

Oct. 25, 1966

K. R. SCHNEIDER ETAL

3,280,860

FLUID DISPENSER

Filed March 27, 1963

2 Sheets-Sheet 1

FIG. 1

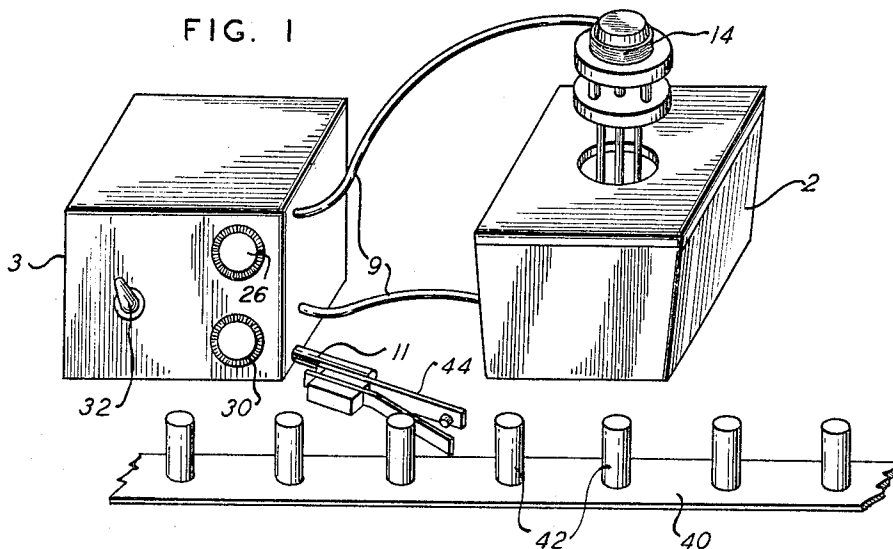


FIG. 3

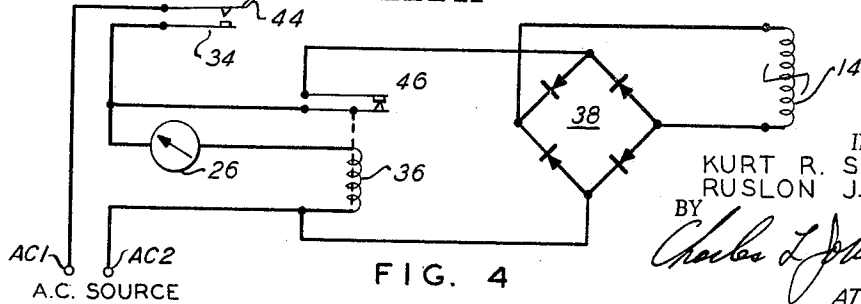
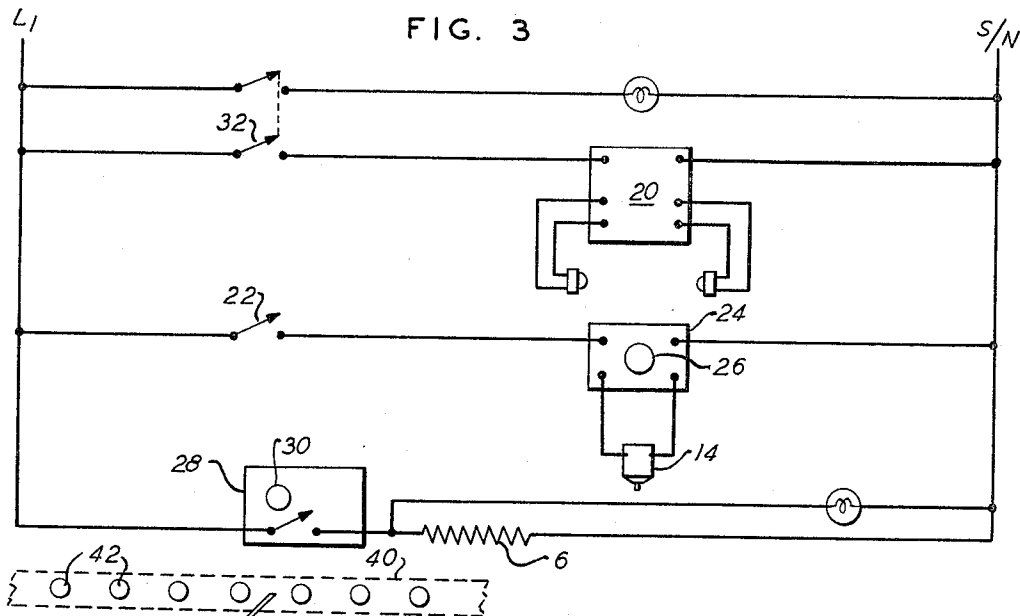


