Nov. 30, 1954 H. SZCZEPANSKI 2,695,592

AUTOMATIC SPRAYING MACHINE

Filed Jan. 7, 1950 3 Sheets-Sheet 1

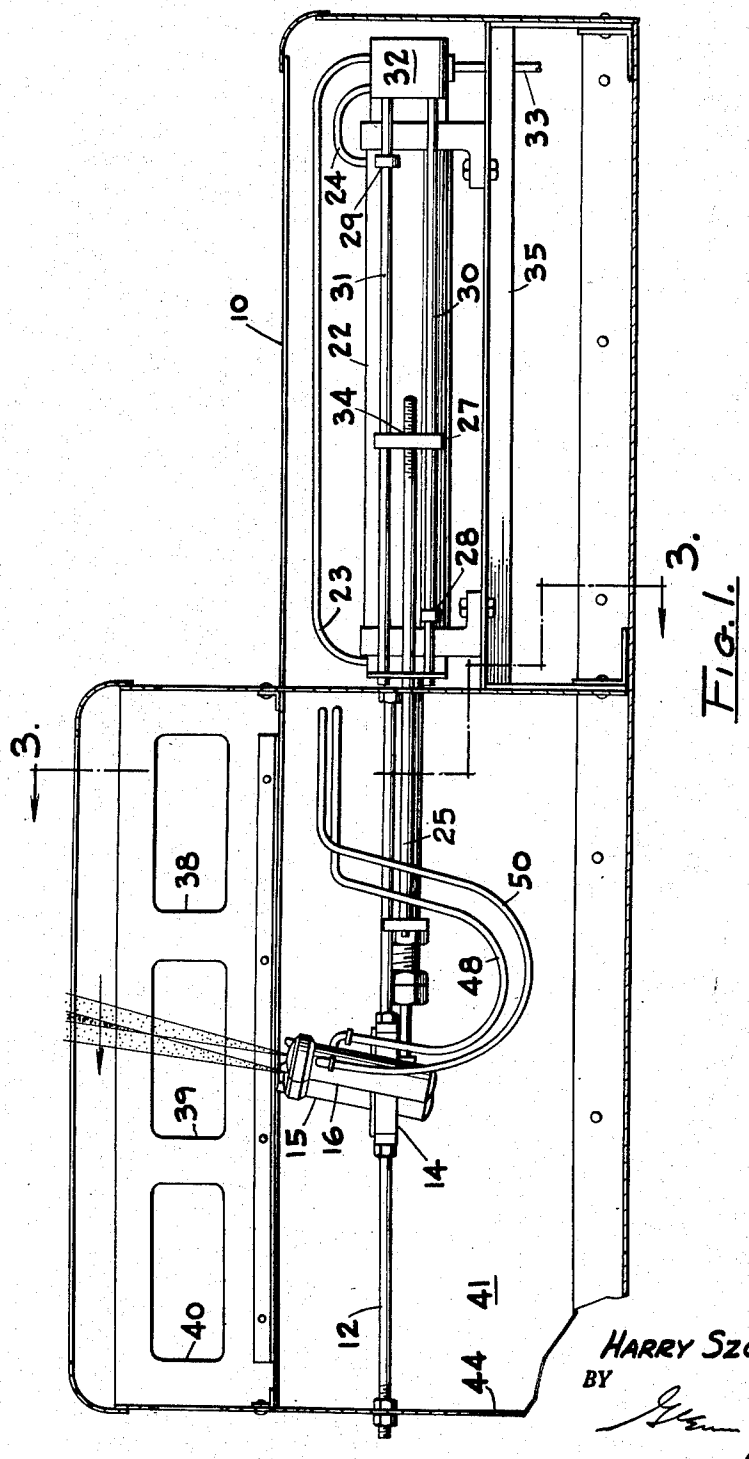


FIG. 1.

