

Aug. 21, 1945.

R. E. SYKES ET AL

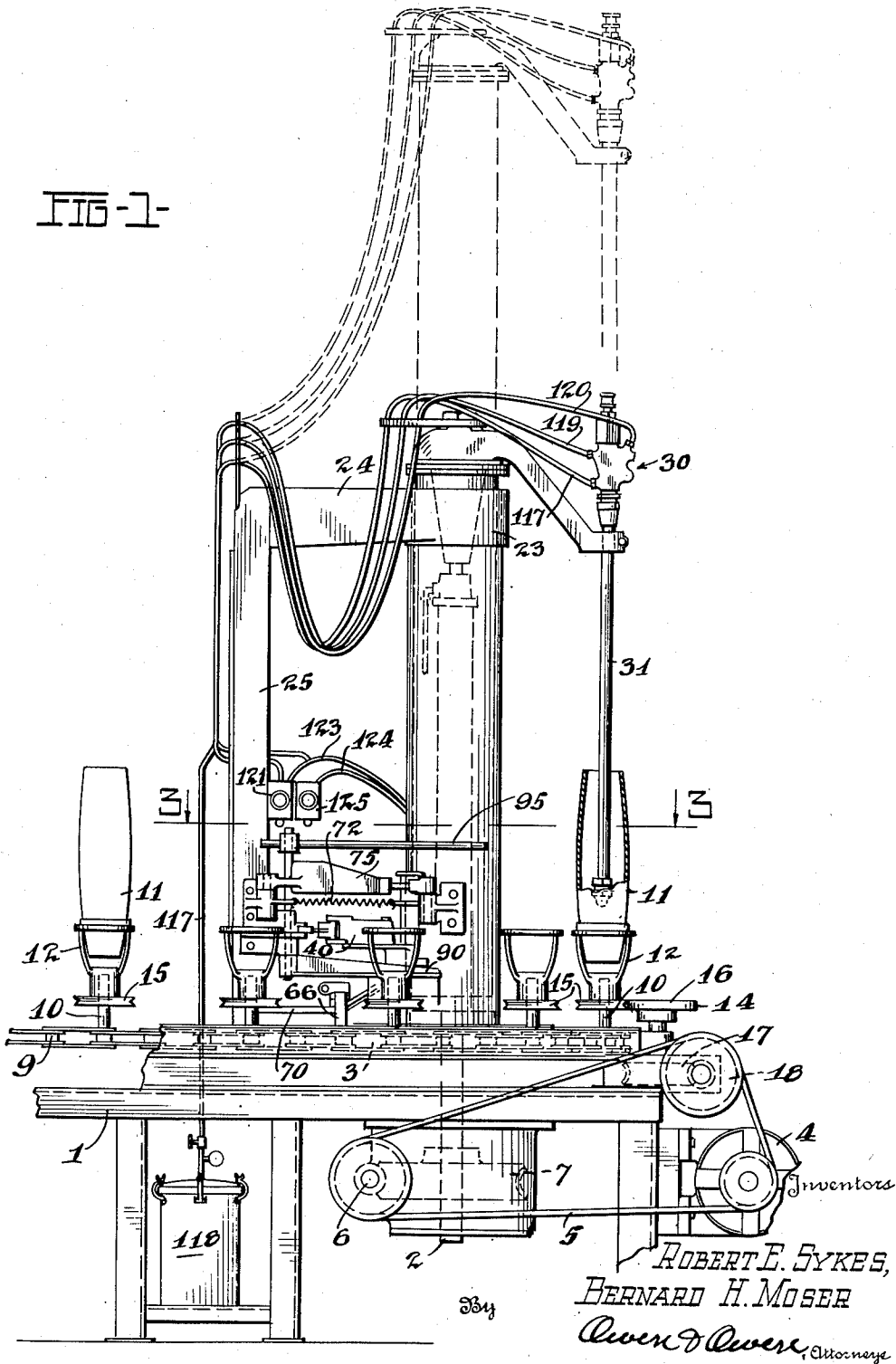
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SPRAY COATING MACHINE

Filed June 14, 1943

8 Sheets-Sheet 1

FIG. 1-



Aug. 21, 1945.

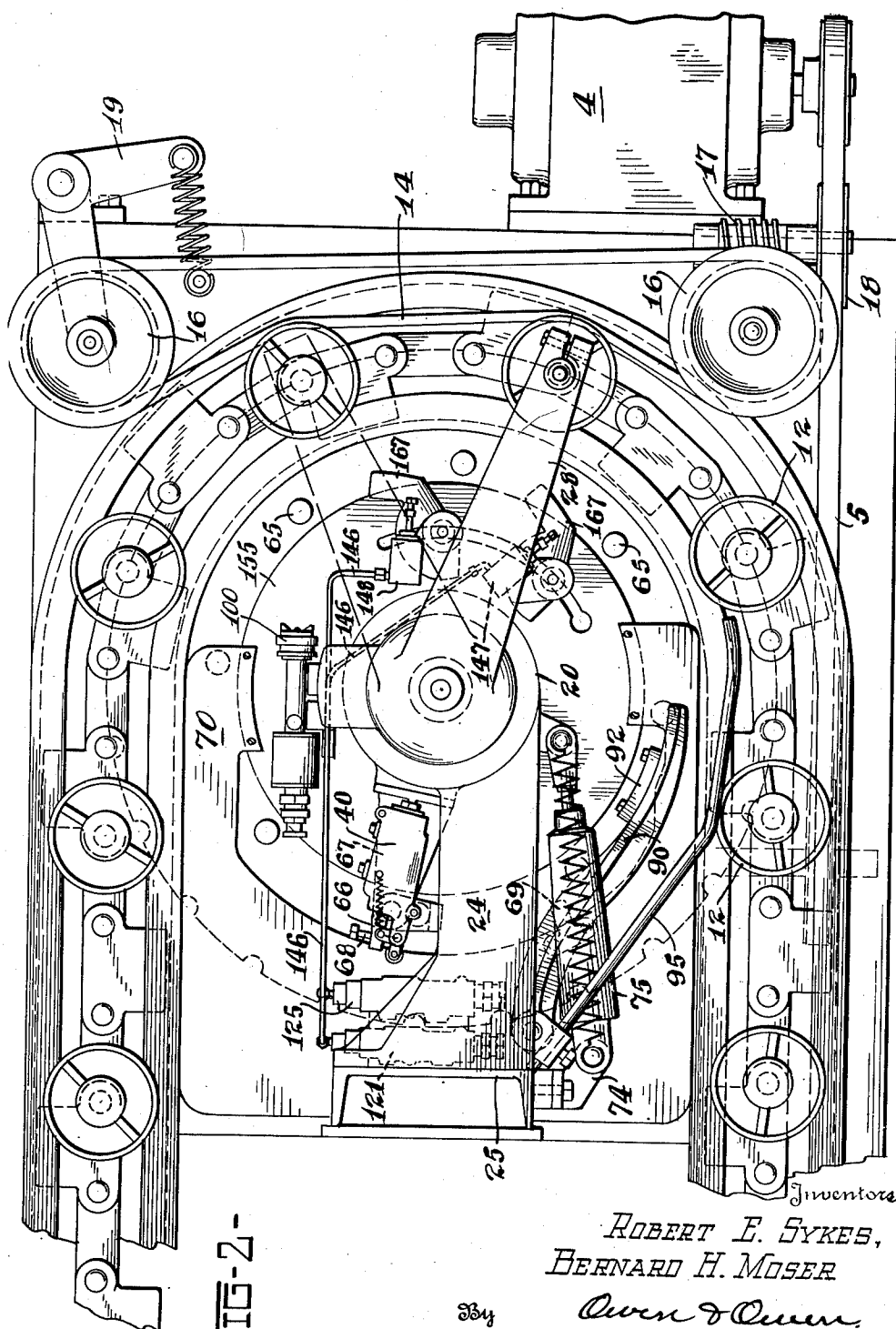
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SPRAY COATING MACHINE