FIG. 4

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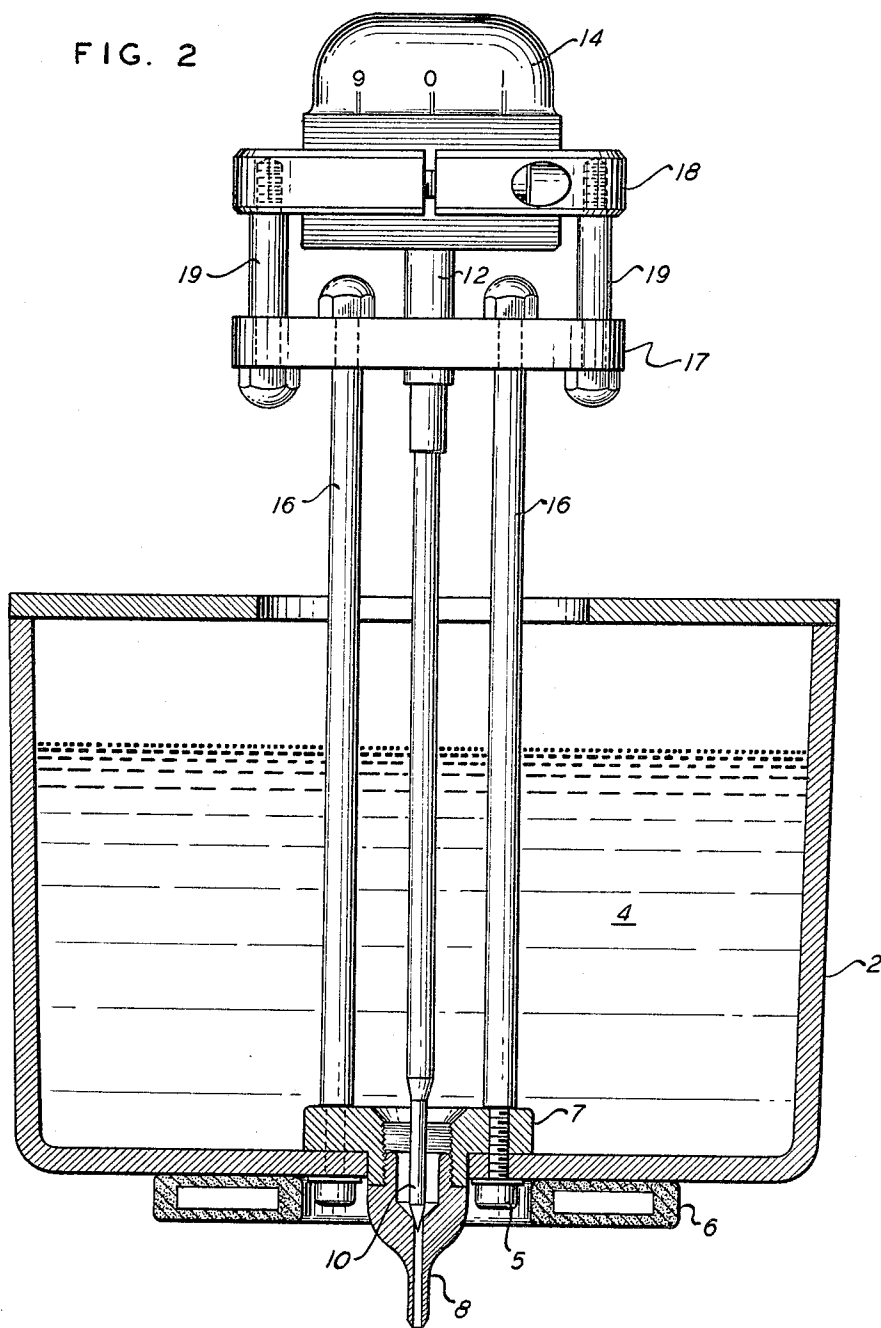
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FLUID DISPENSER

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FLUID DISPENSER

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17 Claims. (Cl. 141-160)

This invention relates generally to dispensing devices and more particularly to apparatus for controlling the dispensing of fluid material.

