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METHOD OF SPRAY PAINTING

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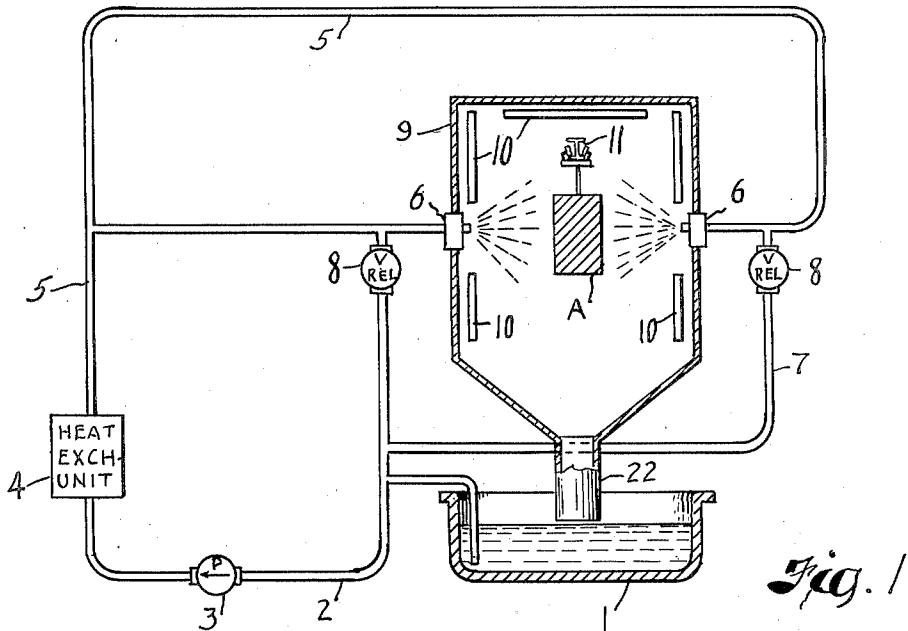


Fig. 1

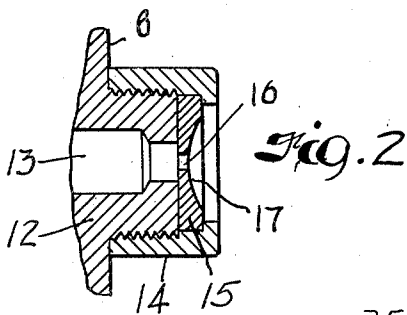


Fig. 2

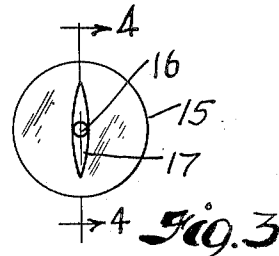


Fig. 3

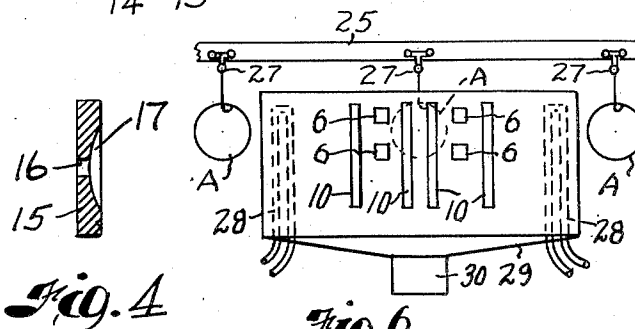


Fig. 4

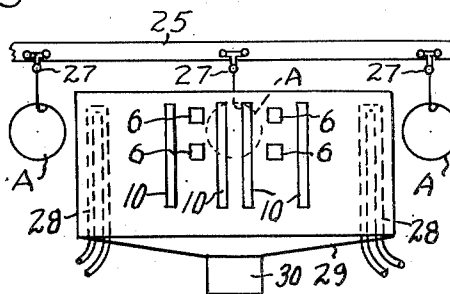


Fig. 5

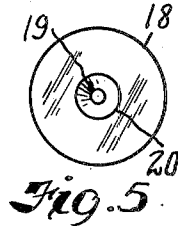


Fig. 6

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2,763,575

METHOD OF SPRAY PAINTING

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16 Claims. (Cl. 117—104)

This invention relates as indicated to a method of spray painting and pertains to the spray application of coating compositions generally, which consist of a solid component (usually a film-forming constituent) and a solvent component. While more accurately some of the compositions which may be thus applied by the use of my invention are particularly definable as varnishes, lacquers, enamels, etc., in addition to the compositions which are ordinarily called paints, I am using the term "paint" throughout the following description and in the appended claims in its generic sense to denote all such coating compositions which, as indicated above, comprise a solid (or film-forming) component which is either present in the paint or formed on "drying" of the paint on the work surface on which it is deposited, and an appropriate solvent which is given off by the paint during the "drying" thereof.

