Feb. 10, 1948. H. V. SCHWEITZER 2,435,931

GLAZING APPARATUS

Filed April 6, 1940 3 Sheets-Sheet 1

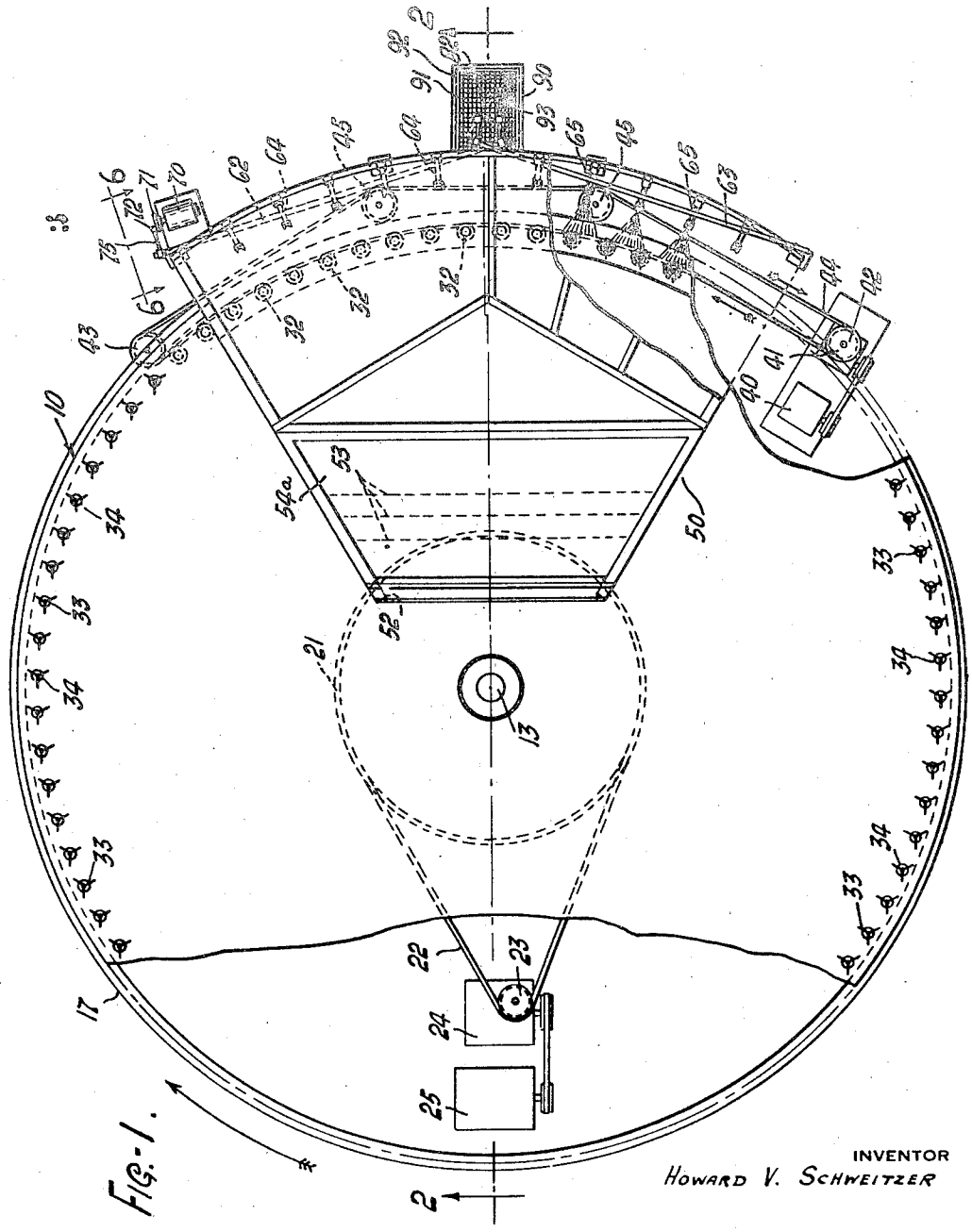


Fig. 1.

