April 30, 1935. E. H. MERRITT 1,999,509

APPLICATION OF MATERIALS TO SURFACES

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Fig. 1.

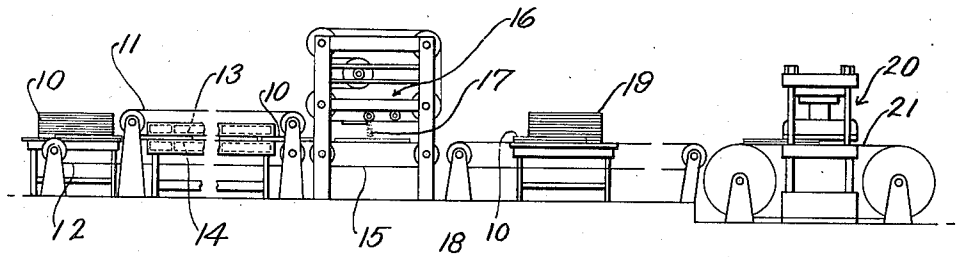


Fig. 2.

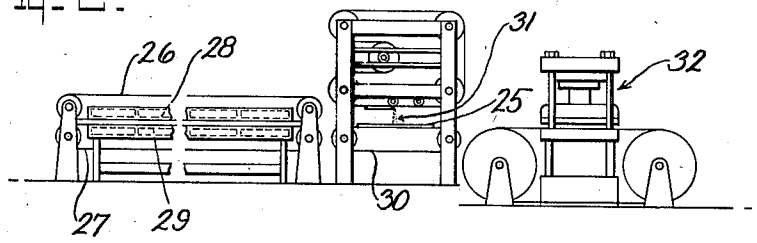


Fig. 3.

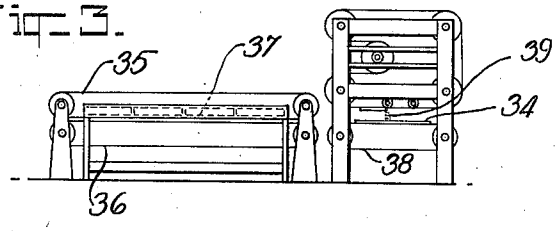
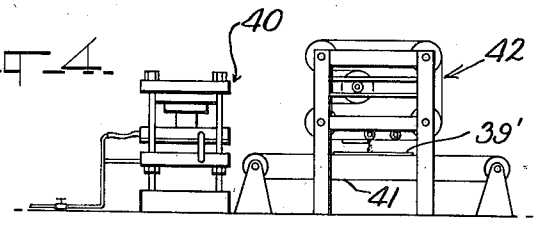


Fig. 4.



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Fig. 5.

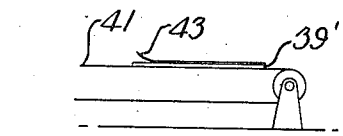


Fig. 6.

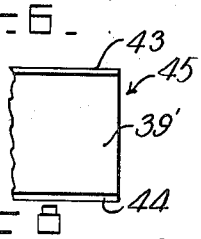


Fig. 7.

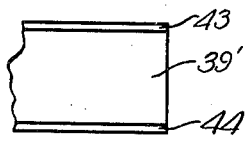
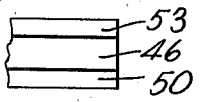


Fig. 8.



