Feb. 21, 1967 W. S. HART ET AL 3,304,909

APPARATUS FOR COATING CYLINDERS WITH URETHANE

Filed May 13, 1963 3 Sheets-Sheet 1

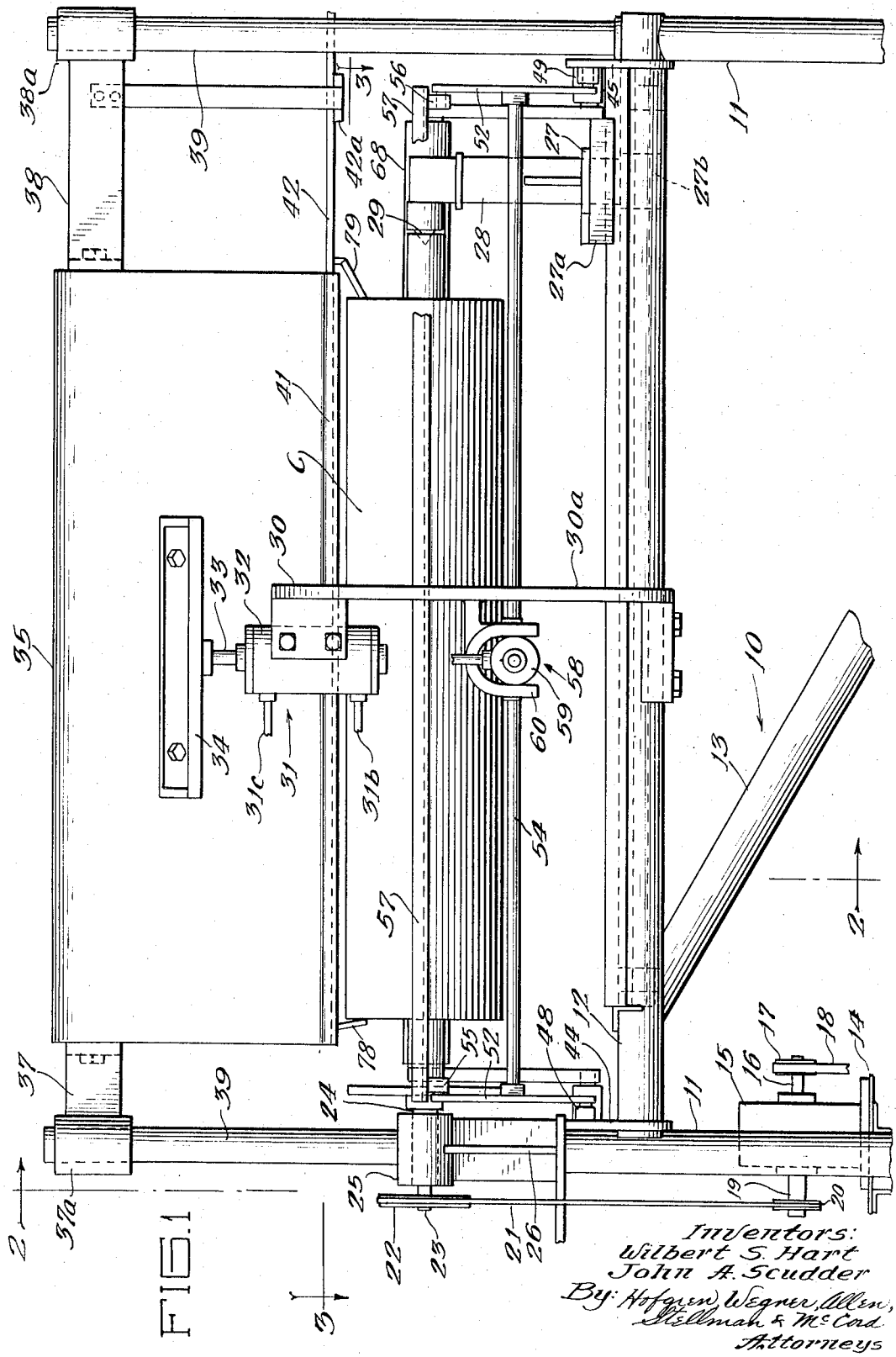


FIG. 1

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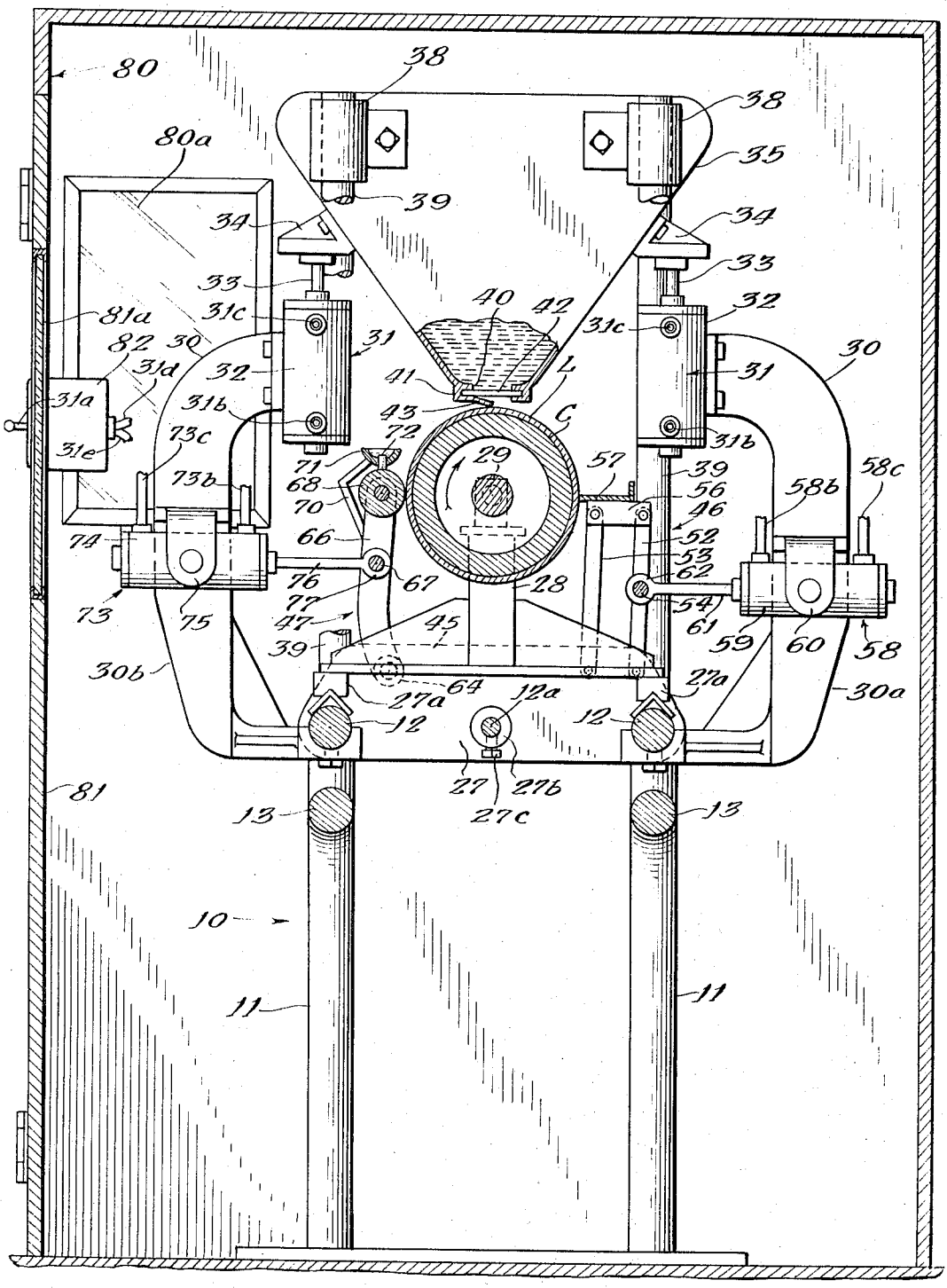


