United States Patent

Gelin

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[54] METHOD AND APPARATUS FOR APPLYING COATING MATERIAL

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[52] **U.S. Cl.**.....**239/336,** 239/422, 239/428

[51] **Int. Cl.**.....**B05b 7/14**

[58] **Field of Search**.....239/DIG. 8, 336, 422, 428; 117/105.5

[56] **References Cited**

UNITED STATES PATENTS

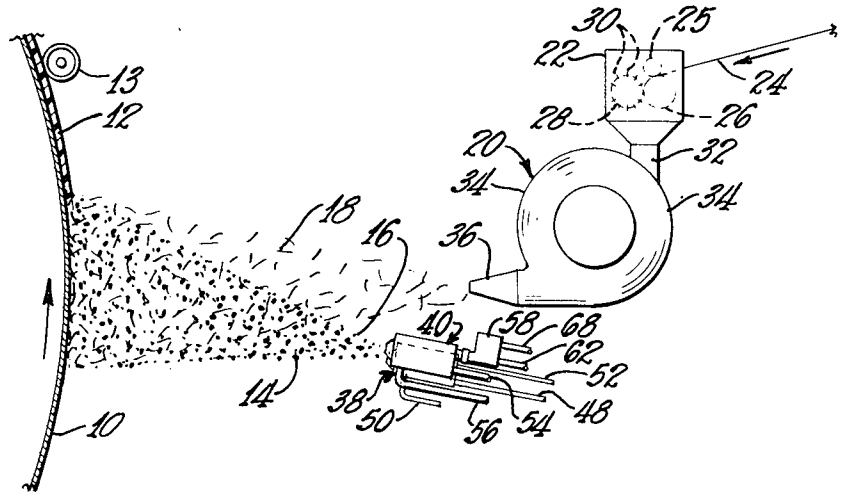
3,542,296	11/1970	Bradley	239/DIG. 8
3,033,472	5/1962	Shelton	239/336 X
3,168,411	2/1965	Walsh	117/105.5 X

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[57] **ABSTRACT**

A method and apparatus are provided for spraying reinforced resinous coating material on a surface. Resin and an accelerator are sprayed from one spray device and resin and catalyst are sprayed from a second spray device, each spray being shaped as a horizontally disposed ellipse, as viewed in cross section. The two sprays are directed in converging paths and a flat spray of reinforcing fibers is directed from above in a converging path with the other two sprays. In a preferred form, the resin and accelerator are mixed upstream of one spray device and the resin and catalyst are mixed in a mixing head adjacent the other spray device.

11 Claims, 4 Drawing Figures



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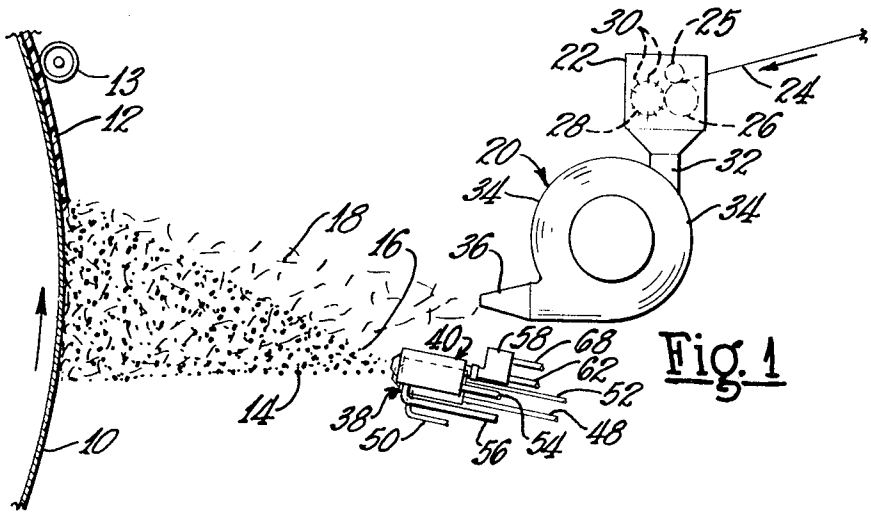


