FLUID MATERIAL DISPENSING APPARATUS

This invention relates to an apparatus and method for dispensing fluid material to a discharge location. More particularly the invention is a fluid material dispenser operable to simultaneously discharge a plurality of substantially equal amounts of fluid material to separate discharge locations, as the windings of a rotor for an electrical machine.

Briefly described, the method and apparatus of the invention function to dispense fluid material to a selected discharge location. The fluid material is initially placed under pressure with the use of a pump. From the pump the fluid material is transported under pressure to nozzles operable to direct the fluid material to the discharge location. After an amount of material has been dispensed movement of fluid material to the nozzles is reversed by a control means operable to terminate the flow of material to the nozzles and withdraw fluid material from said nozzles by creating a suction force thereby preventing dripping of fluid material from the nozzles after the dispensing operation.

One particular adaptation of the apparatus includes a pump operable to withdraw fluid from a reservoir and discharge the fluid in separate but equal amounts to separate discharge locations. The pump has a movable member driven by a motor through a clutch-brake unit and a reverse drive means. On operation of the motor the movable member of the pump is driven in a forward direction to withdraw fluid from the reservoir and discharge the fluid to the discharge locations. Actuation of the brake in the clutch-brake unit terminates the drive to the pump. The reverse drive means is actuated when the drive to the pump is terminated to reverse the direction of movement of the movable member whereby fluid is withdrawn or sucked from the discharge side of the pump and discharged to the inlet side of the pump. Reverse movement of the movable member provides a quick termination of the discharge of fluid and prevents dripping of fluid from discharge means, as nozzles.

The pump has a readily removable stationary casing which cooperates with the movable member to deflect a plurality of tubes carrying the fluid material. The tubes are progressively deflected by the movable member to withdraw fluid from the reservoir and force the fluid through lines leading to discharge locations. The stationary casing being readily removable permits the tubes to be replaced in a minimum of time and labor. The pump is particularly adapted to handle thermo-setting resins, as polyester with a catalyst like tertiary butyl perbenzoate (TBP), used to coat armature windings of rotors for electrical machines.

In the drawings:

FIGURE 1 is a plan view of the fluid material dispensing apparatus of the invention;
FIGURE 2 is an enlarged sectional view taken along the line 2—2 of FIGURE 1 showing the pump of the dispensing apparatus;
FIGURE 3 is a sectional view taken along the line 3—3 of FIGURE 2;
FIGURE 4 is an enlarged sectional view taken along the line 4—4 of FIGURE 1 showing the reverse drive control for the pump;
FIGURE 5 is a fragmentary sectional view taken along the line 5—5 of FIGURE 4;
FIGURE 6 is a diagrammatic view of the fluid material dispensing system showing the pump of FIGURE 3 in combination with nozzles directing fluid material to opposite ends of the windings of an armature;
FIGURE 7 is a diagrammatic view of a modified fluid material dispensing system having flow control units operable to prevent dripping of fluid material; and
FIGURE 8 is an elevation view partly in section of one flow control unit of FIGURE 7.

Referring to the drawings, there is shown in FIGURE 1 the fluid material dispensing apparatus of this invention indicated generally at 10 used to deposit separate and substantially equal amounts of fluid material to a discharge location. Dispensing apparatus 10 is part of an armature trickling impregnation machine operable to impregnate the windings of the armature with a thermostatic resin, as a polyester resin with a catalyst like tertiary butyl perbenzoate. The resin material is applied only to the opposite ends of the windings to eliminate armature cleanup. It is intended that fluid dispensing apparatus 10 is usable to dispense other fluid materials to discharge locations which may or may not have work articles.

Dispensing apparatus 10 is mounted on a support 11, as a table or frame of a machine. Secured to support 11 is an electric motor 12 drivenly coupled to an electric clutch-brake unit 13 having a drive shaft 14 carrying a pulley 16. Power from pulley 16 is transmitted through a belt 17 to a speed reducer unit 18. Unit 18 has a control lever 19 which is manually adjustable to change the speed reducing characteristics of the unit. As shown in FIGURE 5, unit 18 has an output shaft 21 carrying a pulley 22.

