

[54] **BLAST-ACTUATED CONTROL SYSTEM**

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[58] Field of Search **340/261, 227.1, 17, 229, 340/240; 73/386, 393, 406, 35; 92/96; 200/201, 83 B, 83 A, DIG. 20, 61.01**

[56] **References Cited**

UNITED STATES PATENTS

3,562,456	2/1971	Rogers	200/83 B X
3,333,472	8/1967	McLellan	73/406 X
3,651,693	3/1972	Alinari	73/406 X
3,488,470	1/1970	Weaver	219/201
3,576,412	4/1971	Jullien-Davin	73/393
2,721,913	10/1955	Kent	200/61.01

3,269,186	8/1966	Hebenstreit	73/393
2,766,349	10/1956	Hamburg	200/83 A

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[57] **ABSTRACT**

A blast-actuated control system for operatively controlling an alarm circuit in response to shock wave pressure resulting from a nuclear explosion which produces a sudden high rise in the temperature and the pressure of air surrounding the system. The control system comprises a housing having a chamber containing a switch actuator and a flat plate. The plate is loosely supported inside the chamber and is adapted for being raised upward for operating the switch actuator in response to the sudden increase in air pressure that is produced by a nuclear blast. Although the blast also produces a sudden high rise in temperature which causes expansion of both the housing and the plate, this expansion will not impede the movement of the plate because of its loose supporting construction.

