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Nelson

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[54] **VALVE SHUTOFF DEVICE**

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[58] **Field of Search** 137/38, 39, 45, 463; 251/66, 251/68–70, 73, 74

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[57] **ABSTRACT**

A device for shutting off a valve in a supply line carrying combustible gas or liquid which is actuated when subjected to the influence of significant earth tremors or vibratory exitation. A valve stem extension is connected with the stem of an existing valve. The valve stem extension has a lever arm which is normally held in a position at which the connected valve is open. The lever arm is spring biased in a direction in which the lever would travel if the valve were closed; the bias is created by a spring positioned between said lever and one side of a frame attached to said supply line. A latch holds the lever arm in the normal position until and unless the device is subjected to significant earth tremors or vibratory excitation. Under the influence of significant earth tremors or vibratory excitation a weight, balanced on the other side of said frame, will topple, thereby pulling a chain attached to the latch and opening the latch. The spring bias causes the lever arm to move so the valve stem extension and valve stem turn to close the valve.

6 Claims, 3 Drawing Figures

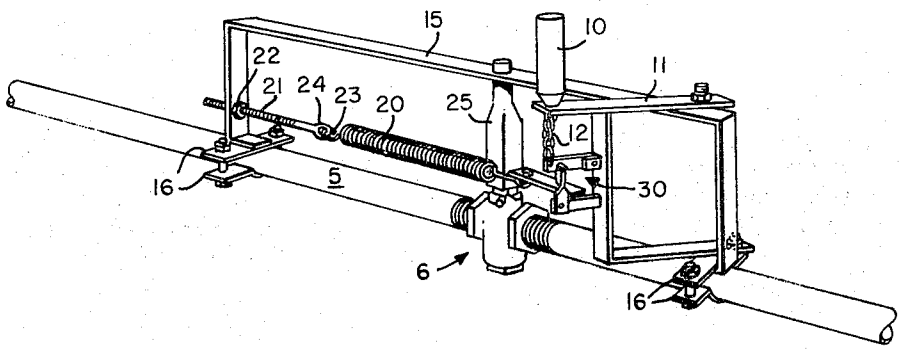


FIG. 1

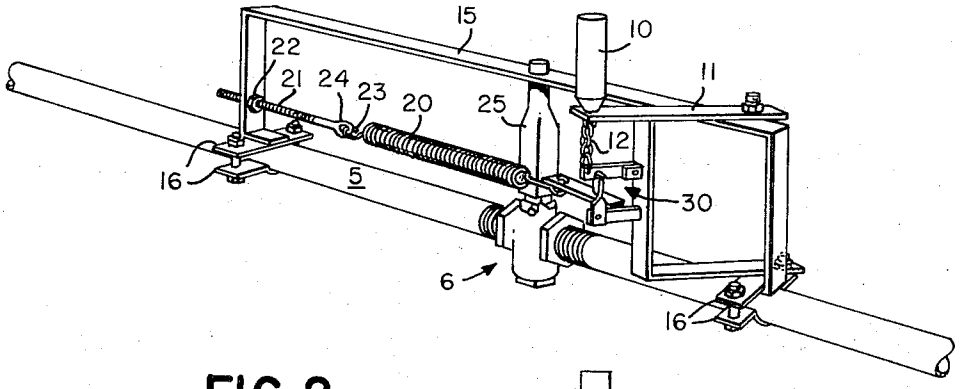


FIG. 2

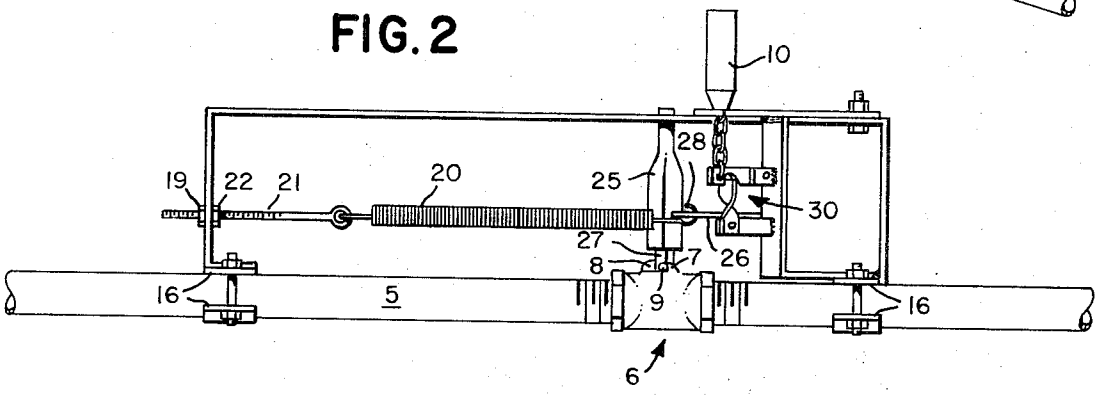
