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METHOD AND APPARATUS FOR HYDROSTATIC SPRAYING

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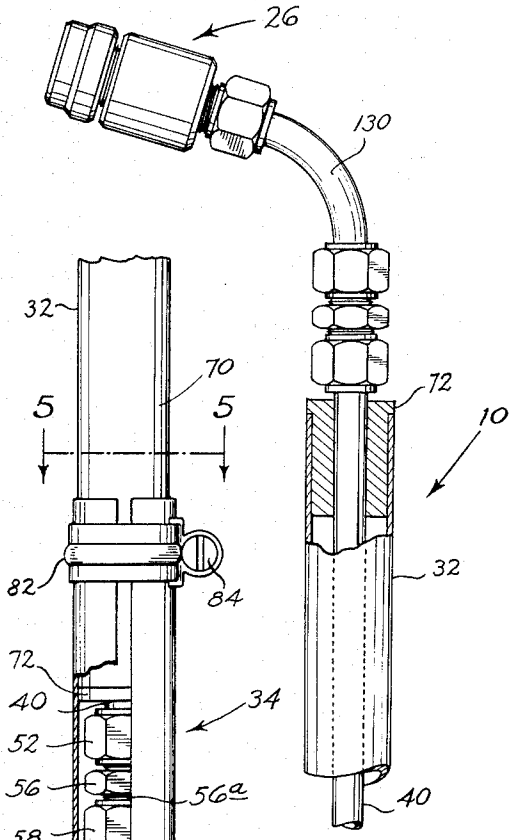


Fig. 4.

Fig. 3.

Fig. 5.

Fig. 6.

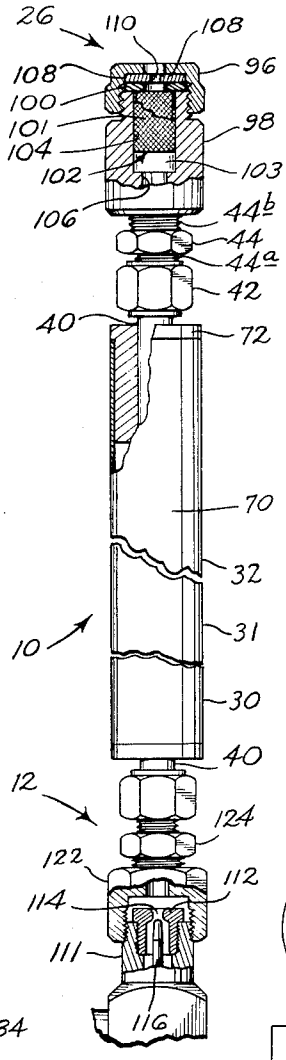


Fig. 2.

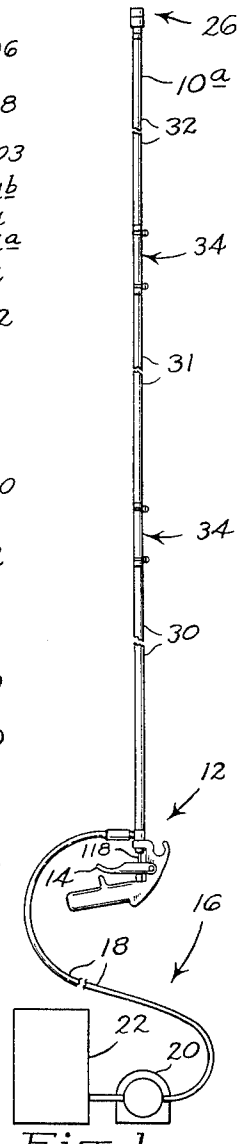


Fig. 1.

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METHOD AND APPARATUS FOR HYDROSTATIC SPRAYING

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This invention relates to a method and means of applying viscous liquids such as paint as a spray. The invention more particularly concerns hydrostatic systems, where a liquid such as paint is applied as a spray, without the admixture of air therewith. Painting according to the invention may be done quickly and easily, with good covering qualities in the paint film applied.

