April 4, 1950 W. A. RAY 2,502,591

ELECTROMAGNET

Filed July 12, 1948 3 Sheets-Sheet 1

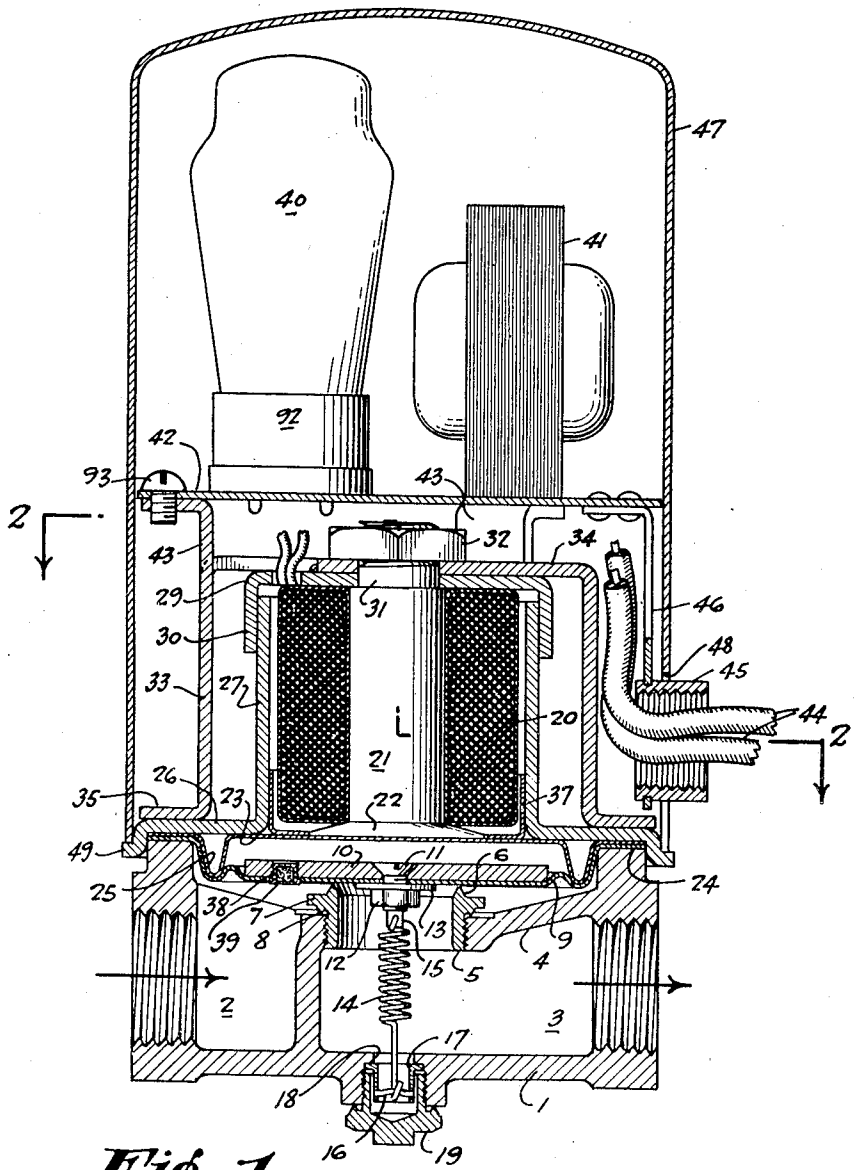

Fig. 1

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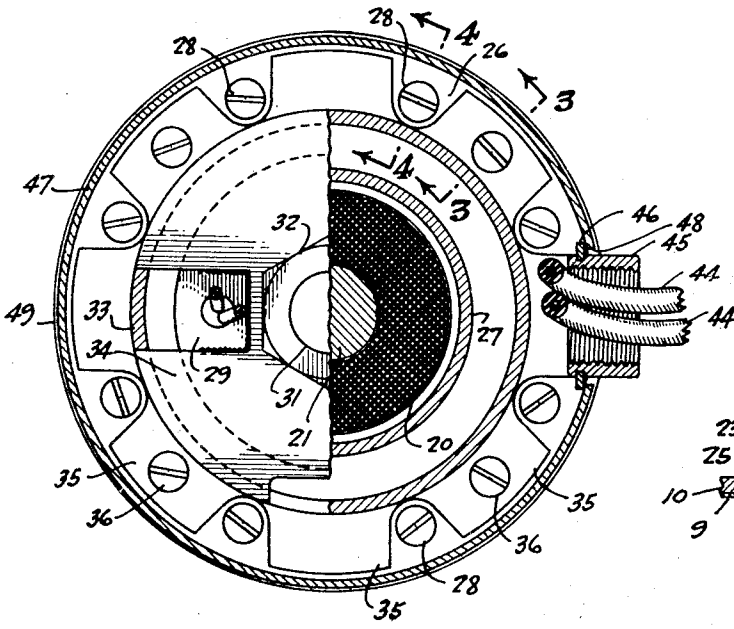

