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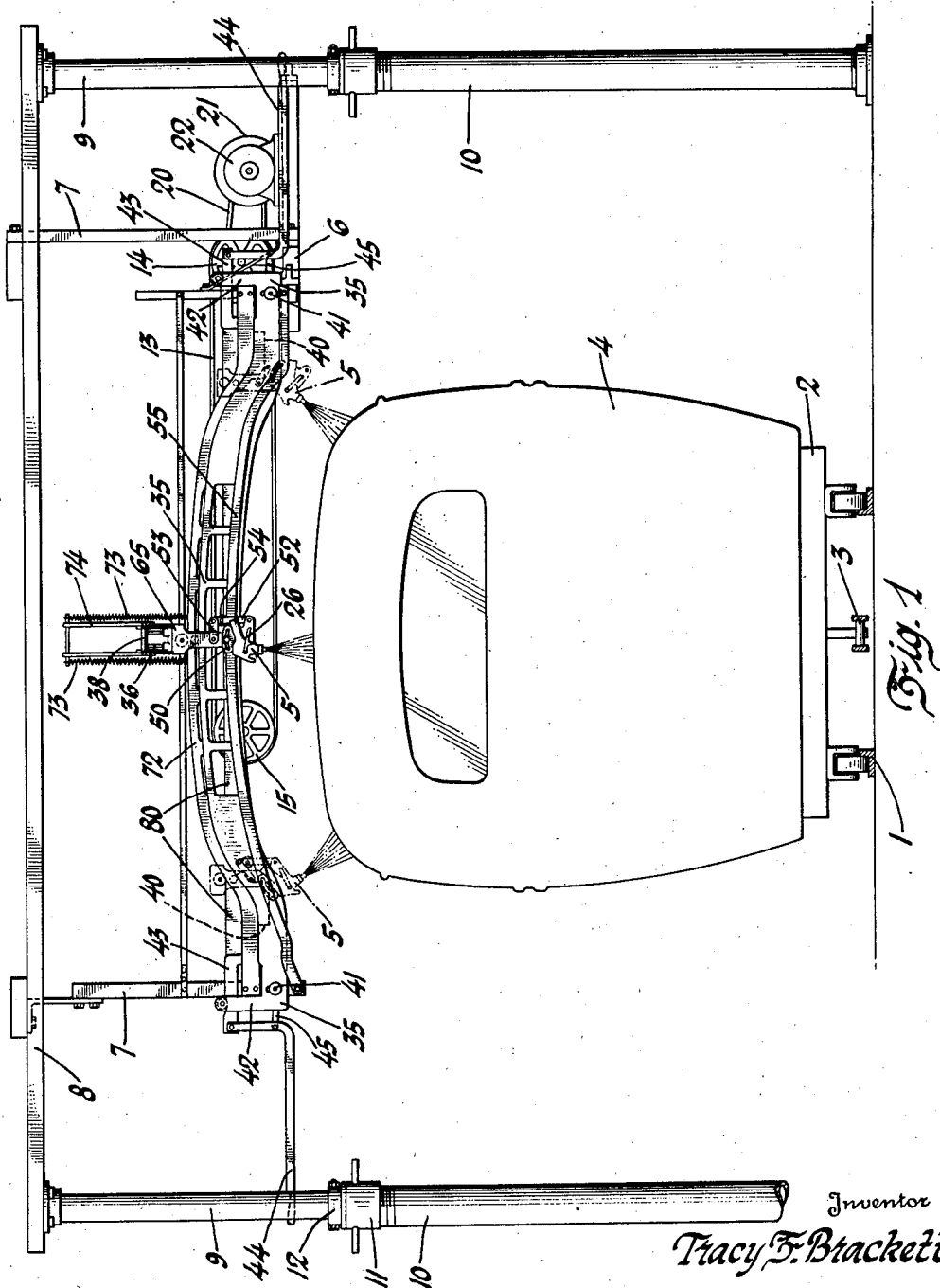
T. F. BRACKETT