To identify or describe, or to supply instructions for the use of the contents of product containers or other objects it is necessary to apply labels, folders or other types of informative material to the container. Although different types of liquid adhesives may be used and are intended as equivalents for this purpose, this description shall refer to the use of wax. This usage however is not intended as a limitation on the many equivalent substances. The term folder is used generically herein to include all types of labels, folders, signs, marks or other indicia which may be used by application to containers or products as an informative supplement thereto. One specific folder which may be applied by use of the described device is the Outserts folder.

In applying a folder to a container one procedure is to apply adhesive to the container and then apply the folder to the adhesive. Any or all of the steps associated with this operation may be carried out manually or automatically.

In carrying out the operation it is obvious that certain conditions are desirable to assure that the folder is attached to the article in an efficient and secure manner. If the adhesive is applied to the container by the use of a wax applicator having a dispensing nozzle and the physical position where the folder is applied is a distance affecting timing, it is of great importance to provide the proper fundamentals necessary to overcome the time lag so that the adherence and cohesion properties of the drop of wax is not impaired. It is important to obtain a drop of wax which, in formation, takes on the shape of a flattened out sphere after being deposited upon an article ready to receive a folder.

It should be noted that certain different results may be desired depending upon the use as a label or folder applicator. Whereas a label is generally applied for the purpose of staying with the container, it is in some instances desirable that a folder be applied to an article in such a way that it may be easily removed from the article without damage to the folder. In this instance a small drop of adhesive is much more desirable than a large adhesive surface which would be preferred in the case of a label.

In addition to the shape of the drop required, it is essential that the hot wax, after being dropped upon an article, retain much of its temperature and, with it, its fluid stage, as long as possible. It is to be remembered that a time lag has to be dealt with from the moment of applying the wax to the instant a folder is placed upon the wax. It can also be seen that, in order to obtain a clean and orderly work procedure, it is important that the size of the wax drop be uniform and that there is no leak from the discharge orifice between articles. Previous experience has indicated that to obtain all of these desired factors has not been a matter of simple solution. Valves and various other methods of dispensing wax have been employed with varying results, but each has had certain disadvantages. It is to the eradication of these difficulties that the present invention is directed.

It is therefore a broad object of this invention to provide an improved fluid applicator.

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It is another object of the invention to provide apparatus for the accurate formation and measurement of a drop of fluid.

It is another object of the invention to provide an automatic wax dispenser.

It is a further object of this invention to provide an improved wax dropper with adjustments for measurement of the fluid dispensed.

It is a further object of this invention to provide an improved wax dropper including control circuitry for operation of the wax dropper.

One feature of the invention is the use of the axial and rotary motion of a rotary solenoid to control the opening and closing of the dispenser nozzle.

Another feature of the invention is the use of a photoelectric cell to control the operation of the fluid dispenser.

Another feature of the invention is the use of an adjustable time delay control to adjust the operation of the dispenser.

Another feature of the invention is the use of an adjustable rotary solenoid so the amount of fluid dispensed may be adjusted either to control the fluid dispensed directly or to compensate for temperature and mechanical variations.

Another feature of the invention is the combined use of a photoelectric cell, time delay and solenoid to provide an automatic wax dispenser.

These and other objects and novel features of the invention are set forth in the appended claims and the invention as to its organization and its mode of operation will best be understood from a consideration of the following detailed description of the preferred embodiment when used in connection with the accompanying drawings which are hereby made a part of the specification, and in which:

FIG. 1 is a perspective view of the fluid dispenser with control panel.

FIG. 2 is an elevation view, partially in cross-section, of the fluid dispenser with solenoid controlled nozzle valve.

FIG. 3 is a schematic diagram of control circuitry for the fluid dispenser using a photoelectric container detector.

FIG. 4 is a schematic diagram of the solenoid control circuitry as used with a mechanical container detector.

The preferred embodiment of this invention provides for a wax dispenser having a nozzle valve which is controlled by the lateral or axial motion, as well as the rotary motion, of a rotary solenoid. In other words the energizing and deenergizing of the type of rotary solenoid using ball bearings in a race, results in a small lateral, in addition to a rotary, motion which is used to valve a wax dispensing nozzle. An adjustable time delay circuit is provided to control the length of time the valve is open and a solenoid spacing adjustment also affects the valve operation so as to vary the amount of fluid dispensed.

