June 6, 1967 H. W. HARTMANN, JR 3,323,458

THERMAL FUZE

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Fig. 1

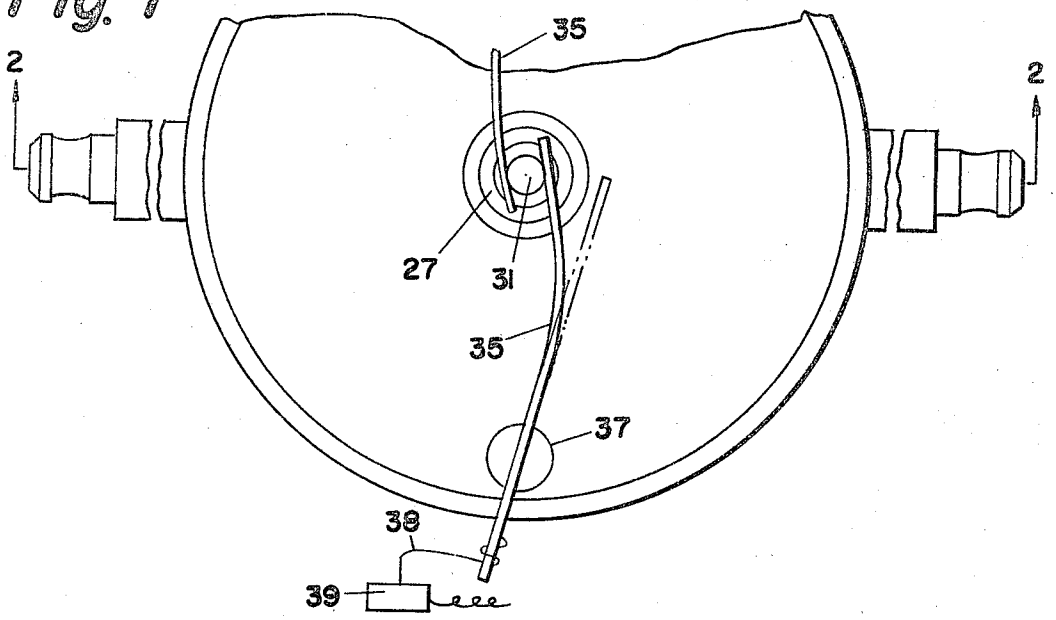
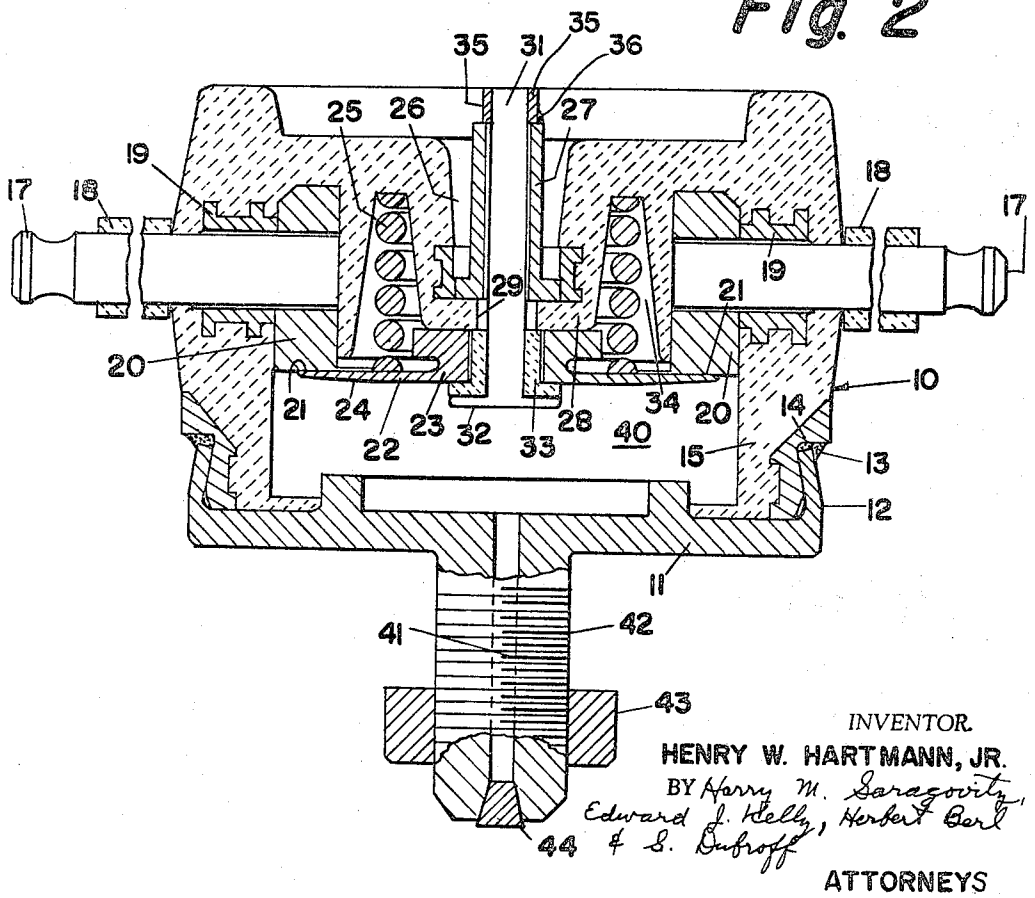