The hydrostatic spraying of paint, where paint is broken up into a spray mechanically and without the introduction of air (as compared to systems where paint is atomized with air to produce a spray) is well known. Conventionally, a paint gun is used, and paint under high pressure is fed the gun, whence it is ejected from the gun through a constricted orifice which serves to break up the paint and form a spray. The ordinary paint gun has included a valve for controlling the flow of paint, with such valve closely associated with the orifice in the gun where the paint is ejected. The close association of the valve and orifice has been a construction thought to be necessary in order to prevent dripping of paint between spraying periods.

The incorporation of a valve close to a spray orifice, while preventing dripping tendencies, has a number of disadvantages. For one thing, many times a painter desires to paint a surface spaced beyond his comfortable reach. To do this, the painter adds attachments to his paint gun, for the purpose of lengthening the gun and thus enlarging the area reached by the gun. Where the valve controlling paint flow is close to the spray orifice, any lengthening of a gun necessitates the addition of a linkage system connecting the valve and the controls for the valve (located at the end of a gun opposite the tip end). This has resulted in painting equipment which is not only expensive, but also bulky and heavy. Bulk and weight in a paint gun, of course, tend to tire the painter and reduce his efficiency.

Another disadvantage of the type of apparatus described is that there has been noted a tendency for the apparatus to "kick back" at the start of a spraying interval when the valve is first opened (as a result of reaction forces set up in the tip when paint is first ejected). In confined spaces, and where accuracy is desired in the painting, this can be extremely troublesome.

According to this invention, a paint device is contemplated comprising an elongated wand or pole with cut-off valve mechanism controlling the flow of paint at one end (the bottom end) and with an open spray orifice for ejecting paint at the other end (the tip end) of the wand. A passageway extends between the ends of the wand connecting the spray orifice and cut-off valve mechanism. The valve mechanism, passageway and open spray orifice are constructed in such a manner that a practical paint device results, having none of the disadvantages above noted.

Thus, since a cut-off valve mechanism for controlling paint flow is provided at the base of the wand, adjacent the usual actuating mechanism for the valve, no alteration need be made in the means for actuating the valve when the length of the wand is changed. A relatively small diameter pole or wand may be utilized, comprising plural sections detachably connected end to end with a passageway therein to convey paint from the

base to the tip of the wand, and to change the length of the wand all that is required is to remove or add a section. Excessive bulk may be eliminated, and the weight of the device kept at a minimum.

Particularly important, and rather surprisingly, it has been discovered that dripping and kick back are not a problem using the device of the invention. A damping action results in the wand which delays or dampens pressure changes at the tip when the flow of paint is started or stopped at the base, with the result that instantaneous reaction forces are not set up at the tip. At the tip of the device an open spray orifice is provided of such a size that the viscosity of the paint prevents flow therethrough as the result of static head pressure and in the absence of any paint under pressure flowing into the device. When the pole or wand, therefore, is tipped from a vertical aspect, to tip the column of paint in the hydraulic line therein, dripping has not been observed even with wands where the tip orifice and cut-off valve are separated by distances up to as much as fifteen feet.

A general object of this invention, therefore, is to provide improved apparatus for spraying viscous liquids, such as paint, that is relatively light and easy to manipulate.

Another object is to provide such apparatus, that includes an elongated wand or pole which may easily have its length changed.

More specifically, an object is to provide apparatus for spraying viscous liquids, such as paint, that includes an elongated hydraulic line or tube, means including a valve orifice at one end of said line for controlling the flow of liquid thereinto, and an open orifice at the other end of said line providing an exit passage for the liquid, the apparatus featuring a construction whereby dripping of liquid is prevented and kick back at the tip orifice is controlled.

A further object is to provide a novel method of spraying a viscous liquid, such as paint, over a surface, that features valving the flow of liquid under pressure into an elongated confined column of the liquid for the control of spraying periods.

A still further object is to provide an improved paint wand having a nozzle mechanism positionable on the ends of various sections in the wand, such nozzle mechanism including a strainer and a spray-producing orifice, with the strainer effective to strain out matter that might clog the orifice.

