July 3, 1962 M. B. PICKETT 3,042,547

MEANS FOR AND METHOD OF PAINTING

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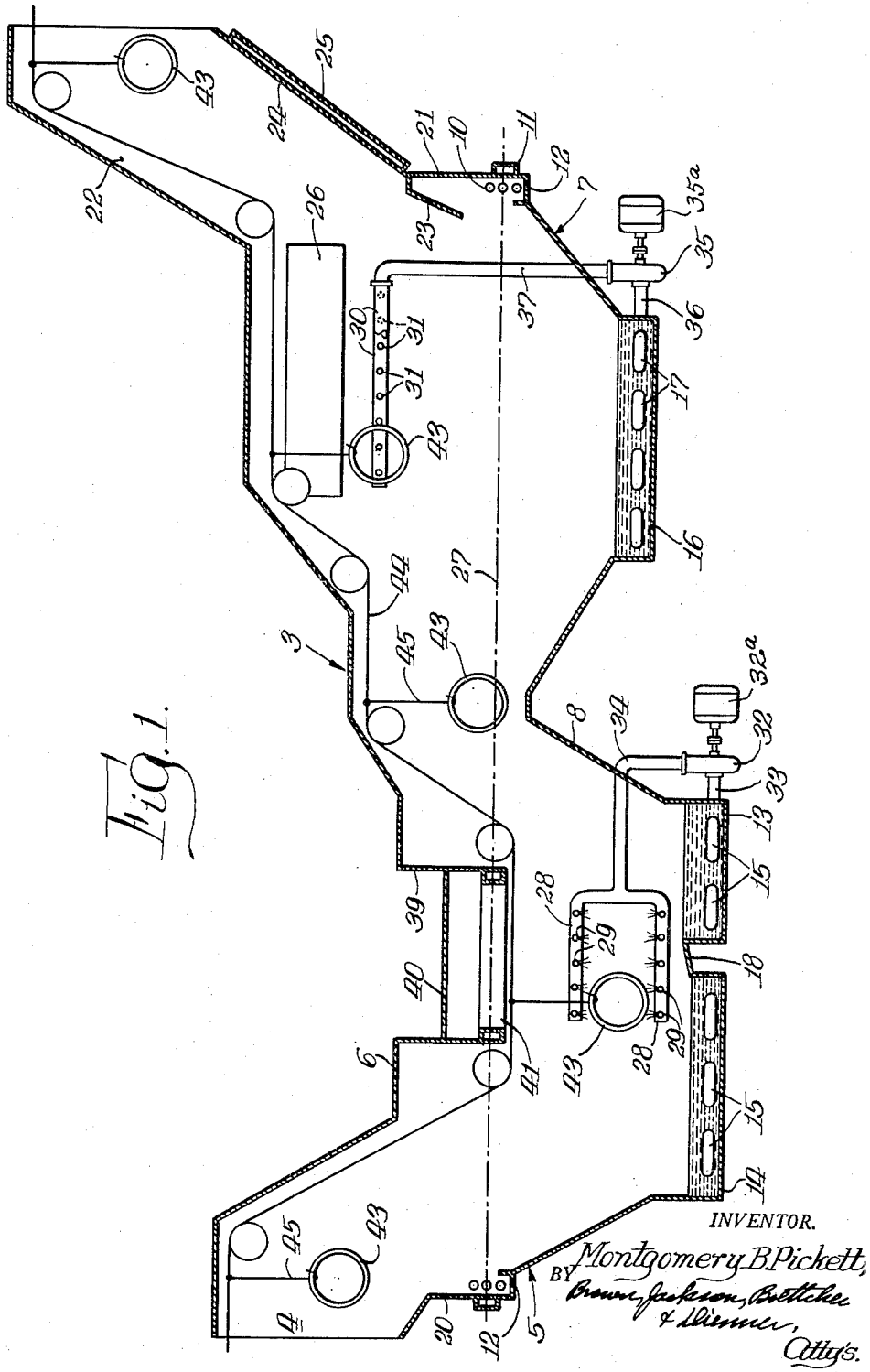


Fig. 1.