2,083,633

PAINT SPRAYING MACHINE

Filed April 6, 1935

6 Sheets-Sheet 1



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6 Sheets-Sheet 2

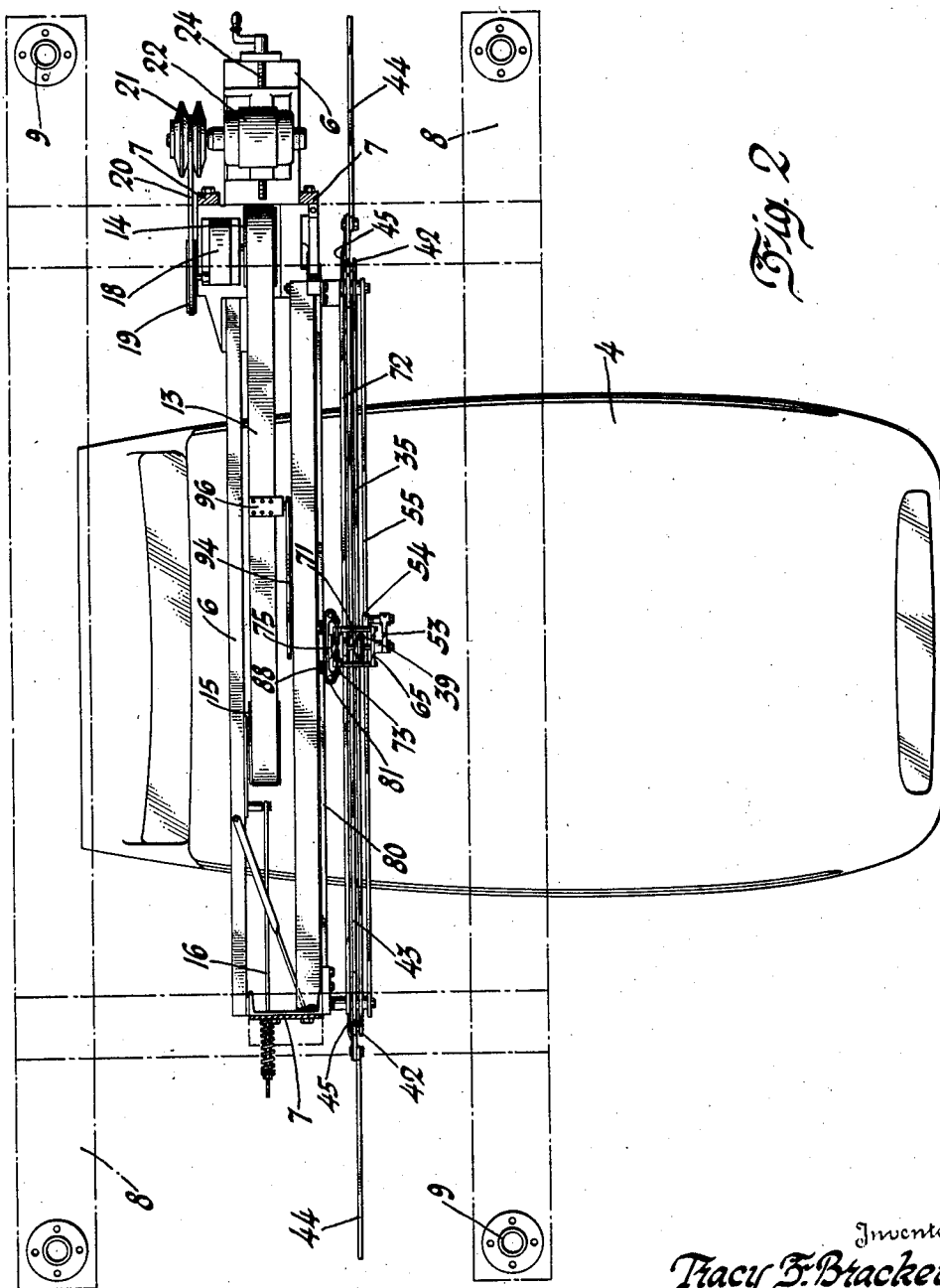


Fig. 2

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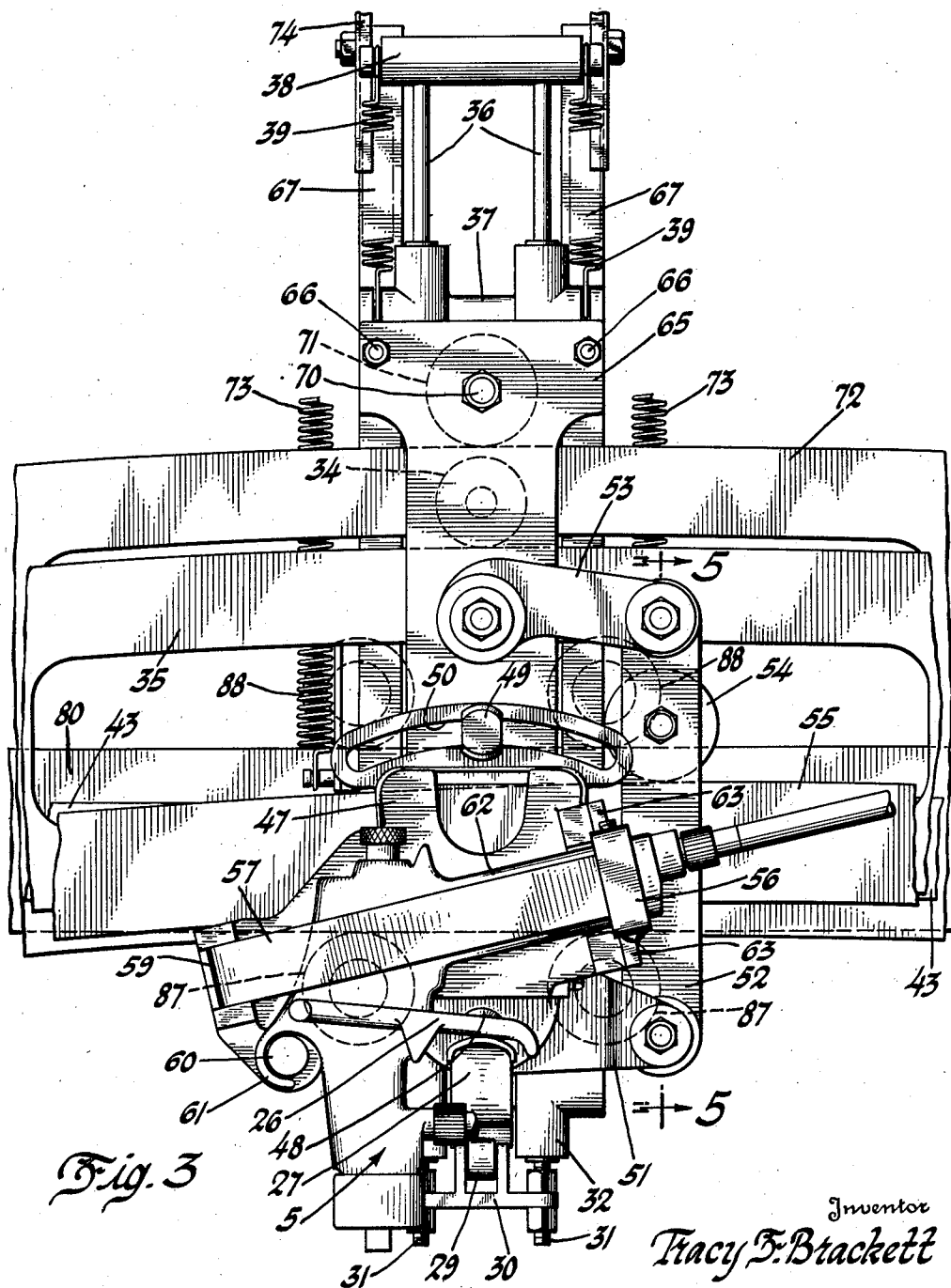
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6 Sheets-Sheet 3



