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[54] PHOTOVOLTAIC CELL POWERED MAGNETIC COIL FOR OPERATION OF FLUIDIC CIRCUIT FLAPPER

8 Claims, 3 Drawing Figs.

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[50] Field of Search ..... 250/218, 212, 206, 215, 221, 222; 137/81.5, 82—86; 317/124

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ABSTRACT: A photofluidic eye comprising a photovoltaic cell and a magnetic coil operated flapper assembly powered thereby for alternately opening and closing fluidic back pressure orifices. No external power or switching arrangement is employed to avoid the occurrence of an electric spark when an environment containing explosive materials is present.

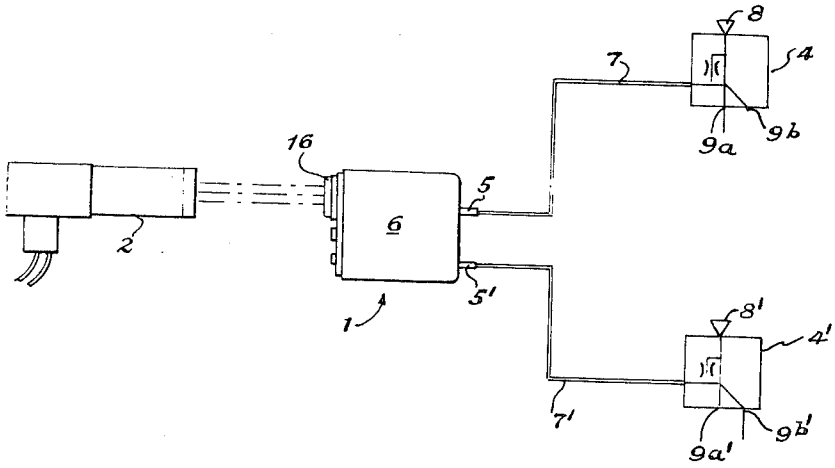


Fig. 1.

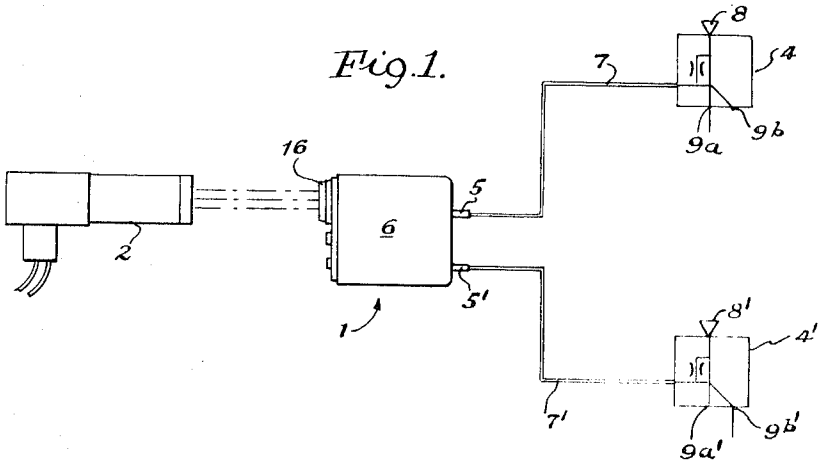
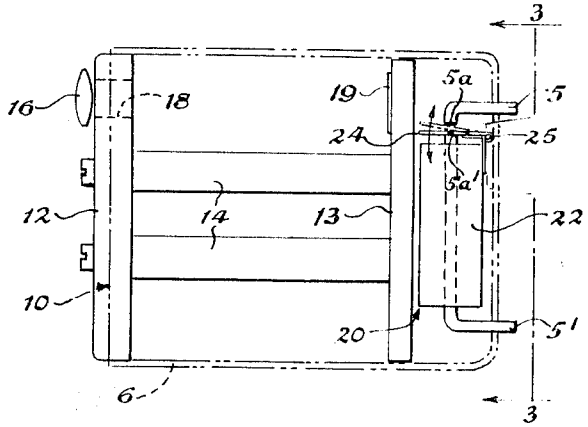


Fig. 2.



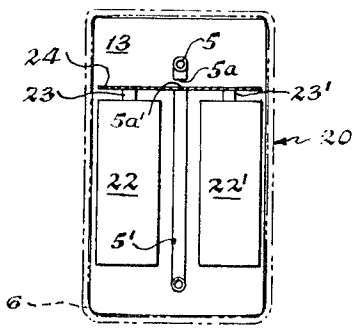


Fig. 3.

