Sept. 20, 1966 G. E. HORECZKY 3,273,752

PHOTO-ELECTRIC CONTROLLED DISPENSER

Filed Feb. 11, 1965

FIG. 1

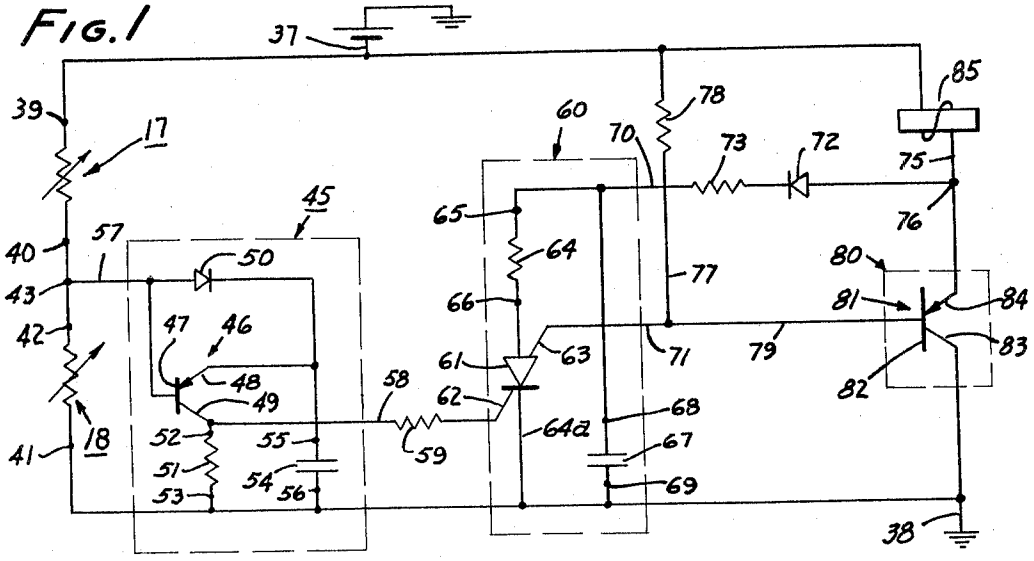

FIG. 2

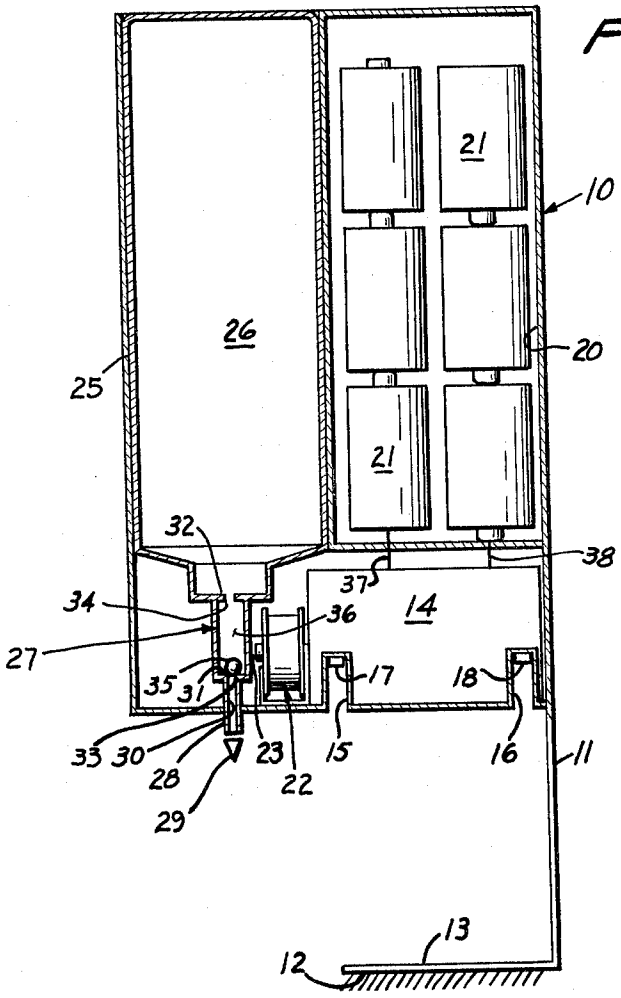

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PHOTO-ELECTRIC CONTROLLED DISPENSER

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This invention relates to dispensers.

