of being acted on throughout in the same manner as the celluloid in the first example. The crystals *a* may be the same as in the first case. It will not be necessary therefore, to describe this method in detail, as it has already been described and all the modifications herein mentioned are applicable to it. In actual practice, however, I frequently shorten and simplify the process. Instead of applying the varnish coating first, and afterward the crystallizable substance, I combine the two operations into one. I make one mixture of the varnish and the crystallizable substance and apply them at once. For example, I use a varnish made by dissolving urea and celluloid in wood alcohol. The crystals are formed and the same process, as in the first example, is carried out. It is convenient to roll up the paper and apply the solution progressively as it comes from the roll.

It will be understood, of course, that in any of these cases, it is not necessary that the substance that is being acted on be immersed in the solution and as a matter of fact when working on a large scale that will not generally be employed. Furthermore, if the material is transparent, as in the case of celluloid or glass, the ornamentation will preferably be placed only on one

surface, provided it is in the form of a sheet, as it would be readily observable from the untreated side, and in fact in the case of a practically transparent body it is difficult to tell on which side the ornamentation is located. In the case of paper or fabric, I find that the crystals can easily be dissolved and rinsed away through the same by the application of water to the back or untreated side, instead of through the last coating. On this account I am enabled to use a stronger and more waterproof coating on the front side and still thoroughly remove the crystals after this coating is hardened.

Although I have described certain specific ways in which the process can be carried out, I am aware of the fact that there are numerous modifications which are also practicable. Some of these I will mention. Referring to Fig. 8, a container is shown with two compartments connected near the bottom. The warm urea solution E is to be put into one compartment and will float above the oil G, it being of lower specific gravity. The oil is to occupy the lower portion of the first compartment F and the whole of the other compartment H. The article J is passed downward through the urea solution into the oil which is cooled at the bottom. When the article reaches the cold oil, the crystals form. The article is passed across into the other compartment and upward and out without again coming into contact with the urea solution. The oil which adheres to the article may be rinsed away with any solvent which does not damage the article, benzol, for example, or even with soap and water.

Instead of having the crystallizable substance dissolved in a solvent, there are other ways in which the crystals can be caused to form. For example, the crystallizable substance can be applied in a liquid or molten state and allowed to solidify. In this case the crystals will form in a similar manner but will give a different appearance in many cases. Again it can be deposited from its gaseous state and another modification is to form the crystallizable substance by a chemical combination directly on the surface to be treated or within the body thereof.

I have already described a way in which the ornamentation can be applied through the medium of a coating or film upon the article. Another modification of this method consists in the formation on the surface of a plate or die of the ornamental matter and then using this to transfer the ornamentation to the article to be ornamented. Such a plate or die can be provided simply with a coating which can be bodily removed and attached to another article, or it can be supplied with markings on its face by crystallization, constituting a matrix which can be impressed on a softer substance, a plurality of impressions being obtainable, or in fact the plate or die can be inked or supplied with some lustrous material as aluminum bronze in the furrows, and the ornamentation printed on another article. Electrometallic deposits can be made upon this crystal ornamentation and then backed up with solid metal. This can be used itself as an ornamental article or also as a printing surface.

Another important branch of this process consists in the ornamentation of the interior of a transparent, or partially transparent article. In this case the material of the article to be ornamented, the solvent and the crystallizable substance are melted up together, preferably to form a homogeneous mass, so far as the eye can determine, and then casting, molding, drawing, or otherwise forming during the act of solidification. In this case the crystals are free to form throughout the three dimensions, and solid crystals are thus formed within the interior of the article, thus in many cases producing most beautiful ornamentations. Preferably I use just sufficient solvent to keep the crystallizable substance in solution while the material is warm. Now if I allow evaporation of the solvent from the surface while the material is still warm, the first crystals will form at the surface and will spread across, at or close to the surface. Later, as the body cools and evaporation continues, other crystals form in the interior. These interior crystals K have less effect on the appearance of the body, as the outer crystals are in clearer view.