FIG. 2

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APPARATUS FOR COATING CYLINDERS WITH URETHANE

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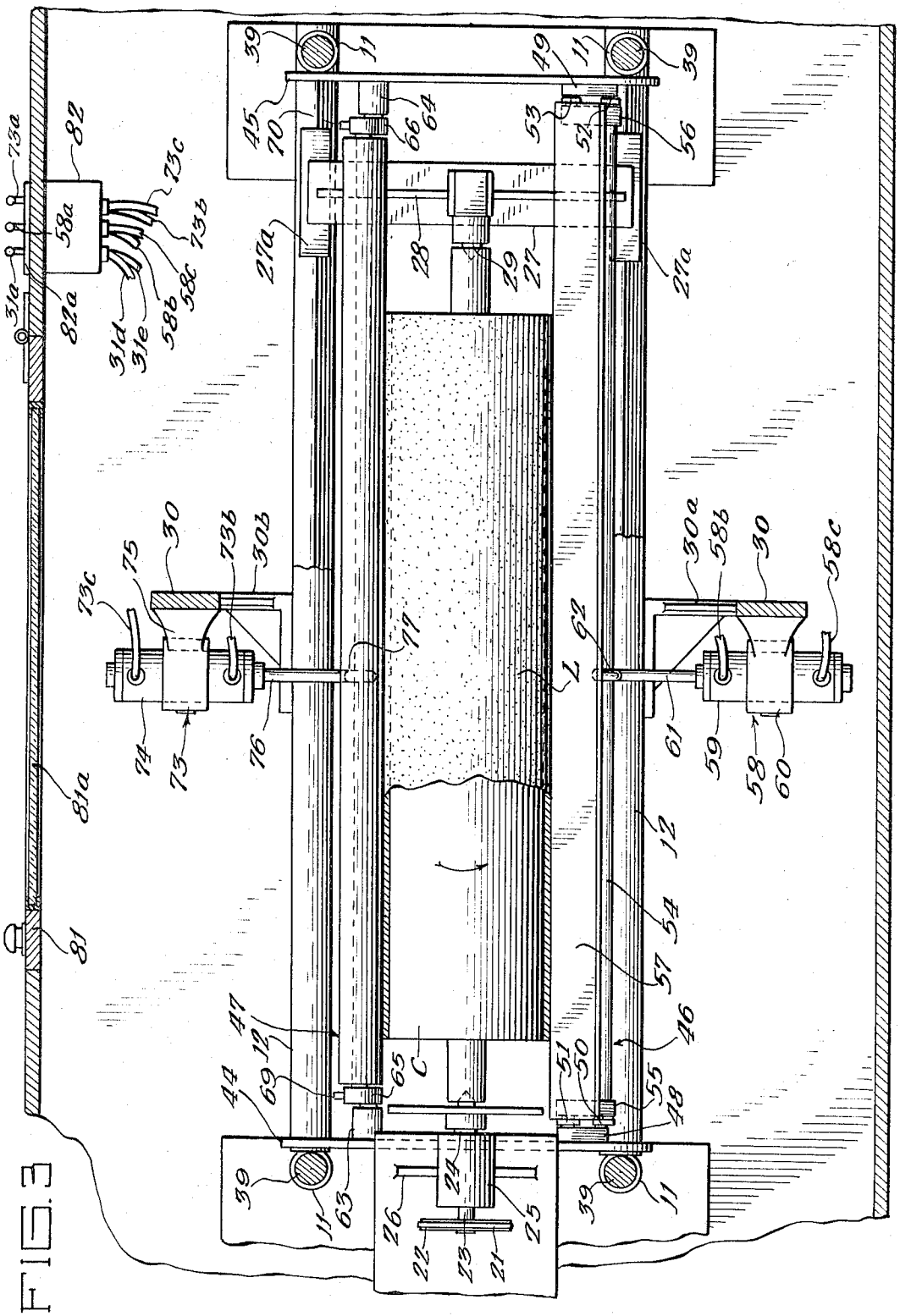


FIG. 3

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3,304,909

APPARATUS FOR COATING CYLINDERS WITH URETHANE

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8 Claims. (Cl. 118—103)

This invention relates to apparatus for coating cylinders with urethane or like material.