Fig. 1

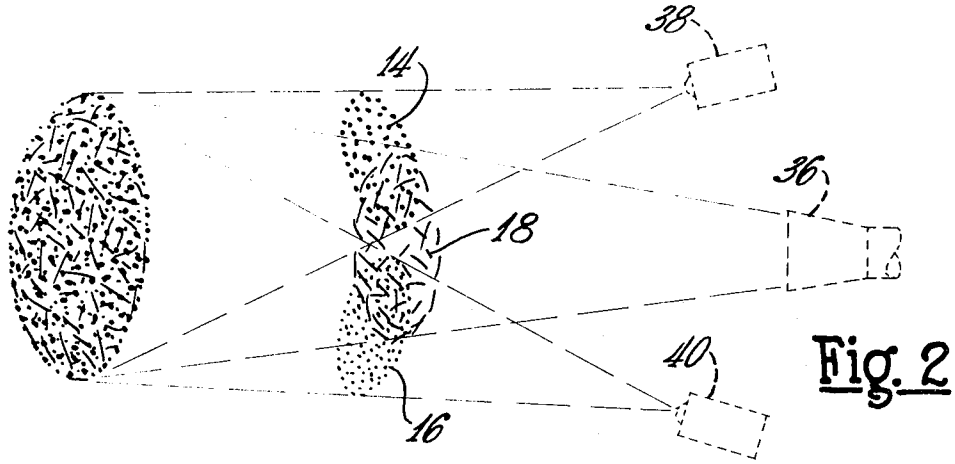


Fig. 2

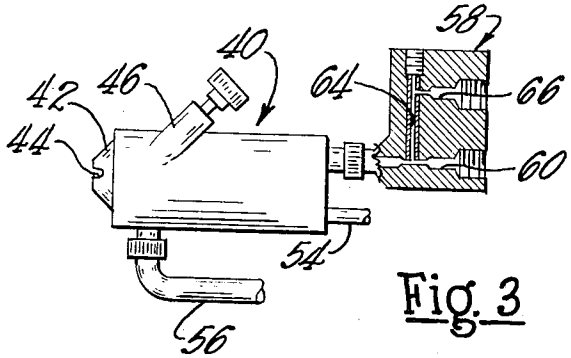


Fig. 3

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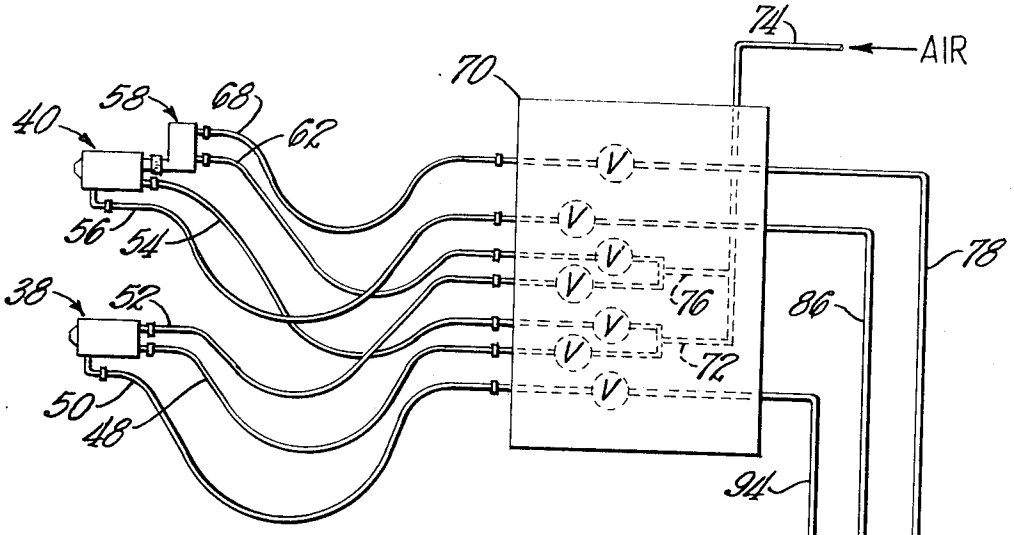
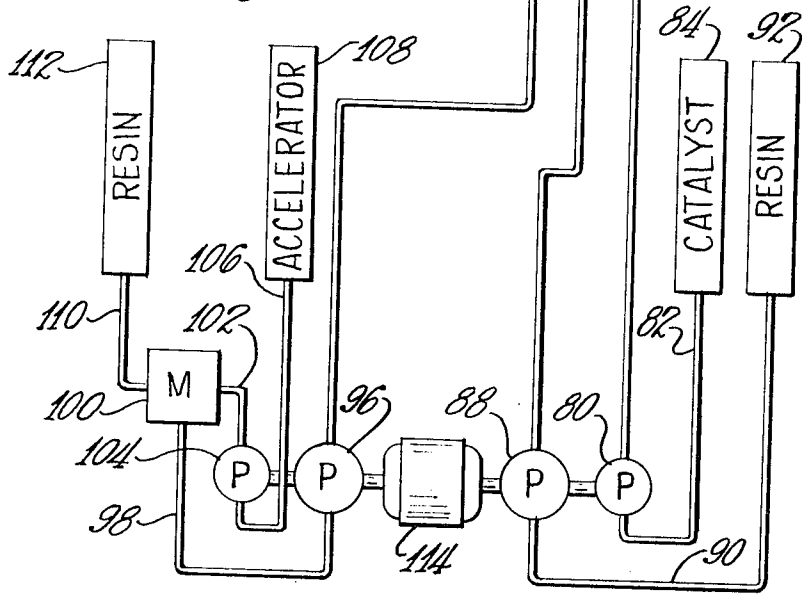