Fluid, depending upon its viscosity, will have a comparable cohesion factor. Therefore, separating any amount thereof by only the force of gravity will vary in volume and speed of separation. The dispensing of a predetermined amount of liquid by the force of gravity alone appears to be dependent upon the accumulation of a precise number of drops corresponding to the specific volume and viscosity of the liquid being dispensed through a given diameter orifice. Accumulation of moisture upon a flat surface will hold until the weight of the mass becomes greater than the cohesion factor of the fluid. When this occurs the fluid will start to move toward the lowest point and begin to form a suspended drop. When a drop has reached a maximum in size and volume so that its weight becomes greater than the

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force of cohesion, the neck of the drop, or its point of attachment, becomes smaller as the weight continues to increase.

There is another factor governing the formation of the size of a drop and that is the influence of atmospheric pressure. This indicates that, as long as the diameter of the neck of a drop comprises an area equivalent to the sphere end of the drop, it will remain suspended. When the pressure differential tips the scale of balance the drop will fall off. All conditions held constant, the drop will be of equal and precise volume each time.

From the foregoing it can be seen that, in order to dispense liquid in minute amounts, and to do so accurately, the discharging orifice should be the lower end of a verticular channel sealed on the upper end by a valve leading to a reservoir.

The smallest amount of any liquid that can be discharged under any given condition will always be the precise equal in volume as a drop formed in the manner previously explained. This means the size of a drop is governed by a fixed physical science rule which is expressed in the relationship of size of orifice of the tubular channel, the length of liquid column above the orifice, the viscosity property of the liquid, the cohesion factor and the atmospheric pressure.

This automatically prescribes in well fixed terms the practical application of what can and what cannot be done.

Any liquid dispenser for the purpose of metering minute amounts accurately can never be actuated to dispense an amount less than one drop, by pure gravity. The size can vary as established above. It can also dispense a larger amount in multiples of precise drops, but never in fractions of a drop, unless means other than gravity is used.

This means that the controlling elements that control the amount dispensed from the column above the orifice must be so accurate as to meter properly the exact amount of one drop or a multiple of drops.

It is to be noted that what is measured by a valve is not necessarily the amount that drops from the orifice if the measuring is not consistently accurate in coordination with the viscosity of the fluid being dispensed; i.e., if the equivalent of 5 drops is desired, but the valve is set so that $4\frac{3}{4}$ drops are measured, 4 drops will fall and $\frac{3}{4}$ drop will adhere to the orifice. On the next cycle, $4\frac{3}{4}$ drops will again be measured, but 5 drops will fall and, now, one-half drop will adhere to the orifice, and so on, in progression.

Referring now to the figures, FIG. 1 is a perspective view of the fluid dispenser of this invention with its control panel for controlling the dispensing of liquid drops. FIG. 1 includes a fluid container 2 in which a rotary solenoid 14 is mounted. A control panel 3 has a control switch 32, a temperature control 30 for adjusting the temperature of the fluid, a time delay control 26 for adjusting the amount of time that the solenoid 14 is energized, and interconnecting cables 9 between the control panel and the fluid container. A container detector 44 acts to detect containers 42 on the conveyer surface 40 and acts through cable 11 to send information to the control panel 3.

FIG. 2 is a partial cross-sectional view of the fluid dispenser. In general, lateral and rotary motion imparted to shaft 12 upon the activation of solenoid 14 operates valve 10 in nozzle 8 to dispense the molten wax 4.

A container or storage means 2 having fluid has valve or valving means such as elements 8 and 10 of FIG. 2 associated with the storage means and also has valve activation means such as the solenoid 14. Various embodiments also include temperature altering means such as the heater 6 under control of an adjustable thermostat means 28, 30, of FIG. 3, control circuitry means

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including a time delay switch 22, FIG. 3, a time delay 24 with adjustment 26, FIG. 3, for operation of solenoid 14. Certain embodiments of the invention visualize the use of object detecting means of the photoelectric type, FIG. 3, or the mechanical type, FIG. 4, which act upon the detection of objects proximate the dispenser, such as on a conveyer, to initiate the operation of the solenoid by way of first activating a time delay switch 22, FIG. 3, or relay contacts 34, 44, of FIG. 4. A more specific description follows.