An object of the invention is to provide a dispenser which is adapted automatically to dispense a predetermined quantity of flowable matter. Liquids such as soaps and lotions may be dispensed by this device, as well as liquid-solid slurries and even fluidized powders.

An additional object of this invention is to provide means for actuating such a dipsenser which means can be energized without physical contact with any object, which means is proof against "hanging up" so that the container might be emptied with one energization, and which means can be wholly self-contained and independent of outside power sources.

Still another object of this invention is to provide a container which carries its own closure means, which closure means can be actuated without direct contact of any kind.

The dispenser of this invention is designed to dispense flowable materials in measured amounts without requiring any physical contact for actuation. There are many fields in which sterile procedures are used wherein this feature is a considerable advantage. Examples are to be found in medicine, and in the food, drug, and space industries.

The system according to this invention can be provided in a completely self-contained unit without dependence on external power connections. It is adapted to be powered by standard flash light batteries which operate at such a low voltage as to prevent shock and sparking hazards. This dispenser can therefore be used to dispense volatile or even explosive materials.

The electronic system as used is designed to assure long battery life so that only occasional maintenance consisting of nothing more than battery replacement is required. Furthermore, except for one single, freely moving pellet, there is no moving part. Furthermore, the circuitry can be made up entirely of solid state components.

Although it operates with light sensitive devices, this system does not depend on any built-in light source, nor upon the breaking of a special light beam. Average room lighting which may range from the brightest sunshine to a mere dim night light is the only requirement for operation. The device adjusts itself to any light levels so that no initial or subsequent adjustments are required. Slow or even rapid changes in light level such as the gradual setting of the sun or the switching on and off of room lights will not interfere with the functioning of this device.

A dispenser according to this invention comprises a container which has an outlet orifice, with an internal seat adjacent to the orifice. A free magnetizible pellet is placed inside the container, this pellet having greater lateral dimensions than the orifice so as to close the same when it rests upon the seat. An electromagnet is placed outside the container adjacent to and spaced above the seat, whereby energizing the electromagnet will remove the pellet from the orifice to permit flow of material through the orifice. A first and a second light responsive member are provided, together with a source of electrical energy. Switching means is provided which is so interconnected with the two reference members, the electromagnet and the source, that a difference in light intensity between the two reference members will actuate the switching means to connect the electromagnet to the source and energize the same, thus removing the pellet from the seat and opening the container.

According to a preferred but optional feature of this invention, the two reference members constitute a voltage divider circuit having a junction between the members, this junction providing a reference voltage for actuation of the switching means.

According to still another preferred but optional feature of the invention, the switching means includes a discriminator circuit responsive to the said reference voltage, a timing circuit actuated by the discriminator circuit, and a power amplifier under the control of the timing circuit. The resultant circuitry serves to energize the electromagnet for a predetermined period of time in response to a difference in light level of the two light responsive reference members.

Further preferred but optional features of this invention reside in a container having said orifice and the pellet, together with the specific sensing and circuitry means that enable the objectives of the invention to be accomplished.

The above and other features of this invention will be fully understood from the following detailed description and the accompanying drawings in which:

FIG. 1 is a circuit drawing of the preferred embodiment of the invention; and

FIG. 2 shows the housing and physical elements which are under the control of the circuit of FIG. 1.

In FIG. 2 there is shown a housing **10** which includes an upright support **11** and a reflector **12**. The upper surface **13** is reflective, which might constitute a white, diffusing painted surface.