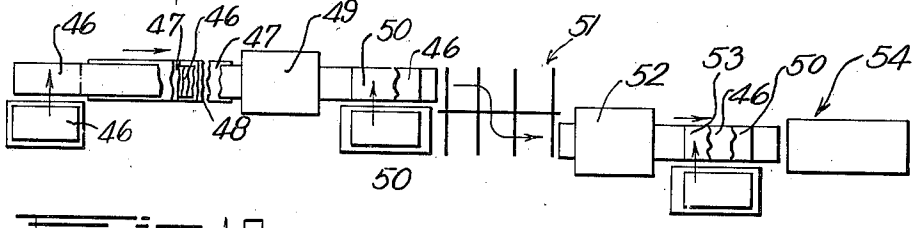
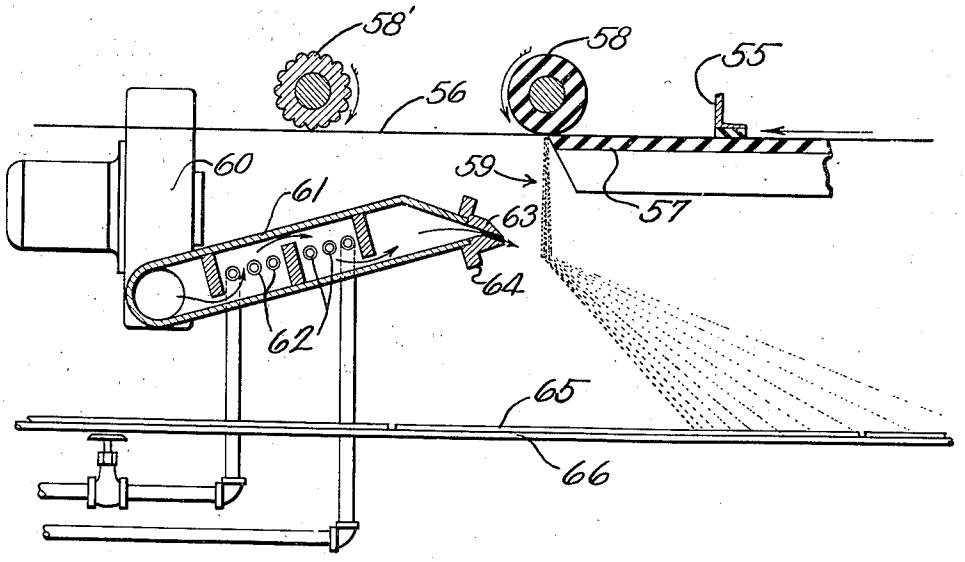


Fig. 10.



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Fig. 11.

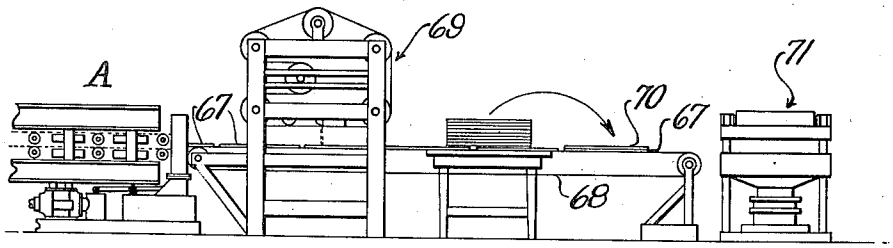
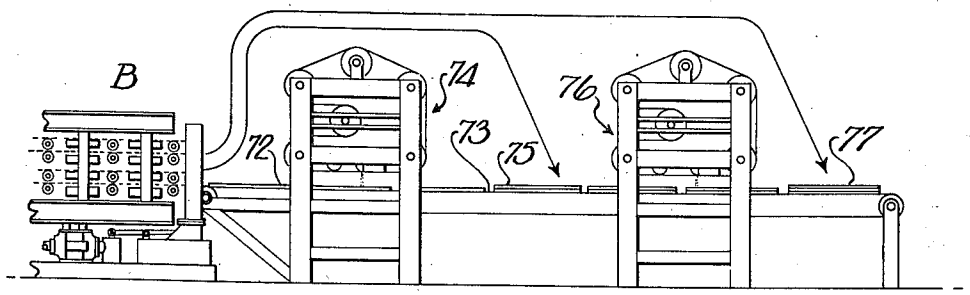


Fig. 12.