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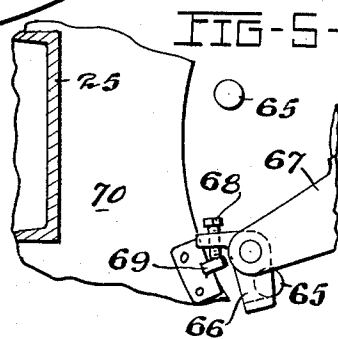
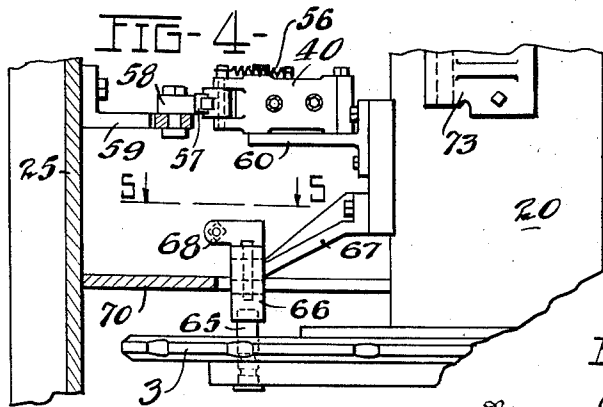
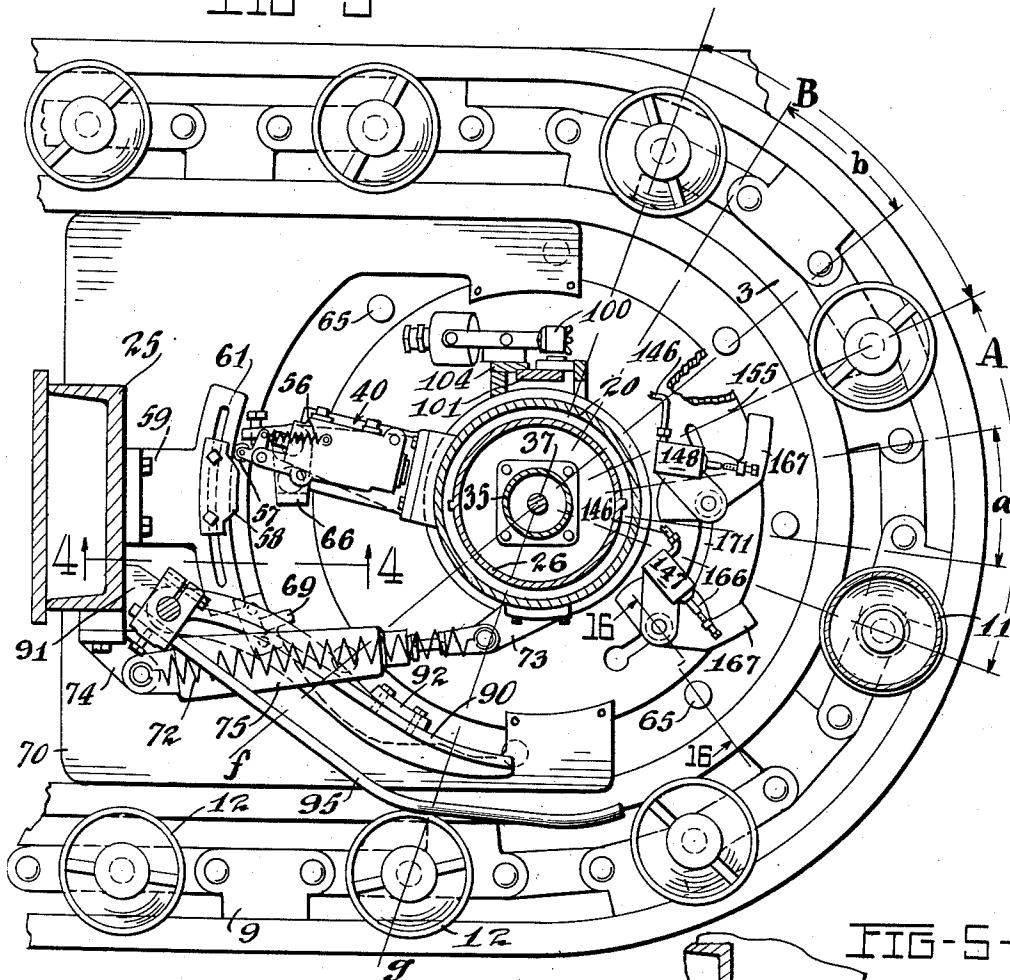
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SPRAY COATING MACHINE

Filed June 14, 1943

8 Sheets-Sheet 3

FIG - 3 -



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2,383,023

SPRAY COATING MACHINE

Filed June 14, 1943

8 Sheets-Sheet 4

FIG-6 -

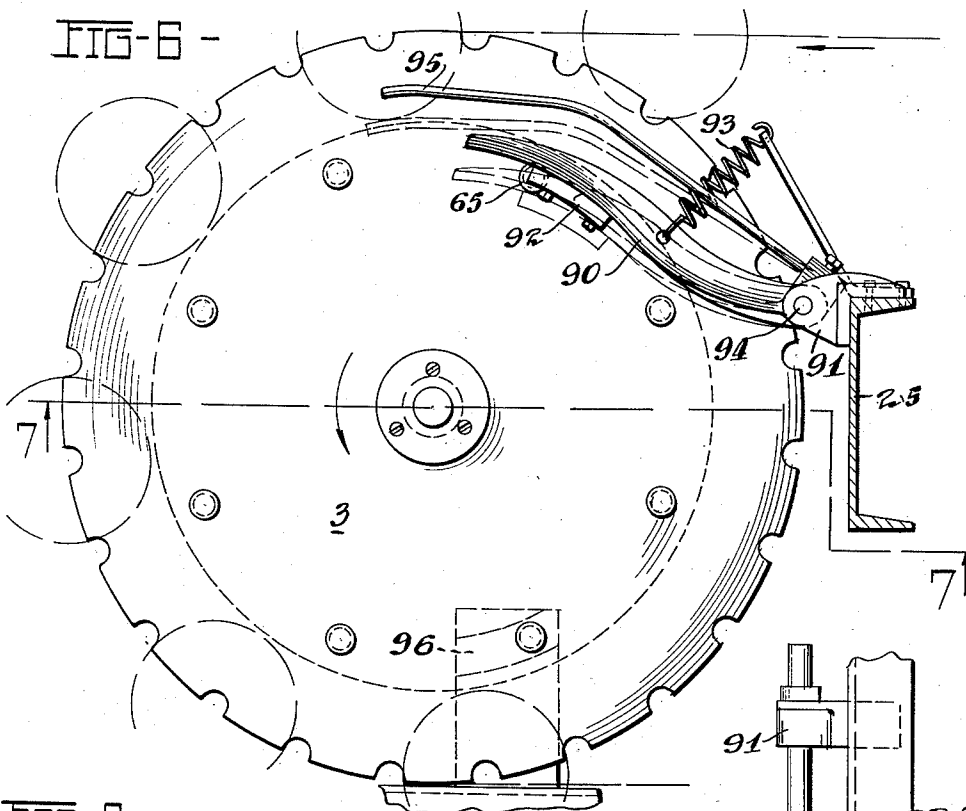


FIG-8 -

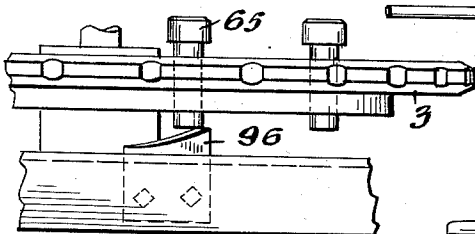
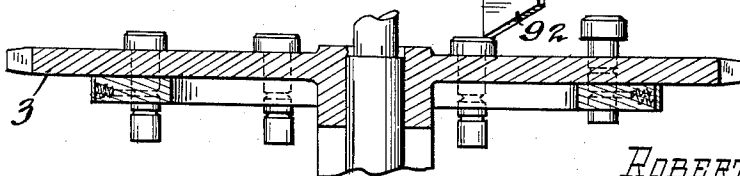
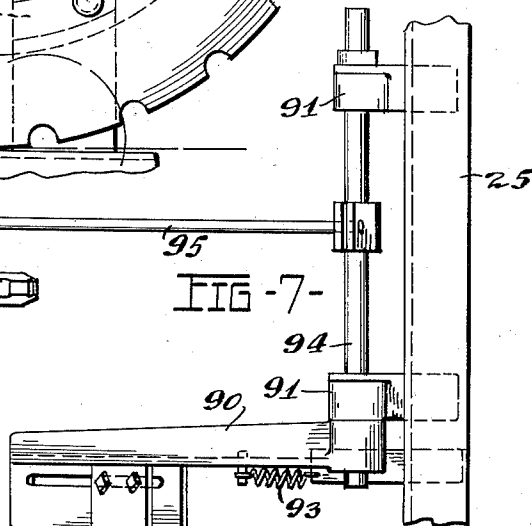