7 Claims, 4 Drawing Figures

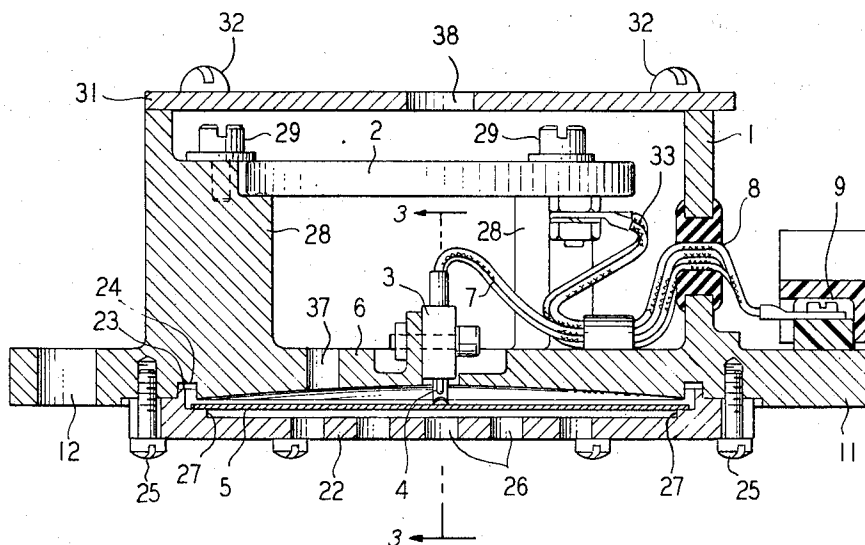


FIG. 1

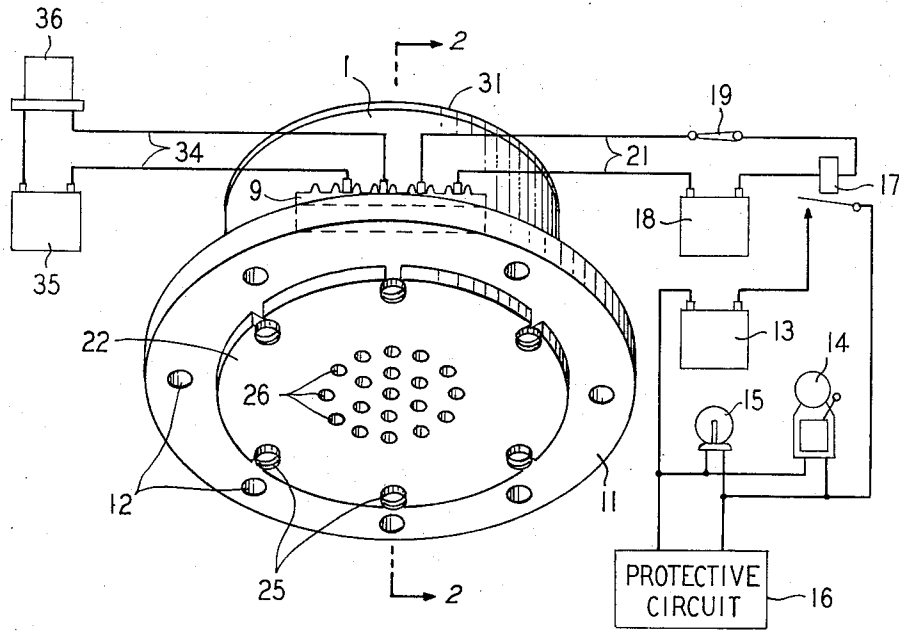


FIG. 2

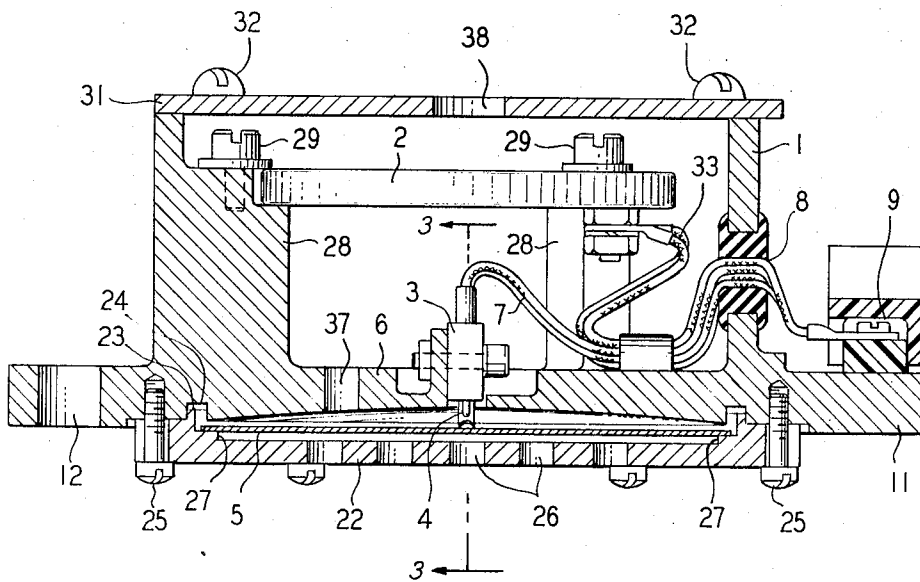


FIG. 3

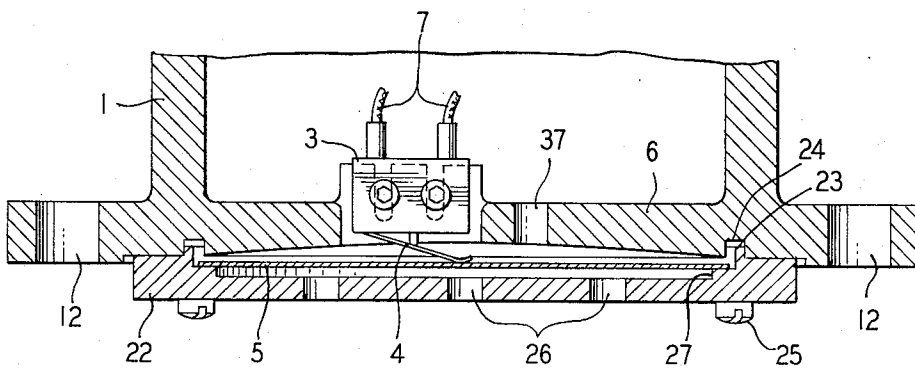
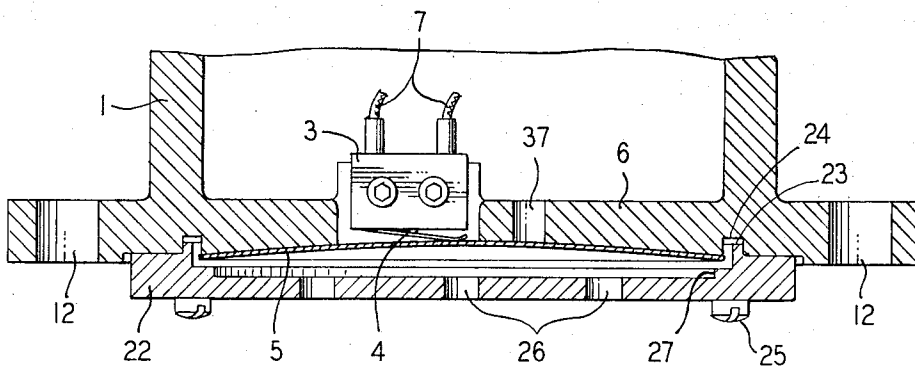