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UNITED STATES PATENT OFFICE

1,999,509

APPLICATION OF MATERIALS TO SURFACES

Ericsson H. Merritt, Lockport, N. Y., assignor, by mesne assignments, to Laminating Patents Corporation, Seattle, Wash., a corporation of Delaware

Application December 21, 1931, Serial No. 582,253

20 Claims. (Cl. 154—40)

This invention relates to the application of materials to surfaces and to correlated improvements and discoveries whereby and wherewith such application may be enhanced and wherein the use thereof is involved.

An object of the invention is the provision of improved methods and apparatus for the application of materials to surfaces.

A further object is the provision of an improved method of spreading surfaces in operations involving coating, bonding or analogous procedures.

A further object is to provide an improved method for applying heat-plasticizable materials to surfaces.

Another object is to provide an improved method for conducting bonding operations.

Another object is to provide improved methods for conducting coating operations.

Another object is to provide improved apparatus for the application of heat-plasticizable material to surfaces.

Another object is the provision of improved methods of forming composite bodies.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation and order of one or more of such steps with respect to each of the others, and the apparatus embodying features of construction, combinations of elements and arrangement of parts which are adapted to effect such steps, all as exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

Figure 1 is a side view of a form of apparatus for carrying out one form of procedure embodying the invention;

Fig. 2 is a side view of a form of apparatus adapted for carrying out another form of procedure embodying the invention;

Fig. 3 is a side view of apparatus for carrying out a procedure wherein only one surface of an article is heated;

Fig. 4 exemplifies apparatus for carrying out another form of procedure;

Fig. 5 illustrates a step involving a further modification;

Fig. 6 illustrates on a greatly enlarged scale a form of structure which may be produced by such a procedure carried;

Fig. 7 illustrates on a similar scale a form of structure which may be produced by carrying out a supplemental procedure;

Fig. 8 illustrates somewhat diagrammatically another form of procedure;

Fig. 9 illustrates on an enlarged scale a structure which may be formed by such a procedure;

Fig. 10 is a partly sectional side view of a form of apparatus embodying the invention and adapted for use in procedures such as contemplated by the invention;

Fig. 11 is a side view of a modified form of apparatus and illustrates a further form of procedure; and

Fig. 12 is a similar view illustrating a further modified form.

The application of a heat-plasticizable material to surfaces to be coated, to be united with other surfaces, or to be otherwise treated, is desirable in many instances. Furthermore, in a number of cases, the use of the material in powdered form is desirable for a number of reasons, including evenness and effectiveness of spread, and economy, efficiency and simplicity of procedure.

It is to be understood that the word "plasticize", together with its derivatives, as used herein, is intended to refer to conversion from a solid state to a plastic state and not to conversion from a liquid state to a plastic state.

In particular, resinous materials, i. e. materials of a resinous nature, such, for example, as phenolic condensation products and other heat-plasticizable synthetic resinous substances, are desirable for use in the coating of surfaces in many cases, and they also have highly desirable qualities when used to join two surfaces. It is desirable, moreover, in many instances, that no unnecessary amount of the resinous material, and that no unnecessary solvent, be used in applying the resin. Furthermore, all irregularities in the layer of resinous material are to be avoided in many cases, as, for example, when such irregularities will result in lack of uniformity in bonding or coating operation. For instance, unevenness in the layer of resinous material on the surface of porous materials may cause unevenness in penetration. Such irregularities may also cause differences in the effectiveness of the bond in various portions of a bonding plane, and unevenness in the appearance or wearing qualities of a coating.

Accordingly, it is desirable that a maximum of

uniformity be obtained and to this end it is desirable that a powdered material be evenly applied and that dislodgment of the applied particles be avoided so far as possible.

With the foregoing and other ends in view, the present invention contemplates heating particles of a synthetic resinous or other material of a heat-plasticizable character sufficiently to transform particles into an adherent condition sufficiently early in the procedure to avoid difficulties due to dislodgment of the particles.

