ABSTRACT

A machine supporting a sub-assembly of masks and work pieces on a mechanism that moves this sub-assembly with a rotary motion between a spray chamber and a loading station, while automatically shifting the relative placement of the masks and the work pieces between a spray relationship and a loading-unloading clearance.

5 Claims, 66 Drawing Figures
Fig. 4

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ROTATIVELY INDEXED SPRAY-PAINTING MACHINE

BACKGROUND OF THE INVENTION

Industrial painting procedures involving substantial production quantities are commonly performed with spray-painting equipment. Articles requiring the application of paint to a fractional part of the total surface at any one time are commonly sprayed through masks that expose only that portion of the work piece which is to receive paint at that painting operation. It is common practice to array a considerable number of work pieces on a holding device commonly referred to as a “nest”, which is then positioned accurately with respect to a mask so as to bring the work pieces into proper registry with the openings in the mask. It is obvious that the efficiency of the operation depends largely on the time necessarily consumed in loading and unloading the work pieces from the sub-assembly of the holding device and the mask. This procedure is complicated by the frequent requirement that the work pieces be interengaged with the mask in the manner of a projection entering into a socket. This sort of relationship necessarily results when the sprayed surface of the work pieces is anything other than co-planar.

The disengagement of work pieces from the sub-assembly of the mask and the nest will therefore usually involve two phases of motion. The first of these is a retraction of the work pieces out of the projection-socket interengagement with the mask, and the second phase is the establishment of sufficient clearance between the mask and the work pieces to permit the operator to remove the painted articles and replace them with those that are to be painted in the next operation. The first phase of the operation of any spraying procedure must then include the re-engagement of the work pieces with the mask, including the removal of the loading-unloading clearance. The movement to clearance position can be conducted with relatively low tolerance requirements, but the engagement and interengagement of the work pieces with the mask requires great precision. Any degree of inaccuracy in this portion of the operation will result in undesirable overlay or misplacement of the sprayed surface. As might be expected, industry has made use of a considerable variety of equipment for performing this type of spraying operation, varying over the full range from manually operated to fully automatic equipment. In the latter type, it is common practice to establish a loading-unloading station at a position exterior to the spray chamber in which the paint is actually applied. This chamber is similar in general construction to a conventional spray booth, as far as overall function is concerned. It is, of course, modified to accommodate the particular type of automatic equipment characteristic of the machine. An example of this type of machine is described and claimed in my co-pending application Ser. No. 79,012, filed on Oct. 8, 1970, now U.S. Pat. No. 3,716,022.

SUMMARY OF THE INVENTION

The present invention provides a simple mechanism permitting the loading-unloading operation to be performed at the same time as the spraying operation, thus producing a maximum utilization of the spraying equipment and the operator’s time. In the preferred form of the invention, a frame is rotatably mounted with respect to a housing defining a spray chamber, with the rotation of the frame bringing a sub-assembly of work pieces, holding device, and mask to and from the spray chamber and the loading-unloading station. The frame rotates at a position within an opening in the housing defining an intake to the ventilation ducting system, and a mechanism responsive to the indexing opens and closes the relationship of the work piece-holding unit and the mask in response to the placement of that sub-assembly either in the spray chamber or at the loading-unloading station. It is preferable that the rotary frame contain two sets of work piece-holding and mask-holding devices at positions 180° apart about the axis of rotation of the frame, with the actuating mechanism for these sets oppositely actuated, thus permitting one actuating mechanism to control both sides of the rotary portion of the machine. The simplest form of this actuating system appears to be produced by mounting the mask carriers on a subframe pivotally mounted on the main rotary frame so that it can rock from an elevated clearance position to a lowered position preparatory for interengagement of the work pieces with the masks.

The mechanism for inducing and controlling the rotation of the entire rotary assembly is mounted exteriorly of the housing, and preferably on the top. This arrangement not only facilitates service and adjustment, but brings this portion of the mechanism outside of the area of possible contamination by spray and solvent materials. The mounting of the rotary assembly on an axis close to the opening in the housing results in a cantilever extension of approximately a half of the rotary assembly out through this opening for accessibility to the loading station, and this relationship makes possible the use of a water-wall immediately underneath the opening to complete the water coverage of all of the surfaces within the chamber that are in position to receive spray that is not impinged on the work pieces or on the components of the machinery.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front quarter perspective view showing a complete machine embodying the invention.

