Jan. 6, 1948. K. T. POTTHOFF 2,434,176

SPRAY COATING MACHINE

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Fig. 1

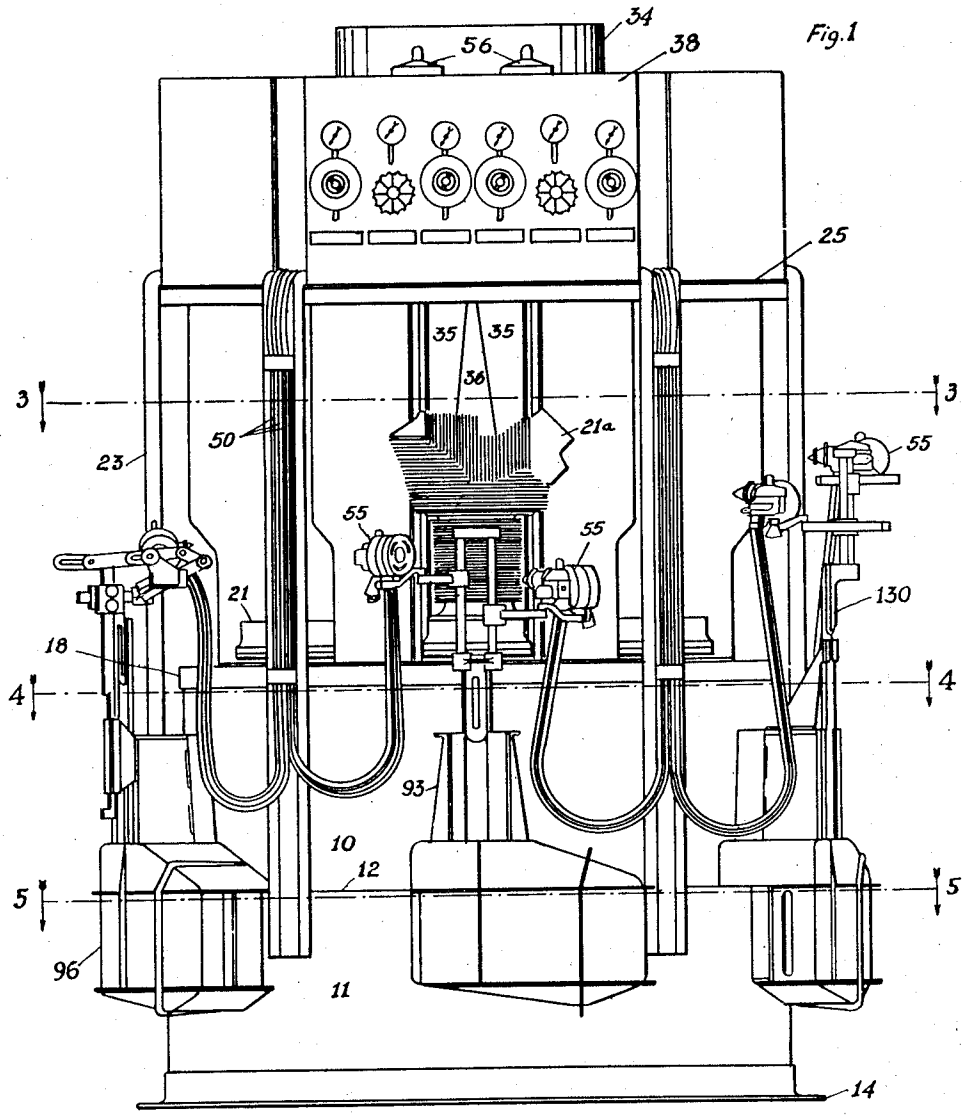


Fig. 6

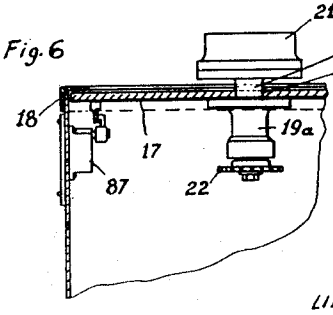
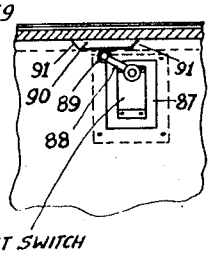


Fig. 7



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SPRAY COATING MACHINE

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Fig. 2

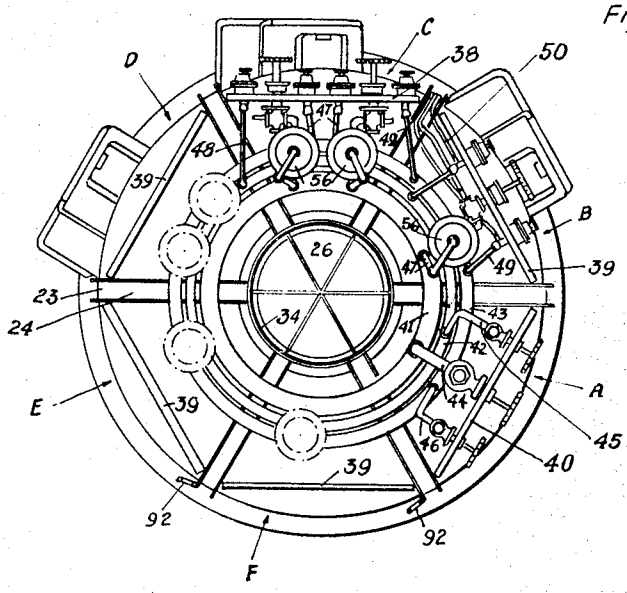
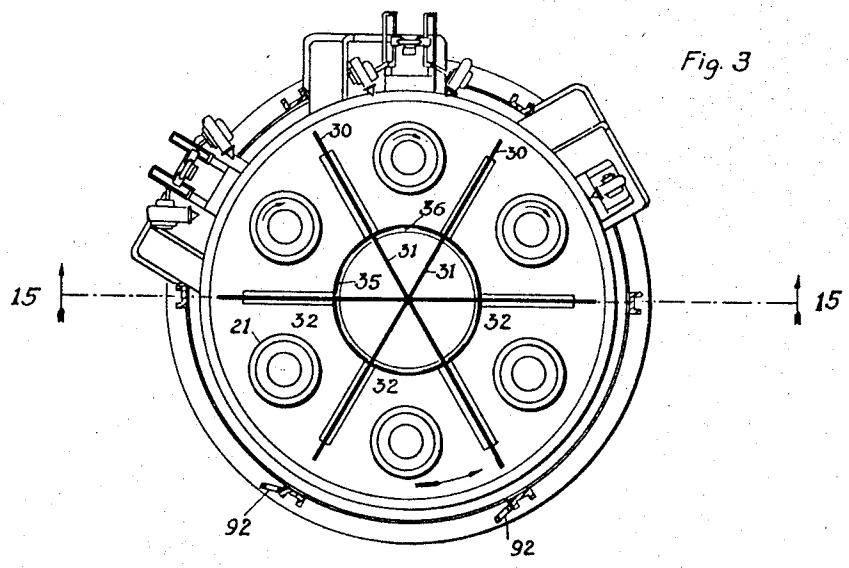


Fig. 3



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SPRAY COATING MACHINE

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Fig. 4

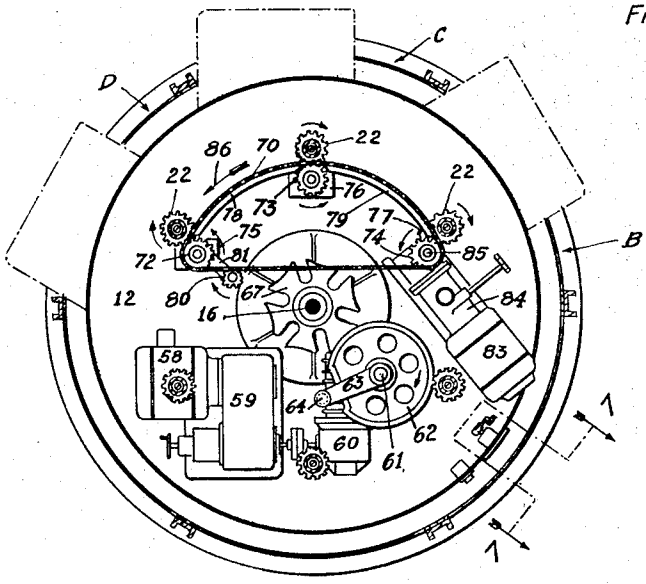
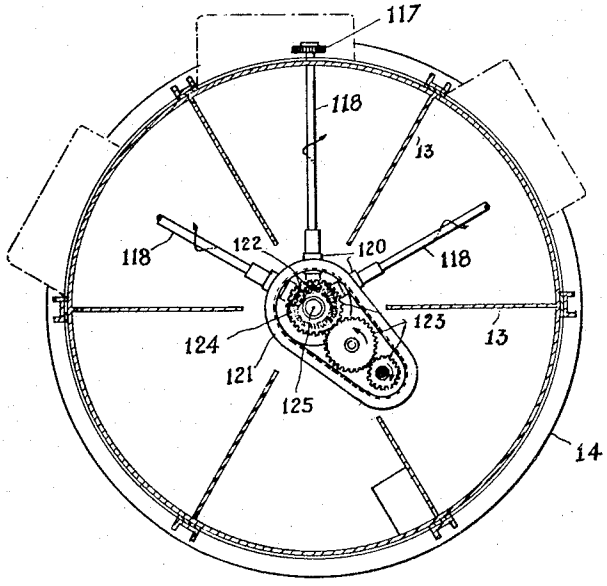