A circuit chassis **14** is mounted in the housing. It has a pair of openings **15**, **16** which respectively house a first and a second light responsive reference member **17**, **18**. Occasionally first member **17** will be referred to as the "trigger member" and the second member **18** will be referred to as the "reference member." Both of these members overhang the reflector and are directed toward the same general region, whereby they will ordinarily receive approximately the same luminous flux.

The housing also includes a battery compartment **20** which provides support for six dry cells **21** which may be connected end to end in series. Adjacent to the electronic chassis there is an electromagnet **22** with its air gap **23** facing to the left in FIG. 2. A container **25** is shown supported, upside down, by the housing. This container includes a base portion **26** and a neck portion **27**. The neck portion is provided with a nozzle **28** which may originally have been provided with a closed tip **29**, which closed tip could be snipped off to open the neck outlet **30**. This construction constitutes a substantially tamper-proof container. It will be recognized that it could have used a standard cap closure if desired, losing only the tamper-proof feature.

The neck encloses a first and a second orifice **31**, **32** each having a central axis lying vertically in the plane of FIG. 2. The axes are coincident in the illustrated example. A seat **33**, **34** is provided adjacent to each of these orifices. A pellet **35** of magnetizible material is placed in the region **36** (sometimes called a "conduit") between the two orifices. The presently preferred embodiment of pellet is a steel ball. It has lateral dimensions (i.e., a diameter) bigger than those of the orifice (i.e., the diameter of a circular orifice), so that when in the position shown in FIG. 2 it will close the orifice and prevent flow from the container. However, the axial spacing between the two orifices is greater than these two lateral dimensions of the pellet, and a lateral dimension of the pellet is less than a lateral dimension of conduit **36**, so that there is a pellet position, such as against the conduit wall, wherein the pellet will leave both orifices unim-

peded, and will permit flow through the conduit. The function of this invention is to draw the pellet toward the air gap of the electromagnet, and thus to this position, by exerting a magnetic field, thereby to open the first orifice. When the electromagnet is de-energized, the pellet will fall upon the seat to rest upon the same and close the orifice.

The second orifice is provided to trap the ball in a more convenient location in the neck while the container is upright, rather than to let it fall into the base portion of the container. Furthermore, should the power in this device fail, with this construction the container can be picked up and shaken to expel the material much as in a salt shaker, with the pellet simply rattling around in the space between the orifices. The preferred material of the container will be plastic or glass, but in any event it should not be magnetizible material lest it interfere with the action of the magnetic flux on the pellet.

The circuitry to cause the energization of the electromagnet in response to partial occlusion of reference member **17** will now be described, with initial reference to FIG. 1. Leads **37**, **38** are shown connected to the battery compartment, and are also shown in FIG. 2. For convenience lead **38** will be regarded as the reference or ground lead.

Light responsive members **17**, **18** are shown in FIG. 1, member **17** having first and second terminals **39**, **40** and reference member **18** having first and second terminals **41**, **42**, respectively. Terminal **39** is connected to lead **37** and terminal **41** to lead **38**. The second terminals **41**, **42** are joined at a reference junction **43** which junction provides the reference voltage which is used as the actuation signal for the entire circuit. The two light responsive reference members which may be photo-cells, have an approximately equal resistance, and are interconnected between the two sides of the battery circuit. Therefore, when their resistances are equal by virtue of exposure to equal luminous flux, the voltage at reference junction **43** will always be the same, that is one-half of the battery voltage. This is true regardless of what the actual resistance of members **17** and **18** may be, and is therefore also true regardless of what the luminous intensity is. The cells may have very high resistances by virtue of a very low luminous intensity, or they may have very low resistances because of a high luminous intensity, but so long as they are substantially the same then the voltage at reference junction **43** does not change. However, should either of the reference members be occluded, such as by placing the hand under reference member **17**, it will serve to change the resistance of one relative to the other. This will result in a change in the voltage at reference junction **43**. The actuation of this device depends upon the occlusion of reference member **17**. When this occurs, the resistance will increase in member **17** and this will cause the voltage at reference junction **43** to drop to a lower value, thereby providing a signal effective to trigger the remainder of the circuit which now will be described.