FIG. 4



BLAST-ACTUATED CONTROL SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to pressure-responsive control systems and, more particularly, to a blast-actuated control system for controlling alarm circuit in response to shock wave pressure resulting from a nuclear explosion which produces a sudden high rise in both the temperature and the pressure of air surrounding the system.

Pressure-responsive control systems have heretofore employed pressure-actuated switches which usually comprise a casing member that encloses a switch actuator and a snap-acting flexible diaphragm. In general, the diaphragm is circular in shape and is deformed so as to have a bulge, or dish-shaped central portion, for providing the desired snap action. The edge of the diaphragm is usually fixedly attached to the casing by any convenient means, such as by welding or clamping it to the casing. Normally, the diaphragm is held in the casing in such a manner that its concave surface does not engage the switch actuator. Under this condition, a suitable increase in the pressure applied to its convex surface will effect the snap action of the diaphragm so that its concave surface will now become convex. This movement of the diaphragm serves to operate the switch actuator which thereupon performs its particular desired control function.

Although pressure-actuated switches of this type have been satisfactory for some purposes, they are not suitable for use in blast-actuated control systems. This is because the thermal radiation from a nuclear explosion may suddenly raise the temperature of such a switch several hundred degrees Fahrenheit thus causing extreme differential expansion between the diaphragm and the casing. Such extreme differential expansion would generally distort both the casing and the diaphragm with the result that the diaphragm would become stressed, cracked, or otherwise damaged in such a manner as to alter or destroy its snap-action capability and thus render it inoperable.

Accordingly, there is a need for an improved type of pressure-actuated switch which will not have its operation adversely affected by a sudden high rise in temperature, such as that produced by a nuclear explosion.

SUMMARY OF THE INVENTION

The present invention is designed to provide a blast-actuated control system with improved pressure-responsive switching control means that will operate reliably within a temperature range of from -40° F. to 500° F. for operatively controlling an alarm circuit. The system comprises an electrical circuit having a switch connected in series with the energizing winding of a relay which has its armature connected into the alarm circuit. The system further includes a steel housing structure having an interior cavity with a partition for dividing it into two portions. One portion of the cavity contains the switch and a heating element. The other portion contains a flat steel plate with means for loosely supporting it. The switch has an actuator that extends through an opening in the partition and protrudes into the other portion of the cavity at a point above the center of one side of the plate. The housing wall of the cavity on the other side of the plate is perforated for the free admission of air.

Thus, when a nuclear explosion occurs, its shock wave pressure will pass through the perforations in the housing and will raise the plate to an elevated position whereby it operates the switch actuator. The operation of the switch actuator in turn operates the switch for controlling the energizing means for the relay and thereby operatively controlling the alarm circuit. Although both the housing structure and the plate will expand in response to the extreme heat of the blast, this expansion will not impede the movement of the plate due to its loose supporting construction.

