

April 2, 1946.

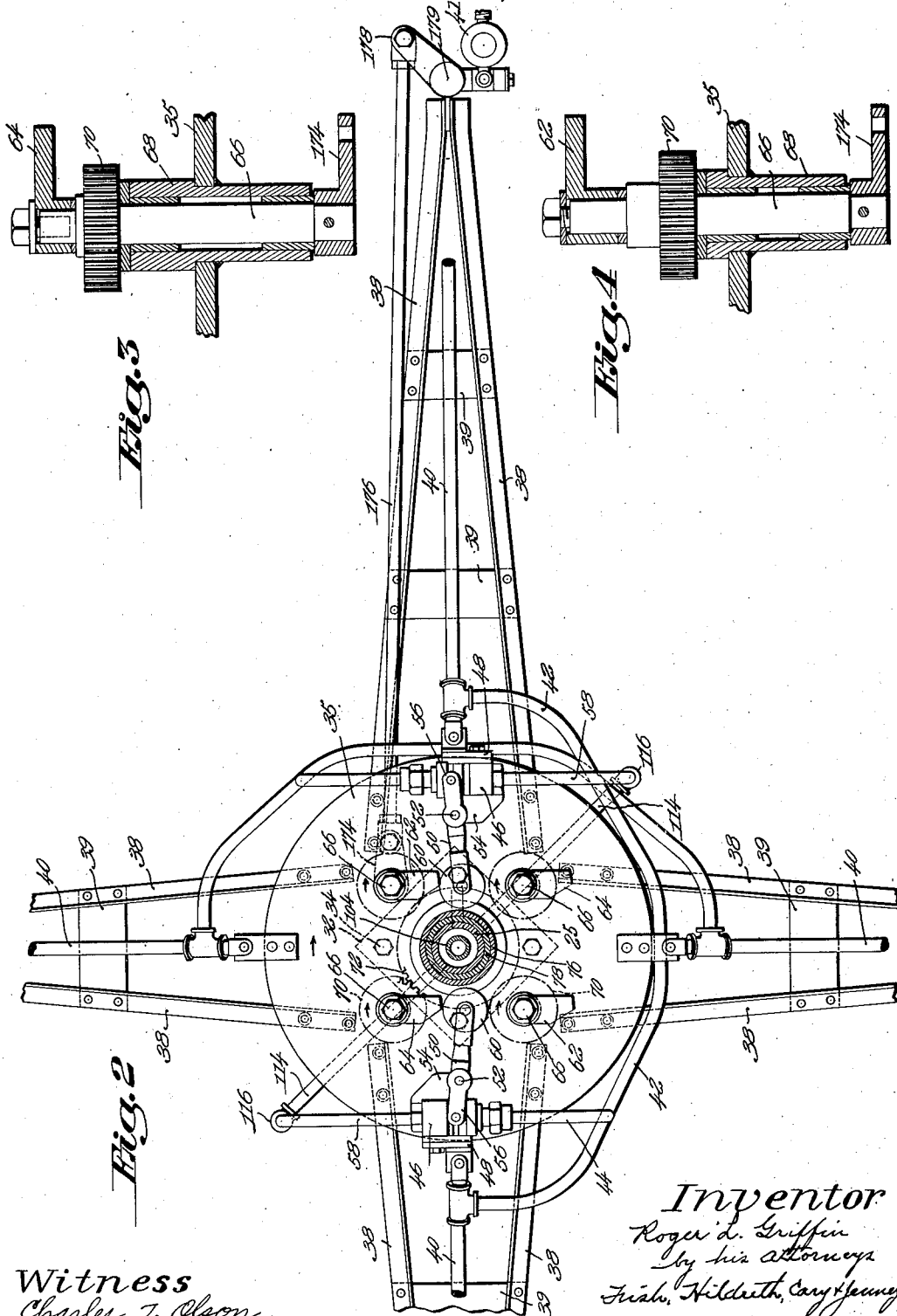
R. L. GRIFFIN

2,397,482

SPRAYING MACHINE

Filed Dec. 24, 1942

4 Sheets-Sheet 2



Witness
Charles J. Olson

Inventor
Roger L. Griffin
by his attorneys
Fish, Hildebrath, Cary & Jensen

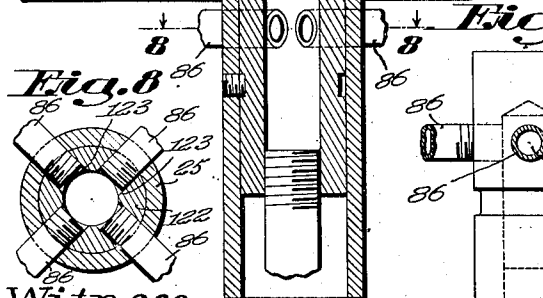
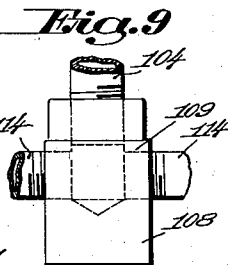
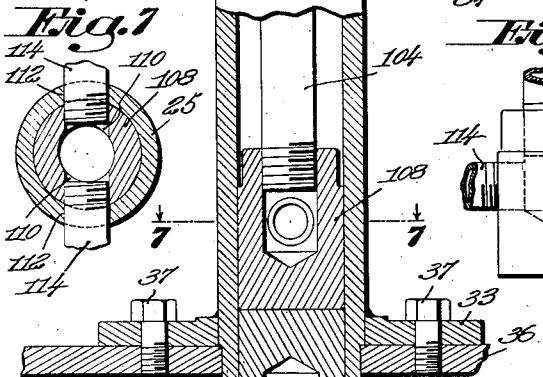