Preferably, the particles are transformed into an adherent condition at least as soon as they are in position on a surface,— i. e. either before or substantially immediately after they reach the surface.

One type of procedure such as contemplated by the invention is the preheating of the surface so that the same may impart to a resin or other heat-plasticizable material sufficient heat to transform particles of the material into an adherent condition as they fall thereon. A form of such procedure is exemplified as used for the formation of plywood from veneer sheets or the like, in connection with the apparatus illustrated in Fig. 1. A series of plies indicated at **10** are passed one after another between metal belts **11** and **12**, each contacting with the surface of one of a pair of heated plates **13** and **14**. From the conveyor belts **11** and **12** the heated plies pass onto a conveyor **15**, by which they are carried beneath apparatus indicated generally at **16** whereby a cloud of powdered resinous material, for example, a partial phenolic condensation product in powdered form is disseminated as indicated at **17** and applied with substantial uniformity. A detailed showing of apparatus of this nature will be found in the copending application of Louis G. Merritt and Ericsson H. Merritt, Serial No. 542,257, filed June 5, 1931.

From the conveyor **15** the plies pass one after another onto a conveyor **18**, and while each is in transit thereon one of a series of additional plies **19** is disposed on its coated surfaces to form an assembly. These assemblies are then passed one after another into a press **20**—which may be suitably heated—by means of an intermittently operable conveyor **21** of any suitable type or by other suitable means, and sufficient heat and pressure, for example, applied for the bonding operation.

Another type of procedure embodying the invention and adapted for use in the production of coated articles is exemplified in connection with the showing in Fig. 2. A series of sheets **25** of composition board, for example, are passed between conveyor belts **26** and **27** in such manner that the upper surface thereof will be carried in proximity to heated plates **28** and **29**. Each sheet is thereupon carried by means of a conveyor **30** through a zone **31** in which a powdered heat-plasticizable substance is being disseminated by suitable disseminating apparatus **32**, and the sheet run into pressing mechanism **33** whereby the finished coating is produced.

In many instances it is unnecessary or undesirable to heat any portion of the article except adjacent to the surface to which the powdered material is to be applied. One such procedure is exemplified in connection with the apparatus illustrated in Fig. 3. Plies, such as indicated at **34**, are run between the conveyor members **35** and **36** and carried under a heated plate **37**, whence it passes onto a conveyor **38** by which it is carried through a zone **39** in which powdered heat-plasticizable material is disseminated. Thereafter the procedure, if not complete, may be continued in either of the exemplified manners or in any other desirable manner.

In this connection it may be noted that the amount of heat carried by the article may be varied considerably under varying conditions. It is preferable, however, in many instances, particularly in laminating, that the heat be sufficient to transform the upper particles of the layer of heat-plasticizable material into an adherent condition.

There is illustrated in Fig. 4 a simple form of apparatus whereby procedures such as contemplated by the invention may be carried out. One form of such a procedure is one whereby a laminated article comprising a central wooden core, and outer layers of paper may be readily produced. A single veneer ply **39'** is placed in a press **40**, the plates of which may be heated to a temperature of 370° F., for example, if a high melting point resin is employed, and kept therein for 15 seconds. Upon opening the press the hot sheet is placed on a conveyor **41**, and by means of disseminating mechanism **42**, a resin, such for example as phenolic condensation product, is spread on the veneer sheet in a suitable amount. The wood ply is removed from the discharge end of the conveyor and returned quickly to the in-feed end and turned over so that it is passed through the zone of a disseminated material a second time. In such a procedure the conveyor should be so constructed that the coating on the lower side is not unduly disturbed. Thin paper plies **43** and **44** (Fig. 6) are then applied to both surfaces of the veneer. Alternatively, and preferably in some instances, the sheet of paper **43** may be applied to the surface first coated, while the veneer ply is on the conveyor, as indicated in Fig. 5, and the sheet **44** similarly applied to the opposite surface after it is coated. After the plies **43** and **44** are in place, the assembly is again placed in the press **40** and maintained therein for thirty seconds, at a temperature of 370° F. and 200 pounds pressure per square inch to form a panel **45**.

