April 24, 1962 H. N. ARNOLD ET AL 3,030,913

MACHINE FOR PAINTING ARTICLES

Filed Sept. 25, 1959 3 Sheets-Sheet 1

Fig. 1.

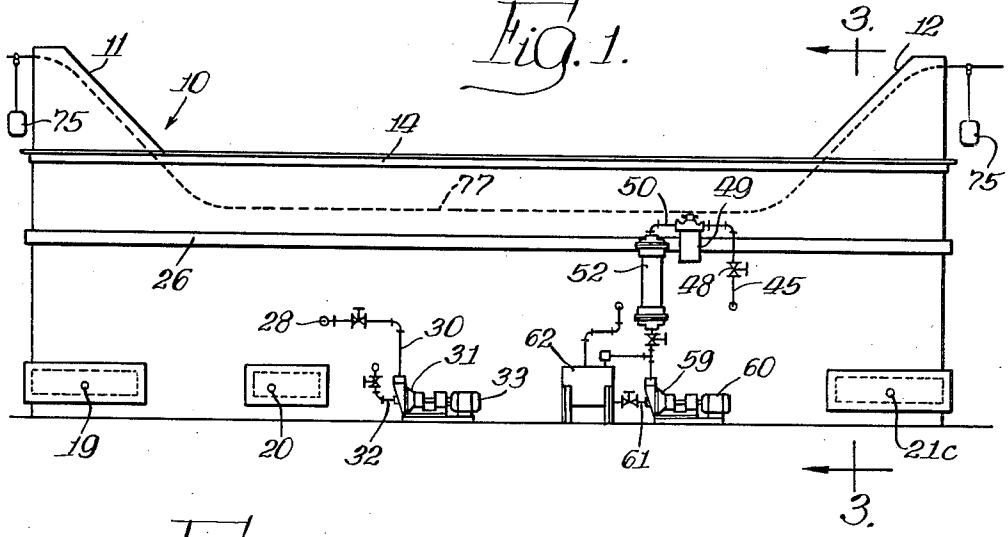


Fig. 3.

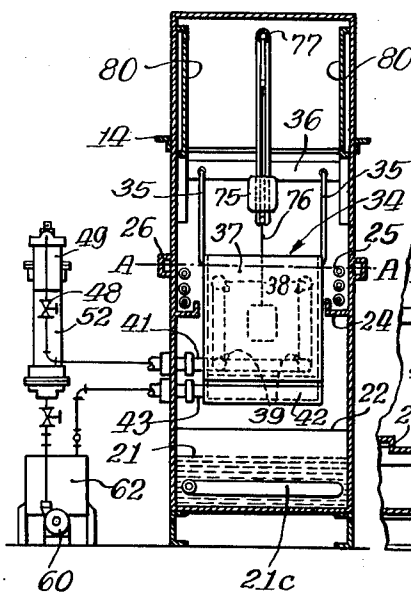
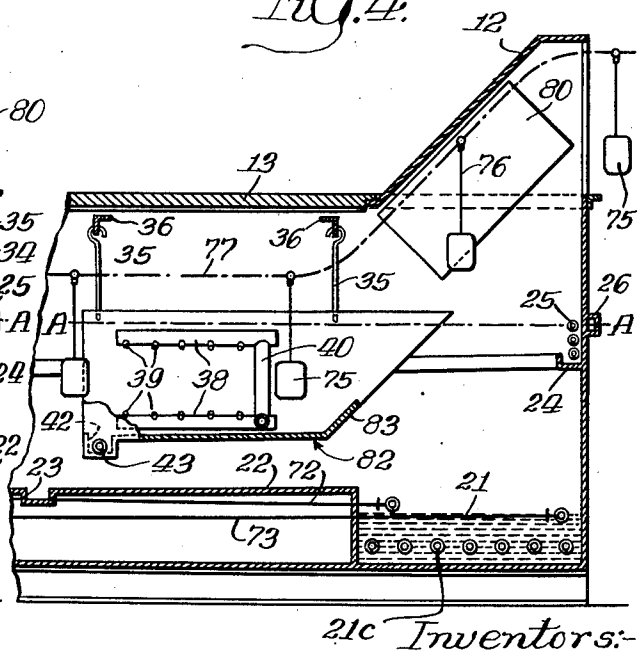


Fig. 4.



Inventors:-
Howard N. Arnold,
Joseph Pokorny,
Montgomery B. Pickett
BY
Brown, Jackson,
Boettcher & Dienner,
Attys

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Filed Sept. 25, 1959 3 Sheets-Sheet 2