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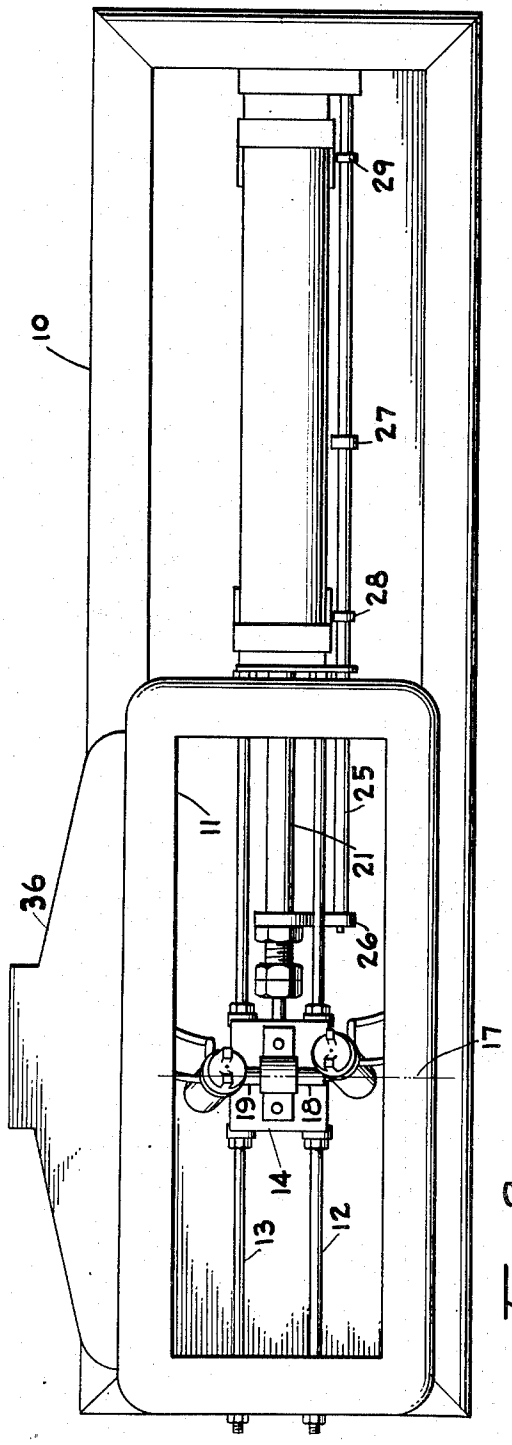


FIG. 2.

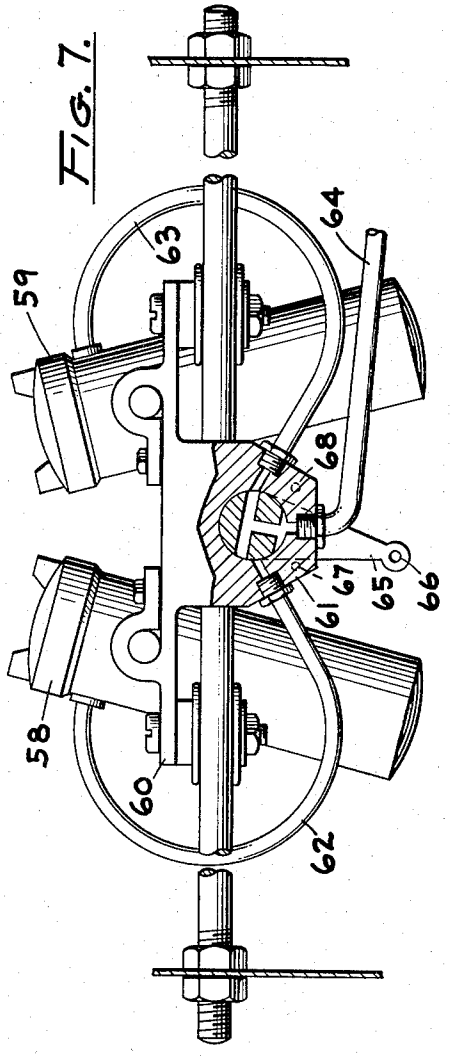


FIG. 7.