Yet another object is to provide an improved paint wand that includes a hydraulic line extending the length of the wand, and sleeve means surrounding the line and making the same rigid, such sleeve means providing a means for gripping the wand and making it rigid without adding appreciable weight. A related feature of the invention is the provision of a hydraulic line and sleeve means made up of plural sections, enabling changes to be made in the length of the wand.

These and other objects and advantages are attained by the invention, and the same is described hereinbelow in conjunction with the accompanying drawings, wherein:

FIG. 1 illustrates painting apparatus constructed according to one embodiment of this invention, such including a paint pole or wand, pistol grip mechanism at the base of the wand for actuating cut-off valve mechanism therein, and connected to the base of the wand a supply line for the delivery of paint under pressure to the wand;

FIG. 2 is a view of the wand in the apparatus on a slightly enlarged scale, and with portions thereof broken away;

FIG. 3 is a view illustrating a means connecting a pair of sections in the wand;

FIG. 4 is a view of the tip of a wand, and illustrating a modified form of construction;

FIG. 5 is a cross-sectional view, taken along the line 5—5 in FIG. 3; and

FIG. 6 is a diagramatic drawing illustrating the flow of paint through the wand, and the interrelation and functioning of orifices therein.

Referring now to the drawings, the apparatus contemplated comprises an elongated wand or pole indicated at **10**. At the base of the wand is cut-off valve mechanism generally indicated at **12**, actuated by a pistol grip actuator **14**.

Paint under pressure is supplied to the paint wand by supply system **16**. As shown, supply system **16** comprises a flexible hose **18** supplying paint under high pressure to valve mechanism **12**. Paint susbtantially devoid of air is pumped by a pump **20** from a reservoir **22** into hose **18**. Pump **20** may be a positive displacement pump, constructed to pump liquid at high pressure. Typically, pressures in the range of 1500 to 2000 pounds per square inch may be involved.

Paint wand or pole **10** at the tip end **10***a* thereof (the top end in FIG. 1) is provided with a nozzle mechanism **26**. Between nozzle mechanism **26** and valve mechanism **12** the wand comprises multiple separable sections, three of which are shown in FIG. 1, and these being indicated at **30**, **31** and **32**.

Sections **30**, **31** and **32** are interconnected at joints **34**. Nozzle mechanism **26** is detachably connected to the top end of section **32**, and each section of the wand is detachably connected to the section adjacent through a joint **34**. Further, section **30** is detachably connected to valve mechanism **12**.

Typically, where three pole or wand sections are provided, two of them may be relatively long, for example, six feet in length, and the other relatively short, for example, three feet in length. With such a combination, a wand varying from three feet to fifteen feet in length may be constructed, using various combinations of the sections. Thus, only the three-foot section may be used, with such mounted on valve mechanism **12**, to produce a wand three feet in length. A six-foot section may be used alone, to produce a wand six feet in length. A combination of the three-foot section and one six-foot section produces a wand nine feet in length. Using two six-foot sections produces a twelve-foot wand. Using all the sections produces a wand fifteen feet in length.

Since the various sections are similar in construction, only one will be described in detail. Reference is now made particularly to FIGS. 2 and 3, for a description of a wand section and the joint connecting two sections together.

As can be seen in these figures, wand section **32** includes a section of hydraulic line or tube **40**. Mounted on the top end of tube section **40** is a nut **42**, that has a coupler **44** with an externally threaded stem portion **44***a* screwed into an internally threaded portion thereof. Coupler **44** has another externally threaded portion **44***b*, used in connecting the wand section to the nozzle mechanism or another wand section, as the case may be. The bottom end of tube section **40** is provided with a similar nut **52**, having a similar coupler **56** screwed thereinto. With wand section **32** fastened to the top end of wand section **31**, coupler **56** is fastened, through its externally threaded stem portion **56***a*, into the nut at the top end of section **31** corresponding to nut **42**, such being indicated in FIG. 3 at **58**.

