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Florant et al.

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[54] **APPARATUS TO PROVIDE PERIODIC MOVEMENT**

[75] Inventors: **Leroy F. Florant,** Hempstead; **Joseph Glickstein,** New York, both of N.Y.

[73] Assignee: **Syncro-Mist Controls, Inc.,** New York, N.Y.

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[52] **U.S. Cl.** **335/59,** 222/70, 317/141

[51] **Int. Cl.**.....**H01h 7/02**

[58] **Field of Search**.....335/59, 62, 205; 317/141 R; 222/70

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Primary Examiner—Harold Broome
Attorney—Edward F. Levy

[57] **ABSTRACT**

An apparatus for providing periodic movement operatively associated with an aerosol dispensing container to actuate the dispenser. The periodic movement apparatus includes a battery-powered drive system which moves an actuating member. Timing means included in the periodic movement apparatus are associated with the drive system so that the actuating member moves at predetermined periodic intervals. The aerosol dispensing container and the entire apparatus for providing periodic movement are contained within a single portable, self-contained housing.

13 Claims, 8 Drawing Figures

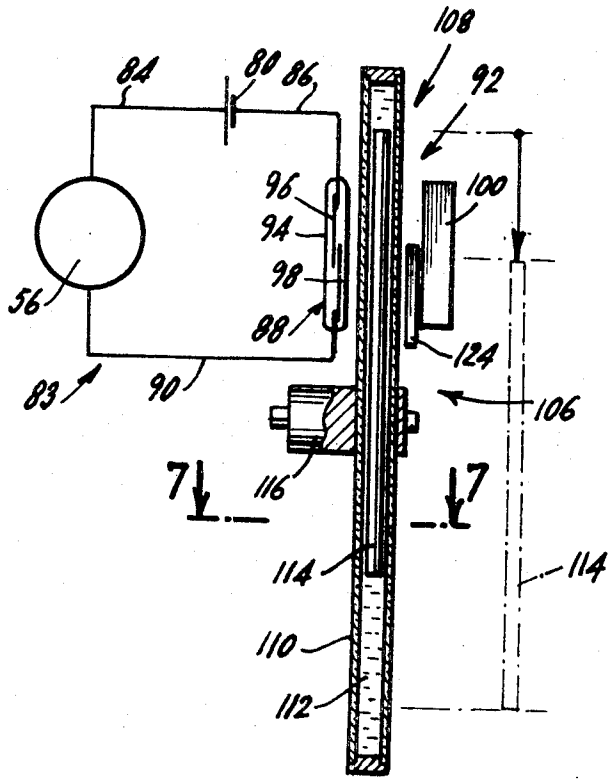


FIG. 1.

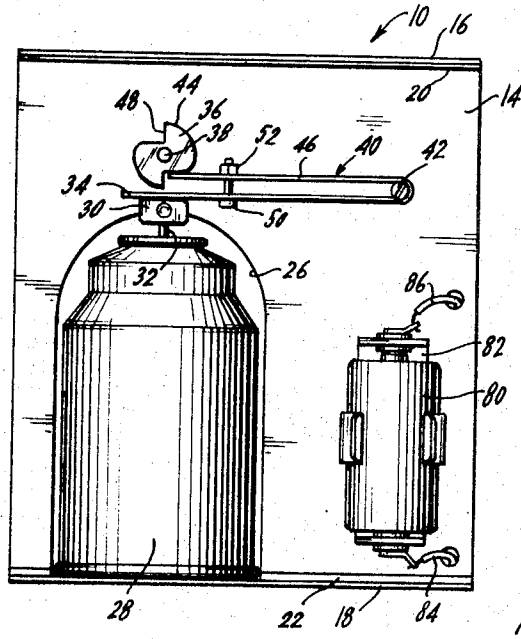
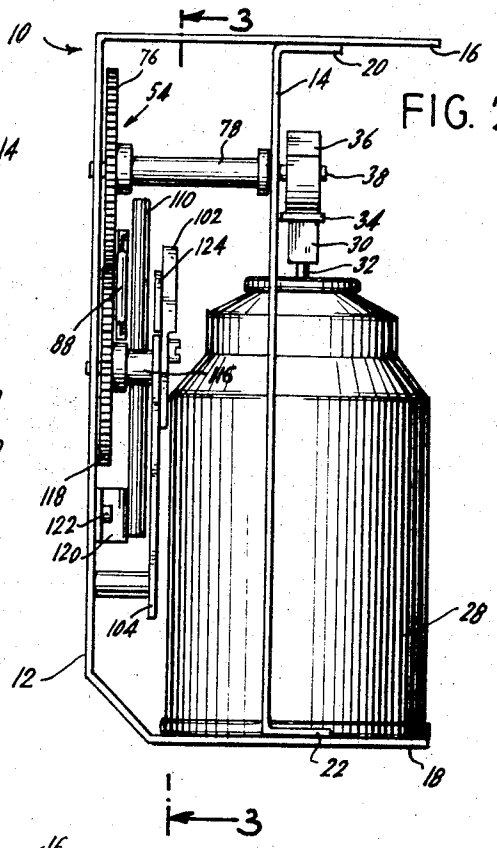