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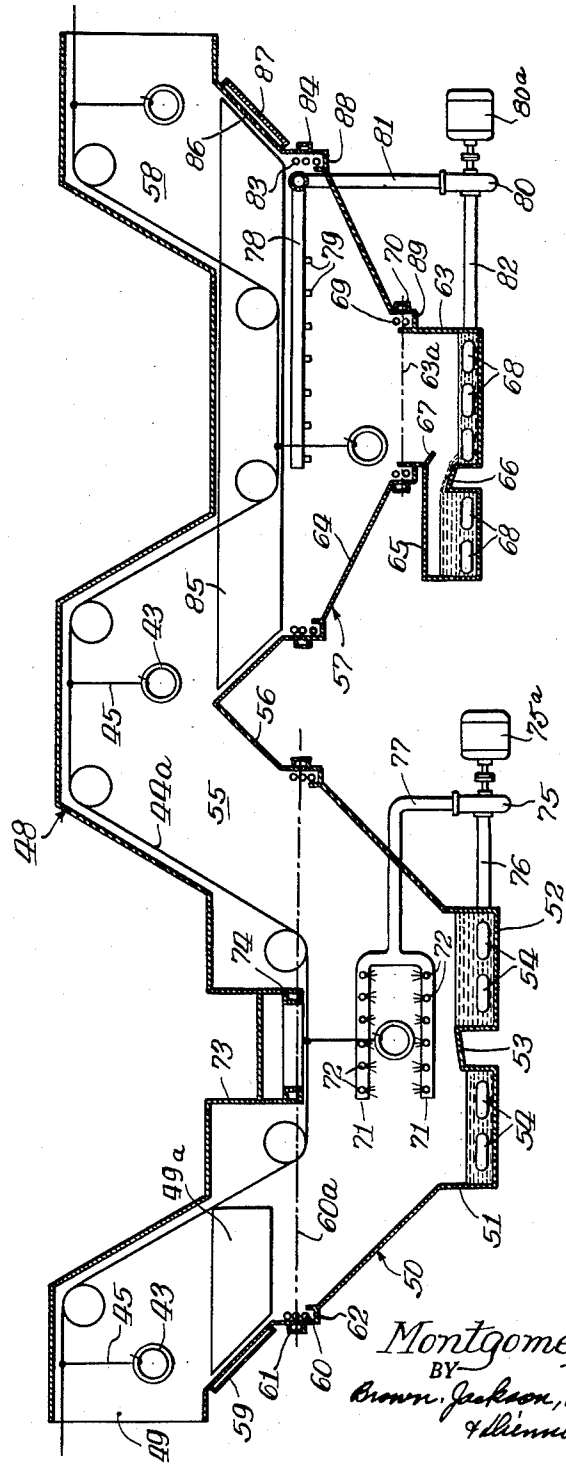
Attys.

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Fig. 2.



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3,042,547

MEANS FOR AND METHOD OF PAINTING

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8 Claims. (Cl. 117—102)

This invention relates to coating articles with a suitable coating material or composition containing a volatile solvent having a comparatively low boiling point and a film forming or coating substance, and has to do with means for and a method of preforming the coating operation.

It is well known to coat objects by spray painting at atmospheric or room temperature, and by dip painting. The paint or coating material used in such known methods usually is slow drying and not well suited to commercial production. It is also known to spray coat or paint articles with a coating material containing a low-boiling volatile solvent such as perchlorethylene, trichlorethylene, and solvents of generally like character. In such known methods the paint is atomized or broken up into fine particles which impinge upon the articles forming small pimples or craters which do not readily coalesce and level off, rendering it difficult to obtain an acceptable coat of paint, which should be smooth and of uniform thickness. With a view to avoiding that difficulty it has been proposed to preheat the articles and spray them in a vapor of the paint solvent, but that incurs difficulties, to be referred to more fully presently. The solvent used is quite expensive and is toxic when mixed with air. It is important, therefore, that escape to atmosphere of the solvent vapors be effectively guarded against, both from the standpoint of expense and the health of the operating personnel.

The Hendrixson patent, No. 2,861,897 discloses an apparatus and a method in which the article is preheated to at least the boiling point of the solvent of the coating material, either exteriorly of the apparatus or by immersion in a vapor of that solvent or another solvent, in the apparatus, and while in its preheated condition is sprayed with the coating material while immersed in the vapor of the solvent used in such material. Preheating in a solvent vapor serves to degrease the article and effectively clean it preliminary to spray coating, which frequently is desirable. During spraying the article remains in the vapor of the solvent of the coating material until the coating attains the desired thickness, the solvent of the sprayed material evaporates rapidly, conducive to rapid drying, and after the coating has attained the desired thickness the coated article is withdrawn from the solvent vapor. The method of the Hendrixson patent provides for rapid coating and drying of articles and is of substantial merit and practical value in certain operations. It is subject to certain difficulties, however, from the practical standpoint. One difficulty is that precise control of temperatures is required, often hard to accomplish, particularly if the article is preheated in the vapor of a solvent the same as that of the coating material or composition. Spraying the article in the vapor of the solvent of the coating material incurs the risk that the article, especially if of metal, will cool to a temperature lower than that of the vapor. That risk is increased by holding the article in the vapor zone until the coating has attained the desired thickness. Should the article cool to a temperature lower than that of the vapor in which it is being sprayed, the solvent vapor would condense upon the cooled article resulting in solvent "wash-off," i.e., removal or washing off of the coating material by the condensed solvent. The length of time that the article can be held in the vapor zone without condensation of vapor and resultant wash-off occurring is rather limited, which limits the possible range of thickness of the coating which can be applied to the

article in the vapor zone of the solvent of the coating material. Also, the temperature of the article as it enters the solvent vapor paint spray zone, at best, is but slightly higher than that of the vapor in that zone. Accordingly, due to the slight temperature differential, the rate of evaporation of solvent from the coating material sprayed onto the article is restricted and the time during which such evaporation occurs is of comparatively short duration, due to necessity of removing the article from the vapor spray zone before it drops to a temperature lower than that of the vapor.