Power from speed reducer unit 18 is transmitted by a reverse drive means indicated generally at 23 to a pump indicated generally at 24. As shown in FIGURE 3, pump 24 is operable to withdraw funds from a pair of reservoir tanks 26 and 27 connected to a mixing manifold or chamber 28. A plurality of lines 29 couple the inlets of the pump to manifold 28. Pump 24 may be connected directly to a single reservoir storing fluid which is to be dispensed to the discharge location. Pump 24 operates to discharge the fluid to a plurality of nozzles 31 or similar discharging units operable to direct fluid to discharge locations. Conduits or lines 32, as plastic hoses, connect the pump outlets with nozzles 31.

As shown in FIGURE 1, an electrical control 33 is connected by line 34 to clutch-brake unit 13 and by line 36 to a control valve 67 of reverse drive means 23. Control valve 67 is connected to the body of control valve 67 thereby terminating the power to pump 24. At the same time control valve 67 is actuated to affect movement to reverse drive means to apply a reverse torque to pump 24 thereby creating a snarl action or a suction force at the discharge side of pump 24 preventing further dispensing and dripping of fluid from nozzles 31.

As shown in FIGURE 5, reverse drive means 23 comprises an upright swinger arm 37 located between a pair of upright stands 38 and 39 secured to the top of
support 11 by bolts 40. The midportion of swinger arm 37 is pivotally mounted on the upper end of stands 38 and 39 by a transverse pin 41 located in axial alignment with output shaft 21 of speed reducer unit 18. A jack shaft 42 rotatably carried in a sleeve bearing 43 secured to the lower end of arm 37 rotates about an axis parallel to the axis of pin 41. A pulley 44 is mounted on shaft 42 in alignment with pulley 22. Power is transmitted from pulley 22 to pulley 44 through a belt 46 trained about the pulleys. The opposite end of shaft 42 carries a pulley 47 located in alignment with a pulley 49 secured to a pivot shaft 51. A belt 48 trained about pulleys 47 and 49 transmits power to pump shaft 51. The diameter ratios of the pairs of pulleys 22, 44 and 47, 49 substantially equal whereby the drive ratio of the reverse drive means is 1 to 1. As shown in FIGURE 5, the lower end of swinger arm 37 has a pair of bifurcated legs 52 located on opposite sides of an eye bolt 53. A set screw 54 threaded into the end of eye bolt 53 engages a transverse pin 56 extended through suitable holes in bifurcated legs 52 to pivotally mount eye bolt 53 to the end of arm 37.

As shown in FIGURE 4, a double acting fluid motor 57, as a stand cylinder assembly, is connected to the shank end of eye bolt 53. Fluid motor 57 has an axially movable piston rod 58 connected to a piston (not shown). The outer end of piston rod 58 is connected to eye bolt 53. The rear or head end of double acting motor 57 has a pair of rearwardly projected ears 59 located on opposite sides of an upright block 61 secured to support 11. A transverse pin 62 pivotally connects the ears to block 61. Located forwardly of bifurcated legs 52 and in the path of movement of the legs is an upright stop 63 mounted on support 11. The stop has an adjustable longitudinal bolt 64 threaded into an upright block 66. Stop 63 fixes the forward movement of the lower end of swinger arm 37. Bolt 64 is adjustable to vary the limits of angular movement of swinger arm 37 from between 20 to 45 degrees.

As shown in FIGURE 1, a solenoid actuated four-way valve 67 is used to connect fluid motor 57 to a source of fluid under pressure, such as air. Valve 67 is connected to the source of fluid pressure by a pair of conduits or lines 68 and 69. Conduits or lines 71 and 72 connect the opposite ends of fluid motor 57 to valve 67. The flow rate of fluid in lines 71 and 72 may be regulated with restrictors 73 located in each of fluid motor 57. Each restrictor has a manually movable member which is adjustable to control the flow rate of fluid into and out of fluid motor 57. Valve 67 is actuated in conjunction with clutch brake unit 13 by the operation of control valve 53.

