United States Patent

Dunkelis

[15] **3,665,958**

[45] **May 30, 1972**

[54] VENT CLOSURE DEVICE

[72] Inventor: **Evald Dunkelis,** Glen Ellyn, Ill.

[73] Assignee: **GPE Controls, Inc.,** Morton Grove, Ill.

[22] Filed: **Sept. 16, 1968**

[21] Appl. No.: **762,252**

[52] **U.S. Cl.**.....**137/522,** 16/189, 49/386, 137/527, 251/337, 267/155, 267/157

[51] **Int. Cl.**.....**F16k 17/04**

[58] **Field of Search**.....267/155, 157; 251/337; 137/522, 527; 220/35; 16/76, 188, 189; 49/386

[56] **References Cited**

UNITED STATES PATENTS

945,151	1/1910	Blauvelt	137/522 X
2,534,003	12/1950	Culver	220/35 X
2,767,735	10/1956	Darling	137/527
3,395,727	8/1968	Weise et al.	137/527 X

Primary Examiner—Laverne D. Geiger

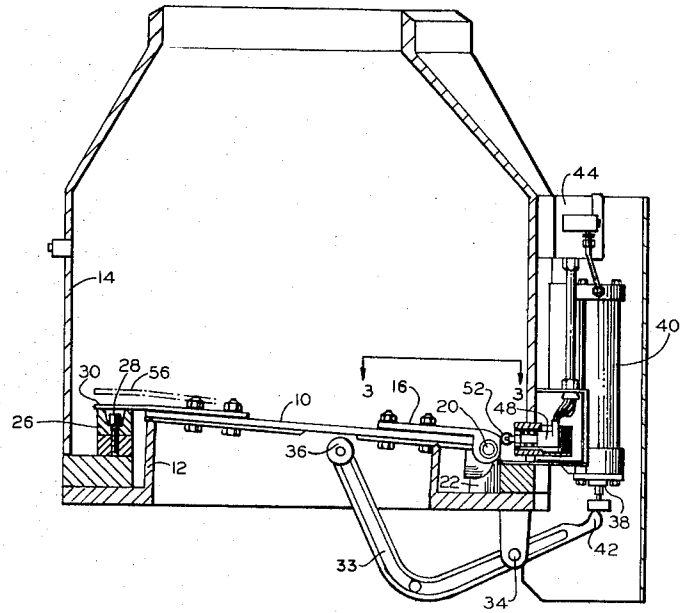
Assistant Examiner—David J. Zobkiw

Attorney—Julian Falk, Chester A. Williams, Jr., Marshall J. Breen and Kinzer, Dorn & Zickert

[57] **ABSTRACT**

A hinged cover for a vent opening with safety features to insure reliability of operation in remote and critical applications, such as nuclear reactors. Means are provided for opening the cover from a remote location to insure its freedom of movement, and to then move it back to the closed position. The latter means comprises a return spring, and a standby spring is provided to become operative only in the event of breakage or other malfunction of the first spring.

