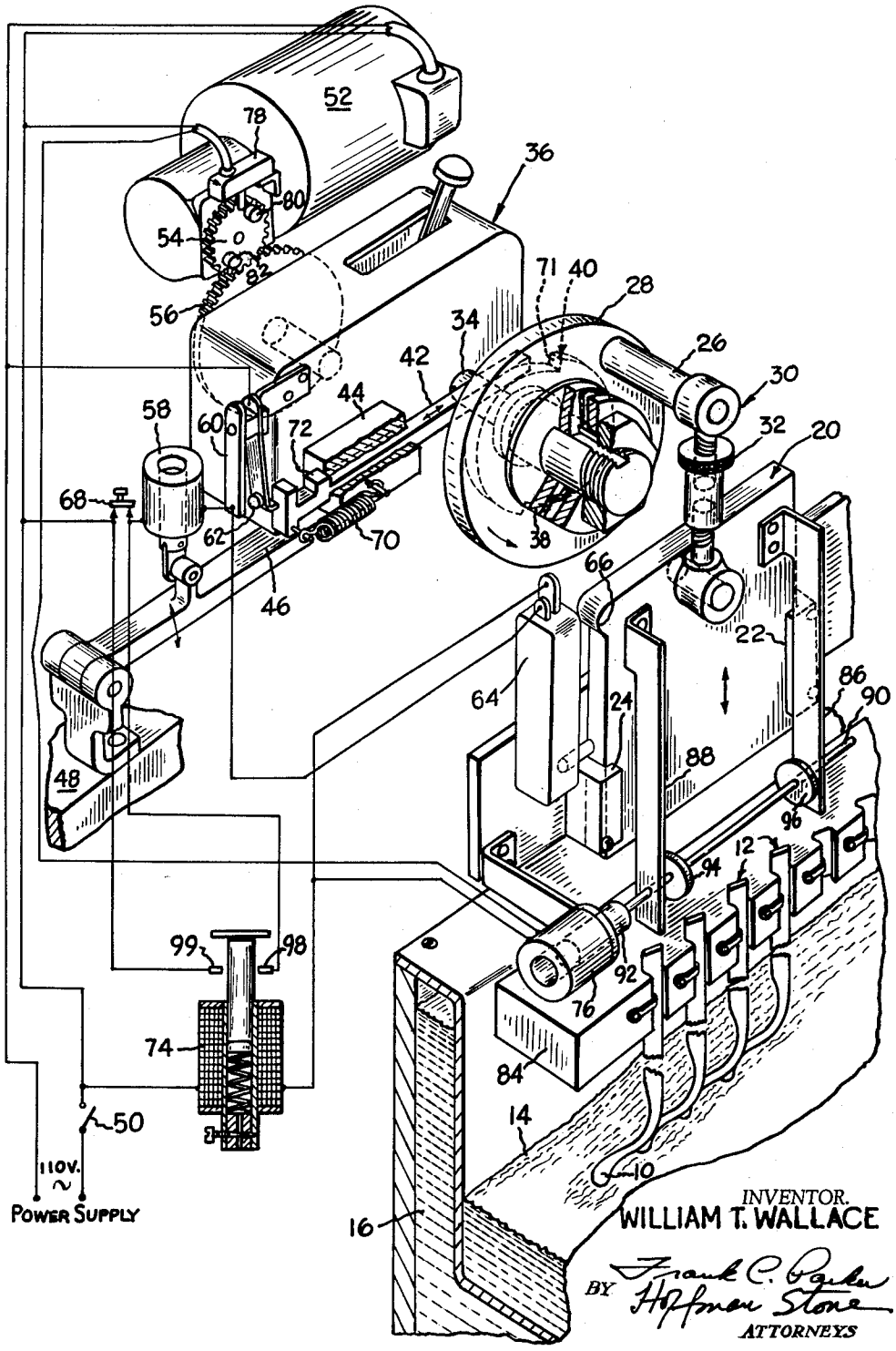
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WORKPIECE DIPPING MACHINE

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WORKPIECE DIPPING MACHINE

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This invention relates to improved apparatus for automatically dipping a workpiece into a bath and for agitating the workpiece therein.

One important object of the present invention is to provide an improved apparatus especially suited for dipping a workpiece partly into a bath and agitating it therein at a non-uniform agitation rate.

Another object is to provide an improved machine of this character including means for withdrawing the workpiece from the bath at a predetermined relatively slow rate.

A further object is to provide an improved apparatus of this character which is of relatively simple yet rugged construction, easy to operate, and long lasting in use.

The foregoing and other objects and advantages of the invention will become apparent in the following detailed description of a preferred embodiment thereof, taken together with the drawing, wherein the single figure is a partly schematic view with parts broken away illustrating apparatus according to a preferred embodiment of the invention and including an electrical control circuit therefor.