The Bede patent, No. 2,763,575 discloses an apparatus and a method, differing from Hendrixson, for spray coating articles with materials or compositions of the character referred to above. In Bede the coating composition is heated, under pressure, to a temperature of at least 135° F., at which the solvent content, within a stated range, would boil off at atmospheric pressure. The hot composition or paint is sprayed onto the article, with the latter at atmospheric or room temperature, approximately 70° F., in a chamber heated to a temperature at least 20° F. higher than that of the article, preferably equal to or slightly less than that of the paint. The sprayed paint condenses on the relatively cold article, spraying being continued until a coating of the desired thickness has been attained. Cooling coils may be provided at areas of the chamber remote from the spray zone, for condensing solvent fumes to prevent escape thereof to atmosphere, the condensate and the excess sprayed paint being returned to a tank from which the paint is delivered to the spray means. The solvent is quickly released from the paint, due to the high temperature and high pressure conditions obtaining. As a result the spray chamber is filled with solvent vapor and the article is sprayed in a solvent vapor laden atmosphere. The method of Bede thus aggravates the difficulty of solvent wash-off and sacrifices rapid drying of the coated article, because the latter is relatively cold and the temperature of the spray zone is approximately the same as that of the sprayed paint. Accordingly, the solvent of the paint is not rapidly driven off by heat derived from the article, but evaporates comparatively slowly in the atmosphere after the coated article passes out of the chamber. Aside from slow evaporation of the solvent, that is objectionable is introducing into the atmosphere toxic vapors of the paint solvent. Bede states that alternatively, when the coating on the article has attained the desired thickness, the spraying operation could be interrupted and the article retained within the chamber until the coating had completely dried. That obviously would increase the risk of solvent wash-off and would also slow down the coating operation to such an extent as to render it impractical for high speed industrial operations. The method of Bede requires precision control of temperatures and accurate timing to assure acceptable results, objectionable in volume production for obvious reasons.

My invention is directed to means for and a method of coating articles with compositions, hereinafter referred to generically as paint, of the character above mentioned, whereby the difficulties encountered in the known methods above described are avoided. The means or apparatus of my invention is, in general, similar to known degreasing machines but differs therefrom in certain important respects having to do with the method of coating or painting articles in accordance with the method of my invention. In its preferred form, the apparatus, hereinafter referred to as a machine, provides for degreasing and preheating the articles to be coated and jet painting the articles while hot in a space free of solvent vapor, either entirely or sufficiently to eliminate condensation of solvent vapor on the coated articles, and has means effective for preventing escape of solvent

vapors to the atmosphere. The jet coating space or zone opens into an exit passage or tunnel so disposed and cooled as effectively to prevent escape therefrom to atmosphere of solvent vapors and the articles are quickly dried by evaporation of the solvent of the coating material or paint, so that the coated articles are compietely free of solvent, or substantially so, as they enter the exit passage, and leave the machine in a coated and solvent free condition. In the method of my invention, the articles may be preheated by degreasing and, while in their preheated condition, jet coated in a space free of solvent vapor whereby risk of solvent vapor wash-off is eliminated and the coating of the articles may safely be continued until the coat applied has attained the desired thickness. Alternatively, if the articles are in a clean condition suitable for painting, the degreasing step may be omitted and the articles, at room temperature, may be jet coated or painted in a space maintained free of solvent vapor in condensible amount, or under conditions effectively guarding against condensation of solvent vapor on the articles. Further objects and advantages of my invention will appear from the detail description.

In the drawings:

FIGURE 1 is a semi-diagrammatic lengthwise sectional view of a painting machine embodying my invention; and

FIGURE 2 is a view similar to FIGURE 1 but of a modified form of painting machine embodying my invention.

