June 27, 1967 S. YERKOVICH 3,327,901

DISPENSER

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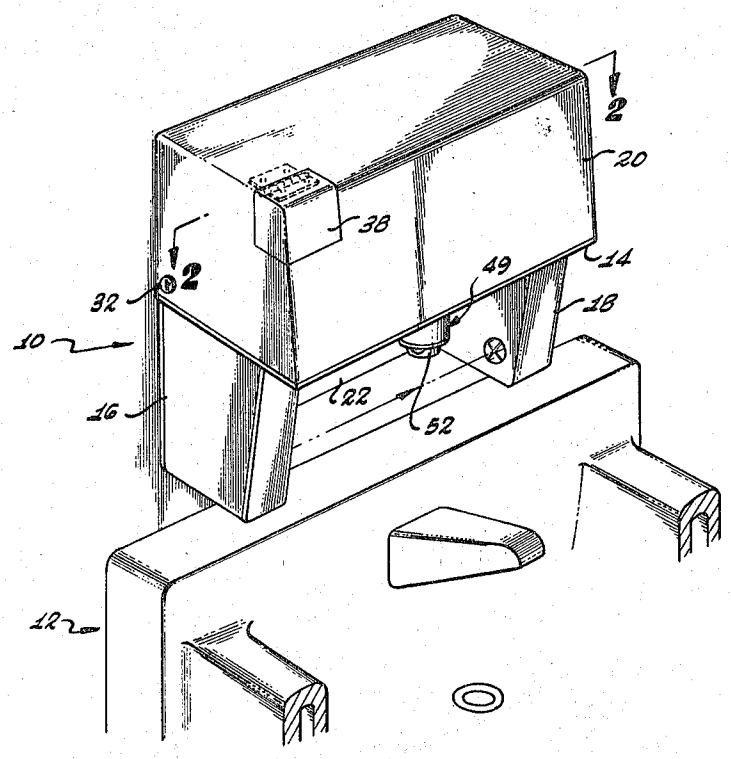