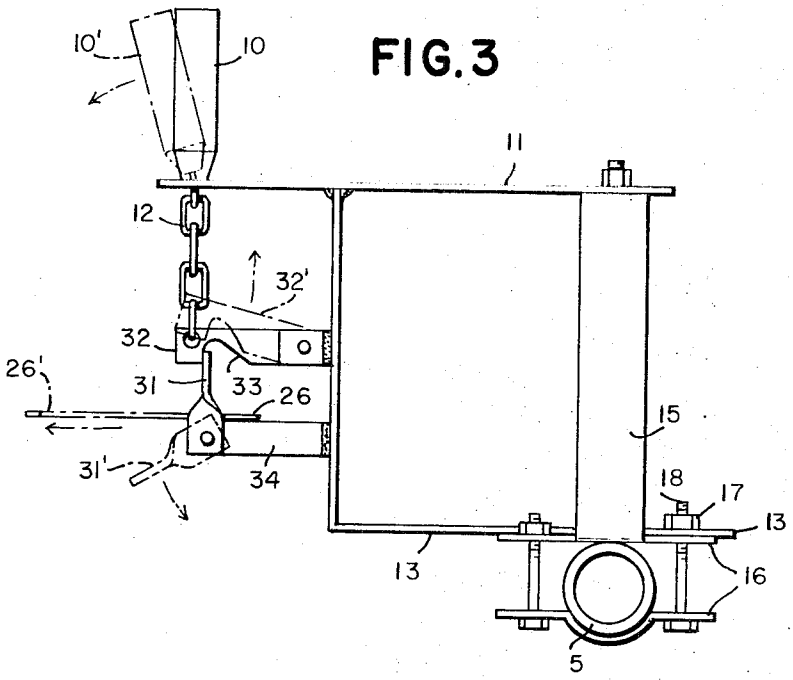


FIG. 3



VALVE SHUTOFF DEVICE

BACKGROUND OF THE INVENTION

Earthquakes are a recurring natural clamity that have wrecked havoc with mankind and with his environment during the course of recorded history. Traditionally, the greatest danger to people has come from collapsing structures. In rural areas the greatest property losses have come from the vibration and collapse of manmade structures. In urban areas, and particularly in recent times, the greatest property losses have come from vast fires which have raged long after the primary tremors have subsided. This problem of fire loss may not be susceptible to complete solution, but just as structures can be constructed to be earthquake proof fire prevention measures may be taken, although few such measures have been taken to work out or enforce a solution.

Explosions in industrial plants occur when explosive or highly combustible materials are mishandled. The initial blasts cause considerable property damage and loss of life but often the greater property damage is caused by raging conflagrations set off by the initial blast. The spread of such fires is aided by the initial widespread distribution of burning materials, by the availability of dry or otherwise combustible materials and, at times, by the availability of liquid or gaseous fuels due to the severing of pipelines or storage tanks. Such fires will be less likely to spread if the last factor is eliminated, e.g., if the supply of liquid or gaseous fuels would be cut off after the occurrance of an explosion.