Fig. 5



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SPRAY COATING MACHINE

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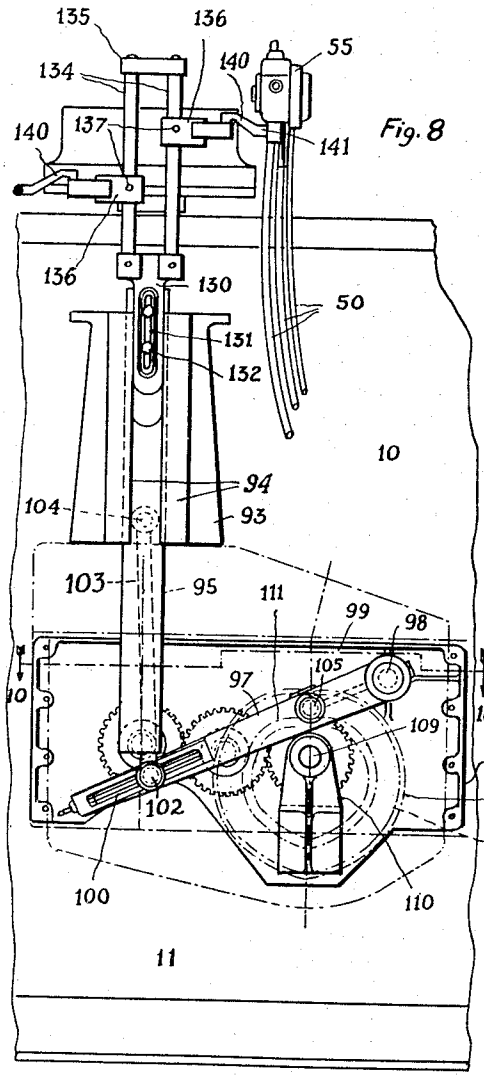


Fig. 8

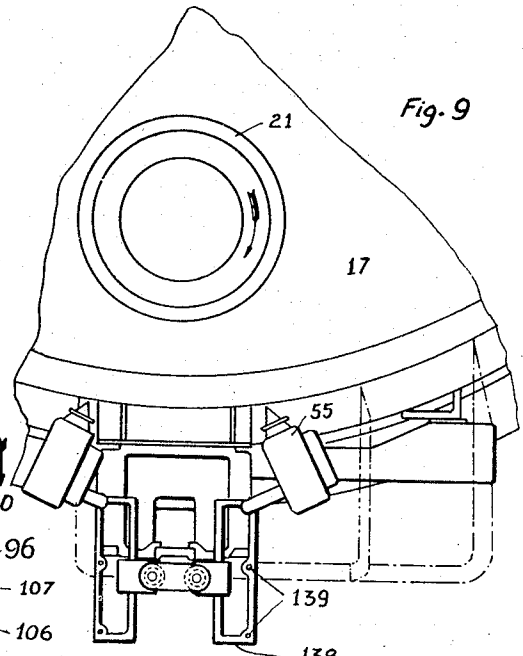


Fig. 9

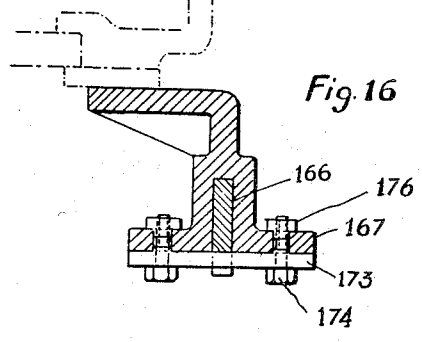


Fig. 16

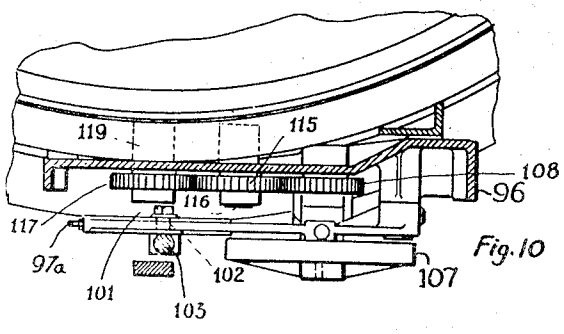


Fig. 10

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SPRAY COATING MACHINE

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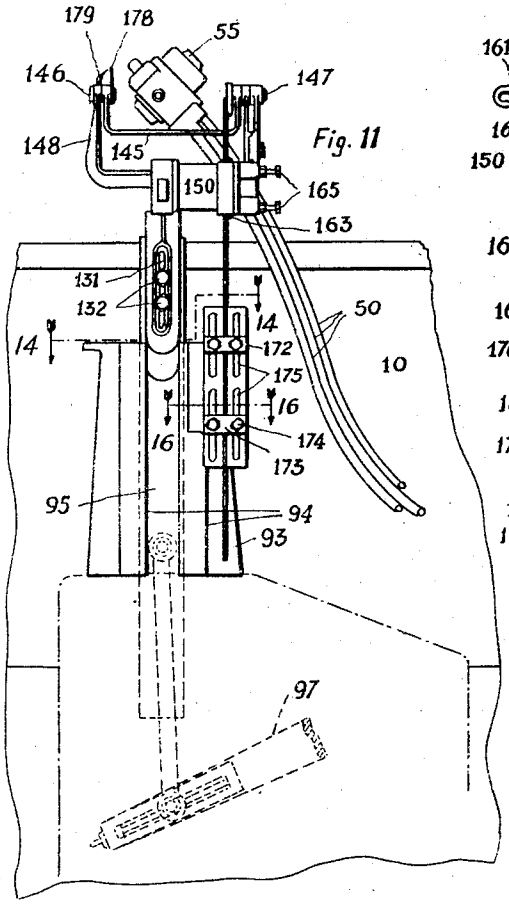


Fig. 11

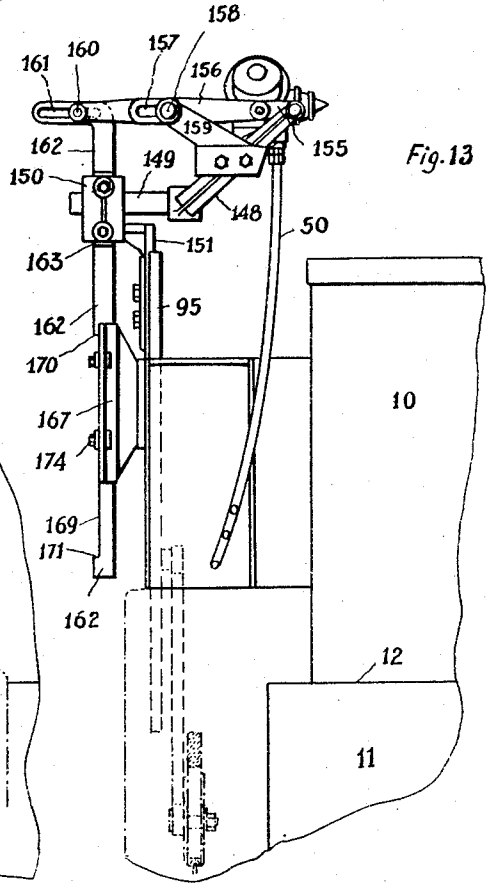


Fig. 13

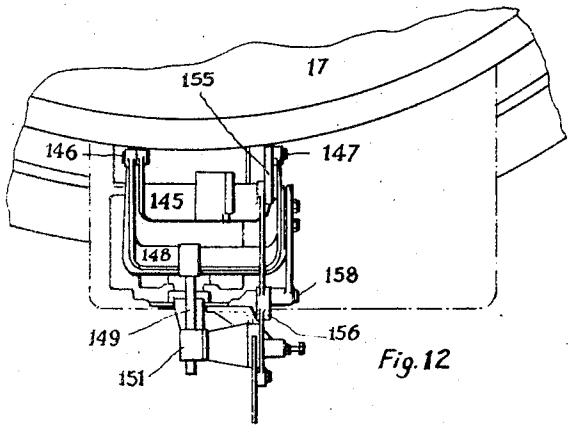
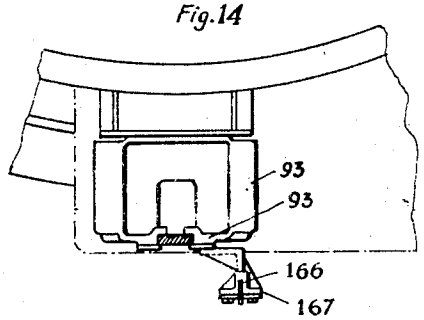