Fig. 1

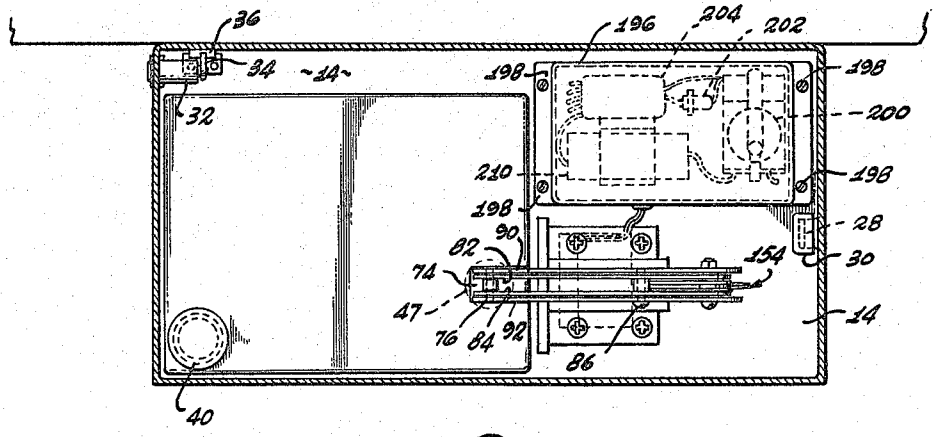

Fig. 2

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DISPENSER

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Fig. 3

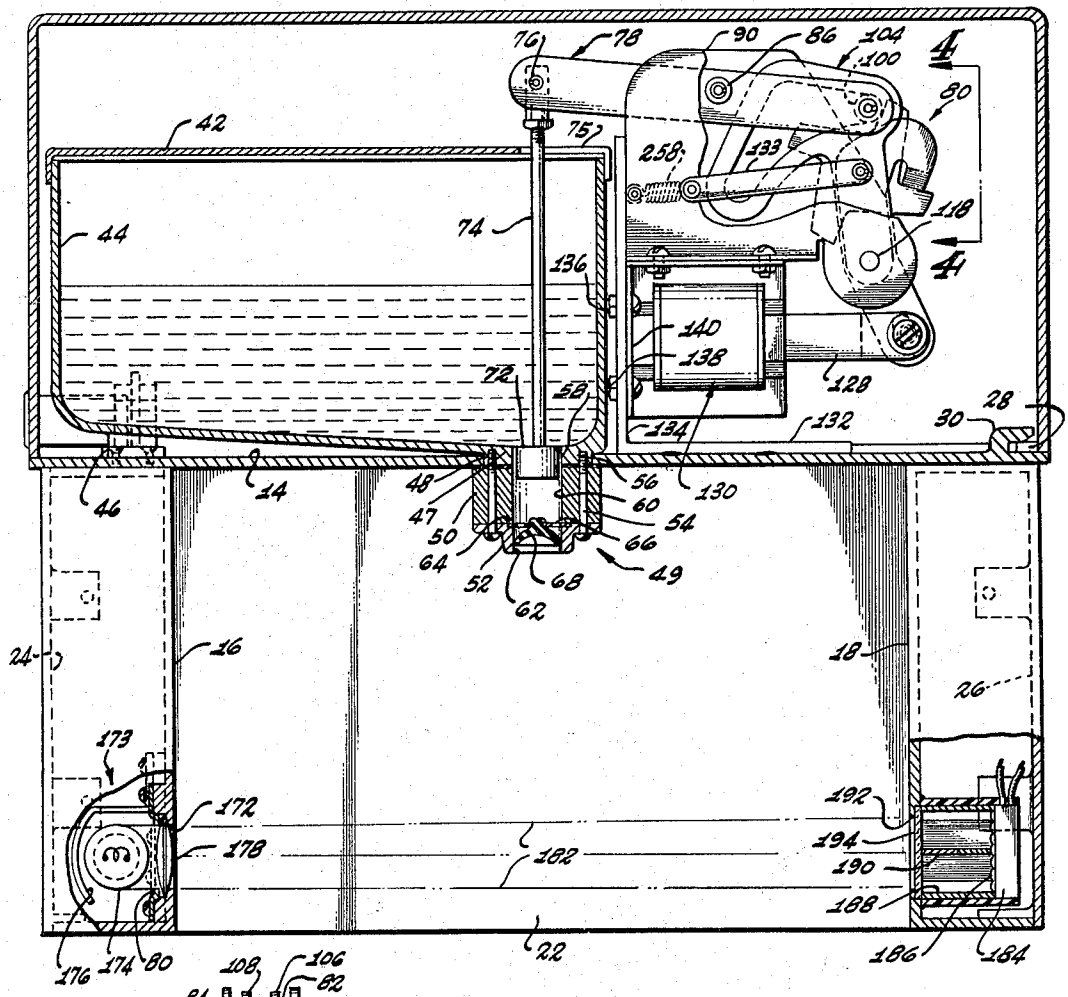

Fig. 4

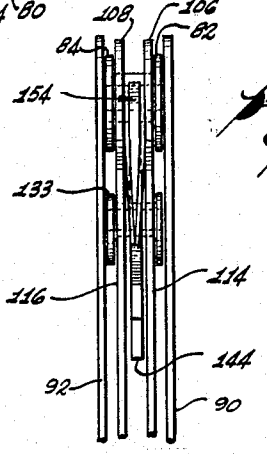

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Fig. 5

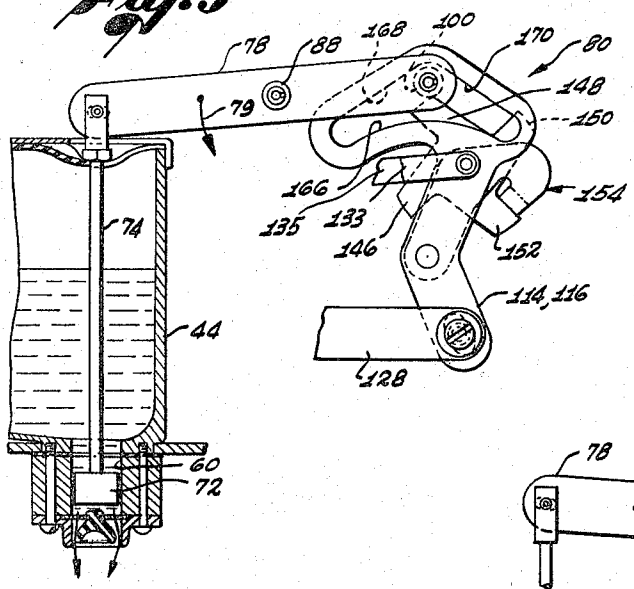

Fig. 7

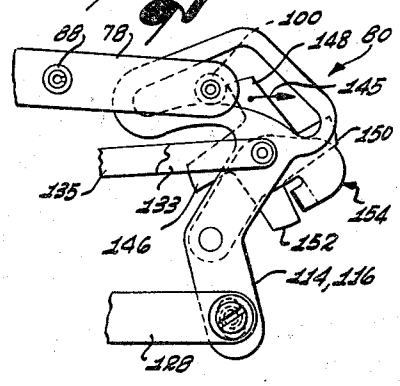

Fig. 6

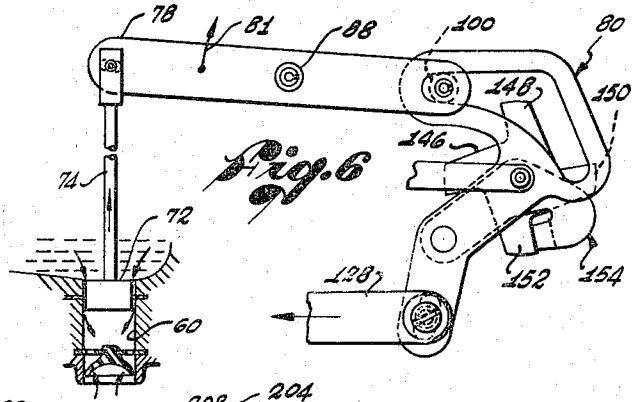

Fig. 11

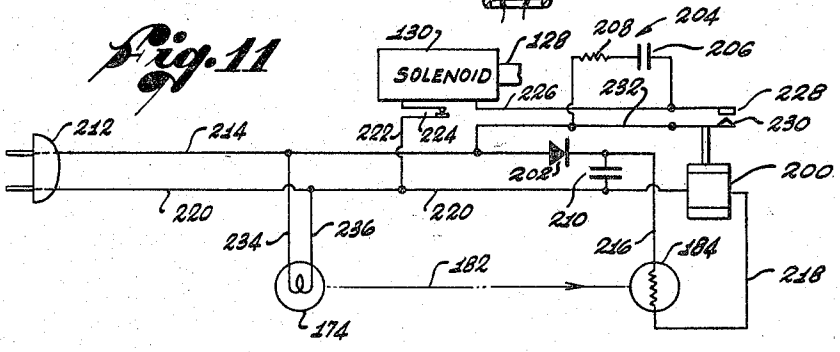

Fig. 12

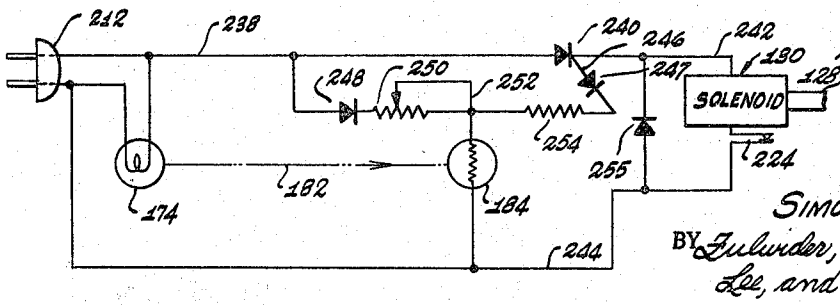

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Fig. 10

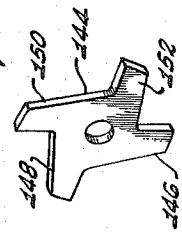
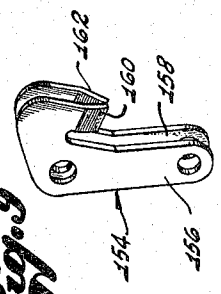