Now when I desire the effect of the interior crystals instead of the outer ones, I use still less solvent, so that a still higher temperature is required to keep the crystallizable substance in solution. I do not allow evaporation from the surface while the crystals are forming. I allow the body to cool slowly. If it is cooled rapidly the outer portion is cooled first and the crystals form first in the outer portion. But when the cooling is slow, large beauteous crystals form in the interior. During the subsequent seasoning of the body the solvent must come to the surface and escape. This action tends to bring crystallizable substance to the surface. When this occurs to such an extent as to impair the appearance, it may be removed with a buffing wheel after the seasoning is completed. I will not describe this in further detail but will say simply that the modifications which I have mentioned above all are generally applicable to this method except those which depend upon the presence of a surface for the application of the ornamentation, and that the ex-

tent of its usefulness is limited only by the fact that not all materials are capable of being molded up in this way and not all are transparent so as to permit of the ornamental effect when produced.

Instead of urea dissolved in wood alcohol, other substances can be used, as for example, sodium acetate dissolved in a mixture of acetic acid and wood alcohol. Mixtures of more than one kind of crystallizable substance can be used in combination, as for example, sodium acetate and urea in wood alcohol, or again, sodium acetate and glacial acetic acid. Aside from celluloid, other materials, such as varnishes containing resins, such as sandarac, dammar, collophony, mastic, turpentine and shellac.

Furthermore, by methods similar to those which I have described, I produce beauteous effects also with water solutions of crystallizable substances and with water varnishes. Examples of suitable water varnishes are those in which glue, gelatin or shellac are important ingredients and examples of suitable crystallizable substances are ammonium chlorid and magnesium sulfate.

As an alternative method of procedure I mention the following:—I make a varnish using for important ingredients, shellac, sodium carbonate and water. I apply this varnish to the article to be ornamented and allow it to harden. To this varnish I then apply acetic acid. Part of the acid unites with sodium and the excess acid passes off. The sodium acetate which results from this combination forms the crystals. The acid, I prefer to apply in the form of a vapor. The reaction liberates carbon dioxid which forms bubbles in the varnish. I allow the acid vapor to act upon the varnish long enough to soften the varnish sufficiently so that the bubbles easily break through the surface and are thus set free. Of course, if desired, some other solvent can be used in connection with the acid for this softening action, and to modify the rapidity of the reaction.

In adapting my process to certain crystallizable substances, I form the crystals directly from the liquid state of the substance, without the instrumentality of a solvent for the substance. The use of the crystallizable substance, glacial acetic acid, I mention as an example. Specifically, I provide a box or chamber in the interior of which I produce a low temperature by usual means of refrigeration. I apply the liquid glacial acetic acid to celluloid articles, allowing sufficient time for it to penetrate beyond the surface. I then put them into the cold chamber and the crystals of acetic acid form immediately. Then I rinse away part of the acetic acid with liquid benzol or with water or other suitable solvent, for the purpose of hardening the celluloid. After the rinsing, I allow the remainder of the acetic acid to season out and evaporate. According to yet another variation, I apply the crystallizable substance as a deposit from its gaseous state. For example, I cause the crystals of ammonium chlorid to be formed upon the moist surface of a water varnish by the deposit of ammonium chlorid from its gaseous state.

However the process is carried out the article is provided with a very attractive surface having crystalline characteristics according to the materials used and the procedure. This surface is substantially permanent, and the article can be used for many decorative, as well as other purposes. I find that such a surface takes ink well and consequently forms a good printing surface. Also the article can be colored in various ways to add to the ornamental effect.

Although I have described several ways of carrying out the process, I am aware of the fact that it can be carried out in many other ways, and with modifications and additions, without departing from the scope of the invention as expressed in the claims. Therefore, I do not wish to be limited to the details herein shown and described, but what I do claim is:—

1. The process of ornamentation, which consists in bringing into contact two substances, a solid one to receive the ornamentation and the other being crystallizable, and causing the second substance to crystallize in contact with the first one and penetrate its surface to form a permanent ornamentation by its crystallization.