In contradistinction to conventional spray painting, my improved method or process as set forth herein eliminates entirely the use of compressed air or equivalent fluid to atomize the paint, as is fully outlined in my co-pending application, Serial No. 337,042, filed February 16, 1953. The present application is a continuation-in-part of my co-pending application Serial No. 184,092, filed September 9, 1950, and now abandoned.

It is a primary object of my invention to provide a method or process by means of which paint, finely subdivided without use of compressed air or equivalent fluid, is deposited on articles by the phenomenon of condensation.

It is another principal object of my invention to provide a process of the character described which can be utilized in the spray application of coating materials which it has heretofore been impossible to apply by spraying.

It is a further object of my invention to provide a process of the character described in which there is an appreciably lower loss of valuable solvent than is customary so that the process is more economical than those heretofore employed.

It is a further and more particular object of this invention to provide a process by which there is an appreciably lower scatter loss of the sprayed composition than in previously available processes, and by which excess particles are recovered in liquid form for re-heating and re-spraying.

Other objects and advantages of my invention will appear as the following description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing:

Fig. 1 is a diagrammatic view of one form of apparatus

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which may be utilized in carrying out the processes of my invention;

Fig. 2 is a cross-section view of one form of spray gun employed in my process;

Figs. 3 to 5 are illustrations of various forms of orifices which may be provided in the spray gun nozzle, Fig. 4 being a cross-section view taken substantially along line 4—4, Fig. 3; and

Fig. 6 is a side elevation view of another form of apparatus.

Broadly stated, the method of my invention comprises the steps of

(a) Heating the paint to a temperature which is at least 135° F. and preferably 150° F. but which temperature is lower than the boiling point, at atmospheric pressure, of at least 50% of the solvent content of the paint and which temperature is preferably such that when a given quantity of the paint is maintained for one minute at that temperature in a closed vessel whose capacity is two times such quantity there will be built up in such vessel a gauge pressure of at least 1.5 pounds per square inch;

(b) Maintaining the heated paint under a pressure sufficient to prevent boiling off of its solvent content;

(c) Projecting the thus heated paint (at a pressure of at least 100 p. s. i. through an orifice in the absence of atomizing gas other than that released from the paint itself) into a chamber heated to at least 90° F., that is, at least 20° F. greater than normal room temperature; and

(d) Passing through said chamber an article to be coated, which article is preferably at normal room temperature of 70° F. or about 20° F. less than the chamber temperature.

Before proceeding onto a more detailed description of my invention, it may be well to elaborate somewhat on the types of coating materials which may be utilized in such process.

THE COATING MATERIALS

The coating materials which may be utilized in carrying out my improved process include practically all of the more commonly used coating compositions provided, however, that they have the following properties:

First, that the viscosity is substantially reduced upon heating.

Second, that they have a solvent content such that the boiling point, at atmospheric pressure, of not more than 50% of the solvent content is at least 135° F. As before indicated, the expression "solvent content" includes those minor amounts of low-boiling fractions which are present in commercial solvents and which are generally omitted in published formulations.

Third, that the film-forming components of the composition are such that there is no substantial degradation thereof at a temperature of at least 135° F.

The broad class of materials which are thus available for use in my process includes most of the commonly used paints, lacquers, enamels, varnishes, fillers, stains, etc. I shall not attempt to give specific formulations of any of the coating compositions which may thus be used and which, as heretofore indicated, are referred to generally herein by the term "paint." By having reference to any painters encyclopedia or similar work, there may be determined the specific compositions which may be used. Actually, however, most coating composition manufacturers have their own particular formulations, some of which are published and some of which are not, but all of which may be utilized so long as they satisfy the requirements above set forth.

THE APPARATUS

In Fig. 1 of the drawing there is a diagrammatic illustration of one form of apparatus which may be used in

carrying out my improved process and in which the coating composition to be sprayed is contained in the paint supply tank 1 from which it is drawn through conduit 2 by means of pump 3 which causes the same to circulate through a heat exchanger 4 and thence through the conduits 5 to the oppositely facing guns 6. From each gun 6 the excess material, not discharged by the gun, is returned through the conduit 7 and pressure release valve 8 to supply conduit 2. It will be noted that the regulation of the pressure control valves 8 regulates the pressure at which the paint is maintained at the spray guns 6. From the spray guns 6 the coating composition is projected into a chamber 9 heated by heating elements 10 to coat an article A adapted to be conveyed, as by overhead conveyor 11, through the chamber 9.