Fig. 4



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METHOD AND APPARATUS FOR APPLYING COATING MATERIAL

This invention relates to a method and apparatus for applying coating material to a surface and particularly for applying a fiber-reinforced resinous coating material.

In accordance with one aspect of the invention, a spray of resin and an accelerator is formed with an elliptical shape in transverse cross section, with the major dimension being horizontal. A spray of resin and catalyst is also formed with an elliptical shape in transverse cross section, again with the major dimension being horizontal. The two sprays are directed on converging paths so as to intersect at least by the time they reach the surface to be coated and preferably prior thereto. A spray of chopped reinforcing fibers is formed also preferably in a generally elliptical shape in transverse cross section, with the major dimension thereof also being horizontal. This spray of fibers emanates from a point above the other two sprays and on a converging path therewith. The flat arrangement of the two liquid sprays and fibrous spray results in a more thorough mixing or wet-out of the fibers and the liquid. Further, by supplying the fibrous spray from above the two liquid sprays, gravity aids in the mixing and wet-out of the fibers and liquid.

In accordance with another aspect of the invention, a method and apparatus for supplying resin, accelerator, and catalyst to the spray devices are provided. Approximately one-half of the total resin and an accelerator are supplied to one of the spray devices, while the other half of the resin and a catalyst are supplied to the other spray device. In the latter instance, the resin and the catalyst are kept separate until reaching the spray device. This virtually eliminates the need for flushing the system, except for a portion of the spray device. The catalyst and atomizing air are combined in a mixing head immediately adjacent the spray device while the resin is supplied directly to the spray device. The resin and catalyst thereby do not come into contact until near the nozzle of the spray device.

For the other spray device, the resin and accelerator can be mixed upstream near the sources thereof and supplied in combined form to the spray device. This is particularly advantageous with accelerators which tend to become stringy under pressure and would otherwise tend to clog the system. However, with accelerators not having this characteristic, the resin and accelerator again can be combined at the spray device with the atomizing air and accelerator first combined in a mixing head adjacent the spray device.

Adjustable, positive displacement pumps are employed for the coating material components, with the pumps being operated by a common drive to maintain coordination and synchronization thereof. This assures maintenance of proper ratios of the materials with any particular ratio easily changed almost immediately by adjustment of the output of the appropriate pump. Further, there is no necessity to employ an additional worker to pre-mix the coating material components as has heretofore been required when the components were mixed at the source.

It is, therefore, a principal object of the invention to provide a method and apparatus for spraying fiber-reinforced liquid coating materials in which the fibers and liquids are more fully wet-out and mixed when reaching the surface being coated.

Another object of the invention is to provide a spray system in which the necessity of flushing the system is substantially eliminated.

A further object of the invention is to provide a spray system for a resin, accelerator, and catalyst, with the components being metered by positive displacement pumps having a common drive.