FIG. 2 is a rear quarter perspective view of the machine illustrated in FIG. 1.

FIG. 3 is a front quarter perspective view of the machine with the guards, closure panels, and the mask rack assembly omitted.

FIG. 4 is a rear perspective view of the machine with the guards and closure panels removed.

FIG. 5 is a section on the plane 5—5 of FIG. 3.

FIG. 6 is a perspective view of the structure for supporting the masks and work pieces, and showing the indexing mechanism on the upper portion of the machine.

FIG. 7 is a fragmentary perspective view of the indexing mechanism in the position opposite to that appearing in FIG. 6.

FIG. 8 is a fragmentary perspective view of the indexing mechanism in an intermediate position.

FIG. 9 is a top view of the indexing mechanism, with the upper plate and bearings removed.

FIG. 10 is a fragmentary top view of the structure for supporting the work pieces, and showing a portion of the mask-supporting rack.
FIG. 11 is an elevation of the structure appearing in FIG. 10, with the mask rack in an intermediate position.

FIG. 12 is a view similar to FIG. 11, with the mask rack at one extreme of its motion.

FIG. 13 is a sectional view on an enlarged scale over the previous views, and showing the double-acting pistons for actuating the mask rack. FIG. 13 is a section on the plane 13-13 of FIG. 14.

FIG. 14 is a section on the plane 14-14 of FIG. 13.

FIG. 15 is a fragmentary end elevation on the plane 15-15 of FIG. 13.

FIG. 16 is a fragmentary end elevation of the central portion of the mask rack adjacent the structure appearing in FIG. 13.

FIG. 17 is a sectional view similar to FIG. 13, with the double-acting piston at the left extreme of its movement.

FIG. 18 is a fragmentary end view of the mask rack corresponding to the piston position shown in FIG. 17.

FIG. 19 is an end view of a modified form of the invention with respect of the actuation of the mask rack, showing the rack in a central intermediate position.

FIG. 20 is a view similar to FIG. 19, showing the mask rack in one extreme of its movement.

FIG. 21 is a view similar to FIGS. 19 and 20, illustrating the mask rack in the opposite extreme of its movement from that appearing in FIG. 20.

FIG. 22 is a fragmentary view on the plane 22-22 of FIG. 19, on an enlarged scale.

FIG. 23 is a fragmentary top view of a workpiece-holding structure.

FIG. 24 is a fragmentary section on the plane 24-24 of FIG. 23.

FIG. 25 is a fragmentary front view of the structure shown in FIG. 23, in the lowered position.

FIG. 26 is a fragmentary front view similar to FIG. 25, showing the elevated position of the workpiece-holding unit.

FIG. 27 is a broken top view of the workpiece-holding structure.

FIG. 28 is a section on the plane 28-28 of FIG. 27.

FIG. 29 is a section on the plane 29-29 of FIG. 28.

FIG. 30 is a top view of the rocking portion of the mask carrier.

FIG. 31 is a side view of the rocking portion of the mask carrier.

FIG. 32 is a fragmentary top view of the structure shown at one corner of FIG. 30, as indicated at 32-32 on FIG. 31.

FIG. 33 is a section on the plane 33-33 of FIG. 30 on an enlarged scale.

FIG. 34 is a section on the plane 34-34 of FIG. 32.

FIG. 35 is a perspective view of a modified form of the mask rack in which the mask-holding mechanism is manually operated.

FIG. 36 is a fragmentary top view on the plane 36-36 of FIG. 35, on an enlarged scale.

FIG. 37 is a section on the plane 37-37 of FIG. 35 on an enlarged scale.

FIG. 38 is a section on the plane 38-38 of FIG. 37.

FIG. 39 is a fragmentary top view similar to FIG. 6, showing the retracted position of the mechanism.

FIG. 40 is a section on the plane 40-40 of FIG. 39.

FIG. 41 is a broken top view of a mask being held by the mask-holding mechanism.

FIG. 42 is a front elevation with respect to FIG. 41.

FIG. 43 is a section on the plane 43-43 of FIG. 41.

FIG. 44 is a section on the plane 44-44 of FIG. 41.

FIG. 45 is a view similar to FIG. 44, showing the holding mechanism in the retracted (release) position.

FIG. 46 is a view similar to FIG. 44, showing exclusively the central portion of the structure.