FIG-7 -



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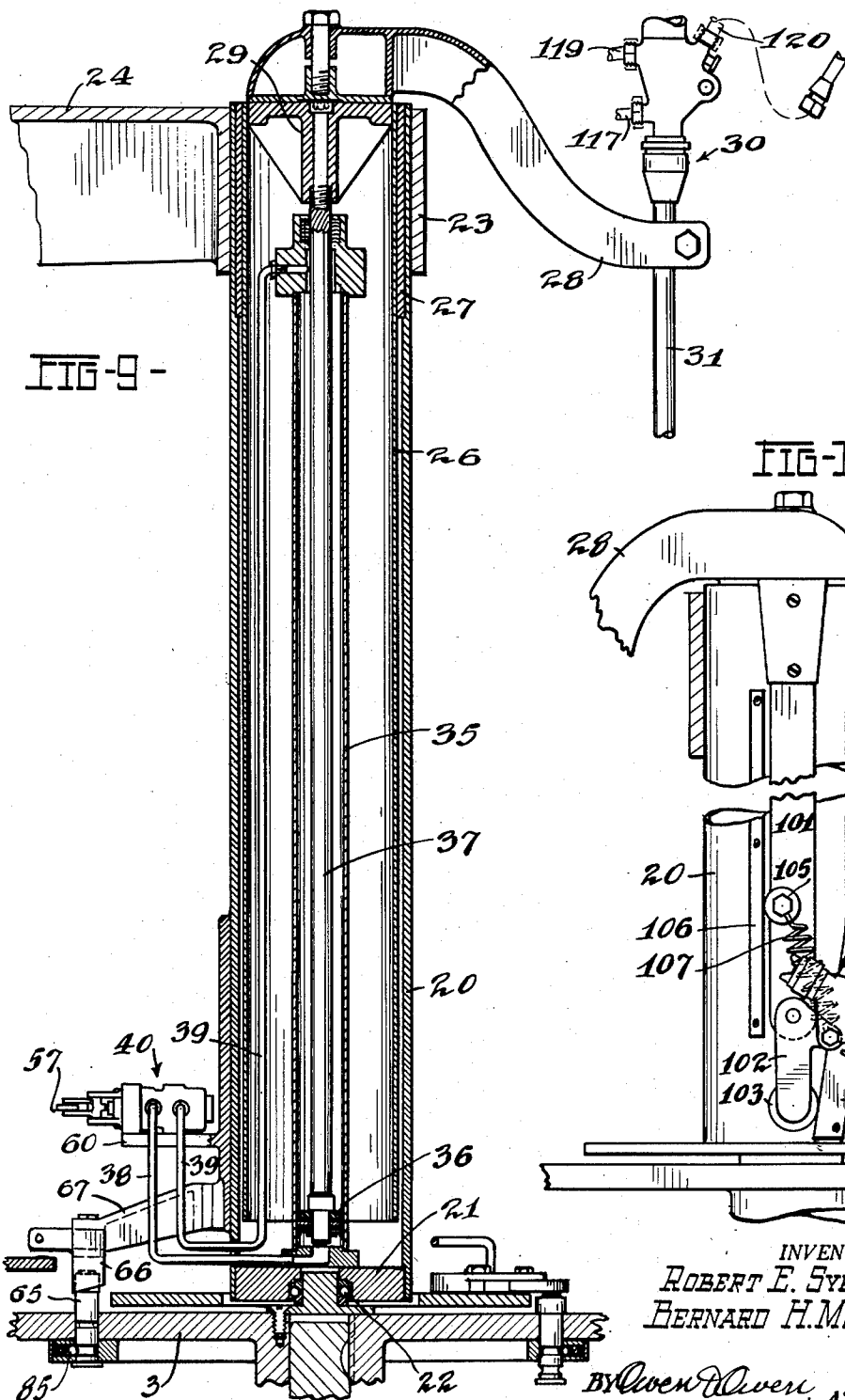
Aug. 21, 1945.

R. E. SYKES ET AL
SPRAY COATING MACHINE

2,383,023

Filed June 14, 1943

8 Sheets-Sheet 5



Aug. 21, 1945.

R. E. SYKES ET AL
SPRAY COATING MACHINE

2,383,023

Filed June 14, 1943

8 Sheets-Sheet 6

FIG-11-

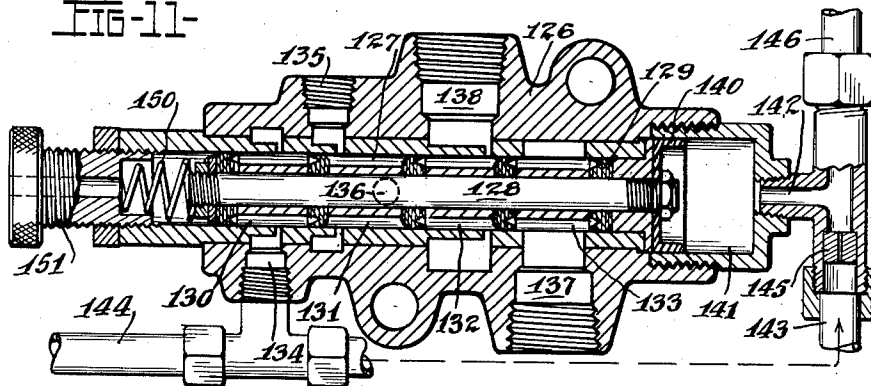


FIG-12-

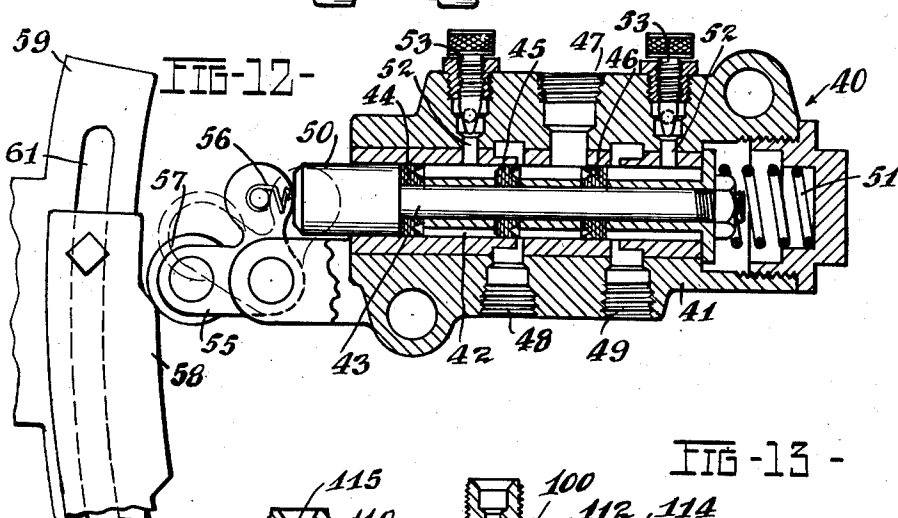


FIG-13 -

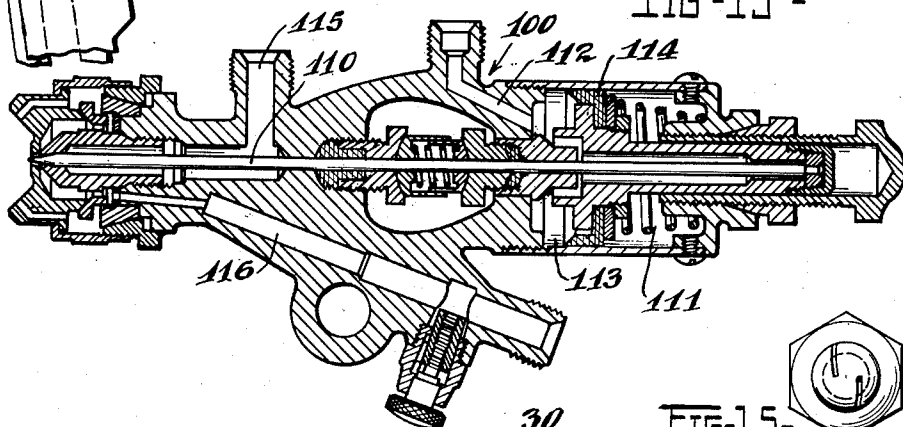


FIG-14-

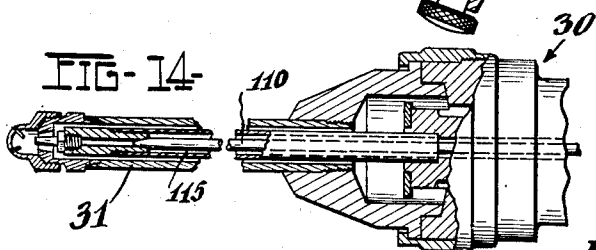
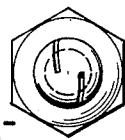