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PHOTOVOLTAIC CELL POWERED MAGNETIC COIL FOR OPERATION OF FLUIDIC CIRCUIT FLAPPER

SUMMARY OF THE INVENTION

The present invention relates generally to photooperated controls and more particularly to a compact, self-powered assembly for interfacing to a fluidic circuit.

The present photofluidic eye assembly includes a photovoltaic cell arranged in circuit with a magnetic coil operated flapper assembly, which is adapted to alternately open and close at least one orifice to be associated with a fluidic circuit whose operation it is desired to control in accordance with the light condition sensed by the photovoltaic cell. The assembly requires no external electrical power or electrical switching arrangement for its operation and thus, may be employed to interface with a fluidic circuit in an environment containing highly explosive materials without fear of the occurrence of a material detonating electric spark.

DRAWINGS

The nature and mode of operation of the photofluidic eye assembly of the present invention will now be more fully described in the following detailed description taken with the accompanying drawing in which:

FIG. 1 is a side elevational view of the photofluidic eye assembly of the present invention, showing the assembly arranged to receive a beam of light from a suitable source and schematically indicating the manner in which it could be connected to a pair of fluidic back pressure switches;

FIG. 2 is a side elevational view of the assembly shown in FIG. 1, but with the assembly cover removed; and

FIG. 3 is a sectional view taken generally along the line 3–3 in FIG. 2.

DETAILED DESCRIPTION

Referring to FIG. 1, it will be seen that the photofluidic eye assembly of the present invention, which is generally designated as 1, is adapted to scan a suitable light source, such as a remotely disposed lamp 2, and control operation of a fluidic circuit, not shown, via one or more suitable, fluidic circuit associated elements, such as back pressure switches 4, 4'.

Switches 4, 4' are shown in FIG. 1 as being removably connected to the ends of back pressure tubes 5, 5', which project through apertures, not shown, provided in a rear wall of assembly cover housing 6, by a pair of back pressure lines 7, 7', respectively. It will be understood that switches 4, 4' are of conventional construction, such that when lines 7, 7' are vented via tubes 5, 5' to atmosphere, clean, dry fluidic circuit air admitted through switch inlet ports 8, 8' passes as output signals through output ports 9*a*, 9*a*', respectively. However, when lines 7, 7' are blocked or closed, the output signals will switch to output ports 9*b*, 9*b*', respectively.

Reference is now made to FIG. 2, wherein assembly 1 is shown as including a supporting framework 10 having mounting plates 12, 13, which are maintained in a spaced parallel relationship by one or more spacer bars 14; an optical lens 16, which is suitably mounted on mounting plate 12 in alignment with plate aperture 18; a photovoltaic cell 19, which is suitably mounted on a front face of mounting plate 13 in alignment wit lens 16; and a magnetic coil operated flapper assembly 20, which is suitably mounted on the rear face of mounting plate 13.

Suitable brackets, not shown, may be provided for supporting tubes 5, 5' adjacent the rear face of mounting plate 13, such that the back pressure orifices 5*a*, 5*a*', which are defined by tubes 5, 5', are disposed in closely spaced vertical alignment.

Mounting plate 12 may be conveniently employed to form the front exterior wall of the assembly and cover housing 6 formed as a cup-shaped metal stamping, which is adapted to be slip-fitted thereover. In this arrangement, mounting plate 13, which is preferably formed of a suitable electrically insulating material, may serve to stabilize the rear of housing 6 so as to insure alignment of the housing rear wall apertures, not shown, with tubes 5, 5', passing outwardly therethrough.

Flapper assembly 20 includes one or more coils, such as coils 22, 22', having ferrous cores 23, 23'; and a flapper valve 24, which is formed of a ferrous material and suitably hinged, as at 25, for vertical pivotal movement between the full and phantom line positions illustrated in FIG. 2. Preferably, suitable spring means, which may if desired by incroporated within hinge 25 in a manner not shown, is employed to normally bias flapper valve 24 into its phantom line position. Alternatively, flapper valve 24 may be formed of a resilient material and mounted such that in its nondeformed condition, it tends to assume the phantom line position shown in FIG. 2. It will be understood that when flapper valve 24 is in its full line position tube orifice 5*a*' is closed and orifice 5*a* open to atmosphere, whereas when the flapper valve is in its phantom line position orifice 5*a* is closed and orifice 5*a*' is open.

