United States Patent

Crandall et al.

[15] **3,662,924**

[45] **May 16, 1972**

[54] **LIGHT-CONTROLLED FLUID DISPENSER**

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[73] Assignee: **Gilbert & Barker Manufacturing Company,** New York, N.Y.

[22] Filed: **Feb. 26, 1971**

[21] Appl. No.: **119,351**

Related U.S. Application Data

[63] Continuation of Ser. No. 790,963, Jan. 14, 1969, abandoned.

[52] **U.S. Cl.** **222/64,** 141/192

[51] **Int. Cl.** **B67d 5/08**

[58] **Field of Search** .... 222/64, 66; 350/96 R, 96 B; 137/93; 141/208, 218, 219, 192, 195

[56] **References Cited**

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Primary Examiner—Stanley H. Tollberg
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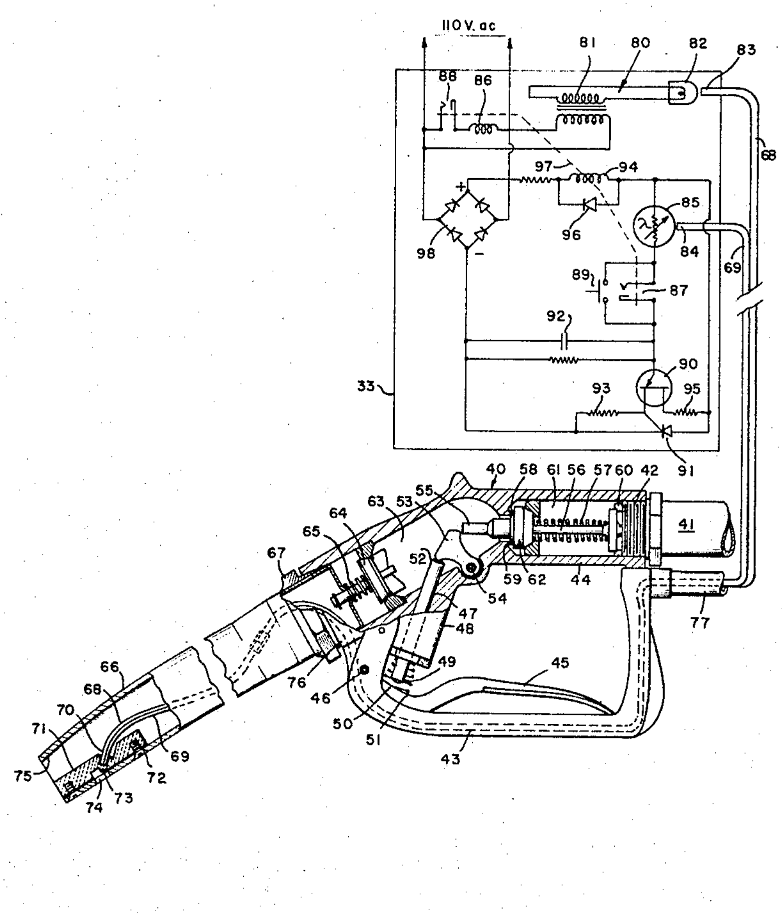
[57] **ABSTRACT**

A fluid sensing device for controlling the dispensing of a liquid into a container in which a light beam is transmitted from a remote source to a predetermined location of fluid discharge and the light beam is reflected to a light responsive control circuit during fluid flow whereby upon light beam interruption or modification fluid flow may be terminated or re-initiated, manually or automatically.