FIG-15-



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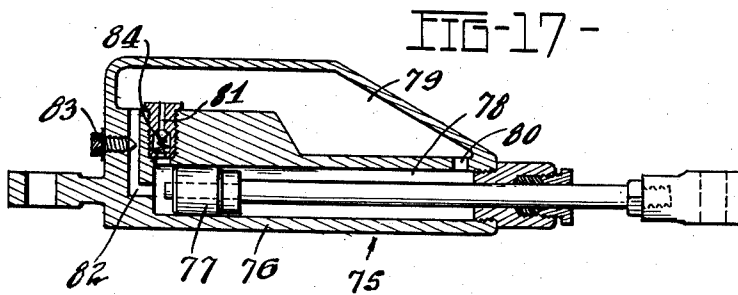
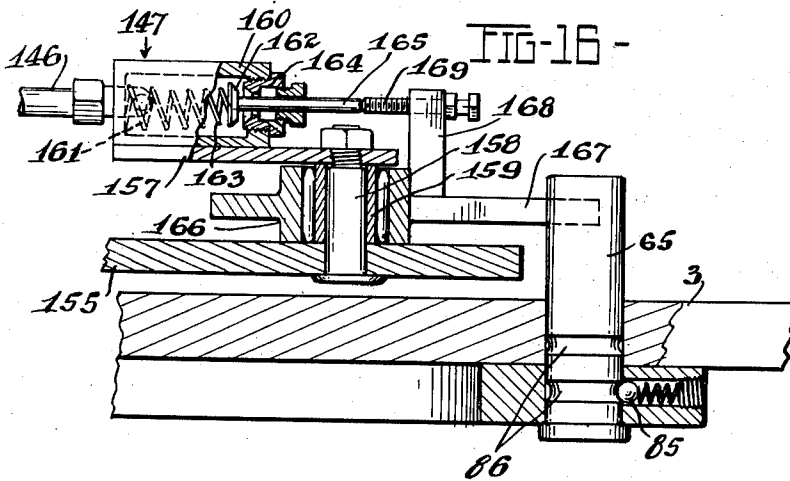
Aug. 21, 1945.

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SPRAY COATING MACHINE

2,383,023

Filed June 14, 1943

8 Sheets-Sheet 7



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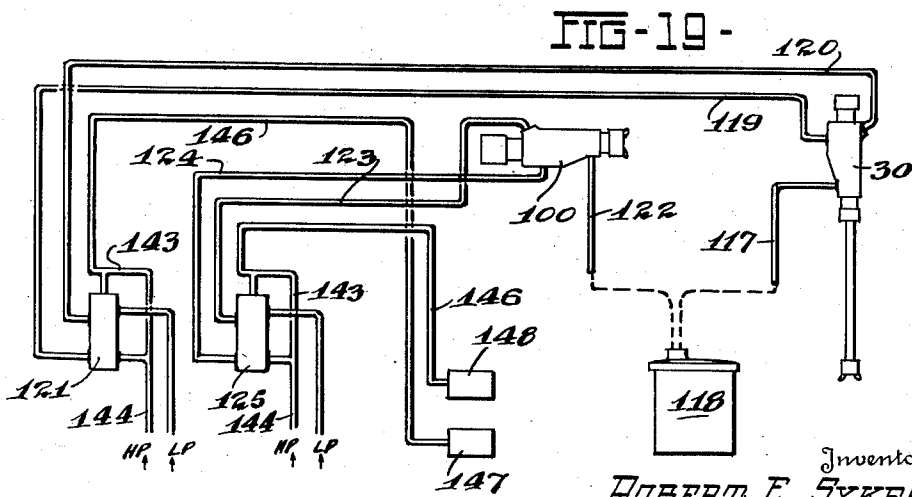
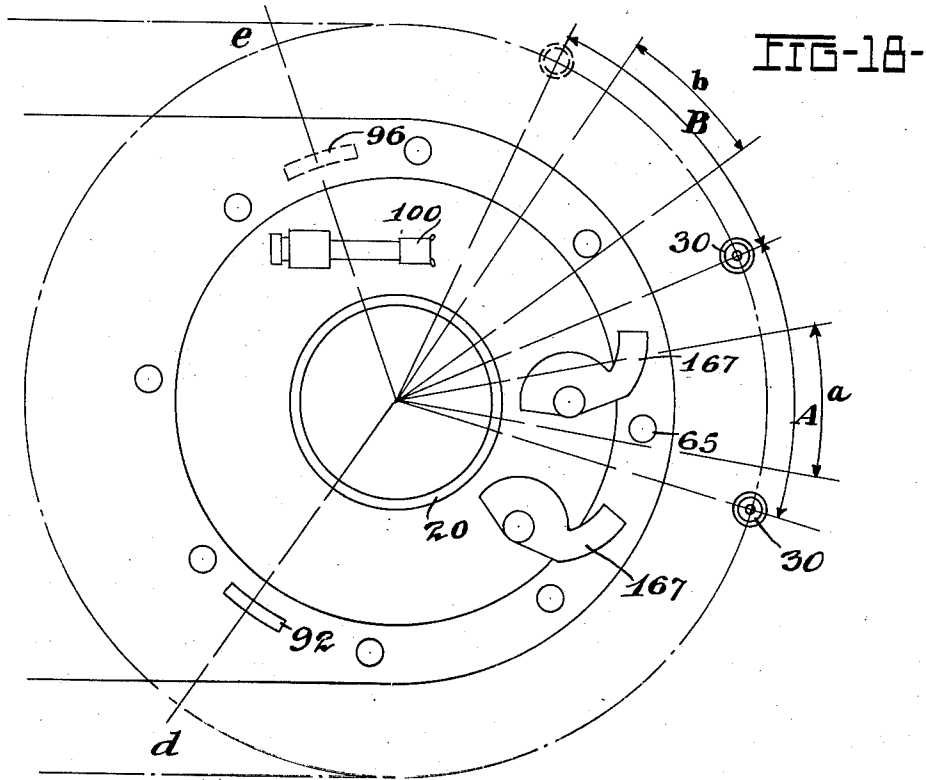
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8 Sheets-Sheet 8



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UNITED STATES PATENT OFFICE

2,383,023

SPRAY COATING MACHINE

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Application June 14, 1943, Serial No. 490,710

22 Claims. (Cl. 91—45)

This invention relates to machines for spray coating articles, and particularly those for spray coating long hollow articles, such, for instance, as explosive shell bodies, inside and out.

In a machine embodying the invention, the articles to be sprayed, which for convenience will hereinafter be referred to as "shells," are fed to and from and through a spraying zone by a conveyor, in the present instance, of the endless type, the shells are rotated, and interior and exterior spraying guns are operated to have predetermined movements whereby an efficient spraying of both the inner and outer surfaces of each shell throughout its entire length, or a predetermined portion thereof, is effected in the spraying zone, preferably during continuous and uninterrupted movement of the conveyor.

The primary object of the invention is the provision, in a machine of this character, of simple and efficient means which is operable during movement of a shell through the spraying zone to effect movement of a spray gun or unit both with the shell in its conveyor actuated travel, and into and out of the shell, so that the entire interior surface thereof may be coated.

A further object of the invention is the provision, in a machine of this character, of simple and efficient means, including inside and outside shell coating guns, operable during movement of a shell through the spraying zone, to move both with the shell in its travel with the conveyor and lengthwise thereof, so that the whole or predetermined portions of the interior and exterior surfaces of the shell may be coated.

Further objects of the invention will be apparent from the following detailed description and the accompanying drawings illustrating one embodiment thereof, and in which—

Figure 1 is a side elevation of a portion of the machine embodying the invention, with parts broken away and with the swing plunger lowered; Fig. 2 is a top plan view thereof, with parts broken away and some removed, and with the normal position of the swinging gun-carrying means shown in full and with its forward swinging position shown in dotted lines; Fig. 3 is an enlarged section on the line 3—3 in Fig. 1, with parts broken away and with the swing parts in the position shown in Fig. 2; Fig. 4 is an enlarged fragmentary section on the line 4—4 in Fig. 3; Fig. 5 is a fragmentary section on the line 5—5 in Fig. 4; Fig. 6 is a cross-section taken approximately on the line 3—3 in Fig. 1 with the view reversed from that of Fig. 3, and with parts broken away and removed; Fig. 7 is a fragmentary side

elevation, with parts in section on the line 7—7 in Fig. 6; Fig. 8 is a fragmentary elevation of the clutch pin raising means shown in Fig. 6; Fig. 9 is an enlarged fragmentary vertical section of the spray gun swinging means of the machine, with parts broken away and parts in full; Fig. 10 is a fragmentary side elevation thereof, viewing it from the opposite side to that of Fig. 9; Fig. 11 is a central longitudinal horizontal section, with parts in full, of one of the gun operating control units; Fig. 12 is a central longitudinal horizontal section, with parts in full, of the control unit, with its operating cam, for raising and lowering the guns; Fig. 13 is a central longitudinal section of the outside spraying gun; Fig. 14 is a fragmentary section of the spray nozzle of the inside gun, with parts in full; Fig. 15 is an end view of the spray cap of the inside gun; Fig. 16 is an enlarged fragmentary section, with parts in full, taken on the line 16—16 in Fig. 3; Fig. 17 is an enlarged central vertical longitudinal section of the cushion means for checking the swinging movements of the gun-carrying means; Fig. 18 is a diagram of the swing and spray zones for the guns, and Fig. 19 is a diagram of the operating air connections and valves for the guns.