There is first provided a discriminator circuit **45** which is responsive to changes in voltage at reference junction **43**. The discriminator circuit includes a pnp transistor **46** having a base **47**, emitter **48**, and collector **49**. The discriminator circuit also includes a diode **50** whose forward direction is as indicated, and also a resistor **51** having first and second terminals **52**, **53** and a capacitor **54** having first and second terminals **55**, **56**.

The base of the transistor and the forward end of the diode are connected to the reference junction by lead **57**. The first terminal of capacitor **54** and the blocking side of the diode are connected to the emitter of transistor **46**. The second terminals of resistor **51** and capacitor **54** are connected to ground lead **38**. The first terminal of resistor **51** and the collector of the transistor are connected by output lead **58** to a safety resistor **59** and thence to a timing circuit **60**. It is a function of the discriminator circuit to provide a signal in output lead **58** which will cause the timing circuit to go into operation, thence to energize the electromagnet.

The timing circuit includes a silicon controlled switch **61** which includes a cathode gate **62** and an anode gate **63**. Output lead **58** beyond the safety resistor **59** is connected to the cathode gate. The base of the silicon controlled switch is connected through lead **64***a* to ground lead **38**. The timing circuit additionally includes a resistor **64** having first and second terminals **65**, **66** and a capacitor **67** having first and second terminals **68**, **69**. Terminals **65** and **68** are connected to each other and to a common lead **70**, and terminal **69** is connected to ground lead **38**. The anode gate is connected to lead **71**.

A diode **72** connects through a resistor **73** to lead **70** the other end of the diode connecting to a power line **75** at junction **76**. Lead **71** joins another lead **77** which through a resistor **78** connects with lead **37** and thence to the source of power.

Lead **70** and its incorporated elements constitutes a charging circuit for capacitor **67**. Leads **71** and **77** join to another lead **79** which extends to power amplifier **80**, this power amplifier constituting a pnp power transistor **81** having a base **82**, collector **83**, and emitter **84**. Lead **79** is connected to base **82**, while power lead **75** is connected to the emitter. The collector is connected to ground lead **38**. An electromagnet is incorporated in power lead **75** which power lead is connected to the coil **85** of the electromagnet. The other side of the coil connects to battery lead **37**.

The operation of this circuit will now be described. Assume first that the circuit is in its rest state with capacitors **54** and **67** charged. The power amplifier is cut off. The electro magnet de-energized because the power amplifier is cut off. The container is closed, because the pellet is released to rest on the orifice. This condition will pertain as long as the resistances of the two reference members **17** and **18** remain approximately equal, i.e., so long as the illuminations on the two members are approximately equal. The two reference members constitute a voltage divider, so that the reference voltage between them is unaffected by absolute values.

Now assume that the first reference member **17** is shaded (occluded) so that it produces a higher resistance. Then the voltage at reference junction **43** will drop below its previous value. The emitter will be held momentarily on the previous voltage by capacitor **54**, and the base at the same time becomes negative relative to the emitter. Transistor **46** will therefore conduct. This will produce a voltage across load resistor **51** that is connected to the collector and to the output lead **58**. Diode **50** prevents the discharge of the capacitor **54** through the second reference member **18**.

This arrangement makes it relatively unimportant what absolute value is produced at the reference junction in the quiescent state. Battery voltage decay or even unmatched reference elements **17**, **18** have no influence. Assuming a quiescent state is once reached, then transistor **46** will respond only in changes in voltages at the reference junction.

The time constant of the voltage which appears on the load resistor is determined by the values of resistor **51** and capacitor **54**. As soon as the light balance is restored on both reference members **17** and **18**, capacitor **54** will be recharged through reference member **17** and diode **50**. Then transistor **46** will be cut off and ready for another triggering.