The principal source of combustible fuel to residential dwellings is natural gas which is transported under pressure and delivered through individual meters and valves. Natural gas is also often delivered through individual meters and valves to commercial establishments and to hospitals, schools and other public buildings. In cold climates, fuel oil is stored in basement tanks and is used during the course of the winter; inflow and outflow valves control the delivery and discharge of the fuel oil. In industrial plants of various kinds, flammable liquids and gases that are used in processing and as product constituents are piped through valves which are used to control thee rate of flow. In all of these situations, in the event the supply pipelines are subjected to significant earth tremors or to vibratory excitation, fires may be started or fueled by broken pipelines. If supply vessels are ruptured then little can be done until the fuel in the vessels is exhausted but if pipelines are broken then the closing of valves will greatly reduce the extent of fire damage. In many instances, it would not be possible for a human operator to get close to the valves to shut them off since the fire may be too hot or the danger too great; an automatic valve shutoff device in such instances would be highly desirable.

Many types of valves are used to control the flow of flammable gaseous and liquid materials including disc valves, wedge-gate valves, angle valves, and ball valves. The valves are ordinarily operated by turning an externally accessable valve stem. In ordinary usage, these valves have an off or closed position and an on or open position. Often only a small angular rotation of the valve stem is required to turn the valve from on to off and the respective positions are fixed by stops which interact with the rotatable externally accessable valve stem. Thus, only a small arc of rotation separates a dangerous condition from a safe one once a supply pipeline has been severed after experiencing significant earth tremors or vibratory excitation.

SUMMARY OF THE INVENTION

A valve stem extension is provided which can be connected with the externally accessable valve stem of a valve installed within a pipeline through which flammable gases or liquids flow. The valve stem extension has a lever arm which protrudes therefrom and which normally occupies a position at which the connected valve is open. The lever arm is biased in the direction in which the lever arm must rotate to close the valve. The bias is created by a spring positioned between one end of a frame attached to the supply pipeline and the lever arm. The lever arm is held in the normal position by a latch which grips the outer end of the arm. The latch is opened under the influence of a significant earth tremor or vibratory excitation by means of a chain which is attached to a weight, balenced on the other end of said frame, which topples. Once the latch releases the lever arm, the attached spring pulls it through an arc of rotation to close the valve whose stem is connected to the valve stem extension.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the valve shutoff device of the present invention reference may be had to the accompanying drawings which are incorporated herein by reference and in which:

FIG. 1 is a perspective view of the valve shutoff device shown to be detachably attached to a supply pipeline;

FIG. 2 is a side view of the valve shutoff device illustrating the connection between the valve stem extension and the valve stem; and

FIG. 3 is a detailed side view of the balanced weight and latch incorporated in the valve shutoff device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The structure of one embodiment of the valve shutoff device of the present invention may be seen by referring to FIGS. 1 and 2 in which a frame **15** is detachably attached by means of contoured parallel plates **16** and attachment bolts to supply pipeline **5**. Frame **15** supports an adjustment rod **21** at one end, a valve stem extension **25** in its middle region and a support assembly **11** at the other end. It is evident that frame **15** has been attached to supply pipeline **5** on either side of a valve **6** located between successive sections of supply pipeline **5**. This positioning permits valve stem extension **25** to fit over the valve stem **27** of valve **6**; typically the inner contours of valve stem extension **25** will be mated to the exterior contours of valve stem **27**.

The range of rotation of valve stem **27** is seen to be limited from the on position at which valve stem nub **9** abuts open stop **7** (the position at which valve **6** is open) and the position at which valve stem nub **9** abuts closed stop **8** (the position at which valve **6** is closed). Normally, the opening or closing of the valve **6** would be accomplished by using an appropriately configured handle over the top of the valve stem **27** or by using a wrench. The valve stem is rotated in accordance with the present invention by forcing the rotation of valve stem extension **25** which forces valve stem **27** to rotate. Other types of connections between a valve stem exten-

sion and a valve stem may be employed including welded or bolt-on connections but a fit-over temporary connection has been found to be the most desirable since the valve shut off device may be more readily installed or removed.