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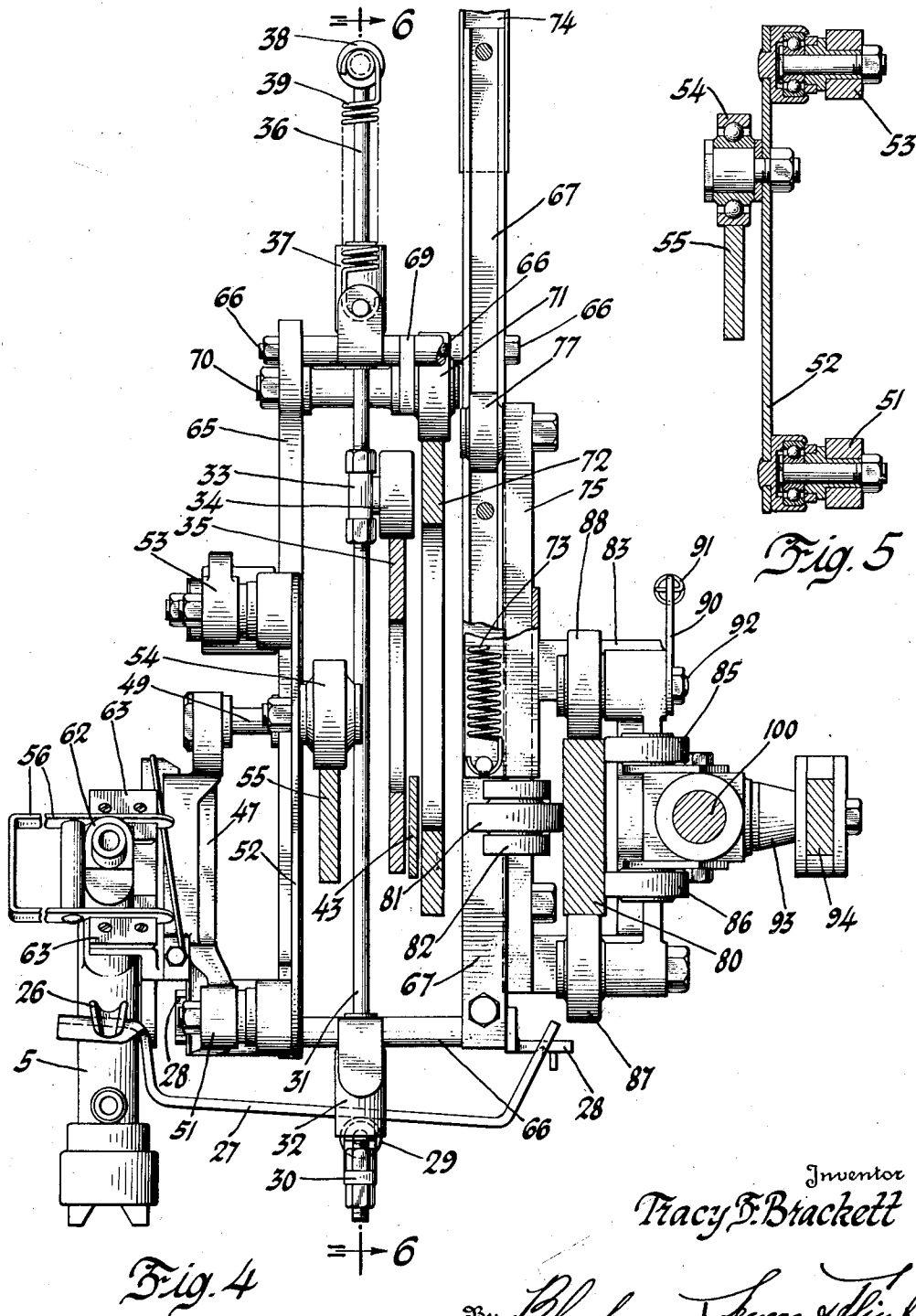
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6 Sheets-Sheet 5