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GLAZING APPARATUS

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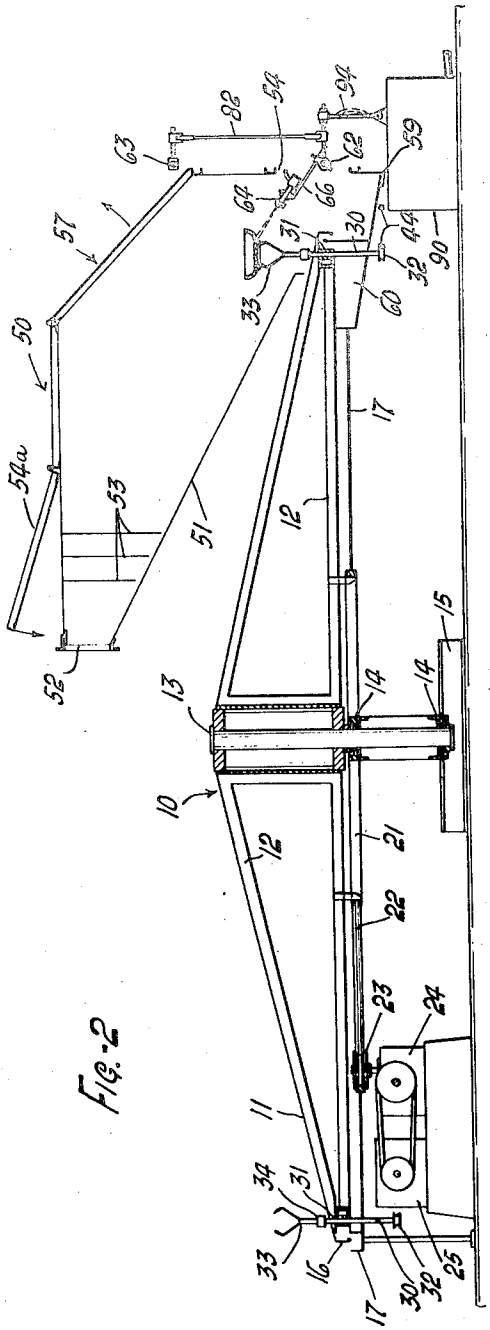


Fig. 2

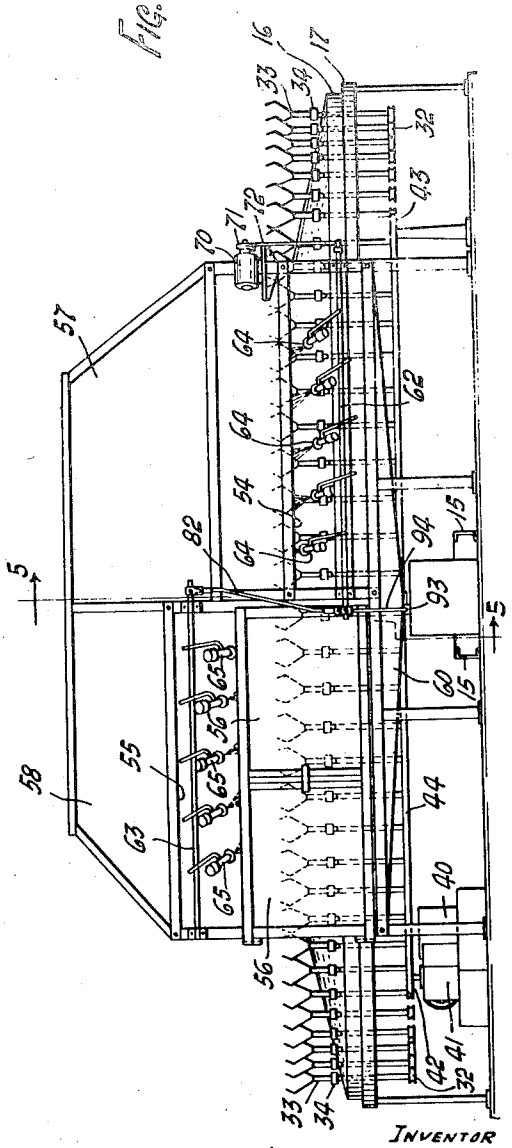


Fig. 3

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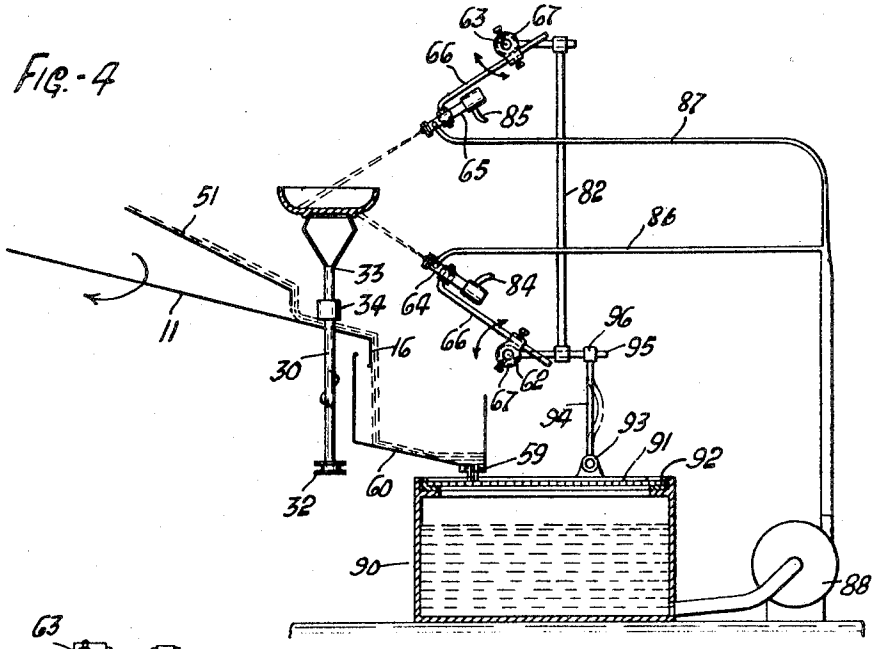
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GLAZING APPARATUS