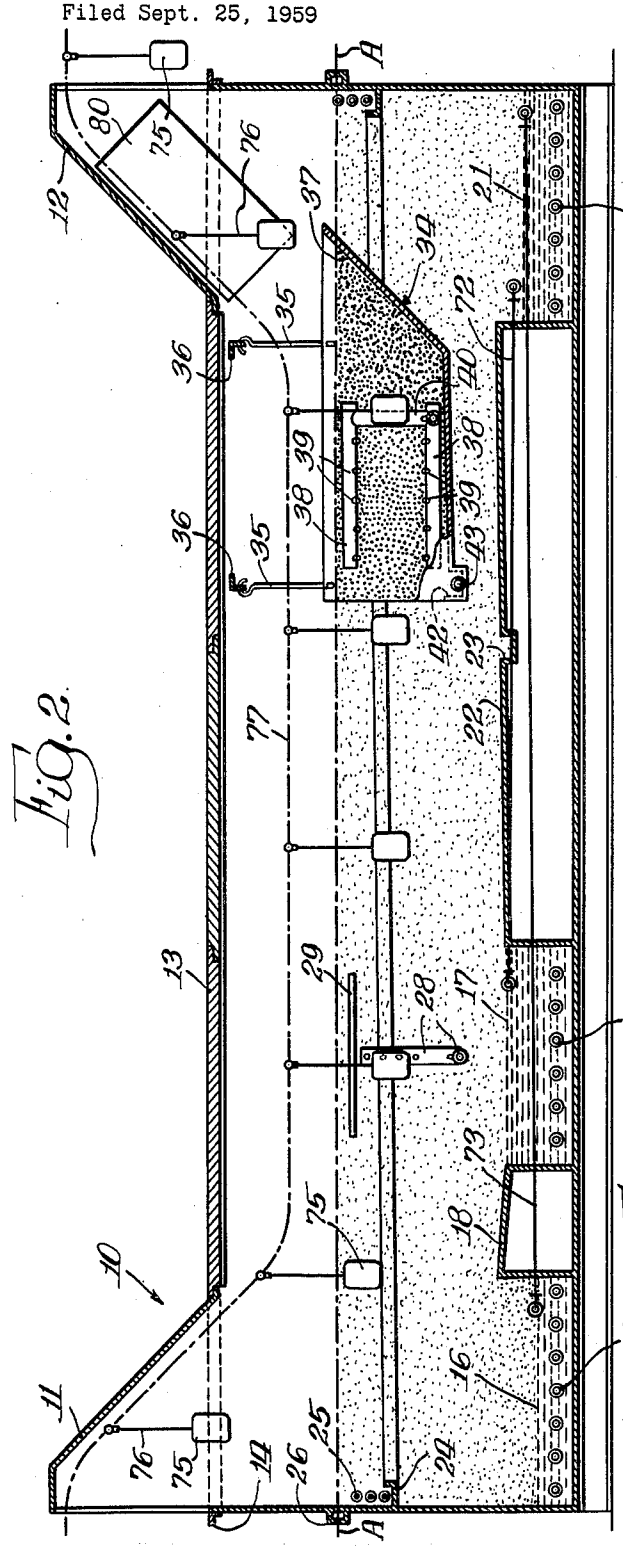


Fig. 2.

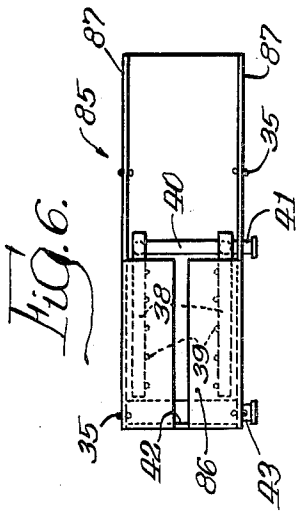


Fig. 6.

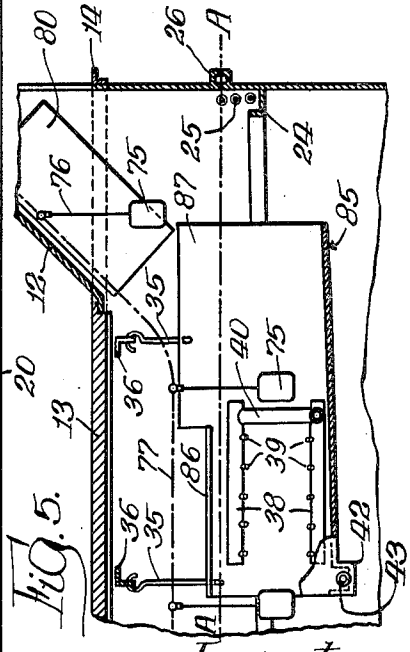


Fig. 5.

Inventors:
Howard N. Arnold,
Joseph Pokorny,
Montgomery B. Pickett
BY Brown, Jackson,
Boettcher & Dienner,
Atty's.

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MACHINE FOR PAINTING ARTICLES