BRIEF DESCRIPTION OF THE DRAWING

The features of this invention are more fully discussed hereinafter in connection with the following detailed description of the drawing in which:

FIG. 1 is a schematic diagram of a blast-actuated control system constructed in accordance with this invention and showing some of the components in perspective;

FIG. 2 is a sectional side view of the major components of the control system taken along the line 2—2 in FIG. 1;

FIG. 3 is a fragmentary sectional side view taken along the line 3—3 in FIG. 2 and showing the switch actuator plate in its normal position; and

FIG. 4 is a fragmentary sectional side view somewhat similar to FIG. 3 but showing the switch actuator plate in its elevated position.

DETAILED DESCRIPTION

The invention will now be described with reference to a specific exemplary embodiment thereof; namely, a blast-actuated control system adapted for operatively controlling an alarm circuit in response to shock wave pressure resulting from a nuclear explosion which produces a sudden high rise in both the temperature and the pressure of air surrounding the system. As is shown in FIG. 1, the system comprises a cylindrical steel housing structure 1 having a diameter of 6 inches and provided with an internal cavity adapted for holding the major components of this control system. These components, which are best seen in FIG. 2, include a conventional heating element 2, a conventional microswitch 3 having an actuator 4, and a flat circular steel plate 5. As is also shown in FIG. 2, the housing structure 1 is provided with a partition 6 for dividing the cavity into an upper portion and a lower portion. In this embodiment of the invention, the partition 6 is formed integrally with the housing structure 1, but it is to be understood that, if desired, it may be constructed as a separate instrumentality.

The microswitch 3 is suitably mounted in the upper portion of the cavity and on the upper surface of the partition 6. The partition 6 is provided with an opening so that the switch actuator 4 can protrude therethrough into the lower portion of the cavity at a point above the center of the plate 5. Normally, the plate 5 is resting in its unoperated position, as is shown in FIG. 2, and is loosely supported in this position by instrumentalities which are fully described hereinafter. In this condition, the actuator 4 is in its fully extended position wherein it is adapted for effecting the closing of the contacts inside the microswitch 3. When a nuclear explosion occurs, the resulting sudden high rise in pressure will cause the plate 5 to be physically moved from its normal, or unoperated, position to an elevated, or oper-

ated, position that is shown in FIG. 4, as is discussed in more detail hereinafter. This raising of the plate 5 to its elevated position pushes the actuator 4 upward to its operated position, seen in FIG. 4, wherein it effects the opening of the contacts in the microswitch 3.

In addition, the microswitch 3 is provided with two electrical conductors 7 which extend from its normally closed contacts and pass through an opening 8 in the housing 1 to a terminal strip 9 that is attached to a flange 11 which is formed at the base of the housing 1. The flange 11 has a plurality of holes 12 formed therein so that the housing 1 can be mounted with screws and placed over a suitable opening, such as in an exterior wall of a hardened building structure which houses the alarm circuit that is to be operatively controlled.

The alarm circuit is represented schematically in FIG. 1 as comprising a battery 13, an audible alarm 14, a visual alarm 15, and a protective circuit 16. This alarm circuit is normally open at the armature and contact of a normally energized electrical relay 17 that has its energizing winding connected into the control system. The protective circuit 16 is indicated schematically for illustrative purposes and includes instrumentalities adapted for closing protective valves over ventilating ducts in the associated building structure in order to exclude radioactive fallout and destructively high blast pressures generated by an atomic explosion.

In the control system, the energizing winding of the relay 17, a battery 18, and a manually operable control switch 19 are all connected in series with a pair of electrical conductors 21. The conductors 21 extend to the terminal strip 9 where they are joined to the conductors 7 which, as was stated above, are connected to the contacts of the microswitch 3. Since the microswitch contacts and the manual switch 19 are normally closed, current from the battery 18 will hold the armature of the relay 17 operated. Accordingly, the alarm circuit is normally open at the contact of the relay 17 thus preventing any flow of current from the battery 13.