The machine shown in FIGURE 1 is, in general, similar to known degreasing machines but differs therefrom in certain respects particularly adapting it for jet painting. It has an enclosing housing **3** providing an entrance passage or tunnel **4** leading at an inclination downward to a solvent tank **5** having a roof **6**, the inner end wall of tank **5** being of less height than the outer end wall thereof and joined to the inner end wall of a paint tank **7**, providing a baffle or partition **8** between the two tanks. The outer end wall of paint tank **7** extends to the same height as the outer end wall of the solvent tank **5** and cooling coils **10** and a cooling jacket **11**, through which a suitable coolant is circulated, extend about the tanks **5** and **7** at the top thereof. A shallow trough **12** underlies the cooling coils **10** and is provided with suitably disposed means (not shown) for draining solvent condensate back into a pure solvent sump **13** at the bottom of the inner portion of tank **5**. The solvent tank **5** is further provided at the bottom of the outer portion thereof with an impure solvent sump **14**. The sumps **13** and **14** have therein suitable heating means, such as steam coils **15**, and the paint tank **7** is likewise provided at the bottom thereof with a paint sump **16** and steam heating coils **17**. The sump **14** contains a body of impure solvent, contaminated by grease and foreign materials from the work pieces or articles under treatment. Pure solvent is supplied sump **13** from trough **12**, supplemented by other means if desired, and flows therefrom over a weir **18** between sumps **13** and **14** into the latter. Alternatively, pure solvent from trough **12** may be delivered, in whole or in part, to sump **16** in replacement of loss of solvent from the paint due to flow of paint solvent vapor into solvent tank **5**.

End walls **20** and **21** extend upward from the outer end of tanks **5** and **7**, respectively. An exit passage or tunnel **22** leads from end wall **21** at an inclination upward to the outlet or discharge end of housing **3**. A condensate and paint drip deflector **23** extends from the lower end of the inclined bottom wall **24** of passage **22** inwardly and downwardly over cooling coils **10** and trough **12** for directing paint drippings, particularly, and solvent condensate into paint tank **7**. The wall **24** is provided with an exterior cooling jacket **25** through which a suitable coolant is circulated in a known manner. Passage **22** preferably is also provided with supplementary cooling means at the sides thereof, such as

cold plates, one of which is shown at **26**, maintained at a suitable temperature in a known manner.

The solvent in tank **5** is the same as the solvent of the paint in tank **7** and is heated to its boiling point, the paint in tank **7** being also heated to approximately its boiling point. The evolved solvent vapor provides a saturated or concentrated vapor zone overlying the liquid solvent and the paint in the tanks and extending across the baffle or partition **8** therebetween, the vapor from the paint tank mixing with the vapor from the solvent tank. The top of the vapor zone, i.e., the vapor-air interface, indicated by the dash and dot line **27**, is maintained substantially constant by the cooling coils **10**, at or adjacent the mid-height thereof, and the condensate therefrom flows back into sump **13**. Upper and lower spray means, comprising spray heads **28** and nozzles **29**, of suitable known type, is mounted in tank **5** within the vapor zone and above the weir **18**. Jet means, comprising jet heads **30** and nozzles **31** is mounted in housing **3**, at opposite sides thereof, above paint tank **7** and in the space above the vapor zone. Solvent under appropriate pressure is supplied to spray heads **28** and nozzles **29** by suitable known means, conveniently by a pump **32** having its intake connected by a conduit **33** to the pure solvent sump **13** and its discharge connected by conduit **34** to the spray heads **28**. In like manner, paint under appropriate pressure is supplied to the jet heads **30** and nozzles **31** by a pump **35** and conduits **36** and **37**, the pressure in the latter instance not being in excess of approximately 10 p.s.i. and such as to assure that the hot paint is projected onto the article in continuous and unbroken jets or solid streams as distinguished from sprays in which the paint is atomized or broken up into fine particles. The pumps **32** and **35** are driven by electric motors **32***a* and **35***a*, respectively.

The spray heads and nozzles **28** and **29** are disposed between a box-like anti-diffusion chamber **39** closed at its top by a wall **40** and extending downward an appreciable distance into the concentrated vapor zone in the tank **5**, and the weir **18**, the articles under treatment passing between the two opposed spray means. Preferably, though not necessarily, the chamber **39** is provided with a cooling jacket **41** through which a suitable coolant is circulated in a known manner. The anti-diffusion chamber is similar to that of the Dammers Patent No. 2,273,939 and functions in the same manner to reduce the effective evaporative area of the vapor, minimize the air velocity over the vapor surface area exposed to atmosphere, eliminate air currents in the area covered by the chamber and to confine turbulence to the area covered by the chamber while isolating the effects of turbulence from the evaporative areas which are necessarily exposed to the atmosphere for passage of the work pieces. In effect, the chamber **39** eliminates vaporization from a vapor area equal to the bottom of that chamber. While the chamber **39** is preferred, as being conducive to reducing possible escape of solvent vapor, an important consideration, it is not essential to my instant invention and may be omitted, though preferred.