Filed April 6, 1940 3 Sheets-Sheet 3

FIG.-4



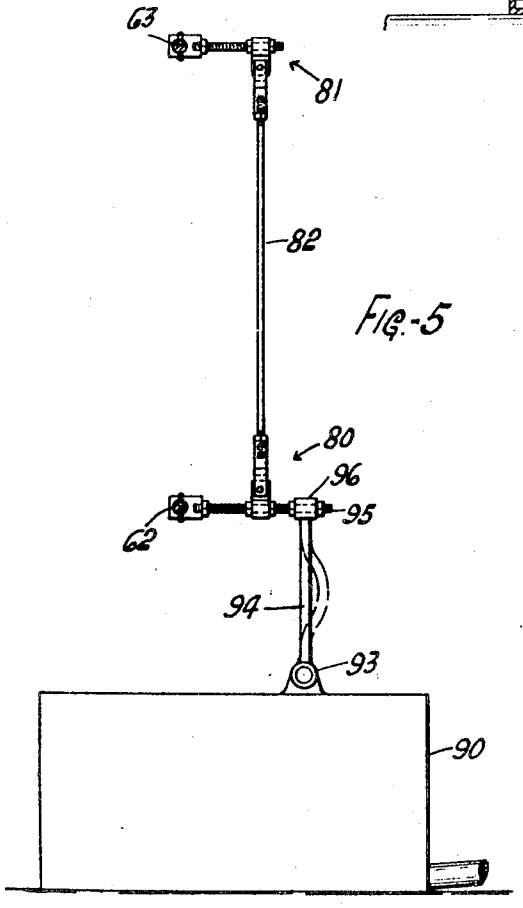


FIG.-5

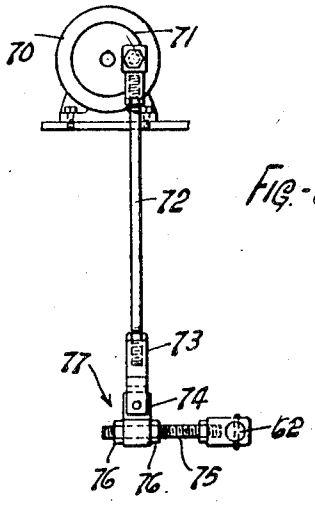


FIG.-6

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UNITED STATES PATENT OFFICE

2,435,931

GLAZING APPARATUS

Howard V. Schweitzer, Shaker Heights, Ohio

Application April 6, 1940, Serial No. 328,272

13 Claims. (Cl. 91—45)

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This invention relates to apparatus for glazing, and, more particularly, to apparatus for spraying glaze upon ceramic ware of substantially all shapes and sizes and for obtaining a smooth and uniform coating of glaze on all surfaces of such ware.

Heretofore the universal practise in applying glaze to ceramic ware was to dip the unglazed ware manually into a vat of liquid glaze and by carefully removing the ware from the vat so that excess glaze did not accumulate on the ware, a smooth coating of glaze was obtained. This manual operation was not only slow and expensive but required considerable skill on the part of the "dipper." Ware not only is substantially unlimited as to size and shape, but vitreous and semi-vitreous ware will vary in porosity depending upon its location in the kiln when fired. Considerable skill must be exercised by the dipper in selecting a thin, medium, or thick glaze to be used so that a thin, wet glaze, for example, will not run or "curtain" before it is dry and absorbed by a piece of ware of low porosity.

It is an object of this invention to provide apparatus for applying glaze mechanically, rather than manually. Another object of this invention is to provide apparatus by which a smooth, even coat of glaze may be applied to ware of substantially any size or shape and of varying degrees of porosity. It is a still further object of this invention to provide apparatus for applying glaze so that the glaze will not curtain on the ware after it is applied.

Other and fuurther objects and advantages of this apparatus will appear from the following specification, claims, and drawings in which:

Fig. 1 is a plan view of a machine made according to this invention with portions broken away to show the table drive and spindle drive;

Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1;

Fig. 3 is a front elevation of the machine;

Fig. 4 is a diagrammatic view illustrating the relationship of the several elements in the glazing apparatus and the glaze circulating system;

Fig. 5 is a detail view of the gun shaft connections taken along the line 5—5 of Fig. 3; and

Fig. 6 is a detail view of the gun oscillating drive taken from the line 6—6 of Fig. 1.