FIG. 2.



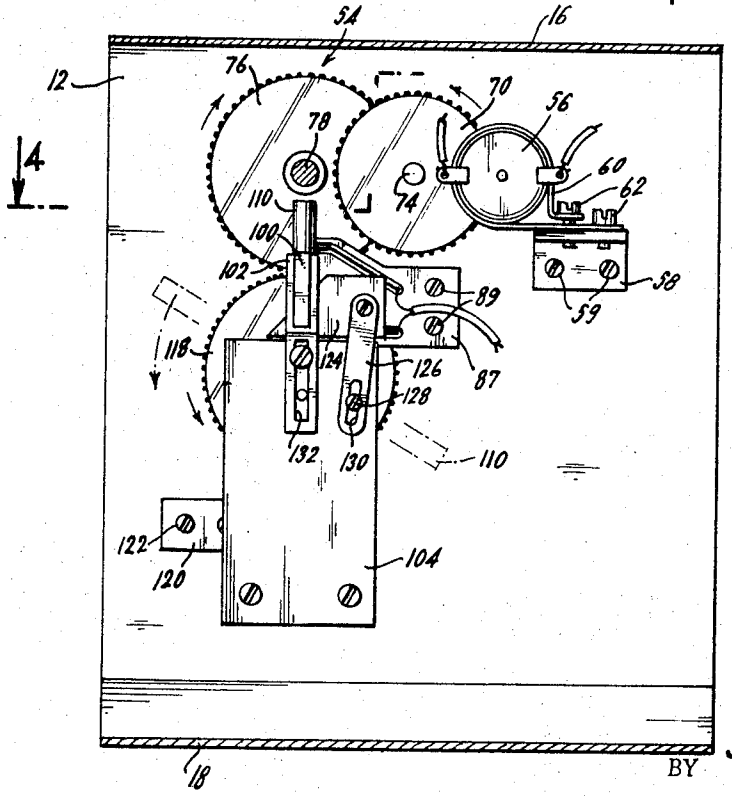
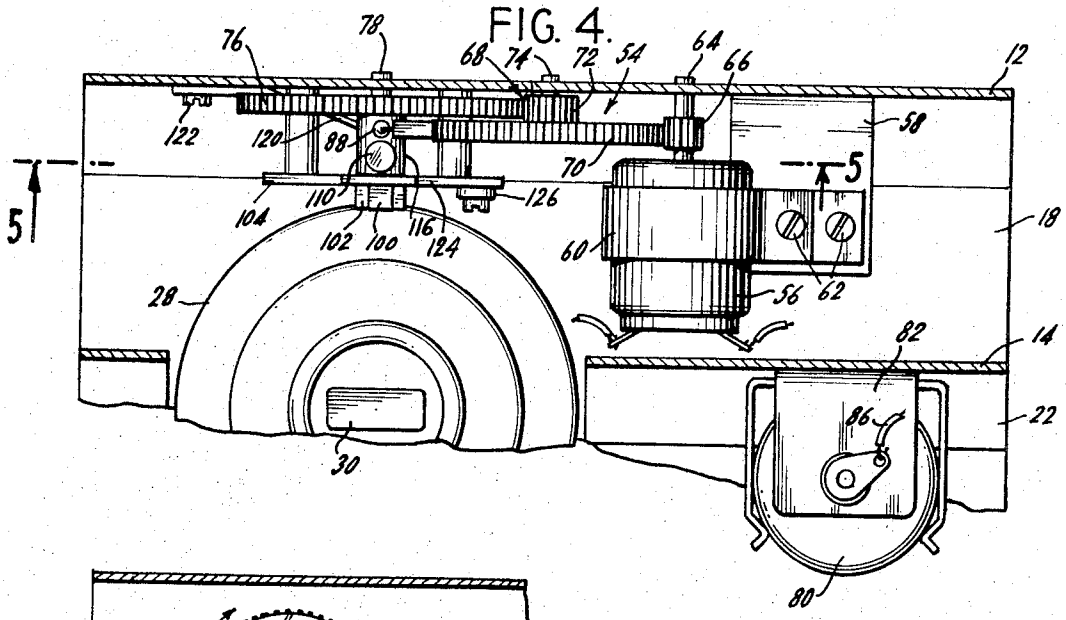


FIG. 3.