11 Claims, 18 Drawing Figures



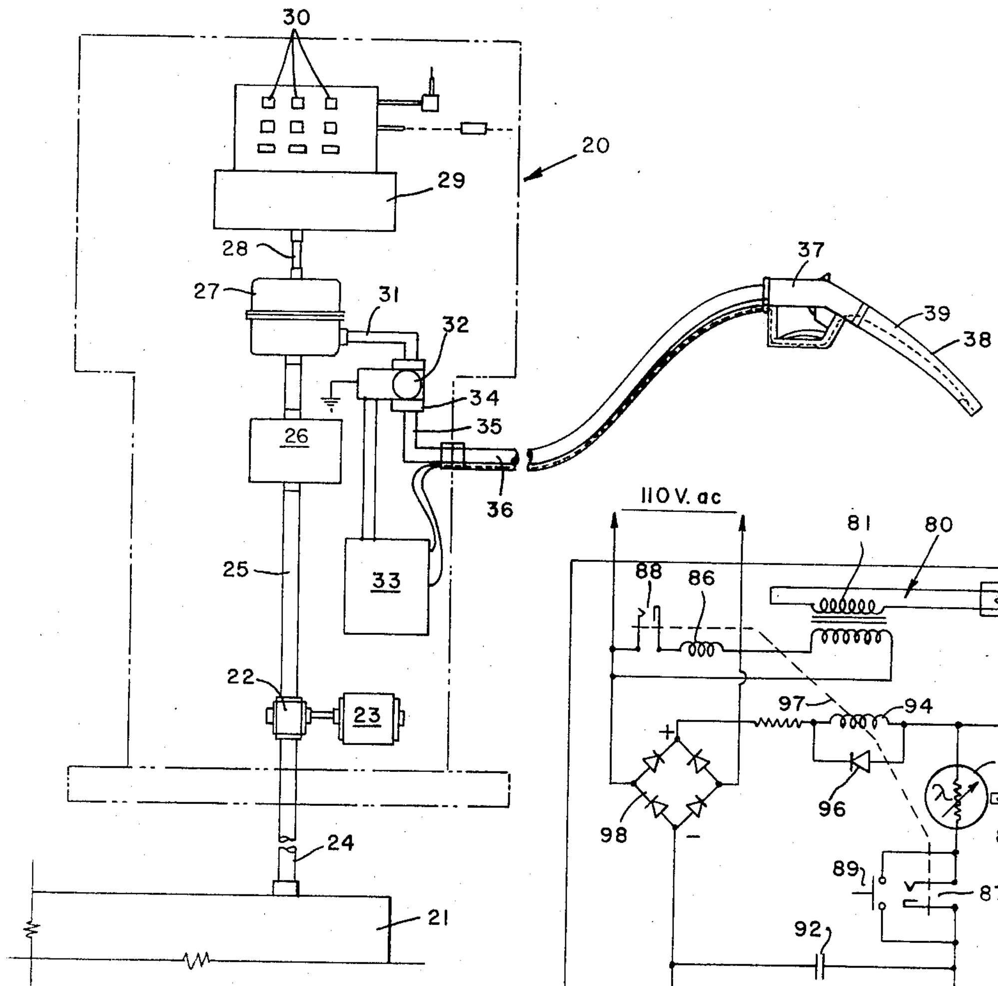


FIG. 1

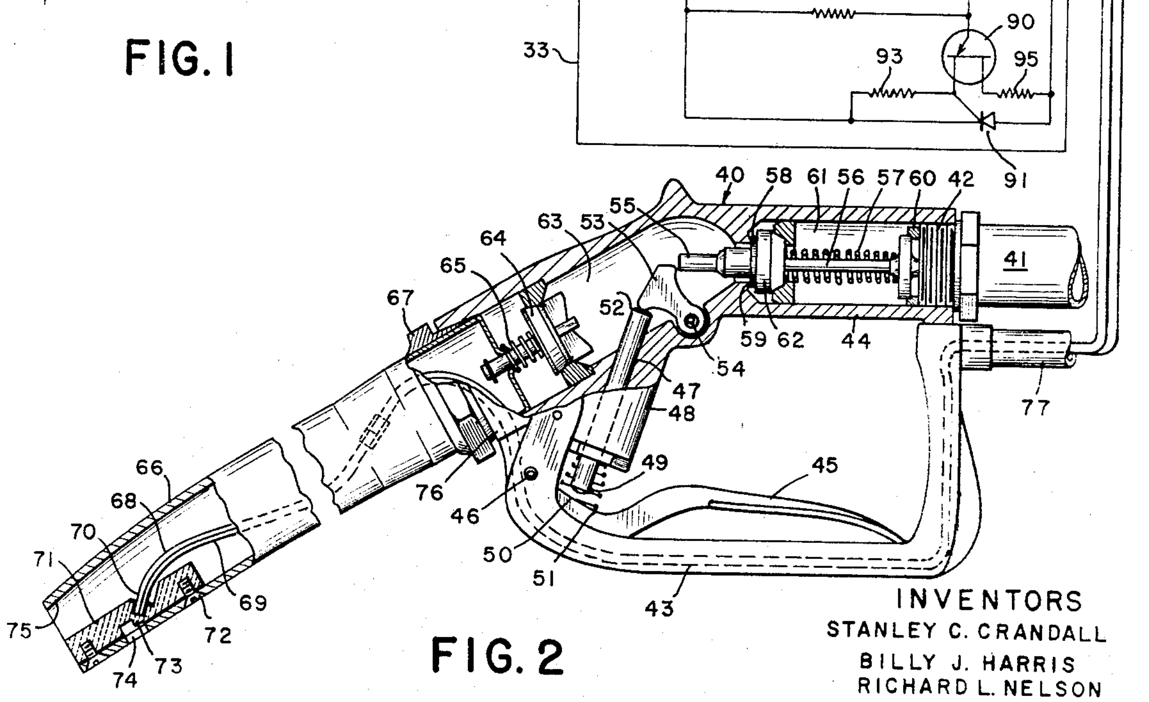


FIG. 2

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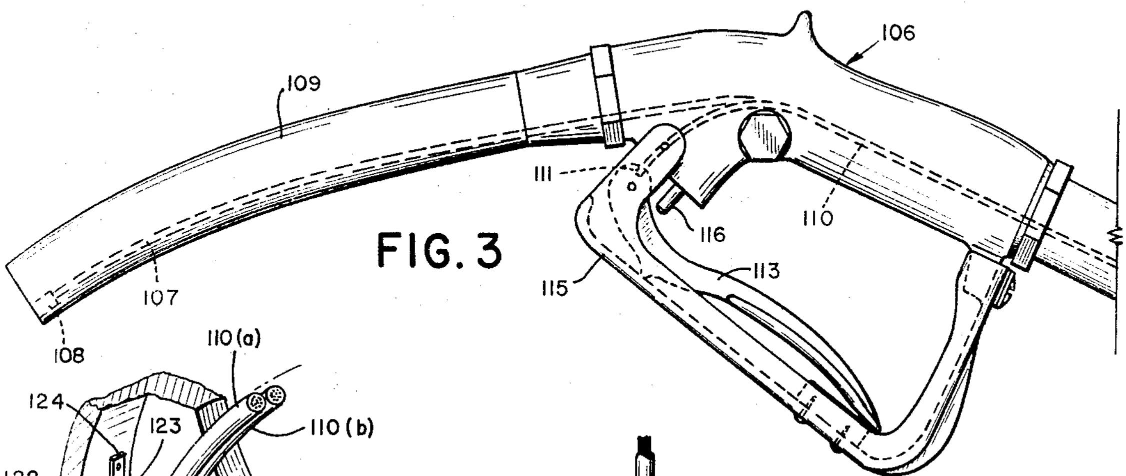

FIG. 3

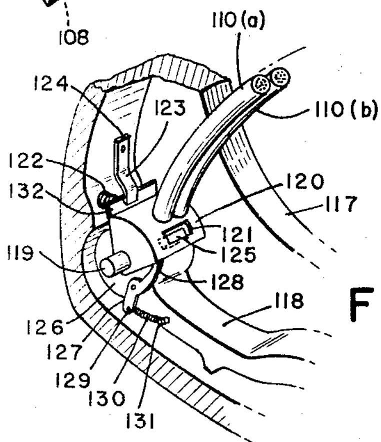

FIG.5

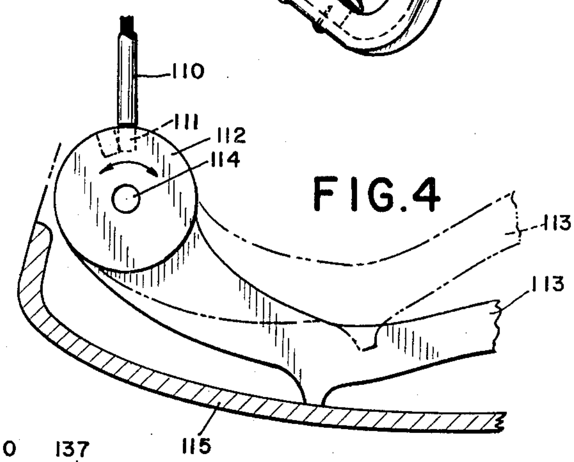

FIG.4

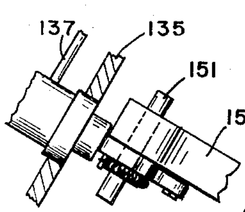

FIG.7

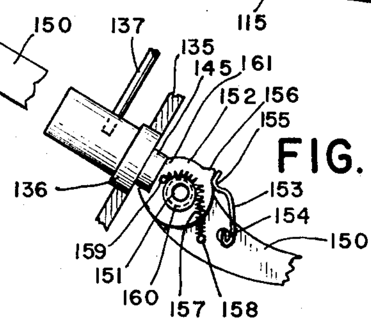

FIG.6

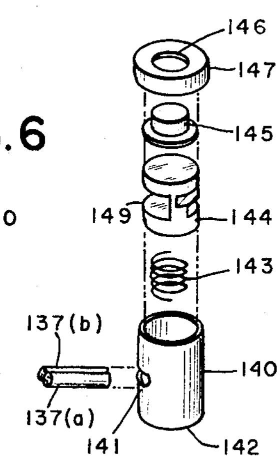

FIG.9

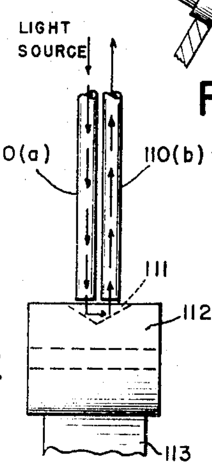

FIG.12

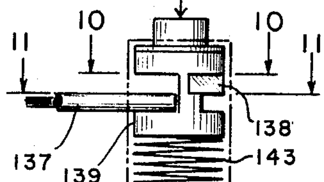

FIG.8

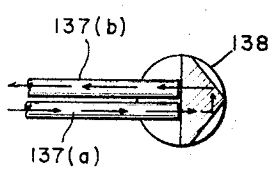

FIG.10

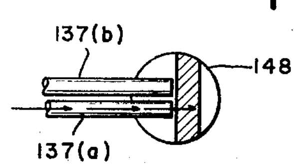

FIG.11

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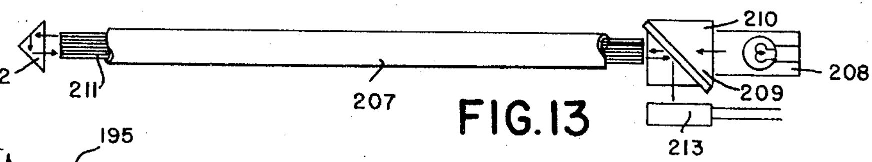