Fig. 9



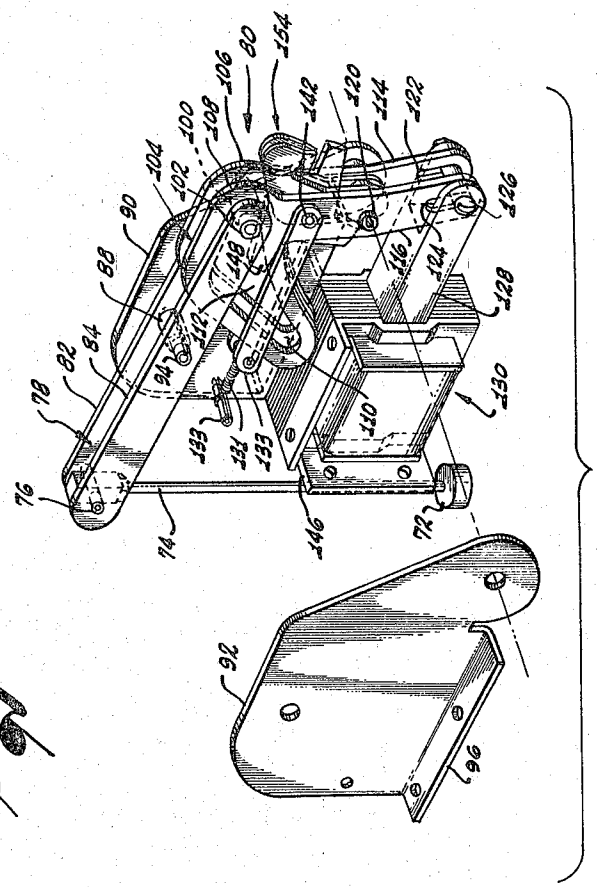


Fig. 8

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3,327,901

DISPENSER

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Filed Dec. 13, 1963, Ser. No. 330,341
12 Claims. (Cl. 222—52)

ABSTRACT OF THE DISCLOSURE

A liquid dispensing apparatus for automatically dispensing small, predetermined quantities of a liquid material such as soap, when a receiving body, such as a hand, is placed in a position to receive such quantity of material. A reservoir is provided for containing the liquid material, a pump is positioned under the reservoir with its inlet communicating directly with the bottom of the reservoir with its discharge downwardly directed therebelow, and a photoelectric device positioned adjacent the discharge of the pump to actuate the pump to deliver such quantity of material when a body, such as a hand, is positioned adjacently below the pump discharge in a material receiving position.

This invention relates to dispensing devices and, more particularly, to a device for automatically delivering small predetermined quantities of liquid soap or the like detergent materials onto the hands of a user without requiring manual operation thereof or any physical contact therewith.

The apparatus of tihs invention is generally suited for use in washrooms or public buildings, restaurants, hospitals, and the like, but its primary purpose and most important function is as a surgeon's antiseptic soap dispenser.

Heretofore, hand washing processes, particularly preparatory to performance of surgical operations, have required some kind of manual operation or handling of a soap container or dispenser, either by the surgeon himself or by an assistant, and such conditions were undesirable, both from the standpoint of insuring sterile working conditions and requiring additional assisting personnel. Also by reason of the peculiar, viscous, thixotropic and semiplastic properties of the soap mixture usually employed, the dispensing apparatus heretofore employed therefor has been erratic and unreliable in operation.

It is accordingly an object of this invention to furnish an improved automatic soap dispenser.

It is another object of this invention to furnish a soap dispenser which may be operated at will by the operator alone, without requiring any physical contact whatsoever wtih the apparatus.

It is still another object of this invention to furnish a soap dispenser device which is automatically actuated merely by placing the hands or other object to which the soap is to be applied in a predetermined soap-receiving position relative to the apparatus.

It is a further object of this invention to furnish an automatic dispenser which embodies improved mechanical and electrical features which render it more reliable and durable and more economical in operation than those herteofore available.

It is a still further object of this invention to furnish an automatic dispenser which embodies improved mechanical and electrical features which render it more reliable and durable and more economical in operation than those heretofore available.

It is a still further object of this invention to provide an improved automatic soap dispenser which can be more easily and effectively maintained in a clean and sanitary condition.

Important features of this invention by which the foregoing objects of this invention are attained and which particularly suit it to hand washing operations wherein conditions of maximum surgical sterility must be maintained, reside in its improved dispensing mechanism and its completely automatic operation, whereby upon each placing of one's hands in position to receive soap therefrom, a measured quantity thereof is automatically ejected upon the hands without requiring manual operation of or any physical contact whatsoever with the dispensing device.

These and other objects and advantages and features of novelty will be evident hereinafter.

In the drawings which illustrate a presently preferred embodiment of the invention and in which like references characters designate the same or similar parts throughout the several views:

FIGURE 1 is a perspective view of the apparatus of the invention as it appears within its enclosing cabinet, and illustrating a wall-mounting arrangement thereof for convenient use over a typical wash basin.

FIGURE 2 is a plan sectional view of the assembly of the apparatus taken on a horizontal plane located approximately on line **2—2** of FIGURE 1.

FIGURE 3 is an enlarged frontal view of the general assembly of the apparatus, partly in elevation and partly in vertical section, and showing the initial position of the actuating mechanism prior to initiating a cycle of operation.

FIGURE 4 is an enlarged, fragmentary end elevational view of a portion of the apparatus as viewed from line **4—4** of FIGURE 3.

FIGURE 5 is a fragmentary, detailed elevational view of a portion of the actuating mechanism shown in FIGURE 3, showing the position of the parts thereof at an intermediate stage in its first one-half cycle of operation.

FIGURE 6 is another fragmentary, detailed view of the same mechanism shown in FIGURE 5, showing the position of the parts thereof at the completion of its one-half cycle of operation.

FIGURE 7 is still another fragmentary, detailed view of the same mechanism shown in FIGURES 5 and 6 showing the position of the parts thereof at an intermediate stage in the second one-half cycle of its operation.

FIGURE 8 is a partially exploded, detailed perspective view of the apparatus elements of the actuating mechanism shown in FIGURES 3, 5, 6 and 7.

FIGURE 9 is a detailed perspective view of one of the parts of the apparatus of FIGURE 8.

FIGURE 10 is a detailed perspective view of another part of the apparatus of FIGURE 8.

FIGURE 11 is a schematic wiring diagram of the electrical control circuit and electrical apparatus elements employed in the apparatus of the invention.

FIGURE 12 is a schematic wiring diagram of an alternative electrical control circuit which may be employed instead of that shown in FIGURE 9.

Referring to the drawing, and first primarily to FIGURES 1, 2 and 3, the apparatus elements of the invention are housed in a cabinet, indicated generally at **10** which is adapted to be positioned upon a suitable supporting means, or preferably as illustrated in FIGURE 1, mounted on a wall in position for convenient use either adjacent to or over a wash basin **12**.

The cabinet **10** includes as its principal components, a rectangular base plate **14**, a pair of downwardly extending, hollow, box-shaped leg members **16** and **18** attached to the lower surface of the base plate **14** adjacent the

opposite ends thereof, and a removable top cover **20** which normally rests upon the marginal portion of the base plate **14** and forms therewith an upper enclosure for portions of the apparatus to be hereinafter described.