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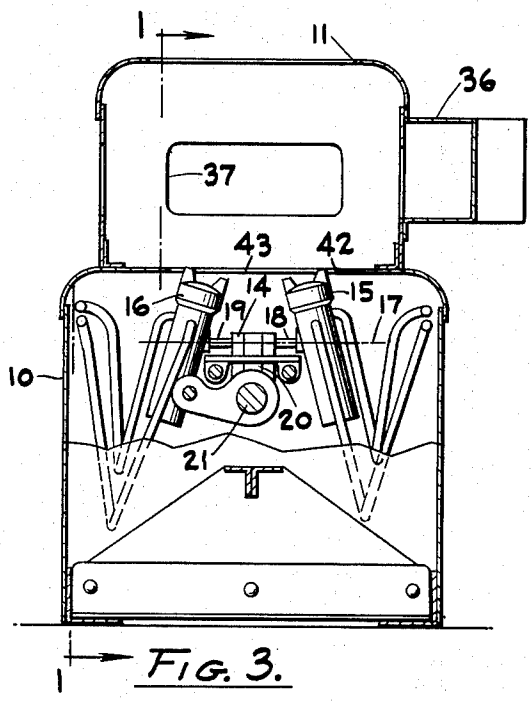


FIG. 3.

FIG. 4.

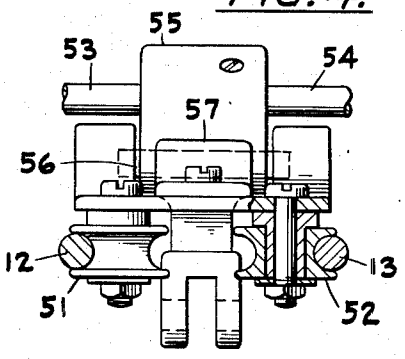


FIG. 5.

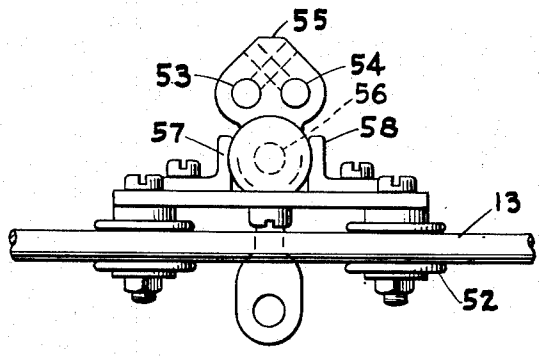
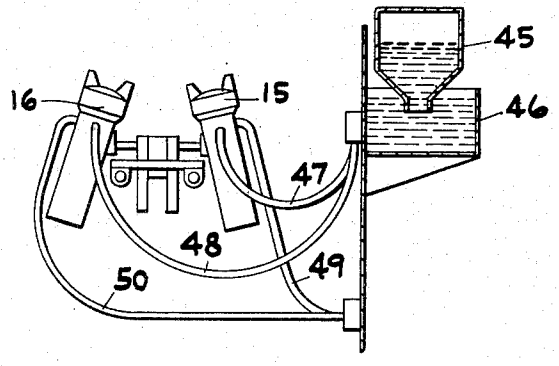


FIG. 6.



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United States Patent Office 2,695,592
Patented Nov. 30, 1954

2,695,592

AUTOMATIC SPRAYING MACHINE

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Application January 7, 1950, Serial No. 137,390

4 Claims. (Cl. 118—301)

The present invention provides an automatic spraying machine. The preferred form of this machine is particularly well adapted to the application of paints or lacquers to recessed surfaces, or to flat surfaces covered by a mask or stencil.

It is a considerable problem to apply paint to a surface covered by a mask having one or more "islands" or sections which are not connected to the principal part of the mask. These areas have to be supported in some way, and it is conventional to provide a "bridge" of wire or similar material to secure the isolated portion in its proper location. When a spray-gun passes opposite such a section of the mask, there is a tendency for the "bridge" to shield a part of the area to be painted and to create a thin spot or "shadow." Even where masks or their equivalent are not used at all, the painting of molded plastic surfaces renders it necessary to project paint into recesses or on either side of projections, and this operation is subject to the same difficulties as are outlined above.

The present invention provides a machine capable of handling the most complex spraying problems with ease and efficiency. Uniformity is assured, and the necessity of using skilled operators is completely removed since the application of the paint or lacquer is controlled by an entirely automatic sequence of operations. Means are provided for applying paint to recesses and semi-obstructed surfaces in a manner which reduces the waste involved in any of the methods involving manual operations or the projection of random sprays. Essentially, the solution of the problem of applying paint to these surfaces is obtained by providing a spray-gun carrier and an actuating mechanism which not only moves the guns opposite the area to be painted, but causes the angular attitude of the guns to be altered during transit. The present invention provides an improvement in this general type of mechanism. This variation of angular attitude is a variation with respect to the surface receiving the paint, and of course results in the substantial removal of the effect of interfering surfaces. When "bridges" are used with a mask, the variation of gun angle causes the spray to be projected around the structure and assures that a coating of paint is applied to all parts of the surface. When recesses or projections are involved on the painted surface, the variation in angular attitude assures that both the first surface to come opposite the gun and the succeeding edge are equally covered. To geometrically define the required movement of the spray-gun, it may be stated that the plane of at least a component of oscillation is substantially perpendicular to the surface being painted and is parallel to the line of movement of the spray-gun carrier. Preferably, the gun carrier may be provided with a plurality of spray-guns disposed at a lateral angle to generate a fan-type of spray which will have a tremendous covering power when coupled with the oscillating system outlined above.