Still another object of the invention is to provide a spray system in which pre-mixing of the components is not required.

Yet a further object of the invention is to provide a spray system in which the ratios of the components being sprayed can be quickly and easily changed.

Other objects and advantages of the invention will be apparent from the following detailed description of a preferred

embodiment thereof, reference being made to the accompanying drawings, in which:

FIG. 1 is a somewhat schematic side view in elevation of spray devices and a fiber source thereabove, and showing the approximate liquid and fibrous sprays emitted thereby and directed toward a surface being coated;

FIG. 2 is a somewhat schematic plan view of the spray devices and further showing transverse cross sections of the three sprays of FIG. 1;

FIG. 3 is a somewhat schematic view in elevation of a spray device with a longitudinal cross section taken through a mixing head of the spray system; and

FIG. 4 is a diagrammatic view of the overall spray system in accordance with a preferred form of the invention.

Referring to the drawings, and particularly to FIG. 1, a surface to be coated with reinforced coating material is indicated at 10. As shown, the surface is in the form of a filament-wound storage tank shown fragmentarily in cross section. The tank wall is rotated in the direction of the arrow as a fiber-reinforced resinous coat or layer 12 is applied. The coat 12 is then pressed on the surface 10 by a roller 13 to provide a denser and smoother layer.

The resinous coat 12 is formed by three sprays 14, 16, and 18, the spray 14 comprising resin and accelerator, the spray 16 comprising resin and catalyst, and the spray 18 being of reinforcing fibers. The three sprays are directed on converging paths so as to meet and mix by the time they reach the surface 10. As shown in FIG. 2, all three sprays are formed with elliptical cross sections, with the ellipses having their major axes lying horizontally. Preferably, the major axis of each of the ellipses is at least 50 percent longer than the minor axis and may be twice as long. The two converging flat ellipses of the liquid components tend to mix more rapidly and also form a trough which receives the flat spray 18 of the reinforced fibrous material. With the fiber spray 18 directed from above the two liquid sprays, the fibers are also aided by gravity in mixing with the liquids.

In a preferred form, as shown, the two liquid sprays are directed on inclined paths as well as converging ones while the fibrous spray is directed generally horizontally but on an intersecting path with the two liquid sprays. The two liquid sprays emanate from sources generally on the same level, and are on each side of, but below, the source of the fibrous spray. However, they can be on a vertical line with, and directly below, the fibrous spray source. In either instance, it is important to aid in the mixing of the liquids and fibers that the sprays tend to be flat, and that the fibrous spray be above the others.

The fibrous spray 18 is produced by a spray device 20. This includes a housing 22 into which a strand 24, preferably of glass, is pulled between rollers 25 and 26. The strand 24 is fed between the lower roller 26 and a chopper wheel 28 which cuts or chops the strand into fibers of predetermined length. Preferably, knives 30 on the chopper wheel 28 are spaced apart varying distances to produce fibers of different lengths since it has been found that such fibers provide superior reinforcement to fibers of a constant length. The chopped fibers are supplied through an inlet passage 32 for a blower 34 which emits them through a nozzle 36 to form the spray 18 directed in the aforesaid path. The nozzle 36 has a rectangular cross section with its longer dimension being horizontal (as shown in FIGS. 1 and 2) to produce the flat shape of the spray 18.

The liquid sprays 14 and 16 are produced by spray guns or devices 38 and 40 which can be of similar design and commercially available. An air cap or nozzle end 42 (FIG. 3) of each of the spray devices 38 and 40 has a nozzle 44 designed to emit a spray which is elliptical in cross section. However, the spray can also be formed by air horns on the air cap, above and below the nozzle, which direct air streams against the spray emitted from the nozzle to shape it into the horizontal ellipse. Each of the spray devices also has an atomizing air adjusting valve 46.

Actuating air is supplied to the spray device 38 through a line 48 (FIGS. 1 and 4). Air pressure from this line causes an

air-operated valve within the spray device **38** to open to supply the liquid spray. However, other types of valves can be employed for this purpose, including electrically and manually operated ones. A combination of resin and accelerator is supplied through a lower line **50** to the nozzle end of the spray device with atomizing air being supplied through a line **52**.