The base plate **14** together with the leg members **16** and **18** and a back panel **22** which extends between the rearward surfaces thereof, forms an approximately rectangular recess into which one's hands may be extended for receiving soap from the outlet nozzle **52** of a soap dispensing pump **49** which projects downwardly into said recess through an intermediate portion of the base plate **14**. The leg members **16** and **18** which may be made integral with the base plate or attached thereto by suitable means such as by welding are provided with removable end panels **24** and **26** for access to the interior thereof.

The top cover **20** is provided with means for locking it in closed position upon base plate **14**, which includes at one end thereof a tongue member **28** fastened to the inner lower edge of the top cover in position to extend slidably under a clip **30** attached to an adjacent portion of the top surface of the base plate **14**, and at the other end a locking attachment means which includes a conventional key operated cylindrical type lock mechanism fixed through the end wall of the top cover as shown at **32** and carrying at its innermost end a finger latch member **34** rotatable by a suitable key into and out of locking engagement with a slotted clip **36** fixed to the base plate **14**. The left hand, forward corner of the top cover **20**, as viewed in FIGURE 1, is provided with a hinged opening **38** through which convenient access may be had to an inlet opening **40** in the lid **42** of a soap reservoir **44**.

The soap reservoir **44**, which may be made of Monel metal, stainless steel, plastic or the like suitable noncorrosive material, is supported upon and attached to the upper surface of the base plate **14** by suitable means which includes a cross-wise extending bottom leg member **46** adjacent one end, and adjacent the other end by means of an integrally formed annular outlet nipple **47** which extends downwardly, from the lowest point in the bottom of the reservoir, through a correspondingly sized circular opening **48** in the base plate **14**.

Connected to the lower end of the annular outlet nipple **47** of the reservoir **44** and extending downwardly therefrom below the base plate **14** is the beforementioned soap dispensing pump shown generally at **49**. The dispensing pump **49** includes a pump cylinder **50**, the upper end of which is attached to the bottom of the outlet nipple **47** and also clamped in retaining engagement with the surrounding marginal portion of the base plate opening **48**. Also attached to the lower end of the cylinder **50** is the beforementioned discharge nozzle **52**. The outlet nipple portion **47**, pump cylinder **50** and dischage nozzle member **52** are bolted coaxially together, as before described, by means of a plurality of circumferentially spaced-apart, axially extending through-bolts as shown at **54**, the upper ends of which are threaded into the lower end of the outlet nipple **47** as shown at **56**. The outlet nipple **47**, pump cylinder **50** and the discharge nozzle member **52** are formed with interconnecting, coaxial bores **58**, **60** and **62** respectively of the same inside diameter, and which are in direct communication through the outlet nipple **47** with the lowermost interior portion of the bottom of the soap reservoir **44**.

Clamped in a radially inwardly facing, annular groove **64** formed between the upper end of discharge nozzle **52** and the lower end of the cylinder **50** is the outer marginal portion of a perforated, rigid transverse diaphragm member **66**, and supported centrally in bore **62** of the discharge nozzle **52** by means of the diaphragm member **66**, is a resilient, downwardly facing, cup-shaped, one-way acting valve member **68**. The valve member **68** which may be composed of a suitable material such as,

for example, rubber, neeoprene plastic or the like resilient material, is formed at its apex with an upwardly extending button-like supporting attachment projection **70** which is detachably press-fitted into a central opening in the diaphram **66**. The maximum diameter of the rim of the cup-shaped portion of the valve member **68** is normally slightly greater than the inside diameter of bore **62** of the discharge nozzle **52** whereby upon installation within the bore **62** as shown in FIGURE 3, its periphery makes sufficiently firm sealing engagement with the surrounding wall of the bore normally to prevent escape of fluid, such as liquid soap, from the reservoir **44** through the pump, and out of the discharge nozzle, but to be automatically deflectable upon application of increased pressure in excess of a predetermined maximum value in the lower end of the bore of the cylinder caused by downward movement of the pump piston, to permit discharge of liquid soap from the discharge nozzle **52**.

Vertically, reciprocally supported within the beforementioned bores **58** and **60** is a loose-fitting piston **72**. The outside diameter of piston **72** is less than the inside diameter of the bores **58** and **60** to provide an annular clearance space therebetween sufficient to prevent sealing engagement between the piston and core but small enough to permit generation of a substantial differential fluid pressure thereacross upon rapid axial movement of the piston **72** in the cylinder as will be further explained in connection with the operation of the apparatus. The piston **72** is vertically reciprocally supported within the beforementioned pump bores **58** and **60** by means of a vertical piston rod **74**, which extends through a slot **75** formed in the edge of cover **42**, and which is in turn pivotally coupled at its upper end as shown at **76** to the outer end of a lever member **78**, which is connected to and forms a part of a solenoid-operated dispenser pump-actuating mechanism shown generally at **80** in FIGURES 3, 5, 6, 7 and 8.

The lever member **78** is constructed of two interconnected parallel, arms **82** and **84** which are pivoted adjacent their mid-points on a common fixed bearing **86** which consists of a spacer bearing bushing **88** supported between a pair of vertical, spaced-apart, outer supporting plates **90** and **92** by means of a coaxial roll pin **94**. The supporting plates **90** and **92** are both formed at their lower edges with horizontally extending angle legs as shown at **96**, by means of which they are fixed to the upper surface of base plate **14**.

The inner end of lever member **78** carries a cam follower roller **100** which is retained between the inner end portions of the lever arms **82** and **84** by means of a roll pin **102**. Positioned between the lever arms **82** and **84** and encompassing the cam follower roller **100** is an open-centered, cam head **104** which is constructed of two parallel, spaced-apart, interconnected cam members **106** and **108** having generally triangular cam openings therethrough as shown at **110** and **112**, and through which the beforementioned cam follower roller extends.

The cam members **106** and **108** are supported for limited rocking motion upon integrally formed, downwardly extending cam levers **114** and **116** which are in turn pivotally supported adjacent their mid-sections upon a fixed pivot bearing **118** which is supported by means of a roll pin **120** extending between the beforementioned supporting plates **90** and **92**. The lower ends of cam levers **114** and **116** are provided with longitudinally elongated holes **122** and **124** through which they are pivotally coupled as shown at **126** to the outer end of a solenoid armature **128** which extends from and is axially reciprocable relative to a solenoid electromagnet field assembly shown generally at **130**. The solenoid assembly **130** is fixedly supported by means of an angle clip, the horizontal leg **132** of which is fastened to the base plate **114** and the vertical leg **134** of which is bolted, as shown at **136** and **138**, to a flanged member **140** attached to and forming a portion of the housing of the solenoid electromagnet assembly **130**.