One problem involved in dip coating portions of a workpiece in a relatively viscous bath relates to the formation of a curved "meniscus" line defining the margin of the coating material. Due to surface tension forces, wetting characteristics, and the like, the line between the uncoated, or non-immersed portion of the workpiece and the part of the workpiece which is wetted by the bath is usually in the form of a line having a characteristic meniscus-like curvature. When coating workpieces such as, for example, spectacle temples by dipping them partly into a raw plastic bath, such curvature is highly undesirable.

According to the present invention, it has now been found that agitating the workpiece with a damped vibratory motion and at a non-uniform rate minimizes the curvature of the coating material margin and results in a substantially straight demarcation line between the coating material and the uncoated portion of the workpiece, substantially completely eliminating the curved meniscus effect.

Referring now to the drawing, the apparatus illustrated therein is specially designed for dipping the paddle tips 10 of spectacle temples 12 in a bath of an uncured plastic material 14, which is held at a predetermined working temperature by any convenient means such as by the hydrothermal tank 16 illustrated. The uncured plastic 14 is usually in a relatively viscous state.

The apparatus includes an elevator mechanism and an agitation mechanism. The elevator mechanism will be described first, and includes an elevator slide 20, which is vertically slidable in a pair of guides 22 and 24, and which is adjustably connected to a pin 26 carried by a drive wheel 28. The connecting rod 30 between the slide 20 and the pin 26 includes a right and left screw coupling 32 for adjusting the height of the elevator slide 20 relative to the crank pin 26. The drive wheel 28 is journaled on the shaft 34 of a variable speed transmission device 36 and is driven from the shaft 34 through a friction coupling 38. A two-step ratchet wheel 40 is fixed upon one face of the drive wheel 28 for rotation therewith, and is engageable by a pawl 42 which is mounted for limited sliding travel in a block 44. The

block 44 is fixed at one end of a vertically swingable arm 46 which is pivoted at its opposite end upon a fixed support 48.

In operation, as long as the main power supply switch 50 is closed, the motor 52 drives the variable speed transmission 36 through a pair of pinion gears 54 and 56, and the output shaft 34 of the transmission is thereby driven continuously. The drive wheel 28, however, is stopped and the friction drive 38 continues to slip whenever the ratchet wheel 40 is engaged by the pawl 42. The drive wheel 28 starts to turn only when the pawl 42 is raised out of engagement with the ratchet wheel 40 by the solenoid actuated plunger 58. The ratchet wheel is arranged to engage the pawl 42, thereby stopping the drive wheel 28 when the crank pin 26 reaches either the top or the bottom of its stroke.

Other details of the construction of the apparatus will become apparent in the following description of the operation thereof during a typical cycle. To start operation, the main power switch 50 is closed thereby energizing the motor 52 and the electrical control circuit. It will be assumed that the power switch 50 was last opened after the ratchet wheel 40 had engaged the pawl 42 and driven it to the left, as viewed in the drawing, to its limit position, which is defined by the limit stop 60. The pawl limit switch 62 mounted on the limit stop 60 is thus held closed. It is also assumed that the crank pin 26, and therefore the elevator slide 20 are in their uppermost positions, so that the cam 66 on the slide 20 holds the slide limit switch 64 open.

To initiate lowering of the slide 20, the operator momentarily closes the push button switch 68 thereby energizing the solenoid 58, which then raises the arm 46 to raise the pawl 42 out from engagement with the ratchet wheel 40. The pawl biasing spring 70, which is connected between the rear end of the pawl 42 and the block 44 then drives the pawl 42 forwardly to clear the ratchet wheel tooth 71. Forward travel of the pawl 42 is limited by a stop 72 carried by the pawl 42 for abutting engagement with the rear face of the block 44. The drive wheel 28 then rotates to lower the elevator slide 20 and the workpieces 12 into their lowered position. As soon as the pawl 42 moves forwardly, the limit switch 62 opens, thereby positively deenergizing the solenoid 58, and permitting the pawl 42 to fall upon the ratchet wheel where it rests until it is engaged by the next tooth.

When the crank pin 26 and the slide 20 reach their lowermost position the pawl 42 is engaged again by the ratchet wheel 40 and driven rearwardly to its limit stop, stopping the drive wheel 28 and closing the pawl limit switch 62. At this time the slide limit switch 64 is closed, and closing of the pawl limit switch 62 completes a circuit to energize the dwell relay 74. The dwell relay 74 may be of any desired delayed closing type, and the slide 20 remains in its lowered position during the delay time.