Each wand section includes, in addition to a hydraulic line or tube section, an encircling sleeve section, with such sleeve section being indicated for wand section **32** at **70**. The sleeve section has ends adjacent the ends of the tube section inside it. Mounting a sleeve section in a substantially concentric position with respect to the tube section inside it are bushings **72**.

Interconnecting the sleeve sections of adjacent sections in the wand, and part of a joint **34**, is clamp mechanism **76**. Mechanism **76** includes opposed segments **78**, **80**, having a curvature substantially conforming to the curvature of the outside of the sleeve sections. Segments **78**, **80** extend over the ends of adjacent sleeve sections, and a pair of bands **82** encircling the segments adjacent their ends, and fastened to each as by welding, are brought together, by screw adjusters **84**, to tighten the segments against the outside of the sleeve sections.

In the construction, a relatively small diameter line or tube may be used to convey paint between the ends of the paint wand, and thus the weight of the column of paint in the wand and the weight of the wand is minimized. By including the sleeve sections that surround the hydraulic line, and by interconnecting them (as by the clamp mechanism described), a wand of larger diameter than the hydraulic line is provided, which is easier to hold onto and manipulate. Most important, strength is added to the wand producing rigidity therein. Thus a wand of substantial length may be moved from area to area, without whipping and excessive movement in the extreme end. This rigidity is without sacrifice of lightness.

Explaining how a section may be removed from the wand, for instance wand section **31**, the clamp mechanisms surrounding the joints at either end thereof are first removed, to expose at each end of the wand section a coupler with nuts on either side thereof. Tube section **70** of the wand section is then separated from the tube sections connected to its ends. The top and bottom wand sections may then be connected, through a coupler, by means of a joint similar to the one illustrated in FIG. 3.

Nozzle mechanism **26** at the top or tip end of the wand includes a housing comprising a cap **96** screwed onto a retainer portion **98**. Retainer portion **98** has an internally threaded end which is fastened onto the end of a wand section by screwing it onto the threaded stem of a coupler, as shown in FIG. 2.

Within the nozzle mechanism is a strainer **102**, comprising a hollow cylinder of wire mesh **101** loosely received within a bore **104** in retainer portion **98**. At the top of the strainer and integral therewith is a mounting flange **100** that supports the strainer properly positioned within bore **104**, and at the bottom of the strainer is a plug **103** closing off the end of mesh cylinder **101**. Paint flows upwardly from the hydraulic line of the wand, through a passage **106** in retainer portion **98** and thence inwardly through the sides of mesh cylinder **101**.

Mounted adjacent the top of the strainer is a disc **108** having an aperture **110** therein. Aperture **110** is the spray-producing orifice of the nozzle mechanism, and is effective to break up paint and produce a spray on the paint flowing therethrough. It is important that the orifice not exceed a certain critical size, if dripping tendencies in the wand between spraying periods are to be prevented. In the usual instance, and for paints of ordinary viscosity (the usual paint may have a #60 viscosity in kreb units), orifices with diameters between about .005 and .046 inch may be used, with dripping prevented. To increase the factor of constriction at the tip of the wand, it should be noted that a sharp-edged orifice is provided in disc **108**.

Considering now cut-off valve mechanism **12** at the base of the paint wand, this comprises a housing **111** with a valve seat element **112** mounted therein having a streamlined valve opening or orifice **114** extending therethrough. Paint flows from hose **18** into the valve mechanism and upwardly through orifice **114**. Projecting into the valve orifice is a valve needle **116**. The valve needle is connected by a rod **118** (see FIG. 1) to actuator **14**. On manual pulling of the actuator downwardly in FIG. 1, the valve needle is moved downwardly and out of the valve orifice to open it, and on release of the actuator the valve needle moves upwardly to close the valve orifice. The valve seat and needle valve are made of a tough, abrasion-resistent material, such as tungsten carbide, to resist wear as paint flows thereover.

The connection of the bottom end of wand section **30** with the valve housing is similar to the connection between two wand sections. Thus, an adaptor member **122** is provided that is screwed onto an externally threaded portion of valve housing **111**. An internally threaded bore in the upper end of the adaptor receives the externally threaded stem of a coupler **124** similar to the other couplers discussed.