The arm levers **114** and **116** and the cam members **106** and **108** carried thereby are constantly urged pivotally counterclockwise, toward the position thereof shown in FIGURES 3 and 8 by means of a helical spring 131, one end of which is attached to a pin **133** extending between the supporting plates **90** and **92** and the other end of which is connected through a pair of links **133** and **135** pivotally to the outer ends of a roll pin **142** which extends crosswise between the cam lever arms **114** and **116**.

Referring again to the cam head **104**, rotatably supported between the inner faces of the cam levers **114** and **116** upon the roll pin **142**, is a star wheel **144** having four, equally circumferentially spaced-apart, approximately radially extending arms as shown at **146**, **148**, **150**, and **152**. The pivot of the star wheel **144** is so positioned on the cam levers **114** and **116** that by rotation of the star wheel, the arms **146**, **148**, **150** and **152** thereof are rotationally movable in succession into positions in which they project into the opening in the cam head **104** as best shown in FIGURES 3, 5, 6 and 7.

Also fixedly positioned between the cam levers **114** and **116** by means of roll pins **120** and **142** is a ratchet pawl device shown generally at **154**, and which consists of two spaced-apart hook-shaped, spring members **156** and **158**, between which the star wheel is rotatably supported upon the beforementioned roll pin **142**. The pawl spring members **156** and **158**, as best shown in FIGURE 9, are formed with downwardly convergingly inclined tips as shown at **160** and **162** which are resiliently biased toward closed engagement with one another, are deflectable apart to permit passage of star wheel arms therebetween when the star wheel is rotated clockwise as viewed in the figures. However, counter-clockwise rotation of the star wheel is prevented by the pawl and normally stopped from such rotation at a position such as shown in FIGURES 3, 5 and 6 at which the closed ends **160** and **162** of the pawl members **156** and **158** engage a laterally extending edge surfaces of a star wheel arm.

The beforementioned generally triangular opnings **110** and **112** formed through the two cam head member **106** and **108** are shaped such as to provide a pair of identically shaped, side-by-side continuous cam surfaces, such surface each having an arcuate section as indicated at **166** concentric with the cam head pivot **120**, and two radially opposite angularly disposed, substantially straight sections as indicated at **168** and **170**. Such cam surface sections are interconnected by circular sections each of which has a radius substantially equal to the radius of the cam follower roller **100**. In operation, upon imparting pivotal rocking motion to the cam head **104** about its pivot center **120**, the cam follower **100** is caused to move in accordance with the contour of the continuous cam surface, in a generally counter-clockwise direction relative thereto, as will be further explained hereinafter in connection with the operation of the apparatus.

Referring again primarily to FIGURE 3, contained within the box-shaped leg member **16** adjacent the lower end thereof and directly behind a circular aperture **172** formed through the inwardly facing wall thereof, is a light source **173** comprising preferably an incandescent electric lamp **174**. A suitable reflector **176** is positioned back of the lamp **174** and a collimating lens **178** is positioned in the aperture **172** in front of the lamp and retained there by means of a retainer ring **80**. The reflector **176** and lens **178** are designed, as is well known in the art, to direct a relatively narrow light beam across the space separating the leg members **16** and **18**, as indicated by the broken lines **182**. Located within the box-shaped leg member **18** adjacent the lower end thereof, and directly behind a circular aperture **192** formed through the inwardly facing wall thereof, directly opposite the beforementioned light source **173**, is a light sensitive cell **184**. The cell **184** may be any one of a number of suitable light sensitive devices, used in conjunction with suitable electrical circuits, such as, for example, a cadmium sulfide photoconductive cell manufactured by the International Rectifier Corporation. This cell is usually provided with a forward, multi-lenticular-shaped transparent covering as shown at **186**, and in the present arrangement a relatively long light entrance tube **188** is additionally provided between the front surface of the covering **186** and the aperture **192**, having a plurality of longitudinally extending, cross-wise baffles for the purposes of excluding extraneous ambient-light from the cell **184**. The circular aperture **192** is preferably closed by a protective, transparent disk **194**.

Referring next primarily to FIGURE 2, the electrical components of the apparatus are suitably supported, as shown, on the upper surface of the base plate **14** and are enclosed under a box-shaped cover **196** which is secured by a plurality of machine screws as shown at **198**, in gas-tight sealing engagement with the upper surface of the base plate **14**. The electrical components comprise a solenoid control relay **200**, a rectifier **220**, a relay-contact arc suppressor network **204**, and a smoothing capacitor **210**.

Referring now principally to the circuit diagram shown in FIGURE 11, the electrical elements and circuits for the apparatus, generally described in connection with FIGURE 2, are as follows: A plug **212** is provided for making electrical connection to a conventional 110 volt A-C electric power source outlet. From the connector plug **212** electrical connection is made through conductor **214**, rectifier **202**, conductor **216**, photoconductive cell **184**, conductor **218** and through the windings of the electromagnet of the control relay **200** and return through conductor **220** to the plug **212**. The capacitor **210** is connected between the conductors **216** and **220** on the output side of the rectifier **202** and serves to smooth the rectified, pulsating direct current which, in operation, is applied by the rectifier **202** across the photoconductor cell **184** and windings of the relay **200**. The effect of the capacitor **210** is thus to smooth the action of the relay **200** when actuated. The field windings of the electromagnet of the solenoid **130** are connected across the conductors **214** and **220** by way of conductor **222**, thermostat circuit breaker **224**, conductor **226**, relay contacts **228** and **230**, which are normally open, and return through conductor **232**. The series connected resistor **208** and capacitor **206** of the beforementioned arc suppressor network **204** are connected across the relay contact points **228** and **230**, and serve to suppress arcing which tends to occur between the contact points when they open. The light source for the photoconductive cell **184** which, as hereinbefore mentioned, preferably consist of an incandescent electric lamp **174**, is connected through conductors **234** and **236**, directly across conductors **214** and **220** leading from the connector plug **212**.

The electrical apparatus elements which have been found satisfactory for the before described circuitry of FIGURE 11 are as follows: Solenoid **130** may be a No. AC–102 alternating current solenoid, manufactured by West Coast Electric Manufacturing Company. The thermostat circuit breaker **224** may be a hermetically sealed Klixon protector Mod. 7895, manufactured by Texas Instruments Incorporated, and designed to open at a temperature in excess of 170° F. and to close at about 140° F. This thermostat is fastened in close thermal proximity to the windings of the solenoid **130** whereby in event the temperature of the windings exceed the predetermined value of approximately 170° F., the solenoid elecertcial circuit will open and remain open until the solenoid cools to a temperature of approximately 140° F.