Filed Sept. 25, 1959 3 Sheets-Sheet 3

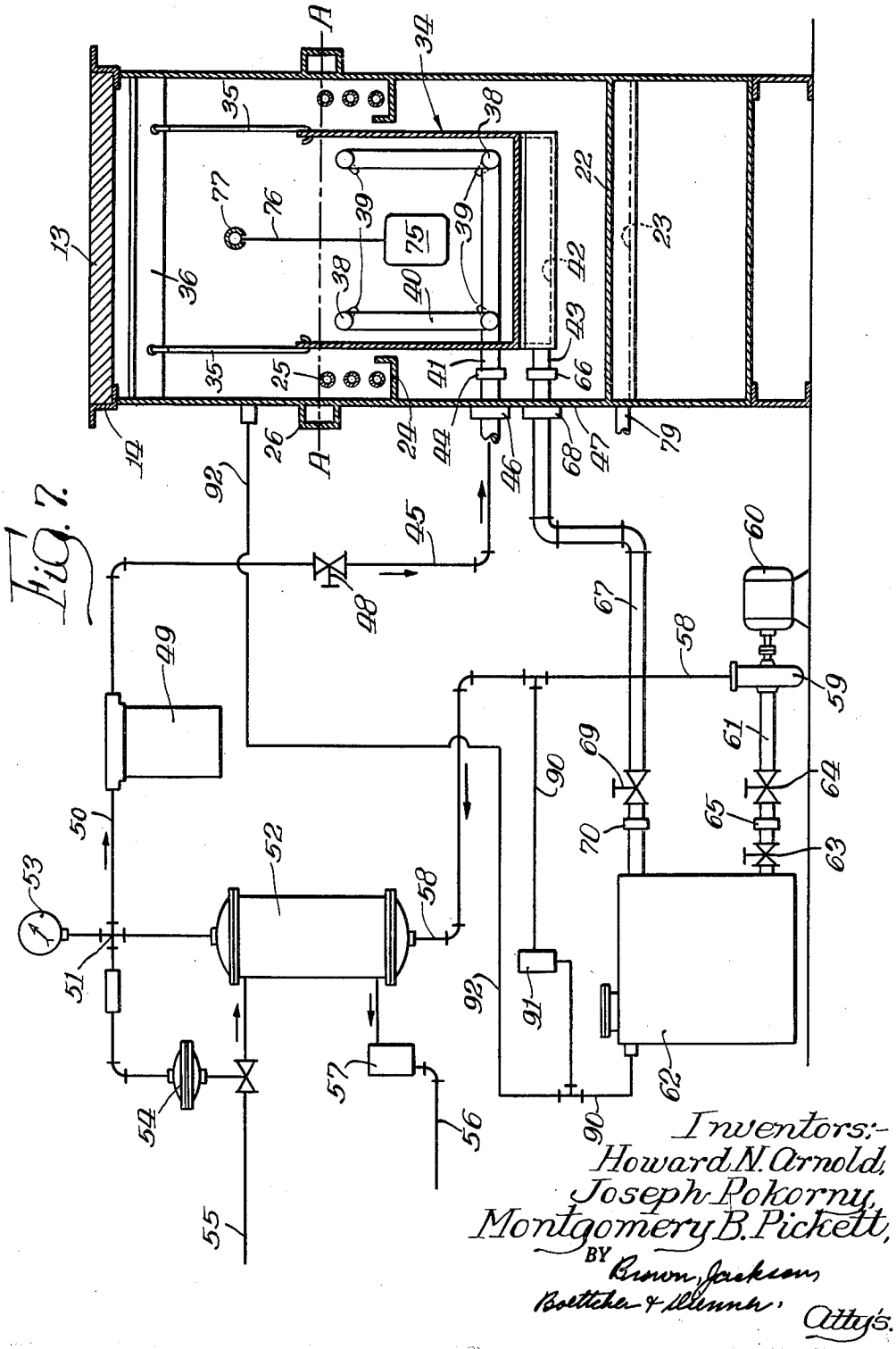


Fig. 7.

Inventors:-
Howard N. Arnold,
Joseph Pokorny,
Montgomery B. Pickett,
BY Brown, Jackson,
Boettcher & Dienner,
Atty's.

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3,030,913

MACHINE FOR PAINTING ARTICLES

Howard N. Arnold, Western Springs, Joseph Pokorny, Lincolnwood, and Montgomery B. Pickett, Glen Ellyn, Ill., assignors to G. S. Blakeslee & Co., Cicero, Ill., a corporation of Illinois

Filed Sept. 25, 1959, Ser. No. 842,325
5 Claims. (Cl. 118—72)

This invention relates to painting or coating articles by projecting onto them a coating composition or paint comprising a volatile solvent having a comparatively low boiling point and a film forming or coating substance, and has to do with means for performing such an operation.

It is known to paint articles by spraying them with paint containing volatile solvents such as trichlorethylene, perchlorethylene and the like, but is difficult to obtain satisfactory results. Such paints do not, under ordinary conditions, readily coalesce and level off to form a smooth and continuous coating. Spraying with resultant atomizing of the paint, produces multitudinous specks upon the article, which become pimples or craters causing a rough and unsatisfactory coating surface. It has been proposed to avoid that difficulty by preheating the article to about the temperature of the vapor of the paint solvent, spray the preheated article in the solvent vapor with paint heated to the boiling point of the solvent at atmospheric pressure, and dry the applied coating by rapid evaporation of the solvent content thereof by the heat of the article. In such a method, the preheated article is at a temperature but several degrees higher than that of the solvent vapor, at best, and the paint is cooled incident to spraying thereof to below its boiling point. That incurs risk of cooling of the article, while in the vapor zone, to a temperature lower than the solvent vapor with resultant condensation of solvent vapor upon the sprayed article. When that happens solvent wash-off, i.e., removal of the paint from the article by the solvent condensate thereon, occurs rendering it impossible to obtain a uniform and satisfactory coating. Accordingly, in that method precise control of temperatures, often difficult to attain, is essential and the time during which the article or work piece can remain in the vapor-spray zone without solvent wash-off occurring is limited. That limits the possible maximum thickness of the paint coating which can be applied to the article, and accurate timing also becomes a critical factor. In view of the necessity for precise control of temperature and of timing, the method referred to is not best suited to quantity production in industrial operations.