Fig. 2



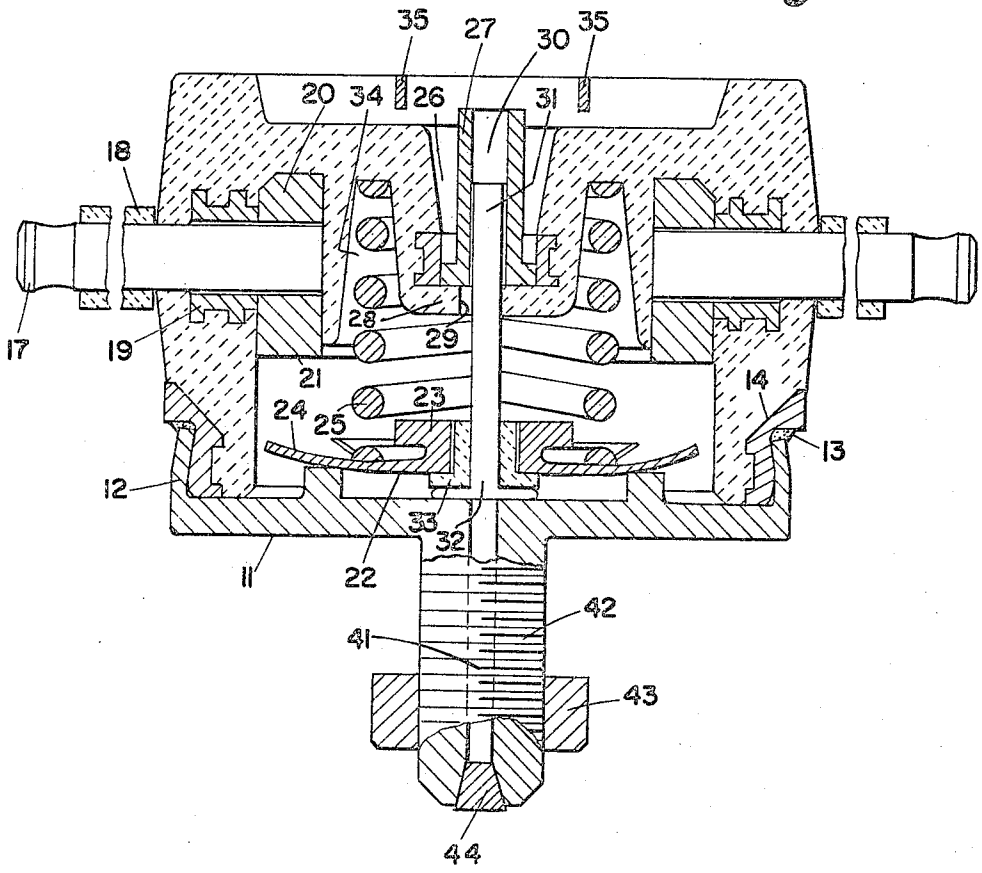
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Fig. 3



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THERMAL FUZE

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14 Claims. (Cl. 102—70.2)

The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment to me of any royalty thereon.