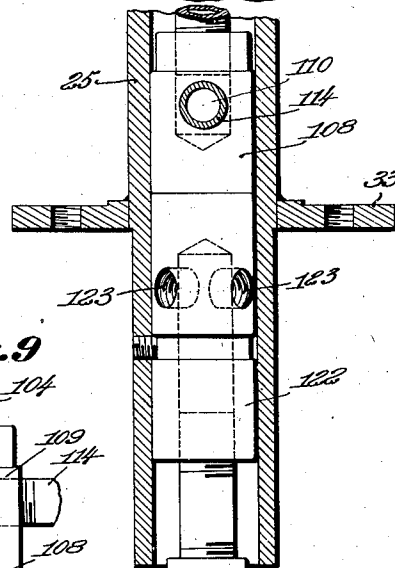
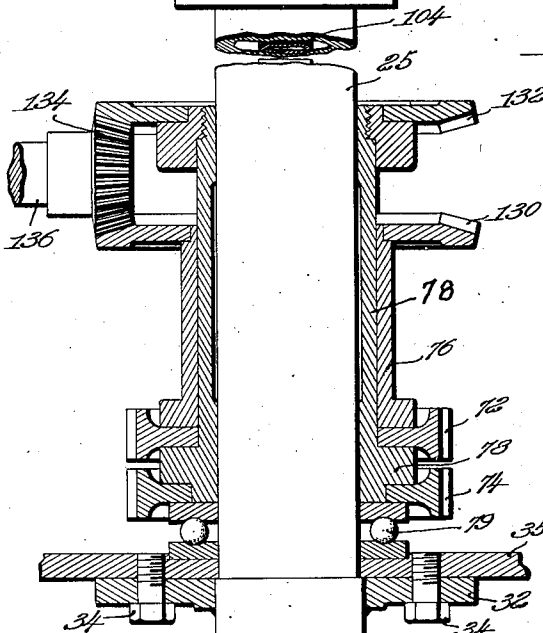
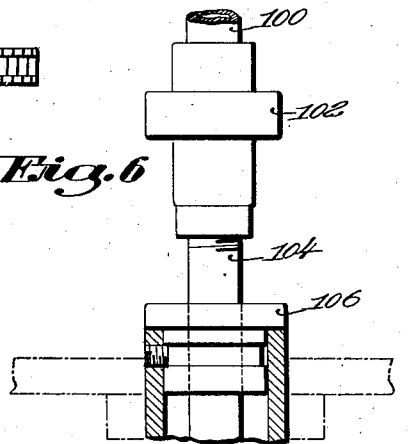
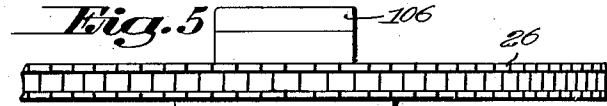
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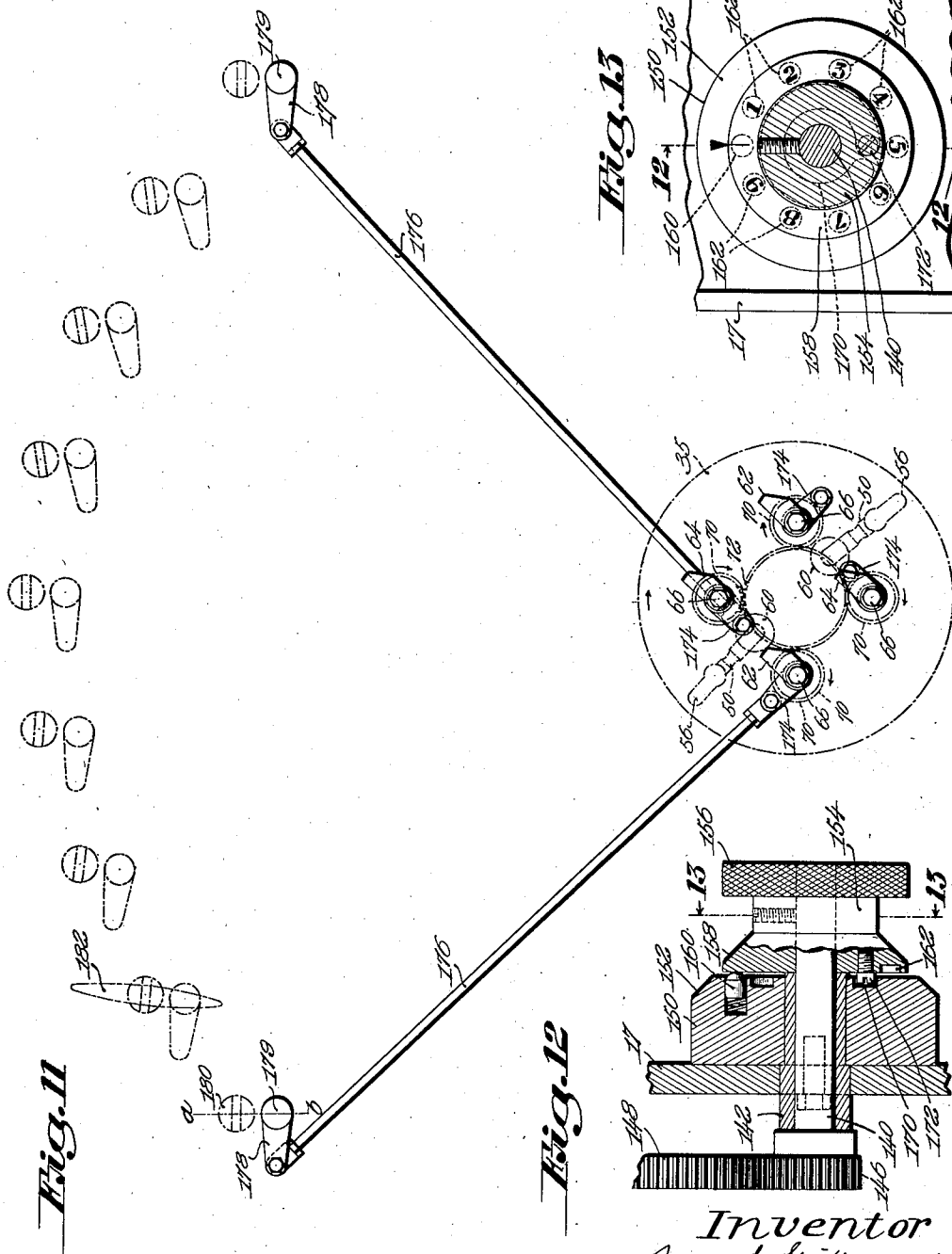
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4 Sheets-Sheet 4