FIG.13

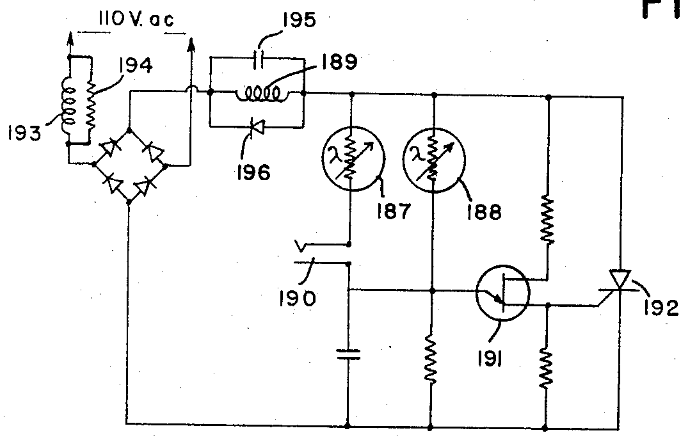

FIG. 16

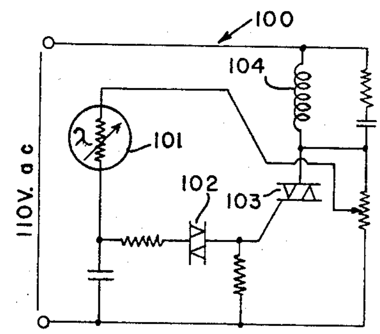

FIG.18

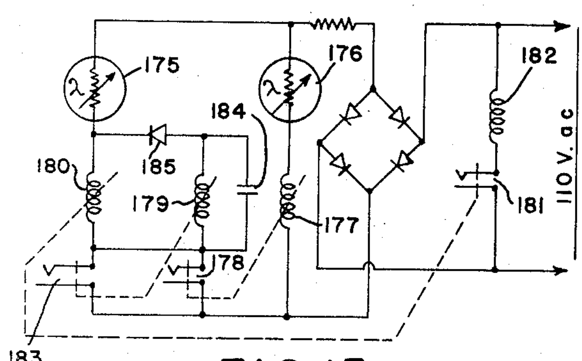

FIG.15

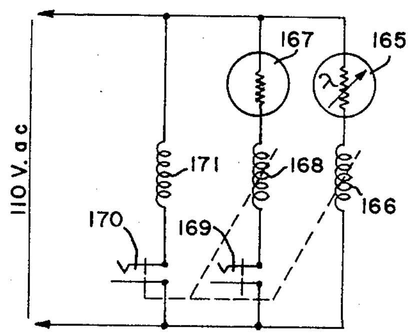

FIG. 14

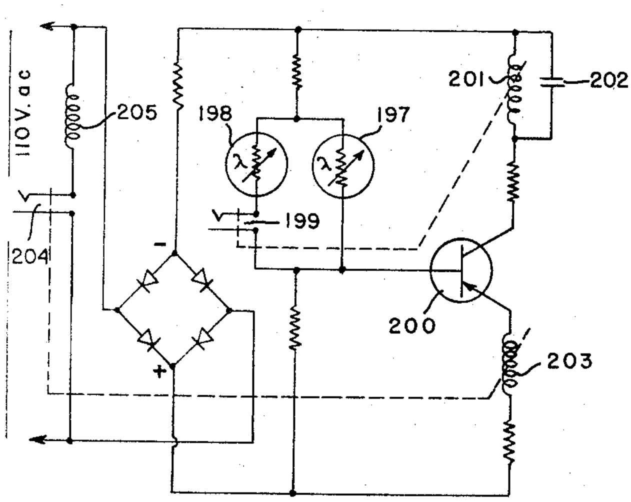

FIG.17

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LIGHT-CONTROLLED FLUID DISPENSER

This is a continuation of Ser. No. 790,963 filed Jan. 14, 1969, and now abandoned.

BACKGROUND, BRIEF SUMMARY, AND OBJECTIVES OF THE INVENTION

The control of fluid flow into a tank or other receptacle has been achieved by various manually and automatically operated valves and nozzles depending upon the specific application or environment of the receptacle or tank to be filled. Substantial volumes of gasoline are dispensed to fill or fill partially fuel tanks in automobiles, vehicles, vessels and various types of movable and stationary storage tanks. Additionally, other petroleum products varying in viscosity are pumped into tanks in which visual or other tank capacity measuring devices are employed. Gasoline dispensing nozzles that are presently available employ various types of automatic tripping mechanisms that are generally dependent upon pressure responsive devices thereby freeing an attendant to perform other tasks for patrons without awaiting the filling of a tank at the filling location. Numerous types of automatic shut-off and safety nozzles that are presently available enable a service station attendant to supervise and perform simultaneously, while the gasoline tank is being filled, other services for patrons without observing continuously the gasoline pump computer when a gasoline tank is being filled. However, presently available automatic shut-off and safety nozzles are bulky, rather complex internally, and difficult to maintain, in addition to being quite costly. Significantly, presently available dispensing nozzles that are responsive to suction pressure fluctuations will be tripped automatically into the "off" position when there is a backward surge of fluid that occurs rather frequently when an empty or partially filled tank is being filled rapidly due to air displacement from within the tank to the tank inlet which may cause fluid turbulence at the inlet resulting not only in tripping the nozzle automatically into the closed position but the overflow creates a dangerous fire hazard in the area where the overflow or spillage has occurred.

Numerous unsuccessful attempts have been made to utilize a low voltage sensing device in the fuel nozzle as a cut-off for fluid flow but the utilization of any electrical signals in the vicinity of the fluid dispensing nozzles has been rejected because it is not intrinsically safe particularly where highly flammable liquids are dispensed. Maximum precautionary measures are required to eliminate the occurrence of any static charge that may be developed in the dispensing apparatus and dispensing equipment must be grounded adequately to avoid fire hazards.

The introduction of self-service gasoline service stations with coin and bill-operated gasoline dispensers, and the use of remotely controlled pre-set gasoline dispensing apparatus which enables a customer to dispense gasoline to his own vehicle create added problems and hazards in service stations. Bulky, heavy and complex automatic, safety dispensing nozzles require trained personnel to operate them. Customers who experience a backward surge of gasoline during fill-up may not be aware of the cause of this phenomenon and may panic or complain to the management or may never return to the same self-service station fearful that similar experiences may occur.

The fluid sensing system of this invention employs an intrinsically safe light beam in proximity of the discharge of the dispensing nozzle with a light responsive control circuit for detecting fluid to terminate or monitor, within limits, fluid flow through the nozzle into a receiving tank. A flexible fiber optic element "pipes" or transmits light from a light source to the point of fluid discharge which discharge may be at a predetermined position relatively in a tank being filled. Another fiber optic element cooperates with the fiber optic element that receives the light from the light source to transmit a light beam from the fluid discharge position to a light responsive control circuit or receiving detector, generally at a remote location, to actuate the dispenser circuitry, within prescribed limits, either to terminate fluid flow or re-initiate fluid flow within a predetermined time interval in the event light conduction through the fiber optic elements is momentarily interrupted for a predetermined interval as during a backward surge of fluid.

The light-controlled fluid dispensing apparatus of this invention basically incorporates an intrinsically safe light beam for actuating and de-actuating the flow of fluid by sensing directly through a modification of the refractive index of a light transmission medium, such as a prism, the interruption or modification of light intensity to activate a control circuit when fluid impinges or "wets" the transmission medium which "feels" the fluid level in the receptacle to be filled while the light transmission medium is insensitive to the flow of fluid through the dispensing apparatus. By providing suitable holding circuits, "surges" and "topping" phenomena may be treated without complete fluid flow shutdown as such phenomena are momentarily only, however, in the event such phenomena are for sustained intervals, the system will be shutdown thereby obviating the necessity for repetitious manual resetting.