In Fig. 2, there is illustrated the essential components of a gun 6 wherein a nozzle body 12 has connected thereto the paint supply conduit 5 for communication with passage 13.

Clamped to the end of said body 12, as by means of nut 14, is an orifice plate 15 through which the heated paint is discharged. As shown in Ser. No. 337,042, a valve may be provided in each spray gun 6 to selectively open and close the passage 13 thereof just ahead of orifice plate 15.

Fig. 3 is an elevational view of an orifice plate 15 such as may be used in each of the guns 6 as illustrated in Figs. 1 and 2. As illustrated in Figs. 3 and 4, this orifice plate may be provided with a relatively small size aperture or orifice 16 (usually .007 to .024" dia.) with the face of said plate surrounding such aperture provided with a diamond-shaped tapered recess 17 which is effective, as is well known in the art, to discharge the paint in flat fan-shaped form. Should a cone form of projection of the coating material be desired, an orifice plate such as 18, illustrated in Fig. 5, may be used and which differs from the orifice plate, Figs. 3 and 4, only in that the orifice 19 thereof is, on the outer face of the plate, provided with a circular tapered recess 20.

For best results, the size of the orifices in the orifice plates should be such that at a spraying pressure of about 450 lbs. per square inch the orifice will deliver about 12 gallons per hour of material having a viscosity of approximately 17 seconds (No. 4 Ford cup). It will be observed that it is a notable feature of my invention that I do not employ any atomizing gas other than that which is liberated from the heated paint as it issues from the spray orifice; and in this particular, my process is a marked departure from the prior art.

SPRAYING CONDITIONS

As previously indicated, there are certain critical conditions of operation which should be observed in carrying out my process. These are basically:

- (1) The temperature to which the paint is heated,
- (2) The pressure at which the thus heated paint is discharged from the spray orifice, and
- (3) The temperatures of the chamber and of the article A being painted.

The temperature

My process is characterized in that the painting composition is heated to a temperature of at least 135° F., the upper limit of the temperature which may be used being determined by the solvent content of the particular paint composition being employed. As previously indicated, such upper temperature must be lower than the boiling point, at atmospheric pressure, of at least 50% of the solvent content of the painting composition. My process is not applicable to advantage to painting compositions in which more than 50% of the solvents boil from the paint at a temperature less than 135° F.

As a practical matter, the foregoing are the only criteria which determine the temperature which may be selected for use. While some coating compositions would be harmed, i. e. deteriorated, by being subjected to too

high a temperature, most of the commercially available paint compositions are such that the degradation temperature is well above the limits set forth above. If it should be found that there is some degradation of the coating composition when used at an elevated temperature, satisfactory results can always be secured by reduction of the temperature to the zone which lies immediately below that at which the coating composition is harmed.

The elevated temperature to which the coating composition is subjected has three primary functions. First, it causes the paint to become more fluid, i. e. to have its viscosity substantially reduced, thus making it possible for the composition to be subdivided into sufficiently small particle size after issuing from the discharge orifice. Second, the paint or coating composition, even after being projected from the spraying orifice and deposited on the work (with the latter at room temperature) will remain at a sufficiently elevated temperature long enough so that there is the necessary coalescence or spreading of the thus deposited particles into a continuous film of the uniform thickness, such elevated temperature also increasing the "drying" rate of the thus produced finish film which is another advantage. Third, the elevation of the temperature of the painting composition raises the vapor pressure of the solvent content thereof so that at least 5% (including low boiling point fractions or impurities) but not more than 50% of the solvent content would boil from the paint at atmospheric pressure.

I shall not at this point enter upon a discussion of the effect upon true boiling point of the solvent or solvents in the composition by virtue of their combined presence or by virtue of their presence in the remainder of the painting composition. These are factors which are well known and which need not be elaborated upon at this point. It is believed sufficient to the understanding of my invention to state that the composition is heated to a temperature such that, at atmospheric pressure, at least 5% and not more than 50% of the solvent content thereof would boil off from the total composition in the act of spraying. For most purposes, superior results will be secured if the temperature to which the composition is raised is such that at least 10% of the entire solvent content of the composition would boil off in the act of spraying. It will be evident that in the step of heating the composition care should be observed that such heating is done uniformly so that there are no local areas in the mass in which the composition would be heated to a temperature very substantially greater than the remainder of the mass. Apparatus such as is disclosed in my issued Patent No. 2,576,558, dated November 27, 1951, will be found to be entirely suitable for this purpose.