Various urethane formulations are widely used in industry, and most commonly articles formed of the urethanes and polyurethanes are cast either at room temperature or at slightly elevated temperatures. Various types of urethanes are particularly useful in coating various types of rollers, drums, pulleys and the like; but casting urethanes onto cylindrical articles is extremely difficult because of the need to locate the cylinder axis, or spindle, precisely in the center of the mold. The only practical procedure heretofore available was to cast onto a cylinder an external layer which was considerably thicker than the finished diameter of the cylinder, and then grind the newly cast surface until it was perfectly concentric with the cylinder axis. Obviously this is a relatively slow and expensive operation.

In accordance with the present invention, the apparatus has coaxial spindles on which a cylinder is mounted and rotated at a slow rate of speed, i.e., somewhere between about 10 and 25 r.p.m. A thin layer of urethane or like material is fed onto the rotating cylinder where it is smoothed and spread by a doctor blade until a coating of the desired thickness is obtained. A pressure roller then is used to work the coating and squeeze out air or other gas bubbles; and heating means are provided to hasten the cure of the coating. Ordinarily the coating is subjected to pressure from the roller and to heat for a substantial period of time after the deposition of urethane is complete, so as to properly work and cure the coating material.

The apparatus of the present invention includes means for adjusting the distance between the spindles to accommodate the device to the coating of cylinders of different length, means affording controlled radial movement of the doctor blade, the pressure roller, and a hopper from which the material pours onto the cylinder, not only to accommodate cylinders of different diameters, but also to permit necessary movement of each of the three radially movable elements of the machine during a coating operation.

Accordingly, the principal object of the present invention is to provide a simple and dependable apparatus for coating cylinders with urethane and like materials which set at room temperature or slightly elevated temperatures.

Another object of the invention is to provide apparatus for applying a coating of any desired thickness to a cylinder.

Yet another object of the invention is to provide apparatus for coating cylinders of various lengths and diameters with urethane or other like materials.

Still another object of the invention is to provide apparatus which may be used to apply a coating of urethane or like material to a cylinder in any desired thickness.

The apparatus of the present invention is illustrated in a preferred embodiment in the accompanying drawings in which:

FIG. 1 is a fragmentary side elevational view of the present coating apparatus with a curing cabinet omitted for clarity of illustration;

FIG. 2 is a vertical sectional view taken substantially as indicated along the line 2—2 of FIG. 1, with the curing cabinet in place; and

FIG. 3 is a horizontal sectional view taken substantially as indicated along the line 3—3 of FIG. 1 with the curing cabinet in place.

Referring to the drawings in greater detail, the apparatus includes a base, indicated generally at **10**, having corner posts **11** at the upper ends of which are parallel longitudinal support rails **12**, with diagonal bracing members **13**. A platform **14** between two of the corner posts **11** supports a reduction gear box **15** having an input shaft **16** with a pulley **17** that is driven by a belt **18** from a motor (not shown) which may conveniently be mounted on the floor between the adjacent corner posts **11**. An output shaft **19** on the gear box carries a pulley **20** from which a belt **21** encircles a pulley **22** on an input shaft **23** of a live center **24** that is journalled at **25** in a support bracket **26**.

Slidably mounted on the parallel support rails **12** is a carriage **27** having sliders **27***a* on the support rails and a central boss **27***b* that embraces a center guide rod **12***a*; and a set screw **27***c* locks the carriage in any desired position. A central pedestal **28** on carriage **27** supports a dead center **29**, so that a cylinder C to be coated may be spindled between the live center **24** and the dead center **29** for rotation during the coating process. By adjusting the position of carriage **27** along the rails **12** the apparatus may accommodate a cylinder C of any length up to the maximum length of the rails **12**. Preferably the apparatus is capable for receiving a cylinder at least 10 feet long, and may be adjusted to accommodate a cylinder only a few inches long.