Fig. 12

Fig. 14



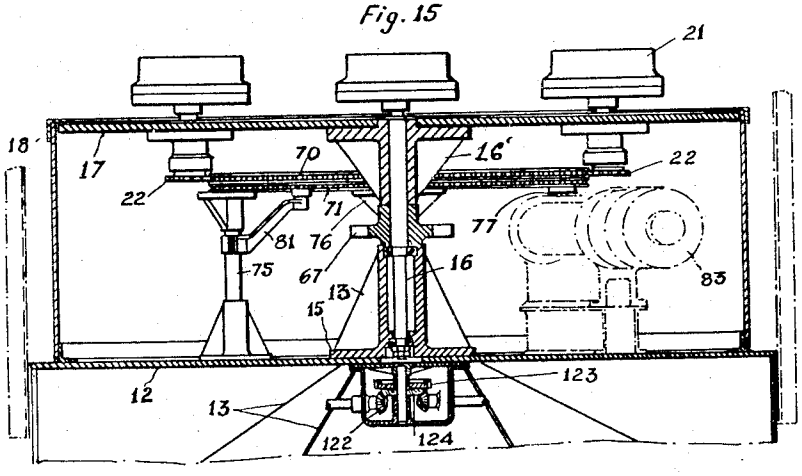
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Jan. 6, 1948. K. T. POTTHOFF 2,434,176

SPRAY COATING MACHINE

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Fig. 15



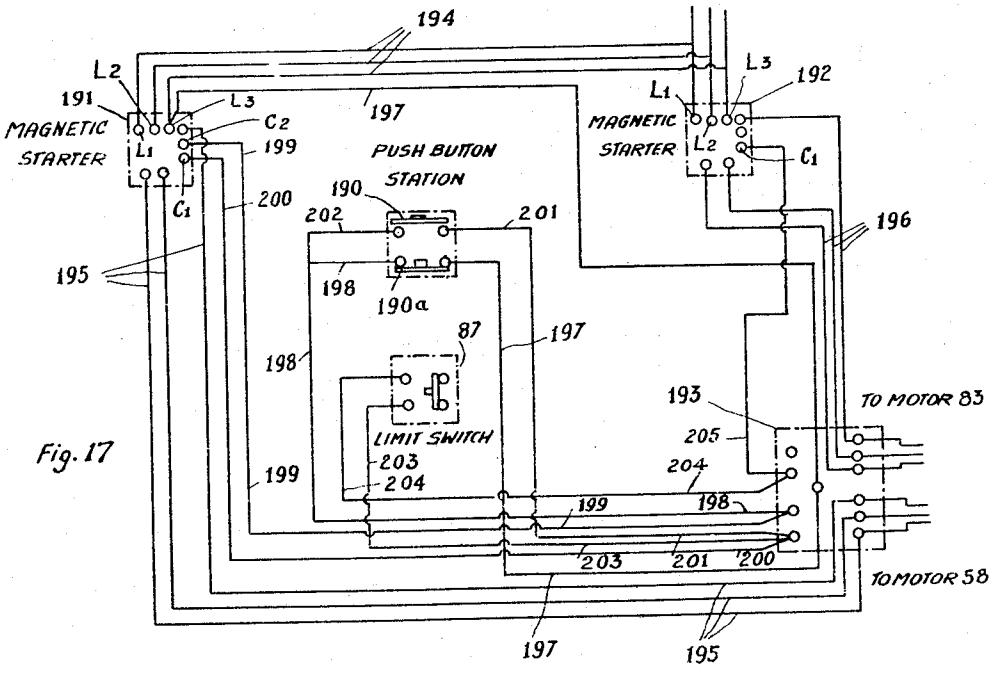


Fig. 17

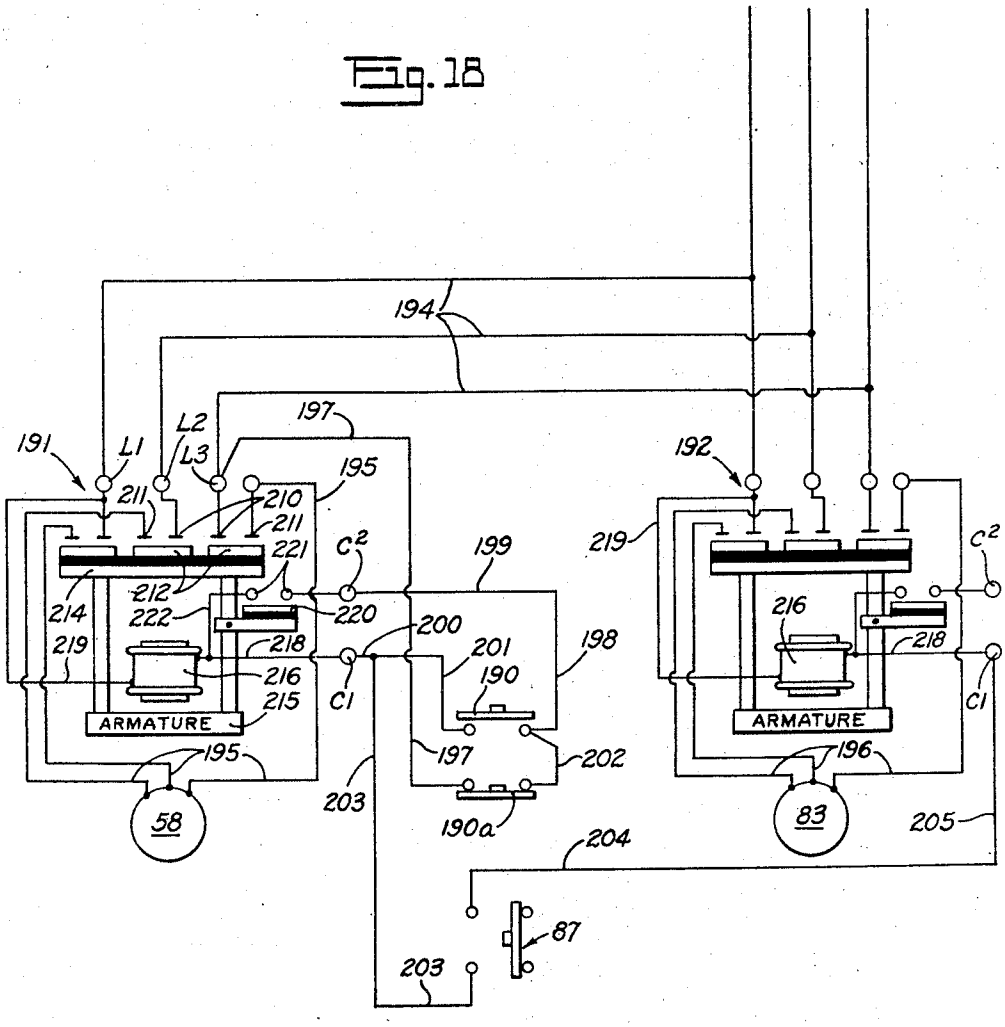
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Fig. 18



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Patented Jan. 6, 1948 2,434,176

UNITED STATES PATENT OFFICE

2,434,176

SPRAY COATING MACHINE

Kurt T. Potthoff, Brooklyn, N. Y.

Application November 17, 1942, Serial No. 465,836

37 Claims. (Cl. 91—45)

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This invention relates to coating and spraying machines and to automatic method and means for applying coatings, and more particularly to apparatus and devices for controlling movements of articles or objects and intermittently spraying them so that the various parts of objects may be coated with metal as the objects are moved from one spray station to another, though it is noted that in many of the claims the invention is not limited to metal spraying devices, nor even to devices for applying coatings.

Objects of the invention are to provide an improved apparatus of this kind which will present successive objects to a spraying means or gun, and to rotate the presented object, and to vertically reciprocate the gun during the spraying to reach various parts of the object.