A unique adaptation of fiber optics, in addition to fluid detection or sensing when a receptacle is filled to a predetermined level, is the incorporation of a light beam in a first fiber optic system to initiate fluid flow by manual displacement of a nozzle lever through a predetermined position to transmit a beam of light to a light detector which will activate a circuit to commence fluid flow. The combination of a fiber optic system for actuating fluid flow and a second fiber optic system to sense fluid capacity in a receptacle to interrupt flow, momentarily and then re-initiate flow or terminate flow completely, presents a versatile and safe system that is most efficacious for dispensing fluids particularly those fluids that are highly flammable.

Briefly, the light-controlled fluid dispenser includes a fluid dispensing nozzle to which a fluid is supplied by a pump located at a remote location which may be actuated at the commencement of each pumping cycle with a light conducting fiber optic element leading from a light source to a light transmission element having a refractive index responsive and modifiable to fluid impingement and from the light transmission element to a light sensitive detector, such as a photocell, which detector controls by the light transmitted to the photocell the condition of a circuit for enabling fluid to flow. A second fiber optic system, preferably but not necessarily linked in the same circuit, is positioned for fluid flow actuation in a manually operable lever of a dispensing nozzle with fiber optic elements transmitting light from a light source to a displaceable transmission element before light transmission to a light detector for controlling an electrical ciccuit for actuating fluid flow. A current sustaining circuit is provided which re-initiates fluid flow when light conduction is momentarily interrupted or modified but re-established.

BRIEF DESCRIPTION OF DRAWINGS ILLUSTRATING PREFERRED EMBODIMENTS

Several preferred embodiments of this invention will be more readily understood from the following detailed drawings in which like characters of reference designate corresponding parts throughout the several views, and in which several of the figures are diagrammatic or schematic illustrations of the circuitry, and wherein:

FIG. 1 is a schematic illustration of a gasoline dispenser pump and fluid dispensing nozzle incorporating the invention;

FIG. 2 is a partial longitudinal sectional view, with portions removed, of a fluid dispensing nozzle and a schematic illustration of a light supply, light detecting and a light sensitive fluid control circuit incorporating one preferred embodiment of the invention;

FIG. 3 is a side elevational view of a modified dispensing nozzle containing fiber optic elements for controlling the initiation and termination of fluid flow;

FIG. 4 is an enlarged, partial, side elevational fragmentary sectional view of the dispensing nozzle trigger handle or lever of FIG. 1 in closed and partially open positions;

FIG. 5 is an enlarged, partial perspective and fragmentary sectional view of another modified embodiment of a nozzle trigger handle or lever which contains a light conducting prism therein for cooperative alignment with light-conducting fiber optic elements;

FIG. 6 is a partial side elevational view of another modified nozzle trigger lever assembly for transmission of light between light-conducting members;

FIG. 7 is a partial plan view of FIG. 6;

FIG. 8 is an enlarged side view of a light conducting device for transmitting light between adjacent fiber optic elements of FIGS. 6 and 7;

FIG. 9 is a perspective and exploded view of the device of FIG. 8;

FIG. 10 is a transverse sectional view taken along the section line 10—10 of FIG. 8;

FIG. 11 is a transverse sectional view taken along the section line 11—11 of FIG. 8;

FIG. 12 is a partial right elevational view of the nozzle trigger and fiber optic elements of FIGS. 3 and 4;

FIG. 13 is a diagrammatic view of a modified fiber optic control system utilizing a single fiber optic bundle in conjunction with a beam splitter;

Fig. 14 is an electrical diagram of a basic circuit arrangement for actuating a dispenser solenoid valve in response to a light pulse;

FIG. 15 is an alternative electrical diagram for controlling the actuation of a dispenser solenoid valve;

FIG. 16 is another alternative electrical diagram for controlling a solenoid valve of a dispensing system for reinitiating fluid flow;

FIG. 17 is still another electrical diagram for a light-responsive system for actuating a solenoid valve of a dispensing system for re-initiating fluid flow; and

FIG. 18 is a further alternative electrical diagram for a light-responsive control system to actuate a solenoid valve of a dispensing system.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Referring to the drawings, and particularly to FIG. 1, there is illustrated, in outline form a gasoline dispensing pump housing **20** for enclosing the operating mechanisms and controls for dispensing gasoline which is stored in the storage tank **21** from which the fluid is withdrawn by the pump **22** that is driven by motor **23** enabling the fluid to flow through pipe **24** and pumped through line **25** under pressure through the air separator **26**. Fluid will flow through the meter **27** that is connected by output shaft **28** to the computer **29** which houses a cost variator (not shown) which will actuate and display through suitable apertures **30** the volume and cost of the liquid dispensed for observation by a customer and service station attendant. The liquid will be discharged from the meter **27** through line **31** which is provided with a solenoid-operated valve **32** which may be actuated to initiate fluid flow manually through conventional mechanisms by an attendant or a customer or by actuation of one or more of the devices described herein. A control panel housing **33** mounted within housing **20** contains a light supply source, light detecting means, and light responsive circuitry for controlling fluid flow as will be described hereafter. The discharge end **34** of valve **32** is connected to the line **35** which in turn is suitably connected to the flexible discharge hose **36** at the end of which is mounted a gasoline dispenser nozzle **37** with a discharge spout **38** which will be introduced into the fill spout of a tank to be filled. Nozzle **37** is provided with light-conducting means **39** for terminating fluid flow as will be described hereinafter.

There is illustrated in FIG. 2 a fluid-dispensing nozzle **40** that is connected to a flexible hose **41** which leads to a fuel-dispensing pump with the hose **41** being connected to the nozzle through the threaded bushing **42**. A lever guard **43** is secured to the nozzle housing **44** and pivotally supports the hand-pivotable lever **45** which pivots about the pivot pin **46** in the guard **43**. A valve-actuating plunger **47** is slidably positioned in the packing gland boss **48** with the depending end **49** to be engaged by the plunger-engaging surface **50** on lever **45** with the helical spring **51** that encircles the depending end **49** of plunger **47** resiliently urging lever **45** out of engagement with plunger **47**. The upper end **52** of plunger **47** engages with valve lever **53** that is pivotally supported on the valve lever pin **54** mounted in housing **44** with the valve lever **53** engaging the projecting end **55** of the valve assembly rod **56** which is urged by the encircling helical spring **57** into the seated position, as shown in FIG. 2, by having the valve disc **58** seated against the valve seat **59**. The valve guide plate **60** is positioned in the valve housing to guide the displacement of the valve rod **56** therethrough and to provide a stationary support for spring **57** which extends longitudinally in the chamber **61** to engage with the rear of the slide washer **62**. The valve guide plate **60** is provided with fluid flow apertures (not shown) through which the fluid may flow into chamber **61**. Upon actuation of lever **45**, plunger **47** will pivot valve lever **53** clockwise to displace valve rod **57** to the right against the action of spring **57** thereby opening the valve by unseating disc **57** against the seat **58** permitting the flow of fluid into the nozzle chamber **63** in which there is suitably supported a check valve **64** that is urged by helical spring **65** into the seated position, as shown in FIG. 2. Adequate fluid pressure of incoming fluid will displace check valve **64** from the seated position overcoming the force of spring **65** permitting flow of fluid through the nozzle into the discharge pipe **66** which is suitably fastened by the connecting bushing **67** to the housing **44**.

A pair of flexible fiber optic light conducting elements **68** and **69** extend into the nozzle discharge pipe **66** and are suitably secured therein to minimize any fluid resistance to flow. The fiber optic elements may consist of a plurality of monofilaments arranged in a suitable sheath covering, and representative specimens No. 1410X and No. 1610X produced by du Pont have been suitable although other fiber optic elements capable of transmitting a light beam should be adequate for use in this environment provided the sheath is resistant to deterioration from exposure to gasoline and other types of fluides which may have a dissolving action. In particular, it may be advantageous to prevent exposure of the light guide sheath to gasoline in some applications to have the fiver optic elements supported within a separate external tube. The forward ends **70** of the light-conducting elements **68** and **69** are releasably securely fastened in a suitable recess formed in plastic or glass fiber optic retaining member **71** which is securely fastened to the interior of the nozzle pipe by the screws **72**.