The preferred form of attitude-changing mechanism provided by the present invention involves an actuator adapted to move a spray-gun carrier along a particular guiding means. The attachment of the actuator to the carrier also controls the angular attitude of the carrier between suitable limit stops resulting in a characteristic attitude of the spray-guns for each direction of movement of the carrier along the guiding means. This arrangement is accomplished by pivotally mounting a set of gun clamps upon the carrier, and connecting the

actuator to the carrier at an arm directly associated with the clamp structure. With this arrangement, a force applied by the actuator first causes a rotation about the hinge point which continues until a limit stop is engaged. The force applied than causes movement of the entire carrier until the direction of the application of force is reversed by the actuator.

A modified and slightly more complicated version of the present invention involves the use of a plurality of spray-guns or sets thereof each disposed at a characteristic angle with respect to the carrier and fixed in such position. The air pressure required to operate these guns is supplied thereto through a selector valve adapted to determine which of the sets of spray guns receives air at a given moment. The selector valve preferably provides the connection between the actuator and the carrier in a similar fashion to the preferred form of the invention described above. With such a system, the force first applied by the actuator causes the movement of the selector valve to a position permitting air to be applied to a particular set of spray-guns. When the limit of movement of the valve is reached, the movement of the carrier begins.

The preferred form of the associated mechanism used in connection with the system outlined above involves a pneumatic or hydraulic actuator and suitable control valves accessible to the operator. The preferred form of the guiding means used to establish the path of the moving carrier involves a pair of parallel rods with which the carrier co-operates. The carrier may either surround the rods in the manner of a cross-head on a steam engine, or the carrier may be provided with a set of rollers for engagement with the rods if it is desired to minimize the friction involved.

It is definitely preferred to form the machine involving the above noted features in such a manner that the sprays are directed upwardly at an opening which may be covered by a mask, or by a workpiece alone if a mask is not to be used. It will be noted that this arrangement makes it possible for an operator to place a workpiece down upon the painting "station" in a manner similar to laying an article upon a table. The simplicity of this arrangement over a separate assembly of mask and workpiece is obvious. The mask is preferably semi-permanently attached to the machine opposite the opening, and suitable locating means are provided to establish the desired relative position of mask and workpiece. This general system permits entire concealment of the spray itself and the application of suitable ventilating and ducting systems capable of completely preventing the escape of vapors into the surrounding room.

The present invention also provides features which are very valuable in regard to the ventilation and removal of excess spray. The sprays from the gun are actually projected through a panel or diaphragm which is in spaced and generally parallel relationship with the workpiece. The chamber provided by this panel between it and the workpiece is equipped with suitable ventilation ducts capable of establishing a flow of air across the passage of the spray. The ventilating stream of air also passes across the opening in the diaphragm through which the spray is projected, and it is preferred to provide a pressure differential in which the pressure in the chamber housing the spray-gun equipment is slightly in excess of the pressure in the ventilating chamber. A small aperture is then provided in the mechanism chamber permitting the inflow of air from the outer atmosphere resulting in a secondary ventilating flow from the mechanism chamber out through the spray aperture which merges with the ventilation flow and prevents the accumulation of particles or droplets of paint in the mechanism chamber and around the guns themselves.

The spray-guns preferably are so mounted with regard to the supply of paint that the normal level of paint without the urging of the air is just at or slightly below the point of ejection. This arrangement prevents the continued flow of the paint after the air is turned off, and also minimizes the amount of "lift" which the air must apply to the paint before the orifice is reached. This arrangement is of particular value when the spray-

guns are not provided with a valve for controlling the flow of paint except as induced by the movement of air.