INVENTORS
LEROY FLORANT
JOSEPH GLICKSTEIN
BY
Edward F. Levy
ATTORNEY

FIG. 4.



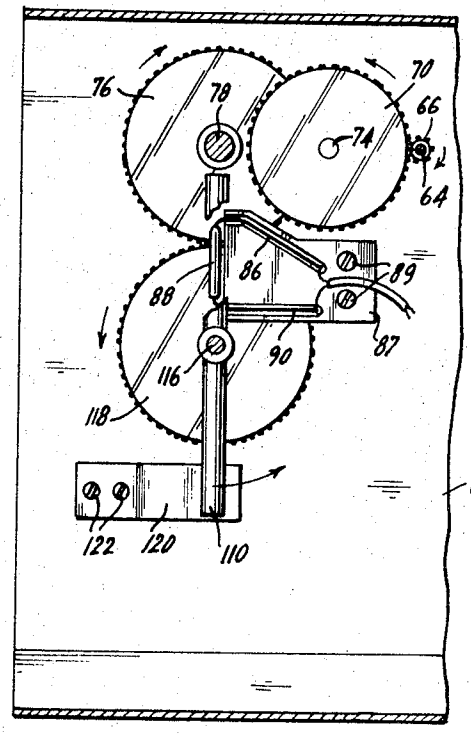


FIG. 5.

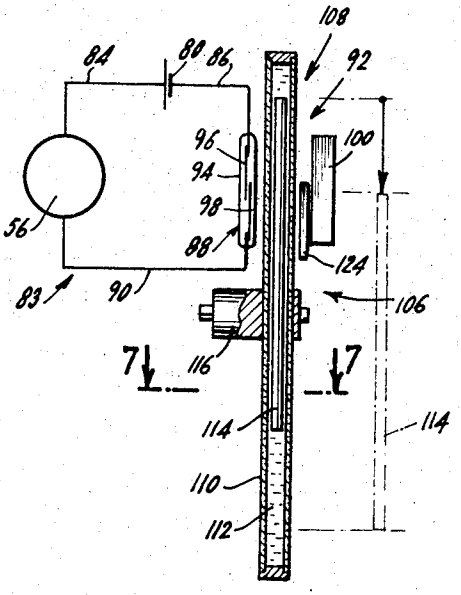


FIG. 6.

FIG. 7.

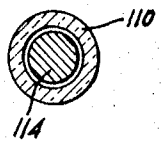
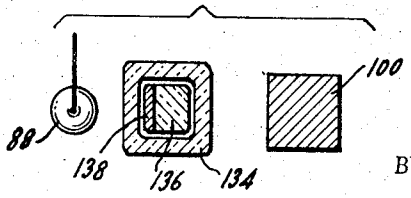


FIG. 8.



INVENTORS
LEROY FLORANT
JOSEPH GLICKSTEIN
BY
Edward F. Levy
ATTORNEY

APPARATUS TO PROVIDE PERIODIC MOVEMENT

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to control devices in general, and to devices which automatically dispense a spray at predetermined, periodic intervals, in particular.

2. Description of the Prior Art

It has long been desired to obtain an apparatus to provide periodic movement which apparatus is completely portable and is capable of operating automatically in a wide variety of applications under varying conditions. In order to fulfill these requirements, such an apparatus must be able to operate for extended periods of time without requiring re-energization, maintenance or supervision, and must be completely independent of any external power source. An example of an application for such an apparatus would be for automatically operated spray dispensing devices.

Automatic spray dispensing devices have many important applications, such as for dispensing quantities of an insecticide during extended periods of time in various locations where insects pose a problem. However, the automatic dispensing devices previously available provided many problems which made their use unnecessarily expensive and inconvenient, if not completely impractical.

For example, many of the previously available automatic dispensing devices required an external power supply which made their use out-of-doors difficult, if not impossible. The dispensing devices which were battery powered required either large batteries or frequent battery changes in order to provide enough power to continuously operate the timing mechanisms and other apparatus which periodically actuate the dispensing devices. Further, the timing mechanisms incorporated in the previously available automatic spray dispensing devices were usually of a delicate nature and were prone to failure or required frequent servicing.