Referring now to FIG. 3, which shows the lower portion of the housing 1 on a larger scale, it can be clearly seen that the switch actuator 4 is positioned above the center of the plate 5 and that, since the plate 5 is not in its elevated position, the switch actuator 4 is not operated at this time. It can also be seen that the lower portion of the housing cavity is closed by a steel disk 22 having a larger diameter than the plate. The disk 22 has a circular flange 23 formed in its upper surface and adapted to fit into a groove 24 cut in the lower surface of the partition 6. The disk 22 thus serves as a bottom for the housing cavity and is securely fastened to the housing 1 by a plurality of screws 25. A number of holes 26 are drilled through the disk 22 for admitting the shock wave pressure from a nuclear explosion.

It should be noted that the upper surface of the disk 22 is circularly recessed over a somewhat larger area than that occupied by the plate 5. Immediately below the plate 5, a second circular recessed portion is formed in the disk 22 concentrically with the first recessed portion. This second recessed portion has a smaller area than that of the plate 5 so that it causes the formation of a peripheral ledge 27 that is positioned immediately below the first recessed portion. Thus, the plate 5 fits loosely within the upper recess of the disk 22 and is loosely supported therein by the ledge 27. Due to this loose supporting construction, the movement of the plate 5 will not be impeded when the hous-

ing 1, the plate 5, the partition 6, and the disk 22 all expand rapidly in response to the sudden and intense heat produced by a nuclear explosion.

Since this control system is also designed to be capable of operation at low temperatures, such as -40°F ., there is the hazard that moisture might condense and freeze within the housing cavity. If ice should form in the area around the plate 5, it might impede the movement of the plate 5. This hazard is prevented by employing the above-mentioned heating element 2. As is shown in FIG. 2, the heating element 2 is positioned within the upper portion of the housing cavity and is mounted upon supports 28 formed therein and to which it is fastened by screws 29. It also can be seen that the heating element 2 is positioned above the microswitch 3 and beneath the cover plate 31 which forms the top of the housing 1 and which is attached thereto by screws 32.

The energizing circuit for the heating element 2 comprises two electrical conductors 33 which are connected thereto and which pass through the opening in the housing 1 to the terminal strip 9. At this point, the conductors 33 are joined to two other conductors 34 which, as is shown in FIG. 1, form an electrical path in which a battery 35 and a thermostat 36 are connected in series. Thus, the thermostat 36 controls the application of energizing current from the battery 35 for operating the heating element 2 whenever the ambient temperature approaches 32°F .

It is to be noted that the lower surface of the partition 6 has a concave shape which is designed to restrict the upward movement of the plate 5 and to limit any stresses or deflection produced therein by the force of a blast pressure wave. In this embodiment of the invention, this construction is designed to withstand safely a pressure of 100 psi. Since the upward movement of the plate 5 will force a displacement of the air in this portion of the housing cavity, the partition 6 is provided with a plurality of vent holes 37 so that the air can move into the upper portion of the housing cavity. As this will tend to compress the air in this upper cavity, the cover plate 31 has a vent hole 38 formed therein so that this air can escape. This vent hole 38 needs no moisture barrier because the housing 1 is mounted on the wall of a hardened building in such a manner that the vent hole 38 is inside the building structure.

Accordingly, when an atomic explosion occurs, its blast pressure wave will enter the holes 26 in the disk 22 and will force the plate 5 to move to its elevated position in the lower portion of the housing cavity, as is shown in FIG. 4. Since the switch actuator 4 has a portion thereof which normally is positioned within the lower housing cavity, the elevation of the plate 5 will cause this portion of the actuator 4 to be moved upward to a higher position. As the actuator 4, when in its lower normal position, is adapted for effecting the closure of the contacts in the microswitch 3, it can be understood that the movement of the actuator 4 to its higher operated position will effect the opening of the contacts in the microswitch 3.

The opening of the microswitch contacts effects the opening of the control circuit and interrupts the flow of current from the battery 18 to the relay 17 which thereupon releases its armature. This action operatively controls the alarm circuit by completing the paths for current from the battery 13 to operate the audible alarm 14, the visual alarm 15, and the protective circuit 16.