Referring to FIGURE 2, pump 24 has axially spaced upright end walls 74 and 76 secured to a flat base plate 77. End walls 74 and 76 have axially aligned holes accommodating ball bearings 78 and 79 used to rotatably support pump shaft 51. The top and side portions of the pump are enclosed with a housing or casing 81 movably secured to the ends of end walls 74 and 76 by two pairs of bolts 82 and 83. As shown in FIGURE 3, casing 81 has an inverted U-shape with an open lower side. The inner peripheral surface of casing 81 has an inverted semicircular inner wall 84 joined with spaced downwardly projected straight walls 86 and 87. Walls 86 and 87 are parallel to each other and are continuous extensions of inverted semicircular wall 84. The walls 84, 86 and 87 extend axially between end walls 74 and 76 and define a generally inverted U-shaped inner peripheral surface. Located axially within the space enclosed by casing 81 is the movable member or rotor 88 fixedly mounted on pump shaft 51. As shown in FIGURE 2, rotor 88 comprises an axial sleeve 89 fastened to shaft 51 by splines, keys or the like (not shown) whereby sleeve 89 rotates with shaft 51. Integral with the opposite ends of sleeve 89 are oppositely directed radial arms 91 and 92, 93 and 94 positioned close to end walls 74 and 76. Interposed between adjacent radial arms 91 and 92 and arms 93 and 94 are longitudinal rollers 96 and 97 respectively. Pins 98 and 99 extended through suitable holes in arms 91 and 92 and 93 and 94 support rollers 96 and 97. Bearings 101 and 102 concentrically positioned about pin 98 rotatably mount roller 96 between arms 91 and 92. In a similar manner bearing 103 and 104 concentrically positioned about pin 99 rotatably mount roller 97 between arms 93 and 94.

As shown in FIGURES 2 and 3, a plurality of flexible tubular members extend around rotor 88 between the rotor and casing 81. Tubular members are located in a side-by-side relation and engages inner peripheral surfaces 84, 86, 87 of casing 81 and rollers 96 and 97 as they move around the pump axis. A plurality of fittings 107 and 108 secure the opposite ends of tubular members 106 to base 77 and align the ends of members 106 with separate fluid inlet conduit 129 and outlet conduits 32. Flexible tubular members 106 are made from elastic tough resilient synthetic material which can be repeatedly deformed and yet returned to their original shapes, as fluoroelastomer synthetic rubber.

As shown in FIGURE 3, there is a variable clearance between the outer peripheral surfaces of rollers 96 and 97 with the inner face of casing 81. The straight downward walls 86 and 87 lie along planes which are tangent to the outermost periphery portions of the rollers. As the rollers rotate and move with sleeve 89 they gradually compress flexible tubular members 106 until the rollers are opposite semicircular wall 84. As the rollers reach the straight portion 87, they gradually release the force on elastic flexible tubular members 106.

Referring to FIGURE 6, there is shown a dispensing system having apparatus 10 dispensing resin material to the opposite ends of windings on an armature or rotor 112. Rotor 112 has a shaft 113 and winding ends 114 and 116 which are to be coated and impregnated with resin material. The opposite ends of shaft 113 are rotatably supported on blocks 117 and 118 carried by endless conveyors 119 used to move the rotor through the impregnating machine. A moving belt 121 in engagement with the top of rotor 112 rotates the rotor about a horizontal axis on blocks 117 and 118 so that the fluid material discharge from nozzles 31 is distributed to all areas around the winding ends.

On operation of motor 12 with clutch-brake unit 13 energized by electric control 33 to rotate the drive shaft 14, power is transmitted to belt 17 to speed reduction unit 18. As shown in FIGURE 5, speed reduction unit 18 drives the output pulley 22 thereby transmitting power to the reverse drive means 23. Belt 46 transmits power from pulley 22 to pulley 44 which in turn rotates jack shaft 42. Belt 48 and pulleys 47 and 49 connect shaft 42 with pump shaft 51.