Valve orifice **114** ordinarily has a size at least as great as the size of orifice **110** at the tip of the wand. Typically, the orifice may have a diameter of about .050 inch. As is brought out below, because of the size of the orifice, and the type of flow occurring therethrough, the factor of constriction introduced by the orifice at the base of the wand is considerably less than the factor of constriction introduced at the tip of the wand by spray-producing orifice **110**.

Various modifications of the invention are possible. As already indicated, the length of the wand may be changed by using different combinations of wand sections. Further, the angle of discharge at the tip end may be changed, by inserting an adaptor such as adaptor **130** illustrated in FIG. 4. The adaptor has an upper end bent at an angle with respect to the longitudinal axis of the paint wand, and enables paint to be discharged from the wand at an angle.

It has been mentioned above that desirable features of the invention are that the paint wand is dripless, and that tendencies of the wand to kick back when spraying is first started are substantially eliminated. These characteristics, as far as can be determined, are apparently the result of several factors.

The usual paint is relatively viscous, having a consistency approaching that of light syrup. Because of this viscosity, and possible because of surface tension effects, flow through the tip orifice because of static head pressure in the wand does not occur when tip orifices are used having a size within the range indicated above. This is true, even with wands up to fifteen feet in length, which is the length of the wand disclosed herein when all sections of wand are used. With a fifteen-foot wand a column of liquid about fifteen feet in length is present in the wand, yet when the wand of the invention is tipped from a vertical aspect the column of liquid is contained within the wand without discharge at the tip.

With the wand of the invention, the major drop in the pressure of the paint as the pain flows from hose or supply **18** is at the tip. This is because, of the two orifices (the valve and tip orifices), the major factor of constriction is provided by the tip orifice. There is a negligible amount of resistance to fluid flow in the hydraulic line or tube, because of its relatively large cross-sectional area. The hydraulic line is straight, and little turbulence is introduced in the straight course that paint follows in flowing between the base and tip of the wand.

The valve orifice is streamlined and the tip orifice is sharp-edged. Thus, even though the two orifices may have close to the same diameter, there is greater resistance to a flow at the tip orifice than at the valve orifice because of the shapes of the orifices. A study of flow patterns has shown that a sharp-edged orifice restricts the cross-sectional area of the jet admitted therethrough to about 64% of the area of the orifice, as compared to a jet having 96% of the area of the orifice in the case of a streamlined orifice. Further, paint when it flows through the valve orifice flows into an existing column of paint, and there is no turbulence or sudden enlargement occurring in the paint, as there is at the tip orifice where paint is dispersed as a spray into the atmosphere. FIG. 6 illustrates the type of paint flow that occurs through the wand, and the constrictive effect of the sharp-edged orifice at the tip.

The hydraulic line, having some length and a relatively large cross-sectional area in comparison to areas of the orifices at the valve and tip, sets up a substantial volume of paint between the two orifices. Further, because of the viscous nature of paint, flow into and out of the wand does not immediately fully respond to an increase in paint pressure. These factors introduce a dampening effect when the valve orifice is first opened at the start of spraying. Thus, on opening of the valve, it takes a perceptible period of time for a quantity of paint to flow from the valve into the column of paint between the two orifices, and thence to build sufficient pressure in this column to produce maximum spray discharged. Kick back in the wand is controlled, since there are no sharp reaction forces set up at the tip of the wand at the start of spraying.

The primary restrictions to flow in the wand are at the base and tip orifices, and these are fixed. Between these orifices, resistance to paint flow is insignificant, and thus, changes in length of the wand produce no observable change in the flow of paint from the end of the wand.

Using the wand of the invention, paint may be applied easily and accurately. Thus, the wand is ideal for painting stripes and areas of limited size. While spraying the paint on an elevated area, the wand is held upright and the hydraulic line within the wand is effective to hold an elongated upright column of paint substantially devoid of air. The tip orifice provides a continuously open exit passage at the tip of the column of paint, and spraying is done by valving the flow of paint into the base of the column of paint confined within the wand. Paint flow into the base is from the supply of paint under pressure provided by hose **18**. Thus, a novel method of spraying is contemplated, where spray periods are determined by valving the flow from a supply of paint to the base of a confined column of paint, where such column of paint communicates with an open exit passage.

