July 13, 1954 H. C. SWARTFIGUER 2,683,425

PUMPING SYSTEM

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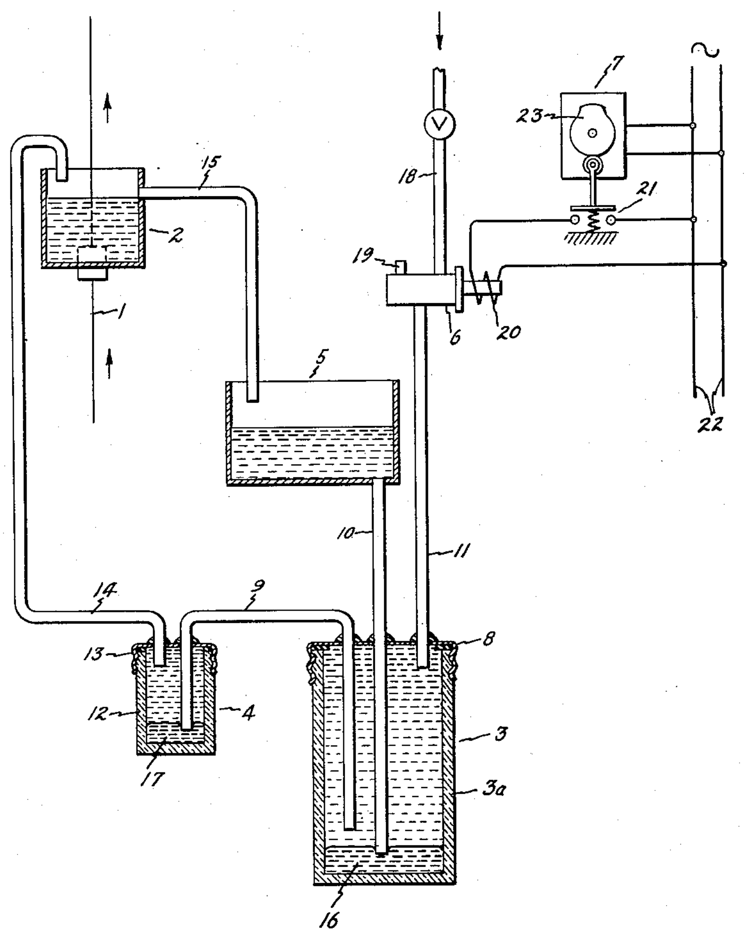

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PUMPING SYSTEM

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4 Claims. (Cl. 103—234)

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This invention relates to a pumping apparatus and in particular to an improved pumping apparatus for a polymer such as polytetrafluoroethylene.

Wire used in the windings of transformers and other magnetic structures requires an insulation which will have desirable electrical properties and a minimum wall thickness to reduce bulk. One of the more modern insulation materials for such wire, hereinafter called magnet wire, is a polytetrafluoroethylene coating in the nature of a paint or varnish. This material, in one form is sold under the trade name of Teflon by the E. I. du Pont de Nemours Company.

It is not intended that this invention should be limited simply to an apparatus for pumping polytetrafluoroethylene or any other particular polymer because the apparatus will work equally well with many polymers and coagulative dispersions. For the sake of ease of description, however, the apparatus will be described in conjunction with a polymer.

Polymers for use as magnet wire insulation are received as water dispersions which cannot be pumped by ordinary means. That is, if the water dispersion is run through a gear pump it tends to coagulate; it will foam and coagulate if agitated violently as would be the situation if it were handled by a centrifugal pump. So, too, the action of a ball valve or any similar squeezing of the material between two solid materials tends to coagulate it.

Accordingly, it is an object of this invention to provide an improved pumping system for polymers and other coagulative dispersions.

It is a further object of this invention to provide an improved inexpensive pumping system whereby polymers and other similar materials may be pumped without coagulation or foaming.

It is a further object of this invention to provide an improver pumping system for cyclically supplying polymers or other similar material to a wire coating apparatus.

Further objects and advantages of this invention will become apparent and the invention will be more clearly understood from the following description referring to the accompanying drawing and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

The single figure in the drawing is a schematic representation of my improved pumping system.

Briefly, this invention comprises a system of containers and tubes defining a predetermined

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flow path in combination with suitable valves and a cyclically applied air pressure supply for the intermittent circulation of a polymer type material to a wire coating mechanism.

In one method of applying a polymer to a wire, the wire 1 is passed through a bath or applicator 2 containing a water dispersion of the polymer. The wire picks up a thin film which is then baked in ovens (not shown) to form a flexible enameled coating. Obviously, the wire can be passed through the bath as many times as necessary to pick up the desired thickness of the polymer.

The problem encountered in this application is to maintain the polymer in a constant state of change to prevent the water dispersion from settling out; that is, the polymer-water dispersion must be circulated through the applicator for the dispersion to retain its desired flexible insulating properties.