The articles **43** to be jet coated or painted are passed through the machine, from the entrance end to the exit end thereof, by an endless conveyor **44** of known type the lower run of which underlies the roof of housing **3** adjacent thereto and generally parallel therewith. Hangers **45** attached to conveyor **44** depend therefrom and are provided at their lower ends with suitable means, such as hooks, for receiving the articles **43**, shown as rings by way of illustration. The articles may, of course, be of any suitable shape and suspended from the conveyor in any suitable manner. The hangers **45** are of such length that the articles **43** first pass through the concentrated vapor zone overlying the solvent in tank **5**, where they are heated to a temperature approximately the same as, or higher than, the boiling point of the pure solvent, the vapor being at a temperature somewhat higher than the

boiling point of the pure solvent due to the presence of some impurities in the vapor evolved from the contaminated solvent in sump **14**. The articles **43** are then sprayed with pure solvent, effective for removing any adhering particles of foreign materials or grease from the articles.

The heated articles then pass upward over the baffle or partition **8** between tanks **5** and **7** into the painting zone, which is above the concentrated vapor zone and is free of solvent vapor, either completely or substantially so, effectively eliminating possibility of condensation of solvent on the coated articles. In that connection, it is necessary for a solvent vapor-air mixture to contain at least approximately 17% by volume of solvent vapor in order to obtain condensation of the solvent vapor. Accordingly, the statement that the painting zone is free of solvent vapor is to be construed as meaning that such zone contains not over 17% of solvent vapor, usually considerably less or none. Paint under appropriate pressure—approximately 10 p.s.i.—is supplied to the jet heads **30** and nozzles **31** by pump **35**. The temperature of the paint is lowered slightly by the jetting thereof and the jets of paint impinge upon the preheated articles **43**, which are then at a temperature approximating the boiling point of the pure solvent. As the paint impinges upon the article the solvent is rapidly volatilized and flashed off by heat derived from the article supplemented by the heat of the paint, leaving the article with a uniform coating of paint in a substantially solvent free condition. The excess paint drips back into the paint sump **16** and the liberated solvent vapor, being heavier than air, rapidly sinks into the concentrated vapor zone. Such small amount of solvent vapor as may remain in the painting zone is in highly attenuated form due to the much greater volume of air present there, and will not condense. The cooling means in the painting zone and exit passage or tunnel **22** effectively cools the air therein and causes any solvent vapors present in such areas to sink rapidly into the concentrated vapor zone and to the bottom wall **24** of exit passage **22**, effective for keeping the painting zone and passage **22** substantially free of solvent vapors while creating a slight down draft which effectively prevents escape to atmosphere of solvent vapor present in passage **22**. Such down flow of solvent vapor creates at the top of the concentrated vapor zone and at the bottom wall **24** of passage **22** a vapor-air mixture containing solvent vapor in condensible amount, in excess of 17%. The solvent present in that mixture is condensed and the condensate is returned to tank **7** and sump **13**. That assures continued down flow of the solvent vapor-air mixture from the painting zone and in passage **22**, such that the latter and the painting zone are maintained free of solvent vapor, either completely or to such an extent that solvent vapor in condensible amount is not present therein.

Due to the fact that the painting zone is maintained free of solvent vapor, either completely or to an extent eliminating possibility of solvent vapor condensing upon the painted article, the article may remain in the painting zone until the paint coating thereon has attained any desired thickness, within practical limits, without risk of solvent wash-off of the paint. Any solvent vapor present in the bottom of the exit passage **22** in condensible form is rapidly condensed, as above explained, and the condensate flows down the inclined bottom wall **24** of that passage into the paint tank **7** and thence to the sump **16**. The exit passage **22** is thus maintained free of solvent vapor which could condense upon the coated article, even if the latter were at a temperature substantially lower than the boiling point of the solvent. That assures that the jet painted articles will leave the machine with a uniform coating of paint of the desired thickness in a dry condition and unimpaired by solvent wash-off.

The method of painting in the machine of FIGURE 1 comprises preheating the article to a temperature as high as the boiling point of the solvent of the paint, projecting

solid streams or jets of the paint onto the article while the latter is at approximately the boiling point of the solvent and in a space free of solvent vapor, either completely or sufficiently to eliminate possibility of condensation of solvent vapor on the article being painted, and rapid drying of the coating on the article by evaporation of the solvent of the paint by heat derived from the article. More specifically, and as practiced with the apparatus or machine of FIGURE 1, the method comprises cleaning and preheating the article in the solvent vapor and pure solvent spray, positioning it in a vapor free painting zone above the vapor zone, jet coating the article in the painting zone while preheated, and removing the coated article from the painting zone. The preferred method of my invention is, in its broader aspects, more closely analogous to a flow coating method than a spraying method and avoids the difficulties inherent in the latter due to the atomizing and breaking up of the paint into fine particles, referred to above.