The paint wand is easily cleaned after a period of painting. To clean the wand, the conduit leading to the intake of the pump is disconnected from the reservoir of paint and connected to a solvent such as paint thinner, and the like. If the pump is then started, and valve mechanism **12** then actuated, the thinner will pass through the pump and wand with cleaning of all surfaces contacted.

We claim:

1. Hydrostatic painting apparatus comprising elongated pressure tube means defining a passageway for paint including multiple tube sections and means detachably connecting the tube sections end to end, cut-off valve mechanism including a valve housing with means joined to the housing for supporting the housing with one hand and a valve-controlled opening through which controlled amounts of paint flow, means fixedly securing one end of said pressure tube means to said valve housing with the interior thereof communicating with said valve-controlled opening, nozzle mechanism mounted adjacent the end of said tube means opposite its said one end including an open spray-producing orifice communicating with the interior of said tube means and providing an exit for paint from said passageway elongated hollow sleeve means substantially as long as said tube means, said sleeve means comprising multiple sections corresponding to said sections of said tube means disposed end to end, and means mounting said sleeve means about said pressure tube means with said other end of said pressure tube means protruding out from one end of said sleeve means, the outside of said sleeve means providing a surface to hold onto when supporting the painting apparatus with the other hand.

2. Painting apparatus comprising elongated pressure tube means defining a passageway for paint including multiple sections and means detachably connecting the tube sections end to end, cut-off valve mechanism mounted adjacent one end of said tube means for controlling the entrance of paint thereinto, nozzle mechanism mounted adjacent the other end of said tube means including a

spray-producing orifice communicating with the interior of said tube means and providing an exit for paint, elongated hollow sleeve means substantially as long as said tube means encircling the tube means, and bushing means mounting said sleeve means on said tube means, said sleeve means comprising multiple sections corresponding to the sections of said tube means disposed end to end, each section of said sleeve means encircling its corresponding tube section and terminating short of the ends of the tube section, and clamp means clamping together adjacent ends of said sleeve sections.

3. In the hydrostatic spray painting by a painter of various surfaces spaced at different distances from the painter; the method comprising providing an elongated, confined column of paint for the various surfaces, with the column of paint substantially devoid of air; varying the length of said column of paint between a maximum length for the most distant surface, and lengths shorter than said maximum for surfaces closer to the painter than said most distant surface; providing an open spray-producing orifice for one end of said confined column of paint; limiting the size of said orifice to a constriction small enough whereby the viscosity of the paint prevents flow of the paint through the orifice because of the static head pressure of the column of paint for all lengths of said paint column; holding a supply of the paint under pressure and with the same substantially devoid of air adjacent the other end of said column of paint; and valving the flow of the liquid from said supply to said other end of said column of paint thus to produce periods of flow and non-flow.

4. In hydrostatic painting apparatus; an elongated pressure tube means defining a passageway for paint; said pressure tube means including multiple sections, and means detachably connecting the sections end to end; cutoff valve mechanism including a housing with means joined to the housing for supporting the housing with one hand, and a valve-controlled opening in said housing through which controlled amounts of paint flow; means fixedly securing one end of said pressure tube means to said housing with the interior of the pressure tube means communicating with said valve-controlled opening; nozzle mechanism mounted on the other end of said pressure tube means and including an open spray-producing orifice communicating with the interior of the pressure tube means; elongated hollow sleeve means substantially as long as said pressure tube means; said sleeve means comprising multiple sections corresponding to the sections of said tube means disposed end to end; each section of said sleeve means encircling its corresponding section of the tube means and terminating short of the ends of the latter, a bushing for each end of each section of the sleeve means mounting the end of the sleeve means section on the tube means section, and clamp means extending between and clamping together adjacent ends of said sections of said sleeve means; the outside of said sleeve means providing a surface to hold onto the apparatus with the other hand.

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