Additionally, the timing mechanisms of the previously available devices could not automatically compensate for changes in temperature of the environment in which the spray dispensing device was placed. These environmental changes are of significance in that very often the requirement for the material dispensed, as for example, an insecticide, will increase with an increase in temperature.

SUMMARY OF THE INVENTION

To overcome the problems inherent in the prior art, the present application sets forth a portable, self-contained apparatus for providing a periodic movement which includes a battery-powered electrical system which energizes a drive system to produce movement of a member of the apparatus. Timing means within the apparatus control the operation of the electrical system and the drive system so that the moving member moves at predetermined periodic intervals. Neither the drive means nor the timing means requires any power during the dormant periods in between the periods when the moving member is actually moving. Therefore, the entire apparatus utilizes only a minimal amount of power from the battery for each movement that the system produces. This efficiency of conservation of electrical power enables the entire apparatus to operate for extended periods of time on limited amounts of battery power.

In view of the above, it is an object of the present invention to provide apparatus for providing periodic movement which is completely portable.

Another object of the present invention is to provide apparatus for providing periodic movement which needs no external power source.

It is a further object of the present invention to provide apparatus for providing periodic movement which can be operated by a single battery for extended periods of time.

Yet another object of the present invention is to provide apparatus for providing periodic movement having means to adjust or vary the timing cycle of the apparatus.

It is another object of the present invention to provide apparatus for providing periodic movement which apparatus can operate for extended intervals of time between periodic servicing.

A further object of the present invention is to provide apparatus for providing periodic movement which is of simple construction and has a minimum of moving parts.

Still another object of the present invention is to provide apparatus for providing periodic movement which has no clock mechanism.

It is yet another object of the present invention to provide apparatus for providing periodic movement which incorporates a simple gravity-operated timing device, whose period of operation can be readily adjusted.

A further object of the present invention is to provide apparatus for providing periodic movement which is reliable and cheap to operate.

It is an object of the present invention to provide a spray dispensing apparatus which will continuously dispense material at predetermined intervals.

Another object of the present invention is to provide a periodic spray dispensing apparatus which is completely portable.

Yet another object of the present invention is to provide a periodic spray dispensing apparatus which needs no additional power source.

It is a further object of the present invention to provide a periodic spray dispensing apparatus which can be operated by a single 1½ volt dry cell.

Still another object of the present invention is to provide a periodic spray dispensing apparatus having a timing cycle for dispensing spray which can be varied.

It is another object of the present invention to provide a periodic spray dispensing apparatus which can vary the timing for dispensing the material in accordance with increases in the temperature of the surrounding environment.

Yet another object of the present invention is to provide a periodic spray dispensing apparatus having an extended operating period between routine servicing.

It is a further object of the present invention to provide a periodic spray dispensing apparatus which requires absolutely no power during periods of the cycle in which the apparatus is dormant.

Still another object of the present invention is to provide a periodic spray dispensing apparatus which can operate for periods of longer than 3 calendar months on a single "D" cell type of flashlight battery.

Another object of the present invention is to provide a periodic spray dispensing apparatus which is of simple construction.

Yet another object of the present invention is to provide a periodic spray dispensing apparatus which has a minimum of moving parts.

It is a further object of the present invention to provide a periodic spray dispensing apparatus which has no clock mechanism.

Still another object of the present invention is to provide a periodic spray dispensing apparatus which incorporates a simple gravity-operated timing device, whose period of operation can be readily adjusted.

It is another object of the present invention to provide a periodic spray dispensing apparatus which is reliable and cheap to operate.

Yet another object of the present invention is to provide a periodic spray dispensing apparatus which requires minimum maintenance during operation.

It is a further object of the present invention to provide a periodic spray dispensing apparatus which is designed so that all operating parts are easily accessible for servicing.

Other objects and advantages will be apparent from the following description of an embodiment of the invention and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front view of the spray dispensing device built in accordance with the teachings of the invention.

FIG. **2** is a side elevation of FIG. **1**.

FIG. **3** is a front elevation taken along lines **3—3** of FIG. **2**.

FIG. **4** is a top elevation, taken along lines **4—4** of FIG. **3**.

FIG. **5** is a partial front elevation, taken along lines **5—5** of FIG. **4**.

FIG. **6** is a schematic representation of the timing system of the invention.

FIG. **7** is a top sectional view, taken along lines **7—7** of FIG. **6**.