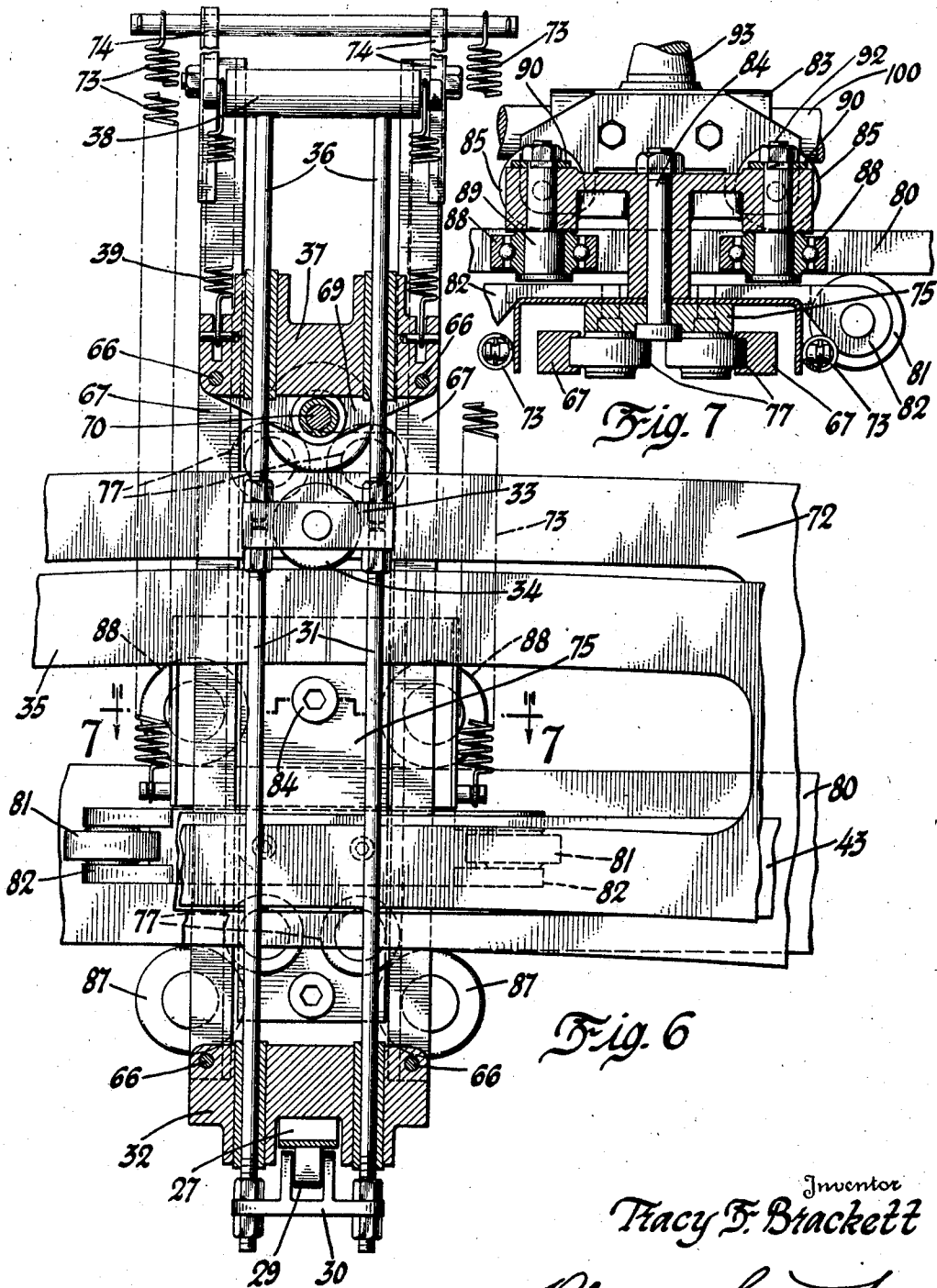


Fig. 6

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UNITED STATES PATENT OFFICE

2,083,633

PAINT SPRAYING MACHINE

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13 Claims. (Cl. 91—45)

This invention relates to the art of surface finishing and particularly to a machine for applying a uniform coating of paint or other liquid finish at a rapid rate over a large surface area. While its field of usefulness is unlimited the machine has been designed and will be described hereinafter as factory equipment for painting curved roofs of automobile bodies traveling continuously on a conveyor line in the paint shop.