Fig. 2

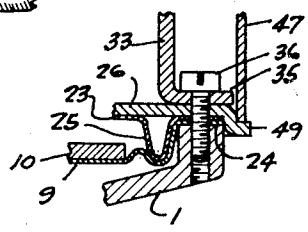

Fig. 3

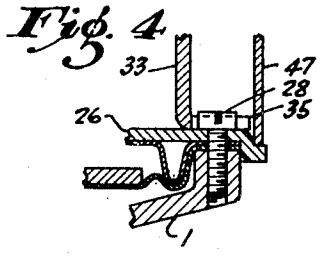

Fig. 4

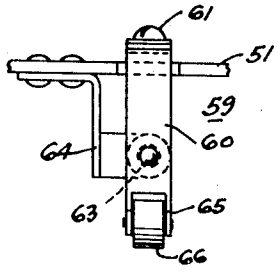

Fig. 8

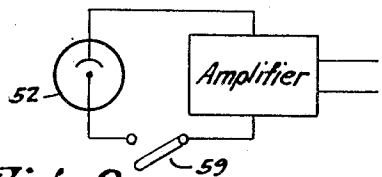

Fig. 9

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Fig. 5

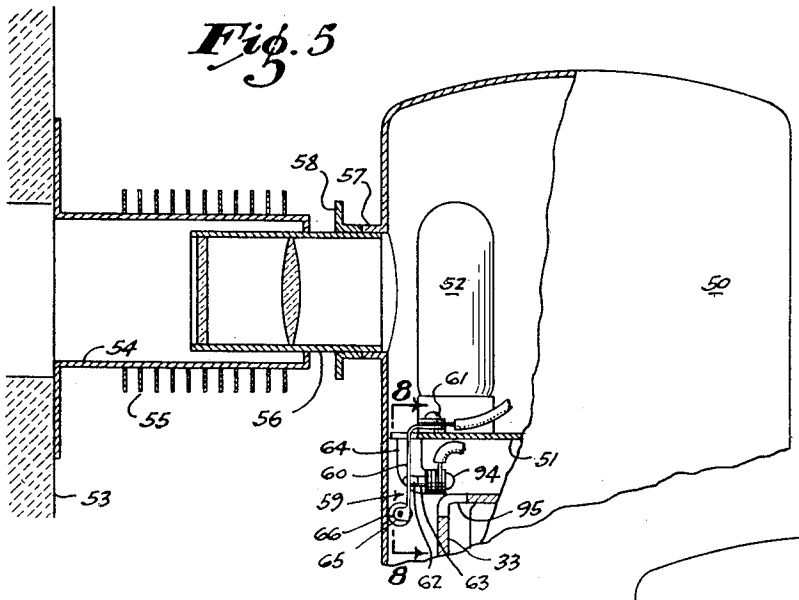


Fig. 6

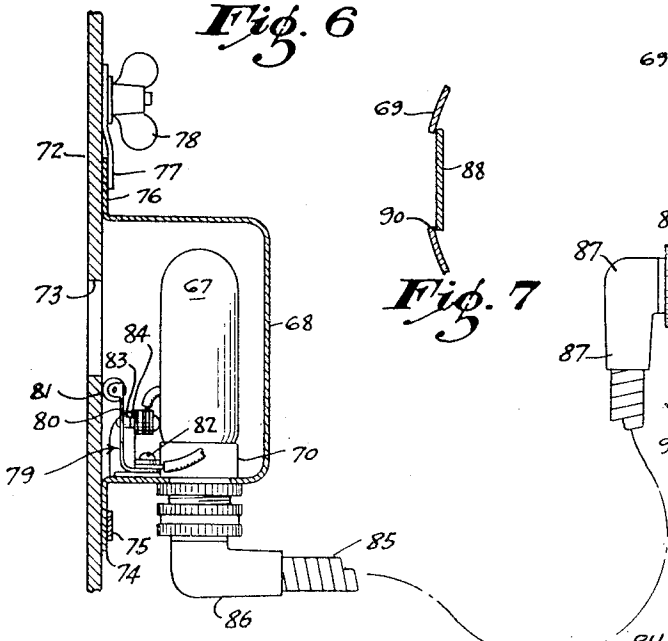
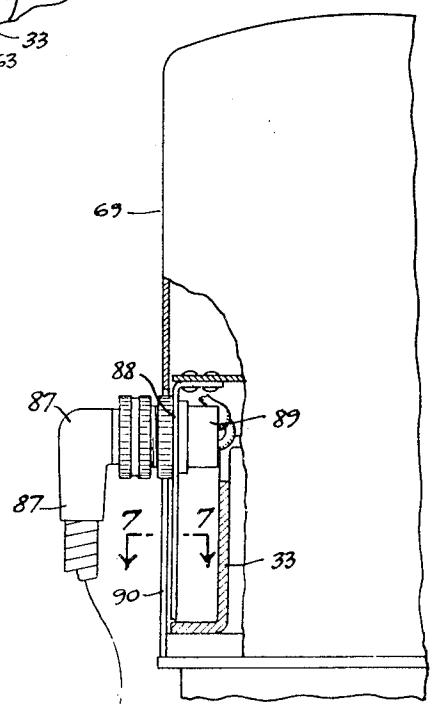


Fig. 7



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Patented Apr. 4, 1950 2,502,591

UNITED STATES PATENT OFFICE

2,502,591

ELECTROMAGNET

William Alton Ray, North Hollywood, Calif., assignor to General Controls Co., a corporation of California

Original application September 13, 1943, Serial No. 502,268. Divided and this application July 12, 1948, Serial No. 38,344

5 Claims. (Cl. 250—239)

1

This invention relates to electromagnets; and more particularly, to the electromagnet adapted to control and operate a valve.

This application is a division of application, Serial No. 502,268, filed on September 13, 1943, now Patent No. 2,465,036 for a valve structure.

It is one of the objects of this invention to improve electromagnets of this character in general.

It is an object of this invention to make it possible easily to assemble the structure or to remove, or replace, the operating parts; and, particularly, to change the operating coil as may be required for different conditions of operation.

Often the electromagnetic control of the valve is made dependent upon a condition of a furnace or burner. Thus, photoelectric means, affected by illumination produced by a flame, may be utilized for creating the control currents for the electromagnets. It is another object of this invention to provide a compact photoelectric system in conjunction with the valve.

In using such a photoelectric system, care is taken to confine illumination of the photoelectric cell substantially entirely to that which is derived from the flame. Accordingly, a cover screening the cell from general external illumination is required. This cover may also serve to provide a convenient housing for the valve operating elements. It is another object of this invention to render the photoelectric cell circuits inactive when the cover is removed. In this way, injurious overloading of the cell is prevented.

This invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of several embodiments of the invention. For this purpose there are shown a few forms in the drawings accompanying and forming part of the present specification. These forms will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a longitudinal sectional view of a structure embodying the invention;

Fig. 2 is a sectional view taken along plane 2—2 of Fig. 1;

Figs. 3 and 4 are fragmentary sectional views taken along correspondingly numbered planes of Fig. 2;

Fig. 5 is a fragmentary view, partly in section, of a modified form of the invention;

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Fig. 6 is a fragmentary view, partly in section, of a still further modified form of the invention;

Fig. 7 is a sectional view, taken along plane 7—7 of Fig. 6;

Fig. 8 is a sectional view, taken along plane 8—8 of Fig. 5; and

Fig. 9 is a wiring diagram of a photosensitive cell and its circuit, which may be controlled by the aid of those forms shown in Figs. 5 and 6.