Witness
Charles T. Olson

Inventor
Roger L. Griffin
By *His Attorney*
Fish, Aldrich, Cary & Jenney

UNITED STATES PATENT OFFICE

2,397,482

SPRAYING MACHINE

Roger L. Griffin, Marblehead, Mass., assignor to
A. C. Lawrence Leather Company, Peabody,
Mass., a corporation of Maine

Application December 24, 1942, Serial No. 470,064

12 Claims. (Cl. 91—45)

The present invention relates to spraying machines and more particularly to that class of machines in which the work to be sprayed is fed across the path of a movable spraying nozzle.

Heretofore in this class of machines it has been customary to reciprocate the nozzle back and forth across the path of the feed of the work from one side to the other. This arrangement is objectionable in that it requires the nozzle on its supporting head or carrier to be repeatedly stopped and reversed in its direction of motion at very short intervals, as every second or two. Such reversals entail a substantial waste of power, inasmuch as the reciprocating carrier or head and the nozzle are of considerable weight.

Furthermore, the frequent stopping and starting causes excessive wear and breakage of the parts and objectionable noise of operation. These machines, moreover, are necessarily limited in their speed of operation and tend to apply the sprayed material more or less unevenly and wastefully.

It is the object of the present invention to provide a spraying machine of the above type in which the nozzles with their spray supplying devices are continuously rotated across the path of feed of the work, thus enabling the machine to operate smoothly and evenly at high speed, with a minimum of noise, wear, and expenditure of power, and to apply the spray material in an even coating on the work with a minimum of waste.

To the above ends the present invention consists in a novel arrangement of the continuously rotating head for the nozzle or nozzles which carries the same across the path of the feed of the work on suitable supporting means, controlling devices being provided for turning on the spray as the nozzle swings over the work and turning it off when the nozzle swings off the work. Preferably the nozzle will be rendered operative twice each complete revolution as the work passes beneath the circular path of the nozzle. Thus two applications of the spraying material may be made on every portion of the work, such applications being spaced apart and sprayed on the work at such intervals that each coating has time to partially set before the second one is applied.