The machine of FIGURE 2 is, in general, similar to that of FIGURE 1. It comprises an enclosing housing **48** having an entrance passage **49** inclined downward to a solvent tank **50** provided with contaminated solvent and pure solvent sumps **51** and **52**, respectively, separated by a weir **53** and each provided with heating coils **54**. An intermediate passage **55** of generally inverted V shape leads from tank **50** upwardly and then downwardly over a partition **56** separating tank **50** from a paint tank **57** into which passage **55** opens. An exit passage **58** leads upward at an inclination from tank **57**. The entrance passage **49** is cooled at its inner portion in a suitable manner, conveniently by cold plates, one of which is shown at **49***a* disposed at opposite sides thereof, and by a bottom wall cooling jacket **59**. Cooling coils **60** and a cooling jacket **61** extend about the top of tank **50**. Sump **51** contains a body of contaminated liquid solvent and sump **52** contains a body of pure solvent, each maintained at boiling point by heating coils **54**, the evolved solvent vapor providing a concentrated vapor zone the top of which, indicated by the dot and dash line **60***a*, is maintained adjacent the midheight of the cooling coils **60** by the cooling effect thereof. A shallow trough **62** underlies the cooling coils **60** for receiving solvent condensate therefrom and returning it to sump **52**. The paint tank **57** is of stepped formation, comprising a lower box-like sump **63** of substantial depth, which receives a body of paint and from which extends an upwardly flaring upper portion **64**. A pure solvent sump **65** overflows into paint sump **63** at one end thereof and above the level of the body of paint therein, through a downwardly inclined passage or neck **66** defined in part by a baffle **67**, sump **65** being otherwise closed and containing a body of pure solvent. Heating coils **68** are disposed in each of the sumps **63** and **65** effective for maintaining the paint or solvent, as the case may be, therein at about boiling point. Cooling coils **69**, and a cooling jacket **70** extend about the top of sump **63** effective for maintaining at a constant level therein, indicated by the dot and dash line **63***a*, adjacent the midheight of coils **69**, the top or upper face of the concentrated vapor zone produced by solvent vapor evolved from the boiling paint in sump **63** and solvent or paint in sump **65**. Upper and lower spray means respectively comprising a spray head **71** and nozzles **72**, of suitable known type, are provided in the solvent tank in underlying relation to an antidiffusion chamber **73** provided with cooling jacket **74**, as before. Pure solvent is delivered from sump **52** to spray head **71** by means of a pump **75**, intake conduit **76** and discharge conduit **77**. Pump **75** is driven by electric motor **75***a*.

The upper portion **64** of paint tank **57** provides an enclosed painting zone overlying the concentrated vapor zone of sump **63**. Suitable jet means comprising a jet head **78** and associated jet nozzles **79**, of suitable known type, is provided at the top of the painting zone. Paint is delivered from sump **63** to each of the jet heads **78**, under appropriate pressure—approximately 10 p.s.i.—by

a pump 80 having its discharge connected by a conduit 81 to jet head 78 and its intake connected by a conduit 82 to sump 63 adjacent the bottom thereof. Cooling coils 83 and a cooling jacket 84 extend about the top of portion 64 of paint tank 57, the space overlying portion 64 of paint tank 57 is cooled in a suitable manner, as by a cold plate 85 disposed at each side thereof, and the downwardly and inwardly inclined bottom wall 86 of exit passage 58 is cooled by a cooling jacket 87. The pump 80 is driven by an electric motor 80*a*.

In certain cases it may be desirable to preheat the articles to a temperature substantially higher than the boiling point of the paint solvent, to assure extremely rapid drying. In such cases the solvent in the solvent tank 50 may be different from the paint solvent. For example, the solvent in tank 50 may be perchlorethylene, which has a boiling point of about 121.2° C. and the paint solvent may be trichlorethylene, which boils at about 86.9° C. at atmospheric pressure. Still referring to FIGURE 2, the articles 43 to be jet painted are suspended by hangers 45 from the lower run of a conveyor 44*a* of conventional type, with the lower run thereof generally paralleling the top wall or roof of housing 48 but dipping downward over portion 64 of paint tank 57. The cold plates 85, in conjunction with the cooling coils 83 and jacket 84 and the jacket 87, assure that the area above the painting zone is maintained free of condensible solvent vapor. The solvent vapor, being heavier than air, sinks rapidly into the concentrated vapor zone in the upper portion of sump 63, carrying with it the vapor liberated from the paint jets, and the vapor entering the upper portion of the concentrated vapor zone is there rapidly condensed by the cooling coils 69 and jacket 70. The article being painted is heated to the temperature of the paint, which is higher than that of the solvent vapor liberated from the paint, due to the cooling effect incident to liberation of such solvent. The net result is that acculation of solvent vapor in substantial amount in the painting zone is guarded against and the temperature of the article being painted in that zone is maintained higher than the temperature of such solvent vapor as may be present therein. That effectively eliminates possibility of vapor condensation on the article with resultant solvent wash-off, and the article may safely remain in the painting zone as long as desired. The solvent condensate from above portion 64 of paint tank 57 flows into trough 88 underlying cooling coils 83 and thence into trough 89 underlying cooling coils 69, condensate from trough 89 being delivered to sump 65 from which pure solvent overflows into sump 63. The baffle 67 guards against paint drip or splash from the paint nozzles 79, entering the sump 65.