The rectifier **202** may be a conventional silicon power rectifier, rated at **750** peak inverse volts and capable of passing up to 50 ma. D-C. The cell **184** as beforementioned may be a cadmium sulfide photoconductive cell, such as an I.R.C. No. CS 120M6, manufactured by International Rectifier Corporation. This cell has a resistance of approximately 1600 ohms under an illumination intensity of 100 foot-candles. The relay **200** may be a Guardian No. 1R625–10 manufactured by Guardian

Electric Manufacturing Company of California, Incorporated, and which has a windings resistance of approximately 10,000 ohms. The resistor **208** has a resistance of 150 ohms and is rated at one-half watt, and the capacitor **206** has a capacity of 0.1 mfd. with a maximum rating of 600 volts. The light source **174** is preferably 110 volt 10 watt incandescent electric lamp.

Reference is next directed to FIGURE 12 in which an alternative, so-called solid state version of the electrical components of the circuits of the apparatus are shown and in which the control relay **200** and its associated contacts **228** and **230** have been eliminated, thereby minimizing certain hazards which might otherwise exist by reason of arcing at the relay contact points, such as for example, the danger of explosions occurring in an atmosphere containing combustible anesthetics. The power economy and reliability of operation of the apparatus as a whole is also improved.

In the electrical circuits of FIGURE 12, electrical connection is made from the connector plug **212**, through conductor **238**, a semiconductor controlled rectifier **240**, and conductor **242** to the electromagnet windings of the solenoid **130** and return through conductor **244** to the connector plug **212**. Connected between the conductor **238** and the control or gate terminal **246** of the controlled rectifier **240**, is a series electrical circuit consisting of rectifier **248**, resistor **250**, conductor **252**, resistor **254**, and a Zener voltage regulator diode **247**. Connected between conductor **252** and conductor **244** is the photoconductive cell **284**. Also, connected in shunt to the electromagnet windings of the solenoid **130** is a rectifier **255**, with its polarity reversed relative to that of rectifier **240**, and which serves in effect as a capacitance which smooths the pulsating direct current from the controlled rectifier **240** and acts as a conductive shunt to absorb inductive counter potential surges from the solenoid coil which occurs upon deenergization thereof. Thus, in operation, the rectifier **255** serves to smooth out the action of the solenoid and protect the other elements of the circuit. The thermostat **224** shown in this circuit serves the same purpose as that hereinbefore described in connection with the circuit of FIGURE 11.

The electrical apparatus elements which have been found satisfactory for the before described circuitry of FIGURE 12 are as follows: the solenoid **130** may be the same as or similar to that hereinbefore described in connection with FIGURE 11. The controlled rectifier **240** may be a silicon controlled rectifier No. 3RC25 manufactured by the International Rectifier Corporation. The rectifiers **248** and **255** may each be a No. 10D3 silicon rectifier rate at 300 peak inverse volts, 210 r.m.s. voltage input and 1000 ma. D-C output. The resistor **250** may be variable from 0 to 50,000 ohms with a 1 watt rating, and resistor **254** may have a value of 10,000 ohms with a rating of 2 watts. The diode **247** may be a Zener I.R.C. No. IZ6.8T20, manufactured by the International Rectifier Corporation. The photoconductive cell **184** and the light source **174** may be the same as those hereinbefore described in connection with FIGURE 11.

The operation of the apparatus as controlled by the electrical apparatus hereinbefore described in connection with FIGURE 11 is as follows:

Upon energization of the electrical circuit, of FIGURE 11, and so long as the light beam **182** between the light source **174** and the photoconductive cell **184** remains uninterrupted, the conductivity of the photoconductive cell **184** will be sufficient to permit rectified alternating current to flow from the rectifier **202** through the windings of the control relay **200**, thereby energizing the control relay **200** sufficiently to maintain open the normally closed relay contacts **228** and **230**, under which conditions the solenoid **130** remains unenergized. Upon interruption of the light beam **182** by any means, such as by positioning one's hands, in the path of the beam below the soap dispensing nozzle **52**, illumination of the photoconductive cell **184** is cut off causing its resistance immediately to rise sufficiently to cut off substantially all flow of current from the rectifier **202** through the control relay **200**. The control relay **200** being thus deenergized, the normally closed relay contacts **228** and **230** close, thereby completing the electrical circuit from the power source through the solenoid **130** by way of conductors **222**, **226** and **232**. Upon thus energizing the solenoid **130**, the solenoid armature **128** is pulled into the solenoid core, thereby pivoting the cam levers **114** and **116** and the cam head **104** carried thereby in a clockwise direction about the cam lever pivot bearing **118**, from the initial position shown in FIGURES 3 and 8 to that shown in FIGURE 6. Such movement of the cam head **104** relative to the cam follower roller **100** results in movement of the cam follower roller along the slot formed between the cam section **170** and the adjacent parallel upper edge of arms **148** of the star wheel **144**, until the cam follower reaches a point adjacent the outer end of such arm as shown in FIGURE 5. During this time the star wheel is locked in the position shown by the pawl device **154**. Following this the cam follower roller continues to move relative to the cam head **104** along the cam section **168** to a position at the juncture of the cam sections **168** and **166** shown in FIGURE 6. Such motion of the cam follower roller **100** relative to the cam surfaces **170** and **168** within the cam head **104** results in first rocking the lever member **78** in a clock-wise direction as shown by arrow **79** from its position shown in FIGURES 3 and 8, to the position shown in FIGURE 5, followed immediately by rocking the lever member **78** in the reverse direction indicated by arrow **81** to the position shown in FIGURE 6, which is the same position the lever member initially occupied as shown in FIGURES 3 and 8. This results in a complete reciprocatory cycle of operation of the piston rod **74** and of the piston **72** within the bores **58** and **60** of the pump cylinder **50**, from the uppermost position thereof shown in FIGURE 3 to the lowermost position as shown in FIGURE 5 and returned to the uppermost position as shown in FIGURE 6. The piston **172** is thus positively actuated throughout both its downward and upward motions for each single energization of the solenoid **130**.