Another object is to provide means whereby the gun may be tilted at the end of each stroke to shift the angle of the spray to reach irregular surfaces of the articles.

Other objects of the invention are to provide improved means for adjusting the mechanisms of this kind to adapt the device to various sizes and shapes of articles as they are brought into position opposite spray guns, or devices, and to adjust the angle and travel of the spray guns.

Additional objects of the invention are to effect simplicity and efficiency in such methods and apparatus and to provide simple apparatus of this kind which is economical, durable, speedy and reliable in operation, and economical to manufacture and install.

Still other objects of the invention will appear as the description proceeds; and while herein details of the invention are described in the specification and some of the claims, the invention as described in the broader claims is not limited to these, and many and various changes may be made without departing from the scope of the invention as claimed in the broader claims.

The inventive features for the accomplishment of these and other objects are shown herein in connection with an automatic spraying machine which briefly stated includes a rotary table divided into similar sector-shaped work stalls by means of radial partitions meeting at the axis of the table. A number of fixed stations are located adjacent the periphery of the table, the number being equal to that of the stalls, so that each stall will register with successive stations as the table rotates. Automatically controlled spray guns are operatively mounted at some of the stations, while other stations may be used for hand-spraying, inspection, loading, unloading and the like.

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A rotary work piece support is mounted on the table in each stall and motor means are provided to rotate the table step-by-step, to bring to rest the successive supports opposite successive stations. When the table comes to rest, the spray guns are raised and lowered, and the supports opposite the automatically operated spray guns are rotated by timed motor means controlled by a limit switch controlled by the table movement.

In the accompanying drawing showing, by way of example, one of many possible embodiments of the invention,

Fig. 1 is an elevation showing the spraying machine and automatic stations and also on one support a cylinder head;

Fig. 2 is a plan of the machine;

Fig. 3 is a horizontal sectional view, partly in plan, showing the table, guns and supports, the section being taken substantially on the line 3—3 of Fig. 1, looking in the direction of the arrows of said line;

Fig. 4 is a horizontal sectional view, partly in plan, showing actuating mechanisms, the section being taken substantially on the line 4—4 of Fig. 1 looking in the direction of the arrows of said line;

Fig. 5 is a horizontal sectional view, partly in plan, showing the machine, the section being taken substantially on the line 5—5 of Fig. 1, looking in the direction of the arrows of said line;

Fig. 6 is a fragmental side view showing the support and limit switch in elevation and the table in radial section;

Fig. 7 is a fragmental vertical sectional view, partly in elevation, showing the limit switch, the section being taken substantially on the line 7—7 of Fig. 4, looking in the direction of the arrows of said line;

Fig. 8 is a fragmental front elevation showing a gun support and actuating mechanism;

Fig. 9 is a fragmental plan showing the support of Fig. 8;

Fig. 10 is a fragmental horizontal sectional view, partly in plan, showing the mechanism of Fig. 8, the section being taken substantially on the line 10—10 of Fig. 8, looking in the direction of the arrows of said line;

Fig. 11 is a front elevation showing a gun support having means for automatically changing the gun angle;

Fig. 12 is a plan of the support of Fig. 11;

Fig. 13 is a side elevation of the support of Fig. 11;

Fig. 14 is a horizontal sectional view, partly in plan, the section being taken approximately

on the line 14—14 of Fig. 11, looking in the direction of the arrows of said line;

Fig. 15 is a fragmental vertical sectional view, partly in elevation, showing table support and mechanism for rotating the work supports, the section being taken substantially on the line 15—15 of Fig. 3, looking in the direction of the arrows of said line;

Fig. 16 is a sectional view taken on the line 16—16 of Fig. 11;

Fig. 17 is a wiring diagram showing the electric control of the motors and the connections with the switches and junction box;

Fig. 18 is a diagram omitting the junction box and showing the interior of the magnetic starters.

Main frame and housing

The spraying machine includes axially upright substantially cylindrical housing walls 10, 11 (Fig. 1) of about table height and forming a housing having a horizontal intermediate floor 12 (Figs. 4 and 5), mounted in the main housing to form upper and lower chambers, the lower housing wall 11 being supported on the angle piece 14. A central pedestal 15 (Fig. 15) on said floor 12 having lower strengthening ribs 13 rotatably bearingly mounts a vertical shaft 16 (Figs. 4 and 15) carrying an upper bracket 16' on which is mounted a circular table 17 (Fig. 15) with its periphery spaced under a flange 18 on the wall 10. Said table is provided about half way from center to periphery with a series of bearing openings 19 with bearings 19a fast therebeneath, six openings being here provided for example, spaced at equal angles apart around the table, and all the same distance from the axis of the shaft 16. A short shaft 20 in each of the bearing openings has a suitably shaped work support 21 fast on its upper end above the table, on which may be placed an article 21a to be metalized. A small traveling sprocket 22 is fast on the lower end of each shaft 20, below the table.

A frame mounted on said wall 11 comprises uprights or channel bars 23 (Figs. 1 and 2) secured to and extending above the wall 11, equal in number to said bearing openings, on the inturned upper ends 24 (Fig. 2) of which uprights an annular ceiling 25, having a large central opening 26, is secured a distance above the table. The uprights 23 cooperate with the wall 11 to define a loading and an unloading station A, three automatic stations B, C and D and hand spraying, retouching and inspection stations E and F.

The space between the ceiling and table is divided by radial partitions 30, 31 (Fig. 3) secured to said table and extending substantially to the ceiling, the partitions when the table is stationary, extending inwardly from near the uprights 23. All partitions 30, 31 meet at the vertical axis of the table to form compartments or stalls 32 so that material sprayed in one compartment will not enter another. The partitions revolve with the table and divide the space above the table into six stalls which, when stationary cooperate with said stations.

A vertical suction flue 34 (Fig. 2) extends downwardly through said central opening 26 to said table, the lower portion of the flue being in the form of segments formed by the inner portions 31 of the partitions and curved plates 35 (Figs. 1 and 3) therebetween. The curved plates 35 form therebetween opposite each station, an upwardly tapering opening 36, narrow at said ceiling and widest at the table and forming a passage for dust and fumes from the station into the flue, whereby the suction will be properly distributed and sufficient at the bottom. An exhaust fan or conduit (not shown) may be mounted coaxially above the flue for drawing fumes and atomized metal from the stalls, through said tapering openings and flue, for conducting them away.

Manifold chamber

Panel boards 38, 39, 40 (Figs. 1 and 2) mounted above the margin of the ceiling serve to mount instruments and form an upper manifold chamber in which are mounted annular manifold supply pipes 41, 42, 43 disposed around the chamber to receive oxygen, acetylene, compressed air or the like through valved pipes 44, 45, 46, for supplying these gases through valved pipes 47, 48, 49 and flexible tubes or hose 50 (Fig. 1) extending in the channels of the uprights 23 to the spray guns 55 at the gun stations B to F. Filter chambers 56 may be inserted in the air pipes 47.

Step-by-step drive mechanism

During operation, step-by-step movement is imparted to said table for moving said supports from a middle position of one station to that of the next and stopping them there. This step-by-step movement is effected by a continuously running main electric motor 58 (Fig. 4) mounted on the floor 12 and operating a speed reducing gear 59 driving, through suitable miter and other gears in housing 60, a vertical Geneva drive shaft 61 rotatably mounted near said drive miter gear and having fast on its upper end a stop disk 62 and a short arm 63 carrying a roller 64. A driven Geneva member 67 is carried fast by said shaft 16 and is engaged, by the disk 62 to hold the shaft 16 stationary, and by said roller 64 for driving the shaft and table step-by-step. The Geneva member 67, roller 64, the work supports 21 and traveling sprockets 22 are so positioned that the table is caused to come to rest when the work supports and sprockets are positioned in the middle position of said respective stations A to F.

Work support rotating mechanism

The traveling sprockets 22 and supports 21, when at the three automatic spraying stations C, B and D, are rotated by means of a double coursed roller sprocket chain 70, 71 (Figs. 4 and 15) comprising an upper drive portion 70 and a lower driven portion 71, the lower portion 71 being meshingly carried on non-traveling sprockets 72, 73, 74 in position for the upper drive portion 70 to mesh with the traveling sprockets 22 as the table comes to rest. The axially vertical non-traveling sprockets 72, 73, 74 are rotatably mounted on brackets or pedestals 75, 76, 77 mounted on said floor 12 at said automatic stations B, C and D with the axis of each sprocket spaced radially inwardly of the axis of the traveling sprocket 22. The upper portions of the brackets 75, 76, 77 carry a horizontally disposed arcuate chain-backing guide members 78, 79 of vertically elongated cross section and having an outwardly disposed smooth outer face concentric with the shaft 16 and engaged against the inner face of the double coursed sprocket chain where the latter meshes with the sprockets 22, to hold the chain in position to mesh with the sprockets 22 in all positions of their movement from station B to station D.