It has been pointed out that a polymer suspension cannot be pumped by ordinary mechanical devices, otherwise it will either coagulate or foam. My improved pumping system which prevents coagulation and foaming comprises in addition to applicator 2, a storage tank 3, an anti-flow-back device 4, a return tank 5, a solenoid operated valve 6 for supplying air to the storage tank 3 and a timer 7 for controlling the flow of air through the solenoid valve 6.

Storage tank 3 can be of any suitable size and material providing the material is compatible with the polymer. Glass is one example of such a material, and in the illustrated embodiment a glass jar *3a* is fitted with a tight cover 8 punctured to receive tubes 9, 10 and 11 and then sealed to prevent leakage. Tube 9 interconnects storage tank 3 with anti-flow-back device 4. The latter comprises a storage jar 12, similar to storage tank 3, having a cover 13 apertured and sealed as is cover 8 to receive tubes 9 and 14. Tube 14 interconnects anti-flow-back device 4 with the applicator 2, which in turn is interconnected by means of tube 15 to return tank 5. Return tank 5, which may be physically similar to tanks *3a* and 12 is then interconnected by return line or tube 10 to the storage tank 3.

The interconnected system described and illustrated in the drawing is so constructed that when air is forced through tube 11, which connects the storage tank 3 with an external air supply, the air tends to displace the polymer from tank 3 into tubes 9 and 10 and thereby force the liquid material into both the anti-flow-back device 4 and return tank 5. To prevent the polymer from flowing up into tube 10, a quantity of mercury 16 is placed in the bottom of storage tank 3 to a depth that just covers the end of tube 10. Under these circumstances when air is forced into tube 11, the pressure will act on the polymer and force it up into tube 9 which does not extend as far into the tank 3 as does tube 10. The air pressure in tank 3, simultaneously will force mercury 16 into tube 10 to act as a valve thereby preventing the polymer from flowing up into the return tank 5. Obviously, the mercury will rise only a few inches in the tube 10 when a pressure, in the order of say thirty inches of water is used to force the polymer from storage tank 3 to anti-flow-back device 4.

To prevent liquid flow from anti-flow-back device 4 to tank 3, a second valve is provided by a quantity of mercury 17 positioned to cover the end of tube 9 within jar 12. The function of the mercury 17 is similar to the mercury 16; that is, under pressure conditions wherein there is a greater pressure in tube 14 than in tube 9 the mercury will flow into the end of tube 9 and act as a valve. The mercury pool 17 will also prevent siphoning of the polymer into the storage tank 3 when air pressure is taken off tube 11.

This structure provides a basic flow path for the polymer wherein, under suitable pressure conditions, the polymer flows through tube 9 from tank 3 to anti-flow-back device 4, through the mercury 17 and through tube 14 to the applicator 2. The polymer is then free to flow by gravity from the applicator through tube 15 to return tank 5.

It has already been stated that when the air pressure is raised in tube 11, the mercury pool 16 is forced up into tube 10 to act as a valve thereby preventing the flow of the polymer from storage tank 3 to the return tank 5. This same mercury pool serves a dual function in that it prevents the siphoning or gravity flow of the polymer from return tank 5 to the storage tank 3 when the pressure is raised in tube 11. When air pressure is released from the tube 11, however, the mercury pool 16 will settle to its normal level and the polymer will flow from return tank 5 through tube 10 into storage tank 3. The polymer will bubble through the mercury pool 16 to refill the storage tank 3 and tube 11 up to the level of the return tank 5.

Since the polymer in the storage tank 3 must be replenished periodically from the return tank 5, it is advantageous to provide a mechanical means for supplying an intermittent flow of air through tube 11 into storage tank 3. Such a mechanical means is accomplished in the illustrated embodiment by a solenoid valve 6 which is positioned to interconnect tube 11 with an air supply line 18. When solenoid valve 6 is open, the outlet valve 19 is closed to the atmosphere and the air from supply line 18 passes through the valve into tube 11, and thence into storage tank 3. When valve 6 is closed, the outlet tube 19 is opened to the atmosphere whereby the air contained in storage tank 3 can flow through tube 11 and to the atmosphere.

While a solenoid valve has been illustrated, and while its operation will hereinafter be described, it is to be understood that other pumping devices, for example, a diaphragm pump of the automobile fuel pump variety will also function satisfactorily to furnish an intermittent supply of air to storage tank 3.

For the cyclic opening of solenoid valve 6, which has an operating coil 20, a switch 21 is positioned in one of the conductors connecting coil 20 to a power line 22. The closing of switch 21, in turn, is controlled by a timer 7 driven from the power line 22. The timer has a cam 23 positioned to act on a cam follower 24 to close the contacts of switch 21 at every revolution of the cam 23. Obviously, the time of closing of the contacts 21 and the rate of rotation of the cam 23 can be controlled by simple mechanical arrangements.