If it is desired to surface the panel with resin, a panel such as **45**, formed as above outlined, for example, is, either upon removal from the press or at a later time, coated with resin on both surfaces. If there is an interval between the formation of the panel **45** and its subsequent treatment, the panel should be pre-heated in the press for 15 to 30 seconds. The resin is applied to both surfaces and the coated structure is again inserted in the press and pressure of 200 pounds per square inch at 370° F., for example, may be applied for one minute, and a coated panel such as exemplified in Fig. 7 produced.

In accordance with the invention, moreover, laminating or coating operations may be conducted in a continuous and effective manner at a relatively high speed. One such method is exemplified in Fig. 8 as adapted for the formation of plywood or other laminated structure. A series of plies **46** are run through pre-heating mechanism comprising heated plates **47** and **48**, thence under a disseminating mechanism **49** after which a ply **50** is placed on each coated ply, the partial assembly turned over by reversing mechanism **51**, and moved under a disseminating mechanism **52**, after which a ply **53** is placed thereon, and the assembly moved into a press **54**. If desired, the plies **50** and **53** may be heated before being put in place, or the upper surface of the ply **46** may

again be heated before it moves under the disseminating mechanism 52. There is thus produced a laminated structure as exemplified in Fig. 9.

As above set forth heat may be applied to the particles from a number of sources other than from the surfaces upon which they fall. For example, the particles may be heated in any desirable manner during their movement toward the surface. One such manner is by directing a current of heated air against the particles during their movement toward a surface. There is exemplified in Fig. 10 a form of apparatus embodying the invention whereby such a procedure may be carried out. This apparatus comprises disseminating means which, as exemplified, is of the type disclosed in the copending application of Ericsson H. Merritt and Louis G. Merritt above referred to, and comprises a container 55 through the bottom of which there passes an endless foraminate belt 56. The belt passes over a support 57 and between the edge of this support and a doctor roll 58. Powdered heat-plasticizable material in the container is picked up in the openings of the belt, and is caused to fall therefrom at the point where the belt leaves the support 57 by means of a vibratory roll 58'. Against the disseminated material, which is indicated at 59 as falling from the belt, there is directed a current of air which is driven by a blower 60 through a conduit 61, containing heating elements 62, and out between nozzle members 63 and 64. The heated air directs the particles of material toward the surfaces of articles, which are indicated at 65 as carried on a conveyor 66. At the same time the air serves to heat the particles during their transit and to transform them into an adherent condition so that the uniformity of deposit of the particles will not be disarranged by displacement of the particles after they have contacted with the surface on which they fall. In such a procedure the air may, for example, be heated to a temperature of from 400° F. to 600° F.

It has been found advantageous in certain cases to proceed with the coating or laminating steps directly upon the removal from a hot drier or kiln of the object desired to be treated. Under such conditions the veneer ply or other element is brought from the drier at a temperature sufficiently elevated to cause the particles of powdered resinous material to adhere as they are applied to the surface. This sequence of steps makes for efficiency in the use of heat and labor.

Procedures of this nature are exemplified in Figs. 11 and 12. Fig. 11 shows veneer plies 67 coming in a heated condition from a veneer drier A—which as shown is of the general type exemplified in the patent to Louis G. Merritt et al. No. 1,757,092—and being carried on a conveyor 68 under a disseminating mechanism 69 by which powdered resinous material is applied thereto. A ply 70 may, if desired, be placed upon each ply 67 and the assembly subjected to heat and pressure in a press 71. Fig. 12 shows a multiple unit drier B. Plies 72 coming therefrom are carried by the conveyor 73 under the disseminator 74. Plies 75 coming from the drier are laid on the coated plies 72, either manually or by suitable automatic means, and their upper surfaces coated by a disseminator 76. Plies 77 coming from the drier are similarly placed on the plies 75.