Other features of the invention will be apparent to those skilled in the art from a perusal of the following specification and a study of the accompanying drawings in which Fig. 1 is a front elevation of the machine transversely of the conveyor, with portions omitted for clearness of illustration; Fig. 2 is a top plan of the rotating spraying head with some duplicate parts omitted

and the hollow supporting spindle shown in section on line 2—2 of Fig. 1; Figs. 3 and 4 are enlarged sectional details of the crank and cams for controlling the angular position of the nozzle and the discharge of the spraying material therefrom, Fig. 3 showing the closing cam and Fig. 4 the opening cam; Fig. 5 is an enlarged view, partly in vertical section, of the hollow spindle of the spraying head, showing the timing gears for actuating the cranks and the cam, together with a portion of the mechanism for adjusting such gears for varying the duration of the spraying interval in accordance with variations in widths of work; Fig. 6 is a vertical section of such spindle showing the air and spraying fluid connections from the upper and lower ends thereof, respectively; Figs. 7 and 8 are horizontal sections on lines 7—7 and 8—8, respectively, of Fig. 5 showing in Fig. 7 the diametrically opposite ports for the compressed air supply, and in Fig. 8 the four ports for the fluid supply; Fig. 9 is an elevation of the air plug to the air ports in Fig. 7, and Fig. 10 is an elevation of the fluid plug or connection for the fluid ports of Fig. 8; Fig. 11 is a diagrammatic plan showing the cranks and connections for oscillating the nozzle, with a series of views illustrating the positions of the crank and of the nozzle in consecutive intermediate points as the nozzle passes from one margin of the work to the other; Fig. 12 is an enlarged horizontal section of the hand control devices for the timing gear adjusting means; and Fig. 13 is a sectional view of the timing adjuster indicator on line 13—13 of Fig. 12.

The machine shown in these drawings comprises briefly a traveler conveyor for supporting the work such, for example, as leather skins, and passing them in a continuous succession beneath the orbit of the continuously rotating nozzles, four in number, and carried by a rotating head. The spraying material, such as a dye for the skins, is discharged in the form of a spray from the nozzles by means of compressed air in the usual manner. The discharge of the spray material from the nozzles is controlled by opening and closing the supply of the compressed air through air supply valves, which are alternately opened and closed by a pair of rotating cams mounted upon the rotating spray head and rotated upon the head by gears engaging one or the other of a pair of gears fixed on the rotating spindle of the head.

The spray nozzles as they rotate in their circular orbits are passing over the work as it advances towards the spraying position for about 90° of their full rotation, and for another 90° portion as the work leaves the spraying position.

Between these two positions are quadrants of the orbit where the nozzles are beyond the path of the work. The air valve controlling cams are so arranged that each nozzle becomes operative to discharge spraying material just as the nozzle comes over the work, and inoperative just as it leaves the work, the angular position of the timing gears for the cam being adjustable to provide for varying widths of work.

As shown in Fig. 1, the spraying mechanism is supported upon a girder and angle-iron framework, having upper and lower horizontal members 15 and 16, respectively, vertical supporting members 17, and cross members 18. The horizontal members 15 and 16 extend transversely across a continuously moving, horizontal conveyor which comprises a plurality of spaced endless steel wires or bands 21 for supporting the work 22 and presenting it to and withdrawing it from the spraying devices.

Rotatably mounted in suitable upper and lower bearings 23 and 24 on the cross members 18 and lower horizontal member 16 is the hollow spindle or shaft 25 continuously rotated through large sprocket 26, chain 27 and small sprocket 28 of reduction gear box 29 driven by the electric motor 30.

Fixed upon the spindle 25 by welding are two square plates 32 and 33. To the upper plate 32 is secured by cap screws 34 the timing cam or gear plate 35 which carries the air valves and their actuating mechanism for turning on and off the compressed air to the nozzles, and also the crank mechanism for varying the angularity of the nozzle so that the fan-shaped spray will be substantially parallel to the feed of the work at all times while the nozzle is passing over the work and discharging the spraying material.

To the second or lower plate 33 is secured by cap screws 37 the nozzle arm plate 36 which carries fixed thereto the nozzle supporting arms each comprising two angle-iron members 38 and cross members 39. There are four of these arms, but for clearness of illustration only one complete arm is shown in the drawings.

At the outer extremity of each of these nozzle supporting arms is mounted a spraying nozzle unit or gun 41, that shown in the drawings being a well known commercial type comprising a nozzle proper and an air actuated valve for the spray fluid. Compressed air is supplied to each gun through a fixed pipe 40, such air serving not only to atomize the spray material and discharge it onto the work, but also to control the delivery of the spray material to the nozzle, as hereinafter explained. The inner end of this pipe and also of a similar pipe for the diametrically opposite nozzle, is connected to an air manifold 42 which in turn is connected through short branch pipe 44 to the air control three-way valve 46 which also is of standard commercial construction, and when in one position supplies compressed air to pipe 40 through pipe 44 and manifold 42, and when in the other position cuts off such supply and vents such pipes and manifold to the open air.