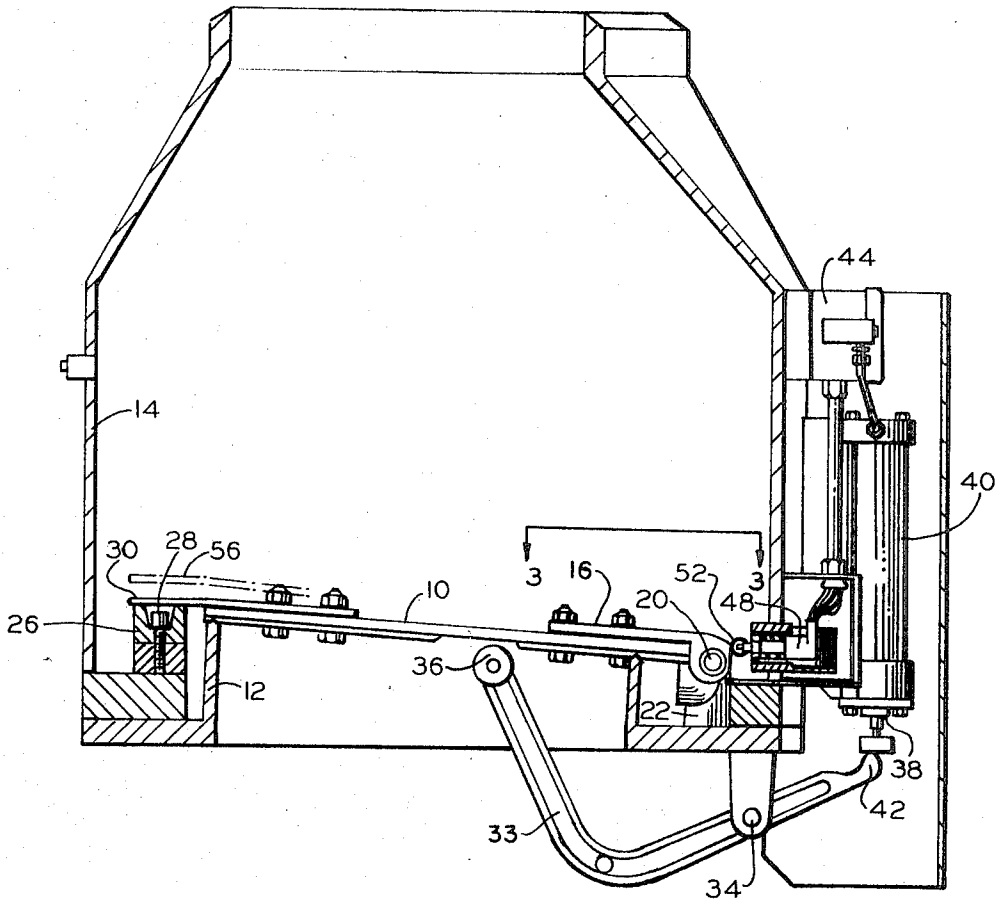
10 Claims, 5 Drawing Figures



Patented May 30, 1972 3,665,958

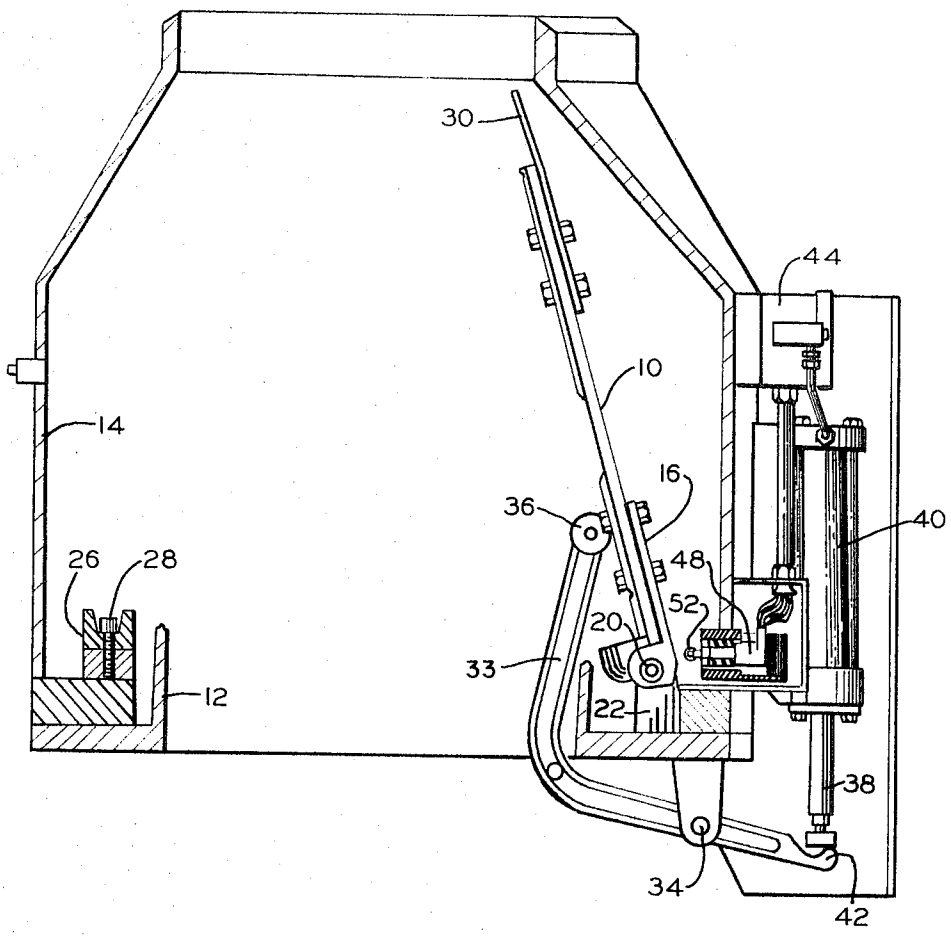
3 Sheets-Sheet 1

FIG. 1



INVENTOR.
Ewald Klunkelis
BY Charles S. McGuire,
Attorney

FIG. 2



INVENTOR.
Ewald Klunkelis
BY
Charles S. McGuire,
Attorney

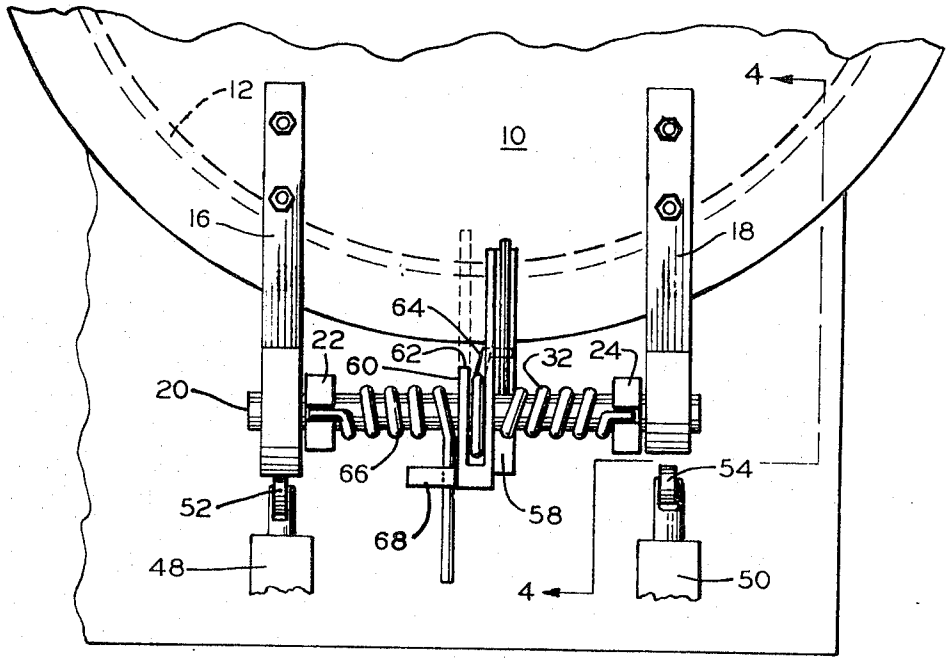


FIG. 3

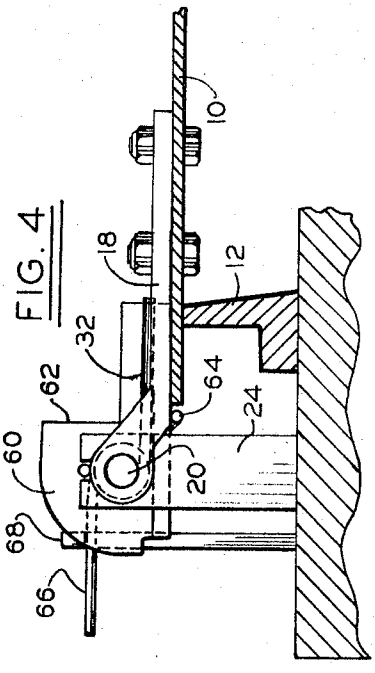


FIG. 4

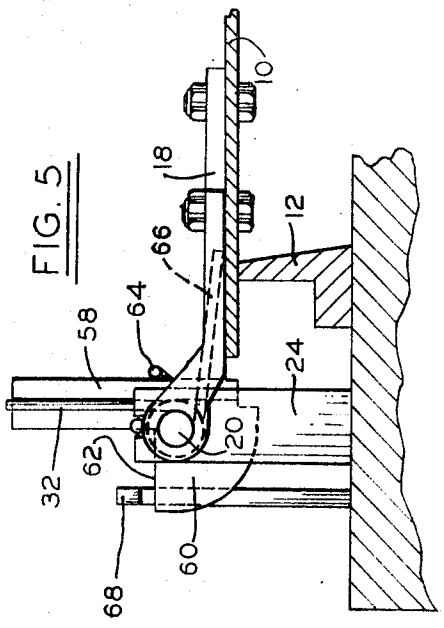


FIG. 5

INVENTOR.
Ewald Punkelus
BY
Charles S. McGuire,
Attorney

VENT CLOSURE DEVICE

The present invention relates to covers or closure devices for vent openings for the relief of a predetermined pressure differential on opposite sides of the cover. More specifically, the invention relates to vent covers and associated structure for use in extremely critical conditions where reliability of operation is of the utmost importance.