The rotation of valve stem extension **25** is forced by the bias action of spring **20.** Adjustment rod **21** passes through the end of frame **15** and is adjustable in position by means of adjustment nut **22.** Eyelet **24** of adjustment rod **21** receives spring hook **23** at one end of spring **20.** The other hook on spring **20,** hook **28,** passes through an opening in extension lever **26** which is integral with valve stem extension **25.** When extension lever **26** is free to move, as described below, the bias action of spring **20** pulls extension lever **26** so that valve stem extension **25** is rotated clockwise and valve **6** is closed. Other tension means may be used to generate the bias of lever arm **26** in place of spring **20** including hydraulic means or a weight and pulley system. It has been found that simple springs are preferrable since they are inexpensive and do not degrade easily over an extended period of time.

The release of lever extension **26** to permit the rotation of valve stem extension **25** is accomplished by the action of the triggering mechanism of support assembly **11.** Support assembly **11,** as shown, is rotatably attached to frame **15.** As shown in FIG. **3** the upper ledge is connected directly to frame **15** while lower arm **13** is bolted, for convenience, to attachment bolt **18** which holds contoured parallel plates **16** of frame **15** to supply pipeline **5.** A latch assembly **30** normally holds lever extension **26** in place in opposition to the bias produced by spring **20.** Balanced weight **10** rests on the upper ledge of support assembly **11** and is connected to latch assembly **30** by a chain **12.** When the device is subjected to a significant earth tremor or to vibratory excitation balanced weight **10** will topple, thereby pulling chain **12** upwards and causing latch assembly **30** to effect the release of lever extension **26** with the resultant closing of valve **6.**

The operation of the triggering mechanism of the valve shutoff device may be seen clearly from FIG. **3.** The solid lines indicate the mechanism in its normal position while the phantom lines indicate the mechanism immediately after a significant earth tremor or vibratory excitation has been experienced. Balanced weight **10** is seen to normally rest in an upright position on the upper ledge of support assembly **11,** and is seen to topple over as shown by the position of phantom balanced weight **10'.** When balanced weight **10** topples, it pulls attached link chain **12** upwards and lifts notched latch member **32** to position **32'.** The bias on extension lever **26** then pushes latch member **31,** attached to support assembly **11** by member **34,** out of the way by rotating it to position **31'** and causes extension lever **26** to move to position **26'** with the resultant closing of the valve as described above. Various types of linkage means and latches may be employed but it is desirable to use simple mechanical parts since the valve shutoff device is likely to have to remain in place for periods up to tens of years. Also, it is desirable for homeowners to be able to install and repair their own valve shutoff devices without having to rely on the services or professional repairmen.

A crucial design factor in building a device for shutting off valves subject to the influences of significant earth tremors or vibratory excitation is the selection of the tremor or vibration intensity required to trigger the shutoff device. The intensity selected will depend on the particular application. For commerical, residential or occupied structures generally the device should be triggered whenever an earth tremor is experienced which would be sufficient to cause structural damage including the severing of combustible gas or liquid supply pipelines or which would be sufficient to create stresses at the boundaries between structures and their foundations which would rupture supply pipelines. For schools and hospitals a higher standard may be prescribed. For industrial plants the standards may be based on the concern for human safety, the likelihood of fires following an explosion and the predictable losses due to a fire loss as against the inherent loss in shutting down the systems in a factory; thus, it is conceivable, if the latter factor is of prime importance in industrial settings, that the device will be designed to be actuated only if violent vibratory excitation is experienced.