In the drawings, in which like reference characters refer to like parts, 10 refers to a large conical table having a smooth, sheet metal surface 11 supported by a plurality of spokes 12 secured to a central post 13 which revolves upon suitable thrust bearings 14 mounted in the base frame 15. The sheet metal surface 11 overhangs the periphery of the table 10 to form a depending eave 16 which revolves in a fixed circular trough 17. The trough 17 is preferably supported from the base frame 15 or from the floor upon which the machines rests so that the trough is provided with a fall from the back to the front of the machine.

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Depending from the table 10 is a large V-belt table sheave 21 which carries one or more V-belts 22 driven by the pulley 23 of a Reeves speed reducer 24 which, in turn, is driven by an electric motor 25. Suitable slack take-up means (not shown) are provided to insure an effective drive from the motor 25 to the Reeves 24 and from the pulley 23 to the table sheave 21.

A plurality of vertical spindles 30 are rotatably mounted in suitable bearings 31 adjacent the periphery of the table 10 and substantially equidistant from each other. Each spindle 30 carries a small V-belt pulley 32 on its lower end below the table 10, and above the table it is equipped with a removable ware holder 33 provided, preferably, with three wire prongs. A cup 34 is carried on the portion of the spindle 30 which extends above the table to protect the bearing 31 from glaze.

A spindle drive is located across the front of the machine and comprises, at one end, a motor 40 and a Reeves speed reducer unit 41 which carries a main drive pulley 42 adapted to engage the flat back of a V-belt. At the other end of the drive is a main idler pulley 43, the drive pulley 42 and idler pulley 43 being so located that a line through their centers would be a chord subtending an arc of the spindle orbit across the front of the machine. Each spindle pulley 32, as it passes across the front of the machine, therefore, engages the V-face of a V-belt 44 driven by the main drive pulley 42 and supported by the main idler pulley 43. Because the path of the drive portion of the V-belt is arcuate, the return portion of the V-belt is spaced therefrom by the auxiliary idler pulleys 45. The V-belt 44 thus is employed to impart planetary motion to the spindles 30 across the front of the machine. The rotation of the spindles is usually in a direction opposite to the direction of revolution of the table 10, and, if the table 10 revolves in a clockwise direction, as shown, the V-belt 44 is usually driven in a counter-clockwise direction to increase the speed of rotation of the spindles over that which would be obtained if the V-belt 44 would be held stationary. Since the speed and direction of rotation of the drive pulley 42 is variable, the speed of rotation of the spindles 30 is variable over a wide range and may be decreased from a high counter-clockwise speed to a peripherial speed, i. e., the spindle rotation speed obtained when the V-belt 44 is stationary, and, by reversing the motor 40, the spindle speed may be further reduced until there is no spindle rotation at all, i. e., when the speed and direction of travel of the V-belt 44 is equal to the peripherial speed of the table 10.

A spray booth 50 is located over the front of the table 10 and is provided with a floor 51 converging upwardly and rearwardly toward an outlet 52 which may be connected to a suitable exhaust system (not shown). The outer margin of the floor 51 is conical so that the edge thereof is closely adjacent the conical surface 11 of the table 10 inside the spindles 30. Located within the booth 50 adjacent the outlet 52 are a plurality of spray baffle plates 53, for which an inspection and wash-down door 54a is provided in the top of the booth. The front of the booth is curved to be substantially concentric with the table 10 and is located outwardly beyond the periphery of the table 10, so that the spindles 30 travel within the booth 50. The front wall of the booth is preferably closed except for a lower gun opening 54 which extends from one side wall of the booth to the center of the front wall and an upper gun opening 55 which extends from the center of the front wall of the booth to the other side wall of the booth. Below the upper opening 55 are a pair of inspection doors 56 to permit inspection of the spindles 30.

The front of the ceiling of the booth is provided with a pair of wash-down doors 57 and 58 which are hinged well back of the orbit of the spindles 30 and are slanted at a steep angle forwardly toward the front wall of the booth so that excess glaze spray which may accumulate on the doors 57 and 58 will not drip down on ware carried by the spindles but will run down the underside of the doors to the front wall of the booth. The bottom of the booth comprises a deep arcuate trough 60, the bottom of which slopes forwardly and toward the center of the booth to a drain 59. The ends of the trough 60 are connected to the table trough 17 so that glaze caught in the table trough 17 will drain into the booth trough 60 and the depending eave 16 which runs in the trough 17 overhangs the back wall of the trough 60. The two side walls of the booth 50 are closed, except for the necessary openings (not shown) for the table 10, spindles 30 and the ware carried thereby which must pass through the side walls of the booth.