2. The process of ornamentation, which consists in bringing two substances into contact, causing one of said substances to form large numbers of minute crystals naturally arranged in contact with and partially embedded in the surface of the other substance, whereby said crystals provide a permanent ornamentation therefor.

3. The process of ornamentation, which consists in applying to the surface of an article to be ornamented, a crystallizable substance in a non-crystalline condition and causing said substance to crystallize on and in the surface of said article to form a permanent ornamentation on said article.

4. The process of ornamentation, which consists in applying to the surface of a solid article, a crystallizable substance in a non-crystalline condition, causing said substance to crystallize on and within the surface of said article, and producing a plurality of regions thereon provided with crystals arranged around nuclei to constitute the ornamental surface.

5. The process of ornamentation, which

consists in applying to the surface of the substance to be ornamented, a crystallizable substance dissolved in a solvent and causing the solvent to be removed so that the crystallizable substance will crystallize on said surface to form a permanent ornamentation thereon.

6. The process of ornamentation, which consists in applying to the surface to be ornamented, a crystallizable substance in a liquid condition, softening said surface, and then allowing the crystallizable substance to crystallize on that surface, whereby the crystals will slightly penetrate the softened surface and form a permanent ornamentation thereon.

7. The process of ornamentation, which consists in applying to the surface of a solid body, a crystallizable substance dissolved in a solvent capable of softening said surface, and causing the crystallizable substance to harden and crystallize and thus penetrate the softened surface of said substance so as to form an ornamental crystalline surface thereon.

8. The process of ornamentation, which consists in bringing two substances into contact, causing one of said substances to form large numbers of minute crystals naturally arranged in contact with the other substance, and removing the crystals so as to leave an ornamental surface formed by the imprints of said crystals.

9. The process of ornamentation, which consists in applying to the surface of the substance to be ornamented, a crystallizable substance in a non-crystalline condition, causing said substance to crystallize on said surface, and removing the crystals so as to leave imprints of said crystals on said surface.

10. The process of ornamentation, which consists in applying to the surface of the substance to be ornamented, a crystallizable substance dissolved in a solvent, causing the solvent to separate so that the crystallizable substance will crystallize, and removing the crystals so as to leave an ornamental surface formed by the imprints of said crystals.

11. The process of ornamentation, which consists in applying to the surface of the substance to be ornamented, a crystallizable substance dissolved in a solvent, causing the solvent to separate so that the crystallizable substance will crystallize, removing the crystals so as to leave an ornamental surface formed by the imprints of said crystals, and covering the surface with a coating.

12. The process of ornamentation, which consists in forming crystals on, and penetrating partially within, an article having a celluloid surface.

13. The process of ornamentation, which consists in crystallizing of urea on the surface of celluloid.

14. The process of ornamentation, which consists in forming crystals from a solution of urea in wood alcohol on a celluloid surface.

15. The process of ornamentation, which consists in forming crystals from a solution of urea in wood alcohol on a surface, and then dissolving the crystals to leave their imprints.

16. An article of the class described having crystals of another substance embedded therein.

17. An article of the class described having crystals of another substance partially embedded in the surface thereof.

18. An article of the class described having the imprint of crystals of another substance on its surface.

19. An article of the class described having crystals of another substance embedded therein, and covered with a transparent layer.

20. An article of the class described having the imprints of crystals of another substance on its surface, and covered with a transparent layer.

21. An article having a celluloid surface and provided with ornamentation thereon formed by crystals.

22. An article having a celluloid surface and provided with ornamentation thereon formed by crystals of urea.

23. An article of celluloid having an ornamental formation therein consisting of crystals.

24. An article of celluloid having an ornamental formation therein consisting of crystals of urea.

In testimony whereof I have hereunto set my hand.

HOWARD T. JUDSON.