Because the paint composition is thus heated to a temperature at which at least some of the solvent content thereof would boil off, at atmospheric pressure, actual boiling is prevented by maintaining the paint under pressure during the heating operation. In the form of apparatus illustrated in Fig. 1, the paint in the heat exchanger 4 is maintained under the full pressure at which it is ultimately delivered from the spray gun 6. Generally this pressure will be more than sufficient in order to prevent boiling of solvent during the heating step. It is thus possible to modify the illustrated apparatus by including the main high pressure pump 3 in the conduit 5 between the heat exchanger 4 and the spray guns 6 and to employ a suitable low pressure pump ahead of the heat exchanger so as to maintain the paint in the heat exchanger 4 under only sufficient pressure, i. e. on the order of 30 lbs. per square inch to prevent boil off of solvent during heating.

The spray pressure

As previously indicated, the pressure at which the paint is projected through the discharge orifices in the guns 6 should be at least 100 lbs. per square inch gauge. The

upper limit of the pressure which may be employed is determined by considerations of pressure limitations of the equipment. Generally, best results from the standpoint of performance and economy will be secured in the range of from 200 to 600 lbs. per square inch gauge. Since all of the components of the painting composition are liquid and thus substantially incompressible at these pressures, pumps of small size and requiring only a minimum of power input are satisfactory for use. This is another of the principal advantages of my process. For example, I have sprayed most of the commercially available coating compositions at a temperature of about 150 to 250° F., and at a pressure of from 250 to 700 lbs. per square inch gauge through an orifice delivering 10 to 20 gallons per hour under those conditions by means of a pump driven by a ½ H. P. electric motor. By comparison of these values with the power required by conventional spray painting processes of the prior art, the decided saving in power will be self-evident. While the minimum pressure of 100 lbs. per square inch gauge at the discharge orifice is a critical minimum, when the pressure is raised to values on the order of from 300 to 600 lbs. per square inch gauge, fluctuation of as much as 100 lbs. per square inch is not detrimental to the operation, so that pressure drop in the lines of the equipment, which always accompany the actual operation of processes of this kind, does not lead to any difficulties or detrimental results. This flexibility and lack of criticality is a further advantage of my process in its actual use.

As previously indicated, it is a notable and novel feature of my improved process that there is not employed any atomizing gas for the projected stream of paint material other than that which is released from the paint itself. I am fully aware of the fact that it has been proposed to spray coating compositions by airless atomization and for example, that there are on the market at the present time paint "bombs" which are small pressure vessels holding about a pint of liquid under pressure composed of about 90% low boiling solvent and about 10% actual film forming components. Release of the pressure to the atmosphere causes this low boiling solvent to vaporize which projects the paint through the discharge nozzle and vaporization of such solvent in the paint stream causes the same to be disrupted. Aside from the fact that those devices are extremely expensive from the standpoint of the amount of paint actually applied, they are furthermore not capable of use to secure the results secured by my process. For example, because of the high solvent content of such "bombs," it is possible to apply in one application a maximum final solid film of only about .0002" in thickness because the high solvent content in the film as laid down causes it to run, if greater weights are applied. By the use of my process, films of .001" and thicker are easily obtained in one application. While my process can be utilized in the application of extremely thin films, it is generally desirable and required to deposit films of many times the maximum which can thus be laid down in one operation by the "bomb" type equipment, and which greater thicknesses are, as indicated, easily obtainable by my process.

The combination of the use of elevated temperatures on the order of those stated and pressures on the order of those stated, makes it possible to secure full mechanical subdivision of the projected stream with a minimum of solvent evaporation and with a minimum of scatter of the subdivided stream. The fact that there is no atomizing gas used other than that liberated by the paint itself makes it possible for the subdivided stream to impinge onto the work surface with a very minimum of loss due to scatter. When an atomizing gas such as air is employed, it flowing along with the subdivided stream strikes the work and is deflected by the work, and as deflected carries with it large percentages of the valuable coating composition particles. It is a well known fact that in present spray coating operations as commonly employed,

there is an average loss of approximately 50% of the valuable coating components due to scatter loss. A striking illustration of the advantage of omitting outside atomizing gas occurs when one seeks to spray into the open end of a container or into a sharp internal corner. By use of conventional air atomized sprays, both of these procedures are virtually impossible if a uniform coating is to be secured, where as by the use of my process, there is no extra gas present in the stream so that the projected coating impinges uniformly on the surface even if the latter be, for example, the interior walls and bottom of a box or container. Because of the absence of an atomizing gas, the chilling effect of such gas as it expands at the nozzle is eliminated; and, accordingly, the actual coating composition particles reach the work with a minimum of cooling so that they may properly coalesce and spread to a continuous coat of uniform thickness by the use of a minimum of solvent.