FIG. 47 is a modified form of the invention with respect to the construction of the masks.

FIG. 48 is a further modification of the invention with respect to the construction of the masks.

FIG. 49 is a fragmentary sectional elevation on an enlarged scale showing the centering mechanism at one side of the mask-supporting structure.

FIG. 50 is a fragmentary sectional view of the portion of a mask as it is prepared for a welding operation for securing the locating ball.

FIG. 51 is a fragmentary sectional view of the centering structure appearing in FIG. 49, without the associated mask.

FIG. 52 is a fragmentary end view on the plane 52-52 of FIG. 49.

FIG. 53 is a fragmentary top view of the structure shown in FIG. 52.

FIG. 54 is a perspective view at the left end of the structure associated with the spray gun carriage, as viewed in FIG. 1.

FIG. 55 is a side view of the device for supporting the cables associated with the flexible conduits.

FIG. 56 is an end view of the structure shown in FIG. 54.

FIG. 57 is a view similar to FIG. 55, showing the cable support and associated conduits.

FIG. 58 is a perspective view of the rotary device mounted on the carriage for supporting the spray guns.

FIG. 59 is a top view of the mechanism shown in FIG. 58.

FIG. 60 is a top view of the spray hose support cable system showing one hose in retracted position.

FIG. 61 is a view similar to FIG. 60, showing the hose in an extended position on the support cables.

FIG. 62 is a front view of the structure adjacent the cables supporting the hoses shown in FIGS. 60 and 61.

FIG. 63 is a sectional perspective view showing the water-wash system.

FIG. 64 is a perspective view of a distribution plate appearing in FIGS. 55 and 56.

FIG. 65 is a sectional view of the left portion of the structure shown in FIG. 63, on an enlarged scale.

FIG. 66 is a view similar to FIG. 65, showing the behavior of the distribution valve.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Housing and Spray Chamber

Referring to FIGS. 1 through 5, the housing generally indicated at 70 is a box-shaped structure of sheet metal panels and tubular reinforcing members defining a spray chamber 71 and a water sump 72. The tubular
cross beam 73 defines the lower extremity of an opening in the housing communicating between the spray chamber and the work area at the left in FIG. 5. This work area is a loading-unloading station, which will normally be served by an operator. The side extensions 74 and 75 of the housing, together with the top structure interconnecting these extensions, form an entrance duct for the inflow of ventilating air through the opening above the beam 73, and through the spray chamber. This air flow moves downward through the spray chamber under the suction established by the blower 76 in the stack 77, and moves upward from the rear of the sump 72 through the exhaust duct 78. Baffles as shown at 79 in FIG. 6 are conventional, and are used for the entrainment of droplets of liquid entrained in the moving exhaust air stream. The removable panel 80 at the rear of the machine includes a group of shelves 81-83 which register with the baffles to form seals so that the primary air stream is directed along the path of the arrows. Removal of the panel 80, however, exposes the surface of the baffles for cleaning.

The lower portion of the spray chamber 71 is defined by a series of surfaces covered with flowing water during the operation of the machine. Troughs as shown at 84 and 85 at the rear and front of the spray chamber, respectively, are fed with water by pipes as shown at 86 and 87 (referring to the FIG. 63), and the side troughs 88 and 89 are fed from the central risers 90 and 91, respectively. Sections a-d of supply pipe 92 extends from the pump unit 93 mounted on the outside of the housing. The intake of this pump is connected to the perforate pipe 94, extending along the bottom of the sump at the rear of the machine. This portion of the pump may be isolated by suitable partitions and filters, as shown at 95 in FIG. 6, to minimize the possibility of contamination of the pump 93. The access door 96 is removable to expose the interior of the sump for cleaning.

Water from the troughs 84 and 85 overflows continually to provide a sheet of water over the inclined surfaces 97-99. The overflow from the end troughs 88 and 89 flows down directly over the side structure defining these troughs, and the combined flow ultimately arrives at the receiving trough 100. Water spilling over from the side edges 101 and 102 forms a pool 103, and then spills over into the sump 72 to form a settling mass 104. The arrangement shown in FIGS. 64-66 is used to assure a relatively even distribution of water flow around the trough system. At an intermediate point in the height of the troughs, a distribution plate 105 is supported on suitable flanges 106 and 107, and is provided with a series of ports as shown at 108 in FIG. 64. A disc 109 of a diameter larger than the diameter of the ports 108 is loosely placed on the top of the plate 105 at each of the ports, and a stabilizing bolt 110 is secured to the disc 109 by the nuts 111 and 112. The presence of the bolt tends to stabilize the position of the disc 109 against lateral displacement and excessive tipping, the function of the discs being to assure an even distribution of fluid flow along the length of the trough, and to deflect the substantial upward velocities through the risers so that the overflow at the edges of the troughs is not excessively localized.