In the form of the invention illustrated in Figs. 1 to 4 inclusive, there is a valve body 1 having an inlet passageway 2 and an outlet passageway 3. Such valves may be used to control the flow of fluid at relatively low pressures; for example, for transmitting gaseous fuel to a furnace. Passageways 2 and 3 are separated by wall 4 that is provided with a valve port. The port is formed by a hollow member 5 threaded into wall 4. The upper edge of this member 5 forms a thin annular valve seat 6. The flange 7 of member 5 has a downwardly projecting sealing edge 8 engaging the top surface of the wall 4.

In the present instance, a diaphragm type of valve is illustrated. Thus, there is a flexible diaphragm 9, extending over the seat 6. Attached to the central portion of the diaphragm is the disc closure member 10. A flat head screw 11 passes through the center of the disc 10 and through the diaphragm 9 for fastening these two parts together. A nut 12 serves to hold the screw 11 in tight position. A washer 13 of suitable size is interposed between nut 12 and diaphragm 9.

The weight of the disc 10 serves to urge it to closing position. The closing force is assisted by a tension spring 14. The upper end of this spring is anchored in the ear 15 formed at the end of the screw 11. The lower end of the spring 14 is anchored to a cross wire 16 fastened to extend across the hollow bushing 17. This hollow bushing has a flange engaging the edge of the aperture 18, said flange being pulled against the edge of the aperture 18 by the tension of the spring 14. In order to seal the valve body 1 in a fluid-tight manner where the bushing 17 is located, a sealing cap 19 of conventional form may be provided.

The disc 10 is made from magnetic material so that it may be lifted against the force of gravity and of the spring 14. As hereinafter explained, the pressure from the inlet 2 is also effective to urge the disc 10 to closed position.

The electromagnetic means for operating the closure 10 includes a coil 20 that surrounds a magnetic core 21. The manner in which the coil

20 and the core 21 is supported will be hereinafter described.

The core 21 is provided with a lower polar extension, or pole piece, 22, which is joined to the core 21 by a conical surface. The bottom of the polar extension 22 rests upon an impervious thin partition 23 made from non-magnetic material. This partition 23 serves to isolate the elements of the electromagnet from the valve passages, ensuring against leaks or danger or injury to the electromagnet by flow of the fluid being controlled.

Attraction of the disc 10 by the electromagnet causes the diaphragm 9 to flex upwardly. Flexure of the diaphragm, to ensure long life, should be confined to an annular pattern; in this way irregular creasing or pinching may be prevented. In the past, the danger of creasing the diaphragm was obviated by clamping the diphragm at its edge by a clamp ring disposed above the valve body. The level of the diaphragm edge, when the valve was closed, was at or near that of the valve seat. By the aid of the present arrangement a separate clamp ring is obviated, and yet the effect is the same as if such a ring were used. For this purpose, the edges of partition 23 and the diaphragm 9 are fastened to the annular surface 24, disposed on the top of the valve body 1. Nevertheless, in order to ensure that flexure of the diaphragm 9 will be guided in the proper manner, the partition 23 is provided with a downwardly extending annular ridge 25. This may be bent in the partition 23 and, although the partition 23 is made of thin material, the ridge 25 exhibits substantial strength. As the diaphragm 9 flexes, it bends around the lower edge of ridge 25. This ridge prevents the outer portions of the diaphragm from flexing irregularly.

The magnetic disc 10, when attracted, serves to bridge the gap between the polar extension 22 and a flange 26 that is formed on a tubular shell 27 of magnetic material. This shell 27 surrounds the coil 21 and forms a part of the magnetic circuit. The flange 26 forms an annular pole around the opposite pole formed by extension 22. Furthermore, the flange 26 may be utilized as illustrated in Fig. 4 as a clamp ring for the edges of the diaphragm 9 and partition 23. For this purpose a plurality of machine screws 28 is provided.

In order to complete the magnetic circuit between the core 21 and tubular member 27, this core is attached to a cap or cover member 29 made of magnetic material. This cover 29 has a depending flange 30 which telescopes over the top of the member 27. The core 21 may be fastened to the cover 28 by the aid of the threaded extension 31 and the nut 32.