The peaceful uses of atomic energy include reactors wherein the heat generated by atomic fission is utilized to convert water to steam. Thus, in effect, the object of such reactors is to provide a more efficient steam generating plant, normally to drive steam turbines for generating electric power. Since atomically active materials are used in such plants it is necessary to exercise the utmost caution and safety procedures in the operation thereof. Thus, all equipment having an effect on the operation of the reactor, particularly in operation of the portions thereof having a direct effect on the control of radioactive contamination, must be as safe and reliable as possible.

The design of a typical plant of this type includes a generally circular layout with the reactor at the center surrounded by the boiler, with appropriate piping for feeding the water in and the steam out. The boiler is located within a larger spherical enclosure through which the steam pipes extend, whereby any escaping steam due to pipe rupture, or the like, will be discharged inside the spherical enclosure. The latter is connected by a number of radially extending, large pipes to a doughnut shaped suppression chamber containing water. The vent piping provides for the removal of steam from the spherical enclosure to the suppression chamber and reduces the steam pressure by causing it to pass through the water before being returned to the enclosure, thereby insuring that the internal pressure does not exceed predetermined limits. A sudden drop in the pressure within the enclosure due to condensation of steam by sudden temperature drop, for example, may cause an extreme vacuum within the vent piping.

In order to prevent severe damage to the system and possible radioactive contamination of the surrounding atmosphere due to these large pressure differentials, a vent opening is provided in association with certain sections of vent piping. The vent openings have appropriate covers which are moveable to the open position in response to a predetermined vacuum within the system. From the nature of the process it is apparent that the vacuum vents must operate properly at all times, even if this results in an increase in cost over other similar type vents for use in less critical applications.

It is a principal object of the present invention to provide a relief vent which is thoroughly reliable in operation and which opens in response either to a predetermined pressure differential or to manual remote actuation.

A further object is to provide a vacuum relief vent especially suited for use in atomic reactor steam generating plants, and other such critical applications.

Another object is to provide a relief vent moveable to the open position by remote manual operation, to insure its freedom of movement, having a limit switch arrangement to indicate at the remote location the open or closed condition of the vent and backup means for returning the cover to the closed position in the event of failure of the primary means provided for such purpose.

A still further object is to provide a relief vent cover having a first return spring for moving the cover back to the closed position, and a standby spring which becomes operative only in the event of failure of the return spring.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed

description taken in connection with the accompanying drawings, in which:

FIG. **1** is a plan view showing one embodiment of the relief vent device of the invention with the cover in the closed position;

FIG. **2** is a plan view, as in FIG. **1**, showing the cover in the open position;

FIG. **3** is an elevational view of a portion of the apparatus of FIGS. **1** and **2** as seen generally from the position indicated by the lines **3—3** in FIG. **1**; and

FIGS. **4** and **5** are fragmentary, elevational views in section along the lines **4—4** of FIG. **3**, showing certain elements in two positions of movement.

Referring now to the drawings, the relief vent generally comprises a cover **10** hingedly moveable between closed (FIG. **1**) and open (FIG. **2**) positions with respect to seat **12**, which is shown in the drawings as mounted within a section of piping **14**. Hinge bars **16** and **18** are fixedly attached at one end to cover **10** and, at the other end, encircle hinge pin **20**. Hinge posts **22** and **24** support pin **20**, thereby forming a hinged mounting for movement of cover **10** about an axis through pin **20**.

In the illustrated embodiment, cover **10** is shown as being held in the closed position by fixed permanent magnet **26**, held in a desired position by bolt **28**, contacting magnetically permeable lip **30** extending from cover **10** on the side opposite the hinged mounting thereof. Lip **30** may form an integral part of cover **10** or may comprise a separate element attached thereto, as shown. Magnetic biasing means of this type are shown more fully in copending U.S. application, Ser. No. 732,972, filed May 29, 1968, of Walter Sieverin and assigned to applicant's assignee and now issued as U.S. Pat. No. 3,502,361. Such biasing means are shown here by way of example only, and it will be understood that more conventional means such as weight or spring loading may also be employed in connection with the present invention. Also tending to hold cover **10** in the closed position is torsion spring **32** (FIG. **3**) having one end retained in a slot in hinge post **24** and the other end bearing against cover **10**.