Upon removal of the obstruction from the light beam **182**, the photoconductive cell **184** is again fully illuminated whereupon its resistance drops sufficiently to permit sufficient flow of rectified direct current through the windings of the control relay **200** to open its contact points **228** and **230** thereby interrupting the flow of current through the solenoid **130** and thereby deenergizing the solenoid **130**. Upon such deenergizing of the solenoid **130**, the solenoid armature **128** moves outwardly from the solenoid **130** under the force of spring **131** acting on the cam levers **114** and **116**, through the linkages **133**, thereby pivoting the cam head **104** in a counterclockwise direction, thereby returning it to its initial position shown in FIGURE 3. Upon such return counterclockwise movement of the cam head **104**, the cam follower **100** moves along the arcuate cam section **166** until it engages the inwardly projecting end of the arm **148** of the star wheel **144** causing the star wheel to rotate in a clock-wise direction as indicated by the arrow **145** shown in FIGURE 7, thereby permitting the cam follower roller **100** to continue to move along the arcuate section **166** until it comes to rest in the position it initially occupied relative to the cam head **104**, shown in FIGURE 3. Inasmuch as the cam section **166** is concentric with the pivot point **188** of the cam head **104**, no rocking motion is imported to the lever member **78** during this return motion.

Upon each cycle of actuation of the soap dispenser pump, as before described, the piston **72** is moved downwardly within the cylinder **50** with sufficient velocity to discharge a quantity of liquid soap past the valve member

68 despite the relatively large clearance between the piston and cylinder bore. Upon the upward return stroke of the piston 72, the cup-shaped valve member 68 assumes its normally closed position thereby causing a reduction in pressure in the cylinder bore 60 below the piston 72 sufficient to draw liquid soap from the reservoir 44 through the clearance space between the piston 72 and the bore 70, thereby refilling the cylinder bore below the piston 72 in readiness for another cycle of operation.

Important advantages reside in constructing the soap dispensing pump, as hereinbefore described, with the inlet end of the pump bore 60 in direct communication with the bottom of the reservoir 44, with the piston 72 in direct agitating contact with the contents thereof and with a relatively large clearance provided between the piston 72 and the inside of the cylinder bore 60. Among these advantages are the resultant constantly self-priming and self-cleaning action of the pump and the elimination of all interconnecting tubing and all pump intake valve mechanisms which would otherwise be necessary. Difficulties heretofore encountered in connection with such dispensing mechanisms, particularly when employed in connection with a material such as a so-called liquid soap, which often exhibits some of the properties of a semi-plastic material and which also has a tendency to build-up solidified deposits when in use and to settle out and solidify upon remaining quiescent for a length of time, has thereby been minimized. Furthermore, the employment of the kind of discharge valve 68 herein disclosed has also minimized many difficulties hereinbefore encountered, such as clogging of the valve and adjacent discharge opening of the dispensing mechanism by reason of progressive accumulation of solidiled soap within and adjacent the discharge valve and within the discharge nozzle. Dripping of soap from the nozzle following each use is also minimized.

The operation of the apparatus when employing the alternative electrical elements and circuits shown in FIGURE 12 is similar to that heretofore described and is as follows: While the light beam extending from the light source 174 to the photoconductive cell 184 remains uninterrupted, the resistance of the photoconductive cell 184 remains sufficiently low to permit sufficient rectified direct current to flow from conductor 238 through rectifier 248, resistor 250, through the photoconductive cell 184 and return to the conductor 244 to lower the D-C potential of the circuit consisting of conductor 252, resistor 254, Zener diode 247, and gate terminal 246 of the silicon controlled rectifier 240, sufficient to prevent initiation of conductivity thereof. Thus, while the light beam remains uninterrupted, the solenoid 130 remains unenergized. Upon interruption of the light beam 182, the resistance of the photoconductive cell 184 rises sufficiently to substantially cut off flow of current through the rectifier 248 and resistor 250 thereby permitting the potential of the circuit consisting of conductor 252 and resistor 254 to reach the conductive potential of the Zener diode 247, whereupon the potential of the gate terminal 246 suddenly rises sufficiently to initiate conductivity of the silicon controlled rectifier 240, thus permitting rectified direct current to flow from conductor 238 through rectifier 240 and conductor 242 through the solenoid 130 and return through conductor 244, thereby energizing the solenoid electromagnet 130 which in turn results in actuation of the dispenser pump actuating mechanism through the first half of its operating cycle, as hereinbefore described in connection with the circuit of FIGURE 11. Upon removing the obstruction to the light beam 182, permitting it to again illuminate the photoconductive cell 184, the resistance thereof lowers sufficiently again to lower the potential across the Zener diode 247 to a value at which it is nonconductive and thereby in turn lowering the potential of the gate terminal 246 of the silicon controller rectifier 240 whereupon the silicon controlled rectifier 240, by reason of the reversing nature of the alternating current applied thereto, returns to its non-conductive condition, thereby cutting off the flow of current through the solenoid 130 and permitting the dispenser pump actuating mechanism to complete the second half of its cycle of operation, under the force of spring 131, as hereinbefore described in connection with the circuit of FIGURE 11.

It is to be understood that the foregoing is illustrative only and that the invention is not limited thereby but may include various modifications and changes made by those skilled in the art without distinguishing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. In a fluid dispensing device having a pump cylinder, and a piston axially reciprocably contained in said cylinder, apparatus for imparting a positive reciprocation cycle to said piston relative to said cylinder in response to a single power impulse applied thereto, comprising:

a lever rockably supported at a point intermediate its opposite ends, said lever being coupled adjacent one end to said piston and carrying adjacent the other end a cam follower;

a cam head pivotally supported on a cam pivot for pivotal movement through a predetermined limited angle, said cam head having a continuous cam surface having inner and outer radially oppositely positioned sections, a first of such sections having a circular curvature substantially concentric with said cam pivot, and the second of such sections having a curvature, at least a portion of which has a radius substantially less than, and eccentric to that of said first of such sections;

means carried by said cam head for restraining said cam follower substantially to continuous following travel in one direction around said continuous cam surface from and return to a given point thereon, said travel being first along said second one of said sections as said cam head is pivoted from an initial position forward through said predetermined angle and second along said first one of said sections back to said given point thereon as said cam head is pivoted back through said predetermined angle to said initial position, thereby imparting one complete rocking movement cycle to said lever in response to said forward pivotal movement of said head from said initial position through said predetermined angle, and imparting no rocking movement to said lever in response to pivotal movement of said head back through said predetermined angle to said initial position;

power means coupled to said cam head and energizable for positively imparting pivotal movement of said cam head forward and back through said predetermined angle;

and control means actuatable for intermittently energizing said power means.

2. Apparatus according to claim 1 in which said power means comprises an electromagnet having an armature means movable in response to energization of said electromagnet;

and lever means coupling said armature means to said cam head.