This invention relates to fuzes and, more particularly, to a fuze for protection against premature arming or detonating of a nuclear device during uncontrolled exposure to high temperatures, such as that of a warehouse fire.

One of the objects of the invention is to provide a thermal fuze having means for actuating a nuclear device which is automatically rendered ineffective at predetermined high temperature environments.

Another object of the invention is to provide such a fuze with an electrically separate but mechanically interlocked monitoring circuit capable of readily indicating the condition of the actuating means.

A further object of the invention is to provide a thermal fuze having high sensibility to external temperature combined with insensitivity to internally liberated heat.

Another object of the invention is to provide such a fuze having an internal chamber inherently resistant to out-gassing vapors.

A further object of the invention is to provide a temperature sensitive electrical fuze that is resistant to contact chatter when subjected to powerful vibration or mechanical shock.

A further object of the invention is to provide a thermal fuze of high inherent reliability.

In one aspect of the invention a thermal fuze includes separate terminals in one electric circuit that are normally connected by a switch means, a monitoring spring in an electrically separate monitoring circuit and releasably connected to the switch means, and means for opening the switch means upon disconnection of the monitoring spring therefrom.

In another aspect of the invention the fuze includes a housing having a shell portion of electrically non-conductive material in which the terminals are mounted, the switch means includes an apertured disk, and a reduced portion of a headed elongated member extends through both the apertured disk and a shell opening with the reduced portion free end positioned exteriorly of the housing and fused to an end of the monitoring spring so that the head is urged toward the disk in opposition to a biasing means.

In further aspects of the invention the electrically conductive disk and terminal elements within the housing are substantially isolated from the fusing media by ceramic material, and the disk includes a central hub section and a plurality of radially extending cantilevered leaf-spring tabs that normally electrically connect with the terminals.

These and other aspects, features and advantages will become apparent from the following description and accompanying drawings in which:

FIG. 1 is a top plan view of the thermal fuze constructed in accordance with the principles of the invention;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1 with the parts in position to establish electrical continuity across the terminals; and

FIG. 3 is a view similar to FIG. 2 with the electrical continuity interrupted.

The housing, shown generally at **10**, preferably includes a brass base **11** having a peripheral upstanding annulus **12** the upper portion of which is crimped inwardly and solder connected at **13** to an appropriately flanged annular

metal ring **14** which is molded in the lower portion of an inverted substantially cup-like ceramic shell **15**. The shell **15** is provided with suitable openings, preferably diametrically opposed, for reception of copper terminals **17, 17**, the outer ends of which protrude from insulating sleeves **18, 18** in position for respective connections to a source of electrical power (not shown) and nuclear weapon arming or detonating media (also not shown) adapted to be actuated thereby. The walls of the shell openings each include a terminal seal **19** positioned adjacent one of a pair of split or physically separate conducting ring portions **20, 20**. The ring portions are molded into the electrically non-conductive ceramic shell **15**, as are the terminal seals **19**, in such a manner as to preclude normal electrical conductivity between the ring portions. The lower surface of each ring portion **20** is crowned at **21** and plated with silver to enhance contact conductance with a switch means **22** for establishing current flow across the terminals **17, 17** under predetermined normal temperature conditions.

The switch **22** preferably is in the nature of a formed copper disk having a suitably apertured central hub portion **23** and a plurality of split cantilevered leaf-spring tabs **24** extending radially therefrom. Each of the spaced tabs **24** is normally upwardly curved (FIG. 3) from the central hub and extends outwardly a distance sufficient to underlie and make a firm contact with the annular crown **21** when the disk is positioned in its uppermost extremity (FIG. 2) against the force of biasing helical spring **25**. The top of shell **15** extends across the fuze body and the central portion thereof is offset downwardly to form recess **26** in which a hollow substantially cylindrical member **27** is positioned in an appropriately sealed manner. The bottom wall **28** of the recess has a central opening **29** vertically aligned with the guide cylinder bore **30** for upward reception of the reduced portion **31** of a headed elongated copper member or nail **32**. A ceramic eyelet or flanged bushing **33** telescopes the nail with its lower flange supported on the upper surface of the nail head. The eyelet engages the ceramic shell offset to electrically insulate or separate the nail and disk when they are in their FIG. 2 elevated position.