A light transmission prism member **73** is formed in the member **71** for cooperation with fiber optic elements **68** and **69** to receive a light signal from light conducting element **68** and to transmit it to element **69** provided the environment surrounding prism **73** has the proper refractive index. The prism **73** is suitably shielded from fluid flowing through the nozzle pipe **66** but the prism is exposed to fluid levels and surges through the wall aperture **74** of nozzle pipe **66** and is responsive to fluid that may rise or flow rearwardly about the discharge end **75** of the nozzle pipe **66**. Discharge flow of fluid through the nozzle pipe **66** will not impinge of "wet" the light transmission prism member **73** which will be guarded by the member **71** from such flow. However, rearward or upward fluid flow as when a tank is filled or there is a surge of fluid rearwardly about the discharge end **75** of nozzle pipe **66**, prism **73** may have fluid impinged thereon or become immersed through the aperture **74** so that the refractive index of the prism with respect to the surrounding medium may be altered thereby interrupting light conductance. The light transmission through the prism **73** will be modified when in contact with liquid because the relative index of refraction is different from that when the prism is surrounded by air.

The fiber optic elements **68** and **69** extend rearwardly in pipe **66** and through the gland **76** for retention in the handle guard **43**, and through the protective sleeve **77** which may be suitably secured to the flexible hose **41** into the dispenser housing **20** where the elements **68** and **69** will be introduced into the control panel housing **33**. Suitably sealed within the control panel housing **33**, and shown diagrammatically and schematically in the electrical circuit portion of FIG. **2**, is a light supply source **80** to which current is supplied from a 110 volt AC line through the step-down transformer **81** to the fiber optic illuminating lamp **82** adjacent to which the end **83** of the light conducting fiber optic element **68** is supported to transmit a light beam from the lamp **83** to the prism **73** when the pump motor **23** of the dispenser **20** is actuated for each pumping cycle. However, it may be desirable to utilize a combination lamp and lens, in some instances, to focus a light beam on the end **83** of the light conducting element **68**. The end **84** of the return light conducting fiber optic element **69** is positioned adjacent to the light sensor, photo conductive cell or photocell **85** to transmit to the photocell **85** any light transmitted to the fiber optic element **69** by prism **73**. The solenoid coil **86** controls the actuation of the solenoid-operated valve **32** which, when properly conditioned, will permit fluid to flow when the pump **22** is driven by the motor **23**.

Before commencement of a pumping cycle, contacts **87** and **88** are open and the solenoid valve **32** is closed since no current is supplied to the solenoid coil **86**. At the commencement of a pumping cycle, the dispenser is turned on supplying current to the light supply source **80** and the photocell **85** will receive light reflected from prism **73** provided no fluid surrounds the prism to modify its refractive index with the light intensity thereby lowering or decreasing the resistance of the photocell **85**. Upon actuating the reset push button **89** an electrical by-pass is provided around contacts **87** supplying current to the uni-junction **90** which will then trigger the silicon controlled rectifier (SCR) **91**. Initially, current will flow in the circuit while the photocell **85** is illuminated and the reset **89** is actuated charging capacitor **92** to introduce a time delay before the emitter of the uni-junction **90** reaches its peak voltage and triggers the SCR. When the uni-junction **90** triggers, the capacitor **92** discharges through the resistor **93** and the gate of the SCR. Current flow to the gate of the SCR allows current to flow from the anode to the cathode of the SCR, and the SCR permits the rectified current to flow for all but a small initial portion of a half wave. Current flow through the SCR is adequate to cause the relay coil **94** to close the contacts **87** and **88** with the resistor **95** such that the voltage across the base of the uni-junction **90** does not exceed a predetermined value. The reset push button **89** may be released after contacts **87** close. The solenoid valve **32** will open when the contacts **88** close preconditioning the system for fluid delivery when the nozzle lever **45** is pivoted sufficiently to displace the valve lever **53** and the valve assembly rod **56** is urged to the right to admit fluid into the nozzle. The relay coil **94** is used in conjunction with a diode **96** which is in parallel therewith to insure drop-out of the SCR at each half-cycle. There is a mechanical connection **97** between the relay coil **94** and the solenoid coil **86** through the contacts **88** and **87**. The contacts **87** adjacent the manual reset **89** are in direct line with the photocell **85**. Should the reset **89** be actuated when the photocell has insufficient light reflected thereon, there will be insufficient current passing through contacts **87** to activate the relay coil **94** and the solenoid coil **86**. When adequate current flows through the photocell **85**, upon actuation of the reset button, current will flow through the uni-junction transistor **90** to trigger the SCR, and current will then flow to the bridge rectifier **98** causing current to flow through the relay coil **94**, closing contacts **88** to energize the solenoid **86**.

When the refractive index about the prism **73** is altered, as when a liquid wets or engulfs or impinges on the prism **73**, the photocell **85** will be darkened as the light intensity of the light beam returning through the element **69** is reduced and the resistance in the photocell is increased thereby decreasing current flow through the photocell causing the uni-junction to cease to trigger the SCR. Diode **96** provides a path to collapse the flux field of the relay coil **94** in order to turn off the SCR. Current flow through the SCR drops thereby causing the relay coil **94** to open the contacts **87** and **88** which will then cause solenoid coil **86** to close solenoid valve **32** terminating fluid flow through the dispenser and nozzle by virtue of the light responsive circuit which will interrupt fluid flow upon fluid impingement on the light conducting element, and particularly the light transmission prism **73**.

The system illustrated in FIG. **2** is adequate to perform automatic shut-off as well as topping fill of a tank. The feature of topping may be accomplished by resetting the push button **89** as many times as may be necessary in the event automatic shut-off occurs when fluid impinges upon the prism.

The manually reset light-responsive circuit included in FIG. **2** may be replaced by the automatic light-responsive circuit **100** of FIG. **18** while retaining the light supply source **80** and the light transmitting elements **68** and **69** while still utilizing a 110 volt AC supply so that when the dispenser is energized to turn the pump on, the photocell **101** receives light that is reflected from the prism **73** through the element **69** from the end **84** thereof and lowers the resistance of the photocell increasing current flow therethrough to the trigger **102** with the trigger current to the triac **103** causing current to flow through the triac thereby increasing current flow through the triac which amplifies current to flow to the solenoid coil **104** which will control the operation of solenoid valve **32**. Solenoid valve **32** will open and allow fluid to flow when adequate current flows to the solenoid coil **104**, and liquid will be supplied to the nozzle when the nozzle lever **45** is actuated to open the nozzle valve. When the liquid lever engulfs prism **73** of liquid impinges thereon to modify the refractive index causing an interruption of modification of the intensity of the light returning to the photocell **101**, the increase in resistance of the photocell will drop the current flow through the photocell and the trigger **101** and **102** causing the triac **103** to stop conducting de-energizing solenoid coil **104** which will then close solenoid valve **32** thereby terminating fluid flow from the dispenser to the nozzle. The system illustrated in FIG. **18** is capable of performing automatic shut-off as well as topping without the necessity of manual reset as required in the light responsive control circuit of FIG. **2**.