Referring to FIG. 2 a wax pot 2, is mounted in the conventional way, relative to the positioning of passing containers on a conveyer. The pot 2 may be a casting having on the bottom, on the outside, a conventional electrical heater, preferably a "Chronalox Ring Type Element." This heater being in the form of a ring has a large center portion free for access to the bottom portion of the pot.

In operation, this heater is controlled by a thermostat assuring proper melting condition for the wax and maintaining of the proper viscosity.

The center section of the pot 2 as shown, reveals the valve mechanism which actually is an independent unit that can be removed in its entirety and installed in any other receptacle or fluid retaining reservoir.

This assembly consists of the following elements: base and mounting 7, for nozzle 8, shown cross-sectioned; needle valve 10, stilt 16, platform 17, leg 19, connector 12, supporting and clamp ring 18, and solenoid housing 14. The solenoid employed is a standard "Ledex Rotary Solenoid," a product of Ledex, Inc., Dayton, Ohio.

As we see the base 7 is held onto the inside surface of the pot 2 by screws 5 which are spaced equally and within the space available of the ring heater element 6. The nozzle 8 screws into the flange projection of the base 7 and therewith provides a seat for the needle valve 10. The stilts 16 also screw into the base 7 in three equally spaced positions. The upper ends being the support for the heat suppressing platform 17. Three legs 19, in turn, are the standards for the clamp ring 18. The solenoid 14, is held adjustable in secure position by the supporting and clamp ring 18.

As described, this assembly is fully self sustained and is operable wherever it is mounted. To explain its simple but precise function, it is assumed that the design and action of a "Ledex Rotary Solenoid" is fully understood.

Such teachings are present in the Ledex Bulletin C-961, where a full description of this type of solenoid and its circuitry is to be found.

From this description, we learn that this solenoid employs a rotor-like acting armature which converts linear electromagnetic pull into rotary motion. This has been the substantiating function which prompted the adaption of this solenoid for the design of a liquid dispenser as disclosed.

Being aware of a powerful and fast linear and rotary motion within precise limits in either direction, a further description of the instant valve mechanism is now in order.

The connector 12 forms a continuation of the shaft extension of the armature of the solenoid (not shown). Both are held firm together by a setscrew, the shaft end being within the sleeve-like connector 12.

The other end of the connector is held also tight together with the needle valve 10 in the same manner by a setscrew. It can now be seen that the armature, the connector 12, and the needle valve 10 form one solid member which, in turn, assures the fact that any motion imposed upon the armature in its normal prescribed manner will also be evident in facsimile on the other two attached members 10 and 12.

One other way of a positive and efficient valve construction is to have the armature shaft extend its standard length to become the equivalent of the members 10 and 12 forming in itself the needle valve.

Having established this fact, we can now fully realize the precise and positive action which the needle valve is exercising upon its seat of the nozzle 8.

In operation, energizing the solenoid will rotate the armature by about 45 degrees and, at the same time, introduce an axial or linear motion. A coil spring, part of the solenoid itself, will return the armature to its normal position when de-energization takes place.

Now, looking again to FIG. 2, we see that the solenoid 14, connector 12 and needle valve 10 forming one independent unit itself can be screwed into the clamp ring 18 until the end of needle valve 10 has seated itself in the nozzle 8.

Remembering now that the needle valve will lift as well as turn when the solenoid is energized, we begin to see that, from the point where the needle valve barely touches its seat in the nozzle, if held there as a starting point, it will lift up the highest or the full travel of the solenoid, if the latter is energized.

Any additional turning of the solenoid 14 by divisions of its calibrated scale will therefore shorten the travel of the solenoid armature and, with it, the lift of the needle valve. Likewise, it is also clear now that the return coil spring of the solenoid will not only press the needle valve against its seat for a leak-proof seal, but it is subjected to a screwlike twist. This prevents the accumulation of impurities on the valve seat.

It, furthermore, by the twisting action, continuously retains and improves its sealing facility.

Turning adjustment of solenoid 14 thus controls the amount of fluid dispensed and may be utilized to compensate for wear of the various parts or for relative positioning variances which may arise due to expansion or contraction due to temperature changes. We have now established the mechanical functions to ascertain a precise and foolproof valve action. It is also easy to understand that, with a given constant lift of the needle valve, there will be a continuous dispensing of liquid in a quantity depending on the size of the valve seat diameter and the duration of the time it is held open.