In the ordinary paint shop, a conveyor line moving continuously, carries an endless succession of bodies upon which the several operations of cleaning, sanding, painting, drying, polishing, etc., are performed. Every body receives several paint coats and each coat is sprayed on with a hand manipulated gun. For the workman's health and comfort various precautions are taken, including the installation of extensive ventilation systems to prevent inhalation of the mist and fumes. Where metal roof coverings are sprayed with the ordinary equipment the workman's face necessarily is above and sometimes directly over the roof surface in the path of the rising fumes, which is much to his discomfort even though he wears a mask. To avoid that unpleasant job and improve conditions under which spray painters work is one of the aims of the present invention.

A further object of the invention is to provide an overhead carrier, under control of an operator positioned to one side and out of the way of the harmful effects of the spraying operation, for moving the spray gun back and forth across the roof of the traveling body.

Another object is to provide a machine wherein the discharge nozzle of the gun will be maintained at a proper distance from and on an axis normal to the surface being sprayed, having in mind that the surface may be curved or other than flat, and wherein the discharge is controlled manually by the operator at all times and automatically by the machine according to given positions of the gun in its range of reciprocatory travel.

A further object of the invention is to provide a variable speed drive by which rate of reciprocation of the gun holder may be regulated in accordance with the speed of the moving conveyor line.

Additional objects and advantages of the invention will become apparent during the course of the following specification, when taken in connection with the accompanying drawings, illustrating a preferred embodiment and wherein Figure 1 is an elevation and Figure 2 a top plan

view showing the assembled machine in spraying relation to an automobile body; Figures 3 and 4 show on a larger scale in front elevation and in side elevation, respectively, the gun carrier; Figure 5 is a section taken on line 5—5 of Figure 3; Figure 6 is a view looking in the direction of the arrows on line 6—6 of Figure 4 and illustrates the trigger valve operating mechanism; Figure 7 is a detail section on line 7—7 of Figure 6 and shows the roller mounting of a carriage on its supporting track, and Figure 8 is a top plan view partly in section of the traveling carriage and the mechanism for reciprocating the same.

Referring to Figure 1 in the drawings, the numeral 1 indicates a track for a dolly 2 which is connected with a conveyor chain 3. The dolly supports and carries the automobile body 4 shown in outline, the curved roof of which is to be coated as the body moves on the conveyor line. For this purpose an ordinary spray gun 5 is carried by an overhead structure for swift movement back and forth across the top. Best results are obtained when the discharge nozzle of the gun is maintained at substantially a given uniform distance from the surface being sprayed and additionally when the axis of discharge is substantially normal or at right angles to the surface. The mechanism for accomplishing these results will be described in more detail hereinafter.

For mounting the traveling gun carriage, its track and various control rails associated therewith, any suitable supporting structure may be employed. As shown in the drawings, the main frame 6 is carried at opposite ends by dependent suspension bars 7 from overhead beams 8, the opposite ends of which rest on adjustable posts extending upwardly from the floor. Each post is shown as comprising a pair of telescopic tubes 9 and 10 with the outer post 10 having at its upper end a screw threaded sleeve 11 engaging a collar 12 clamped or otherwise fixed to the inner tube 9. Adjustment of the sleeve 11 controls the extension of the telescopic tubes and the range of adjustment may be increased further by shifting the fixed position of the collar 12 on the inner tube 9. By this adjustment the height of the supporting frame may be altered for an initial adjustment of the spaced relation between the discharge nozzle of the gun and the roof surface.

For reciprocating the gun carriage use may be made of an endless belt 13 which as shown in Figure 2 passes over a pair of spaced pulleys 14 and 15 supported by the main frame 6. The pulley 15 is adjustably mounted for movement

relative to the pulley 14 and the spring loaded rod 16 connected with the mounting plate for the movable pulley 15, tends to spread the pulleys and automatically take up slack in the belt 13. The pulley 14 is driven through speed reduction gearing housed within a casing 18 from a V-grooved pulley 19, in turn driven through a V-belt 20 from an expansible pulley 21 fixed on the shaft of an electric motor 22. The expansible pulley 21 may be of any of the well known types on the market and comprises a pair of cooperating discs yieldingly held together by spring pressure and provided with inclined belt engaging faces which may be spread apart against the force of the spring by an increase in belt tension. The belt moving in or out of the groove, varies the diameter of the pulley driving surfaces and changes the rate of speed. To adjust the spacing of the pulleys 19 and 21 and thereby the tension on the belt, the motor 22 is slidably supported on one end of the main frame 6 and engaged by a hand operated screw shaft 24 whereby variations in speed of carriage reciprocation may be easily and quickly effected to suit conveyor line speed. It will be understood that the speed of the conveyor line is set according to production schedules and that the adjustment of carriage reciprocation in relation to conveyor travel eliminates the need for frequent adjustments of the feed of the sprayer gun and insures proper overlap of the paint sprayed on succeeding strokes of the carriage.

The gun used is of the conventional type and has leading to it flexible hose conduits for air under pressure and paint supply. Its valve is controlled by a trigger lever shown at 26 and it is proposed to operate this valve so that the flow of paint is automatically cut off at the end of each stroke and again turned on at the start of the succeeding stroke. The automatic cut-off is provided to eliminate excessive deposit as would otherwise occur due to the momentary stop and reversal of movement of the carriage at the completion of each stroke. Throughout the major portion of travel the carriage moves at a uniform speed but at the end of each stroke the speed decreases to what may be considered a dead stop before direction is reversed.