FIG. **8** is a schematic representation of the components of the invention, showing the relative disposition of these pieces.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIGS. **1** and **2** show the invention applied as a spray dispensing apparatus, indicated generally at **10**. The apparatus is enclosed in a housing having a back wall **12**, a front wall **14**, a top wall **16**, and a bottom wall **18**. Front wall **14** is connected to top wall **16** and bottom wall **18** by upper and lower flanges **20** and **22**, which are fastened to upper and lower walls by any convenient means, such as welding, tacking, bonding, etc. Front wall **14** has a large cut out section **26** in which an aerosol dispensing container **28** is positioned, with its nozzle **30** mounted atop valve stem **32**, disposed directly below actuating arm **34**, which is part of a moving member means, whose function will now be explained.

The moving member means includes a cam **36** which rotates on a shaft **38**, extending through the front wall **14** of the housing, and U-shaped translating member, generally indicated at **40**, which is pivotally mounted on front wall **14** by means of a screw-type connection **42** so that the entire U-shaped member is free to move in response to motion induced by contact between cam **36** and the upper arm **46** of the translating member **40**. Rotation of cam **36** causes displacing lobes **44** of the cam to move the entire translating member downward, so that linear actuating arm **34** of the translating member will depress valve stem **32** and valve nozzle **30** combination of aerosol container **28** to cause the aerosol container to discharge a spray of material stored within the aerosol container. As the cam continues to rotate, rest lands **48** of the cam will be in contact with the cam following arm **46** of the translating member, and the resilience of the valve stem **32** of the aerosol container acting on the lower arm **34** of the translating member will force the entire translating member **40** up against the rest lands and allow the aerosol container valve to shut, ending the spray dispensing period. In order to accommodate different sizes of aerosol containers and different lengths of valve travel necessary to actuate aerosol container valve, an adjusting means is included on the translating member which consists of a bolt **50** and nut **52**, which extends through each of the arms to maintain the space between the arms of the translating member.

The cam **36** of the moving member means is driven by a drive system which generally includes an electric motor and a power train. The power train, generally indicated at **54**, is shown in FIGS. **2** and **3**, mounted on rear wall **12** of the housing and the electric motor **56** is mounted on a bracket **58**, extending from rear wall **12** of the housing and connected to the wall by screws **59**. The motor is mounted on bracket **58** by means of a strap **60** and screws **62**.

Motor **56**, as shown in FIG. **4**, has a shaft **64** which is journaled in rear wall **12** of the housing and which shaft has a drive gear **66** which engages a gear reduction assembly, generally indicated at **68**. The gear reduction assembly includes a duplex gear assembly consisting of a large gear **70**, which is engaged with gear **66** of motor **56**, and a small gear **72** mounted on a common shaft **74**. Small gear **72** engages a second large gear **76**, so that the gear reduction assembly substantially reduces the number of revolutions of large gear **76** in comparison to the number of revolutions of drive gear **66** on shaft **64** of motor **56**.

Large gear **76** is mounted on a shaft **78** which, in turn, is a portion of cam shaft **38** for cam **36**, so that when electric motor **56** is energized, the rotation of electric motor shaft **64**, acting through gear drive **68**, will cause cam **36** to rotate.

Electric motor **56** is powered by an electrical power means including a battery power source and an electrical circuit. The power source is a standard flashlight-type battery **80**, shown in FIGS. **1** and **4**, which is held in a mounting container **82**, which, in turn, is fastened to front wall **14** of the housing. The battery and the motor from an electrical circuit, generally indicated at **83** in FIG. **6**, with battery lead **84** going to the housing of motor **56** and battery lead **86** going to a switching device in the circuit, generally indicated at **88**, whose function will be explained below. Lead **90** connects switch **88** to motor **56** to complete the circuit.

A timing means, generally indicated at **92**, in FIG. **6**, is incorporated in the circuit to provide periodic operation of motor **56** and, therefore, periodic movement of cam **38** to periodically actuate the aerosol spray dispenser. Timing means **92** include switch means **88**, previously mentioned, which is a magnetically responsive, normally open, reed switch, having an outer casing **94** and two metal reeds **96** and **98**, both reeds being magnetically sensitive. Reed switch **88** is mounted on bracket **87** which is fastened to rear wall **12** of the housing by screws **89**. A magnet **100** is disposed fairly close to reed switch **88** and tends to cause reeds **96** and **98** to contact each other thereby closing the switch to complete circuit **83** and energize motor **56**. Magnet **100** is held in a bracket **102** connected to a support wall **104** which extends outwardly from the rear wall **12** of the housing.