A lower gun shaft 62, suitably supported in bearings secured to the frame of the booth 50, extends across the lower gun opening 54; an upper gun shaft 63, similarly supported, extends across the upper gun opening 55. A plurality of lower glaze spray guns 64 (five in the embodiment shown in the drawings) are carried by the lower gun shaft 62; similarly, a plurality of upper spray guns 65 are carried by upper gun shaft 63. As shown in Fig. 4 of the drawings, each glaze spray gun is mounted on a gun shaft by means of a holder comprising a rod 66 slidably mounted in a collar 67 attached to the gun shaft, each gun being pivotally secured on a bent stud end of the rod 66. Thus, it is apparent that each spray gun may be universally adjusted as to the angle at which its jet is directed and also as to its distance from the ware which is to be sprayed. Also, as shown by Figs. 4 and 1, the spray guns are preferably designed to spray glaze in thin flat fans of spray, i. e., the glaze is sprayed so that it diverges laterally, but the depth of the spray is thin at the jets and remains substantially constant throughout the length of the spray. Also, the guns are held on the gun shafts so that in their normal position the jets of spray are directed toward the center of the ware supported by the spindles and so that the spray tends to diverge laterally.

The number of guns mounted on each shaft may be varied, of course, the number of guns on each shaft being spaced from each other so that the sprays from adjacent guns do not interfere. As is also apparent from the drawings, the lower gun shaft 62 is located well below the ware carried by the spindles and the upper gun shaft 63 is located above the ware. Thus, the lower guns 64 are directed upwardly and are adapted to spray the lower and outer surfaces of ware carried by the spindles; the upper guns 65 are directed downwardly and are adapted to spray the upper or inner surfaces of ware.

In order to coat the ware with a plurality of successive thin coats of glaze, the gun shafts carrying the spray guns are oscillated so that the thin fans of spray will coat all portions of the ware carried by the spindles. A motor 70 for oscillating the gun shafts is located adjacent an end of the booth and is preferably mounted thereon. The motor 70 is provided with a crank disk 71 which drives a connecting rod 72. The end of connecting rod 72 is threaded in a forked member 73 to which is pivoted a knuckle member 74. The knuckle member 74 is slidably mounted on a crank arm 75 which is fixed at right angles to one end of the lower gun shaft 62. The crank arm 75 is threaded throughout its length so that the position of the knuckle 74 thereon may be adjusted and secured by the locking nuts 76. Thus the throw of the crank arm 75 may be adjusted at will and the angle of oscillation of the gun shaft 62 may be varied to suit the size of the ware which the lower guns 64 must spray. The forked member 73, knuckle member 74, crank arm 75, and locking nuts 76 will be referred to hereafter as the crank and knuckle assembly 77.

To transfer the oscillating motion of the lower gun shaft 62 to the upper gun shaft, a crank and knuckle assembly 80, similar to the crank and knuckle assembly 77, is secured to the other end of the lower gun shaft 62, and a similar crank and knuckle assembly 81 is secured to the adjacent end of the upper gun shaft 63, the assemblies 80 and 81 being threadedly connected to the connecting rod 82. Because the crank throw in each of the assemblies 77, 80, and 81 is variable, it is possible to adjust the amplitudes of oscillation of the gun shafts 62 and 63 independently of each other. This is a desirable feature since it is often advisable, for example, to have the upper guns 65 oscillate through a small angle while the lower guns oscillate through a wide angle. If, in adjusting the throw of the several crank arms to vary the amplitude of oscillation of the shafts, the gun shafts are twisted from their normal stationary position and the guns are no longer directed toward the ware at the proper angle, the gun shafts may be returned to their proper normal positions by lengthening or shortening the connecting rods 82 and 72 in the forked members in which the connecting rods are threadedly secured.

The lower and upper guns 64 and 65 are supplied with the required atomizing and operating air from suitable compressors (not shown), through suitable flexible tubing 84 and 85. Liquid glaze is supplied under pressure to the guns 64 and 65 through flexible tubing 86 and 87, respectively, from the centrifugal pump 88. The pump 88 is supplied with glaze from the glaze tank 90, which is preferably located under the booth drain 59 and is covered by the bouncing lawn 91. The bouncing lawn 91 comprises a frame 92 over which is loosely stretched a fabric, preferably of

finely woven lawn or muslin. Integral with the lawn frame 92 is a boss 93 which is connected by a flexible shaft 94 to a sleeve 96 secured to the end of the crank arm 95 of the crank and knuckle assembly 80. The flexible shaft 94 is substantially equal in length to the vertical distance between the boss 93 and the lower gun shaft 62. Thus, as the crank arm 95 oscillates up and down from the normal position shown in Figs. 4 and 5, the flexible connection 94 causes the lawn 91 to be "bounced," so that glaze poured upon the lawn 91 will run through the fine glaze straining fabric. Because glaze is rather viscous, the lawn 91 must be "bounced" to prevent it from clogging, as it would do if it were merely vibrated.

Operation

In the embodiment of this invention disclosed herein, the table 10 is revolved in a clockwise direction by the motor 25 driving through the Reeves speed reducer 24 and the sheave 21. Ware is placed upon the spindles before they enter the booth 50 and preferably while the spindles are not rotating, i. e., before the spindle pulleys 32 engage the V-belt 44. Before the ware does enter the booth 50, however, the spindle pulleys 32 engage the V-belt 44 so that when the ware is revolved past the first spray guns, it is rotating at a fairly constant and, preferably, high rate of speed.