The valve is supported upon a bracket 48 fixed upon the timing gear plate 35 and is actuated by means of the cam lever 50 pivoted intermediate its ends upon the stud 52 fixed in the flange 54 projecting from the valve casing. The outer end of the lever is in the form of a yoke 56 engaging a groove in the actuating member of the valve, to shift such actuating member from one position to the other.

The inner end of the lever 50 is provided with a cam roll 60 positioned to be engaged by the rotating valve cams 62 and 64, the cam 62 actuating the lever 50 in a direction to open the valve, while cam 64 actuates the lever in the opposite direction to close it. The method of actuating these cams is illustrated in Figs. 3 and 4 which show them mounted upon vertical spindles 66 supported in bearings 68 carried by the cam gear plate 35. The spindles are rotated by means of pinions 70 fixed thereon, but at different heights above the plate, these pinions engaging and rolling around upon normally fixed gears 72 and 74 secured upon the normally stationary sleeves 76 and 78 surrounding the rotating spindle 66 and supported upon the anti-friction bearing 79. (See Fig. 5.)

As the hollow spindle rotates in operation, carrying with it the cam gear plate and the pinions and cams, the gears, being twice the diameter of the pinions, impart thereto two complete revolutions to each one of the spindles 66. Thus each valve is opened and closed twice in each rotation or cycle of the machine to render each nozzle operative for two spaced substantially quarter revolutions to apply spray material to the work as the latter comes beneath the orbit of the rotating nozzle, first, as the work is approaching the spraying mechanisms, and a second time as it is leaving the spraying mechanism. The rate of advance of the work on the conveyor is so regulated that a uniform coating will be obtained, free from streaks. The proper setting of the first application or coat of sprayed material before the second is applied is secured by regulating the amount of material applied and the degree of atomization employed.

The nozzle units or guns, of which there are four in number, one for each arm, comprise the spray nozzle proper 80, constructed and arranged to deliver the spraying material in a fan-like spray which is discharged under air pressure supplied through air pipes 40 through suitable flexible hose connections 82 to port 84 of the spray unit or gun. The supply of compressed air to each pair of diametrically opposite guns is controlled by their common air valve 46, which is timed to open just as the nozzles come over the work, and similarly closes just as the nozzles leave the work.

The spray fluid is delivered to each nozzle separately through a separate fixed pipe 86 connected by means of flexible hose 88 with the fluid port 90. The delivery of spraying fluid to the nozzle is controlled by a fluid valve within the nozzle unit, which is opened and held open by the pressure of the compressed air from the pipe 40 through the flexible hose connection 92 to the air control port 94 when air valve 46 is opened. When the valve 46 is closed, thereby cutting off the supply of compressed air to the pipe 40 and venting the same to the open air, the nozzle valve closes to shut off the supply of spray material so that it will not escape and be wasted while the nozzle is passing through the quadrant beyond the path of the work. Manually operated cut-off valves 96 and 98 are provided at the end of the pipe 40 for cutting off the compressed air from the hose connections 82 and 92 when desired.

Compressed air is supplied to the control valves 46 from some suitable source of supply through the stationary air inlet pipe 100. This pipe is connected by means of rotary packing joint 102 with the rotating air pipe 104 entering the upper end

of the hollow spindle 25 of the machine through the closure or cap 106. Upon the threaded lower end of this pipe is secured the air plug 108, see Fig. 9, which fits snugly within the hollow spindle, rotating therewith, and is counter-bored at 109 with oppositely disposed threaded openings 110 which register with the diametrically opposed openings 112 (see Fig. 7), in the wall of the hollow spindle 25. Through these openings 112 are passed the inner ends of pipes 114 which are screwed into the opening 110 in the air plug. The outer ends of these pipes 114 are then connected by suitable couplings 116 with the air supply pipes 58 leading to the air valves. Thus air is supplied from some stationary source and pipe, through the rotary packing joint, the rotating pipe, and connections, directly to the air control valves.

In a similar manner the spray fluid is delivered from a stationary source of supply with fixed pipe 118 through the rotary packing joint 120, fluid plug 122, four ports 123, pipes 86, and hose connections 88 to the nozzle units.