In coating procedures, it is preferable that the veneer or similar porous material be dried down to 8% moisture content or less; and in laminating procedures that it be dried down to 12% moisture content or less.

A wide variety of resinous and other heat-plasticizable materials may be utilized in accordance with the invention. Partial condensation products of phenol and formaldehyde and other synthetic resinous materials are especially desirable for use in many cases. The type of resin most desirable for a particular use will depend to some extent upon the absorptive quality of the surface to which it is applied.

Since certain changes in carrying out the above method and in the constructions set forth, which embody the invention may be made without departing from its scope, 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.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which as a matter of language might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In the art of applying materials to surfaces, the method which comprises releasing a stream of discrete, solid particles of a heat-plasticizable material, directing the particles against a surface, and applying to the particles during their movement toward the surface sufficient heat to transform the same into an adherent condition, and subjecting to bonding conditions including the application of pressure while the particles are still in discrete form.

2. In the art of coating, laminating and the like, the method which comprises releasing a stream of a heat-plasticizable resinous material in powdered form, directing the particles against a surface and heating the particles of the material during their movement toward the surface and subjecting the surface to pressure, while the particles are still discrete.

3. In the art of applying materials to surfaces, the method which comprises disseminating a cloud of solid, discrete particles of a heat-plasticizable material, and directing against said cloud after their dissemination a current of hot air moving generally toward a surface, said air being heated sufficiently to transform the particles into an adherent condition but insufficiently to fuse the same.

4. The method of coating, laminating or the like, which comprises directing particles of a heat-plasticizable synthetic resinous material in powder form toward a surface, applying to the particles during their movement toward the surface sufficient heat to transform the surfaces of the particles into an adherent condition without destroying their discrete particle form, and thereafter further plasticizing and setting the material by heat and pressure applied to the particles in situ.

5. The method of forming laminated structures, which comprises heating a ply sufficiently to incipiently plasticize the surfaee of applied particles of a heat-plasticizable material but insufficiently to melt them, applying a heat-plasticizable adhesive material in powdered form and substantially uniformly to opposite surfaces and the ply, forming an assembly by steps which include disposing additional plies adjacent the coated surfaces while the adhesive material thereon is in

such an incipiently plastic state but still in discrete particle form, and subjecting the assembly to heat and pressure.

6. The method of coating, laminating or the like, which comprises applying in powdered form a heat-plasticizable synthetic resinous material to a surface heated sufficiently to transform the particles into an adherent condition but insufficiently to melt them, but insufficient to fully plasticize the particles, associating with said surface the surface of a wooden or similar porous member while the particles are still in discrete particle form, and setting the material under heat and pressure.

7. The method of coating, laminating or the like, which comprises heating a wooden or similar porous member adjacent to a surface thereof, applying to said surface a heat-plasticizable synthetic resinous material in powdered form, the stored heat being utilized in preventing the displacement of the particles without melting them, and subsequently subjecting to a setting treatment including the application of pressure while the particles are still in discrete particle form.

8. The method of laminating, which comprises applying, without the presence of vaporizable material, a layer of particles of a heat-plasticizable synthetic resinous material to a surface of a wooden or similar porous member containing sufficient heat to transform the upper particles of the layer into an adherent condition without melting them, disposing the surface of another member against said surface, and subjecting to bonding conditions including the application of pressure while the particles are still in discrete particle form.

9. In the art of coating, laminating or the like, the method which comprises applying dry, discrete particles of a heat-plasticizable material substantially uniformly over a surface, causing the particles to adhere substantially to the points at which they are applied, the adhesion being caused by a heating of the particles substantially at least as soon as they are in position on the surface and to an extent such that they are not melted, and subsequently applying additional heat in conjunction with the pressure, the particles remaining distinguishable until said subsequent application of heat.