Referring to FIGS. 5 and 54-62, the spray guns 113 and 114 are mounted on the rotary unit 115 suspended from the carriage 116. The shaft 117 of the rotary unit 115 is rotatively supported in the bearing block 118 secured to the central plate 119 of the carriage. The pulley or sprocket 120 secured to the top portion of the shaft 117 is driven by the motor 121 through the belt or chain 122. This portion of the structure is conventional. The central plate 119 is supported on the spaced rails 123-124 interconnected at one end by the angle member 125 to which the bearing block 126 is secured. This bearing block engages the guide rod 127 secured at its opposite ends to the sub-frame structure shown in FIG. 54, which is mounted in the housing of the machine. The guide rod 128 at the opposite side of the carriage supports axially-spaced bearing blocks 129 secured to the angle member 130, which also supports the nut block 131 engaging the screw 132 driven by the motor 133 through the belt 134 and an appropriate pulley 132a on the end of the screw 132 (refer to FIG. 3). Cylindrical end portions of this screw are supported in a conventional manner in bearing blocks as shown at 135 and 136 mounted on the cross beams 137 and 138, respectively, of the assembly shown in FIG. 54. Rotation of the motor 133 in either direction will thus move the carriage toward one end or the other of the spray chamber, carrying the spray gun assembly with it. The direction of rotation, as well as the starting and stopping of the motor 133, is controlled by conventional programming equipment (not shown). Removal of the bolts 261 and 262 permits removal of the beam 137 to provide for the insertion and removal of a complete carriage assembly. The housing section 311 covering the structure shown exposed in FIG. 4 is removable to provide access.

The cross members 137 and 138 are adjustably secured to the uprights 139-140 and 141-142, respectively. Bolts as shown at 143 and 144 engage selected groups of holes 145 and 146 at the opposite ends of the machine for placement of the cross members 137 and 138 at a height to establish the proper relationship between the spray guns and the articles to be painted. Normally, the guns will be rotated by the motor 121 as the carriage is being moved along the guide rods 127 and 128 by the motor 133. The opposite ends of the sub-assembly shown in FIG. 54 are interconnected by the horizontal rails 146-149, and this structure is removable secured to the housing 70 by conventional bolts. This unit may be removed in its entirety, and replaced by another unit arranged to perform a different spraying operation. Since the spray guns supported by the carriage 116 must necessarily be supplied with paint and compressed air, flexible lines are coiled about an assembly of rods 150 extending between the brackets 151 and 152 secured respectively to the uprights 141 and 142. Adjustment plates 151a and 152a on these brackets engage the rod ends, and are secured to the fixed portions of the brackets. FIGS. 60 and 61 show the manner in which a supply line indicated at 153 retracts and extends during the movement of the carrier 116. The fixed end of these supply lines is connected to the terminal plate 154 with standard fittings.

Rotary Assembly

The primary active portion of the machine centers in the rotary assembly mounted on the shaft 155. This shaft is supported in the bearing block 156 secured to the plate 157 carried by the beams 158-161 of the housing structure. A pair of spaced crank arms 162 and 163 are secured to the shaft 155, and the outer extremi-
ity of these arms is pivotally connected to the piston rod 164 of the hydraulic actuator 165. This actuator is itself pivotally mounted in the bearings 166 and 167 secured, respectively, to the plate 157 and the parallel plate 168. This latter plate is interconnected with the lower plate 157 by the fixed posts 169–172. The hydraulic connections to the actuator 165 are omitted for clarity, but actuation of this piston-cylinder unit will induce rotation of the shaft 155 to the extent of 180°. The extent of this 180° swing will, of necessity, bring the crank arms 162–163 and the piston rod 164 across a dead-center relationship, and the inertia of the assembly mounted on the shaft 155 will normally be sufficient to assure a smooth transition across this point where no torque is applied. The lower extremity of the shaft 155 is stabilized by a bearing engagement with the recess 173 in the beam 73 of the housing, and this hole is preferably reinforced by some conventional form of bearing block (refer to FIG. 63).