In order to adjust the opening and closing positions of the air valves in the cycle of operation of the machine to advance or retard the time of operation to accommodate for varying widths of work, means have been provided for shifting the angular position of the gears 72 and 74, which normally in the operation of the machine remain stationary, and do not turn with the spindle and other parts. These gears, as illustrated in Fig. 5 and as above described, are carried by sleeves 76 and 78, sleeve 76 being loose upon sleeve 78 which in turn is loose upon the spindle 25. The adjusting or timing means, which also serve to hold these sleeves and their gears from rotation, comprise two bevelled gears 130 and 132 fixed respectively upon the upper ends of sleeves 76 and 78. Engaging these gears is the bevelled pinion 134 fixed upon the shaft 136 supported in bearings 138. (See Fig. 1.)

When the shaft with its pinion remains stationary, both the bevelled gears, the sleeves and the cam gears are all locked in fixed position. If adjustment shaft 136 be rotated, bevelled gear 130, sleeve 76 and cam gear 72 will all be turned in one direction, while bevelled gear 132, sleeve 78 and cam gear 74 are turned an equal distance in the opposite direction, thereby either increasing or decreasing the time interval between the opening and closing of the air valve according to the direction of rotation imparted to the adjustment shaft 136.

To lock the shaft from axial rotation during the normal operation of the machine, and at the same time facilitate its adjustment for any desired width of work, there have been provided the devices illustrated in detail in Figs. 12 and 13, which comprise a stub shaft 140 mounted in bearings 142 fixed in the supporting member 17 of the frame of the machine. On the inner end of this stub shaft is the pinion 146 meshing with the gear 148 secured to the end of the adjustment shaft 136. Fixed upon the outer face of the member 17 and supporting the outer end of the bearing 142 is the circular block 150 having the bevelled corner 152. Secured upon the outer end of the stub shaft 140 and closely adjacent the block 150 is the actuating knob 154 for rotating the stub shaft to adjust the timing of the cams. This knob is provided with a knurled head 156 and a bevelled indicator face 158 provided with a series of numbers, see Fig. 13, ranging from 1 to 9, one or another of which will be indicated by means of a pointer or arrow in the bevelled face 152 of the

fixed block 150, the numbers corresponding to the widths of work for which the gears may be set for operation.

The adjustment knob is held in its adjusted position to lock the gears in their desired angular adjustment by means of a spring plunger 160 arranged to enter one or another of a series of recesses 162 in the back face of the knob.

To limit the rotation of the knob to slightly less than a full rotation, thus avoiding the possibility of uncertainty as to the actual adjustment of the gears and the width of the band over which the nozzles may discharge the spraying fluid, the outer face of block 154 has been provided with an arcuate groove 170, slightly less than 360° in extent, to receive the stop screw or pin 172 projecting from the rear face of the knob. Thus the operator is unable to operate the knob beyond the point indicated by No. 1 in one direction and No. 9 in the other direction and, therefore, is always certain of the exact width of work for which the machine is adjusted.

To avoid any substantial variation in the amounts of spraying material applied to different portions of the skin, it is necessary to keep this type of nozzle which discharges the spraying material in a flat fan-like spray so that the plane of the spray will be practically parallel to the path of movement of the work, while the nozzle is in operation. Accordingly, means comprising pairs of cranks with link connection have been provided for varying the angular adjustment of the nozzle throughout its travel across the work.

Fixed upon the bottom end of each of the spindles 66, which at their upper ends carry one or the other of the opening and closing cams, is the crank 174 connected by means of a link 176 with the longer crank 178 fixed upon the stud 179 carrying the nozzle unit 41. Cranks 174 are continuously rotated, but cranks 178, being of greater length, are merely oscillated toward and from the head of the machine. The ratio of the lengths of these crank arms and the setting of the cranks with relation to one another and with relation to the nozzle is such that in a quadrant of operation the fan spray will be at all times substantially parallel to the line of feed.

In Fig. 11 are shown diagrammatically the several positions occupied by the nozzle as it passes from one margin of the work, when the machine is adjusted for the maximum width of work. In this diagram the discharge end of the nozzle is indicated at 180 and the plane of the spray discharged from the nozzle by the broken line *a-b*. The cross-sectional shape of the spray as it contacts the work is shown in dotted outline at 182. At both margins and at the middle of the work this line is exactly parallel to the line of feed, but while moving from the entering margin to the middle of the work, the plane of the spray is very slightly inclined in one direction, while when moving from the middle to the leaving edge of the work, there is a similar very slight inclination but in the opposite direction. These deviations from exact parallelism are so slight, however, as to be negligible in commercial practice.

The construction and arrangement of the machine as shown in the drawings, where such nozzle has two spraying periods for each cycle of rotation, one on the work as the latter is approaching the spraying head and the other as it is leaving the spraying head, also is conducive to an even distribution of the spraying material over the work, as the paths of movement of the

nozzle at such times are oppositely curved and therefore cross one another at an inclination at all points except at the middle of the work where they are parallel.