10. In the art of laminating, the method comprising applying dry, discrete particles of a heat-plasticizable material to at least one surface of a lamination and causing said particles to be incipiently plasticized by heat at least as soon as they are in position on said surface and thereby to adhere to said surface, attaching a second lamination to said surface after said incipient plasticization but while still in discrete particle form, similarly applying an outer coating of such particles to said second lamination, and simultaneously setting the laminations with the first-mentioned particles and the outer coating through further plasticization under heat and pressure.

11. In the art of laminating, the method comprising applying particles of a heat-plasticizable material to at least one surface of a lamination, causing said particles to be incipiently plasticized by heat at least as soon as they are in position on said surface and thereby to adhere to said surface, attaching a second lamination to said surface during or after said incipient plasticization but before the particles become fluid, and thereafter permanently setting said material through further plasticization under heat and pressure.

12. In the art of coating, laminating and the like, the method which comprises directing a heat-plasticizable resinous material in powder form toward the surface so that they fall thereon in a substantially uniform layer, heat plasticizing the resinous material and hardening the resinous material under pressure, a portion of said plasticization occurring in time to prevent displacement of the resinous particles on said surface, and final plasticization occurring only after the application of pressure.

13. In the art of coating, laminating and the like, the method which comprises directing a heat-plasticizable resinous material in powder form toward the surface, heat plasticizing the resinous material and hardening the resinous material under pressure, a portion of said plasticization occurring before the resinous material reaches the surface, and final plasticization occurring only after the application of pressure.

14. In the art of coating, laminating and the like, the method which comprises heating the surface of an article, applying thereto a heat-plasticizable resinous material in powder form, the heat serving to retain the particles on the surface in the position in which they fall and hardening the resinous material under pressure, said heat being insufficient to melt the particles before pressure is applied.

15. In the art of coating, laminating and the like, the process which comprises uniformly applying heat-plasticizable material in powder form to a surface and thereafter subjecting the applied particles to pressure without disturbing their lie, the particles being held during the time intervening between the application and the pressure steps in the position at which they originally reach the surface by heating the particles at least as soon as they are in position on the surface.

16. In the art of coating, laminating and the like, the process which comprises disseminating substantially non-adherent dry particles of heat-plasticizable material, guiding the particles toward a surface so that they fall substantially uniformly thereon, and subjecting the still discrete particles to pressure without disturbing their lie, the particles being held in the position at which they originally reach the surface by heating the particles at least as soon as they are in position on the surface.

17. In the art of coating, laminating and the like, the process which comprises disseminating substantially non-adherent particles of heat-plasticizable material, guiding the particles toward a hot surface so that they fall substantially uniformly thereon, and thereafter subjecting the still discrete particles to pressure without disturbing their lie, the particles being held in the position at which they originally reach the surface by the heat transferred from the hot surface to the particles.

18. In the art of coating, laminating and the like, the process which comprises disseminating particles of a heat-plasticizable material in a substantially non-adherent condition, guiding the particles toward a surface by means of a current of heating air so as to be substantially uniformly deposited thereon, and so as to reach said surface in an adherent condition, and thereafter subjecting the still discrete particles to pressure without disturbing their lie.

19. The method of coating articles which com-

prises uniformly applying a heat-plasticizable synthetic resinous material in powder form to the surface of an article, and thereafter disposing a hot-pressure plate against the still discrete particles, the particles being held between the applying and the pressing operations in the position at which they originally reach the surface by the application of heat to the particles at least as soon as they are in position on the surface.

20. The method of laminating which comprises uniformly applying heat-plasticizable synthetic resinous material in powder form to the surface of a member, disposing another member adjacent said surface while the particles are still discrete, and pressing the members together, the particles being held between the applying and pressing operations in the position at which they originally reach the surface by the application of heat to the particles at least as soon as they are in position on the surface.

ERICSSON H. MERRITT.