From the foregoing it is apparent that a pressure differential on opposite sides of cover **10** of sufficient force to overcome the combined magnetic holding force exerted by magnet **26** on lip **30** and the biasing force of spring **32** will move cover **10** away from the closed position. The magnetic biasing force rapidly decreases upon movement of cover **10**, whereby only the biasing force of spring **32** must be overcome in order to move the cover to its fully open position after a small amount of initial movement. This is the desired manner of operation of the relief vent in operation under conditions of predetermined pressure differential on opposite sides of cover **10**. In many applications, the aforedescribed structure is sufficient to produce the desired results; in fact, in many conventional applications the cover would be mounted for return to the closed position under its own weight, thereby allowing omission of spring **32**. As previously mentioned, however, the relief vent of the present invention is intended for use under conditions which make reliability of operation imperative, and the vent may be in a location which makes frequent visual inspection impractical. Therefore, the present invention provides means by which the cover may be moved to the open position by selective manual actuation from a position remote from the vent location together with an observable indication, at such remote location, of the actual position of the cover.

Means are provided for selectively moving cover **10** to the open position in the form of bell crank **33**, mounted for movement about fixed pivot **34**. One end **36** of crank **33** is positioned to bear against cover **10** upon rotation of the crank in a clockwise direction as seen in FIGS. **1** and **2** about its pivotal mounting. Such rotation is effected by extension of rod **38** from cylinder **40** to act upon the other end **42** of crank **33**. Cylinder **40** may comprise a conventional hydraulic or pneumatic cylinder and is actuated, in the disclosed embodiment, by energizing solenoid **44** through suitable circuitry by operat-

ing a switch (not shown) at some remote location. Energization of solenoid **44** operates a valve, or the like, which controls the flow of fluid into cylinder **40**, moving rod **38**, crank **33** and cover **10** from the FIG. **1** to the FIG. **2** position. De-energization of the solenoid allows the biasing force of return spring **32** to move the elements back to the FIG. **1** position. In a preferred embodiment, cover **10** is mounted with the axis of hinge pin **20** in a vertical position, whereby spring **32** need be strong enough only to overcome the inertia and friction of the elements to be moved. Also, the force exerted by cylinder **40** in such an arrangement need be only great enough to overcome the biasing forces of magnet **26** and spring **32**, and not the additional weight of cover **10** as would be the case if hinge pin **20** were mounted horizontally and the cover moved upwardly to the open position. Furthermore, it is preferred that some positive means be provided to move the cover back to the closed position rather than relying on gravity to cause cover **10** to close under its own weight as when it is mounted for rotation about a horizontal axis. Actually, the arrangement of the present invention allows mounting of the cover in any orientation, with proper balancing of the forces exerted by magnet **26**, spring **32** and cylinder **40**.

A pair of limit switches **48** and **50** are provided with roller end portions **52** and **54** which are biased forwardly toward engagement with hinge bars **16** and **18**, respectively, as shown in FIG. **3**. The opposing end portions of the hinge bars are so positioned and shaped that they act as cam surfaces with respect to the limit switches as cover **10** moves between its open and closed positions. End portions **52** and **54** thus serve as cam followers, and are positioned with switch **48** retracted or closed, and switch **50** extended or open, when cover **10** is in the closed position, as seen in FIG. **3**. The opposing surfaces of end portion **52** and hinge bar **16** are such that switch **48** moves to the open position, in response to appropriate biasing means, upon movement of cover **10** a short distance, e.g. to the position indicated in the dot dash lines designated by the reference numeral **56** in FIG. **1**, toward the open position. Switch **50** is closed through engagement of end portion **54** by hinge bar **18** as cover **10** approaches its fully open position. Switches **48** and **50** are connected through conventional electrical circuitry to indicating means, such as lights, at the remote location where the switch for solenoid **44** is operated. In this way the operator is provided with a constant visual indication of the position of cover **10**, which is especially important in checking the effectiveness of the auxiliary opening and closing means. The circuitry may, of course, provide for solenoid control switches and indicating lamps for many vents at a single operator station.