Because of the very marked reduction in scatter loss when using my process, the cost of spray booth necessary and the cost of its operation are both greatly reduced. While there is, of course, some scatter and solvent evaporation accompanying my process in chamber 9, most of the paint is recondensed and returned through passage 22 into tank 1, and if desired, some means may be provided to carry away any fumes.

With my process I have been able to spray full-bodied materials such as lacquer, for example, which has a viscosity of about 90 to 100 sec. (No. 4 Ford cup) at a temperature of 75° F. by heating the same to a temperature of about 160° F. at which latter temperature the viscosity is reduced to a good spraying viscosity of about 17 to 20 sec. (No. 4 Ford cup). If it were attempted to so reduce the viscosity to this extent by thinner alone, 90% thinner would have to be added to the full-bodied material. This heated full-bodied material is then projected through an orifice plate at a pressure of 300 to 600 lbs. per square inch, for example, whereby the heated material is discharged in the form of a finely divided spray without the use of an atomizing gas other than that which is liberated from the heated material itself. As previously mentioned, this spray, the particles of which are still in warm condition, can be applied on the work surface in a single application to produce a uniform, continuous film of much greater thickness than can be obtained with other known spraying processes.

The chamber and article temperatures

As before mentioned, the chamber 9 into which the heated paint is discharged in fine particle form is heated by heating elements 10, which may comprise electric or equivalent heaters, the temperature in the chamber being maintained at a temperature of at least 90° F. (20° F. above normal room temperature). The maximum temperature in such chamber 9, for obvious reasons, should not be greater than that of the paint introduced thereinto. The heating of the chamber offsets the natural refrigerating effect of the sprayed particles and thereby prevents premature cooling of the particles before they reach the article A. Such heating of chamber 9 also promotes finer subdivision of the paint particles. In addition, the hot solvent in the paint dissolves oil films on the work surface, the paint displacing such solution and penetrating the surface. Otherwise, cold paint deposited on an oil surface will not harden but rather will become "cheezy."

The article A to be painted may be transported through chamber 9 as by overhead conveyor 11 or by an equivalent means and when introduced into said chamber, the article A is at normal room temperature of 70° F. as compared with the minimum temperature of 90° F. of said chamber. It has been found that the minimum temperature differential of the chamber 9 and article A should be 20° F. and of course, if the normal room temperature is 80-85° F., as it may well be in the summer months, then the chamber temperature will be at least 110-115° F., so long as this temperature has no harmful effects on

the paint. A temperature differential greater than 20° F. is preferred for best results, and therefore the chamber temperature will usually be equal to, or slightly less than, that of the paint introduced thereinto, but in no case will it be required to artificially cool the article A except under conditions where room temperatures may approach or exceed 100° F.

In other words, while some improvements in results may be obtained by introducing articles cooler than normal room temperature into said chamber 9, the extra time and expense of artificial cooling will usually not be justified.

When an article A at normal room temperature (at least 20° F. less than that of chamber 9) is introduced into the latter, the sprayed particles of paint will be attracted to and condense thereon, and of course the particles which miss the article as it passes through the chamber will drop through passage 22 into tank 1 for re-heating and re-spraying.

The length of time that the article A is exposed to the spray will control the film thickness deposited thereonto, as will the rate of spraying through guns 6.

In the form of apparatus illustrated in Fig. 6, the article conveyor 25 is located above chamber 26, the latter having a slot lengthwise through its top for passage of the hangers or carriages 27 of said conveyors from which the articles A are suspended for movement through said chamber. The ends of said chamber 26 are open at least enough to permit passage of the hangers 27 and articles A therethrough. Spray guns 6 are suitably arranged at opposite sides of an intermediate portion of said chamber to direct the sprayed, heated paint uniformly against all of the surfaces of the article A passing therebetween, and this portion of chamber 26 is, as in the case of the apparatus of Fig. 1, heated by heating elements 10 preferably mounted on the outside of said chamber.