In order to prevent magnet **100** from continuously actuating reed switch **88**, a control means, generally indicated as **106** in FIG. **6**, in the form of an interfering means **108**, is disposed between magnet **100** and the reed switch **88**. The interfering means **108** consists of a closed cylindrical container **110** filled with a liquid **112** of predetermined viscous characteristics and a plunger member **114** which is magnetically opaque in that it does not allow a magnetic field to pass through it, as for example, a ferrous metal. The closed container is pivotally mounted by means of a shaft **116** which is connected to a large gear **118** which is of the same size and mates with large gear **76** in a one-to-one ratio.

Operation of the control means is as follows. The bouyancy relationship of plunger member **114** to the liquid **112** within closed container **110** is such that the plunger will have a negative bouyancy and will tend to sink to the bottom of the closed tubular container. However, because of the viscosity of the liquid and the fairly close fit between the plunger and the walls of the container, it will take a substantial period of time for plunger **114** to move from its uppermost position in the container where it would be interposed between the magnet and the reed switch, to a position where it would no longer be between these two elements. Additionally, the magnetic field of magnet **100** will exert a sidewise force on magnetically opaque plunger member **114**, drawing the plunger against the wall of tubular container **110** and thereby tending to retard the downward movement of the plunger. Once the plunger has dropped below the level of reed switch **88**, the magnetic field will be unimpeded and will be able to actuate the reed switch.

Once the reed switch is actuated, the motor will be energized and gear **76**, connected to cam **36**, will be rotated, thereby pivoting closed tubular container **110**. Since plunger member **114** has sunk to the bottom of closed tubular container **110**, the rotation of the tubular member around the axis of shaft **116** will bring the plunger member back to its upper position disposed between the magnet and the reed switch, thereby opening the switch and de-energizing the circuit to stop the motor. Therefore, the rotation of the motor transmitted through the power train **54** will place the opaque member of the control means between the magnet and the reed switch to effectively control operation of the circuit. The bouyancy forces between the liquid and the plunger member, the viscosity of the liquid and the magnetic attraction of the plunger member to the magnet, will provide the means by which the magnetically opaque material will remain between the magnet and the reed switch for the desired time interval between actuations of the aerosol container.

To insure that motor **56** stops when closed tubular container **110** is in the proper position, a positioning means for the closed tubular container is provided which consists of a spring member **120** extending from rear wall **12** and is fixed to the wall by means of screws **122**. The spring member provides a lateral force which will tend to hold the bottom of tubular member **110** in the upright vertical position to allow for the proper operation of the plunger means within the timing apparatus.

It is possible to adjust the time interval provided by the timing means between periods of operation of the motor. Two different methods of adjustment are provided. The first method of controlling the timing is to effectively reduce the strength of the magnetic field acting on the plunger member. This is done by means of a magnetic field blocking member **124** which is shown in FIG. **3**, mounted on support wall **104** by means of slotted bracket **126** which is fastened to the blocking means by a screw **128** in the slotted screw hole **130** to the support bracket. The front edge of magnetic field blocking means **124** is biased so that movement of the blocking means from left to right by merely pivoting bracket **126** will interpose a greater or lesser portion of the magnetically opaque blocking means between magnet **100** and closed tubular container **110**. The field blocking means is made of a magnetically opaque material and, therefore, by being selectively interposed between the magnetic means and the plunger member, effectively controls the strength of the magnetic field exerted on the plunger member and on the reed switch.

A second means of adjustment is the means for positioning the magnetic means which consists of a large slotted mounting hole **132** in bracket **102** which holds the magnetic means to support wall **104**, thereby allowing the magnetic means to be moved in the vertical direction. As seen in FIG. **6**, movement of the magnetic means vertically upward will elevate the magnetic field with relation to the plunger member **114**, and therefore the plunger member need sink only a relatively short distance before it reaches a point at which it is no longer interfering with the magnetic field between the raised magnet and the reed switch **88**.

As can be seen in FIG. **6**, once plunger means falls below the level of the magnetic field blocking means **124**, there will be no effect on the plunger means by the magnetic field, and the plunger will tend to more rapidly fall to the bottom of the closed tubular member. Therefore, when the motor starts as a result of reed switch **88** closing, the plunger means will be in a position at the end of the closed tubular member as the member is rotated by operation of the motor, so that the plunger will be properly positioned at or near the end of the tubular container in between the magnetic means and the reed switch in order to de-energize the circuit and stop the motor.