Referring now to FIGS. **3–5**, return spring **32** is seen to be arranged with one end retained in the notch in hinge post **24** and the other end acting upon cover **10** through element **58** which is loosely mounted upon hinge pin **20** for rotation thereabout. Element **58** includes ear portion **60** having edge **62**. Spring **64** is mounted to exert a biasing force on element **58** in opposition to the direction of the force exerted by return spring **32**. Spring **64** preferably exerts only a small fraction of the force of spring **32**, and is intended to move element **58** only in the event of breakage or similar malfunction of spring **32**. In the event that such malfunction should occur and spring **32** exerts little or no biasing force tending to move cover **10** towards its closed position, spring **64** causes rotation of element **58** in a counterclockwise direction, as seen in FIGS. **4** and **5**.

Standby spring **66** is positioned about hinge pin **20** with one end retained in a slot in hinge post **22** and the other end retained under an end portion of hook element **68**. In addition to being wound torsionally, spring **66** is also somewhat axially compressed, whereby the end retained under hook **68** tends to move outwardly from under the hook, but is prevented from doing so by ear portion **60** of element **58** when the latter is in the position shown in FIG. **4**. In the event of movement of element **58** to the position shown in FIG. **5**, under the influence of spring **64**, edge **62** will move past the end of spring **66** which is retained by hook **68**, thereby allowing sufficient axial movement of this end of spring **66** to release the latter from under the hook. Since one end of spring **66** is retained by the slot in hinge post **22**, as previously mentioned, the other end will immediately rotate into engagement with cover **10** upon being released from engagement by hook **68**. Thus, when spring **32** becomes inoperative to apply return force to cover **10** it is moved, along with element **58**, by spring **64** to the position shown in FIG. **5** and spring **66** is released to become operative and apply the required force urging cover **10** toward its closed position. The vent may be moved to its open position as before under the operation of cylinder **40** and it will be returned to the closed position by standby spring **66**.

It is apparent that the present invention provides effective means for venting portions of atomic reactors to prevent damage thereto due to excessive vacuum which is sometimes created while offering the utmost in reliability and safety of operation. Auxiliary means are provided for opening the vent at any time from a remotely located operator's station with indicating means showing the actual position of the cover. Positive closure means are provided in the form of a spring and a second spring insures closure in the event of failure of the first spring by automatically coming into biasing position in response to such failure.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained, and since certain changes may be made in the above construction without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a relief vent having a cover movable between open and closed positions relative to a seat in response to a predetermined pressure differential, the combination comprising:

a. first means biasing said cover toward said closed position;

b. second means movable from an inoperative to an operative position, in the latter of which said second means biases said cover toward said closed position; and

c. third means for permitting said second means to move from said inoperative to said operative position in response to a failure of said first means rendering the latter ineffective to exert a biasing force on said cover.

2. The invention according to claim **1** wherein said cover is hingedly mounted and said first means comprises a first torsion spring biasing said cover about its hinged mounting toward said closed position.

3. The invention according to claim **2** wherein auxiliary means are provided for selectively moving said cover to said open position independently of said pressure differential.

4. The invention according to claim **3** wherein said auxiliary means comprise a rotatable arm mounted for coaction with said cover.

5. The invention according to claim **3** and further including limit switch means movable between open and closed positions in response to movement of said cover to indicate whether said cover is in its open or closed position.

6. The invention according to claim **2** wherein said second means comprises a second torsion spring held in said inoperative position by said third means which includes retaining means responsive to the biasing force supplied by said first torsion spring.

7. The invention according to claim **6** wherein said retaining means comprise hook means releasably holding one end of said second spring and a movable element held in an initial position by said first torsion spring wherein said movable element prevents release of said one end of said second spring.

8. The invention according to claim **7** wherein said third means further includes additional biasing means for moving said movable element away from said initial position upon failure of said first spring, thereby releasing said one end of said second spring from said hook means for movement into biasing engagement with said cover.

9. The invention according to claim 8 wherein said movable element is mounted for rotational movement away from said initial position and is biased toward such movement by said additional biasing means with a considerably smaller force than that exerted by said first spring on both said movable element and said cover.

10. The invention according to claim 6 wherein both of said first and second torsion springs are mounted upon the hinged mounting of said cover.

* * * * *