In order to enable a more complete recovery of solvent, and also paint composition, there is provided, adjacent the heated spraying zone, cooling zones consisting of, for example, cooling coils 28 through which cold water or like coolant may be circulated to maintain the temperatures thereat at about 10 to 50° F. less than ambient temperature, that is, 20 to 60° F. when the ambient temperature is 70° F.

Accordingly, the portions of the chamber 26 containing said coils 28 constitute traps for solvent fumes which otherwise tend to pass out of the ends of said chamber. Thus, the solvent fumes given off by the sprayed paint are effectively condensed in these cooling zones and on the coils 28 for dropping down to the sloping bottom 29 of said chamber for discharge through conduit 3 into a tank 1 (see Fig. 1) for re-heating and re-spraying or for make-up with additional film-forming constituents.

ILLUSTRATIVE EXAMPLES

Following is a list of a few illustrative examples of coating compositions which may be employed with my process; and in the chart herebelow are given the preferred spraying conditions for these compositions.

Composition #1.—Lacquer primer

	Percent
Titanium dioxide	12.180
Alkyd resin	13.524
Nitrocellulose	10.542
Plasticizer	5.754
Ethyl acetate	10.788
Methyl isobutyl ketone	8.236
Butyl acetate	10.440
Butyl Cellosolve	2.900
Toluol	12.238
Xylol	12.006
Amyl acetate	1.392

100

Composition #2.—Lacquer topcoat

	Percent
Nitrocellulose	11.7272
Vinyl resin	6.2488
Plasticizer	6.4628
Inert pigments	6.3772
Titanium dioxide	11.9840
Ethyl acetate	6.8640
Methyl-isobutyl ketone	8.6944
Butyl acetate	10.5820
Amyl acetate	3.1460
Butyl Cellosolve	2.0020
Toluol	18.1324
Xylol	7.7792

100

Composition #3.—Synthetic resin paint

	Percent
Titanium pigment	11.50
Inert pigment	38.50
Alkyd resin	16.00
Nitrogen resin	2.50
Volatile	31.50

100

Composition #4.—Synthetic resin primer

	Percent
Prime pigments	21.3850
Inert pigments	24.1150
Epon resin	17.3310
Aromatic hydrocarbons and alcohols	37.1690

100

Composition #5.—Synthetic resin paint

	Percent
Titanium dioxide	22.66
Inert pigment	5.60
Urea formaldehyde resin	27.19
Glyceryl phthalate resin	7.82
Butanol	12.50
Xylol	20.10
Aromatic hydrocarbon such as Solvesso 150	4.13

100

Composition No.	Temperature (° F.)	Pressure (p. s. i.)	Orifice Dia. (in.)	Chamber Temp. (° F.)	Article Temp. (° F.)
#1.....	165	450	.012-.020	110	72
#2.....	165	500	.012-.020	110	72
#3.....	190	500	.012-.020	120	72
#4.....	190	600	.012-.020	120	72
#5.....	180	450	.012-.020	120	72

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such be employed.

I therefore particularly point out and distinctly claim as my invention:

1. The method of spray painting paint having a solid constituent and a solvent constituent which comprises: (a) heating the paint to a temperature which is at least 135° F. but which is such that, when the heating is conducted in a closed container, a vapor pressure of at least 1.5 p. s. i. in excess of normal atmospheric pressure is created therein; (b) maintaining the heated paint under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated paint at a pressure of at least 100 p. s. i. through an orifice in the absence of atomizing gas other than that released from the paint itself into a space maintained at a temperature not greater than that to which the paint is heated but at least 20° F. greater

than normal atmospheric temperature; and (d) introducing into such space an article to be sprayed which is at normal atmospheric temperature whereby paint particles are deposited thereon directly and by condensation.

2. The method of spray painting paint having a solid constituent and a solvent constituent which comprises: (a) heating the paint to a temperature which is at least 135° F. but which is such that, when the heating is conducted in a closed container, a vapor pressure of at least 1.5 p. s. i. in excess of normal atmospheric pressure is created therein; (b) maintaining the heated paint under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated paint at a pressure of at least 200 p. s. i. through an orifice in the absence of atomizing gas other than that released from the paint itself into a space maintained at a temperature not greater than that to which the paint is heated but at least 20° F. greater than normal atmospheric temperatures; and (d) introducing into such space an article to be sprayed which is at normal atmospheric temperature whereby paint particles are deposited thereon directly and by condensation.