The signal derived from the load resistor appears on output lead **58** and is conducted to the cathode gate of silicon controlled switch **61** in the timing circuit. This voltage will serve to trigger the silicon controlled switch "on." At this time, capacitor **67** discharges through resistor **64** and through the silicon controlled switch. As long as this capacitor discharges, but only so long, the silicon switch will conduct, and the anode gate of the

silicon controlled switch will assume and remain at cathode potential. The cathode is grounded.

On resistor **78** which is located between the anode gate and the supply voltage there will therefore appear a negative-going square pulse. The duration of this square pulse is essentially determined by the time constant of resistor **64** and capacitor **67**. After capacitor **67** is discharged, the silicon controlled switch will cease to conduct and the capacitor **67** will be recharged for another cycle through diode **72** and resistor **73**. However, it cannot again be discharged until the silicon controlled switch conducts, which is a function of the discriminator circuit.

The power amplifier comprises the transistor **81**. The collector of this transistor is grounded and the emitter is connected to the coil of the electromagnet. In the absense of the aforementioned square pulse, both the base and the emitter of transistor **81** have the same potential and the transistor will not conduct. However, the presence of the fully negative-going square pulse drives the transistor into saturation and permits it to conduct, and the current flow through this circuit energizes the electromagnet. The pellet is then moved off the orifice, and a dose of material is discharged.

The recharging of capacitor **67** is accomplished through diode **72** and resistor **73**. This circuit is connected to the emitter of transistor **81**. The capacitor will be charged by this circuit only so long as transistor **81** is cut off. As soon as transistor **81** conducts upon the appearance of the square pulse signal as previously described, charging of the capacitor is impossible. The then-reversed biased diode **72** prevents the discharge of capacitor **67** through the power amplifier. The only way for this capacitor to discharge is through resistor **64** and the silicon controlled switch. Resistor **73** limits the current which can flow through diode **72** to prevent damage to it during the charging operation, and also to prevent accidental triggering of the silicon controlled switch due to transients.

The electromagnet in the output of this unit is constructed so as to produce a strong magnetic field in the air gap. The air gap is physically located at the outside wall of the nozzle to one side and somewhat above the first orifice. The sphere inside the nozzle when resting on the seat by the first orifice sits slightly below the air gap. When the electromagnet is energized, the sphere is pulled away from its seat on its orifice and toward the side wall of the nozzle next to the air gap of the electromagnet. It will be held in this position as long as the electromagnet is energized, which in turn is a function of the duration of the square pulse signal from the timing circuit. This action provides for the measured outflow of the contents of the container, which is also a function of the viscosity of the material, and of the orifice diameter. Only one amount is dispensed at a time, no matter how long the first reference remains shaded. This is a safeguard against accidental emptying of the entire contents of the container at once, because the system cannot "hang up."

This device thereby provides a new and improved dispenser system which can be actuated without any physical contact, and which can be moved from place to place in a room of any light intensity without in any way interfering with the action of the device. Maintenance and construction are simple and the cost can be quite low compared to other systems having fewer functional advantages.

This invention is not to be limited by the embodiments shown in the drawings and described in the description which are given by way of example and not of limitation, but only in accordance with the scope of the appended claims.

I claim:

1. A dispenser comprising: a container having an outlet orifice, an internal seat adjacent to the orifice, and a free, magnetizable pellet inside said container, said pellet having greater lateral dimensions than the orifice so as to close the same when resting on the seat; an electromagnet outside the container, adjacent to and spaced above the seat, whereby energizing the electromagnet will remove the pellet from the orifice to permit flow of material through the orifice; a first and a second light-responsive reference member; a source of electrical energy; and switching means so interconnecting the two reference members, the electromagnet, and the source, that a difference in light intensity between the two reference members will actuate the switching means to permit current flow through the electromagnet, and thereby energize the same to remove the pellet from the seat.