An annular flange fitting 174 is secured to the shaft 155, and positions the central plate 175 secured to the parallel beams 176–177 (refer to FIG. 10). The diametrically opposite ends of the beams 176 and 177 are secured to the tangential members 178a–b and 179a–b, carrying the brackets 180–181 and 182–183, respectively, at their opposite ends. These brackets form receptacles for the nest assemblies 184 and 185 shown in detail in FIGS. 23–29. The work-supporting platform 186 is provided with bearing blocks 187–188 at its opposite ends across the gap provided by the channel-shaped cross-sectional configuration of the platform 186. These bearing blocks rotatably support the shafts 189–190 carrying the spur gears 191–192 and 193–194 at their opposite ends, respectively. These gears are in mesh with the racks 195–196 and 197–198 fixed with respect to the opposite brackets 180 and 182, respectively. The gears at the opposite ends of the platform 186 are themselves interengaged, in addition to being in engagement with the associated racks. This relationship assures a uniform equal vertical movement at all four corners of the platform 186. This movement is controlled by the air or hydraulic actuators 199–200 shown in FIG. 28. These units are essentially conventional piston-cylinder devices, with fluid pressure applied preferably through openings as indicated at 201 and 202 in the floor of the channel-shaped support beam 203, which is carried by the angle members 204 and 205 secured to the brackets 180 and 182. It is preferable that the lateral position of the platform 186 be stabilized by the guide pin 206 slideably received within the bearing sleeve 207 mounted in the tubular boss 208, which is secured to the underside of the support beam 186. Pressure to the actuator units 199 and 200 is preferably utilized for inducing engagement and disengagement of work pieces carried in a nest assembly (not shown) mounted on the beam 186 with a mask unit carried by the shifting rack assembly 209 shown in detail in FIGS. 10–22 and 30–53. Since the movement of this latter assembly is primarily to provide loading-unloading clearance, and produces an arcuate path of movement, the direct vertical action of the support beam 186 is better adapted for the precise linear engagement and disengagement of work pieces from masks that may have a three-dimensional surrounding relationship with respect to at least portions of the work pieces carried by the nest assembly supported by the beam 186.

The fulcrum members 210 are respectively mounted on the plates 211 and 212 interconnecting the opposite ends of the beams 176 and 177, respectively. The actuating arms 213 and 214 are connected to the beams 215–216 and 217–218, respectively by the gusset plates 219–220 and 221–222, as shown in FIG. 6. The pivot pins 223 traverse the bearing blocks 210, as well as the associated actuating arms and gusset plates, and are held in position with the bolts 225 and 226 and the washers 227 and 228, respectively.

Movement of the rack assembly 209 from the intermediate position shown on FIG. 16 to the tilted position shown in FIG. 18 (in either direction) is induced by the actuators 229 and 230 mounted on the opposite sides of the rotary structure on the brackets 231–232 and 233–234. Tie rods as shown at 235 and 236 are preferably incorporated to maintain the spacing between the brackets against the action of the fluid pressure within the actuators 229 and 230. One form of actuator structure is shown in FIGS. 13–18, and includes a moving cylinder unit as shown at 237. A central plug 238 is provided with transverse grooves slideably receiving the blocks 239 and 240, which are pivotally connected to the arms 241 and 242 secured to the actuating arms 213 and 214. The sliding relationship of the blocks 239 and 240 with respect to the plug 238 accommodates the divergence between the linear movement of the cylinder unit 237 and the arcuate movement of the actuating arms. Application of fluid pressure to the tubular bolts 243 or 244 securing the fixed piston units 245 and 246 to the bracket assemblies will induce the rocking action of the mask-carrying rack 209 to provide loading-unloading clearance between masks supported at the outer ends of the rack and the nest structure associated with those masks.