Referring to the drawings, 1 (Fig. 1) designates a base frame having a vertical drive shaft 2 journaled therein and fixedly carrying a large circular member 3, in the present instance a sprocket wheel, at its upper end for rotation in a horizontal plane. The shaft is slowly driven, in the present instance, from a motor 4 through a belt 5, which drives a worm shaft 6, the worm of which is in mesh with a worm wheel 7 on the shaft 2.

A work carrying sprocket chain 8, at one end of its course, passes around the sprocket wheel 3 and is driven thereby. This chain, at equidistantly spaced intervals throughout its length, has its link pintles 10 projected upwardly above the plane of the chain and each forming a stub shaft or pin on which a work piece 11, which may be referred to as a "shell," may be mounted to be carried with the chain and to have rotation about its longitudinal axis and that of its supporting pin. In the present instance, a shell supporting holder or cradle 12 is rotatably mounted on each pin 10.

In Figs. 3 and 18, A indicates the zone in which the inner spray gun swings and sprays, B the zone in which the outer gun swings and sprays, and a and b approximately the zones in which the spraying of said guns respectively occur. Each holder 12 (Fig. 2) with its shell 11, when passing through the zones A, B, is rotated on its

supporting pin by the inner run of a drive belt 14 engaging a sheave 15 (Fig. 1) on the holder. This belt is guided for a horizontal run by sheaves 16, one of which has its shaft connected by a worm and gear connection 17 to a shaft carrying a sheave 18 with which the drive belt 5 engages. The sheave 16 is carried by a spring held lever 19 to take up slack in the belt 14.

A hollow swing column 20 is mounted on and rises from the central portion of the sprocket wheel 3 for concentric rocking movements relative thereto. The lower end of this column is closed by a bottom member 21 (Fig. 9), which has a centering bearing on the wheel 3, as shown at 22, to permit free rotation of one relative to the other. The upper end of the column 20 is open and is journaled in a bearing 23 carried by a bracket arm 24. This arm extends from an upright 25 rising from the frame 1 at the inner side of the sprocket wheel 3 between the two runs of its chain 9.

Gun raising and lowering means

A hollow cylindrical guide plunger 26, open at its lower end, is mounted for longitudinal reciprocatory movements in the swing column 20, being guided thereby, in the present instance, by a bearing bushing 27 set into the upper end of the column 20 and to which the guide plunger 26 is feathered so as to turn with the column. An arm 28 fixedly projects from the upper end of the guide plunger 26 transversely of its axis, and, in the present instance, is fixed at its inner end to the plunger through the medium of a plug part 29. This arm carries the spray gun 30 for passing vertically into and out of a registering shell 11 and spraying its interior during a portion of its passage through the zone A, as hereinafter described.

A fluid pressure cylinder 35 (Fig. 9) fixedly rises from the bottom 21 of the swing column 20 and extends upward within the guide plunger 26 centrally thereof and to near its top. A cupped plunger 36 operates within the cylinder 35 dividing it into upper and lower compartments, and has its rod or stem 37 projecting upward through a packing gland at the upper end of the cylinder 35 and attached at its outer end to the top part 29 of the guide plunger 26, so that the rod and its plunger 36 have reciprocatory movements with the guide plunger 26. The admission and exhaust of air or other operating fluid under pressure to and from the lower and upper compartments of the cylinder 35 is effected through tubes 38 and 39, respectively. These tubes connect with a control valve 40, a preferred embodiment of which is shown in detail in Fig. 12.

The valve 40 includes a casing 41 having a cylindrical valve chamber 42 lengthwise therein in which a valve core 43 operates. This core has a reduced stem portion carrying three longitudinally spaced cup plungers 44, 45 and 46, which divide the chamber 42 into three separate sections. A pressure supply port 47, in communication with any suitable source of air or other fluid pressure supply, is provided in the casing in constant communication with the center compartment, which is between the cups 45 and 46, while ports 48 and 49 in the casing communicate alternately with the center chamber when the valve is reciprocated, and connect respectively with the tubes 38 and 39. The valve 43 has an exposed head 50 at the outer end of the casing and the valve is normally held at the limit of its outward movement by a coiled expansion spring

51 within a chamber in the opposite end portion of the casing. Each end chamber of the valve has a respective exhaust port 52, the exhaust through which is properly metered by a metering valve 53 to suit operating conditions. A rocker 55 of bell crank form is fulcrumed to the valve casing 41 for rocking movements in a horizontal plane and has one arm held in side thrust engagement with the outer end of the valve head 50 by a spring 56, while the opposite arm carries a roller 57 for engagement with a stationary cam 58. The valve 40 is mounted on a bracket 60 which is fixed to the outer side of the swing cylinder 20 near its lower end, and the valve roller 57 is intended to engage the cam 58 at a predetermined point in a forward swinging movement of the cylinder 20, effected as hereinafter described. The cam 58 is carried by a bracket 59 projecting from the frame upright 25 and is adjustably fixed thereto by bolts engaging through a segmental slot 61 in the bracket. The slot 61 is concentric to the swing axis of the valves 40.

The valve core 43 is normally held in its outward position under the action of the spring 51 with the air line 38 in communication with the air supply port 47 and with the air line 39 in communication with the right hand exhaust port 52, so that the plunger 36 and connected parts, including the spray gun carrying arm 28, are normally at the upper ends of their strokes, with the long discharge nozzle 31 of the inside spraying gun 30 raised above the path of movement of the shells 11 with the conveyor. When the inside spraying gun is thus in its raised position, it normally stands approximately at the rear end of its swinging stroke. As each shell on the conveyor moves into vertical register with the spray gun 30 in its raised position, the swing cylinder is coupled to the sprocket wheel 3, as herein after described, and is caused to swing with it through the arc A. Approximately when the movement of the swing parts is started, the trip roller 57 of the valve 40 engages the cam 58, thus causing movement of the valve plunger to reverse the air pressure supply to the power cylinder 35, so as to open the air supply through the tube 39 to the upper end of the cylinder and open the exhaust from its lower end through the tube 38. This imparts a downstroke to the plunger and causes the long discharge nozzle 31 of the gun 30 to pass down into the registering shell. The downstroke of the plunger is quite rapid and, as soon as it has been accomplished, the trip roller 57 passes from the cam 58 and permits the valve plunger 43 to return to its normal position, which reverses the air flow to the power cylinder 35, so that the plunger and spray gun are forced upward by air admitted to the cylinder through the tube 38. The speed of this upward stroke is regulated to suit the spraying action by proper adjustment of the exhaust metering valve 53 at the right of Fig. 12.

Swing means

A forward swinging movement is imparted to the swing column 20 and associated parts each time a shell passes through the zone A by reason of an associated catch pin 65 on the member 3 engaging a catch finger 66 that is pivotally carried by an arm 67 projecting from the lower end of the swing column 20, in the present instance, below the bracket 60, as best shown in Figs. 3, 4, 5 and 9. This finger is of bell crank form and has one arm downwardly angled to stand in the path of movement of the pin 65, while its other

arm carries an adjustable screw 68 which, when the swing parts have been given the intended limit of swing, will strike a stop finger 69 on a stationary bracket 70 and effect a tripping of the catch finger 66 to release the engaged pin 65. The bracket 70 is attached to the frame upright 25.