It has also been proposed to spray articles, at room temperature of approximately 70° F., with full bodied or unthinned paint heated, while maintained under pressure, to a temperature substantially higher than room temperature. The paint is sprayed under pressures of at least 100 p.s.i. preferably 200 to 600 p.s.i., in a chamber of 20° F. above room temperature, i.e. approximately 90° F. In actual practice the paint is heated to a temperature of about 150° F. to 250° F. and is sprayed under a pressure of from 250 to 700 p.s.i., so that it is thoroughly atomized and mechanically subdivided into fine particles. The solvent is released from the paint and the temperature of the latter is substantially reduced, incident to spraying and atomizing thereof under high pressure. The small particles of paint deposited on the relatively cold article or work piece condense thereon and are, for a short time, at a slightly higher temperature so that they coalesce to form a smooth coating. The solvent released from the atomized paint mixes with the air present in the chamber and the spraying of the article occurs in a zone of solvent vapor laden air. The article is at room temperature of 70° F. as it enters the spray chamber, and

the latter is at a temperature of approximately 90° F. Assuming the paint solvent to be trichlorethylene, the temperature of the solvent vapor, lowered somewhat by spraying of the paint possibly would be around 180° F. and it would condense on the relatively cold article causing solvent wash-off. In this method, as in the first method referred to above, precise control of temperatures and accurate timing are critical factors and the maximum possible thickness of the applied coating of paint is limited by the shortness of the time the article being spray painted can safely remain in the solvent vapor spray zone without risk of solvent wash-off.

In the known method first mentioned above, the articles are preheated by degreasing in a first compartment of a degreasing machine and are spray-coated or painted in a second compartment or section of the same machine. The paint or coating material is contained in a sump or tank of the second compartment, from which it is withdrawn and sprayed onto the article. That incurs the difficulty that the degreasing solvent vapor condenses on the side walls of the machine and the condensate, in substantial portions, flows into the paint sump diluting the paint to objectionable extent. A further objection to both of the known methods referred to is that, after prolonged use, the interior of the machine, in the painting zone, becomes coated with the paint. If the type or color of paint to be used is changed, the painting section should be thoroughly cleaned, necessitating shut down of the machine during the cleaning operation. Also, in the machine used in the first mentioned known method, the paint, in finely subdivided or atomized condition, mixes to substantial extent with the degreasing solvent vapor and renders necessary precautions against objectionable paint contamination of the degreasing solvent.

Our invention is directed to an apparatus for coating articles with compositions, hereinafter referred to generically as paint, of the character above mentioned, whereby the difficulties encountered with the known methods and apparatuses, above referred to, are avoided. The means or apparatus of our invention is, in general, similar to known degreasing machines but differs therefrom in important respects particularly adapting it to painting operations. The apparatus of our invention includes means for degreasing and preheating the articles and for coating them in a painting compartment or chamber, within but isolated from the housing of the machine in a manner to guard effectively against possibility of wash-off. The painting chamber is suitably mounted within the housing so as to be readily removable therefrom, is spaced from the walls of the housing so as to provide a painting zone in which objectionable cooling of the articles with possibility of resultant wash-off is eliminated, prevents coating of the interior of the housing with paint, and reduces mixing of the paint with the degreasing solvent vapor while also eliminating necessity for the painted articles passing through the concentrated vapor of the degreasing solvent with possibility of resultant wash-off. Further objects and advantages of our invention will appear from the detail description.

In the drawings:

FIGURE 1 is a side view of a painting machine embodying our invention;

FIGURE 2 is a semi-diagrammatic vertical lengthwise sectional view of the machine of FIGURE 1;

FIGURE 3 is a transverse sectional view taken substantially on line 3—3 of FIGURE 1;

FIGURE 4 is a view similar to FIGURE 2, but of the painting area only of the machine, showing a modified form of painting chamber on an enlarged scale;

FIGURE 5 is a view similar to FIGURE 4, but showing a second modified form of painting chamber;

FIGURE 6 is a top plan view, on an enlarged scale, of the painting chamber of FIGURE 5;

FIGURE 7 is a diagrammatic view, on an enlarged scale, of the means for heating paint under pressure and projecting it onto the articles, and associated parts, the painting chamber and the machine housing being shown in section.

The machine of our invention is, in general, similar to known degreasing machines but differs therefrom in certain respects particularly adapting it for painting. It comprises a housing **10**, which may be of any suitable construction. The housing **10** is shown, by way of illustration, as of box like form having a downwardly and inwardly inclined hood **11** opening into its inlet end and an upwardly and outwardly inclined hood **12** opening from its exit end. The top of housing **10**, between hoods **11** and **12**, is closed by a removable cover **13** preferably formed in several sections having overlapping rabbetted ends to assure a tight-closure. The cover **13** sections may fit snugly within an angle iron reinforcing frame **14** extending about the top of the housing **10** and may be held in place by its own weight or in any suitable known manner.