In the travel of the conveyor from the entrance end to the exit end of housing 48, the articles pass through the concentrated vapor zone of the solvent tank 50, where they are preheated and degreased and sprayed with pure solvent, from which they pass upward over partition 56 and then downward into the painting zone, where they are jet coated or painted. In that connection, the jets of paint from the nozzles 79 are directed downward onto the articles being painted. The solvent vapor released from the paint is heavier than air and is caused, by the downwardly directed jets of paint, to flow downward into the concentrated solvent vapor zone overlying the paint in sump 63. That, in conjunction with the cold plates 85 and the cooling coils 83 and jacket 84 normally assures that solvent vapor in condensible amount can not be present in the painting zone, and the heating of the article by the paint guards against condensation of solvent vapor thereon, if solvent vapor in condensible amount is present in the painting zone, as may occasionally happen.

Due to the fact that the maximum amount of solvent present in the painting zone normally is so slight as to preclude possibility of solvent vapor condensing upon the coated article, and the heating of the article by the paint to a higher temperature than the solvent vapor, the risk of solvent wash-off is eliminated and articles being jet painted may safely remain in that zone until the applied coating has attained any desired thickness, within practical limits. The articles pass from the painting zone through the exit passage or tunnel 58 and out of the machine in a substantially completely solvent free and smoothly coated condition. The cooling of the space above the paint tank and of the bottom wall 86 of exit passage 58, supplemented by the downwardly projected jets of paint, tends to cause a slight downdraft in the latter, effective for preventing escape to atmosphere of solvent vapor or fumes, desirable as saving solvent and as avoiding risk of harmful effects of vapor fumes to operating personnel.

In the preferred form of the method of my invention, the paint is projected onto the articles in solid jets or streams and is not atomized or otherwise broken up into small particles. It is possible however, to obtain acceptable results by spraying the point onto the articles while they remain in the vapor free painting zone, because the heat of that zone, supplemented by the heat of the article and of the paint, in conjunction with the solvent vapor released from the paint and flowing downward over the article, will in certain cases suffice to cause coalescence and levelling of the paint particles. It will be understood that, in its broader aspects, the method of my invention includes spraying the paint onto the articles as well as projecting the paint onto the articles in solid streams or jets, though the latter method is the more reliable of the two as and for the reasons above stated and is preferred. In either case the paint is projected onto the articles in a space free of condensible solvent vapor thereby eliminating risk of solvent condensate wash-off, or under conditions precluding condensation of solvent vapor on the articles; as explained above.

As has been indicated above, if the articles are in a clean condition suitable for painting, they do not need to be degreased. In such cases, the degreasing section of the machine of FIGURE 2 may be omitted and the articles, at room temperature, may be passed through the painting section of that machine, or equivalent means, and there jet painted in the manner above described.

It is customary to provide degreasing machines, which are similar, in general, to the machines herein disclosed, with various accessories which have no direct bearing on the machines of my invention so far as their use for practising the method of my invention is concerned. It is to be understood that the machines of my invention may be provided with such accessories. It will also be understood that changes in detail may be resorted to, both as to the machines and the method of my invention, and I intend to include all such variations, as fall within the scope of the appended claims, in this application in which the preferred forms only of my invention have been disclosed.

I claim:

1. In painting means, a tank having in the lower portion thereof a sump for containing a body of paint including a volatile solvent the vapor of which is toxic and heavier than air, means for heating the paint in said sump, cooling means extending about said tank above said sump, said tank extending upward a substantial distance beyond said cooling means and the latter being effective for restraining upward flow of evolved solvent vapor and to provide a concentrated vapor zone in the lower portion of said tank between the body of paint and said cooling means and a painting zone in the upper portion of said tank overlying and opening downward into said concentrated vapor zone and substantially free of solvent vapor, means for supporting articles to be painted within said tank above said concentrated vapor zone and in said painting zone and overlying said sump, and means mounted within said tank and disposed in said painting zone in

overlying relation to said sump for projecting onto articles in said painting zone paint taken from said body of paint.

2. In painting means, a tank having in the lower portion thereof a sump for containing a body of paint including a volatile solvent the vapor of which is toxic and heavier than air, means for heating the paint in said sump, cooling means extending about said tank above said sump, said tank extending upward a substantial distance beyond said cooling means and the latter being effective for restraining upward flow of evolved solvent vapor and to provide a concentrated vapor zone in the lower portion of said tank between the body of paint and said cooling means and a painting zone in the upper portion of said tank overlying and opening downward into said concentrated vapor zone and substantially free of solvent vapor, means for supporting articles to be painted within said tank above said concentrated vapor zone and in said painting zone and overlying said sump, and means mounted within said tank and disposed in said painting zone in overlying relation to said sump for projecting downwardly onto articles in said painting zone paint taken from said body of paint.