Heretofore there has been described a light-controlled fluid dispenser in which a light-detecting circuit is responsive to light intensity in order to interrupt fluid flow. It has been found desirable to utilize light-conducting members in combination with such light-responsive means for interrupting fluid flow to initiate fluid flow directly at the nozzle through which the fluid is dispensed as will be described in the several illustrated embodiments in FIGS. **3** through **12**. There is illustrated in FIGS. **3** and **4** a fluid dispensing nozzle **106** that is substantially comparable in construction to the fluid dispensing nozzle assembly **40** in which there is light-conducting fiber optic elements **107** for transmitting a beam of light from a remote light source to a light transmission member **108** within the discharge pipe **109** and a return for reflected light to a photocell of the type heretofore described for interrupting fluid flow upon flow immersion or impingement on the light-conducting transmission member **108**. The combination or auxiliary system for initiating fluid flow incorporates light receiving and reflecting fiber optic elements **110** which are employed in combination with a light transmission member or prism **111** that is suitably embedded protectively in the hub **112** of the nozzle hand actuating lever **113** that is pivotally mounted on the pivot pin **114** to the depending hand guard **115** for the lever **113**. A light transmission prism **111** which is shown protectively embedded in the boss **112** of the hand lever **113**, as shown in FIG. **12**, more clearly indicates the side-by-side relationship of the fiber optic elements **110***a* and **110***b* in which light from a remote light source will be conducted through the element **110***a* to the prism **111** and, when coincidence of path of light may occur, as when prism **111** will permit reflection of the light beam therethrough, as the lever **113** is pivoted through its arc of displacement, the reflected light from element **110*b*** will be detected at a photocell, as will be described. A momentary pulse of light is adequate to initiate circuit operation when a proper combination of photodetector circuits is utilized. In FIGS. **3, 4** and **12**, the light pulse for initiating circuit operation and commencing fluid flow will occur as the lever **113** is pivoted through approximately 10° to 15° from the full-line off position of the lever shown in FIG. **4**. A light pulse will occur when the lever **113** reaches the broken line position in FIG. **4**, and as shown in FIG. **12**, but the lever **113** is only partially depressed in its displacement to urge the valve open through elevation of the plunger **116**.

A description of alternative embodiments for initiating a light pulse will be described briefly before describing in detail the electrical circuits for initiating fluid flow and fluid interruption. In FIG. **5**, the lever guard **117** cooperatively and pivotally receives the lever **118** mounted on the pivot pin **119** about which pin **119** a shutter **120** having an aperture **121** is yieldably biased by the spring **122** in a clockwise direction against the limiting stop **123** which is secured to the guard **117** at one end **124** thereof. Prism **125** is protectively embedded in the hub **126** of the lever **118** comparable to that shown in FIG. **12** with the light-conducting elements **110*a*** and **110*b*** being suitably supported in spaced relation to the surface of shutter **120** and out of contact therewith. A shutter displacing and release lever **127** is pivotally mounted intermediate its length to the boss **126** with the free end **128** engaging the shutter **120** and the other end **129** being connected to the spring **130** with the other end of the spring being connected to the lever mounted spring engaging stud **131**. As the lever **118** is pivoted counterclockwise, shutter **120** will be displaced counterclockwise against the action of spring **122** which engages the upturned lip **132** of shutter **120**. When the shutter aperture **121** is in registry with the terminal ends of the elements **110*a*** and **110*b***, the prism **125** will also be in registry with the aperture **121** and light transmitted through element **110*a*** will be reflected through the prism **125** to element **110*b*** momentarily since the shutter engaging and activating member **128** will become disengaged with the shutter by virtue of the eccentric mounting thereof enabling spring **122** to pivot shutter **120** in a clockwise direction after a light pulse has been reflected back to a photocell through light conducting element **110*b***. Lever **118** may continue to be displaced counterclockwise throughout fluid flow and until fluid is impinged upon the light conducting prism **108** to interrupt the light beam and thereby interrupt fluid flow as heretofore described. In the event of lever release or fluid flow interruption, lever **118** may be recycled subject to fluid level in the nozzle at the prism or fluid impingement.

In FIGS. **6** through **11**, there is illustrated another embodiment for providing a light pulse to initiate fluid flow in which the lever hand guard **135** retains a displaceable prism-supporting housing **136** into which housing light conducting elements **137** are supported for transmitting and reflecting a light beam upon communication with a light-conducting prism portion **138** which is provided in the displaceable cylinder **139**. The housing sleeve **140** is provided with light-conducting element-receiving openings **141**. The end **142** of sleeve **140** is closed for cooperatively receiving the coil spring **143** at the base above which the plastic or glass cylinder **144** is positioned for displacement within limits, and above which cylinder the contact button **145** is seated for projection through the opening **146** provided in the closure cap **147**, as shown in FIG. **9** in the exploded condition. The assemblage shown in FIG. **8** depicts the light-conducting elements **137** in the non-conductive position, also shown in FIG. **11** wherein the light-conducting elements **137*a*** and **137*b*** are presented to a non-conducting member **148** in cylinder **144** at one extremity of the light element receiving recess **149**. Upon displacement of the button **145** downwardly, as shown in FIG. **8** but displaced to achieve the orientation as shown in FIG. **10**, the elements **137** will be seated against the opposite side of the recess **149** in the plane of prism **138** to transmit light therethrough for reflection through element **137b**. The lever **150** is pivotally supported to the guard **135** through the pivot pin **151**, and a button-actuating cam **152** is mounted on the pivot pin **151** for pivotable movement with the lever **150**, within limits. A leaf spring **153** is secured at one end to the lever **150** through the stud **154** with the other end **155** being cooperatively seated against the cam projection **156**. Coil spring **157** is fastened at one end to the spring-supporting stud **158** mounted on the lever **150** with the other end of the spring being fastened to the cam **152** by the spring-fastening stud **159**. Spring **157** is trained about the spring guide washer **160** which is contiguous to cam **152** and mounted on the pin **151**. A button-receiving recess **161** is provided on cam **152** for cooperatively seating against button **145** as shown in FIGS. **6** and **7**. Upon counterclockwise pivoting of lever **150**, spring **153** urges cam **152** to rotate in a counterclockwise direction. Cam **152** will urge button **145** into housing **136** against the action of spring **143** displacing cylinder **144** sufficiently to place the prism **138** in light-transmitting communication with elements **137*a*** and **137*b***. Upon further rotation of lever **150**, spring **155** will pass over projection **156** on cam **152** thereby restoring button **145** to the projected position as shown in FIGS. **6** and **7**. Spring **157** will endeavor to restore the cam **152** to the position shown in FIG. **6** after a light pulse has passed through prism **138** to initiate circuit operation. In the event of fluid level rise to interrupt flow or from fluid impingement through the light-conducting member **108**, lever **150** may be released to its starting position and recycled to reinitiate fluid flow in the event the fluid level is below the light transmission member.

A combination electrical circuit for responding to the level of fluid in a tank and for initiating fluid flow is illustrated in FIG. **14** in which power is supplied through a **110** volt A.C. line and in which a light supply source comparable to light source **80** shown in FIG. **2** is utilized preferably for supplying light beam not only to the fluid level light-conducting elements **107** but also the light-conducting elements **110** or **137** shown in FIGS. **3, 4, 5, 6, 7, 8, 10, 11** and **12**, although a separate light source may be utilized, if desired. The photocell **165** will receive reflected light from the light transmission prism **108** through a light conducting element comparable to element **69** in FIG. **2** when the liquid level is below the prism **108** in FIG. **3** thereby reducing the resistance in photodetector **165** to energize coil **166**. Photocell **165** will permit the instant passage of a light pulse to reduce the resistance in photocell **165** when the light transmission prisms **111** in FIGS. **3, 4** and **12**, or the prism **125** in FIG. **5**, or the prism **138** in FIGS. **6, 7** and **8**, permit the transmission of a light beam to increase current flow with the associated coil **168**. When the coils **166** and **168** are energized, the contacts **169** and **170** are closed in response to the currents passing through the coils **166** and **168** thereby energizing the solenoid valve coil **171** which will actuate solenoid valve **32** into the open position thereby initiating fluid flow. When fluid impinges or touches the light-conducting prism **108** (FIG. **3**) **125** (FIG. **5**) **138** (FIG. **6** and **8**), the refractive index thereof changes and light passage through the prism is reduced which decreases the illumination at the resistive photocell **165** thereby greatly increasing the resistance thereof to deenergize coil **168** causing contacts **170** to open. Deenergization of the solenoid valve coil **177** will occur upon separation of contacts **170** terminating fluid flow as the solenoid valve **32** will close. It will be readily apparent that in those instances when a solenoid coil energizes or deenergizes the solenoid valve **32**, the windings of the pump motor may be substituted, if desired. The cycle may be reinitiated by recycling the hand lever to supply an additional light pulse provided the liquid level has been lowered to permit light conduction through the light transmission prism **108**.

