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METHOD OF SPRAY PAINTING

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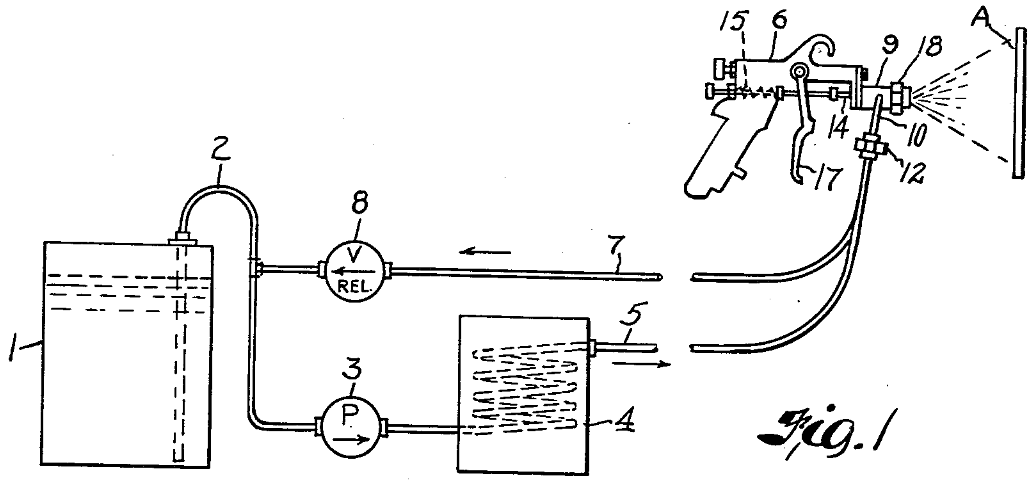

Fig. 1

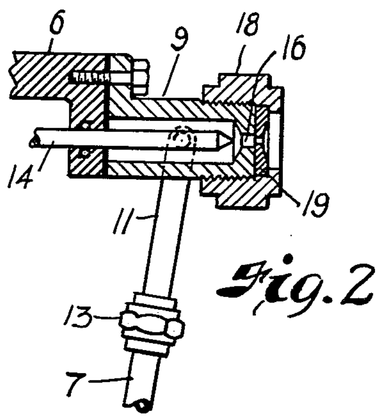

Fig. 2

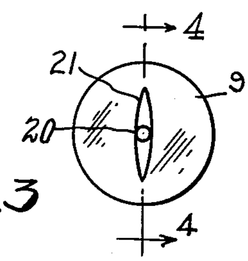

Fig. 3

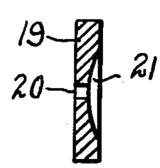

Fig. 4

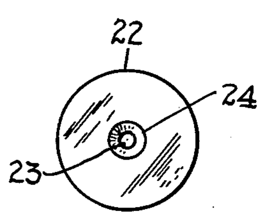

Fig. 5

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METHOD OF SPRAY PAINTING

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4 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.

Conventional paint spraying since its inception approximately fifty years ago has remained unchanged in general principle, compressed air being still employed as the atomizing agent to finely divide the paint and as a propellant to blow the paint particles against the work surface being painted. Such conventional paint spraying as presently practiced requires approximately 15 to 22 cubic feet per minute of air at a pressure of approximately 60 to 80 lbs. per square inch for each spray gun in order to effect proper atomization. Because of the large volume and high velocity of the air involved in the operation of the conventional spray gun, not only is a cloud of spray dust created by reflection or rebound of the paint-particle carrying air stream from the work space, but the large volume of air in itself creates a problem. In order to meet health regulations as to working conditions, and in order to dispose of such large volume of free air, it has been the standard practice to carry on such conventional spray painting in specially constructed spray booths which are equipped with exhaust fan connections capable of exhausting approximately 4000 to 5000 cubic feet of free air per minute (or of creating an air draft of from 150 to 200 lineal feet per minute in a direction away from the operator), and which is equipped with a water wash system or the like whereby the excess of paint which is carried beyond the work surface being coated will be collected in the form of water precipitated sludge.

Not only does the installation of such specially constructed spray booth involve a considerable initial cost, but there is a continuing operating expense because of the consumption of power involved. Furthermore, the paint loss due to scatter or what is often termed in the art as "overspray" or "backlash" is approximately 35 to 50% even when spraying an impervious continuous surface, and is approximately 50 to 90% when spray painting products such as desks, chairs, washing machines, and the like. While the aforementioned water wash systems will serve to collect most of such "overspray," the resulting sludge is largely waste despite the fact that processes for recovering at least some of the values have been recently introduced. In addition, it is especially difficult

to use ordinary spray painting methods in painting the interior surfaces of articles such as artillery shells, buckets, tool boxes, and the like because, in such conventional spraying, the spray rebound is so great as to prevent uniform coating especially in the corners, and creates health hazards to the operator.