The housing **10** is provided, at its entrance portion, with two liquid solvent sumps **16** and **17** separated by an upwardly projecting weir **18** extending between the side walls of housing **10** and having its top surface inclined downward toward sump **17**. Each of the sumps **16** and **17** contains a body of a suitable volatile liquid solvent and is provided with heating means of suitable known type, such as steam coils **19** and **20**, respectively. The housing **10** is further provided, adjacent the exit end thereof, with a third liquid solvent sump **21** separated from sump **17** by a raised floor **22** of substantial length inclined downwardly to sump **17** and provided at its midportion with a transverse trough **23**. The sump **21** also contains a body of liquid solvent and is provided with heating coils **21C**. A shallow trough **24** extends along the sides and the ends of housing **10** interiorly thereof, a substantial distance above the liquid solvent sumps and underlies interior cooling coils **25** also extending along the sides and the ends of housing **10**. A cooling jacket **26** extends about the sides and the ends of housing **10** exteriorly thereof, a short distance above trough **24**. The liquid solvent in the sumps **16** and **21** is heated to its boiling point and the liquid solvent in sump **17** is heated to near its boiling point, at atmospheric pressure, by a suitable heating medium, conveniently steam circulated through the coils **19**, **20** and **21C**, respectively, in any suitable known manner. The evolved solvent vapor fills the interior of the housing **10** to a height determined by the cooling coils **25** and jacket **26**, through which a cooling medium, conveniently cold water, is circulated, as is known. There is thus created within the housing **10** a concentrated solvent vapor zone of predetermined height, the top of which, i.e., the solvent vapor air interface, normally is at approximately the midheight of cooling jacket **26**, as indicated by the broken line A—A in FIGURE 2.

Spray means **28** of suitable known type is disposed within housing **10** above sump **17** and underlying a splash shield **29** extending transversely of housing **10**. The shield **29** is formed in two sections spaced apart for passage between them of hangers carrying the work pieces or articles to be painted, as will appear more fully presently. The spray means **28** is connected by a conduit **30** to the discharge of a rotary pump **31**, of suitable known type, the intake of which is connected by a conduit **32** to sump **17**. The pump **31** is driven by an electric motor **33** and the conduits **30** and **32** may be provided with suitable control valves, as is usual in degreasing machines. A box-like unit **34** defining a painting chamber is removably mounted in housing **10**, spaced above floor **22** at the rearward or exit end portion thereof. The unit **34** comprises imperforate side walls connected by an imperforate bottom wall and an imperforate outer or exit end wall **37**, and may be mounted in any suitable manner. Conveniently it is supported by hangers **35** suitably attached to the side walls of unit **34** and having hooks at their upper ends engaging through openings in angle cross-bars **36** extending between and secured to the side walls of housing **10** a short distance below the cover **13**. The painting chamber unit **34** is of generally box like formation, open at its top and its inner or entrance end and closed at its outer or exit end by end wall **37** underlying, and substantially parallel with, the inclined top wall of exit hood **12**. The painting chamber unit **34** is, preferably but not necessarily, of a height to extend above the concentrated solvent vapor zone and is so mounted that its bottom wall is inclined downwardly and inwardly toward floor **22**. Headers **38** are mounted in chamber unit **34**, at the sides and adjacent the top thereof and at the midportion and a short distance above the bottom thereof, and are provided with nozzles **39** for directing paint downwardly and inwardly thereof and upwardly onto articles passing therethrough. The headers **38** are connected together by a substantially U-shaped pipe frame **40** from which a nipple **41** extends through one side wall of painting chamber unit **34**. A trough **42** extends across the inner end of painting chamber unit **34** and is provided with an outlet nipple **43**.

Referring to FIGURE 7, nipple **41** is connected by a union coupling **44** to the inner end of a paint supply conduit **45** passing through a stuffing box **46** in side wall **47** of housing **10** and provided with a hand control valve **48**. The upper end of conduit **45** is connected to the outlet of a paint filter **49** of conventional type, the inlet of which is connected by a conduit **50** to one arm of a cruciform fitting **51** a second arm of which is connected to the outlet of a heat exchanger **52**. A pressure gauge **53** is connected to a third arm of fitting **51**, the fourth arm of which is connected to a pressure responsive valve **54** of conventional type. Valve **54** is disposed in steam supply line **55** connected to the inlet end of the heating coil of the heat exchanger **52**, which is of conventional type, the outlet end of the heating coil being connected to a discharge line **56** provided with a condensate trap **57**, as usual. The inlet of heat exchanger **52** is connected by a conduit **58** to the discharge of a rotary pump **59** of suitable known type, driven by an electric motor **60**. The intake of pump **59** is connected by a conduit **61** to a portable paint supply tank **62**, of adequate capacity, near the bottom thereof, mounted adjacent side wall **47** of housing **10**. The conduit **61** is provided with two hand valves **63** and **64** and, between them, with a union coupling **65**. Nipple **43** of trough **42** is connected by a union coupling **66** to the inner end of a paint return conduit **67** passing through a stuffing box **68** in side wall **47** of housing **10**. The conduit **67** opens at its outer end into tank **62** adjacent the top thereof and is provided with a hand valve **69** and with a union coupling **70** between tank **62** and valve **69**.

Conduit **58** is connected by a pressure relief conduit **90** to the top of tank **62**, the latter conduit being provided with a pressure relief valve **91** of suitable known type which may be adjusted to open responsive to any desired pump pressure, within limits. If the pump pressure in conduit **58** tends to exceed a desired predetermined maximum, the valve **91** opens, effective for returning a portion of the paint to tank **62** and thereby lowering the pressure in conduit **58** to the desired value. That guards against projecting the paint onto the articles being painted under excessive pressure while also assuring that it is projected at substantially uniform pressure, conducive to uniformity in the painting operation, desirable for obvious reasons. A venting conduit **92** is connected at one end to conduit **90**, between relief valve **91** and tank **62** and opens at its other ends, into housing **10** through side wall **47** thereof. Conduit **92** vents tank **62** and guards against possibility of apprecibale pressure being built up therein by solvent vapor released from the hot paint. That is conducive to uniform delivery of the paint

by pump 59 to the paint projecting means and facilitates flow of paint from trough 42 of the painting chamber through conduit 67 to tank 62.