Operation of the device is fairly straight-forward and simple. Aerosol container **28** is positioned in the housing with its spray nozzle **30** oriented in the direction in

which the aerosol spray is desired. A conventional "D" cell type of flashlight battery **80** is placed in the battery holder **82**. Since the closed tubular container **110** will have stopped in the desired operating position because of positioning means **120**, plunger member **114** will be at the bottom of the container and reed switch **88** will be closed to energize circuit **83** and start motor **56**. The motor will operate at a fairly high RPM and revolve numerous times, but the numerous revolutions of the motor will be effectively reduced by the power train gear reduction assembly **68**, so that after the motor has operated a short period of time, gear **76** and cam **36** will have revolved approximately ½ revolutions, or 180°. Cam member **36** will have caused cam follower arm **46** of translating member **40** to have been depressed, thereby pivoting the entire translating member so as to cause translating arm **34** to depress valve stem **32** of the aerosol container **28** to dispense a quantity of spray. As the cam continues to rotate a full 180°, the resiliency of the spray valve of the aerosol container forces the translating member **34** and cam follower arm **46** of translating member **40** upward into the rest lands **48** of the cam member to close the aerosol spray valve.

At the same time that cam **36** is rotating, large gear **118** which is connected to tubular closed container **110** has rotated the tubular container 180°, so that plunger member **114** which was at the bottom of the tubular container is now positioned between the magnetic means **100** and reed switch **88**, thereby blocking the magnetic field from magnet **100** and allowing the reed switch to return to its normally open position. The reed switch, therefore, de-energizes circuit **83** from battery **80** to electric motor **56** and effectively stops the motor's operation. Plunger **114** will be held against the wall of closed tubular container **110** by the magnetic field of magnetic means **100** and will gradually sink downward until it is no longer able to interfere with the effect of the magnetic field on the reed switch. The magnet will then close the reed switch and repeat the cycle.

It should be pointed out that closed tubular container **110** need not be cylindrical in shape, nor need the plunger be made entirely of a magnetically opaque material. As shown in FIG. **8**, a tubular container **134** and a plunger **136** are rectangularly shaped and the magnetically opaque material can simply be a fairly thin strip of material **138** on one surface of the plunger member **136**.

It should also be noted at this time that there are several distinct features of this apparatus. Although the invention has been described in an application for actuating the spray valve of an aerosol container, it should be apparent that the means to provide an actuating movement can be applied to actuating any type of device susceptible to actuation by a simple mechanical movement. This can include automatic switching means, control means, counting means, etc.

It should also be pointed out that there is absolutely no outside physical force required for functioning of the apparatus between periods of actuation. The only force acting on the system during the inactive periods are the buoyant and gravitational forces and the magnetic field of the magnet. Since there is absolutely no power consumed during the dormant period of the cycle, the apparatus operates extremely economically and efficiently. Tests to date have shown that it is possible to obtain over 10,000 actuating cycles of this system from a single "D" cell flashlight type battery, when the system has been set to operate with a dormancy period between actuating times of fifteen minutes. Therefore, it is possible to use a single "D" cell power source for more than 3 months without requiring a replacement.

It should also be pointed out that the mechanism of the apparatus is extremely simple for the task it is to perform. There are no delicate mechanisms, such as springs, escapements, or other clock mechanisms, used in this system. The only possibly sensitive member of the system is the closed tubular container in which the plunger member travels. But, since this member is completely sealed, there is almost no way that a malfunction can occur within it.

It should also be noted that it is extremely easy to completely alter the timing sequence of the entire periodic movement apparatus. All that is necessary is to remove the closed tubular container and replace it with a closed tubular container having a liquid with a substantially different viscostic property. For example, using the same plunger member, if one container were to be filled with a thick oil of high viscosity, while a second container were to be filled with an alcohol liquid of low viscosity, the timing sequence provided by the tubular container with the alcohol would be substantially shorter than the timing sequence provided by the container with the viscous oil.

It should also be noted that preselection of the type of liquid used in the tubular containing member can provide for variations in the time period of the apparatus depending upon the ambient temperature. It is well known that viscosity characteristics of various liquids vary substantially with changes in temperature. Therefore, if for example, it is desired to shorten the dormant period of the apparatus during the daylight hours, this can be done by providing a liquid whose viscosity will significantly decrease with the increases in temperature which usually occur during the daylight hours as compared to the temperature of the evening hours.