The two limit switches 62 and 64 are also series connected in a circuit for energizing the agitation solenoid 76. A trip switch 78, which is actuated by crank pins 80 and 82 fixed to the motor driven pinion gear 54 is also in series with the agitation solenoid 76. The trip switch 78 is of the normally open type, and is momentarily closed at short intervals by the trip pins 80 and 82 as the pinion 54 rotates. When both of the limit switches 62 and 64 are closed, the trip switch operates to complete the circuit for energizing the agitation solenoid 76 for agitating the workpieces 12 in the bath 14.

As shown, the workpieces 12 are releasably secured in a rack 84 which is resiliently mounted on the elevator slide 20 by relatively long leaf springs 86 and 88. A pull rod 90 is connected to the plunger 92 of the solenoid 76 and extends through suitable apertures (not separately designated) in the leaf springs 86 and 88 near the

ends thereof adjacent to the rack **84**. Stop members **94** and **96** are fixed on the rod **90** for abutting engagement against the respective springs **86** and **88**.

While the elevator slide **20** is in its lowermost position, both of the limit switches **64** and **62** are closed, and during this time actuation of the trip switch **78** periodically energizes the solenoids **76**. Each time the solenoid **76** is energized, it pulls the rod **90** to the left, as viewed in the drawing, engaging the left-hand stop member **94** with the left-hand spring **88** to pull the rack **84** together with the workpieces **12** to the left. When the pin **80** or **82** passes by the trip switch **78** allowing the trip switch **78** to open, the solenoid **76** is deenergized, and the springs **86** and **88** return the rack to its initial position. The springs **86** and **88** are relatively strong, and when the solenoid **76** is deenergized, they return the rack to its initial position with a vibratory motion. The springs **86** and **88** together with the rack **84** and the load constitute an inertial system, which is damped by the relatively viscous plastic material in the bath **14**. When the solenoid **76** is deenergized, this system undergoes a damped oscillation, coming to rest with the workpieces in a "normal" position. The solenoid **76** is energized and deenergized several times as the pinion **54** rotates during the delay time of the dwell relay **74**. The delay time, and the number of the trip pins **80** and **82** may be selected to control the number of times the solenoid **76** is energized during each dwell period.

When the dwell relay **74** times out, it closes its contacts **98** and **99**, which are connected directly in parallel with the start switch **68**. Closing of the dwell relay **74**, therefore, energizes the lift solenoid **58** to raise the pawl **42** out of engagement with the ratchet wheel **40** and thereby to permit the drive wheel **28** to be again rotated by the friction drive mechanism **38** to raise the main slide **20**. When the lift solenoid **58** raises the pawl **42** out of engagement with the ratchet wheel **40**, the spring **70** drives the pawl **42** to the right, as viewed in the drawing, thereby opening the limit switch **62** to break the energization circuit of the agitation solenoid **76** so that further actuation of the trip switch **78** has no further effect on the agitation solenoid **76**.

It has been found that the type of oscillatory agitation provided by the solenoid actuated movement is exceptionally effective in reducing the curvature of the meniscus line between the plastic coating material and the surfaces of the workpieces **12** that are being coated. The margin between the uncoated parts of the partly

dipped workpieces **12** and the coated portions thereof lies substantially in a single plane and has a straight line appearance. In operation, the initial movement of the workpieces to the left in response to energization of the solenoid **76** is extremely rapid and covers a relatively large distance. When the solenoid is subsequently deenergized, the springs **86** and **88** return the workpieces **12** back to their normal position with an oscillatory motion having a relatively rapidly decreasing amplitude and rate. This non-uniform type of agitation has been found to be surprisingly effective in reducing the undesired marginal curvature effect.

I claim:

1. Apparatus for agitating a workpiece comprising a rigid support, a leaf spring fixed at one end to said support and having its other end free, means for securing a workpiece to the free end of said spring, and means for alternately deflecting and releasing the free end of said spring, said deflecting means having a period at least several times as long as the natural period of vibration of said spring and a workpiece supported thereon, whereby when said spring is released it returns the workpiece to a normal position with an oscillatory motion.

2. Workpiece handling apparatus comprising a rigid elevator slide, means for mounting said slide for smooth vertical travel, means for lowering said slide, means for stopping said slide at a lower limit position, means including a timing device for raising said slide after a predetermined dwell time at said lower limit position, a leaf spring fixed at one end to said slide and having a free end, means for securing a workpiece to said free end, a solenoid connected to said free end for deflecting said spring away from its normal unstressed position, and control means for periodically momentarily energizing said solenoid during said dwell time, said control means including means for keeping said solenoid deenergized at all other times, said control means for periodically momentarily energizing said solenoid having a period at least several times as long as the natural period of vibration of said spring and a workpiece supported thereon.

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