Coils 22, 22' are arranged in parallel circuit with photovoltaic cell 19 by lead wires, not shown. It will be understood that when photovoltaic cell 19 is exposed to light passing through lens 16, an electrical current is generated by the photovoltaic cell and passed through coils 22, 22' to effect operation thereof and thus the attraction of flapper valve 24 into its full line position wherein orifice 5*a* is closed. When, however, an object, not shown, is interposed between lamp 2 and lens 16 or the lamp is extinguished so that photovoltaic cell 19 ceases to be illuminated, the photovoltaic cell will cease to generate current and the flapper valve will return to its normal position, wherein orifice 5*a* is closed. As a result, when the photovoltaic cell is illuminated, the output signals of back pressure switches 4, 4' pass through ports 9*a*, 9*b*', respectively, and when the photovoltaic cell ceases to be illuminated, the output signals of the back pressure switches pass through ports 9*b* and 9*a*'.

Fluidic air emitted through orifices 5*a*, 5*a*' may be vented to atmosphere through suitable apertures, not shown, conveniently located in housing 6.

By arranging photovoltaic cell 19 and coils 22, 22' in a closed circuit, there exists no switching or mechanical circuit interruptors, whose operation could produce an electrical spark which might lead to detonation of material in the atmosphere surrounding the assembly. Furthermore, the circuit is fully insulated with respect to the remaining components of the assembly by mounting both the coils and the photovoltaic cell on the electrically insulated rear plate.

It will be understood that the specific structural design of lens 16 and photovoltaic cell 19 form no part of the present invention, it being only necessary that lens 16 assure proper illumination of the photovoltaic cell and that the photovoltaic cell has a sufficient power level to effect proper operation of the flapper valve assembly and be compatible with the light source.

I claim:

1. A photofluidic eye assembly having utility for interfacing with a fluidic control circuit whose operation it is desired to control in accordance with a light condition, said assembly comprising in combination:

a photovoltaic cell for sensing said light condition and for generating an electrical current when said cell is illuminated;

a valve assembly, said valve assembly including an electromagnetic coil means and a valve means, said valve means being normally disposed in a first position but being movable into a second position upon energization of said coil means;

closed electrical circuit means directly connecting said cell and said coil means such that said coil means is energized by the current generated by said cell upon illumination thereof;

mounting means for electrically isolating said cell, said coil means and said circuit; and

means defining at least one orifice, said valve means being arranged to alternately close and open said orifice to atmosphere when moved into said positions, and said orifice being adapted to be placed in fluid communication with an element of said fluidic control circuit, such that the opening and closing of said orifice to atmosphere as determined by the light condition sensed by said cell controls operation of said fluidic circuit.

2. A photofluidic eye assembly having utility for interfacing with a fluidic control circuit whose operation it is desired to control in accordance with a light condition, said assembly comprising in combination:

a photovoltaic cell for sensing said light condition and for generating an electrical current when said cell is illuminated;

a valve assembly, said valve assembly including electromagnetic coil means and a valve means, sad valve means being normally disposed in a first position but being movable into a second position upon energization of said coil means;

closed electrical circuit means connecting said cell and said coil means such that said coil means is energized only when said cell is illuminated;

means defining at least one orifice, said valve means being arranged to alternately close and open said orifice to atmosphere when moved into said positions, said orifice being adapted to be placed in fluid communication with an element of said fluidic control circuit, such that the opening and closing of said orifice to atmosphere as determined by the light condition sensed by said cell controls operation of said fluidic circuit;

a framework, said framework including a front plate forming a font outward wall of said assembly, a rear plate and means to maintain said plates in a spaced relationship, said front plate having an aperture therethrough, said rear plate mounting said cell adjacent a front surface thereof in facing relationship to said front plate so as to permit illumination thereof by light passing through said aperture; and

an assembly cover, said cover being of generally cup-shaped configuration and having the rim portion thereof supportingly engaged by said front plate so as to enclose said rear plate therein.

3. A photofluidic eye assembly according to claim 2, wherein said rear plate is formed of an electrically insulating material, said rear plate additionally mounting said valve assembly and said circuit means, whereby said cell, said coil means and said circuit means are electrically insulated from said front plate and said cover.