The mechanism controlling trigger operation includes a lever 27 engaging the trigger at one end and pivotally mounted at its other end to the traveling carriage. A simple mounting for the lever may involve the use of a pin 28 passing through an opening in the end of the lever. At an intermediate point the lever is engaged by a roller 29 on a cross piece 30 mounted at the lower ends of a pair of slidable rods 31. These rods extend upwardly through a guide block 32 forming a part of the traveling carrier, and at their upper ends are connected to a bar 33 on which is pivoted a roller 34 engaging a cam rail 35. In order to hold the roller on the rail a pair of rods 36 extend upwardly from the bar 33 through a guide block 37 and carry a cross piece 38 for connection at each side with the end of a coil spring 39 mounted at its opposite end to the guide piece 37.

Thus as the carriage moves back and forth the lever 27 is raised and lowered to control the valve through the engagement of the roller 34 with the cam rail 35, the formation of which is selected beforehand to insure opening of the valve throughout the intermediate portion of the range of carriage travel and closing of the valve at opposite limits. In this connection, it is

found that the interval of cut off should be different for certain types of bodies than for others and with this in mind it is proposed to provide in the rail 35 near opposite ends of the cam formation, a replaceable member, as indicated at 40 in Figure 1 for which may be easily and quickly substituted a similar part with a different contour.

Additionally, the cam contour of the member 40 may be such as to close and open the valve either suddenly or gradually depending upon operating condition. Thus where the surface of the work is substantially flat the cut off can be instantaneous, but where an irregular surface is involved as in the case of the curved corners of the automobile body shown, the actuation of the valve preferably is gradual at the beginning and the end of each stroke. This tapering off of the flow insures a more uniform coating inasmuch as the distance traveled by the gun is greater when a convex surface is being sprayed. In other words, in any spraying operation, uniformity of surface coating depends upon the relation existing between the extent of surface area to be covered, the amount of paint, discharged and the time and distance of gun movement. Considering the painting of a curved surface, the difference in the lengths of the arc of surface and the arc of gun travel may be compensated for by changing either the speed of gun movement or the rate of paint flow. For present purposes, the easiest method is to maintain gun travel at constant speed and vary the amount of paint sprayed as the gun passes over the curvature at the roof sides. This can be done simply by properly designing the contour of the trigger control ramp 35. More complex surfaces may be handled in the same fashion. For example a surface to be coated may be substantially ogee in contour in which case the trigger valve is actuated to flow more paint when the gun travels over the concave portion and to flow less during passage over the convex portion.

In order that the action of the valve may be controlled manually, the cam rail 35 is movably mounted on the frame work 6 by means of a pin and slot connection 41 and each end is provided with an upward extension or leg 42 carrying a roller or abutment for engagement with a transversely shiftable rail 43 having a ramp thereon to raise or lower the rail 35. For shifting the rail 43 there may be provided a bell crank hand lever 44 pivoted on a swinging link 45 and connected at one end to the rail with its opposite end extending outwardly to one side of the conveyor line for convenient grasp of the operator. As shown in the drawings a hand lever is associated with each end of the shift rail 43 so that the control may be from either side. Alternately, the position of the cam rail may be electrically or magnetically controlled, and for fully automatic operation, its action may be dependent upon the interruption of a light beam projected across the path of the moving body toward a photo-electric cell.

In order that the nozzle of the gun will be directed at the proper angle to the work the gun is mounted in an oscillating holder 47 pivoted at its lower end on a pin 48, the axis of which is aligned with the valve trigger so as not to disturb valve operation. To steady the holder an additional pin 49 on the carriage projects through an elongated arcuate slot 50 in the upper end of the holder and defines the range of swinging movement. At its lower end the holder has a lateral

ear 51 for pivotal connection with a link 52 projecting downwardly from a swinging lever 53 and carrying a roller 54 which rides on a cam rail 55. The shape of the cam rail 55 is such that the roller 5 rides down when the movement of the carriage is toward the right in Figure 1 to swing the gun to the dotted line position indicated, wherein the nozzle is directed inwardly toward the curved side of the roof while the movement in the other direction lifts the roller in conformity to roof contour and swings the gun to the other limit of oscillation in which the nozzle is again directed inwardly and toward the roof curvature along the opposite side of the body. Thus in all positions of the gun the direction of spray is substantially normal to the surface.

In this connection, it should be noted that at the curved corners along opposite sides of the roof, the direction of discharge and the cut off are controlled so that the spray cannot pass down and wash over the sides of the body. For some styles of corner curvature it may even be desirable to incline the nozzle inwardly to a greater extent than is here shown with the nozzle at a slight angle to the normal, this being a matter of cam design for controlling the oscillation of the gun holder.