3. The method of spray painting synthetic resin paint having a solvent constituent which comprises: (a) heating the paint to a temperature which is at least 170° F.; (b) maintaining the heated paint under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated paint at a pressure of at least 200 p. s. i. through an orifice in the absence of atomizing gas other than that released from the paint itself into a space maintained at a temperature approximately the same as that of the paint; and (d) introducing into such space and in the path of the paint particles an article to be painted which is at normal atmospheric temperature.

4. The method of spray painting lacquer having a solvent constituent which comprises: (a) heating the paint to a temperature which is approximately 170° F. but which is such that, when the heating is conducted in a closed container, a vapor pressure of at least 1.5 p. s. i. in excess of normal atmospheric pressure is created therein; (b) maintaining the heated lacquer under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated lacquer at a pressure of at least 200 p. s. i. through an orifice in the absence of atomizing gas other than that released from the lacquer itself into a space maintained at a temperature approximately the same as that of the lacquer; and (d) introducing into such space and in the path of the lacquer particles an article to be lacquered which is at normal atmospheric temperature.

5. The method of spray painting synthetic resin paint having a solvent content of approximately 25 to 40% which comprises: (a) heating the paint to a temperature approximately 180 to 190° F. at which temperature, when the heating is conducted in a closed container, a vapor pressure of at least 1.5 p. s. i. in excess of normal atmospheric pressure is created therein; (b) maintaining the heated paint under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated paint at a pressure of at least approximately 400 p. s. i. through an orifice in the absence of atomizing gas other than that released from the paint itself into a space maintained at a temperature approximately the same as that of the paint; and (d) introducing into such space and in the path of the paint particles an article to be painted which is at normal atmospheric temperature.

6. The method of spray painting paint having a solid constituent and a solvent constituent which comprises: (a) providing a paint which, when heated to at least 135° F. in a closed container, creates therein a vapor pressure of at least 1.5 p. s. i. in excess of normal atmospheric pressure; (b) heating the paint to at least such temperature but to a temperature lower than the boiling point, at atmospheric pressure, of at least 50% of the solvent content; (c) maintaining the heated paint under a pressure suf-

ficient to prevent boiling off of its solvent content; (d) projecting the thus heated paint at a pressure of at least 100 p. s. i. through an orifice in the absence of atomizing gas other than that released from the paint itself into a space maintained at a temperature approximately the same as that of the paint; and (e) introducing into such space and in the path of the paint particles an article to be painted which is at normal atmospheric temperature.

7. The method of spray painting lacquer, synthetic resin paint and the like having a solvent content in the amount of at least 30% and selected from the group of organic paint thinners consisting of: ethyl acetate, solvent ketone, butyl acetate, butyl Cellosolve, toluol, xylol, amyl acetate, alcohols, butanol, mineral spirits, and aromatic hydrocarbons, which comprises: (a) heating the paint to a temperature which is at least 135° F. but which is lower than the boiling point, at atmospheric pressure, of at least 50% of the solvent content of the paint; (b) maintaining the heated paint under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated paint at a pressure of at least 100 p. s. i. through an orifice in the absence of atomizing gas other than that released from the paint itself into a space maintained at a temperature approximately the same as that of the paint; and (d) introducing into such space and in the path of the paint particles an article to be painted which is at normal atmospheric temperature.

8. The method of spray painting paint having a solid constituent and a solvent constituent which comprises: (a) heating the paint to a temperature which is at least 135° F. but which is such that, when the heating is conducted in a closed container, a vapor pressure of at least 1.5 p. s. i. in excess of normal atmospheric pressure is created therein; (b) maintaining the heated paint under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated paint at a pressure of at least 100 p. s. i. through an orifice of approximately .007 to .024" diameter in the absence of atomizing gas other than that released from the paint itself into a space maintained at a temperature approximately the same as that of the paint; and (d) introducing into such space and in the path of the paint particles an article to be painted which is at normal atmospheric temperature.

9. The method of spray painting lacquer which is composed essentially of a pigment, a film-forming or bodying constituent, and a volatile solvent or thinner, which comprises: (a) heating the lacquer to a temperature which is at least 135° F. and not more than about 175° F. but which is lower than the boiling point, at atmospheric pressure, of at least 50% of the solvent content of the lacquer; (b) maintaining the heated lacquer under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated lacquer at a pressure of at least about 200 p. s. i. through an orifice in the absence of atomizing gas other than that released from the lacquer itself into a space maintained at a temperature approximately the same as that of the lacquer; and (d) introducing into such space and in the path of the lacquer particles an article to be lacquered which is at normal atmospheric temperature.