As illustrated in the drawings the gear box **15** is a single speed unit; but it is obvious to those skilled in the art that a variable speed unit might be employed so as to afford a substantially constant surface speed with cylinders of different diameters, as taught by Smith Patent 2,055,318.

As best seen in FIG. 2, a pair of generally U-shaped central support arms **30***a* and **30***b* extend outwardly and upwardly from the parallel rails **12** on opposite sides of the base frame, and at the upper ends of said arms are vertically oriented hydraulic cylinder and piston units, indicated generally at **31**, which have their cylinders **32** bolted to the upper ends of the brackets **30**, while their pistons **33** carry brackets **34** that are secured intermediate the ends of a material hopper **35**. As best seen in FIG. 1, at the ends of the hopper are stabilizing brackets **37** and **38** having sleeves **37***a* and **38***a*, respectively, that are impaled by guide rods **39** which extend upwardly from the corner posts **11** of the base. Thus, it is apparent that retraction of the piston rods **33** of the cylinder and piston units **31** lowers the hopper **35** with respect to a cylinder C, while extension of the piston rods raises the hopper with respect to the cylinder.

The material hopper **35** is seen in FIG. 1 to extend a distance equal to the maximum length of cylinder C which may be coated in the apparatus, and has a continuous longitudinal feed opening **40** in its lower end beneath which there is a slideway **41** for a slidable control gate **42** by means of which the length of the opening **40** through which material may be discharged from the hopper onto a cylinder C is controlled in accordance with the length of the cylinder being coated. As seen in FIG. 1, a guide member **42***a* extends between two of the guide rods **39** to support the outer end of control gate **42**. A material guide plate **43** closes one side of the entire opening **40** and is slightly inclined as seen in FIG. 2 so as to direct material from the hopper onto the cylinder surface along a line which is just forward of the vertical median plane of the cylinder, "forward" and "rearward" here being used with reference to the clockwise direction of rotation of the cylinder C as viewed in FIG. 2.

Between the corner posts **11** at opposite ends of the apparatus are upright brackets **44** and **45** which provide supports for a doctor blade assembly, indicated generally at **46**, and a pressure roll assembly, indicated generally at **47**.

The doctor blade assembly includes a pair of opposed mounting plates **48** and **49** on the end brackets **44** and **45**, with parallel arms **50** and **51** pivoted on the plates **48**, arms **52** and **53** pivoted on the plate **49**, a longitudinal tie rod **54** joining the arms **50** and **52**, supporting flanges **55** and **56** which surmount the arms **50–51** and **52–53**, respectively, and a doctor blade **57** which has its ends secured to the flanges **55** and **56**. Controlled, generally radial movement of the doctor blade **57** with respect to the cylinder C is afforded by a cylinder and piston unit, indicated generally at **58**, there being a cylinder **59** pivotally mounted in a yoke **60** on the U-shaped arm **30***a*, and a piston rod **61** the outer end of which has a connector **62** embracing the tie rod **54**. Thus, as the piston rod **61** is retracted it withdraws the doctor blade **57** generally radially with respect to the cylinder C, while extension of the piston rod **61** moves the doctor blade generally radially inwardly to accommodate the apparatus to a cylinder of smaller diameter than the cylinder C.

Also mounted upon the brackets **44** and **45** are bosses **63** and **64** which pivotally support arms **65** and **66**, respectively; a tie bar **67** connects the arms **65** and **66**; and a pressure roller **68** is journalled between the arms substantially directly opposite the doctor blade **57**. Also carried upon arms **65** and **66** are brackets **69** and **70** which extend outwardly around the pressure roller **68** and then inwardly to support a trough **71** above the roller. A slot in the bottom of the trough is blocked by a wick **72**, so that oil in the trough may be absorbed by the wick to maintain a thin film of oil constantly upon the entire surface of the pressure roller **68** so as to keep it from adhering to the outer surface of a layer L of coating material on the cylinder C.