The operation of the machine as shown in the drawings and above described is as follows: Ordinarily the conveyor is first set in operation by starting its independent motor. The motor 30 for operating the spraying head is then started, but with the supply of compressed air and spraying fluid cut off by suitable controlling valves somewhere between the source of supply and the mechanism. Next, the operator adjusts the timing of the gears and air valves by means of the knob 154, rotating the latter until the proper numeral corresponding to the width of the work to be operated upon is opposite the indicator mark.

The materials to be sprayed, as for example, leather skins, are positioned upon the conveyor closely following one another, and before the first skin reaches the path of the spraying nozzles, the valves controlling the compressed air and the spray material supplies are opened and each rotating nozzle begins to discharge a fan-like spray every time it passes over that portion of the conveyor corresponding to the width of the work for which the machine was adjusted, that is, twice for each complete rotation. This field of operation is preferably not in excess of two quadrants of the same rotation, spaced from one another by an idler quadrant where no spray is being discharged.

During the passage of the nozzles over these working quadrants where the spraying takes place, the nozzles are being angularly adjusted through the crank and link connections so that the fan spray is always discharged with its plane substantially parallel with the line of feed. As a consequence, the spraying material is applied to the work in curved bands of substantially equal width measured in the direction of feed, and an even distribution over the surface of the work is obtained.

Due to the fact that the spraying head is rotated continuously in the same direction, it is enabled to operate at high speed without shock or jar and with a minimum of power consumption and of wear of the working parts. With the high speed of rotation of the spraying head a corresponding speed of feed is employed and a maximum output obtained.

If the width of the work changes, as where the skins supplied are of a larger or smaller size than those upon which the machine had previously been operating, the operator may quickly and accurately readjust the timing of the cams and air valves without interfering in any way with the continuous operation of the machine. By thus readjusting the machine whenever a change occurs in the width of the work operated upon, the wastage of the spraying material by allowing the nozzles to operate where there is no work beneath them is avoided, and a high economy of operation insured.

When all the skins have been sprayed, the supply of spraying material is cut off and the machine may, if desired, be permitted to run for a short time so that the compressed air will blow out the spray nozzles and clear them from any spray material left in them, or water or other cleansing fluid may be supplied to the nozzle to wash them clear.

While the present invention has been shown and described as embodied in a certain construc-

tion and arrangement, it is to be understood that in its broader aspects it is not to be limited thereto, but may be embodied with other constructions and arrangements within the language and scope of the claims. Nor is the machine of the present invention restricted to the spraying of skins or other material having relatively large flat unbroken surfaces, but may be successfully used to spray or treat or coat articles and material of all kinds and sorts, suitable mechanism for presenting the articles to the spray material being provided in accordance with the requirements of the same.

Having thus described the invention, what is claimed is:

1. A spraying machine having, in combination, a pivoted fan-spray nozzle, means for moving the nozzle in a curved path, means for passing the work across said path, and devices including cranks and link mechanism for angularly adjusting the nozzle while in operation to maintain the plane of the fan spray substantially parallel to the direction of feed of the work.

2. A spraying machine having, in combination, a hollow spindle, a support for the same in which the spindle is rotatably mounted, means for rotating the spindle, means for supplying compressed air to the interior of the spindle, a nozzle supporting arm rigidly connected with the spindle, a spray nozzle carried by the arm, rotary cams constructed and arranged to open and close the air valve, pinions rigidly connected with the cams, and gears engaged by the pinions and loosely mounted upon the rotating spindle and held from rotation therewith for rotating the pinions and cams.

3. A spraying machine having, in combination, a hollow spindle, a support for the same in which the spindle is rotatably mounted, means for rotating the spindle, means for supplying compressed air to the interior of the spindle, a nozzle supporting arm rigidly connected with the spindle, a spray nozzle carried by the arm, rotary cams constructed and arranged to open and close the air valve, pinions rigidly connected with the cams, gears engaged by the pinions and loosely mounted upon the rotating spindle and held from rotation therewith for rotating the pinions and cams, and means for varying the angular setting of the gears to vary the times of operation of the cams.

4. A spraying machine having, in combination, a hollow spindle, a support for the same in which the spindle is rotatably mounted, means for rotating the spindle, means for supplying compressed air to the interior of the spindle, a nozzle supporting arm rigidly connected with the spindle, a spray nozzle carried by the arm, means for supplying spray material to the nozzle, connections including an air valve between the interior of the spindle and the nozzle constructed and arranged to supply compressed air to the nozzle, rotary cams constructed and arranged to actuate the air valve, pinions rigidly connected with the cams, a first sleeve loosely mounted upon the spindle, a second sleeve mounted upon the first sleeve, a pair of gears for actuating the pinions, one of said gears being fixed upon the first sleeve and the other upon the second sleeve, a pair of bevelled gears, one fixed upon the first sleeve and the other upon the second sleeve, and a bevelled pinion engaging the bevelled gears for holding the said gears and sleeves normally from operation, and when rotated, for actuat-

ing said bevelled gears and sleeves in opposite directions to vary the timing of the cams.