10. The method of spray painting synthetic resin paint which is composed of a pigment, a film-forming or bodying constituent, and a volatile solvent or thinner, which comprises: (a) heating the paint to a temperature which is at least 135° F. and not more than about 250° F. but which is such that, when the heating is conducted in a closed container, a vapor pressure of at least 1.5 p. s. i. in excess of normal atmospheric pressure is created therein; (b) maintaining the heated paint under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated paint at a pressure of at least 200 p. s. i. through an orifice in the absence

of atomizing gas other than that released from the paint itself into a space maintained at a temperature approximately the same as that of the paint; and (d) introducing into such space and in the path of the paint particles an article to be painted which is at normal atmospheric temperature.

11. The method of spray painting a paint which has a solvent constituent and which, when heated to at least 135° F., has a substantially lower viscosity than at 75° F., which comprises: (a) heating the paint to a temperature which is at least 135° F. but which is such that, when the heating is conducted in a closed container, a vapor pressure of at least 1.5 p. s. i. in excess of normal atmospheric pressure is created therein; (b) maintaining the heated paint under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated paint at a pressure of at least 100 p. s. i. through an orifice in the absence of atomizing gas other than that released from the paint itself into a space maintained at a temperature approximately the same as that of the paint; and (d) introducing into such space and in the path of the paint particles an article to be painted which is at normal atmospheric temperature.

12. The method of spray painting paint having a solid constituent and a solvent constituent which comprises: (a) heating the paint to a temperature which is at least 135° F. but which is lower than the boiling point, at atmospheric pressure, of at least 50% and not more than 95% of the solvent content of the paint; (b) maintaining the heated paint under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated paint at a pressure of at least 100 p. s. i. through an orifice in the absence of atomizing gas other than that released from the paint itself into a space maintained at a temperature approximately the same as that of the paint; and (d) introducing into such space and in the path of the paint particles an article to be painted which is at normal atmospheric temperature.

13. The method of spray painting lacquer having a solvent constituents which comprises: (a) heating the lacquer to a maximum temperature of about 170° F. but which is lower than the boiling point, at atmospheric pressure, of at least 50% of the solvent content of the lacquer; (b) maintaining the heated lacquer under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated lacquer at a pressure of at least 200 p. s. i. through an orifice in the absence of atomizing gas other than that released from the lacquer itself into a space maintained at a temperature approximately the same as that of the lacquer; and (d) introducing into such space and in the path of the lacquer particles an article to be lacquered which is at normal atmospheric temperature.

14. The method of spray painting synthetic resin paint having a solvent content of approximately 25 to 40% which comprises: (a) heating the paint to a temperature

approximately 180 to 190° F. which is lower than the boiling point, at atmospheric pressure, of at least 50% of the solvent content of the paint; (b) maintaining the heated paint under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated paint at a pressure at least approximately 400 p. s. i. through an orifice in the absence of atomizing gas other than that released from the paint itself into a space maintained at a temperature approximately the same as that of the paint; and (d) introducing into such space and in the path of the paint particles an article to be painted which is at normal atmospheric temperature.

15. The method of spray painting lacquer, synthetic resin paint and the like having a solvent content in the amount of at least about 30% and selected from the group of organic paint thinners consisting of: ethyl acetate, solvent ketone, butyl acetate, butyl Cellosolve, toluol, xylol, amyl acetate, alcohols, butanol, mineral spirits, and aromatic hydrocarbons, which comprises: (a) heating the paint to a temperature which is at least 135° F. but which is such that, when the heating is conducted in a closed container, a vapor pressure of at least 1.5 p. s. i. in excess of normal atmospheric pressure is created therein; (b) maintaining the heated paint under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated paint at a pressure of at least 100 p. s. i. through an orifice in the absence of atomizing gas other than that released from the paint itself into a space maintained at a temperature approximately the same as that of the paint; and (d) introducing into such space and in the path of the paint particles an article to be painted which is at normal atmospheric temperature.

16. The method of spray painting paint having a solid constituent and a solvent constituent which comprises: (a) heating the paint to a temperature which is at least 135° F. but which is lower than the boiling point, at atmospheric pressure, of at least 50% of the solvent content of the paint; (b) maintaining the heated paint under a pressure sufficient to prevent boiling off of its solvent content; (c) projecting the thus heated paint at a pressure of at least 100 p. s. i. through an orifice of approximately .007 to .024" diameter in the absence of atomizing gas other than that released from the paint itself into a space maintained at a temperature approximately the same as that of the paint; and (d) introducing into such space and in the path of the paint particles an article to be painted which is at normal atmospheric temperature.

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