A non-traveling idler sprocket 80 mounted on an arm 81 adjustably mounted on the bracket 75 serves to take up slack in the chain so as to readily permit meshing of the traveling sprocket with

the chain as they are brought into position by the rotating table.

Intermittent means such as an intermittently energized electric motor 83 is provided with a reducing gear 84 which drives the shaft 85 carrying the sprocket 74 for driving the chain continuously when the table is stationary and discontinuing its drive when the table is moving. The drive could be effected through any of the non-traveling sprockets such as the sprocket 74, but any other suitable interacting motor driven means may be used. The direction of rotation of the intermittent motor is such that the part of the chain engaged by the traveling sprocket 22 is moving in the direction of the arrow 86, the direction in which the sprocket travels at the time of coming into the engagement.

The limit switch

An electric circuit for controlling and driving the motor 83 is shown in Fig. 16 later to be described, and includes a limit switch 87 (Figs. 6 and 7, Sheet 1) which is mounted on the housing wall 10 just below the table and comprising a lever 88 provided with a roller 89 on its free end and adapted to be lowered to close the switch. A cam 90 mounted on the lower face of the table under each stall and having beveled end portions 91 holds the limit switch closed just before, during and just after the table is in position of rest and allows the lever to rise and the switch to open when the table is in position of movement. The cam 90 is so positioned that said double chain 70, 71 is driven just before, during and just after the time the table is at rest.

Spray guns

The spray means for spraying metal on the article on the work support at the spraying stations include, at each spraying station, one or more spray guns 55 or coating means of any well-known type such for instance, as the gun described in United States Patent No. 2,227,752, each gun being provided with inlets for oxygen, acetylene and compressed air, respectively connected by flexible hose or tubing 50 to the corresponding manifolds as above explained. At each hand station E and F a hook 92 on an upright 23 may be provided for hanging the gun, while automatic means about to be described are mounted at the automatic spraying stations B to D for holding the gun directed toward the article and raising and lowering the guns during the spraying.

Spray gun reciprocating mechanism

Each of said automatic means includes a bracket 93 (Figs. 8 to 14) mounted on the outer face of the housing wall 10, each bracket including a pair of upright spaced guides 94 between which a vertically reciprocating upright slide bar 95, carrying means later to be described, is adapted to support the gun.

Below each bracket 93 a gear housing 96 (Fig. 1) extends a distance around the wall 11 and has therein a lever 97 (Fig. 8) having one end fulcrumed on a stub shaft 98 carried by the rear wall 99 of the gear housing. The other end of the lever is provided with a longitudinal slot 100 receiving a screw 101 (Fig. 10) by means of which a fulcrum block 102 is clamped to the lever. To this block is pivoted the lower end of the link 103 which is pivoted at its upper end 104 to the back of the bar 95. The lever 97 is provided intermediately with an outwardly disposed lateral roller 105 engaging in an endless cam groove 106 around the inner face of a cam disk 107 fast on a gear 108 rotated as will be explained, on a cam shaft 109 mounted in said inner wall 99, and a bracket 110 carried by the lower part of the housing 96, whereby the bar 95 and consequently the gun is vertically reciprocated. The cam is shown as provided with a land portion 111 so the gun will remain in its lowermost position a perceptible length of time as the cam rotates, during which time the table is rotated a step. Said groove 106 is of a shape to raise and lower the lever, link and bar 95 during the complete rotation of the cam and hold them stationary during the rotary indexing movement of the table. The stroke of the bar 95 may be varied by a change in the pivot block 102 by means of an adjusting screw 97A.

Each cam gear 108 (Fig. 10) is driven by an idler gear 115 removably mounted on a fixed shaft 116 mounted in the housing wall 99, said idler being in turn driven by a gear 117 mounted on one of the radial shafts 118 (Fig. 5), one for each cam 107. The outer ends of the shafts 118 are mounted in outer end bearings 119 in the gear housing wall 99. The shafts extend into the lower chamber above the level of the flange piece 14 (Fig. 5), and are mounted at their inner ends in bearings 120 mounted in housing 121 mounted on the lower face of intermediate floor 12.

The inner end of each radial shaft is provided with a miter gear 122 each meshing with a large miter gear 124 loose on the lower part of the pedestal 15 or on a separate fixed shaft 125. The gear 124 may be driven by the Geneva drive shaft 61 through a train of gears 123 in the housing 121. The gears of the cam drive means are so proportioned and the cam grooves are so contoured that the gun supporting block will rise and lower once when the table is stationary.

Gun mounting means

At stations C and D the reciprocatory bar 95 adjustably carries at its upper end a supporting member 130 provided with a vertical slot 131 receiving screws 132, the threads of which are received in the bar 95, whereby the member 130 may be adjusted as to height. The end of this member mounts a pair of columns or rods 134 connected at the top by a yoke 135 on which blocks 136 may be adjustably held by means of set-screws 137. Said blocks 136 are oppositely directed and carry mounting frames 138 (Fig. 9) having therein a plurality of vertical bores 139 any one of which is adapted to receive a downturned hook member 140 (Fig. 8) of a bracket 141 carrying the gun. By this arrangement the guns 55 may be angularly adjustably mounted different distances from the article to be metallized and at different horizontal angles.

Gun swinging mechanism

The angle of the gun at one or more stations, for instance the station B, may be automatically changed during spraying. In this instance the gun is carried by a swinging gun support or cradle 145 (Fig. 11) pivotally carried on pivots 146, 147 carried by the arms of a U-shaped cradle support 148 mounted fast on the inner end of a supporting bar 149 (Fig. 13) adjustably slidably received in a transverse opening passing through a block 150 carried on an adjustable L member 151 adjustably carried on the upper end of the bar 95 as described of the block 130 of Fig. 8.

Thus the support 148 is vertically reciprocated;

and the cradle 145 carrying the gun is swung in the support 148 by means now to be described.

The gun cradle 145 carries fast thereon a short lever arm 155 (Fig. 13) to which is pivotally connected a lever 156 provided with an intermediate longitudinal slot 157 pivotally slidably receiving a fulcrum pin 158 fast on an arm 159 secured fast on the support 148. The outer end of the lever 156 carries a lateral pin 160 slidably received in a horizontal slot 161 of the laterally turned upper end of a vertical friction bar 162 frictionally slidably received in a vertical slot passing through the block 150, and pressed upon by a friction member 163 pushed upon by setscrews 165 for adjusting the friction. The lower part of the bar 162 slides in a groove 166 (Figs. 14 and 17) in a fixed block 167 mounted on a bracket 93. Said bar 162 is narrowed at the part 169 where received in the groove 166 to provide upper and lower shoulders 170, 171 facing each other and adapted to engage transverse stop pieces 172, 173 adjustably secured across the block 167 by bolts 174 (Figs. 17) passing through vertical slots 175 and having nuts 176 engaged behind the block 167.

As the bar 95 and consequently the block 150 are vertically reciprocated, the friction on the bar 162 at the block 150 raises or lowers the bar 162 without movement relative to the block 150 or the support 148 until one of the shoulders 170 or 171 reaches a stop piece 172 or 173. When the assembly is moving down and the shoulder 170 engages the stop piece 172, the block 150 continues to move down thus overcoming the friction in the block 150, but relatively raising the bar 162 relatively to the downwardly moving support 148, thus relatively raising the rear of the lever 156 and lowering the arm 155 relative to the support 148 and tilting the gun upwardly to cause the gun on the next upstroke to spray under the fins of the article or engine if the article is an engine or has fins.

On the upward movement of the assembly, the shoulder 171 is engaged under the stop piece 173 and the above movements are reversed, and the gun sprays the top of the fins as the gun later moves downward.

Adjustment of the stop pieces 172, 173 and the block 102 (Fig. 10) may be made to cause the reversal to be made at the appropriate place, depending upon the shape and size of the article. The angle which the gun assumes will depend upon the amount of movement of the bar 95 after the bar 162 is stopped; and this angle can be read on the scale plate 178 (Fig. 11) on the cradle 145 movable relative to the pointer 179 carried by the support 148.

Electrical connections

The circuit for controlling the motors 58 and 83 are arranged to be controlled from push button switches 190, 190*a* mounted on a single fixture as shown in the diagram of Fig. 16. As shown in the diagram, the motors 58 and 83 are respectively controlled by two magnetic starters 191, 192 fed from a suitable source of 3-phase current through line wires 194 connected to the terminals L1, L2, L3.