Provisions are made for detachably fastening the cover 29 to the shell 27. For this purpose, an external cylindrical member 33 is provided, and which surrounds the member 27. This member 33 has an upper portion 34 which is welded, or otherwise permanently attached, to the top of the cover 29. The annular member 33 is also made of magnetic material and forms a part of the magnetic circuit. It is provided at its lower edge with a flange 35. This flange overlies the flange 26. It is arranged, however, to be independently fastened to the valve body 1, as by the aid of the screws 36. The flange 35 is interrupted, as shown most clearly in Figs. 2 and 4, so that screws 28 may be used for independently fastening the member 27 in place without attaching the flange 35 to the body 1.

In this way, if it is desired to remove the core

21 and the associated coil 20, screws 36 only are removed. When this is accomplished, the member 33, with cover 29 and the core 21, may be removed as a unit, the shell 27 being left attached to the body. The coil 20 is also removed with this assembly, since it is held against the top of cover 29 by the polar extension 22. Accordingly, removal and replacement of the coil 20 are relatively simple.

Should it be desirable to reinforce the thin partition 23 against stresses imposed by the pressure of the fluid under control, this may be accomplished by the aid of a reinforcing angle 37, disposed in the form of an annulus around the lower inner edge of the member 27 and attached thereto. Furthermore, in order to utilize the pressure of the fluid being controlled to hold the disc 10 against the seat 6, a port 38 is provided through the disc 10. This port may be provided with a filter or strainer device 39. Fluid under pressure from the inlet side may pass through this strainer to the space above the disc 10.

It is desirable, as heretofore stated, to operate the electromagnet coil 20 by direct current. For this purpose, use is made of a rectifier device associated with the valve. This device may conveniently be in the form of an electronic rectifying tube 40, its connecting base 92, and other apparatus such as a transformer 41. These are conveniently supported on a platform or base 42 disposed immediately above the electromagnet. This base 42 is in the form of a thin disc supported upon three brackets 43 that are stamped out of the member 33 and that are bent to form supporting brackets.

Connections for the rectifier device and coil 20 are indicated by the leads 44 passing through a bushing 45. This bushing 45 is shown as attached to a bracket 46 depending from the base 42. By supporting the rectifier device in this way, it, too, is removable along with the cover or cap 30. It may, however, be independently removed with base 42 by removal of the screws 93 that attach base 42 to the brackets 43.

A removable cover 47 is used to enclose the rectifier device and the electromagnet. This cover is slotted, as indicated at 48, to permit its lower edge to be passed downwardly beyond the bushing 45. The lower edge rests upon a shoulder 49 formed on the flange 26. No special provisions may be made for retaining the cover 47 in place, ordinary friction between its lower edge and the outer edge of flange 26 being sufficient for this purpose.

In another form of the invention illustrated in Figs. 5, 8, and 9, an electromagnetically operated valve is used, incorporating a dust cover 50 similar to the dust cover 47. In this form of the invention, a photoelectric device is utilized as a part of the valve control system. For this purpose the base 51, corresponding to the base 42 of the valve shown in Fig. 1, serves as well to support a photoelectric cell 52 and its base. This cell is so arranged that its electron emitting electrode is exposed to the radiations from a source of light: for example, a flame in a furnace 53. The furnace wall is provided with a tubular extension 54 having cooling fins 55. This tubular extension is arranged to direct illumination toward the device 52. Furthermore, for further focusing the radiations upon the electron emitting electrode of the photosensitive device 52, use is made of a lens structure 56. The barrel for this structure is shown as telescoping within the tubular extension 54. It is also slidable within

a tubular extension 57 fastened to the cover 50. For manipulating the lens barrel, a collar 58 is attached thereto.

If it be desired to remove the cover 50, the collar 58 may be manipulated to move the lens structure 56 toward the left until it clears the extension 57. Then the cover 50 is free to be removed.

When the cover 50 is removed, the photosensitive device 52 may be subjected to excessive general illumination, causing severe overloading. It is important, in order that the device 52 be uninjured, to render the circuits thereof inactive, and thereby reduce the emission of electrons from the cathode to a safe value. In this way, no potential difference between the anode and cathode being in existence, emission of the electrons is greatly reduced.