Earth tremors are quantified in strength in two principal ways. The magnitude of an earthquake is a measure of the energy released by the earth movement at the epicenter of the disturbance and is presently described by an absolute number on the Richter scale; the scale is logarithmic to the base **10** so an increase in magnitude of 1 signifies an increase in energy of 10. The intensity of an earthquake is a measure of the energy transmitted by an earth disturbance to a particular observation point and is described by a rating on an intensity scale such as the Rossi-Forel, the Modified Mercalli Intensity Scale of 1931 or the Egen Scale of Intensity; such scales are arithmetic so that the energy associated with intensity VI is six times greater than the energy associated with intensity I. Since the valve shutoff device of the present invention is concerned with preventing fire damage after a significant earth tremor or vibratory excitation is experienced at a particular location the threshold tremor or vibratory excitation level for the device should be set in accordance with one of the intensity scales. It is believed the tremor threshold or equivalent vibratory excitation threshold for the triggering of the valve shutoff device of the present invention should preferrably be set at between intensity V and intensity VII on the Modified Mercalli Intensity Scale of 1931 as revised by C. F. Richter in 1956 and included herein as Table I. (see William Mansfield Adams, Earthquakes, 1964, pp 55–57). The actual setting can be made after a balancing of the risks is made in accordance with the discussion above. It is possible that governmental bodies will establish threshold standards which will be incorporated in the manufacture of devices in accordance with the present invention.

The sensitivity of the triggering mechanism of the automatic valve shutoff device depends principally upon the shape and weight of balanced weight **10** as shown in all figures of the drawing. Stability is obtained by lowering the center of gravity of balanced weight **10,** increasing its surface area which rests on support member **11** and by providing a stable resting surface on the upper ledge of support member **11.** Stability, and thus the intensity of the earth tremor or vibratory excitation required to trigger the device, is decreased by heightening the contrary characteristics. A wide variety of design features may be employed to obtain the desired tremor or excitation threshold and all are contemplated

within the scope of this invention. Of course it would be possible to provide weights of different sizes and shapes which could be made detachably attachable with the device and used as the need arises.

While the invention has been described in connection with specific embodiments thereof, it will be understood that it is capable of further modification, and this application is intended to cover any variations, uses or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains and as may be applied to the essential features hereinbefore set forth, and as fall within the scope of the invention and the limits of the appended claims.

TABLE I

Modified Mercalli Intensity Scale of 1931

I. Not felt. Marginal and long-period effects of large earthquakes....

II. Felt by persons at rest, on upper floors, or favorably placed.

III. Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake.

IV. Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV wooden walls and frame creak.

V. Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate.

VI. Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken. . . .

VII. Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices.... Some cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.

VIII. Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.

IX. General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged.... Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluviated areas sand and mud ejected, earthquake fountains, sand craters.

X. Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Dand and mud shifted horizontally on beaches and flat land. Rails bent slidhtly.

XI. Rails bent greatly. Underground pipelines completely out of service.

XII. Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.

That which is claimed is:

1. A valve shutoff device which is activated when subjected to earth tremors or other vibratory excitation, comprising:

a frame positionable in the vicinity of a valve, said valve being in a supply pipeline for combustible gases or liquids;

a lever attached to the stem of said valve;

means attached between said frame and said lever for biasing said lever to propel said lever in a direction in which it will move to close said valve;

a catch member rotatably attached adjacent one end thereof to said frame, said lever being held by said catch member against the propulsion of said biasing;

a latch member rotatably attached adjacent one end thereof to said frame, said latch member being detachably attachable to said catch member exteriorly along the length of said catch member relative to the point said lever is held by said catch member;

a weight normally balanced on said frame, and

means for connecting said weight with said latch member so that the toppling of said weight moves said latch member to allow said catch member to move, thereby permitting said lever to rotate under the impetus of said biasing means and effect the closing of said valve.

2. A device as in claim **1** further characterized in that said biasing means comprises spring tension means.

3. A device as in claim **2** wherein said spring tension means is a coil spring attached to said frame by an adjustment rod attached between said coil spring and said frame, said adjustment rod being adjustably attached to said frame to permit the tension in said spring to be changed.

4. A device as in claim **1** including a valve stem extension connected with said stem of said valve to extend the length thereof, said valve stem extension also being connected with said lever.

5. A device as in claim **1** in which the arc of rotation of said valve stem is limited by a pair of stop means which define an on position at which said valve is open and an off position at which said valve is closed.

6. A device in accordance with claim **1** wherein said latch member comprises a notched bar and said catch member is detachably attachable at said notch in said bar.

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