Controlled radial movement of the pressure roller **68** is produced by a cylinder and piston unit, indicated generally at **73**, said unit having a cylinder **74** pivoted in a yoke **75** on the U-shaped arm **30***b*, and a piston rod **76** having an eye **77** which embraces the tie bar **67** of the pressure roller assembly so that retraction or extension of the piston rod **76** moves the pressure roller **68** generally radially outwardly or inwardly with respect to the pivot axis of the cylinder C.

Proper operation of the apparatus requires that the coating material applied to a cylinder C be confined so that it does not run off the ends of the cylinder, and for this purpose a fixed doctor blade **78** is secured to the end of the hopper **35** adjacent the live center **24**, while a movable doctor blade **79** is fixedly connected to the slidable closure **42** for the hopper **35** in such a location as to bear upon the adjacent end of a cylinder C in any adjusted position of the closure **42**.

To accelerate curing of coating material in the layer L as material is applied to the cylinder C, the entire apparatus **10** is enclosed within a curing cabinet, indicated generally at **80**, which has a large hinged door **81** along one side affording access to the interior of the cabinet for changing cylinder C and making any needed adjustments to the apparatus. Any suitable heating means (not shown) may be provided to heat the interior of the curing cabinet **80**. This may take the form of electrical or gas heating elements inside the cabinet, a system of pipes for circulating steam or hot water within the cabinet, or a hot air manifold and blower system for circulating heated air through the cabinet. In order that an operator may observe the progress of a coating operation, the ends of the curing cabinet **80** are provided with windows **80***a*, and the door **81** is provided with a window **81***a*.

Control of the hydraulic cylinder and piston units **31**, **58**, and **73** is afforded by a control box **82** having a control panel **82***a* on the outside of curing cabinet **80** alongside the door **81**, and in the control panel **82***a* are three electrical control switches **31***a*, **58***a* and **73***a* of the three position toggle type which control, respectively, the operation of the hydraulic cylinder and piston units **31**, **58** and **73**. As will be obvious to one skilled in the art, the hydraulic cylinder and piston units are all connected by suitable conduits to solenoid valves in the control box **82**, and the solenoid valves control admission of hydraulic fluid under pressure to the various cylinders **32**, **59**, and **74** in response to actuation of the toggle switches **31***a*, **58***a* and **73***a* which control energization of the solenoids which operate the valves.

By way of example, opposite ends of both cylinders **32** are provided with corresponding hydraulic lines **31***b* and **31***c* with both lines **31***b* connected to a line **31***d* and both lines **31***c* connected to a line **31***e*. Admission of hydraulic fluid through the lines **31***d*–**31***b* extends both piston rods **33** simultaneously and at the same rate, while admission of hydraulic fluid through the lines **31***e*–**31***c* retracts both piston rods **33** simultaneously. Toggle switch **31***a* has a mid-position in which the solenoid valves for both lines **31***d* and **31***e* are closed, a first active position which energizes the solenoid to open the valve in the line **31***d*–**31***b*, and a second active position to energize the solenoid for the valve in the line **31***e*–**31***c*. Similarly, hydraulic fluid lines **58***b* and **58***c* connect the cylinder **59** directly to valves in the control box **82** which are controlled by the toggle switch **58***a* while hydraulic fluid lines **73***b* and **73***c* connect the cylinder **74** to solenoid valves in the control box **82** which are controlled by the toggle switch **73***a*. Such simple electro-hydraulic control equipment is so commonly used in a wide variety of apparatus that no further detailed description or electrical or hydraulic circuit diagrams are necessary to a full understanding of the apparatus on the part of any person skilled in the art.

The electro-hydraulic controls permit an operator to effect controlled withdrawal of the hopper and the doctor blade as the layer L of coating material builds up on the cylinder; and to move the pressure roller as needed to properly work the material. Alternatively, of course, a suitable control may be provided to move the hopper and doctor blade automatically at a controlled rate in response to increasing thickness of the layer L. Movement of the pressure roller must be very delicate, in accordance with progress in the smoothing and compacting of the layer of polyurethane; so hand control of the pressure roller at the will of the operator is preferred.