The solvent used in the sumps 16, 17 and 21, and in the paint, may be any suitable volatile solvent the vapor of which is heavier than air, preferably, though not necessarily, a chlorinated hydrocarbon solvent. It may be assumed for purposes of description, that the solvent is trichlorethylene, having a boiling point of about 188° F. at amtospheric pressure. A conduit 72 may connect a point at the level of the liquid solvent in sump 17 to a lower point at about the level of the liquid solvent in sump 21 and is inclined downward toward the latter. Distilled solvent is supplied to sump 17, in a known manner, and the excess flows through conduit 72 into the sump 21, effective for maintaining the latter filled with substantially pure solvent. Also, a conduit 73 may connect the sump 21, at the normal level of the liquid solvent therein to sump 16, at the normal level of the liquid solvent in the latter, conduit 73 being inclined downward toward sump 16 for delivering to the latter any excess liquid solvent which may tend to collect in sump 21.

The solvent in the sumps 16 and 21 is heated to its boiling point, effective for maintaining the housing 10 filled with solvent vapor to the level A—A at a temperature of about 188° F. assuming the solvent to be trichlorethylene. The solvent in sump 17 is maintained at a temperature of about 160° F., at which it may readily be pumped. The articles 75 to be painted are suspended by hangers 76 from an endless conveyor 77, of suitable known type, the lower run of which extends downwardly through hood 11, then parallel with cover 13, spaced a substantial distance therebelow, and thence upwardly and outwardly through hood 12. In the travel of the conveyor 77 the articles 75 are moved through the machine from the entrance passage thereof, defined by hood 11, to and through the exit passage thereof, defined by hood 12. The first enter the concentrated vapor zone, indicated by the light stippling, at a point but slightly in advance of the inner end of sump 16 and soon thereafter pass above the weir 18. The solvent vapor condenses upon the relatively cold articles, effective for removing any grease therefrom, and the condensate drips onto the top of weir 18 from which it flows into sump 17. The articles then pass through the solvent spray zone, where they are subjected to a spray of hot liquid solvent, effective for removing from the articles any adhering particles of foreign materials, the liquid solvent flowing back into sump 17 and thespray shield effectively preventing objectionable turbulence of the vapor at the top of the concentrated vapor zone in the spray area. From the spray zone the articles again pass through the concentrated vapor zone for a substantial distance, for further degreasing and preheating, to the painting chamber unit 34. They are then disposed above the floor 22 and solvent condensate driping from the articles, before they reach trough 23, is discharged from floor 22 into sump 17. In their contained travel, the articles pass into the painting chamber unit 34, in which the paint is projected onto them, either in the form of sprays or in the form of unatomized jets, the latter being preferred but not essential. The paint solvent is the same as the solvent in the solvent sumps, assumed to be trichlorethylene for the purposes of description. The paint is heated to a suitable temperature, appreciably above room temperature and which may be either above or below the boiling point of its solvent at atmospheric pressure, as determined by the setting of the valve 54, and the hot paint is projected onto the articles under appropriate pressure, usually less than 10 p.s.i., which may be varied as desired or as circumstances require.

The painting chamber unit 34 is isolated from the housing 10, except for the hangers 35, and is spaced from the side walls and the cover 13 and floor 22 thereof. It is thus effectively insulated thermally from the housing and does not suffer the heat radiation losses of the latter. Further, the painting chamber unit 34 is substantially surrounded, except at its top, by the vapor of the concentrated vapor zone, at a temperature of about 188° F., conducive to retention of heat by the article being painted. The vapor liberated from the paint in chamber unit 34 creates therein a localized concentrated solvent vapor zone, indicated by the heavier stippling. The vapor of the latter zone is at a lower temperature than the surface of the article being painted, due to the cooling effect incident to liberation of the vapor from the paint and the surface heating effect of the hot paint projected onto the article. There is, therefore, no risk of solvent vapor condensing upon the article with resultant solvent condensate wash-off and the article may safely remain in the painting chamber until it has received a coating of any desired thickness, within practicable limits. When the article has been coated to the desired thickness, it passes upwardly out of chamber unit 34 and thence through hood 12 to the exterior of the machine. The solvent in the paint coating on the article is rapidly volatilized by the surface heat of the article and the heat of the paint, so that when the article leaves the machine, the paint coating is free of solvent, or substantially so. In that connection, the painting chamber unit 34 preferably extends above the concentrated vapor zone in housing 10, as above noted. Accordingly, the painted article does not enter that zone as it passes out of chamber unit 34. That precludes possibility of vapor in the concentrated vapor zone of the machine condensing upon the painted article and effectively eliminates any risk in that respect. As previously indicated, it is preferred but not essential, that the painting chamber unit 34 extend above the concentrated vapor zone in housing 10. If painting chamber unit 34 extends to a height below the solvent vapor-air interface A—A, the article is still surrounded by the localized concentrated vapor zone in chamber 10, extending to the level A—A and at a lower temperature than the surface temperature of the article being painted, and is thus effectively guarded against solvent vapor condensate wash-off. In view of the open inner end of painting chamber unit 34 there may be some tendency to mixing of the vapor of the concentrated vapor zone of the machine with the vapor in chamber unit 34. That tendency is reduced by the fact that the vapor released from the paint is largely confined within chamber unit 34 and opposes entry thereinto of vapor from the concentrated vapor zone of housing 10.