2. A dispenser comprising: a container having an outlet orifice, an internal seat adjacent to the orifice, and a free, magnetizable pellet inside said container, said pellet having greater lateral dimensions than the orifice so as to close the same when resting on the seat; an electromagnet outside the container, adjacent to and spaced above the shoulder, whereby energizing the electromagnet will remove the pellet from the orifice to permit flow of material through the orifice; a first and a second light responsive reference member, a source of electrical energy; a power amplifier in series connection with the electromagnet; a discriminator circuit response to differences in luminous flux between the light responsive reference members; and timing means so connected to the discriminator means and to the power amplifier as to be triggered by a signal by the discriminator circuit to permit current flow through the power amplifier and thereby through the electromagnet to remove the pellet from the seat for a predetermined period time.

3. A dispenser according to claim **2** in which the reference members are connected in series across a voltage source to form a reference junction between them, and in which the discriminator circuit is connected to this reference junction, the discriminator circuit comprising a transistor having a base emitter and cathode, and a load resistor and a capacitor each having a first and second terminal, the second terminals being connected to one side of the power circuit and the first terminals being respectively connected to the emitter and the collector of the transistor, a diode connected between the base and the emitter of the transistor, and an output lead connected to the collector of the discriminator circuit; the timing circuit comprising a silicon controlled switch having a cathode gate and an anode gate, the output lead being connected to the cathode gate, the timing circuit further including a resistor and a capacitor each having first and second terminals, the second terminal of the resistor being connected to the silicon controlled switch and the second terminal of the capacitor and a terminal of the silicon controlled switch being connected to a terminal of the source, the first terminals of the resistor and the capacitor being connected to each other, a signal lead connected to the anode gate, the power amplifier comprising a transistor having a base, emitter, a collector, the signal lead being connected to the base and to a resistor that is connected to another terminal of the source, the electromagnet being connected between the source and the emitter of the transistor, and the collector being connected to another terminal of the power source, and a diode and resistor connected in series between the emitter of the power amplifier and the first terminals of the resistor and capacitor in the timing circuit.

4. A container having an orifice with a central axis, and means for opening and closing said orifice comprising a pellet of magnetizable material having greater lateral dimensions than the orifice and freely movable both laterally and axially relative to the orifice, whereby the pellet may close the orifice by resting in the same in the absence of a magnetic field sufficient to move the pellet away from the orifice, and may be moved away from the orifice to open the same when in the presence of a sufficient magnetic field to cause said movement.

5. A container according to claim 4 in which there are provided two of said orifices, one lying within the container, a conduit connecting the said orifices and having a dimension of axial length and a lateral dimension, the pellet being trapped in said conduit between the two orifices, the orifices being spaced apart by a distance greater than any lateral dimension of the pellet in order that there will be a pellet position wherein both orifices are open, a lateral dimension of the conduit being greater than a lateral dimension of the pellet, whereby fluid can flow past the pellet when it is moved off the orifices, the pellet being freely movable to contact both orifices.

6. A container according to claim 4 in which the orifices are formed in a neck on the container, and in which a removable cap is provided outside of the container relative to the orifices, so as to enclose both orifices within the container.

7. In combination, a container having an orifice with a central axis, and means for opening and closing said orifice comprising a pellet of magnetizable material having greater lateral dimensions than the orifice and freely movable both laterally and axially relative to the orifice, whereby the pellet may close the orifice by resting in the same in the absence of a magnetic field sufficient to move the pellet away from the orifice, and may be moved away from the orifice to open the same when in the presence of a sufficient magnetic field to cause said movement, and

an electromagnet so disposed and arranged as to supply said sufficient magnetic field when energized.

8. A combination according to claim 7 in which there are provided two of said orifices, one lying within the container, a conduit connecting the said orifices and having a dimension of axial length and a lateral dimension, the pellet being trapped in said conduit between the two orifices, the orifices being spaced apart by a distance greater than any lateral dimension of the pellet in order that there will be a pellet position wherein both orifices are open, a lateral dimension of the conduit being greater than a lateral dimension of the pellet, whereby fluid can flow past the pellet when it is moved off the orifices, the pellet being freely movable to contact both orifices.

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