Inasmuch as it may be desired to use the same machine for applying paint of different colors it is proposed to provide the gun holder with a quick detachable mounting for securing thereto any one of a number of replaceable spray guns. For this purpose a hinged latch 56 adapted to be swung into and out of hooked engagement with inclined abutment faces, as seen in Figure 8, positions an inwardly bowed spring blade 57 pivoted at 59 to removably clamp the gun against the face of the holder 47. The pressure of the spring blade serves both to prevent accidental disengagement of the hooked latch 56 and to hold the gun firmly regardless of any slight variations in the size of the several guns used interchangeably. For supporting and locating the gun in the holder a pin 60 is provided to engage with the finger piece 61 formed on conventional guns and the hand grip portion 62 on the gun is received between a pair of spaced lugs 63—63 projecting from the face of the holder. By this arrangement the substitution of guns may be accomplished easily and quickly without stopping the conveyor line and between the time one body passes beyond the sprayer machine and the next succeeding body moves into position to be coated. The provision of a number of interchangeable guns one for each color to be sprayed enables a predetermined production schedule to be laid out and followed as regards color selection.

The traveling carriage which supports the oscillating gun holder includes a plate 65 forming a part of a vertically reciprocable frame and having rearwardly projecting bolts 66, one in each of the four corners thereof, for attachment with a pair of vertically extending guide rails or channels 67. Mounted on the upper and lower pairs of pins 66 and located by suitable spaced sleeves on the pins are the guide blocks 37 and 32, respectively, referred to hereinbefore as providing bearings for the valve operating rods 31. Also carried by the uppermost pair of pins 66 is a transverse bar 69 supporting the inner end of a bearing pin 70 projecting from the plate 65 and carrying a roller 71 which engages a roof contour ramp or rail 72. The rail 72 which is fixedly mounted in the main frame of the machine has

a roller engaging surface which conforms substantially to the roof outline whereby as the carriage reciprocates back and forth across the roof it will also move vertically in relation to roof contour in order that the spray nozzle will at all times be maintained at approximately uniform distance from the surface being sprayed. To maintain the roller 71 on its rail, tension springs 73 are provided connected at opposite ends to extension members 74 on the channel 67 and to a plate 75, respectively, which plate has no vertical movement but forms a part of the reciprocating carriage.

Projecting forwardly from the plate 75 are two sets of vertically spaced rollers 77, one set for each of the vertically projecting channel rails 67. The channel rails 67 opening inwardly toward each other and engaging with the rollers 77 locate the parts and provide for relative vertical movement between the plate 75 and the parts associated with the roof contour roller 71.

This plate 75 carries a series of rollers which engage on all four sides of a track 80 which is straight from end to end and is fixedly mounted in the main frame of the machine. A pair of such rollers 81 are carried in transversely spaced relation in a bracket 82 for engagement with the front face of the rail 80. Another bracket 83, which may be in the form of a casting secured to the plate 75 by a stud 84, carries the remaining rollers, two spaced pairs of which as at 85 and 86, engage the vertical face of the rail 80 opposite to that engaged by the roller 81 in above and below the plane of the roller 81 in order to insure lateral stability to the moving parts. Another pair of transversely spaced rollers 87 engage the underside of the rail while the spaced rollers 88 engage the upper surface of the rail. Each roller 88 is mounted on an eccentrically disposed bearing shoulder 89 of a rotatable stud 92 projecting through the bracket 83 and having an upwardly extending arm 90. By means of a coil spring 91 connected at opposite ends to the respective lever arms 90 the bearing studs are under a constant force which tends to impart rotation thereto for crowding the rollers 87 and 88 into engagement with the top and bottom of the track 80 at all times.

Projecting rearwardly from the bracket 83 is a pin 93 to which is pivotally secured in any suitable fashion one end of the connecting rod 94 which imparts movement to the carriage from the traveling belt 13. The opposite end of the connecting rod 94 is connected to a journal pin 95 secured to one leg of an angle plate 96, the other leg of which is fastened by a series of studs 97 to the flexible belt 13. Thus as the angle bracket 96 is carried by the belt on a straight line between the pulleys the movement is transmitted through the connecting rod to the carriage, the direction of movement reversing itself as the angle plate travels in the curved path as the belt carries it around each pulley.

The rather sudden reversal of movement obviously places some strain on the connection between the belt and the angle plate and in order that these inertia forces may be decreased or damped an air cushion has been provided which comes into action at the end of each stroke. A satisfactory arrangement for this purpose involves the mounting on the carriage bracket 83, of a pair of oppositely projecting rods 100, each of which carries a piston or cupped packing 101 adapted to enter a mating cylinder 102 fixed on the frame of the machine and provided with a

suitable bleed opening 103. The size of the bleed opening will be predetermined to secure the proper degree of cushion action through the escape of air trapped and compressed within the cylinder 102 by the movement of the piston packing 101 thereinto.

From the above description, it will be apparent that there has been provided a spraying machine in which the gun is oscillatably mounted in the carriage for directing the nozzle at the proper angle to the work surface and in which the carriage is reciprocable transversely to the direction of conveyor travel as well as in the vertical direction for imparting to the nozzle a path of movement substantially following roof contour, with automatic feed control and means for readily adjusting speed of operation in relation to conveyor travel.