With this, we are now aware of the necessity of a precise control means to limit the time of holding the valve open to very close fractions. We must capture the time it takes to form a drop on the end of a tubular orifice up to the point just when it is ready to drop off for the previously explained reasons. This must be done without leaving an accumulating bubble, or vice versa, with a slowly but steadily diminishing volume creating the eventual miss of a drop.

The differential of volume causing failure by either having too much or too little to form a bubble is considered the tolerance within which the time control must take place. This tolerance becomes very small when a drop is also small.

At this point, it must be defined that the size of a drop is determined by the diameter of the discharging orifice, the viscosity and cohesion factor and atmospheric pressure.

Therefore, we can state that, for any given size of a drop desired, the size of the nozzle is the deciding factor. For the accuracy of forming the drop, however, the time controlling element is responsible.

For these reasons a variety of nozzle sizes may be interchanged for a given size of drop.

The timing control for holding the valve open is done electrically in the following conventional manner, in one embodiment.

Since the solenoid is of the D.C. type, a corresponding rectifier is employed. A normally open microswitch is closed by a passing article moving on the conveyer belt. The microswitch closes an A.C. circuit to the rectifier which, in turn, triggers the D.C. side to the solenoid energizing it.

Likewise, a second circuit from the microswitch energizes the coil of a variable timing relay actuating it in

a delayed manner regulated by a potentiometer. A pair of contacts of this relay, normally closed, are in series with the A.C. circuit of the rectifier. This causes the A.C. supply to the rectifier, and, in turn, the D.C. line to the solenoid, to be interrupted as soon as the timing relay responds. The time it takes and which is variable by the potentiometer is the time duration the value will stay open.

The accuracy of the time delay relay and its manual variable control is responsible for holding, within a positive range, for dispensing a liquid within the tolerance limit of forming a drop of whatever size is fixed by the nozzle and the other known component factors. A detailed description of the operation appears infra.

FIG. 3 is a schematic representation of the control circuitry for the fluid dispenser in which a photoelectric unit 20, upon the interruption of its light beam by a container, acts to close switch 22 to apply voltage to the time delay unit 24. The time delay unit 24 has an adjustable control 26 which controls the operation of the solenoid 14 relative to the closing of the photoelectric circuit. The thermostat 28 with its control 30 controls the current to the heating element 6 so as to maintain the wax in its proper molten condition. Switch 32 acts as an on-off switch for the dispenser control panel.

FIG. 4 relates to the use of a control circuit activated by a mechanical container detector.

The main elements to be presented in the circuit of this electrically operated wax dispensing valve are as follows:

A normally open microswitch 34, a one pole normally closed time delay relay 36, a silicon bridge type rectifier 38 and a rotary solenoid 14.

In operation a conveyer belt 40, upon which articles 42 are moved, passes the microswitch 34. The interposing arm 44 is actuated by the passing article and thereby closes the contact and keeps it closed for the duration of passage.

One side of an A.C. source will form a circuit from AC1 through now closed contacts 34-44, through the closed contact 46 of the time delay relay 36, to one side of the A.C. input of the bridge 38 and then back to AC2.

A circuit will also be established from AC1 through the closed contact of the microswitch 34 to one side of the time delay rheostat 26 through coil 36 and out to the other side of AC2.

The D.C. side of the bridge 38 is in series with the coil of the rotary solenoid 14.

By the foregoing described circuit it can be seen that with the closing of the microswitch 34 we have supplied an A.C. current to the bridge 38 which in turn renders a D.C. current to the rotary solenoid 14, activating it and holding it operative for as long as the contact 46 of the time delay relay 36 remains closed.

However, since the coil of the time delay relay 36 is also in the same A.C. circuit which will be established when the microswitch 34 is closed, it too will be energized. When that occurs the contact 46 will open and therefore interrupt the A.C. supply to the rectifier which in turn will deenergize the rotary solenoid 14.

Since the relay 36 is of the time delaying type controlled in the conventional way manually by the potentiometer 26 its time of response can be varied as desired thereby holding the dispensing valve open for any predetermined duration.

When an article has passed the microswitch 34 position the contact 34-44 is rendered open, so that the A.C. circuit to the relay coil 36 is broken and therefore closes its contact 46 again.

With another article now approaching the microswitch 34 the circuit to operate the rotary solenoid 14 of the dispensing valve is now ready for the next cycle.

From the above it is readily seen that apparatus has been described which carries out the objects of the invention.