5. A spraying machine having, in combination a hollow spindle, a support for the same in which the spindle is rotatably mounted, means for rotating the spindle, means for supplying compressed air to the interior of the spindle, a nozzle supporting arm rigidly connected with the spindle, a spray nozzle carried by the arm, means for supplying spray material to the nozzle, connections including an air valve between the interior of the spindle and the nozzle constructed and arranged to supply compressed air to the nozzle, rotary cams for actuating the air valve, pinions rigidly connected with the cams, a first sleeve loosely mounted upon the spindle, a second sleeve mounted upon the first sleeve, a pair of gears for actuating the pinions, one of said gears being fixed upon the first sleeve and the other upon the second sleeve, a pair of bevelled gears, one fixed upon the first sleeve and the other upon the second sleeve, a bevelled pinion engaging the bevelled gears for holding the said gears and sleeves normally from operation, and when rotated, for actuating said bevelled gears and sleeves in opposite directions to vary the timing of the cams, and indicating means connected with said bevelled pinion constructed and arranged to indicate the relative angular adjustment of the sleeves and gears and timing of the cams.

6. A spraying machine having, in combination, a hollow spindle, a support for the same in which the spindle is rotatably mounted, means for rotating the spindle, means for supplying compressed air to the interior of the spindle, a nozzle supporting arm rigidly connected with the spindle, a spray nozzle carried by the arm, means for supplying spray material to the nozzle, connections including an air valve between the interior of the spindle and the nozzle constructed and arranged to supply compressed air to the nozzle, a crank shaft, a crank fixed upon the shaft, means between the crank and the nozzle constructed and arranged to oscillate the nozzle, and means for rotating the cam shaft.

7. A spraying machine having, in combination, a conveyor for feeding the work, a pivoted fan-spray nozzle to discharge spray material onto the work, a rotary spindle and means for rotating the same, a support fixed upon the spindle, means carried by said support on which the nozzle is pivotally mounted, a cam shaft rotatably mounted in the support, a cam, a crank, and a pinion fixed upon said shaft, a gear mounted upon the spindle and normally held from rotation therewith, the gear meshing with and rotating the pinion and cam shaft, connections for supplying compressed air to the nozzle including a valve controlled by the cam, and connections between the pivoted nozzle and the crank for oscillating the nozzle to maintain the plane of the fan spray substantially parallel to the direction of feed of the work.

8. A spraying machine having, in combination, a rotary spindle and means for rotating the same, a support fixed upon the spindle, a rotary cam carried by the support, means mounted upon the spindle and normally held from rotation therewith for rotating the cam, a spray nozzle carried by the spindle, and connections for supplying compressed air to the nozzle including a valve controlled by the cam, the cam and valve being spaced radially from the spindle.

9. A spraying machine having, in combination, a rotary spindle and means for rotating the same, a support fixed upon the spindle, a pair of rotary cams carried by the support, a pair of gears mounted on the spindle and normally held from rotation therewith for rotating the cams, a spray nozzle carried by the spindle, connections for supplying compressed air to the nozzle including a valve opened and closed by the cams, and means for adjusting the angular position of the gears on the spindle to vary the times of opening and closing of the valve by the cams.

10. A spraying machine having, in combination, a conveyor for feeding the work, a pivoted fan-spray nozzle constructed and arranged to discharge spray material in a fan-spray onto the work, means for supporting the nozzle and moving the same in a curved path over the work, and supplementary devices for angularly adjusting the nozzle in its support while the nozzle is in operation to maintain a substantially constant angular relation between the plane of the fan-spray and the direction of feed of the work.

11. A spraying machine having, in combination, a hollow spindle, a support for the same in which the spindle is rotatably mounted, means for rotating the spindle, means for supplying compressed air to the interior of the spindle, a compressed air valve supported by and revolving with the spindle, compressed air connections from the spindle to the valve and from the valve to the nozzle, rotary cams supported by and revolving with the spindle for actuating the air valve, and means for rotating the cams from the spindle.

12. A spraying machine having, in combination, a hollow spindle, means for rotating the same, a spray nozzle carried by the spindle, connections including a valve carried by the spindle for supplying compressed air to the nozzle, rotating cams for actuating the valve, means including a pair of spur gears for rotating the cams, the spur gears being rotatably mounted upon the spindle and normally held from rotation therewith, a pair of bevel gears rigidly connected one to each spur gear, a bevel pinion engaging both bevel gears, a shaft for the pinion, means for manually rotating the shaft and pinion to angularly adjust the spur gears for varying the timing of the cams, means for normally holding the bevel pinion from rotation, and indicating devices for indicating the timing of the cams.

ROGER L. GRIFFIN.