A modified form of actuator for the mask rack is illustrated in FIGS. 19–22. In this arrangement, the pairs of actuators shown at 246 and 247 are pivotally connected at their outer ends to brackets as shown at 248 and 249, and at the center of the device to the depending actuating arm 250 of the mask rack 251. The brackets 248 and 249 are mounted on a rotary frame of the same general configuration as that described in connection with FIG. 6. Selective actuation of the actuators 246–247 will induce the rocking motion of the mask rack 251 between the positions shown in FIGS. 19, 20, and 21. The details of the pivotal interconnection between the actuators and the actuating arm 250 are best shown in FIG. 22. The piston rod 246a of the actuator 246 has a forked end 252 permitting the pin 253 to interconnect the coupling member 254 of the piston rod 247a to the fork 252, as well as to the spaced portions 250a and 250b of the arm 250.

The mechanism for securing the mask units with respect to the rack is illustrated in FIGS. 30–53. The mask unit 255 shown in FIGS. 41–45 is in the form of a blank panel 256 with parallel side flanges 257 and 258. The return flanges 259 and 260 provide a "U"-shaped configuration at the opposite edges of the mask panel for interengagement with the bars 265 and 267 of the mask rack 209. The flange 257 is interrupted at the opposite ends of the mask units, and the sheet metal material of the central portion of the mask panel is extended as shown at 263 and 264 to provide a protective shield for the components of the rack structure immediately underneath. This arrangement prevents the accumulation of paint on the portions of the rack that
might interfere with the continuing operation of the machine. It is common practice to periodically clean the masks in a solvent solution, and the envelopment of the portions of the machine exposed to paint spray by the mask eliminates the need for a separate cleaning operation for the machine.

The engagement and disengagement of the masks from the supporting rack, and the securing of the masks in operating position, are provided by two different forms of the mechanism. Referring to Figs. 31 to 34, the mask rack 209 has outer bars 265–266 fixed with respect to the members 215–218 and 216–217, respectively. The movable inner bars 267 and 268 are slideably mounted with respect to the rack on a guideway structure provided by the end plates 269–272 (secured to the associated members 215–217, respectively) and the short top plates 273–276 secured to the top of the members 215–218. Air or hydraulic piston-cylinder actuators 277–280 are mounted on the members 215–218, respectively, with the pistons connected to the opposite ends of the moving bars 267–268 as shown in Figs. 32 and 33. The extended position shown in full lines in these figures corresponds to the locked position of the mask with respect to the rack illustrated in Fig. 44. Retraction of the actuators to bring the bars 267 and 268 to the dotted line position shown in Figs. 32 and 33 corresponds to the relative placement illustrated in Fig. 45, releasing the flange 257 (and the corresponding flange of the mask at the opposite side of the rack) for upward movement. The extent of the retraction of the movable bars is sufficient to provide freedom for a radially outward movement of the masks (with respect to the central shaft 155) sufficient to also disengage the outer return flange 260 from the associated fixed bar, thus permitting the mask to be lifted directly upward. The elevation of the return flange 259 will permit a sufficient lifting action of the masks to disengage it from the locating device illustrated in Figs. 49–53, thus permitting the lateral shift required to disengage the return flange 260.

Figs. 46 through 48 illustrate some of the various options available with regard to the structural details of the mask units themselves. Normally, the central portion of the mask will be provided with various forms of cut-out areas, and some of the configuration of this portion of the mask may be three-dimensional to accommodate particular forms of work pieces and spray areas. This central portion of the mask is shown in the drawings as a plain panel 281 for simplicity, and the side flanges 282 and 283 and return flanges 284 and 285 may be formed integrally with the central panel portion 281 as a single piece of sheet metal work. This arrangement is shown in Fig. 46. In Fig. 47, the central panel 280 is provided with straight flanges 287 and 288, and the angle members 289 and 290 provide the return flanges for retention on the mask rack. These angle members would normally be spot-welded to the side flanges 287 and 288. This arrangement is shown in Fig. 47. Fig. 48 illustrates the use of a channel-shaped pair of side rails 291 and 292 secured to a flat central panel 293. These rails provide the equivalent of the side flanges and return flanges discussed in the previous forms of the structure.

Figs. 35 through 40 illustrate a modified form of mechanism for controlling the position of the movable bars of the mask rack. In place of the actuators 277–280, the arrangement shown in Figs. 35 through 40 utilizes a component having a locking action similar to the bolt action of a rifle. The construction at all four corners of the rack shown at Fig. 35 is similar, and includes a rod 294 slidable and rotatably mounted in a guideway unit 295 secured to each of the rack beams 215–218. This rod is rotatable, but axially fixed with respect to the moving rack bars, and is urged to the right, as shown in Fig. 37, by the spring 294a. The bent handle 296 has a configuration cooperating with the cam piece 297 secured to the fixed outer rack bars and to the lower plates 269–272. The extended and retracted positions of the movable bars is illustrated in Figs. 37 and 39, and the locked position of the masks corresponds to the placement illustrated best in Fig. 37.