To effect this result, a control switch mechanism 59 is provided that automatically opens the photoelectric cell circuit when the cover 50 is removed. This switch mechanism includes a spring contact arm 60 attached at its upper end to a binding post 61. This binding post 61 is supported on the base 51. The spring arm carries a movable contact 62 which normally engages a stationary contact 63. This stationary contact 63 is fastened to a bracket 64 attached to the lower side of the base 51. It is connected to a binding post 94 carried in the back of bracket 64. Spring arm 60 has an extension forming a fork 65 between which a roller 66 is pivotally mounted. When the cover 50 is moved into place, the inner surface thereof engages and rolls the roller 66, which is thereby urged toward the right to cause engagement of the contacts 62 and 63. However, the free position of the spring 60 is such that, when the lower edge of the cover 50 passes beyond the roller 66 as it moves upwardly, the spring arm 60 flexes toward the left and the contacts separate.

In order that there be mechanical clearance between the switch parts and annular member 33, this member is cut away as indicated at 95.

The safety switch mechanism 59 may be utilized in other forms of the invention. For example, in the form illustrated in Figs. 6 and 7, the photoelectric cell 67 is shown as supported in a housing 68 separate from the cover 69 for the switch mechanism. The cell 67 has a base 70 that is attached to the bottom of the casing 68 in any suitable manner, so that connections external of casing 68 may be made to the cell.

The casing 68 is detachably supported on a wall 72 that has an aperture 73 for the passage of light to influence the cell 67. For example, the casing 68 may have a lower extension 74 accommodated in a strap 75. An upper extension 76 is held against the wall 72 by the aid of a clamp 77 tightened by a wing nut 78.

As before, there is a safety switch 79 located in the casing 68, for disconnecting the circuits of cell 67 when the housing 68 is removed. This switch 79 includes a spring arm 80 carrying a roller 81. This spring arm is fastened to a binding post 82 attached to the bottom of casing 68. Contact 83 is carried by arm 80. Stationary contact 84 is supported on a bracket 96. These contacts thus have a structure quite similar to those illustrated in Figs. 5 and 8.

When the casing 68 is detached from the wall

72, the spring arm 80 is permitted to flex toward the left, separating contacts 83 and 84.

Connections from the photo-electric cell 67 to the electromagnetic apparatus in cover 69 extend through the flexible conduit 85. This flexible conduit is shown as attached to the elbows 86 and 87, fastened respectively to casing 68 and base 89. Thus, elbow 86 is supported immediately below the base 70, so that the photo-cell connections may pass most conveniently to the elbow 86. The elbow 87 is attached to a bracket 88, depending from the base 87 upon which the rectifier parts are supported. The bracket 88 may be extended downwardly to cover the slot 90 that is formed in the bottom of the casing 68 in order to permit the casing to slip down beyond the sleeve 91 extending from the elbow 87.

The inventor claims:

1. In an electromagnet, a tubular magnetic member, a core, a coil surrounding the core, and means for detachably mounting the core in the tubular member, comprising a magnetic cover for the tubular member, and in sliding telescoping relation to the tubular member, and means for attaching the core to said cover.

2. In an electromagnet, a tubular magnetic member having a bottom flange for attaching it to a support, and open at the top, a core, a coil surrounding the core, and means for detachably mounting the core in the tubular member, comprising a magnetic cover for the member, and carrying the core, and a wall surrounding the member and having a flange overlying the flange on the tubular member and attached thereto, said core and the flanges forming magnetic poles.

3. In a light control system, a light sensitive cell, a circuit for said cell, a support for the cell, a removable cover for the cell having an aperture to admit light to the cell, and a switch operated in response to removal of the cover for rendering said cell circuit inactive.

4. In a light control system, a light sensitive cell, a circuit for said cell, a support for the cell, a removable cover for the cell, a lens system cooperating with the cover for directing illumination toward the cell, said lens system being adjustable with respect to an aperture in the cover, a hollow member external of the cover into which the lens system may project, said lens system being capable of complete withdrawal from the cover to permit the cover to be removed, and a circuit controller for the cell circuit, and operated in response to the removal of the cover, for rendering said cell circuit inactive.

5. In a light control system, a light sensitive cell, a circuit for said cell, a support for the cell, a removable cover for the cell having an aperture to admit light to the cell, and a switch operated in response to removal of the cover for rendering said cell circuit inactive, including a biased arm, and means carried by the arm and engaged by the cover.

WILLIAM ALTON RAY.

REFERENCES CITED

The following references are of record in the file of this patent:

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Number	Name	Date
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