When release of a pin 65 and catch finger 66 has been effected, the swing parts are returned or swung rearward to normal position by a spring 72 connected at one end to a bracket arm 73 on the swing cylinder 20 and at its other end to a bracket arm 74 on the frame upright 25. The swinging movements of the swing parts are cushioned in both directions by a fluid check means 75 connecting the two bracket arms 73 and 74. This check means includes a cylinder member 76 (Fig. 17), pivoted at one end to the bracket arm 74, and a plunger member 77, the stem of which projects from the opposite end of the cylinder member and is attached to the bracket arm 73. The member 76 includes a cylinder 78 in which the plunger works and a fluid storage chamber 79, which has communication with the inner end of the cylinder 78, through a port 80, and has communication with the opposite end of said cylinder through two longitudinally spaced ports 81 and 82. The port 82, which is farthest from the port 80, has a metering valve 83 therein, while the port 81 has an inwardly opening check valve 84 therein. On the outward stroke of the plunger the fluid is admitted to the left end of the cylinder through both ports 81 and 82, the check valve opening for that purpose. During the return movement, however, the check valve closes so that the only exhaust of fluid from the left end of the cylinder is through the metered port, thus retarding the fluid discharge from such end sufficiently to cushion the return stroke of the plunger the desired extent.

A plurality of catch pins 65 are carried in circular series by the sprocket wheel 3 concentric to its axis and in equidistantly spaced relation corresponding to the spacing of the shell carrying pins 10. These pins are vertically movable in the sprocket wheel and each is yieldingly retained in either a raised or a lowered position by a spring pressed detent 85 (Figs. 9 and 16) engaging a registering one of two longitudinally spaced circumferential grooves 86 in the pin.

In order to insure a spraying action of the spray parts only when there is a shell on the holder 12 with which a respective pin 65 is associated during a movement of the shells around the sprocket wheel, a pin depressing arm 90 is employed. Such arm swingingly projects from a bracket 91 on the frame standard 25 over the sprocket wheel at the side thereof which is turning into engagement with the sprocket chain and in position for a cam 92 thereon to engage and depress a pin passing thereunder. A spring 93 normally holds the arm 90 in its outwardly swung position, which is its pin depressing position (Fig. 6).

The shaft 94, which carries the arm 90, has a shell engaging finger 95 projecting therefrom in position for each shell 11, as it passes such finger in its forward travel with the sprocket chain, to have sliding engagement with the finger and to force it inwardly a distance sufficient to swing the arm 90 with its cam 92 out of depressing relation to the associated pin 65. It is thus apparent that if there is no shell on a

holder 12, as the carrying portion of the sprocket chain moves into engagement with the sprocket wheel, the arm 90 will be permitted to remain in its normal position and thus effect a depressing of the associated catch pin 65. It is also apparent that if there is a shell on such holder the arm 90 will be swung inwardly thereby out of depressing relation to the associated catch pin, as shown by dotted lines in Fig. 6, thus leaving the pin in its upwardly extended position to effect subsequent operation of the parts with which it is intended to engage. A pin 65, when thus depressed, remains in such position until the pin is adjacent to the point at which the sprocket chain leaves the wheel, where it is engaged at its lower end and forced up by a cam 96 (Figs. 6 and 8) on the frame 1.

Spray guns and controls

The spraying means includes an inside spraying gun 30 carried by the swinging arm 28 and an outside spraying gun 100 carried by and at the lower end of an arm 101 (Fig. 10) depending from the inner end of the arm 28 at one side of the swing column 20. The spraying of the inside of a shell by the gun 30 takes place during the movement of the shell through the spraying zone a, and the spraying of the next preceding shell by the outside spraying gun 100 takes place simultaneously therewith during the movement of such next shell through the spraying zone b, and this occurs during an upward stroke of the cylinder 20.

The spray gun 100 is fixedly mounted on a rocker arm 102 (Fig. 10) that swingingly depends from the lower end of the arm 101 and has a roller 103 riding on a vertically disposed cam track 104 that is fixed to a side of the swing column 20. The upper major portion of the track 104 is vertical, while its lower end portion is slightly inclined toward the roller 103, so that the line of spray discharge from the gun will be tilted upward a greater extent when the roller is operating on the inclined portion of the track than when operating on the vertical portion. The purpose of this is to better facilitate the spraying of the lower end of a shell. The pressure of the roller 103 against the track 104 is opposed by a roller 105 on the arm 101 acting against a track 106 on the swing column 20. The roller 103 is held against the track 104 by a spring 107.

The spray guns 30 and 100 are the same in construction and operation except that the former has a long discharge nozzle 31 to adapt it to be projected into a shell. The outside gun 100 is shown in section in Fig. 13 and includes a needle valve 110 for the discharge orifice which is held normally closed by a spring 111 and is opened by admission of air pressure through a port 112 into a cylinder 113 against a plunger 114. Material to be sprayed is admitted to the discharge orifice through a port 115 and air under pressure is admitted to the discharge orifice to effect spraying through a passage 116. This gun is of well-known construction and nothing new is claimed for it. The spray head is preferably of the fan spray type. A sectional view of the spray nozzle of the inside gun 30 is shown in Fig. 14. The cap of this nozzle has side discharging spray slots as shown in Fig. 15.

The inside gun 30 has its material port 115 connected through a tube 117 to a tank 118 containing a material to be sprayed and its air passages or ports 112 and 116 are connected through

tubes 119 and 120 to a control valve 121 carried, in the present instance, by the frame upright 25. The outside gun 100 has its material supply tube 122 either connected to the tank 118 or to another material supply tank (not shown), as may be desired, while the two air tubes 123 and 124 of this gun are connected to a control valve 125 carried by the frame upright 25.

The control valves 121 and 125 for the supply of operating air to the inside gun 30 and outside gun 100, respectively, are of the same construction, so that a description of one, as shown in Fig. 11, will suffice for both. Each of these control valves includes a casing 126 having a longitudinally extending bore 127 in which a valve core 128 operates. This core carries a plurality of plunger cups 129 dividing the bore into four compartments 130, 131, 132 and 133. The casing has a high pressure inlet port 134 in communication with the compartment 130; a high pressure outlet port 135 in communication with the compartment 131 when the valve 128 is in left hand position, as shown, and in communication with the compartment 130 and with the high pressure supply port 134 when the piston is moved to its right hand position. An exhaust port 136 to the atmosphere is also provided from the compartment 131. A low pressure inlet port 137 opens into the compartment 133. When the core is in its left position, a low pressure outlet port 138 opens from the compartment 132, and when the core has been moved to the right the ports 137 and 138 are in communication. Inasmuch as low pressure air is used for atomization at the gun, the tube from the port 138 leads to the gun 116, while the high pressure outlet port 135 of the control is connected to the gun passage 112 for retracting the needle valve 110. When no spraying is taking place and the piston 128 of the control valve is in its left hand position, as shown in Fig. 11, the exhaust port 136 is in communication through the port 135 and its connecting tube with the gun passage 112, so as to relieve pressure on the operating side of the gun piston 114.

The valve core 128 at its right hand end is provided with a piston 140 operating in a chamber 141, having at its outer end an air supply and exhaust port 142 in communication through a tube 143 with the high pressure supply tube 144 that also has connection with and supplies air to the high pressure port 134. A metering orifice 145 is provided in the tube 143 so that high pressure air may be slowly supplied therethrough to the piston chamber 141. The port 142 has unrestricted communication through a tube 146 with a proper one of a pair of bleed valves 147, 148 (Figs. 2, 3 and 16), which respectively control the spray guns 30 and 100, as hereinafter described. The left end of the piston 128 is acted on by a spring 150, the tension of which is controlled by a screw plug 151, to move the pistons to the right when the spring pressure overcomes the air pressure in the chamber 141. When the connected bleed valve 147 or 148 is closed, as is its normal condition, the high pressure air metering through the orifice 145 builds up sufficient pressure in the piston chamber 141 to overcome the pressure of the spring 150, thus moving the valve core 128 and piston 140 to inoperative spraying position, as shown in Fig. 11. Upon an opening of a connected bleed valve, the pressure in the chamber 141 is quickly relieved and the valve core is moved to the right to operative spraying position by the spring 150. When

this occurs the high pressure air passing through the ports 134 and 135 actuates the associated gun piston 114 to retract the needle valve 110, while the low pressure air through the ports 137 and 138 effects the spraying operation. The stopping of the spraying action almost immediately follows a closing of the bleed valve as the volume of air passing through the metering port 145 very quickly builds up the pressure in the chamber 141 and bleed line 146.

The two bleed valves 147, 148 are fixedly mounted on a bracket plate 155, which encircles the lower end portion of the swing cylinder 20 adjacent to the sprocket wheel 3 and is in turn fixedly carried by the U-shaped bracket 70 projecting from the frame upright 25. These valves are spaced circumferentially, and, with the present relationship of the various parts, are disposed substantially within the swing zone A of the arm 28. Each valve, in the present instance, as shown in Fig. 16, is carried by a bracket arm 157 that is attached to the supporting plate 155 by a bolt 158 and spacing sleeve 159.