Each of these starters is of the known type having switches each having fixed contacts 210, 211 (Fig. 18) connected respectively to the line wires 194 and to the conductors 195 connected to the motor 58 or 196 connected to the motor 83. Each switch includes movable contacts 212 insulated from and mounted on a movable frame 214 including an armature 215 below the fixed electro-magnet 216, whereby when the magnet is energized the armature and frame are raised bringing the movable contact into contact with the fixed contacts, thereby connecting the motors to the line wires.

When as will be explained, the terminals C^1 and C^2 are connected to the terminal L^3, a circuit is established through conductors 218, 219 and the coil of magnet 216 to the terminal L^1. When this takes place the armature, said frame and the fixed contacts rise thus closing the switches and connecting the motor to the line wire.

When the frame thus rises, a conductive contact member 220 insulated from and mounted on the frame 214 engages the fixed contacts 221. The terminal C^2 being already connected through the normally closed push button 190*a* to terminal L^3, a stick circuit is thus established from terminal C^2, through contacts 220, 221, conductors 222 and 218, coil of magnet 216 and conductor 219 to terminal L^1, thus is formed a stick circuit which when once completed maintains the starter operative for supplying current to its motor until the stick circuit is broken.

In the present instance all of the local conductors pass through a junction or pull box 193 of Fig. 17, which is omitted in the simplified diagram of Fig. 18. The main starter 191 feeds the continuously operated motor 58 through conductors 195, while the secondary starter 192 feeds the intermittently operated motor 83 through conductors 196.

Each starter is as above indicated so constructed that when the terminal L3 and the second terminal C′ are electrically connected exteriorly of the starter there is established through the starter a stick circuit (not shown) from the line wire terminal L3 through the magnet coil to another line wire terminal L1 to start operation of the starter, for operating the motor. Each starter has a third terminal C2 adapted when electrically connected to the first terminal L3 to maintain said stick-circuit to maintain operation of the started starter. This stick-circuit in starter 191 is, after starting maintained through the normally closed push-button stopping switch 190*a* electrically connected by conductors 197, 198, 199 between terminal L3 and terminal C2. When it is desired to start the machine the operator closes the normally open push-button starting switch 190 connected by conductors 200, 201, 202, 198, 199 between the second and third terminals C1 and C2 of the starter 191 thereby to establish the stick circuit in the starter to start the motor 58. The intermittently operated limit switch 87 is connected by conductors 200, 203, 204, 205 between the said second terminal C1 of both starters, whereby after the main starter is started, every time the limit switch 87 is closed a holding circuit is also established through the terminal C1 magnet coil, and conductors 218, 219 of the secondary starter 192, thereby to start the intermittent motor. But whenever the limit switch is opened, a holding circuit through the secondary starter 192 is broken and the secondary starter during that time ceases to feed the intermittent motor 83.

From this it is seen that the starters are controlled by the push buttons 190, 191 setting motor 58 in operation to rotate the table. Motor 83 will be started simultaneously with motor 58, if the limit switch 87 is closed, otherwise the table will be rotated by motor 58 until the stalls come into proper work position, whereupon the limit switch

87 is closed and motor 83 rotates the supports 21.

Operation of the metallizing machine

On closing of the starting switch by the operator, the table 17 starts rotating and rotates until the stalls are opposite the respective stations, whereupon the limit switch 87 is closed, and supports 21 at stations B, C, and D are rotated by the motor 83. The gun mount at stations B, C, and D as shown in Figs. 11 to 14, are driven by the radial shafts 118 (Fig. 5) so as to raise or lower the bars 95. At station B, the block 150 mounted on L-piece 151 moves the bar 162 until the stop piece 172 or 173 prevents further movement of the bar. The relative movement of the bar 162 and support 148 causes the lever 156 to pivot about 158 so as to swing the cradle 145 about pivots 146, 147 to swing the gun upwardly or downwardly. As a result when the gun descends, its direction of spray is downward until the lower limit of movement is reached and the action reversed. Vertical movement of the guns without tilting takes place at stations C and D by means of a support as in Fig. 8.

The design of the metallizing machine as shown provides for six operation stations. The object to be sprayed such as a cylinder head assembly 21*a* is loaded at station A upon the support 21, which supports and properly centers it ready for spraying. Then the table indexes to the next station B, where the cylinder head rotates at a predetermined speed while the single spray gun mounted on a mechanically operated post passes up the cylinder at one angle, and then passes down at another angle, the change in angles being made automatically as the gun reaches the top and bottom of its stroke. At the third station C the rotating cylinder head assembly is sprayed by two guns mounted at fixed opposing angles. These guns also pass up and down and are here shown adjusted for spraying the cylinder body and fins. The following station D has two guns similarly mounted, as at the third station C. These guns are also mounted on opposing angles, and are shown so located that as they travel up and down they spray the cylinder head. At stations E and F manually operated spray guns are manipulated by operators to spray the upper head surfaces and any other parts that were not reached by the guns located at stations B, C and D. At stations A, E and F, the cylinder is not mechanically rotated, but may be rotated by hand, as desired. Station F is used for inspection, unloading and reloading and should it be required, could also be used for touch-up work on the head. Directly above each station there is provided a set of control gauges mounted on the panel 38, within easy reach of the operator. Wire is fed to each gun separately from a reel (not shown) mounted a short distance away from the machine.

Wherever the conditions admit, the invention herein is broad enough to cover spray means of any spray nozzle type and the expression "spray gun" is used for designating purposes and not in a limited sense.

The invention claimed is:

1. A spraying machine comprising in combination; a rotatable table having therein vertical bearing openings; means for rotating the table step-by-step; a short shaft in each bearing opening, each having a work support on its upper end and a sprocket on its lower end; bearing brackets mounted near certain of said sprockets and carrying axially vertical non-traveling sprockets near and inwardly offset from respective associated traveling sprockets; a double sprocket chain comprising a driving course and a driven course, the latter being meshed with and supported by the non-traveling sprockets while the adjacent part of the driven course meshes with associated traveling sprockets; means for driving said chain; and a backing member engaging the inner faces of said courses between said non-traveling sprockets.

2. A spraying machine comprising in combination; a rotatable table having therein vertical bearing openings; means for rotating the table step-by-step; shafts in the openings, each having a work support on its upper end and a traveling sprocket on its lower end; axially vertical non-traveling sprockets rotatably mounted near and inwardly offset from the respective traveling sprockets; a sprocket chain comprising a driving course and a driven course respectively meshed with the non-traveling and traveling sprockets; and means controlled by the table for driving the non-traveling sprockets only while the table is at rest.

3. A spraying machine comprising in combination; a substantially upright cylindrical housing wall about table height; a floor mounted within the wall; an axial shaft mounted on the floor; a table mounted on the shaft about flush with the top of the wall; upright radial partitions mounted equal angles apart and extending from the edge of the table to the axis thereof and dividing the space above the table into stalls; a ceiling over the stalls; a segmental flue coaxial with the table passing through the ceiling and extending to the table; said flue at each stall having an upwardly tapering opening wide at the bottom and extending substantially from table to ceiling; and means for rotating the table step-by-step.

4. An angle changing device for a reciprocating spray gun comprising in combination; a reciprocating block; a substantially Y-shaped cradle support having the shank thereof mounted on said block; the prongs of the Y being forward and upturned; a U-shaped gun cradle having the ends thereof pivoted to the respective ends of said prongs; a spray gun supported in the cradle, whereby the gun may tilt in a plane substantially perpendicular to a line through the ends of said prongs; an arm on said support having a fulcrum piece thereon to the rear of the prong ends; a short arm mounted on the cradle; a lever intermediately loosely fulcrumed on said fulcrum piece and having a forward end pivoted to said short arm; having a rearwardly projecting end; a slide bar substantially perpendicular to said lever and in the working plane thereof and having an end loosely pivoted to said projecting end; a friction block fast on said cradle support and frictionally engaging said bar; and stops for limiting the movement of said bar.

5. An angle changing device for a vertically reciprocating spray gun comprising, in combination; a vertically reciprocatory member; a gun support pivotally mounted on the member so that the supported gun may tilt in a vertical plane; a fulcrum on said member; a lever loosely mounted on said fulcrum and having a forward end pivoted to said support and having a rearwardly projecting end; a friction device fast on said reciprocatory member and approximately under said rearwardly projecting end; a vertical slide bar frictionally slidable in said friction device and

having the upper end thereof loosely pivoted to said projecting end; stationary stops for limiting vertical movement of said bar.