While the operation of the apparatus has been described in terms of the negative buoyancy of a magnetically opaque plunger, the same operation may be obtained with elements of the reverse buoyant and magnetic characteristics. For example, the plunger may be made buoyant and of a material which will allow the magnetic field to penetrate therethrough, while the liquid in container **110** may be magnetically opaque. In this instance, the plunger will have a starting position at the bottom of the container **110** and will travel upwardly through the liquid until it comes within the magnetic field and allows the field to pass therethrough to the reed switch **88**.

It will be understood that various changes in the details, materials and arrangements of parts which have been herein described and illustrated in order to explain the nature of the invention may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

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

1. Apparatus for providing a periodic movement comprising:
electrical power means including a power source and an electrical circuit connected to said power source;
drive means adapted to be powered by said electrical power means, and including an electric motor connected to said power source by said electrical circuit, and a power train driven by said electric motor;
moving member means driven by said drive means; and
timing means operatively associated with said drive means and said electrical power means, said timing means being actuated by said drive means to produce periodic energization of said electrical circuit, so that said moving member will be periodically moved by said drive means;
said timing means including
magnetic means,
switch means operatively disposed in said electrical circuit and responsive to said magnetic means to open and close said electrical circuit, and
control means for controlling actuation of said switch means by said magnetic means, and comprising
interfering means adapted to be disposed between said magnetic means and said switch means to prevent response of said switch means to said magnetic means,
means to relatively rapidly move said interfering means with relation to said switch means and said magnetic means, and
means to gradually move said interferring means with relation to said magnetic means and said switch means.

2. The apparatus for providing periodic movement claimed in claim 1 wherein said control means further comprise:
a closed container formed from magnetically transparent material;
a liquid in said closed container; and
a magnetically opaque member disposed in said container and adapted to travel vertically in said liquid to a rest position when said container is immobile.

3. The apparatus for providing periodic movement claimed in claim 2 further comprising:
means to pivot said container; and wherein:
said closed container is disposed with relation to said switch means and said magnetic means so that a portion of said container will be disposed intermediate said switch means and said magnetic means when said container is disposed in at least two positions greater than ninety degrees apart;
said means to gradually move said interfering means include the buoyant relationship between said magnetically opaque member and said liquid in said closed container; and
said means to rapidly move said interfering means between said switch means and said magnetic means include means to pivot said closed container so that said magnetically opaque member will be pivoted with said container to a position between said magnetic means and said switch means.

4. The apparatus for providing periodic movement claimed in claim 3 wherein said magnetically opaque member has negative bouyancy with respect to the liquid in said closed container so that the rest position of said magnetically opaque member will be at the bottom of said container.

5. The apparatus for providing periodic movement claimed in claim 4 wherein said control means include means to adjust said timing means comprising means to position said magnetic means with relation to said closed container to adjust the forces exerted by magnetic means on said magnetically opaque member.

6. The apparatus for providing periodic movement claimed in claim 4 wherein said control means include means to adjust the timing means comprising magnetic field blocking means disposed between said magnetic means and said control means to adjust the forces exerted by said magnetic means on said magnetically opaque member.

7. The apparatus for providing periodic movement claimed in claim 4 wherein said control means include positioning means to position said closed container, said positioning means comprising:
support means; and
resilient means connected to said support means and disposed with relation to said closed container to engage said container when a portion of said container is pivoted in between said magnetic means and said switch means.

8. The apparatus for providing periodic movement claimed in claim 3 wherein said means to pivot said closed container are operatively associated with said power train.

9. The apparatus for providing periodic movement claimed in claim 3 wherein said moving member means comprise:
cam means operatively connected to said power train;
a translating member displaced by said cam means to convert rotary motion of said cam means to linear motion; and
support means for said translating member.

10. The apparatus for providing periodic movement claimed in claim 9 wherein said translating member includes:
a generally U-shaped member having one arm of said member in contact with said cam means and the other arm adapted to produce linear actuating movement; and
said U-shaped member pivotally mounted on said support means.

11. The apparatus for providing periodic movement claimed in claim 10 wherein said translating member further comprises means to adjust the spacing between said arms of said U-shaped member.

12. The apparatus for providing periodic movement claimed in claim 1 further comprising a housing, including:
a front wall;
a rear wall;
a top wall connecting said front wall with said back wall; and
a bottom wall connecting said front wall with said back wall.

13. The apparatus for providing periodic movement claimed in claim 12 wherein:
said power train is connected to said back wall;

said electric motor is connected to said back wall;
said moving member means is supported by said front wall;
said front wall includes passage means adapted to receive a standard aerosol spray dispensing device; and
said moving member means is adapted to actuate said aerosol dispensing means.

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