The various features of the present invention will be discussed in detail by an analysis of the particular embodiments illustrated in the accompanying drawings. In these drawings:

Fig. 1 shows a sectional elevation of a machine embodying the present invention.

Fig. 2 shows a plan view of the machine illustrated in Figure 1.

Fig. 3 shows an end-view section of the mechanism taken on the plane 3—3 of Figure 1.

Fig. 4 shows an end-view partially in section of a modified form of the spray-gun carrier from that shown in Figures 1 to 3.

Fig. 5 shows an elevation of the mechanism of Figure 4.

Fig. 6 presents a schematic diagram of the relative position of a paint supply system with the spray-guns.

Fig. 7 shows a modified form of the present invention with regard to the variation of spray angle.

Referring to Figures 1, 2, and 3, a machine is shown having a housing **10** surrounding the entirety of the mechanism. An opening **11** is provided at the top of the housing **10** opposite which it is intended that a workpiece or mask shall be placed. The guide rails **12** and **13** are fixed with respect to the housing **10** and establish a path of movement for the spray-gun carrier **14**. The spray-guns **15** and **16** are pivotally mounted upon the carrier **14** to rotate about the axis **17**. The spray-guns themselves are supported upon the rods **18** and **19**, as is best indicated in Figure 3. The angular position of the rods **18** and **19** about the axis **17** is determined by the arm **20** attached thereto and extending downwardly through a suitable aperture in the carrier **14**. Suitable stops (not shown in Figures 1, 2, and 3) limit the degree of rotation permitted to the arm **20**, and thus establish the limiting angular attitudes of the spray-guns **15** and **16**.

An actuating rod **21** is pivotally connected to the lower extremity of the arm **20**, and transmits the driving force necessary to move the carrier **14** and to induce the rotation of the spray-gun assembly about the axis **17**. Rod **21** is associated with a piston and cylinder assembly **22** in which a suitable piston is positioned by the action of compressed air admitted at the points **23** or **24**. A valve-control rod is indicated at **25**, and moves axially with the push rod **21** through attachment at the end-plate **26**. The movement of the valve actuator **25** carries with it the plate **27** which co-operates with the stops **28** and **29** attached respectively to the positioning rods **30** and **31**. The positioning rods **30** and **31** are associated with the valve mechanism generally designated as **32**, and determine whether air is to be admitted to the line **23** or to the line **24**. Pressure is supplied to the inlet **33** of the valve mechanism from a line connected to a suitable off-on manually controlled valve (not shown) positioned by the operator of the machine.

Since the push rod **21** moves along a definite axis, it is obvious that a small degree of lost motion must be provided in the connection between this rod and the arm **20** which controls the position of the spray-guns, due to the fact that the arm moves along a radius and the point of connection has a small degree of vertical movement even though the angular movement is limited. With the mechanism outlined above, the admission of air to the point **33** will cause the carrier to move in whatever direction is determined by the setting of the valve mechanism **32** under the action of the positioning rods **30** or **31**, rod **25**, plate **27**, and the stops **28** and **29**. As the carrier nears the extremity of its movement, either the stop **28** or **29** will be engaged and further movement of the carrier will cause the valve mechanism to be tripped and permit air to be inserted at the opposite end of the piston to begin the motion of the carrier in the opposite direction. Suitable exhaust circuits under the control of the valve mechanism **32** are of course provided and are not shown in these figures. It will be noted that the amount and the location of the reciprocating path of the carrier **14** may be determined by the location of the stops **28** and **29** upon their associated rods and by varying the position of the plate **27** with respect to the rod **25** by the threaded engagement indicated at **34**. The actuating cylinder and associated mechanism are securely supported upon the beam **35** rigidly attached at its ends to components of the housing **10**.

To assure ventilation and remove the vapors and droplets of paint which remain suspended in the atmosphere after the projection of the spray, a suction duct **36** is preferably attached as shown in Figure 3. Openings to the surrounding atmosphere are provided at **37**, **38**, **39**, **40**, and at similar locations not shown on these particular views.