3. In a fluid dispensing device having a pump cylinder, and a piston axially reciprocably contained in said cylinder, apparatus for imparting a positive reciprocation cycle to said piston relative to said cylinder in response to a single power impulse applied thereto, comprising:

a lever rockably supported at a point intermediate the opposite ends thereof, said lever being coupled adjacent one end to said piston and carrying adjacent the other end a cam follower;

a cam head pivotally supported on a cam pivot for pivotal movement through a predetermined limited angle, said cam head having a continuous cam surface encircling said cam follower and having radially inner and outer oppositely confronting sections, a

first of such sections having a circular curvature substantially concentric with said cam pivot, and the second of such sections having a curvature, at least a portion of which has a radius substantially less than and eccentric to that of said first of such sections;

means carried by said cam head for restraining said cam follower substantially to continuous following contact in one direction around said continuous cam surface from and return to a given point thereon, first along said second one of said sections as said cam head is pivoted from an initial angular position through said predetermined angle in a first direction, and second along said first one of said sections in return to said given point thereon as said cam head is pivoted back through said predetermined angle in a direction opposite said first direction, to said initial position, thereby completing one circuit of said cam follower around said continuous cam surface and imparting one complete rocking movement cycle to said lever in response to pivotal movement of said head through said predetermined angle in said first direction, and imparting no rocking movement to said lever in response to pivotal movement of said head through said predetermined angle in said direction opposite said first direction;

and power impulse producing means coupled to said cam head for positively imparting pivotal movement of said cam head through said first predetermined angle in said first direction each time a power impulse is produced thereby;

and resilient means for imparting return pivotal movement of said head through said predetermined angle in said direction opposite said first direction.

4. Apparatus according to claim 3 in which said power impulse producing means comprises an electromagnet having an armature means movable in response to energization of said electromagnet;

and lever means coupling said armature means to said cam head, whereby energization of said electromagnet means imparts said pivotal movement of said cam head through said first predetermined angle in said first direction.

5. Apparatus according to claim 3, and control means actuatable to cause such power impulse to be produced once each time said control means is actuated.

6. In a fluid dispensing device, apparatus comprising:

a reservoir for containing a quantity of fluid to be dispensed;

a pump cylinder extending from the bottom of said reservoir and having a pump bore therethrough in direct communication with the interior of said reservoir;

a piston reciprocably contained in said pump bore;

a discharge opening from the lower end of said pump bore below said piston;

a one-way outlet valve in said discharge opening, openable in response to pressures in excess of a predetermined fluid pressure in said lower end of said pump bore to permit discharge of fluid therefrom through said discharge opening;

a lever rockably supported at a point intermediate its opposite ends, said lever being coupled adjacent one end to said piston and carrying adjacent the other end a cam follower;

a cam head pivotally supported on a cam pivot for pivotal movement through a predetermined limited angle, said cam head having a continuous cam surface having inner and outer radially oppositely positioned sections, a first of such sections having a circular curvature substantially concentric with said cam pivot, and the second of such sections having a curvature, at least a portion of which has a radius substantially less than, and eccentric to that of said first of such sections;

means carried by said cam head for restraining said cam follower substantially to continuous following travel in one direction around said continuous cam surface from and return to a given point thereon, said travel being first along said second one of said sections as said cam head is pivoted from an initial position forward through said predetermined angle, and second along said first one of said sections back to said given point thereon as said cam head is pivoted back through said predetermined angle to said initial position, thereby imparting one complete rocking movement cycle to said lever in response to said forward pivotal movement of said head from said initial position through said predetermined angle, and imparting no rocking movement to said lever in response to pivotal movement of said head back through said predetermined angle to said initial position;

power means coupled to said cam head and energizable for positively imparting pivotal movement of said cam head forward and back through said predetermined angle;

and control means actuatable for intermitently energizing said power means.

7. Apparatus according to claim 6 in which said power means comprises an electromagnet having an armature means movable in response to energization of said electromagnet;

and lever means coupling said armature means to said cam head.

8. In a dispensing device, apparatus comprising:

a reservoir for containing a quantity of fluid to be dispensed;

a pump cylinder in communication with said reservoir and having its upper end in substantially direct communication with the interior thereof;

a piston axially reciprocably contained in said cylinder;

electric power means actuatable to impart reciprocation to said piston relative to said cylinder;

and control means for actuating said power means, said control means including:

a semiconductor controlled rectifier having an input terminal, an output terminal and a control gate terminal;

a series circuit including conductor means connecting said rectifier through said input and output terminals in series with said power means;

conductor means for connecting said series circuit across an A-C power source, whereby said power means may be energized with rectified D-C through said rectifier when said rectifier is conductive;

means including light sensitive means for applying a potential difference between said input and control gate terminals of said rectifier such as to initiate conductivity of said rectifier when said light sensitive means is subjected to one illumination intensity and insufficient to initiate conductivity of said rectifier when said light sensitive device is subjected to another illumination intensity.

9. In a fluid dispensing system having a reservoir for material to be dispensed, a pump cylinder in communication with said reservoir, a piston reciprocable in said cylinder, and power means actuatable to impart reciprocation to said piston relative to said cylinder, control means for actuating said power means comprising:

a first supply conductor means for connection to one side of an A-C power source;

a second supply conductor means for connection to the other side of an A-C power source;

a semiconductor controlled rectifier having an input terminal, an output terminal, and a control gate terminal, said input terminal being connected to said first supply conductor;

conductor means connecting said output terminal, through said power means to said second supply con-

ductor means, whereby said power means may be energized with unidirectional current through said controlled rectifier when said controlled rectifier is conductive;

a second rectifier having its input terminal connected to said first supply conductor on the input side of said controller rectifier;

a photoconductive device;

a resistor having a first end thereof connected to the output of said second rectifier and the second end thereof connected through said photoconductive device to said second supply conductor, whereby unidirectional current flows through said resistor and said photoconductive device when said photoconductive device is conductive;

a control conductor means interconnecting said second end of said resistor to said control gate terminal of said controlled rectifier, whereby when said photoconductive device is conductive or nonconductive the potential of said control gate terminal is such as to render said controlled rectifier respectively conductive and nonconductive when energized by said A-C power source, thereby respectively energizing and deenergizing said power means.

10. Apparatus according to claim **9** wherein said control conductor means includes a Zener diode in series therein with its effective input terminal connected to said second end of said resistor and its effective output end

connected to said control gate terminal of said controlled rectifier.

11. Apparatus according to claim **10** and a resistor connected between said second end of said resistor and said input terminal of said Zener diode.

12. Apparatus according to claim **11** and an electric light source connected across said first and second supply conductors, and positioned normally to illuminate said photoconductive device.

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