The loss of heat by the walls of the housing 10 at the areas thereof below trough 24, results in condensation thereon of the solvent vapor. The resultant condensate flows into the sumps, except the condensate flowing onto the portion of floor 22 extending from trough 23 to sump 21. The latter condensate flows into trough 23, from which it may be delivered, by a conduit 79, to one of the sumps 16, 17 and 21, or to a suitable point exterior of the machine. The solvent condensate occurring on the cooling coils 25 and the wall of housing 10 above trough 24, flows to the lower end of the latter from which it may be conducted to a suitable delivery point, as is known. It is common practice to provide degreasing machines with various accessories including means for cooling condensate delivered from trough 24 and for separating the solvent from water, means for purifying contaminated solvent taken from the machine and returning pure solvent to the machine and means for replenishing solvent in the sumps selectively as required, as well as indicators and other accessories. It will be understood that the machine of our invention may be provided with suitable accessories, which need not be referred to in greater detail. It is desirable that escape to the atmosphere of paint solvent vapor from painting chamber unit 34 incident to travel of the conveyor 77 and the articles 75 through the exit end of the machine, be guarded against. To that end cold plates 80 may be provided at

the sides of housing **10** and exit hood **12**, above painting chamber unit **34**, supplemented, if desired or necessary, by other known means for preventing escape to atmosphere of solvent vapors.

When it is desired to change the type or color of the paint being used, pump **59** is stopped, valves **63**, **64** and **69** are closed, and tank **62** is uncoupled from the conduits **61** and **67** and replaced by a similar tank containing pure solvent. The valves **63**, **64** and **69** are then reopened and the pump is set in operation effective for flushing out the system with solvent and removing therefrom all of the paint previously used. When the system has been thoroughly cleaned by the solvent, the solvent containing tank is removed and replaced by a tank containing the desired paint, after which the painting operation proceeds as before. Usually, flushing of the system with pure solvent effectively cleans the painting chamber unit and the associated paint projecting means, so that replacement thereof is not necessary. In some cases, however, it may be necessary or desirable to remove the painting chamber unit and associated parts for more thorough cleaning, repair, or replacement thereof. That may be accomplished quickly and easily by removing cover **13**, either partially or completely, and uncoupling nipples **41** and **43** from conduits **45** and **67**, respectively, releasing hangers **35**, and moving the painting chamber unit inward beyond cross bars **36** and then removing it through the top of the housing. The unit thus removed may be as quickly and easily replaced by a similar unit in an obvious manner, as may be desired or necessary.

With the valves **63**, **64** and **69** closed the replacement of the painting chamber unit, if desired or necessary, and of the paint supply tank may proceed simultaneously, reducing to a minimum the time required for effecting the desired changes. Obviously, the painting chamber unit may be removed for replacement or repair, where desired or necessary, without replacing the paint supply tank, in cases where a change in paint used is not required. The provision of the painting chamber unit **34** and associated parts, in addition to the advantages in respect to the painting operation and expedition and facility in removal and replacement thereof, possesses the further advantage of preventing coating with paint of the interior of housing **10** and associated parts, in the area of the painting zone, with necessity of shutting down of the machine for cleaning thereof. Further, the painting chamber unit is comparatively small and, when removed from the machine, is readily accessible for cleaning thereof, if necessary or desired.

The modified form of painting chamber unit **82** shown in FIGURE 4 is substantially the same as painting chamber unit **34** of FIGURES 1 to 3, inclusive, except that the exit end wall **83** is substantially reduced in height and the exit end is open for the major portion of its height. In the use of chamber unit **82** there will be a somewhat greater tendency for the paint solvent vapor to mix with the vapor of the concentrated vapor zone, than when chamber unit **34** is used. In either case the article being painted is surrounded by the localized vapor zone in the painting chamber unit **34** liberated from the paint, is at a higher surface temperature than the enclosing vapor of such localized zone, and is effectively guarded against condensation thereon of the vapor of the concentrated vapor zone of the housing **10** with resultant condensate wash-off.

The second modified form of painting chamber unit **85**, shown in FIGURES 5 and 6, is of box form, open at both ends and closed at its top and bottom, top wall **86** having a central lengthwise slot therein accommodating passage therethrough of the hangers **76**. Chamber unit **85**, like units **34** and **82**, is provided at its inner or entrance end with a trough **42**, as and for the purposes above explained, and is supported with its bottom wall inclined downwardly toward the trough. The side walls **87** of chamber unit **85** extend toward the exit end thereof a substantial distance beyond top wall **86**, as shown, effective for retaining within the exit end portion thereof the localized concentrated solvent vapor zone released from the paint, with the advantages explained in respect to the painting chamber units **34** and **82**. Painting chamber unit **82** and painting chamber unit **85**, like unit **34**, preferably, though not necessarily, extend a material distance above the solvent vapor-air interface indicated by line A—A in FIGURE 2, at the top of the concentrated vapor zone in housing **10**, to prevent entry through the top of either of such chambers of vapor from the latter zone.

As above indicated, and as will be understood, changes in detail may be resorted to without departing from the field and scope of our invention, and we 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 our invention have been disclosed.