It has been found desirable to provide a "capping-off" or "-topping" action, that is, to supply additional liquid to the receiving receptacle after a surge of liquid may deactivate the dispensing operation provided the surge is only momentary thereby reinitiating fluid flow automatically until the level of liquid immerses the light conducting prism to alter or modify the refractive index thereof. There is illustrated in FIG. 15 an electrical circuit capable of reinitiating fluid flow automatically to provide the desirable "capping-off" feature. In this circuit, the photocell 175 will receive light reflected back from a light conducting element in communication with the fluid level detecting prism such as 108 in FIG. 3. Photocell 176 will respond to the momentary light pulse provided by the nozzle lever action heretofore described in conjunction with the embodiment shown in FIGS. 3, 5 and 6, wherein there will be a decrease in resistance upon reception of light reflected to photocell 176 causing current to flow through coil 177, assuming photocell 175 is conducting, thereby closing contacts 178 and establishing a circuit through coils 179 and 180. The contacts 181 associated with solenoid coil 182 are closed when a circuit is established so that solenoid valve 32 may be opened (or a pump motor may be energized) to initiate fluid flow. Contacts 178 are open shortly after being closed as the momentary light pulse will lower the resistance of photocell 176 momentarily only. Current will continue to flow through coils 179 and 180 by virtue of the closed contacts 183 which are held by current flowing through coil 179. A capacitor 184, in parallel with coils 179 and 180, is charged to the voltage across coils 179 and 180. When the refractive index of the light-conducting prism 108 is changed or modified due to fluid impingement or envelopment, the resistance of photocell 175 increases due to a decrease in the light reflection intensity and the current is reduced through coil 180 thereby opening contacts 181 which in turn will cause deenergization of solenoid coil 182 closing solenoid valve 32 to terminate fluid flow.

The "capping-off" action or "topping" will occur when a liquid surge envelops or impinges upon the prism 108 momentarily which will terminate fluid flow. However, the capacitor 184 will discharge over a predetermined interval of time through coil 179 to maintain the coil energized which will hold contacts 183 closed thereby providing a circuit for current flow through coils 180 and 179 and the photocell 175 in the event photocell 175 becomes reilluminated if the liquid level subsides in the vicinity of prism 108. In this event, provided the capacitor 184 has not fully discharged, within the predetermined interval to reestablish current flow upon re-illumination of photocell 175, thus, within the time required for the capacitor 184 to discharge through coil 179 to a voltage level sufficient to allow contacts 183 to open, the system may be reinitiated to permit fluid to flow provided the interval of time is not for any sustained period beyond the discharge momentary interval of the capacitor 184. The contacts will remain open and the circuit deenergized unless photocell 175 is again momentarily illuminated to re-initiate the operating cycle. The diode 184 is positioned in series with coil 179 and the capacitor to prevent the capacitor from discharging through coil 180. It is desirable for the capacitor 184 to discharge for approximately a two-second interval during which time fluid flow may be re-initiated upon liquid level subsidence with attendant re-illumination at photocell 175. Dispensing of the fluid will then continue until fluid level rises to engulf the prism 108 at which time delivery will be terminated. This cycle can be repeated a number of times until the tank is completely filled or the liquid remains about the prism 108 for a duration of time necessary for the capacitor 184 to discharge fully through coil 179 to a voltage below that of the holding current required for the coil.

An alternative circuit combination for interrupting fluid flow upon liquid level detection and fluid flow initiation system is shown in FIG. 16 with the fluid level sensitive photocell 187 and the fluid flow initiation photocell 188 being in parallel to each other and to each photocell a light beam from a light-conducting element is reflected as in FIG. 15. When a dispenser nozzle 106 has a light-conducting prism 108 above the fluid level, photocell 187 will conduct and transmit a signal to activate relay coil 189 closing contact 190. Should prism 108 be immersed in fluid or fluid impinged thereon, the refractive index will be altered and photocell 187 will cease to emit any signal and contacts 190 will remain open. Upon actuation of the hand lever 113 (FIG. 3) or 118 (FIG. 5) or 150 (FIG. 6), a light pulse will energize photocell 188 and, provided photocell 187 is preconditioned to conduct a signal, current will flow and the uni-junction 191 will trigger the SCR 192 to amplify current flow to the solenoid valve coil 193 which is directly in the line current with resistor 194 being mounted in parallel with coil 193 to prevent excess current from passing to the coil 193. Capacitor 195 is in parallel with relay coil 189, and with diode 196, which capacitor will maintain current flow in the circuit for a predetermined time interval after photocell 187 ceases to conduct when fluid impinges or immerses prism 108. The resistance in photocell 187 to conduct will increase with diminished light reflection causing the uni-junction 191 to cease to trigger the SCR 192 thereby terminating current flow adequate to retain the solenoid valve 32 in the open condition. In the event of a surge of fluid or rise in liquid level about prism 108, fluid flow will terminate but capacitor 195 will discharge and maintain the contacts 190 in closed condition for a predetermined time interval but the uni-junction 191 will cease to trigger the SCR 192. In the event the fluid level is maintained about the prism 108, the system will shut down. However, in the event the fluid level about the prism 108 subsides, photocell 187 will become reactivated or conductive without recycling the hand lever so that current will be restored to the coil 193 and the uni-junction 191 will recommence triggering the SCR 192 to reinitiate current flow energizing solenoid coil 193 to open valve 32 causing fluid to flow again. The time interval for a surge of liquid to subside may vary but the capacitor 195 will be able to retain the circuit for approximately 2 seconds. In the event the fluid surge does not subside within this predetermined interval of capacitor discharge, the system will shut down and recycling will be necessary by actuating the nozzle hand lever.

Another alternative electrical circuit for use in the combination of fluid level detection and flow interruption, and fluid flow initiation, is shown in FIG. 17 for reinitiating fluid flow in the event of a fluid surge with the photocell 197 being connected to receive reflected light from a nozzle lever to initiate fluid flow as heretofore described provided an associated photocell 198 will conduct current flow received from reflected light from a light-conducting element when the nozzle prism 108 is not immersed in fluid and the refractive index in light remains unaltered. Contacts 199 will be closed when sufficient current flows in the circuit to the uni-junction 200 which will amplify current flow to the coil relay 201 that is connected in parallel with capacitor 202. Relay coil 203 is connected to the contacts 204 leading to the solenoid coil 205 that is connected across the 110 volt AC line. Fluid flow will be initiated upon nozzle lever actuation by passing a light pulse to photocell 197. When prism 108 is impinged with fluid or the fluid level rises to submerge the prism 108, photocell 198 ceases to conduct and there is insufficient base current from the uni-junction 200 to retain the contacts 204 in the coil relay 203. When the resistance in photocell 198 increases above a certain point, current will cease to flow and then capacitor 202 will discharge in order to maintain contacts 199 closed for a predetermined time interval. When photocell 198 ceases to conduct, solenoid coil 205 will be deenergized when contacts 204 open thereby terminating fluid flow. However, within the predetermined time interval of capacitor 202 discharge, should photocell 198 receive light it will recommence current flow automatically without recycling provided the photocell 198 recommences conducting prior to full discharge of capacitor 202. In the event photocell 198 does not recommence activation of the circuit, solenoid coil 205 will remain deenergized and the entire system will shut down.