While the apparatus of the present invention is illustrated herein as an entirely self-contained machine, it is quite apparent that the entire mechanism for supporting and operating the material hopper **35**, the doctor blade assembly **46** and the pressure roller assembly **47** could be in the form of attachments for a pre-existing lathe, so that the cylinder C could be spindled between the centers of the lathe.

The foregoing detailed description is given for clearness of understanding only and no unnecessary limitations are to be understood therefrom, as some modifications will be obvious to those skilled in the art.

We claim:

1. Apparatus for coating a cylinder with urethane or like material, comprising, a frame, a pair of cylinder supporting spindles on the frame on a generally horizontal axis, means for driving one of said spindles at a relatively slow rate to rotate a cylinder supported thereon; one of said spindles being axially adjustable to accommodate cylinders of different lengths; hopper means for continuously applying coating material at a controlled rate to substantially the entire length of the cylinder; said hopper being radially movable with respect to said cylinder to thereby accommodate cylinders of different diameters; the hopper outlet being juxtaposed to and above the cylinder and comprising a material feed slot which is substantially as long as the longest cylinder which can be coated in the apparatus; means for selectively restraining

the length of the slot to coincide with the length of the cylinder; a coating material guide attached to and coextensive with the side of said slot towards which the cylinder to be coated first approaches, said guide extending to the cylinder surface and extending in the direction of cylinder rotation; a doctor blade on the frame for continuously smoothing the coating material along the entire length of the cylinder as it is applied; a pressure roller on the frame for continuously compressing the smoothed coat of material on the rotating cylinder; said blade and roller being each mounted for movement which is generally radial with respect to the cylinder; and means to effect coordinated and simultaneous radial movements of the blade and roller.

2. Apparatus for coating a cylinder with urethane or like material comprising, a frame, a pair of cylinder supporting spindles on the frame on a generally horizontal axis; means for driving one of said spindles at a relatively slow rate to rotate a cylinder supported thereon; one of said spindles being axially adjustable to accommodate cylinders of different lengths; hopper means for continuously aplying coating material at a controlled arte to substantially the entire length of the cylinder; said hopper being radially movable with respect to said cylinder to thereby accommodate cylinders of different diameters; the hopper outlet being juxtaposed to and above the cylinder and comprising a material feed slot to which is substantially as long as the longest cylinder which can be coated in the apparatus; means for selectively restraining the length of the slot to coincide with the length of the cylinder; a coating material guide coextensive with the side of said slot towards which the cylinder to be coated first approaches; said guide extending to the cylinder surface and extending in the direction of cylinder rotation; a doctor blade on the frame for continuously smoothing the coating material along the entire length of the cylinder as it is applied; a pressure roller on the frame for continuously compressing the smoothed coat of material on the rotating cylinder; said blade and roller being each mounted for movement which is generally radial with respect to the cylinder; and means to effect radial movements of the blade and roller.

3. The apparatus recited in claim 2, in which the doctor blade is located at a point of cylinder rotation about 90° from the hopper outlet and the pressure roller is located at a point of cylinder rotation about 180° from the doctor blade.

4. The apparatus recited in claim 2, in which means is provided for applying a thin liquid film to the pressure roller to prevent the roller from sticking to the material on the cylinder.

5. The apparatus recited in claim 4, in which the liquid applying means comprises a liquid reservoir having an outlet disposed toward the pressure roller.

6. The apparatus recited in claim 4, in which a wick is arranged in the outlet, said wick contacting the roller.

7. The apparatus recited in claim 2, in which first hydraulic means is provided for effecting radial movement of the hopper means, second hydraulic means is provided for effecting radial movement of the doctor blade and third hydraulic means is provided for effecting radial movement of the pressure roller.

8. The apparatus recited in claim 2, in which means is provided to prevent coating material from running over the ends of the cylinder.

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