Such operative control of the alarm circuit is assured at all times because, as was stated above, even though the sudden and extreme heat generated by the nuclear explosion will suddenly cause considerable expansion of the housing 1, the plate 5, the partition 6, and the disk 22, this rapid and extensive expansion will not produce any stress or binding action on the plate 5. Therefore, this expansion will not impede the movement of the plate 5 which will be free to move to its elevated position due to its loose supporting construction.

What is claimed is:

1. A blast-actuated alarm system operatively responsive to the occurrence of an explosion which produces a sudden high rise in the temperature and the pressure of air surrounding said system, said alarm system comprising

a switch with a normally unoperated condition and an alternative operated condition,

a flat plate having a normal position and adapted for movement to an operated position in response to said sudden high rise in air pressure produced by said explosion,

said operated position being elevated in space above said normal position,

means responsive to said elevation of said plate to its operated position for changing said switch from its unoperated condition to its operated condition,

a housing having a cavity for surrounding said plate,

both said housing and said plate being adapted for expanding in size in response to said sudden high rise in temperature generated by said explosion,

means for insuring that said movement of said plate to its elevated position will not be impeded or restricted by said expansion of said housing and said plate,

said last-mentioned means including supporting means for loosely supporting said plate within said cavity,

said supporting means comprising a bottom portion of said housing,

said bottom housing portion having means defining a recess formed therein,

and said recess having an area that is larger than the area of said plate whereby said recess is adapted for loosely receiving said plate therein.

2. A blast-actuated alarm system in accordance with claim 1 wherein said bottom housing portion comprises means for defining a peripheral ledge immediately below said recessed area and adapted for loosely supporting said plate thereon.

3. A blast-actuated alarm system in accordance with claim 2 wherein said means for defining a peripheral ledge comprise means defining a second recess formed in said bottom housing portion immediately beneath said first-mentioned recess and concentric therewith, said second recess having an area that is smaller than that of said plate, and said second recess having means for defining at least one hole therethrough for admitting therein

the shock wave air pressure generated by said explosion.

4. A blast-actuated control system for operatively controlling an electrical circuit in response to the occurrence of a nuclear explosion which produces a sudden high rise in both the temperature and the pressure of air surrounding said system, said control system comprising,

a switch operatively connected to said electrical circuit for alternatively opening and closing said circuit,

a housing structure having an internal cavity and a partition for dividing said cavity into an upper portion and a lower portion,

means for mounting said switch on said partition and in said upper portion of said cavity,

a flat plate disposed within said lower portion of said cavity in such a manner as to become physically elevated in response to said sudden high rise in pressure,

an actuator having one position for opening said switch and another position for closing said switch,

said actuator having a portion thereof positioned within said lower portion of said cavity and adapted to be pushed by said elevation of said plate whereby said actuator is moved from one of its positions to the other of its positions,

both said housing structure and said plate being subject to rapid and extensive expansion in response to said sudden high rise in temperature,

and means for preventing said expansion of said housing and said plate from producing stress on said plate such as might restrict its elevation,

said last-mentioned means including supporting means for loosely supporting said plate within said lower portion of said cavity.

5. A blast-actuated control system in accordance with claim 4 wherein said supporting means include a disk for forming the bottom of the lower portion of said cavity,

said disk having a recessed area formed in its upper surface,

and said recessed area having a size greater than that of said plate and adapted for loosely receiving said plate therein.

6. A blast-actuated control system in accordance with claim 5 wherein said disk further including means for defining a peripheral ledge that is positioned immediately below said recessed area and adapted for loosely supporting said plate thereon.

7. A blast-actuated control system in accordance with claim 6 wherein said means for defining a peripheral ledge comprise a second recessed area formed in said disk immediately below said first-mentioned recessed area,

and said second recessed area having a size that is smaller than that of said first-mentioned recessed area and also smaller than the area of said plate.

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