It will be apparent that the disclosed light-controlled fluid dispenser utilizes light-conducting members that are associated with a fluid-dispensing nozzle in which a light supply source will illuminate the light-conducting members which will be used in combination with a light-sensitive member having a refractive index which will vary in air and liquid to interrupt a light signal to actuate a light-detecting means employed in combination with an electrical circuit responsive to the light-detecting means to interrupt fluid flow in the fluid dispensing member and to reinitiate flow depending upon the fluid level sensed. Manual as well as automatic fluid flow reinitiation may occur depending upon the circuitry employed.

It has been found desirable to reduce the size and number of the fiber optic elements by endeavoring to employ the same fiber optic elements for two-way light transmission as shown in FIG. 13. The fiber optic light-conducting bundle **207** includes one or more continuous monofilaments of light-conducting units which will transmit light from the light source **208** through a suitably coated inclined surface **209** supported by the member **210** so that light will be transmitted through the filaments **211** to the light-reversing prism **212** which will be exposed to a fluid being filled in a receptacle. Light will be reflected by prism **212** provided the refractive index remains unaltered through the filaments **211** to the inclined surface **209** which will reflect the light downwardly to a light sensor or photocell **213** which will be sufficiently sensitive to receive the reflected light which passes through the same fiber optic elements in both directions. It is contemplated that prism **212** may be inserted in the nozzle in place of prism **108** as well as in the hand lever positioned prisms for utilizing the single fiber optic element bundle with the inclined surface **209** being located at a remote position to pick up reflected light. The light beam splitter member **209** may have one surface suitably mirrored to permit light to pass therethrough from a light source while the mirrored surface will reflect the light at right angles downwardly to the photocell **213**.

It is further contemplated that the prisms positioned in the nozzle pipe be suitably guarded to prevent fluid impingement during fluid flow through the nozzle that may impair proper functioning of the system. It is intended that where the term "-fluid" is used throughout the specification and claims a liquid medium is the "fluid."

We claim:

1. A light-controlled fluid dispenser comprising; a fluid-dispensing means including a nozzle for discharging fluid from one end thereof, light-conducting means associated with said fluid-dispensing means and having at least a portion thereof located within said nozzle, a light supply associated with said light-conducting means, light-detecting means for receiving light from said light-conducting means, said light supply and said light-detecting means being positioned remote from said fluid-dispensing means and means responsive to said light-detecting means to interrupt fluid flow in said fluid-dispensing means upon fluid impingement on said light-conducting means.

2. A light-controlled fluid dispenser as claimed in claim **1**, and means within said nozzle shielding said light-conducting means from fluid flow through said fluid-dispensing means until fluid rises in the direction opposite from fluid flow to a predetermined level to modify or interrupt light conduction in said light-conducting means.

3. A light-controlled fluid dispenser as claimed in claim **1**, said light-conducting means including a first fiber optic element to receive light from said light supply, means having a refractive index responsive to fluid impingement for receiving light from said first fiber optic element, and a second fiber optic element to return light from said refractive index responsive means to said light-detecting means unless said refractive index responsive means is impinged or immersed in fluid to modify or interrupt the return of light in said second fiber optic element.

4. A light-controlled fluid dispenser as claimed in claim **1**, said fluid-dispensing means nozzle having a fluid discharge end, said light-conducting means having a first fiber optic element having one end proximate said light supply and the other end proximate the discharge end of said nozzle, a light-conductive prism positioned adjacent said other end of said fiber optic element in said discharge end of said nozzle, said prism being sensitive to liquid impingement to alter the refractive index thereof, and a second fiber optic element extending from said prism to said light-detecting means to conduct light from said prism to said light-detecting means.

5. A light-controlled fluid dispenser as claimed in claim **1**, said fluid-dispensing means including a gasoline pump for discharging gasoline from one end of said nozzle, a solenoid-operated fluid control valve actuable by said light-detecting responsive means to control fluid flow through said nozzle, said light-conducting means including a first fiber optic element extending from said light supply to a position proximate the discharge of fluid from said nozzle, a light-conductive prism shielded from fluid flow through said nozzle positioned to receive light from said first fiber optic element and sensitive to liquid impingement to alter the refractive index of said prism, and a second fiber optic element to receive light from said prism for transmission of light to said light-detecting means to actuate said light-detecting responsive means to control fluid flow in said fluid-dispensing means.

6. A light-controlled fluid dispenser as claimed in claim **1**, and means for re-initiating fluid flow after light modification or interruption for a predetermined momentary interval through said light-conducting means to said means responsive to said light-detecting means whereby upon a subsidence of a surge of fluid interrupting light conduction and light restoration to said light-detecting means fluid flow is re-initiated until light conductance is modified or interrupted for a sustained predetermined interval that is longer than said momentary interval.

7. A light-controlled fluid dispenser as claimed in claim **1**, said fluid-dispensing nozzle having manually operable valve means for actuating fluid to flow in said fluid-dispensing means.

8. A light-controlled fluid dispenser as claimed in claim **1**, said fluid dispensing nozzle means having a manually operable displaceable lever for initiating fluid flow, light-conducting means associated with said lever receiving light from said light supply and conducting light therefrom upon lever actuation, and light detecting responsive means controlling the initiation of fluid flow in said fluid dispensing means through said nozzle.

9. A light-controlled fluid dispenser as claimed in claim **8**, said light-conducting means associated with said lever having a first fiber optic element, a second fiber optic element, and light transmission means between said first and second elements whereby displacement of said lever actuates said light-detecting responsive means to initiate fluid flow in said fluid-dispensing means, said means responsive to said light-detecting means having means for re-initiating fluid flow upon cessation thereof from fluid impingement upon said light transmission means within a predetermined momentary interval unless light conductance is interrupted for a sustained predetermined interval longer than said momentary interval.

10. A light-controlled fluid dispenser as claimed in claim **1**; said fluid-dispensing means further including a solenoid actuated valve, said solenoid-actuated valve and said nozzle guiding fluid flow from a remote location into a receptacle, said light-conducting means having a first fiber optic element having one end proximate said light supply and the other end proximate the discharge end of said nozzle, a light conductive prism positioned adjacent said other end of said fiber optic element in said discharge end of said nozzle sensitive to liquid impingement to alter the refractive index of said prism, a second optic element proximate said prism to said light-detecting means to conduct light from said prism to said light-detecting means whereby upon fluid impingement on said prism for a sustained interval said light-detecting means will de-activate said solenoid valve to terminate fluid flow, a manually-operable lever in said fluid-dispensing means displaceable between limits, a first fiber optic element associated with said lever receiving light from said light supply, a second fiber optic element in juxtaposition to said first fiber optic element, a light transmission means for transmitting light from said first fiber optic element to said second fiber optic element at a

predetermined position of lever displacement, a light-detecting means for receiving light from said second fiber optic element to actuate said solenoid-actuated valve to initiate fluid flow to said nozzle, means for sustaining current flow in said light-detecting responsive means for a predetermined momentary interval upon fluid impingement on said prism in said nozzle unless light conductance is interrupted for a sustained predetermined interval longer than said momentary interval to terminate current flow and de-actuate said solenoid valve.

11. A light-controlled fluid dispenser as claimed in claim 1, said light-conducting means including a fiber optic, light-conducting member, means for passing light from said light supply therethrough to said fiber optic, light-conducting member, means for reflecting light through said fiber optic, light-conducting member, and means for deflecting said reflected light from said fiber optic light-conducting member to said light-detecting means.

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