I claim:

1. Factory equipment for use with a conveyor line including means to apply a surface finish to articles traveling on the conveyor line, mechanism for imparting movement to said means in a direction transverse to the direction of travel of said articles and other mechanism acting in simultaneous relation with the action of the first mentioned mechanism for imparting movement to said means transverse to both the first mentioned movement and the travel of said articles.

2. For use with a conveyor line, means for applying a liquid finishing material on the surface of an article moving on the conveyor line, means for reciprocating said applying means in a plane substantially parallel to said surface and other means acting automatically in conjunction with the movement of the applying means from one limit to the other in its range of reciprocation for simultaneously reciprocating said applying means in a direction transverse to said plane.

3. Means for spray painting an irregular surface of an article traveling on a conveyor, including a sprayer device, means for moving said device along the surface transversely to the direction of conveyor travel and other means for moving said device transversely to the direction of conveyor travel and simultaneously with and transversely of the first mentioned movement for cooperation therewith in imparting to the device a predetermined path of movement.

4. In paint spraying mechanism of the character described, a conveyor for moving articles to be sprayed, a reciprocating carriage adapted to be moved back and forth along the article in a direction transverse to the direction of conveyor movement, means operating in timed relation to carriage movement for additionally reciprocating said carriage in a direction transverse to both of the aforementioned movements, and a spraying device supported by said carriage.

5. Paint spraying mechanism for coating curved surfaces, including a conveyor for moving articles to be sprayed, a reciprocating carriage adapted to be moved back and forth transversely of the direction of conveyor movement, a sprayer device supported by the carriage with its discharge nozzle in spaced relation to the surface of the work, means additionally reciprocating said carriage on a line transverse to both of the aforementioned movements and in timed relation to its first mentioned movement, and means for oscillating said sprayer device in relation to said

surface to maintain the axis of said nozzle substantially normal to the surface.

6. Paint spraying mechanism for coating curved surfaces, including a continuously moving conveyor for articles to be sprayed, a reciprocating carriage adapted to support a sprayer device and movable transversely of the direction of conveyor movement in a path substantially conforming to the curved contour of the surface to be sprayed, and means operative during travel of the carriage to oscillate the sprayer device relative to the carriage and direct the sprayer nozzle on a line substantially normal to said surface.

7. Paint spraying equipment for applying a uniform coating on a surface having an irregular curvature, including a track spaced from and conforming to the contour of said surface, means to move a spray gun on said track and valve control means for said gun to vary paint discharge in accordance with surface curvature, said control means including a valve operating member movable with the gun and a control ramp engaged thereby in the movement of the gun and shaped to predetermined contour in relation to track curvature to vary the extent of valve opening in relation to changes in radii of track curvature.

8. Equipment for painting the roof of an automobile body while the body is moving on a conveyor line, including an overhead track, a carriage supported by the track for reciprocation across the roof, a spray gun on the carriage, and means operative during carriage movement to shift the vertical position of the carriage in accordance with roof contour and maintain substantially uniform spacing between the gun and roof in all positions of the carriage.

9. Paint spraying equipment for coating the curved roof of an automobile body, while the body is moving on a conveyor line, including an overhead track, a carriage supported by the track for reciprocation across the curved roof surface, a spray gun oscillatably mounted on said carriage, and means for swinging the gun between opposite limits of its oscillatory path with each stroke of the carriage to position the gun so that the axis of paint discharge is always at substantially 90° to the roof surface being sprayed.

10. Paint spraying equipment for coating the curved roof of an automobile body, while the body is moving on a conveyor line, including an overhead track having a length greater than the width of the roof surface to be treated, a carriage supported by the track for reciprocation across and between opposite limits outside the general outline of the curved roof surface to be treated, means operative during reciprocation of the carriage to shift the vertical position of the carriage to follow roof contour, a spray gun holder oscillatably mounted on the carriage and means to swing the spray gun holder to direct the gun inwardly toward the curved roof contour adjacent opposite limits of carriage reciprocation.

11. Paint spraying equipment for coating the curved roof of an automobile body, while the body is moving on a conveyor line, including a carriage adapted for reciprocation across the roof of the body, a straight line track for the carriage, a gun supporting assembly mounted on the carriage for relative vertical movement, a ramp rail conforming in outline to substantially the roof contour and engaging said assembly to shift the vertical position thereof during

carriage reciprocation for maintaining the same in given spaced relation to the roof surface.

12. In a paint spraying machine, a reciprocating spray gun having a flow cutoff valve, a track follower movable with the gun to control valve action, a track movable in a direction transverse to the direction of gun reciprocation and provided with formations engageable by said follower to open and close the valve at predetermined points in the range of gun reciprocation, and a manually operated rail shiftable in the direction of gun reciprocation and provided with

cam elements engaging the track to move the same to and from position to be engaged by said follower.

13. In a paint spraying machine, a frame, a gun carriage reciprocably mounted on the frame, a drive means for reciprocating the carriage, a pair of oppositely projecting pistons mounted on the carriage and a pair of cylinders mounted on the frame at opposite limits of carriage reciprocation to receive the pistons and check carriage inertia.

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