6. In a spraying machine a mounting member; a table mounted on said member for movement relative thereto; drive sprockets rotatably mounted on said mounting member; a double course chain having a driven portion engaging said sprockets and having a drive portion; and driven sprockets mounted on said table at positions to engage the drive portion of said chain at points substantially opposite said drive sprockets when said table and member are moved relative to each other, the drive sprockets having the double function of driving the chain and holding the drive portion thereof in position to be engaged by the driven sprockets.

7. In combination, a rotatable table; a sprocket chain; means for guiding a course of said chain coaxially with the table; means including a constantly operated motor for rotating the table step-by-step with alternate pauses; rotary work supports on said table each having a sprocket adapted to mesh with the chain just before a pause; and means including an intermittently operated motor for driving said chain.

8. In a metallizing machine comprising a rotary table, a sprocket chain guided arcuately coaxially with the table, means including a constantly operated motor for rotating the table step-by-step, rotary supports on the table having sprockets to mesh with the chain, and means including an intermittent motor for driving said chain, the combination of magnetic starters for the motors; line wires therefor; each starter having a first terminal connected to the same line wire, and second and third terminals, each starter being adapted when the first and second terminals are connected to start operation of the starter and when the first and third terminals are connected to maintain starter operation; a normally open switch means to connect the second and third terminals of the starter of the constantly operated motor; and means operated by the table just as it moves to, and during, its pauses to connect said second terminals; and a normally closed switch means connecting the first and third terminals of the starter of the continuously operated motor and openable to stop both starters.

9. In a metallizing means, the combination of a rotary table; a sprocket chain guided arcuately coaxially with the table; means including a constantly operated motor for rotating the table step-by-step; rotary supports on said table having sprockets to mesh with the chain; means including an intermittent motor for driving said chain; magnetic starters for the motors; line wires therefor; each starter having a first terminal connected to the same line wire, and second and third terminals; each starter being adapted when the first and second terminals are connected to maintain starter operation; a normally open switch means to connect the second and third terminals of the starter of the constantly operated motor; and means operated by the table just as it moves to, and during, its pauses to connect said second terminals; and a normally closed switch means connecting the first and third terminals of the starter of the continuously operated motor and openable to stop both starters.

10. In combination, a rotatable table; a sprocket chain; means for guiding said chain along an arc coaxial with the table; means including a continuously operated motor for rotating the table step-by-step with alternate pauses; rotary work supports on said table each having a sprocket adapted to mesh with the chain just before and during a pause; means including an intermittently operated motor for driving said chain; line wires; magnetic starters for the respective motors, each starter having a terminal connected to the same line wire and a second terminal adapted when electrically connected to the first terminal to start operation of the starter for operating the motor, and a third terminal forming a part of a control circuit and adapted when electrically connected to the first terminal to maintain starter operation; a normally open starting switch connected between the second and third terminals of the starter of the intermittently operated motor; and a limit switch connected between said second terminals and adapted to be closed by movement of the table just before, and during, said pauses to operate the intermittent motor; and a normally closed switch connected between the first terminal of the starter of the continuously operated motor and said part of the control circuit to complete the operating circuit and openable to break the control circuit, whereby if said switch is opened or the control circuit is otherwise opened stoppage of the operation of both starters is effected simultaneously.

11. In combination, a work support adapted to support an article to be sprayed; a bracket mounted adjacent to the work support for reciprocation longitudinally of the article; a spray device adjustably mounted on said bracket and pointed toward said article; a link connected to said bracket substantially longitudinal to its path; a reciprocatory lever disposable substantially right angularly transverse to said link and having pivotal connection with the link, said pivotal connection being adjustable longitudinally of the lever; the lever having a fixed fulcrum a distance from said connection, whereby when the pivotal connection is adjusted toward or from the fulcrum, the amplitude of travel of said bracket is adjusted.

12. In combination, a rotatable work support adapted to support an article to be sprayed; a bracket mounted adjacent to the work support for straight line reciprocation longitudinally to the axis of the work support; a spray device pointed toward said article and pivoted to said bracket for movement in a plane substantially radial to said axis; means to pivotally move said device at its respective limits; a link connected to said bracket substantially longitudinal to its path; a lever disposable substantially right angularly transverse to said link and having pivotal connection with the link, said pivotal connection being adjustable longitudinally of the lever; the lever having a fixed fulcrum remote from said connection; and means for reciprocating the lever.

13. In combination, a rotatable table; means for rotating the table step-by-step; rotatable work supports mounted on said table adapted to support an article to be sprayed; and intermittently operated means for rotating the supports during the pauses between steps; a fixed guide adjacent to the position of a work support during such pause; a bracket mounted on said guide for reciprocation longitudinally to the axis of the work support and extended to near said article; a spray device having a nozzle pointed toward said article; means pivotally mounting said device on said bracket for movement in a plane radial to the axis of the support; means to pivotally move said

device in opposite directions at the respective limits of its movement only; a link connected to said bracket substantially longitudinal to its path; a lever transverse to said link and having pivotal connection with the link, said pivotal connection being adjustable longitudinally of the lever; the lever having a fixed fulcrum at one end and provided intermediately with a lateral roller; and a cam having an endless cam groove receiving said roller; said groove being of a shape to raise and lower the lever, link and block during one complete rotation of the cam.

14. In combination, a rotatable table; a sprocket chain; means for guiding a limited course of said chain coaxially with the table; means for rotating the table step-by-step; rotatable work supports on said table each having a sprocket adapted to mesh with and unmesh from said course and to mesh with said course just during a pause of the table and intermittently operated means for driving said chain during the pauses.

15. In combination, a rotatable table; a flexible member; means for guiding a limited course of said member coaxially with the table; means including a constantly operated motor for rotating the table step-by-step; rotatable work supports on said table each having wheels adapted to engage and disengage said course and to engage with said course just before a pause; and means including an intermittently operated motor for driving said member.

16. In a spraying machine, a mounting member; a table rotatably mounted on said member and provided with a plurality of axially vertical bearing openings equi-distant from the axis of rotation of the table; co-planar traveling sprockets bearingly mounted in each of said openings; non-traveling sprockets rotatably mounted on said member near the circle in which said traveling sprockets must rotate; a double course chain having a driven course belted about said non-traveling sprockets and a drive course engaging successive traveling sprockets as they are brought into position of engagement by rotation of the table.

17. A spraying apparatus comprising, in combination a table; upright partitions on the table forming a stall open at one side and an upright suction flue remote from said side; the partition between the stall and flue having an opening wide at the part of the suction flue remote from the discharge end and less wide nearer the discharge end, whereby suction will be sufficient at said remote part.

18. A spraying apparatus comprising, in combination a table; upright partitions on the table extending from the edge of the table to meet on a vertical line remote from said edge; a plate connecting opposite partitions and forming an upright flue at the rear of the partitions; a ceiling across the upper part of the partitions; a suction flue above and communicating with the first named flue; said plate having an upwardly tapering opening wide at the bottom and extending substantially from table to ceiling.

19. A spraying apparatus comprising, in combination, a table; upright partitions mounted on the table extending from the margin of the table and meeting remote from the margin to form side walls of a stall; a work support in the stall; means for spraying articles on said work supports; a ceiling over the stall; a plate disposed across the inner part of the stall to form a flue; and a suction flue above and communicating with the first named flue, said plate having an upwardly tapering opening wide at the bottom and extending substantially from table to ceiling.

20. A spraying machine comprising, in combination, a rotatably mounted table; upright radial partitions mounted on the table equal distances apart and extending from the edge of the table to the axis thereof and dividing the space above the table into entirely separated stalls; curved plates disposed across the rear of the stalls coaxial with the table; work supports on the table in the respective stalls; means for spraying articles on said work supports; a ceiling over the stalls and joining the partitions; a suction flue coaxial with the table and passing through said ceiling, the portion of the flue beneath the ceiling extending to the table and being formed by the inner part of said partitions and the curved plates therebetween, each curved plate at each stall having an upwardly tapering opening wide at the bottom and extending substantially from table to ceiling, whereby the suction will be properly distributed and be sufficient at the lower part of the stall.

21. A spraying machine comprising, in combination, a substantially upright cylindrical housing wall about table height; a table rotatably mounted coaxially within the wall about flush with the top of the wall; upright radial partitions mounted on the table equal angles apart and extending from the edge of the table to the axis thereof and dividing the space above the table into stalls; rotary work supports on the table in the respective stalls; means exterior to the stalls for spraying articles on said work support at some locations thereof; a ceiling over the stalls; a segmental suction flue coaxial with the table passing through the ceiling and extending to the table; said flue at each stall having an upwardly tapering opening wide at the bottom and extending substantially from table to ceiling; whereby the suction will be properly distributed and be sufficient at the lower part of the stall; and means for rotating the table step-by-step; said flue and radial partitions forming an individual flue from table to ceiling to prevent blowing mist from a spray stall to a non-spray stall.