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. Therefore, it is a primary object of my invention to provide a method or process by means of which efficient spraying is accomplished economically and with a minimum of "overspray" and with only sufficient ventilation as is required to dispose of solvent fumes which evaporate from the paint while in transit from the gun to the work surface and while "drying" on the work surface. If my process is performed in a spray booth, the water wash system may be dispensed with and the exhaust fan connections need have a capacity which is but a minor fractional portion of that required for conventional spray painting, viz. approximately one-tenth.

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 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.

Other objects of my invention will appear as the 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 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; and

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.

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; and

(*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.

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 ot 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 conduit **5** to the gun **6**. From the gun **6** the excess material, not discharged by the gun, is returned through the conduit **7** to pressure release valve **8**, the outfall conduit of which is connected with the supply conduit **2**. It will be noted that the regulation of the pressure control valve **8** regulates the pressure at which the paint is maintained at the spray gun **6**. From the spray gun **6** the coating composition is projected onto the work surface generally indicated at A.

In Figs. 1 and 2, there is illustrated the essential components of the gun **6** wherein a nozzle body **9** is provided with a pair of nipples **10** and **11** to which the conduit **5** and **7** are respectively connected as by means of conventional fittings **12** and **13**. Thus, heated paint is circulated through said body **9**. Reciprocable in said body **9** is a valve stem **14** which is urged by spring **15** to close the opening **16** in said body and which is drawn back to the open position by means of the trigger **17** which is pivotally mounted on the gun **6**.

Clamped to the end of said body **9**, as by means of nut **18**, is an orifice plate **19** through which the heated paint is discharged when the valve stem **14** is shifted by trigger **17** to the open position as shown in Figs. 1 and 2.

Fig. 3 is an elevational view of an orifice plate **19** such as may be used in the gun **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 **20** (usually .077 to .024" dia.) with the face of said plate surrounding such aperture provided with a diamond-shaped tapered recess **21** 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 **22**, illustrated in Fig. 5, may be used and which differs from the orifice plate, Figs. 3 and 4, only in that the orifice **23** thereof is, on the outer face of the plate, provided with a circular tapered recess **24**.

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, and (2) the pressure at which the thus heated paint is discharged from the spray orifice.

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 sub-divided 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 coalescene 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 pump **3** in the conduit **5** between the heat exchanger **4** and the spray gun **6** with another pressure release valve **8** located at the present location of the pump **3** 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 orifice in the gun **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 about 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 on 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 sub-division of the projected stream with a minimum of solvent evaporation and with a minimum of scatter of the sub-divided stream. The fact that there is no atomizing gas used other than that liberated by the paint itself makes it possible for the sub-divided 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 sub-divided 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, whereas 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 minor amount of scatter and solvent evaporation accompanying my process in use, some means must be provided to carry away the fumes so that they do not accumulate in the spraying room. A simple spray booth with a small exhaust draft is all that is necessary. For comparable quantities of composition sprayed, my process requires an exhaust draft for the spray booth which is on the order of about 1/10 of that necessary when using air atomization. Of course, the reduction in velocity of the air sweeping the spray booth further reduces to negligible amount the valuable coating particles which are carried out thereby.

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.

In the foregoing outline of the present method of spray painting emphasis was placed on the correlation of heat and pressure, the heat being conducted in a closed chamber so as to build up a predetermined vapor pressure in the paint, and the pressure being such that a volatilizable liquid component of the paint is maintained in liquid state until such time that the pressure thereon is reduced to atmospheric pressure and such that the heated paint, when projected through a spray orifice is carried through the orifice and against the surface being sprayed solely by the pressure applied and by the vaporization of said liquid component. Said liquid component when volatilized to the extent of from more than 5% to not more than 50% on passing through said orifice thus constitutes an atomizing agent effective to subdivide the mechanically sprayed heated paint particles.

Viewed from a somewhat different aspect, the present method of spray painting involves the correlation of heat and pressure with the particular paint composition which it is desired to spray. The paint to be sprayed not only has the necessary film-forming constituents in solution therein, but in addition, has its own atomizing agent which is liquid and which is compatible with the film-forming constituents, but otherwise not remaining in the dried film on the sprayed article surface. The heating of the paint is carried on in a closed container to maintain such atomizing agent in liquid state in the paint and to a degree sufficient to volatilize such agent at atmospheric pressure.