With a planetary motion imparted to the ware by the action of the revolving table 10 and rotating spindles 30, glaze is applied to the ware in a plurality of successive thin, substantially dry coats of glaze by the oscillating spray guns. As shown in the drawings, the lower spray guns 64 first coat the lower and outer surfaces of the ware, and then the upper guns coat the inner and upper surfaces of the ware. It should be apparent, however, that by reversing the direction of rotation of the table 10 or by simply turning the ware over on the holders 33 that the order of coating the surfaces could be changed. It should also be apparent that by merely mounting the upper gun shafts above the lower gun shafts, that all surfaces of the ware could be coated simultaneously.

Particular attention should be called to the fact that in the preferred operation of this apparatus, a plurality of successive thin and substantially dry coats of glaze are applied to the ware, thus preventing the glaze from running or "curtaining." To perform this operation most successfully, the wetness of the glaze spray is regulated by adjusting the proportions of glaze and atomizing air in the spray. Thus, due to the action of the atomizing air upon the wet glaze, moisture vapor in the liquid glaze is evaporated and the glaze is comparatively dry when it contacts the ware. Because each coat is substantially dry when applied, there is less tendency for the glaze to run than if it were applied in a liquid condition. Furthermore, the glaze is further dried and prevented from running because the more or less porous ware upon which it is applied absorbs the moisture content of the glaze. Therefore, in order to glaze a batch of ware, the glaze spray is adjusted so that it will not run when applied to the least absorptive pieces in the batch. After the glaze sprays have been adjusted for the least absorptive pieces of the batch of ware, the glaze, of course, will not run when applied to the more absorptive pieces of ware in the batch.

Having in mind the fact that the glaze applied to the ware should be dry enough to not run on the least absorptive ware, at the same time the glaze should be applied in a wet enough condition to adhere to the ware. Since a thin coat of more or less wet glaze will not run while a thick coat of the same glaze would run, it is important, therefore, that in operating this apparatus in a manner to obtain best results, a plurality of thin coats be applied. This is achieved in the machine disclosed not only by oscillating the spray guns but by imparting planetary motion to the spindles carrying the ware. Thus, each portion of the surface of the ware is sprayed a large number of times while being conveyed through the booth. The thinness of each coat results, of course, from the fact that each portion of the surface of the ware is subjected to the action of the sprays during each pass of the sprays for only a small instant of time. The preferred flat fan-like jet of spray from each gun also assists in rendering each coat of glaze thin.

In order to coat the glaze upon the ware properly, the glaze should be sprayer at a fairly wide angle to the surface of the ware. Therefore, in addition to achieving the application of a plurality of thin coats of glaze, the combined planetary movement of the ware and oscillatory movement of the flat, fan-like sprays also causes the glaze to be applied to the ware at the proper angle.

Because the configuration of pieces of ware vary widely, not only should the gun shafts be adjustable independently of each other in regard to the angle through which the gun shafts oscillate, but each spray gun should be adjustable with respect to its supporting gun shaft, both as to the angle at which the spray is directed at the ware and as to the distance between the nozzle of the spray gun and the ware. In the embodiment of this invention disclosed, such adjustments as to the distance between the nozzle of the spray guns and the ware may be made by sliding the rod 66 in the collar 67; the angle at which the spray is directed at the ware may be adjusted by turning the collar 67 upon its supporting gun shaft, turning the rod 66 in collar 67, and by pivoting the spray gun upon the bent stud portion of the rod 66. Thus, in order to be certain that each piece of ware may have glaze applied to all portions of its surface at a wide angle, where there are a plurality of guns on each gun shaft, some guns may be directed at an oblique or horizontal angle to coat vertical portions of the ware and other guns on the same shaft may be directed at a substantially vertical angle to coat horizontal portions of the ware.

In Fig. 4, both the lower and upper gun shafts 62 and 63 are shown as being oscillated through the same angle. As pointed out in the description of the gun shaft drive, however, each of the lower and upper gun shafts 62 and 63 may be regulated independently of each other as to the angle through which the gun shaft oscillates by adjusting the position of the knuckle member upon the crank arm in each of the knuckle and crank assemblies 77, 80, and 81. An extreme example of the variation between the angles of oscillation of the lower and upper gun shafts is found in one manner of using this machine to glaze cups. With cups placed upon the ware holders 33, the upper spray guns are adjusted so that they are located substantially above the center of the spindles 30 and are directed at a substantially vertical angle toward the ware, the vertical distance between the cups and the spray guns being sufficient to allow the divergence of the spray to include the diameter of the cup. The connecting rod 82 is then disconnected so that the upper gun shaft

63 does not oscillate at all while the lower gun shaft 62 oscillates through an angle sufficient to allow the lower spray guns to coat the outside walls and handles of the cups. The inside walls and bottoms of the cups are coated by simply rotating the cups under the vertical spray of the upper guns 65. In this connection, it should be noted that when the motor 70 is connected to the upper gun shaft 63, rather than to the lower gun shaft 62, as in the embodiment disclosed, cups may be glazed in the same manner by placing them upside down in the holders 33, disconnecting the connecting rod 82, and then adjusting the lower guns 64 so that they are directed upwardly toward the inside of the cups at a substantially vertical angle.