On rotation of pump shaft 51 rollers 96 and 97 rotate in the direction of arrow 109, shown in FIGURE 3, moving the rollers in a circumferential path, half of which is concentric with the inverted semicircular inner face 84 of the casing 81. As rotor 88 turns with shaft 51, rollers 96 and 97 individually turn about their longitudinal axes and engage progressive portions of all flexible tubular members 106 forcing the fluid material in members 106 to flow toward outlet lines or conduits 32 for discharge through nozzles 31.

As the rollers move over the flexible members 106 they are deformed and pressed against the inner face of casing 81. As soon as the rollers leave tubular members 106, the tubular members expand to their original circular shape and draw fluid from the reservoir manifold 28. Substantially equal amounts of fluid will be pumped through each of the tubular members 106 as long as rotor 88 continues to rotate.

On a signal from electrical control 33, clutch brake unit 13 operates to brake output shaft 14 and thereby stops rotation of speed reduction unit 18. This stops
the rotation of output pulley 22. At the same time electrical control 33 energizes solenoid valve 67 admitting fluid under pressure of the head end of the fluid motor through line 71. The fluid under pressure from the opposite end of the motor returns to the reservoir or is discharged to the atmosphere. The fluid pressure drives piston rod 81 out of the fluid motor thereby moving swivel arm 37 in the direction of arrow 111 as shown in FIGURE 4 until arm 52 hits stop 63. With drive pulley 22 fixed, belt 46 will rotate pulley 44 and drive pump shaft 51 in an opposite direction turning rotor 80 in the reverse direction indicated in FIGURE 3 by broken arrow 110. Pressure forces fluid in tubular members 106 back into the mixing manifold 28 and draws the fluid material backwards in conduit lines 32. This produces a slight suction or snipping action terminating the dispensing of fluid material through nozzles 31 eliminating the dripping of the material through the nozzles. Rotor 80 is shown in the second direction about 30 degrees which may be varied by adjusting stop 63.

Repair and maintenance of pump 24 is greatly facilitated with removable casing 81. In the event that one of the tubular members 106 becomes clogged or broken, the operator merely removes casing 81 by unlatching bolts 82 and 83 and withdraws the casing from about rotor 88. The damaged or clogged tubular member is readily replaced. The pump is quickly reassembled by placing casing 81 about the rotor and securing the ends of the casing to end walls 74 and 76 with the use of the bolts 82 and 83.

Referring to FIGURE 7, there is shown a modified fluid material dispensing system indicated generally at 122 for coating and impregnating armor materialings of an armature or rotor 123. Dispensing system 122 comprises a pump 124 operable to deliver coating fluid material under pressure to a plurality of tubular members 136 and 137 connected to nozzles 128 and 129. The tubular members 126 and 127 are flexible wall conduits made from elastic, tough, resilient material which can be repeatedly deformed and yet returned to their original shape. Nozzles 128 and 129 may be the end sections of the tubular members and are directed in a downward direction opposite the ends 131 and 132 of the windings on rotor 123. Opposite ends of rotor shaft 133 are rotatably mounted on blocks 134 and 135 secured to a conveyor or the like. The conveyor supports the rotor in a horizontal position. A belt 136 engageable with the midportion of the rotor is used to rotate the rotor on blocks 134 and 135. Fluid material discharged from nozzles 128 and 129 is dispensed to all areas around the entire ends of the windings.

The flow of fluid material in lines 126 and 127 is controlled by separate control units indicated generally at 137 and 138 respectively. The control units operate to terminate the flow of fluid in lines 126 and 127 about 15 and 22 degrees which may be varied by adjusting stop 63.

As shown in FIGURES 7 and 8, flow control unit 138 has an upper member indicated generally at 138 and a lower member indicated generally at 141. The midsections of members 139 and 141 are pivoted on a transverse pin 142. Member 139 has an arm 143 having integral transverse head 144 engageable with a first top portion 158 of tubular member 127. A finger 146 projects upwardly from the midportion of the member and a leg 147 projects in a direction generally opposite of arm 143. The outer end of leg 147 has a flat section 158 engageable with a second top portion 157 of the flexible tubular member 127. Lower member 141 is similar in shape to the upper member and has a flat section 151 engageable with portion 157 of the flexible tubular member 127 opposite flat section 148 and a transverse head 149 opposite transverse head 144. An upwardly projected finger is integral with the midsection of member 141.