Each bleed valve includes a casing 160 (Fig. 16) having a chamber 161 therein with which the bleed tube 146 communicates and which encloses a valve member 162 normally held by a spring 163 in closing relation to bleed ports 164. The valve member 162 has a stem projecting outward from the casing, so that inward pressure thereon will effect an opening of the valve. A trip lever 166 (Figs. 3 and 16) for the bleed valve is mounted for rocking movements around the spacing sleeve 159 and has a cam arm 167 projecting outward therefrom in the path of movement of the trip pins 65. A finger 168 rises from the arm 167 and carries a thrust screw 169 in position to engage the outer end of the valve stem 165 and impart an inward valve opening movement thereto when the arm 167 is tripped by a pin 65. The bolts 158 of the two relief valve units are projected through an arcuate slot 171 in the plate 155 to facilitate adjustment of the units around the swing axis to suit the points in a rotation of the member 3 at which it is desired to have the inside and outside spraying operations take place.

Operation

In the operation of the machine in its present embodiment, it will be understood that shells 11 are placed in the holders 12 at some point in the course of the conveyor chain 9 before reaching the sprocket wheel 3, and also that the trip pins 65 on the wheel, which are disposed at the inner run of the wheel between the cams 92 and 96, are in their raised or catch positions. As each shell passes the finger 95, at the beginning of its course of movement around the wheel, it has wiping engagement with the finger and effects an inward swinging thereof to move the cam 92 on the connected arm 90 out of the path of movement of the catch pins 65 on the wheel, so that the pin is permitted to continue its movement in raised or catching position. If any holder 12 on which there is no shell 11 passes the finger 95, the trip cam 92 will be permitted to remain in its normal position and effect a tripping of the associated pin 65, at approximately the point *d* in its movement (Fig. 18), thus moving it to its lowered inoperative position which it retains until it has reached the raising cam 96 in approximately the radial line *e*.

It will be understood that the pins 65 are spaced around the wheel in accordance with the spacing of the holders 12 and that each pin that becomes

associated with a shell in its movement around the wheel axis has, in the present instance, a trailing action with respect to such shell. In other words, with the present arrangement, the radial line of the wheel in which the pin 65 of an associated pin and shell is disposed, which line is indicated at *f* in Fig. 3, is spaced approximately 30° rearwardly from the radial line *g* in which the associated shell axis is disposed.

When the shell axis is approximately at the point of beginning of the zone A, the catch finger 66 carried by the arm 67, projecting from the swing column 20, will have been engaged by a catch pin 65, as indicated in Figs. 2 and 3, thus causing the swing column 20 and the parts carried thereby to move with the wheel, with the inside gun 30 swinging substantially through the zone A and the outside gun 100 swinging substantially through the zone B. When such movement is completed, the catch lever 66 will have engaged the stop 69, thereby moving the lever to release the engaged pin 65 and permitting the swing parts to be returned to normal position by the action of the spring 72, the return movement being cushioned by the check 75.

During said forward swinging movement, the roller 57 of the control valve 40 engages the cam 58 and effects a movement of the core member of such valve to admit fluid pressure to the upper end of the cylinder 35 and cause a lowering of the plunger 36 within the swing column and a corresponding lowering of the inside and outside guns 30 and 100, with the former entering a registering shell. When the downstroke of the two guns has been completed, roller 57 will have moved from the cam 58, thus permitting a return of the core member of the valve 40 to normal position so as to admit air under pressure to the lower end of the plunger 36 and effect a raising of the guns.

At approximately the beginning of the raising movement of the guns the catch pin 65, associated with the shell 11 into which the gun 30 has been lowered, will have moved into engagement with and tripped the cam lever 167 associated with the bleed valve 147 to trip such valve and relieve the pressure in the chamber 141 of the associated control valve 121. This permits movement of the core 128 of such valve to effect spraying operation of the inside gun 30, as previously described. This spraying occurs during movement of the inside gun through approximately the zone *a* of its movement A. Approximately coincident with the tripping of the bleed valve 147 by a trip pin 65, the next preceding pin 65 will move into engagement with and trip the lever 167 of the bleed valve 148. This will cause actuation of the spray control valve 125 for the outside gun 100, so that such gun will spray the outside of the shell 11 which precedes the shell that, at the same time, is being inside sprayed by the gun 30. This spraying action of the outside shell takes place during approximately the portion *b* of its movement B. It will be understood that the time of commencing and the period of spraying action depends on the position and length of the trip cams 167. During the initial upward movement of the gun 100, its spray is upwardly inclined due to the traveling of its roller 103 along the inclined track 104, and such incline of the spray is then lowered a predetermined extent and continued in such lowered position during the remainder of the upstroke of the gun due to the roller passing to and along the vertical portion of the track.

During movement of each shell 11 through ap-

proximately the combined length of the arcs A, B, in which the inside and outside spraying of a shell is effected, the sheave 15 of its holder 12 is engaged by the belt 14 whereby rotation is imparted to the holder and shell. As each trip pin 65 reaches approximately the radial line *e* in its cycle of movements, it will be engaged at its lower end by the cam 96 and forced upward into catch position, if it has been previously depressed, thus completing a cycle of operations.

It is apparent from the foregoing that during each rotation of the wheel 3, the following operations take place:

(1) A pin 65 engages the catch lever 66 of the swing mechanism and carries the swing mechanism, including the guns, therewith throughout the swing stroke, the catch lever being released from the catch pin at the end of the intended stroke by engagement of its screw 68 with the stationary stop 69. The swing stroke in the present instance is approximately 40°.

(2) During forward swinging movement of the swing parts the valve 40 is actuated as it moves into engagement with and passes the cam 58 to impart first a downstroke and then an upstroke to the inside and outside guns 30 and 100.

(3) If a shell is mounted on the holder 12 of the conveyor as the associated pin 65 of such holder passes approximately the radial line *d* in the wheel movement, the cam 92 will be swung inward free from engagement with the pin, thus permitting the pin to remain raised in tripping position during the remainder of its cycle. If a shell is not carried by the holder, the cam 92 will remain in normal position and effect a depressing of the associated pin 65 as it passes thereunder, and the pin will retain this depressed position until it has reached the raising cam 96 at approximately the radial line *e* of a cycle of movements.

(4) The pin 65, if raised, next acts on the cam arm 167 of the bleed valve 147 to effect actuation of the control valve 121 to admit operating air to the inside spray gun 30 to effect a spraying operation. This occurs during the upstroke of the gun and while the inside gun is moving approximately throughout the arc *a*.

(5) The pin 65, during the next upstroke of the guns, acts on the cam arm 167 of the bleed valve 148 to effect actuation of the control valve 125 and a spraying by the outside gun. This occurs during an upstroke of the guns and while the associated shell is moving approximately through the arc *b* of its movement.

(6) During movement of the guns through the respective arcs A, B, in which the respective spraying operations take place, the holder, containing the shell being sprayed, is rotated by the action of the belt 14.

(7) If a pin 65 has been depressed due to the absence of a shell in the associated holder, the pin will be raised to operative tripping position by engagement at its lower end with the cam 96 as the pin passes approximately the radial line *g* in its cycle, thus placing the pin in position to engage the catch lever 66 and impart a swinging stroke to the swing parts as the pin moves through its zone of engagement with such lever.

We wish it understood that our invention is not limited to any specific construction, arrangement or form of the parts, as it is capable of numerous modifications and changes without departing from the spirit of the claims.

Having thus described our invention, what we

claim as new, and desire to secure by United States Letters Patent, is:

1. In a machine for spray coating hollow articles, the combination with a rotatable member, and a conveyor having at least a portion of its movement with the member and concentric to its axis of rotation and having a holder for an upright article, of an inside spray gun, a carrier for moving said gun into and out of and with an article during a predetermined arc of its movement with the conveyor, means operable to actuate the carrier to swing the gun throughout a predetermined arc concentric to said first arc of movement, with the gun in register with the article, means operable during swinging movement of the gun to move it into and out of a registering article, means for causing the gun to have a spraying action during a predetermined portion of its swinging movement with the article, and means for swinging said carrier back to starting position after a spraying operation.

2. A combination as called for in claim 1 wherein the article holder is rotatably carried by the conveyor, together with means for rotating the holder with its article as it travels through the spraying zone.