22. Electric supply current control means for motors of a machine having a rotary table having rotary supports thereon, means including a continuously operated motor for rotating the table step-by-step, and means including an intermittent motor for rotating said supports, said control means comprising line wires; magnetic starters for the respective motors each constructed and adapted when operated to connect the line wires to the associated motor; first, second and third terminals on each starter, the first terminals being connected to the same line wire; said starters being so constructed and connected to a second line wire that when the first and second terminals are connected the starter is operated and the motor started; said starter being so constructed that when the first and third terminals are connected operation of the operated starter will be maintained; a normally open switch means to connect the second and third terminals of the starter of the continuously operated motor; and switch means adapted to be operated by the table during pauses between steps to connect said second terminals; and a normally closed switch means connecting the first and third terminals of the starter of the continuously operated motor and openable to stop the starters.

23. Electric supply current control means for

motors of a machine having a rotary table, means including a continuously operated motor for rotating the table step-by-step, rotary supports on the table, and means including an intermittent motor for rotating the supports when the table is stationary, said control means comprising line wires; magnetic starters for the respective motors each having switches connected between the respective wires and the associated motor and adapted when closed to start the motor; means including an electro-magnet adapted to close the switches; first, second and third terminals on each starter, the first terminals being connected to the same line wire; means connecting a second line wire through the magnet coil to the second terminal, whereby when the first and second terminals are connected the magnet is energized and the motor started; a switch operated and closed by the magnet when energized and connected in series with the magnet coil between the third terminal and said second line wire; a normally open switch means adapted to connect the second and third terminals of the starter of the continuously operated motor; and switch means operated by the table during pauses between steps to connect said second terminals; and a normally closed switch means connecting the first and third terminals of the starter of the continuously operated motor and openable to stop both starters.

24. Electric supply current control means for continuously and intermittently operated motors, said control means comprising line wires; magnetic starters for the respective motors each constructed and adapted when operated to connect the line wires to the associated motor; first, second and third terminals on each starter, the first terminals being connected to the same line wire; said starters being so constructed and connected to a second line wire that when the first and second terminals are connected the starter is operated and the motor started; said starters being so constructed that when the first and third terminals are connected operation of the operated starter will be maintained; a normally open switch means to connect the second and third terminals of the starter of the continuously operated motor; and switch means adapted to be intermittently operated to connect said second terminals; and a normally closed switch means connecting the first and third terminals of the starter of the continuously operated motor and openable to stop the starters.

25. Electric supply current control means for continuously and intermittently operated motors, said control means comprising line wires; magnetic starters for the respective motors each having switches connected between the respective wires and the associated motor and adapted when closed to start the motor; means including an electro-magnet adapted to operate the switches; first, second and third terminals on each starter, the first terminals being connected to the same line wire; means connecting a second line wire through the magnet coil to said second terminal, whereby when the first and second terminals are connected the magnet is energized and the motor started; a switch operated and closed by the magnet when energized and connected in series with the magnet coil between the third terminal and second line wire; a normally open switch means to connect the second and third terminals of the starter of the continuously operated motor; and switch means adapted to be intermittently operated to connect said second terminals; and a normally closed switch means connecting the first and third terminals of the starter of the continuously operated motor and openable to stop both starters.

26. A spraying machine comprising a substantially upright housing wall, mechanisms spaced equal angular distances around the wall constituting work stations, certain of these being automatic spraying stations; a rotary table; means for intermittently rotating said table; a bracket mounted on said wall at each station, each having a vertical guide; a slide bar slidably mounted on said guides; spray guns vertically adjustably mounted on said bar in position to spray an article on a work support; at least one of the guns being frictionally pivotally mounted for angular movement to direct an upwardly or inclined spray to the article; means timed with the intermittent movement of the table to raise and lower each slide bar while the table is at rest, and means on the bracket carrying the pivoted gun support and adapted to engage the gun support as it reaches only its upper and lower limits of movement respectively to tilt the gun support in the respectively opposite directions.

27. An angle changing device for a reciprocating spray gun comprising, in combination, a vertically reciprocatory block; a cradle support mounted on said block and having a pair of upwardly turned prongs; a U-shaped gun cradle having the ends thereof pivoted to the respective ends of said prongs; a spray gun mounted on the yoke part of said cradle, with the nozzle part of the gun near its tip intersecting the axis of the pivoted ends of said gun cradle; and means for changing the tilt of said support.

28. In combination, a reciprocatory member; a spray device; mounting means tiltably mounting said device on said member; a slide element frictionally movable on said member and having connection with the mounting means to tilt the latter as the slide element moves relative to the member; and stops for limiting the movements of said element.

29. In combination, a reciprocatory block; a spray gun; mounting means tiltably mounting the gun on said block; a slide bar frictionally slidable on said block and having connection with the mounting means to tilt the latter as the slide bar moves relative to the block; and stationary stops for limiting the movement of said bar.

30. In combination, a rotatable work support; a fixed guide mounted adjacent to the work support; a slide bar mounted on said guide for longitudinal reciprocation substantially parallel to the axis of rotation of the support; a bracket supported by said bar extended to near an article supported on said support; a spray device having a nozzle pointed toward said article; means pivotally mounting said device on said bracket for movement in a plane substantially radial to said axis; a friction bar slidably frictionally supported by said slide bar; a link means connecting the friction bar and spray device to tilt said device when the friction bar is moved relative to said slide bar; and stops on said fixed guide engageable by the slide bar to shift the position of the friction bar relative to the slide bar when the slide bar reaches its upper and lower limits of movement thereby to tiltingly move the device at such limits only.

31. In combination, a rotatable work support; a fixed guide mounted adjacent to the work sup-

port; an upright slide bar mounted on said guide for vertical reciprocation; a bracket supported by said bar extended to near an article supported on said support; a spray device having a nozzle pointed toward said article; pivotally mounting said device on said bracket for movement in a plane substantially radial to the axis of the support; a friction bar vertically slidably frictionally supported by said slide bar; a link means connecting the friction bar and device to tilt said device when the friction bar is moved relative to said slide; stops on said fixed guide engageable by the friction block to shift the position of the friction bar relative to the slide bar when the slide bar reaches its upper and lower limits of movement thereby to tiltingly move the device at such limits only.

32. In combination, a work support adapted to support an article to be sprayed; a member mounted for reciprocation adjacent to the work support; a spray device pointed toward said article; means supporting said device on said member; a link connected to said member substantially longitudinally of its path; a lever disposable substantially right angularly transverse to said link and having a fixed fulcrum remote from the link, and a pivotal connection connecting the link and lever and adjustable longitudinally of the lever; and drive means for reciprocating said lever.

33. In combination, a work support adapted to support an article to be sprayed; a member mounted for reciprocation adjacent to the work support; a spray device pointed toward said article; means supporting said device on the member and adjustable on said member longitudinally of its path to different locations along the member; drive means; and adjustable means connecting the drive means and said member and adjustable to vary the amplitude of said reciprocation; said adjustable means comprising a link connected to said member substantially longitudinally to its path; and a lever disposable substantially right angularly transverse to said link and having a fixed fulcrum remote from the link, and a pivotal connection with the link, said connection being adjustable longitudinally of the lever.

34. In combination, a rotatable table; a sprocket chain having a limited course disposed in a path disposed coaxially with the table other portions of the chain being disposed interiorly to said path; means for guiding said chain including a backing member having a curved face engaging said course for guiding said course; means for rotating the table; rotatable work supports on said table each having a sprocket adapted to mesh with and unmesh from said course; and means for driving said chain.

35. In combination, a rotatable table; a sprocket chain having a limited course disposed coaxially with the table; a backing member having a curved face engaging said course for guiding said course; means for rotating the table step-by-step; rotatable work supports on said table each having a sprocket adapted to mesh with and unmesh from said course and to mesh with said course during a pause of the table; and intermittently operated means driving said chain during the pauses.

36. In combination, a rotatable table; an endless flexible member; means for guiding said member with a limited course of said member disposed coaxially with the table; means for rotating the table; rotatable work supports on said table each having wheels adapted to engage with and disengage from said course; and means for driving said member.

37. In combination, a rotatable table; an endless flexible member; means for guiding said member with a limited course of said member disposed in a path disposed coaxially with the table and with other portions of the member interiorly to said path; said means including a curved backing element engaging and guiding said course; means for rotating the table step-by-step; rotatable work supports on said table and having wheels adapted to engage with said course during a pause of the step-by-step movement; and means for driving the flexible member.

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