With the position of the elements of this apparatus as shown in the drawing, the contacts of switch 21 are open, coil 20 is de-energized, solenoid valve 6 is closed and tube 19 interconnects tube 11 with the atmosphere. Accordingly, since there is atmospheric pressure within the storage tank 3, the mercury pool 16 has fallen to its normal level and the polymer flows by gravity from return tank 5, through tube 10, bubbles through the mercury 16 and up into tube 11 until it reaches a level as determined by liquid level in return tank 5.

When timer 7 drives cam 23 to a position where it acts on cam follower 24 to close the contacts of switch 21, coil 20 is energized, solenoid valve 6 is opened and air flows from air supply line 18, through valve 6, and tube 11 into storage tank 3. The air then acts upon the polymer within storage tank 3, forces the mercury 16 up into tube 10 and pushes the polymer through tube 9 into anti-flow-back device 4, through the mercury pool 17 into tube 14 and then into the applicator 2. The polymer will flow from storage tank 3 so long as air pressure is applied or until its level recedes below the end of tube 9. Accordingly, the air pressure, as controlled by cam 23, is timed for a flow of a predetermined quantity of the polymer from storage tank 3 to the applicator 2. At the elapse of this predetermined period, the cam 23 releases follower 24 to open the contacts of switch 21; solenoid valve 6 is then closed and tube 11 is again interconnected with the atmosphere through tube 19. Under these conditions, the mercury pool 16 recedes to its normal level and the polymer, which has moved by gravity from the applicator 2 into return tank 5, returns to storage tank 3 and rises in tube 11 to a level which is determined by the head of the polymer in the return tank 5.

It has been found that this embodiment of the pumping system has worked very well in supplying a water dispersed polymer to an applicator, but it is obvious that other modifications of this apparatus will occur to those skilled in the art and it is desired to be understood, therefore, that this invention is not to be limited to the particular embodiment disclosed but rather it is intended to cover all modifications which are within the true spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An improved polymer pumping apparatus comprising a storage tank having an inlet tube, an outlet tube and a return tube therein, the end of said return tube being positioned nearer the bottom of said tank than the end of said outlet tube, a pressure tight cover for said tank apertured and sealed to receive said tubes, a quantity of mercury in the bottom of said storage tank to cover the end of said return tube, an applicator tank, tube means connecting said applicator tank to said outlet tube and means for cyclically supplying air pressure to said storage tank through said inlet tube to force said mercury into said return tube and close the return tube from flow

of said polymer therethrough and to force said polymer through said outlet tube to said applicator tank.

2. An improved polymer pumping apparatus comprising a storage tank having an inlet tube, an outlet tube and a return tube therein, a pressure tight cover for said tank apertured and sealed to receive said tubes, a quantity of mercury in the bottom of said storage tank to cover the end of said return tube, an anti-flow-back tank, first tube means interconnecting said anti-flow-back tank with said outlet tube of said storage tank, a quantity of mercury covering the end of said tube means in said anti-flow-back tank, an applicator tank, second tube means interconnecting said anti-flow-back tank with said applicator tank and means for supplying air pressure to said storage tank through said inlet tube to force said mercury into said return tube and said polymer through said outlet tube to said applicator tank through said anti-flow-back tank.

3. An improved polymer pumping apparatus comprising a storage tank having an inlet tube, an outlet tube and a return tube therein, a pressure tight cover for said tank apertured and sealed to receive said tubes, a quantity of mercury in the bottom of said storage tank to cover the end of said return tube, an anti-flow-back tank, first tube means interconnecting said anti-flow-back tank with said outlet tube of said storage tank, a quantity of mercury covering the end of said first tube means in said anti-flow-back tank, an applicator tank, second tube means interconnecting said anti-flow-back tank with said applicator tank and means for cyclically supplying air pressure to said storage tank through said inlet tube to force said mercury into said return tube and said polymer through said outlet tube to said applicator tank, said pressure means comprising a solenoid operated air valve having an open and a closed position, means connecting said solenoid valve with a compressed air supply whereby air pressure is conducted through said solenoid valve when it is in its open position, said solenoid valve in its closed position connecting said inlet tube to atmosphere, and timer means for cyclically opening said solenoid valve.

4. An improved apparatus for pumping a liquid coagulative dispersion comprising a storage tank having an inlet tube, an outlet tube and a return tube therein, the end of said return tube being positioned nearer the bottom of said tank than the end of said outlet tube, a pressure tight cover for said tank apertured and sealed to receive said tubes, a quantity of mercury in the bottom of said storage tank to cover the end of said return tube, an applicator tank, tube means connecting said applicator tank to said outlet tube, and means for supplying air pressure to said storage tank through said inlet tube to force said mercury into said return tube and close the return tube from flow of said liquid dispersion therethrough and to force said liquid dispersion through said outlet tube to said applicator tank.

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