3. In a machine for spray coating articles, the combination with a rotatable member, and a conveyor having at least a portion of its movement with the member and concentric to its axis of rotation and having an article holder, of a spray gun, a carrier for said gun, means operable to move said carrier to swing said gun throughout a predetermined arc of movement with said member and holder with the gun in spraying register with the article carried by the holder, means operable during swinging movement of the gun for imparting vertical reciprocatory movements to the carrier to vertically reciprocate it relative to the article, means for causing said gun to have a spraying action during a predetermined portion of its swinging movement with the article, and means for swinging said carrier back to starting position after a spraying operation.

4. A combination as called for in claim 3 wherein the article holder is rotatably carried by the conveyor, together with means for rotating the holder with its article as it travels through the spraying zone.

5. A combination as called for in claim 3 wherein the gun is vertically rockable, together with means for imparting predetermined rocking movements to the gun when reciprocated.

6. In a machine for spray coating hollow articles, the combination with a rotatable member, and a conveyor movable with said member having at least a portion of its movement concentric to the axis of rotation of the member, said conveyor having an article holder, of a swingingly mounted spray gun positioned to vertically register with said article during a portion of its said concentric movement and to swing therewith, means operable to swing the gun forward to have predetermined movement with the article in register therewith, means to return the gun to normal position after a forward swing, means operable to lower the gun into the registering article and then to retract it during its swinging movement therewith, and means operable to cause the gun to have a spraying action during a predetermined portion of its movement with the article and while therein.

7. A combination as called for in claim 6 wherein the article holder is rotatably carried

by the conveyor together with means for rotating the holder with its article as it travels through the spraying zone.

8. In a machine for spray coating articles, the combination with a rotatable member and a conveyor movable with and having at least a portion of its movement concentric to the axis of rotation of the member, said conveyor having a holder for an article to be sprayed, of a swingingly mounted spray gun positioned to register with a side of an article during a portion of the concentric movement of its holder with the member and to swing therewith, means operable to swing the gun forward to have predetermined movement with the article in register therewith, means to return the gun to normal position after a forward swing, means operable to vertically reciprocate the gun at a side of the registering article and during the forward swinging movement of the gun, and means operable to cause the gun to have a spraying action during a predetermined portion of its movement with the article.

9. A combination as called for in claim 8 wherein the article holder is rotatably carried by the conveyor, together with means for rotating the holder as it travels through the spraying zone.

10. In a machine for spray coating hollow articles, a rotatable member, a conveyor having at least a portion of its movement with and concentric to the axis of rotation of the member, and having a plurality of equidistantly spaced article holders, a spray gun carrier mounted over said member for vertical reciprocatory movements and for swinging movements concentric to axis of rotation of the member, an inside and an outside article spraying gun carried by the carrier with the inside gun in vertical register with an article on the conveyor and the outside gun in side register with an article on the conveyor during predetermined portions of the concentric movement of the conveyor with said member, means operable to swing the carrier forward a predetermined distance with the rotatable member and conveyor as each article carried by the conveyor moves into spraying register with each gun, means for imparting down and up strokes to the gun carrier during said swinging movement to cause the inside gun to pass into and out of registering article and the outside gun to move along the outer side of a registering article, means operable to cause the guns to have spraying operation during a predetermined portion of the stroke movements of the guns, and means for returning the carrier to normal position after a forward swing.

11. A combination as called for in claim 10 wherein the article holders are rotatably carried by the conveyor, together with means for rotating each holder as it passes through the spraying zone.

12. In a machine for spray coating articles, the combination with a rotatable member and an article holder movable with the member concentric to its axis of rotation, of a catch element movably carried by said member, a gun carrier mounted for swinging movements relative to said member concentric to its axis of rotation and for vertical reciprocatory movements, a spray gun swingable with said carrier, means for engaging said catch element at a predetermined point in a revolution thereof to swing the carrier forward with the member a predetermined distance with

its gun in spraying register with an article on said holder and then to release said element, means operable to impart reciprocatory movements to said carrier during said swinging action to impart predetermined movement to the spray gun relative to the registering article, means operable during a predetermined portion of said reciprocatory movements to cause spraying operation of the gun, and means for returning the carrier to a predetermined position after a forward swinging movement.

13. A combination as called for in claim 12 wherein the article holder is rotatable relative to the rotatable member, together with means for rotating the holder and an article carried thereby during a portion at least of its movement in spraying register with the gun.

14. In a machine for spray coating articles, an article conveyor having a plurality of article holders successively movable through a predetermined arcuate path, a spray gun, a swinging carrier for the gun to swing it forward through an arc concentric with and adjacent to said arcuate path at the speed of movement of each article as it moves with a holder through said arcuate path, means for operating the gun to spray a registering article as it moves therewith, means for imparting predetermined movements to the gun relative to an article as it moves therewith through the arcuate path and means operable to return the carrier to starting position after each forward swing.

15. A combination as called for in claim 14 wherein the gun is for inside spraying hollow articles and vertically registers therewith as it moves through the said arcuate path, together with means operable to impart a down and up stroke to the carrier to move its gun into and out of each registering article as it swings therewith.

16. In a machine for spray coating hollow articles, an article conveyor having a plurality of article holders successively movable through a predetermined arcuate path, an inside and an outside spray gun, a swinging carrier for said guns operable to swing them through arcs concentric with and adjacent to said arcuate path, means operable to actuate said carrier to forwardly swing the guns with and at the speed of the conveyor with each gun in spraying register with a particular article on the conveyor as it moves through a predetermined portion of said arcuate path, means operable to vertically reciprocate the carrier and guns during each forward swinging movement thereof, means for operating each gun to spray a registering article during a predetermined portion of its swinging movement therewith, and means to return the carrier to swing starting position after each forward swing.

17. A combination as called for in claim 16 wherein one of the guns moves into and out of a registering article during each reciprocatory operation thereof to spray the interior of the article, together with means operable to rotate each holder and the article carried thereby as it moves through said arcuate path.

18. A combination as called for in claim 16 wherein one of the guns is vertically rockable, together with means for imparting predetermined rocking movements to the rockable gun when reciprocated.

19. In a machine for spray coating articles, an article conveyor having a plurality of holders successively movable through a predetermined

arcuate path, a spraying system including a spray gun, swingable means carrying the gun for swinging movements concentric with and adjacent to said arcuate path, means operable to actuate said carrying means to swing the gun forward with and in adjacent spraying relation to each article as it moves with the conveyor through a predetermined portion of its arcuate path of movement, means for actuating the spraying system to effect a gun spraying action during at least a portion of the gun movement with each article means operable during said gun and article movement to cause predetermined relative movements thereof in a plane substantially parallel to the axis of said path and means for retracting the gun carrying means after each forward swing.

20. In a machine for spray coating articles, an article conveyor having a plurality of holders successively movable through a predetermined arcuate path, a spraying system including a spray gun, a swing column rising above said conveyor centrally of said path with its swing axis concentric thereto, said column having a laterally projecting arm carrying said gun for swinging movements concentric with and adjacent to said path, means operable to periodically impart a forward swinging movement to said column to swing said gun forward as each article carried by the conveyor moves into register therewith and at the speed of movement of the article, means to actuate the spraying system during at least a portion of the gun movement with each registering article, means to move the gun relative to an article in substantially parallel relation to the axis of said path as the article moves through the path and means for retracting the gun carrying means after each forward swing.

21. In a machine for spray coating articles, an article conveyor having a plurality of holders successively movable through a predetermined arcuate path, a spraying system including a spray gun, a swing column with its swing axis concentric to said arcuate path, a plunger swingable with said column and mounted for vertical reciprocatory movements therein and having at its upper end a laterally projecting arm carrying said spray gun over said arcuate path for movements lengthwise thereof, means operable to impart a forward swinging movement to said column and arm as each article moves through a predetermined portion of said path with said gun in spraying register with the article and moving forward at uniform speed therewith, means operable during said swinging movement to impart predetermined reciprocatory movement to said plunger to vertically move the gun in predetermined spraying relation to the article, means for causing an article spraying operation of said gun during predetermined portions of its swinging and reciprocatory movements, and means for returning the swing column to starting position after each forward swinging stroke.

22. In a machine for spray coating articles, an article conveyor having a plurality of holders successively movable through a predetermined arcuate path, a spraying system including a spray gun, swingable means carrying the gun for swinging movements concentric with and adjacent to said arcuate path, means operable to actuate said carrying means to swing the gun forward with and in adjacent spraying relation to each article as it moves with the conveyor

through a predetermined portion of its arcuate path of movement, means for actuating the spraying system to effect a gun spraying action during at least a portion of the gun movement with each article, means pneumatically operable during said gun and article movement to impart predetermined reciprocatory movements to the

gun carrying means relative to the article in a plane substantially parallel to the axis of said path, and means for retracting the gun carrying means after each forward swing.

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