It should be understood that this invention is not limited to specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit of the invention; the scope of the invention being set forth in the following claims.

What is claimed is:

1. A fluid dispenser: comprising
 - (a) container means adapted to receive a fluid to be dispensed;
 - (b) actuatable valve means disposed in said container means and including an orificed element and a movable restricting element coacting with said orificed element to dispense fluid from said container means; and
 - (c) solenoid operated valve actuating means coacting with said movable restricting element to both rotate and linearly translate said movable restricting element and either move same linearly towards and rotatably upon said orificed element to close said orifice and prevent the dispensing of fluid therethrough when fluid is disposed in said container means, or to move said restricting element in a similar manner away from said orificed element to open said orifice and permit the controlled dispensing of fluid therethrough when fluid is disposed in said container means.
2. The dispenser of claim 1: wherein said solenoid operated valve actuating means includes a rotary solenoid.
3. The dispenser of claim 1: wherein said actuatable valve means is adapted to dispense fluid from said container means in drop form.
4. The dispenser of claim 1: wherein said container means and said actuatable valve means are adapted to dispense the fluid by gravity.
5. The dispenser of claim 1: wherein heater means are associated with said container means to maintain material disposed therein in a fluid condition.
6. The dispenser of claim 1: including
 - (a) conveyor means disposed in proximity to said container means for transporting articles past said container means so as to receive fluid when dispensed from said container means;
 - (b) detecting means responsive to the passage of articles on said conveyor means and electrically interconnected with said solenoid operated valve actuating means to control the operation thereof in relationship with the passage of articles on said conveyor means.
7. The dispenser of claim 6 wherein said detecting means includes a mechanical switch having a pair of normally open contacts disposed in the path of movement of the articles on said conveyor means and closed by each article as it passes by.
8. The dispenser of claim 6 wherein said detecting means includes a photocell disposed in the path of movement of the articles on said conveyor means and responsive to the passage of each article thereby.
9. The dispensing means of claim 1 including electrical delay means coacting with said solenoid operated valve actuating means to control the operation thereof.
10. The dispensing means of claim 1 wherein said solenoid operated valve actuating means is adjustable to thereby control the amount of fluid to be dispensed.
11. Apparatus adapted to dispense drops of adhesive on successive ones of a plurality of articles when transported along a predetermined path; comprising
 - (a) a container adapted to receive adhesive and disposed in proximity to the predetermined path;

- (b) a valve disposed in said container and including an orifice formed to permit the adhesive to pass therethrough in drop form and positioned to drop the adhesive on the articles as they travel along the predetermined path, and a needle adapted to seat in said orifice to prevent the adhesive from passing therethrough;
 - (c) a rotary solenoid connected to said needle to move same in both a rotational and linear manner away from said orifice to permit the fluid to pass therethrough in drop form, and to move said needle both linearly towards and rotatably against said valve to close said orifice with a wiping action to thus prevent fluid from passing therethrough;
 - (d) said rotary solenoid including selectively adjustable control means to control the extent to which said rotary solenoid moves said needle away from said orifice and to thereby control the number of drops of fluid which pass therethrough; and
 - (e) electrical circuit means responsive to the passage of articles along the predetermined path and coacting with said rotary solenoid to energize and deenergize same in proper time to permit fluid to be deposited on each article.
12. The apparatus of claim 11: wherein said container has disposed thereon a heating coil for melting material when disposed therewithin to facilitate the passage thereof through said orifice.
 13. The apparatus of claim 11 wherein said valve and said rotary solenoid are insertable into said container and removable from said container as a unit.
 14. The apparatus of claim 11: wherein said electrical circuit means includes a mechanical switch disposed in the predetermined path to be successively closed and opened by the passage of articles along the predetermined path and coacting with said rotary solenoid to control the energization and deenergization thereof.
 15. The apparatus of claim 14 including adjustable delay means coacting with said electrical circuit means and said mechanical switch to control the extent of time between energization and deenergization of said rotary solenoid.
 16. The apparatus of claim 11 wherein said electrical circuit includes photocell means disposed for operation by each successive article as it passes along the predetermined path and coacting with said rotary solenoid to control the operation, energization and deenergization thereof.
 17. The apparatus of claim 16 including adjustable delay means coacting with said electrical circuit means and said photocell means to control the extent of time between energization and deenergization of said rotary solenoid.

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