The spray device **40** (see also FIG. 3) has a line **54** through which actuating air is supplied to an air-actuated valve within the spray device, as for the device **38**. Resin alone is supplied to the nozzle end of the spray device **40** through a line **56**. In place of the line **52** of the spray device **38**, a mixing head **56** is provided. The mixing head **58** includes a generally venturi-shaped passage **60** to which atomizing air is supplied through a line **62** (FIGS. 1 and 4). A transverse passage **64** communicates with the throat of the passage **60** and is supplied with catalyst through a supply passage **66** and a line **68**. The passage **60** enables the atomizing air and the catalyst to be uniformly mixed, although the air has a limited effect in actually inspirating the catalyst, as in the case of a conventional venturi tube, since the catalyst is at a pressure higher than that of the air. Further, for this reason, all of the supply lines for the spray devices **38** and **40** and the mixing head **58** have check valves (not shown) to prevent the possibility of reverse flow.

The combination atomizing air and catalyst from the mixing head **58** mixes with the resin supplied through the line **56** adjacent the nozzle end of the spray device, with a spray of catalyst and resin then emitted through the nozzle **44**. Since the resin and catalyst do not mix until they are near the nozzle **44**, only a portion of the spray device **40** has be be cleaned when the system is shut down temporarily. For longer periods of shut down, all of the spray devices and lines are flushed.

The system of FIG. 4 is only schematic and a number of components known in the art are not shown. These include such items as pulsation dampeners, flow calibrators, pressure indicators, calibration gauges, and high and low pressure switches.

Referring to the overall system of FIG. 4, the various supply lines referred to above are shown as being flexible and connecting the spray devices **38** and **40** to a control cabinet **70**. The cabinet includes various controls including control valves designated V for the supply lines. Actuating air for the lines **48** and **54** is supplied through a line **72** connected to a main air supply line **74**. Similarly, atomizing air for the lines **52** and **62** is supplied through a line **76** connected to the main air supply line **76** connected to the main air supply line **74**. Thus, the single source of air is adequate for both the actuating air for operating the control valves within the spray devices, and the atomizing air.

The catalyst for the mixing head **58** and the line **68** is supplied through a line **78** from a positive-displacement pump **80**. The pump **80**, in turn, is connected by a supply line **82** to a catalyst source **84**. The resin for the spray device **40** and the line **56** is supplied through a line **86** from a large positive-displacement pump **88**. The resin is fed to the pump **88** through a line **90** from a source **92**.

Both of the pumps **80** and **88** are commercially available, operating with a positive displacement and provided with adjustments for close control of the output. In this manner, the ratio of the resin to the catalyst for the spray device **40** can be carefully controlled and can be quickly changed simply by making manual adjustments at the pump. The close control over the output is obtained through change in the piston stroke length. Pumps suitable for this purpose can be obtained from the Lapp Process Equipment Division of the Lapp Insulator Company, Inc., LeRoy, New York.

The resin and accelerator for the spray device **38** and the lines **50** are supplied in combined form through a line **94** from a large positive displacement pump **96**. The resin and accelerator can also be supplied separately, using a mixing head similar to the head **58** for the accelerator. However, the accelerator often has a tendency to become stringy or more viscous under pressure. In that instance, it has been found to be preferable to first combine the resin and accelerator since only a small percentage of the accelerator is used and any tendency for it to become stringy or more viscous does not cause plugging of the lines. The resin and accelerator are supplied to the pump **96** through a line **98** from a mixer **100** which is of a known, closed, in-line type. A predetermined quantity of accelerator is supplied through a line **102** by a positive displacement pump **104** which receives accelerator through a line **106** from a source **108**. The resin is fed to the mixer **100** by gravity through a line **110** from a source **112**. The quantity of the combined resin and accelerator is known, as determined by the output of the pump **96**. Similarly, the quantity of accelerator is known, through control of the output of the small pump **104**. Consequently, the amount of resin supplied from the source **112** is also predetermined.

All four of the pumps **80**, **88**, **96**, and **104** are driven through a common motor or drive means **114**. This assures that all of the positive displacement pumps are driven at the same speed so that adjustment of stroke length provides an accurate determination of output and ratios.

Various modifications of the above described embodiment of the invention will be apparent to those skilled in the art and it is to be understood that such modifications can be made without departing from the scope of the invention, if they are within the spirit and the tenor of the accompanying claims.