The arrangement for locating the mask unit laterally with respect to the supporting rack is illustrated in Figs. 49 through 53. This relative position must be maintained accurately to assure proper placement of the paint spray. The structure shown in these views is repeated at the opposite ends of the mask unit. The central portions of the mask unit indicated at 298 are drilled through with a hole somewhat smaller than the diameter of a selected ball 229. The drilled hole is used as a locating recess for the application of weld material as shown at 300 to secure the ball with respect to the mask. A socket 301 of a diameter very slightly in excess of that of the ball 299 is secured to the outside of the rack beams 215–218, and the interengagement of the balls 299 with these sockets results in an accurate lateral placement of the mask with respect to the mask-supporting rack. It is preferable that an opening as shown at 302 be provided in the bottom of the receptacle 301 to prevent the accumulation of foreign material in this area. The receptacle 301 may be of any desired construction, and is illustrated in the form of a block secured to the rack by bolts as shown at 303 and 304 in Fig. 52.

The operating cycle of the machine is established by conventional program equipment mounted behind the frontal panel 305 (referring to Fig. 4), and gauges and instruments requiring frequent reference are preferably installed on the inclined central portion 306. The rotation of the assembly carried by the vertical shaft 155 requires the presence of the barrier grille 307 to protect an operator standing in front of the machine. The configuration of this protective grille is such as to allow the rotative structures to swing freely without interference, and without clothing the clothing of the operator. Push buttons as shown at 308 and 309 are preferably used to initiate the cycle of the machine, which is then carried on automatically. The use of spaced buttons can be used as a safety precaution to assure that both hands of the operator are clear of the moving components of the machine. In an emergency, the operator may move forward against the bar 310, which will have the effect of interrupting the automatic programming, and stopping the machine instantly.

1. A spray-painting machine including a housing defining a spray chamber, spray gun means disposed to project spray within said chamber, ventilation means operative to maintain a flow of air within said chamber, wash means providing at least one water curtain within said chamber, and carrier means rotatably mounted in said housing on a vertical axis of rotation, said carrier means having at least two sets of related workpiece-
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11holding and mask-holding means, said sets being angularly displaced from each other about the axis of rotation of said carrier means, said machine also including an indexing mechanism adapted to rotate said carrier means between positions in which each of said sets is, in turn, placed at said loading station and in said chamber, wherein the improvement comprises:
actuating means operative to move the mask-holding means of said two sets oppositely, respectively, to spraying position in said chamber and a position providing clearance over said loading station, said mask-holding means being a unitary structure pivotally mounted on said carrier means at the central portion thereof and adapted to rock between said opposite positions.

2. A machine as defined in claim 1, wherein said actuating means is responsive to said indexing mechanism.

3. A machine as defined in claim 1, wherein said carrier extends in cantilever relationship over the top of a wall defining the lower extremity of an opening in said housing communicating with said chamber.

4. A machine as defined in claim 1, additionally including means mounted on said carrier means and forming a vertical guideway for said workpiece-holding means, and also including positioning means adapted to move said workpiece-holding means to and from a lower position disengaged from a mask carried by said mask-holding means and an upper position engaged therewith.

5. A spray-painting machine including a housing defining a spray chamber, spray gun means disposed to project spray within said chamber, ventilation means operative to maintain a flow of air within said chamber, wash means providing at least one water curtain within said chamber, workpiece-holding means, mask-holding means, and carrier means rotatably mounted in said housing on a vertical axis of rotation, and adapted to transfer said workpiece-holding and mask-holding means between a loading station and said chamber, said carrier means having at least two sets of related workpiece-holding and mask-holding means, said sets being angularly displaced from each other about the axis of rotation of said carrier means, said machine also including an indexing mechanism adapted to rotate said carrier means between positions in which each of said sets is, in turn, placed at said loading station and in said chamber, wherein the improvement comprises: an actuator incorporated in said indexing mechanism and mounted on the exterior of said housing at the top thereof, said actuator being adapted to reciprocate said carrier means through a sector of substantially 180°.

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