4. A photofluidic eye assembly according to claim 2, wherein said orifice defining means includes at least one tube, said tube being mounted adjacent a rear surface of said rear plate and having a first end portion defining said orifice and a second end portion connectable to said fluidic circuit element, said cover having an aperture therethrough, said tube being freely received within said cover aperture when said cover is supportingly engaged as aforesaid so as to position said second tube end portion outwardly of said cover.

5. A photofluidic eye assembly having utility for interfacing with a fluidic circuit whose operation it is desired to control in accordance with a light condition, said assembly comprising in combination:

a photovoltaic cell for sensing said light condition and for generating an electrical current when said cell is illuminated;

a valve assembly, said valve assembly including electromagnetic coil means and a valve means, said valve means being normally disposed in a first position but being movable into a second position upon energization of said coil means;

closed electrical circuit means connecting said cell and said coil means such that said coil means is energized only when said cell is illuminated;

means defining at least one orifice, said valve means being arranged to alternately closed and open said orifice to atmosphere when moved into said positions, said orifice being adapted to be placed in fluid communication with an element of said fluidic control circuit, such that the opening and closing of said orifice to atmosphere as determined by the light condition sensed by said cell controls operation of said fluidic circuit; and

a framework, said framework including a front plate forming a front outer wall of said assembly, a rear plate formed of an electrically insulating material and means to maintain said plates in a spaced relationship, said front plate having an opening therethrough, said rear plate mounting said cell adjacent a front surface thereof in facing relationship to said front plate and in alignment with said plate opening, and said rear plate mounting said valve assembly and said circuit means,

a lens, said lens being mounted on said front plate in juxtaposition to said plate opening, said cell being adapted to be illuminated by light passing through said lens; and

an assembly cover, said cover being of a generally cup-shaped configuration and having a rim portion adapted to be supportingly engaged by said front plate such that said rear plate is enclosed within said cover, said cover having at least one through aperture through a base portion thereof, said orifice defining means includes at least one tube, said tube being mounted on said rear plate and having a first end portion defining said orifice and a second end portion extending rearwardly of the rear surface of said rear plate and being connectable to said fluidic circuit element, said second tube end portion being freely received within said cover aperture when said cover rim is supportingly engaged as aforesaid, so as to position said second tube end portion outwardly of said cover.

6. A photofluidic eye assembly according to claim 1, wherein at least two of said tubes are provided and are mounted on said rear plate so as to define at least two orifices disposed in space facing relationship, said valve means includes a flapper valve disposed intermediate said orifices, said flapper valve being adapted to alternatively open and close said orifices in each of said positions.

7. A photofluidic eye assembly according to claim 6, wherein said flapper valve is a generally rectangular, ferrous, valve plate hingeably supported adjacent one side edge thereof for pivotal movement between said positions and includes spring means adapted to normally bias said valve plate into said first position, said orifice defining first end portions of said tubes being engageable by oppositely facing surfaces of said valve plate substantially centrally of the end edges thereof, and said coil means includes a pair of coils arranged adjacent one of said valve plate surfaces and being disposed on opposite sides of the first tube end portion engageable with said one surface of said valve plate.

8. A photooperated control for determining the presence of an article in an environment containing explosive materials subject to detonation by an electrical spark and controlling an operation in response to the presence of said article, which includes in combination:

a fluidic control circuit for controlling said operation, the operation of said control circuit being determined by the condition of at least one back pressure switch;

a source of illumination;

a photofluidic eye assembly arranged to scan said source of illumination and to change the condition of said back pressure switch whenever said source of illumination is blocked by an article, said assembly including a photovoltaic cell arranged to face said source of illumination for generating an electrical current when said cell is illuminated thereby, a valve assembly including an electromagnetic coil means and valve means, said valve means being normally disposed in a first position but being movable into a second position upon energization of said coil means, a closed electrical circuit means

directly connecting said cell and said coil means such that said coil means is energized by the current generated by said cell upon illumination thereof, means defining at least one orifice arranged in communication with said back pressure switch, said valve means being arranged to alternately close and open said orifice to atmosphere when moved into said positions to change the condition of said back pressure switch, and common mounting means for electrically isolating said cell, said coil means and said electrical circuit.