During the normal operation of the machine the spray guns are operating constantly. Considerable quantities of glaze, therefore, may not be applied to the ware but tend to collect upon the floor 51 of the booth 50. Such excess glaze flows from the booth over the surface 11 of the table 10 and most of it runs over the depending eave 16 into the trough 60. Glaze which is carried outside the booth 50 on the revolving table 10 falls into the circular trough 17 and thence flows into the trough 60. Thus, excess glaze is returned from the trough 60 to the bouncing lawn 91 by the trough drains 59. Glaze which passes the bouncing lawn 91 falls into the glaze reservoir 90 whence it is returned to the spray guns by the pump 86 through the flexible tubing 86 and 87.

The flexible connection 94 not only "bounces" the lawn 91 so that it does not clog, but because of its flexibility, it causes the lawn 91 to "bounce" at a higher frequency than the frequency of oscillation of the crank arm 95. It should be noted here that if the motor 70 is connected to the upper gun shaft 63, instead of the lower gun shaft 62, as in the present instance, the flexible connection 94 may extend from the boss 93 to the knuckle and crank assembly 81 and its length should be substantially equal to the vertical distance from the boss 93 to the upper gun shaft 63.

Coated ware is removed from the ware holders 33 after the spindles ceased rotation caused by the belt 44. In a circular machine as disclosed, the unloading station is most conveniently located adjacent the loading station, i. e., near the entrance of the booth 50 in order to give the glaze on the ware the maximum time for drying, although, since the glaze is applied in a relatively dry condition, the ware may be handled safely shortly after it leaves the booth 50.

From the foregoing it should be apparent that this invention is not limited to the particular embodiment disclosed, either in whole or in part, but is limited only by the appended claims.

What is claimed is:

1. In a machine for applying glaze to ceramic ware, a table, means for revolving said table, a plurality of spindles adapted to support ceramic ware carried by said table, pulleys on said spindles, a spray booth extending over a portion of said table and adapted to permit the revolution therethrough of said table, spindles, and ware supported by said spindle, means adapted to engage said pulleys frictionally to rotate said spindles revolved through said booth, spray guns mounted for continuous oscillation on said booth and directed toward ware carried by said spindles, means independent of the means for revolving said table for oscillating said spray guns with respect to said ware to cover all surfaces of said ware, means to recover excess glaze sprayed by said guns and accumulated in said booth, and means to supply said recovered glaze to said guns.

2. In a machine for applying glaze to ceramic ware, a revolving table, a plurality of spindles carried by said table, a spray booth located over a portion of said table and adapted to permit the revolution of said table therethrough, means for rotating said spindles while said spindles revolve through said booth on said table, spray guns mounted for continuous oscillation on said booth, means operating independently of the revolution of said table for oscillating said spray guns with respect to ware carried by said spindles, and means for recirculating excess glaze sprayed by said guns to said guns.

3. In a machine for applying glaze to ceramic ware, a revolving table, a plurality of spindles adapted to support ceramic ware carried by said table, a pulley secured to each of said spindles, a spray booth extending over a portion of said table and adapted to permit the passage of said table, spindles, and ware supported by said spindles therethrough, a frictional member supported under said table beneath said spray booth, said frictional member engaging said pulleys secured to said spindles to rotate said spindles while said spindles are revolved through said booth on said table, spray guns mounted for continuous oscillation on said booth and adapted to cover with glaze all surfaces of ware supported on said rotating spindles, means to oscillate said spray guns independently of the movement of said spindles.

4. In a machine for applying glaze to ceramic ware, a revolving table, a plurality of spindles adapted to support ceramic ware carried by said table, a pulley secured to each of said spindles, a spray booth extending over a portion of said table and adapted to permit the passage of said table, spindles, and ware supported by said spindles therethrough, a V-belt supported under said table beneath said spray booth, said V-belt engaging said pulleys on said spindles, variable drive means for said V-belt to impart planetary motion to spindles, oscillating spray guns mounted for continuous oscillation on said booth to coat all surfaces of ware carried by said spindles during the planetary movement thereof, and means to oscillate said spray guns independently of the movement of said spindles.