3. In painting means, a tank having in the lower portion thereof a sump for containing a body of paint including a volatile solvent the vapor of which is toxic and heavier than air, means for heating the paint in said sump, cooling means extending about said tank above said sump, said tank extending upward a substantial distance beyond said cooling means and the latter being effective for restraining upward flow of evolved solvent vapor and to provide a concentrated vapor zone in the lower portion of said tank between the body of paint and said cooling means and a painting zone in the upper portion of said tank overlying and opening downward into said concentrated vapor zone and substantially free of solvent vapor, means for supporting articles to be painted within said tank above said concentrated vapor zone and in the lower portion of said painting zone adjacent said concentrated vapor zone and overlying said sump, means mounted within said tank and disposed in said painting zone in overlying relation to said sump for projecting downwardly onto articles in said painting zone paint taken from said body of paint and cooling means disposed at the sides of said tank above and adjacent said paint projecting means.

4. The method of painting an article with a paint including a volatile solvent the vapor of which is toxic and heavier than air, which comprises heating a body of said paint and thereby producing in an enclosed space a vapor of such solvent, cooling such space effective for producing therein a lower concentrated vapor zone and an upper painting zone overlying and opening into said concentrated vapor zone and substantially free of solvent vapor, disposing the article in said painting zone, projecting onto the article in said painting zone hot paint withdrawn from said body of paint while maintaining said painting zone free of solvent vapor in condensible amount, drying the paint on the article in the painting zone by rapid evaporation of the solvent content of the paint by the heat thereof supplemented by the surface heat of the article, and removing the painted article from said painting zone through an exit area free of solvent vapor.

5. The method of painting an article with a paint including a volatile solvent the vapor of which is toxic and heavier than air, which comprises heating in an enclosed space a body of said paint thereby producing a vapor of such solvent, cooling such space effective for producing therein a lower concentrated solvent vapor zone overlying the body of paint and an upper painting zone overlying and opening into said concentrated vapor zone and substantially free of solvent vapor, disposing the article in said painting zone, projecting onto the article in said painting zone hot paint withdrawn from said body of paint while maintaining said painting zone free of solvent vapor in condensible amount, drying the paint on the article in the painting zone by rapid evaporation of the solvent content of the paint by the heat thereof supplemneted by the surface heat of the article, and removing the painted article from said painting zone through an exit area free of solvent vapor.

6. The method of painting an article with a paint including a volatile solvent the vapor of which is toxic and heavier than air, which comprises heating in an enclosed space a body of said paint thereby producing a vapor of such solvent, cooling such space effective for producing therein a lower concentrated solvent vapor zone overlying the body of paint and an upper painting zone overlying and opening into said concentrated vapor zone and substantially free of solvent vapor, disposing the article in said painting zone, projecting downward onto the article in said painting zone hot paint withdrawn from said body of paint while maintaining said painting zone free of solvent vapor in condensible amount, drying the paint on the article in the painting zone by rapid evaporation of the solvent content of the paint by the heat thereof supplemented by the surface heat of the article, and removing the painted article from said painting zone through an exit area free of solvent vapor.

7. The method of painting an article with a paint including a volatile solvent the vapor of which is toxic and heavier than air, which comprises heating in an enclosed space a body of said paint thereby producing a vapor of such solvent, cooling such space effective for producing therein a lower concentrated solvent vapor zone overlying the body of paint and an upper painting zone overlying and opening into said concentrated vapor zone and substantially free of solvent vapor, disposing the article in said painting zone, projecting onto the article in said painting zone hot paint withdrawn from said body of paint while maintaining said painting zone free of solvent vapor in condensible amount, drying the paint on the article in the painting zone by rapid evaporation of the solvent content of the paint by the heat thereof supplemented by the surface heat of the article and removing the painted article upward out of the painting zone and through an exit area free of solvent vapor.

8. In article treating means, a housing comprising a first tank and a second tank with inlet and exit passages leading to and from said tanks respectively, said tanks respectively having in the lower portion thereof a sump adapted to contain a body of a liquid comprising a chlorinated hydrocarbon the vapor of which is toxic and heavier than air, means for heating the liquid in said pumps, cooling means disposed above the sumps of said tanks effective for restraining upflow of evolved solvent vapor to provide a concentrated vapor zone extending upward in each tank to the lower portion of said cooling means, said housing extending a substantial distance upward beyond the cooling means of said second tank providing above the last mentioned cooling means a treating zone overlying and opening downward into the concentrated vapor zone of said second tank and substantially free of solvent vapor, means for conveying articles to be treated through said inlet passage and the concentrated vapor zone in said first tank and thence into said treating zone and from the latter through said exit passage, and means within said housing and overlying the concentrated vapor zone and the sump of said second tank for projecting onto articles in said treating zone liquid taken from the sump of said second tank.

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