We claim:

1. In a machine for degreasing and painting articles, a housing, means for producing within said housing a first zone of predetermined height of a degreasing solvent vapor at an elevated temperature and which is toxic and heavier than air, a substantially horizontal painting unit within said housing spaced from the walls thereof and thereby thermally insulated therefrom, said unit having upwardly extending side walls and a bottom wall and providing a painting chamber extending a substantial distance downward into said first vapor zone and open at its top for withdrawal therefrom of painted articles, means for moving articles to be painted through said first vapor zone and thence through said unit between said side walls thereof and out of the top of said unit, and painting means within said unit disposed to project toward the side walls thereof and onto an article therein hot paint containing a volatile solvent the vapor of which is toxic and heavier than air, said unit being effective for retaining therein solvent vapor released from said paint thereby providing a second concentrated vapor zone at a lower temperature than the painted article and enclosing the article being painted and extending to the upper face of said first vapor zone and through which the painted article is removed from said housing without passing through said first vapor zone.

2. In a machine for degreasing and painting articles, a housing, means for producing within said housing a first zone of predetermined height of a degreasing solvent vapor at an elevated temperature and which is toxic and heavier than air, a substantially horizontal painting unit within said housing spaced from the walls thereof and thereby thermally insulated therefrom, said unit having upwardly extending side walls and a bottom wall and providing a painting chamber extending a substantial distance downward into said first vapor zone and open at its top for withdrawal therefrom of painted articles, said walls of said unit being imperforate and said side walls thereof extending at least to the upper face of said first vapor zone, means for moving articles to be painted through said first vapor zone and thence through said unit between said side walls thereof and out of the top of said unit, and painting means within said unit disposed to project toward the side walls thereof and onto an article therein hot paint containing a volatile solvent the vapor of which it toxic and heavier than air, said unit being effective for retaining therein excess paint projected from said painting means and solvent vapor released from said paint thereby providing a second concentrated vapor zone at a lower temperature than the painted article and enclosing the article being painted and extending to the upper face of said first vapor zone and through which the painted article is moved from said housing without passing through said first vapor zone.

3. In a machine for degreasing and painting articles, a housing having at one end an entrance passage and at its other end an exit passage and being otherwise closed,

means for prodcing within said housing a first zone of predetermined height below said passages of a degreasing solvent vapor at an elevated temperature and which is toxic and heavier than air, a substantially horizontal painting unit within said housing adjacent said exit passage and spaced from the walls of said housing and thereby thermally insulated therefrom, said unit having upwardly extending side walls and a bottom wall and providing a painting chamber extending a substantial distance downward into said first vapor zone and open at its top for withdrawal therefrom of painted articles, means for moving articles to be painted through said entrance passage into and through said first vapor zone and thence into and through said chamber and through the top thereof into and through said exit passage, and painting means within said unit disposed to project toward the side walls thereof and onto an article therein hot paint containing a volatile solvent the vapor of which is toxic and heavier than air, said unit being effective for retaining therein solvent vapor released from said paint thereby providing a second concentrated vapor zone at a lower temperature than the painted article and enclosing the article being painted and extending to the upper face of said first vapor zone and through which the painted article passes to said exit passage without passing through said first vapor zone.

4. In a machine for degreasing and painting articles, a housing having at one end an entrance passage and at its other end an exit passage and being otherwise closed, means for producing within said housing a first zone of predetermined height below said passages of a degreasing solvent vapor at an elevated temperature and which is toxic and heavier than air, a substantially horizontal painting unit within said housing underlying said exit passage and spaced from the walls of said housing and thereby thermally insulated therefrom, said unit having upwardly extending side walls and a bottom wall and providing a painting chamber extending a substantial distance downward into said first vapor zone and open at its top for withdrawal therefrom of painted articles, means for moving articles to be painted through said entrance passage into and through said first vapor zone and thence into and through said chamber and through the top thereof into and through said exit passage, and painting means within said unit disposed to project toward the side walls thereof and onto an article therein hot paint containing a volatile solvent the vapor of which is toxic and heavier than air, said unit being effective for retaining therein solvent vapor released from said paint thereby providing a second concentrated vapor zone at a lower temperature than the painted article and enclosing the article being painted and extending to the upper face of said first vapor zone and through which the painted article passes to said exit passage without passing through said first vapor zone.

5. In a machine for degreasing and painting articles, a housing having at one end a downwardly and inwardly inclined entrance passage and at its other end an upwardly and outwardly inclined exit passage and being otherwise closed, means for producing within said housing a first zone of predetermined height below said passages of a degreasing solvent vapor at an elevated temperature and which is toxic and heavier than air, a substantially horizontal painting unit within said housing underlying said exit passage and spaced from the walls of said housing and thereby thermally insulated therefrom, said unit having upwardly extending side walls and a bottom wall and providing a painting chamber extending a substantial distance downward into said first vapor zone and open at its top for withdrawal therefrom of painted articles, means for moving articles to be painted through said entrance passage into and through said first vapor zone and thence into and through said chamber and through the top thereof into and through said exit passage, and painting means within said unit disposed to project toward the side walls thereof and onto an article therein hot paint containing a volatile solvent the vapor of which is toxic and heavier than air, said unit being effective for retaining therein solvent vapor released from said paint thereby providing a second concentrated vapor zone at a lower temperature than the painted article and enclosing the article being painted and extending to the upper face of said first vapor zone and through which the painted article passes to said exit passage without passing through said first vapor zone.

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