5. In a machine for applying glaze to ceramic ware, a revolving table having a sloping surface, a plurality of spindles adapted to support ceramic ware carried by said table, means to impart planetary motion to said spindles through a portion of the orbit thereof, a spray booth located over said table adjacent the portion of the table at which planetary motion is imparted to said spindles, a floor and a ceiling in said booth, spray guns mounted for continuous oscillation in said booth and adapted to spray glaze upon all surfaces of ware supported by said spindles, means to oscillate said spray guns independently of the planetary motion of said spindles, a glaze reservoir, the floor of said booth being designed to direct excess glaze sprayed by said guns and accumulated on said floor over said table to said glaze reservoir, and the ceiling of said booth being slanted over said spindles to prevent excess glaze spray accumulated thereon from dripping on ware supported by said spindles.

6. In a machine for applying glaze to ceramic ware, a revolving table having a sloping surface, a plurality of spindles adapted to support ceramic ware carried by said table, means to impart planetary motion to said spindles through a portion of

the orbit thereof, a spray booth located over said table adjacent the portion of the table at which planetary motion is imparted to said spindles, a sloping floor in said booth, said floor being located above said table and having its lower edge terminating above said sloping table surface adjacent the orbit of said spindles, spray guns mounted on said booth to spray glaze upon ware supported by said spindles, a trough in said booth below said table, and a circular gutter beneath the periphery of said table outside said booth, whereby, due to the slope of said floor and the slope of said table surface, excess glaze sprayed by said guns and accumulating on said floor will drain off said floor and over said table into said trough, excess glaze carried out of said booth by said revolving table being received in said gutter and draining into said trough.

7. In a machine for applying glaze to ceramic ware, a revolving table, spindles carried by said table for supporting ceramic ware, a spray booth extending over a portion of said table and adapted to permit said table and spindles to revolve therethrough, means for rotating said spindles within said booth, a first gun shaft mounted on said booth, a second gun shaft mounted on said booth, a plurality of spray guns mounted on each of said shafts, said spray guns being directed toward ware supported by said spindles, a gun shaft driving motor, a first connecting means from said motor to said first gun shaft, and a second connecting means from said first gun shaft to said second gun shaft, said first and second connecting means permitting said gun shafts to be oscillated through different angles of oscillation.

8. In a machine for applying glaze to ceramic ware, a revolving table, spindles carried by said table for supporting ceramic ware, a spray booth extending over a portion of said table and adapted to permit said table and spindles to revolve therethrough, means for rotating said spindles within said booth, a first gun shaft mounted on said booth, a second gun shaft mounted on said booth, a plurality of spray guns mounted on each of said shafts, said spray guns being directed toward ware supported by said spindles, a gun shaft driving motor, a first crank arm and knuckle assembly on said first gun shaft, a first connecting rod between said motor and said first crank arm and knuckle assembly, a second crank arm on said first gun shaft, a third crank arm and knuckle assembly on said second gun shaft, a second connecting rod between said second and third crank arm and knuckle assemblies, each of said crank arm and knuckle assemblies being adjustable to oscillate said gun shafts through different angles of oscillation.

9. In a machine for applying glaze to ceramic ware, a revolving table, spindles carried by said table for supporting ceramic ware, a spray booth extending over a portion of said table and adapted to permit said table and spindles to revolve therethrough, means for rotating said spindles within said booth, a first gun shaft mounted on said booth, a second gun shaft mounted on said booth, a plurality of spray guns mounted on each of said shafts, said spray guns being directed toward ware supported by said spindles, a gun shaft driving motor, a first crank arm and knuckle assembly on said first gun shaft, a first connecting rod between said motor and said first crank arm and knuckle assembly, a second crank arm on said first gun shaft, a third crank arm and knuckle assembly on said second gun shaft, a second connecting rod between said second and third crank arm and knuckle assemblies, each of said crank arm and knuckle assemblies being adjustable to oscillate said gun shafts through different angles of oscillation, each of said crank arm and knuckle assemblies comprising a crank arm disposed at substantially right angles to a gun shaft and a knuckle member adjustably secured to said crank arm to vary the radial distance from said gun shaft to said knuckle member.

10. In a machine of the class described, a revolving table, rotatable spindles on said table, a booth extending over a portion of said table and adapted to permit said table and spindles to revolve therethrough, spray guns mounted for continuous oscillation on said booth and adapted to spray glaze on ware supported by said spindles, means to oscillate said spray guns independently of the movement of said spindles, a glaze reservoir, a lawn over said reservoir, an oscillating shaft, a flexible connection from said lawn to said shaft substantially equal to the distance between said lawn and said shaft, said flexible connection being adapted to bounce said lawn over said reservoir at a frequency higher than the frequency of oscillation of said shaft.

11. Apparatus as defined in claim 7 including means for disconnecting a portion of said spray means from said oscillating means.

12. Apparatus as defined in claim 2 in which said spray guns spray a flat spray of atomized glaze and air, and means to adjust the proportion of glaze and air sprayed by said spray guns.

13. A machine for applying glaze to ceramic ware as defined in claim 2, in which said spray guns are adapted to spray the glaze in thin, substantially dry coats of glaze upon the ware carried by the spindles.

HOWARD V. SCHWEITZER.

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FOREIGN PATENTS

Number	Country	Date
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