The spray-guns, carrier, and associated mechanism may be considered as being contained within a chamber **41**. The sprays are projected from the guns through an aperture **42** in a diaphragm indicated at **43** (refer to Figure 3). An opening is provided within the mechanism chamber **41** at **44**, and the reduction in pressure generated by the suction duct **36** within the chamber defined by the diaphragm **43**, the housing **11** and the workpiece or mask opposite the opening **11** draws a small quantity of air in through the hole **44** and thence through the opening **42** in the diaphragm **43** to prevent the accumulation of droplets of paint upon the mechanism. A cross-flow of air is generated by the suction duct which tends to remove vapors and small particles of paint which are not deposited upon the mask or the workpiece during the operation of the machine.

When a mechanism is used which does not include a valve stopping the flow of paint instantly upon the interruption of the air pressure, the paint-supply arrangement of Figure 6 is preferred. A supply bottle **45** maintains the container **46** at a constant level due to the fact that the mouth of the bottle **45** is submerged at which ever level may be desired. This level is established to be approximately at the point of ejection of the spray-guns **15** and **16**. Paint is supplied from the container **46** to the guns by means of suitable tubes **47** and **48**, and air is supplied to the guns by the similar tubes **49** and **50**.

Referring to Figures 4 and 5, a modification of the previously-illustrated carrier mechanism is shown. The difference between the two mechanisms lies in the method of engagement between the carrier and the guide rods **12** and **13**. In the modified form of the invention, sets of rollers **51** and **52** are arranged to engage the rods, and the carrier is supported against the action of vertical forces through the engagement of the grooved periphery of these rollers. As in the previous arrangement, the gun-supporting rods **53** and **54** are rotatably supported upon the carrier through being mounted upon a block **55** pivotally mounted upon the shaft **56**. The angular position of the guns is limited by the presence of the stops **57** and **58**.

Referring to Figure 7, a view is illustrated presenting a modified form of the means for varying the angle of paint spray with respect to the surface being painted. In this arrangement, the spray-guns **58** and **59** are firmly fixed in position upon the carrier **60**, and are supplied with paint in a fashion similar to the connections shown in Figure 6. The supply of air, however, is provided through the selector valve mechanism indicated at **61**. Suitable conduits **62**, **63**, connect the output ports of the valve mechanism to the spray-guns. Air pressure is admitted to the selector valve by means of the flexible conduit **64**, and the position of the valve arm **65** to the left or right will indicate which of the spray-guns **58** or **59** is to receive the required air pressure to generate a spray. With this mechanism, the movement of the carrier is affected by a pushrod similar to that illustrated in Figures 1 to 3, the connection being made at the point **66**. It is necessary to either permit some degree of lost motion at this connection or to provide a link connecting the point **66** to the end of the actuator in order to accommodate the smaller degree of radial movement of the arm. With this arrangement it will be seen that the initial movement of the actuating rod will first position the selector valve and cause the operation of one of the sets of spray-guns **58** or **59**. When the appropriate limit stop **67** or **68** is reached, the arm then ceases angular movement and forces are generated causing the carrier **60** to move along its associated guide rails.

The particular embodiments of the present invention which have been illustrated in the accompanying drawings and described herein are for illustrative purposes only and are not to be taken as limitations upon the scope of appended claims. In these claims it is the intent of the inventor to claim the entire invention to which he is entitled in view of the prior art.

I claim:

1. A spraying machine comprising a housing having an opening adapted to receive a mask, nozzle means and nozzle carrier means therefor arranged in said housing, guide means for said carrier means establishing a path of movement for said nozzle means opposite said opening, means to reciprocate said carrier means longitudinally of said guide means, and nozzle controlling means mounted on said carrier means and movable relative thereto in a plane parallel to said guide means and perpendicular to said opening for periodically redirecting spray from said nozzle means, said carrier reciprocating means including actuating means connected to said nozzle controlling means and to said carrier means adapted to apply reciprocating forces parallel to said guide means to shift said nozzle controlling means with and with respect to said carrier means.

2. A spraying machine as set forth in claim 1 wherein means provide a pivotal mounting for said nozzle means on said carrier means, and said nozzle controlling means interconnects said nozzle means and actuating means and imparts periodic angular adjustment to said nozzle means.

3. A spraying machine as set forth in claim 1 wherein said nozzle means includes a plurality of nozzles directed at different angles towards said opening, and said

nozzle controlling means includes valve means selectively connecting certain of said nozzles with a source of spray fluid.

4. A spraying machine as set forth in claim 1 wherein adjustable limiting means cooperate with said actuating means to control the application of said reciprocating forces.

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