Furthermore, pressure substantially above atmospheric pressure is imposed on the heated paint to prevent volatilization of such atomizing agent and to project the heated paint through a spray orifice to secure mechanical breaking up of the heated paint. It is at this stage of the method that the volatilizable liquid component of the paint or so-called "atomizing agent," upon reduction of pressure thereon to atmospheric pressure, performs its function of atomizing and further sub-dividing the mechanically sprayed paint particles. The thus sub-divided paint particles (yet in liquid form and containing the components required to form a film on the surface being sprayed) continue to move generally toward the surface being sprayed with a minimum amount of scatter and at a rapidly decelerating speed owing to the air resistance imposed on the multitude of extremely small paint droplets issuing from the spray orifice.

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

	Percent
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.)
#1	165	450	.012-.020
#2	165	500	.012-.020
#3	190	500	.012-.020
#4	190	600	.012-.020
#5	180	450	.012-.020

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. In a method of spray painting, the steps which comprise heating in a closed chamber to a temperature of at least 135° F., a paint including components as hereinafter defined; imposing a pressure of at least 100 p. s. i. on such heated paint; and then projecting the latter through a spray orifice; the paint thus sprayed including, in addition to components required to form the desired film on the surface being sprayed, a liquid component compatible therewith but not remaining in the dried film, such last named component being liquid under the aforesaid heat and pressure conditions and being volatilized to the extent of from 5% to not more than 50% on passing through said spray orifice, the temperature of heating being lower than the boiling point, at atmospheric pressure, of at least 50% of said liquid component, whereby said component is effective due to suddent expansion thereof upon discharge of the paint from such orifice to atomize the same, the paint being carried through the spray orifice and against the surface being sprayed solely by the pressure applied and by the vaporization of such liquid component.

2. In a method of spray painting, the steps which comprise heating in a closed chamber to a temperature of at least 170° F., a paint including components as hereinafter defined; imposing a pressure of at least 200 p. s. i. on such heated paint; and then projecting the latter through a spray orifice; the paint thus sprayed including, in addition to components required to form the desired film on the surface being sprayed, a liquid component compatible therewith but not remaining in the dried film, such last named component being liquid under the aforesaid heat and pressure conditions and being volatilized to the extent of from 5% to not more than 50% on passing through said spray orifice, the temperature of heating being lower than the boiling point, at atmospheric pressure, of at least 50% of said liquid component, whereby said component is effective due to sudden expansion thereof upon discharge of the paint from such orifice to atomize the same, the paint being carried through the spray orifice and against the surface being sprayed solely by the pressure applied and by the vaporization of such liquid component.

3. In a method of spray painting heavy-bodied lacquer, the steps which comprise heating in a closed chamber to a temperature of approximately 165° F. a lacquer including components as hereinafter defined; imposing a pressure of about 450 p. s. i. on such heated lacquer; and then projecting the latter through a spray orifice; the lacquer thus sprayed including, in addition to the film-forming components nitrocellulose, resin, and plasticizer required to form the desired film on the surface being sprayed, a liquid component compatible with the lacquer but not remaining in the dried film, such last-named component being liquid under the aforesaid heat and pressure conditions and being volatilized to the extent of from 5% to not more than 50% on passing through said spray orifice, the temperature of heating being lower than the boiling point, at atmospheric pressure, of at least 50% of said liquid component, whereby said component is effective due to sudden expansion thereof upon discharge of the lacquer from such orifice to atomize the same, the lacquer being carried through the spray orifice and against the surface being sprayed solely by the pressure applied and by the vaporization of such liquid component.

4. In a method of spray painting heavy-bodied synthetic resin paint, the steps which comprise heating in a closed chamber to a temperature of approximately 180° F. a synthetic resin paint including components as hereinafter defined; imposing a pressure of about 450 p. s. i. on such heated paint; and then projecting the latter through a spray orifice; the paint thus sprayed including, in addition to a film-forming synthetic resin required to form the desired film on the surface being sprayed, a liquid component compatible with the paint but not remaining in the dried film, such last-named component being liquid under the aforesaid heat and pressure conditions, and being volatilized to the extent of from 5% to not more than 50% on passing through said spray orifice, the temperature of heating being lower than the boiling point, at atmospheric pressure, of at least 50% of said liquid component, whereby said component is effective due to sudden expansion thereof upon discharge of the paint from such orifice to atomize the same, the paint being carried through the spray orifice and against the surface being sprayed solely by the pressure applied and by the vaporization of such liquid component.

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