I claim:

1. Apparatus for spraying coating material comprising a first spray device, means for supplying accelerator to said first spray device, means for supplying atomizing gas under pressure to said first spray device, means for supplying resin to said first spray device, said first spray device being effective to combine and to spray the resin and the combination gas and accelerator, a second spray device, a mixing head adjacent said second spray device, means for supplying catalyst to said mixing head, means for supplying atomizing gas to said mixing head, said mixing head having means for combining the atomizing gas and the catalyst, means for supplying resin to said second spray device, means for supplying the combined atomizing gas and catalyst to said second spray device from said mixing head, said second spray device being effective to combine and to spray the resin and the combination gas and catalyst, said first and second spray devices being positioned such that a spray of resin and accelerator issuing from said first spray device will intersect a spray of resin and catalyst issuing from said second spray device.

2. Apparatus according to claim 1, characterized by said resin-supplying means for said first spray device includes a first positive displacement pump, said resin-supplying means for said second spray device comprises a second positive displacement pump, and common drive means for driving both pumps.

3. Apparatus according to claim 2, characterized by said supply means for supplying accelerator to said first spray device comprises a third positive displacement pump, said means for supplying catalyst to said mixing head comprises a fourth positive displacement pump, said third and fourth positive displacement pumps being driven by said common drive means.

4. Apparatus according to claim 2, characterized by said supply means supplying accelerator to said first spray device comprises said first positive displacement pump and a third positive displacement pump.

5. Apparatus according to claim 4, characterized by a mixing device located between said first positive displacement pump and said third positive displacement pump, means for supplying resin to said mixing device, the resin and the accelerator from said first positive displacement pump being first combined in said mixing device, and the combination then being supplied to said first spray device by said first positive displacement pump.

6. Apparatus according to claim 3, characterized by a mixing device, said means for supplying accelerator and resin to said first spray device comprising means for supplying ac-

celerator first to said third positive displacement pump, means for supplying accelerator from said third pump to said mixing device, means for supplying resin to said mixing device, means for supplying the combination resin and accelerator to said first positive displacement pump, and means for supplying the combination resin and accelerator from said first positive displacement pump to said first spray device.

7. Apparatus for spraying coating material comprising a first spray device, means for supplying a metered, predetermined quantity of accelerator to said first spray device, means for supplying a metered, predetermined quantity of resin to said first spray device, means for supplying atomizing gas under pressure to said first spray device, said first spray device being effective to combine and to spray the atomizing gas and the combination resin and accelerator, a second spray device, a mixing head adjacent said second spray device, means for supplying a metered, predetermined quantity of catalyst to said mixing head, means for supplying atomizing gas to said mixing head, said mixing head being effective to combine the atomizing gas and the catalyst, means for supplying a metered, predetermined quantity of resin to said second spray device, means for supplying combined atomizing gas and catalyst to said second spray device from said mixing head, said second spray device being effective to combine and to spray the resin and combination gas and catalyst, said first and second spray devices being positioned so that the spray issuing from said first spray device will intersect the spray issuing from said second spray device.

8. Apparatus according to claim 7, characterized by each of said metered quantities being controlled by a positive displacement pump, and common means for driving all four of said pumps.

9. Apparatus for applying a reinforced coating material to a surface comprising first spray means for forming a first spray of liquid coating material in a pattern which is elongate in a direction taken transversely through the spray with the major dimension thereof disposed generally horizontally, said first spray means directing the first spray toward the surface, second spray means for forming a second spray of liquid coating material in a pattern which is elongate in a direction taken transversely through the spray with the major dimension thereof disposed generally horizontally, said second spray means directing the second spray toward the surface on a converging path with the first spray, third spray means for forming a spray of particulate, reinforcing material, said third spray means directing the last-named spray toward the surface and on a converging path with the two liquid sprays.

10. Apparatus according to claim 9, characterized further by said third spray forming means being effective to form said last-named spray in a pattern which is elongate in a direction taken transversely through the spray, with the major dimension thereof being disposed generally horizontally.

11. Apparatus according to claim 9, characterized further by said first spray of liquid coating material being resin and accelerator and said second spray of liquid coating material being resin and catalyst.

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