Members 139 and 141 are moved from open and closed positions by a solenoid 153 having a movable core 154. A toggle linkage 156 connects core 154 with the upper ends of fingers 146 and 152.

As shown in FIGURE 7, control unit 138 is in the open position wherein flat sections 148 and 151 have partially closed tubular member 157 providing a restricted passage for the flow of fluid material from the pump to nozzle 129. As shown in FIGURE 8, with the solenoid 153 actuated, control core 154 spreads the toggle linkage thereby spreading fingers 146 and 152 forcing heads 144 and 149 toward each other to pinch section 158 of flexible tubular member 127. This terminates the flow of fluid material from pump 124 to nozzle 129.

With the heads 144 and 149 in a pinched position the flat sections 148 and 151 move in opposite directions away from the flexible tubular member. While the holding force of sections 148 and 151 is removed the tubular member assumes its normal position thereby expanding or increasing the volume of the tubular member downstream from pinched or closed portion 158. This increase in volume of the tubular member reduces the pressure on the fluid material in the tubular member creating a suction or a snipping action which withdraws fluid material up nozzle 129 thereby preventing the dripping of material onto armature winding 132.

In terms of a method of dispensing an amount of fluid material at a discharge location, as the ends of windings of an armature, the invention comprises the steps of placing the fluid material under pressure and moving the fluid material under pressure to a position above the discharge location. The fluid material under pressure is directed by nozzles downwardly to the discharge location, for example, the opposite ends of windings of a rotor. Before the fluid material is dispensed on the windings the axis of the rotor is positioned in substantially a horizontal plane and the rotor is rotated about its axis so that the fluid material may be spread around the windings of the rotor. After a predetermined amount of fluid material has been discharged the flow of fluid is terminated. At the same time the movement of the fluid material toward the discharge location is reversed to prevent the dripping of fluid material from the nozzles to the discharge location.

The invention is defined in the following claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An apparatus for dispensing fluid material comprising a pump means having a member movable to draw fluid material from a supply source and discharge fluid material to a discharge location, power means having a power output member, power transmitting means coupling the power output member with the member of the pump means operable to transmit motion in opposite directions to the member of the pump means, said power transmitting means including control means movable to reverse the direction of the drive to the movable member of the pump means when the power output member of the power means is held stationary thereby reversing the flow of fluid material through said pump means.

2. The apparatus of claim 1 wherein said pump means has a stationary casing having a generally U-shaped inner face, said movable member being a rotor extended axially in the casing, at least one flexible tubular member extended around the rotor and engageable with the inner face of the casing, said tubular member being coupled to the fluid material supply source and the opposite end coupled to means for carrying the fluid material to a discharge location, said rotor having means movable in a circulatory path engaging and compressing successive fluid passages. The fluid material is thus dispensed from the nozzle portion of the pump means.
portions of the tubular member against the inner face whereby fluid material in the tubular member is moved toward the discharge location.

3. The apparatus of claim 2 wherein said casing is removably mounted on end walls of the pump means, a plurality of side-by-side flexible tubular members extend around said rotor and said movable means of said rotor comprising roller means engageable with all of the flexible tubular members whereby separate amounts of fluid material are moved toward discharge locations.

4. The apparatus of claim 3 wherein said flexible tubular members are hoses of fluorelastomer synthetic rubber.

5. The apparatus of claim 1 wherein the power means includes a motor coupled to a clutch-brake unit, said clutch-brake unit selectively operable to prevent movement of the power output member.

6. The apparatus of claim 1 wherein said power transmitting means comprises a shaft, arm means rotatably mounting the shaft, stand means pivotally mounting the arm for movement about an axis extended generally parallel to the axis of the shaft, drive means connecting the shaft with the movable member of the pump means and the power output member, said control means connected to the arm and operable to pivot the arm whereby the drive to the movable member of the pump means is reversed when the power output member of the pump means is held stationary.

7. The apparatus of claim 6 wherein said control means is a double acting fluid motor.

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ROBERT M. WALKER, Primary Examiner.
WILLIAM L. FREEH, Examiner.