Ths undersurface of the shell top is provided with an elongated recess **34** surrounding the offset and in which is seated one end of the spring **25**. The recess **34** is properly dimensioned to receive the spring with a relatively close-fit tolerance to preclude slippage of coils past one another should the spring rupture. The other end of the spring exerts a downward force against the disk tabs **24** to positively move the tabs away from the crown when any force opposing the spring has been removed.

To the free end of the nail reduced portion, innermost ends of a pair of transversely extending monitoring springs **35** (FIG. 1) are solder connected by a fusible alloy **36**, which melts at a predetermined temperature environment, the connection serving to urge or hold the nail head and switch upwardly against the force of the compressed spring **25** (FIG. 2). Preferably, the normally straight monitoring springs **35** are connected in a bowed or curved position between the releasable or meltable fusion connection and respective anchoring brass inserts **37** located at diametrically opposed edges of the shell top. The insert ends of the monitoring springs serve as terminals for electrical wires **38, 38** to complete an electrically separate monitoring circuit which may include any form of indicating means such as lamp **39** to denote the breaking of the circuit simultaneously with the opening of switch **22** in the first nuclear actuation circuit when the fused connection **36** melts to release the nail **32** and springs **35, 35**. Of course, visual observance of springs **35** will render the same function in ascertaining when the selected, highly sensitive, fusible alloy has experienced an unsatisfactorily high temperature. The monitoring springs

35 also act as fins to assist the fusion alloy in sensing outside temperature deviations.

The electrically conductive disk 22 and terminal elements within the housing are substantially isolated from the sensitive fusible alloy by the ceramic materials in the shell top and eyelet 33. This minimizes the influence of any heat generated internally from the electric current on the triggering of the thermal fuze.

The hermetically sealed fuze chamber 40 preferably is evacuated via a small elongated hole 41 drilled through the center of the threaded stud 42 of the base 11. A nut or securing means 43 having sufficient thread-length permits attachment to a unit for purging and pressurizing the chamber 40 with an inert, dry gas prior to plugging or wedging the hole 41 with a small tapered metal pin 44 which may be further sealed in position with solder.

The actuating temperature of the thermal fuze can be readily altered by employing fusible alloys from a variety having selective melting temperatures.

Various changes, alterations or modifications may be resorted to without departing from the scope of the invention as defined in the appended claims.

I claim:

1. In a temperature sensitive electrical fuze having a housing with a shell portion of electrically non-conductive material.

separate terminals mounted in said shell portion,

means including an apertured disk normally connecting said terminals in a first electrical circuit,

a headed elongated member having its reduced portion extending through both said apertured disk and an opening in said shell,

a monitoring spring in an electrically separate monitoring circuit,

means fusing said spring to said elongated member and urging the head of said elongated member toward said disk, and

means biasing said disk toward said head in opposition to said urging means,

so constructed and arranged that when the fusing means experiences a predetermined temperature environment it will melt and said biasing means will move said disk and head away from said terminals to break electrical continuity therebetween.

2. The structure of claim 1 wherein said spring is fused to said elongated member reduced portion.

3. The structure of claim 1 in which said reduced portion has its free end positioned exteriorly of said housing, and said spring being fused to said elongated member free end.

4. The structure of claim 1 wherein said disk and separate terminals within said housing are substantially isolated from said fusion means by ceramic material.

5. The arrangement of claim 1 in which said housing defines an hermetically sealed chamber containing said disk, and said housing has apertured means for releasing vapors from within said chamber.

6. The fuze as defined in claim 1 wherein said disk is provided with a central hub section and a plurality of radially extending tabs that normally electrically connect with said terminals.

7. The fuze of claim 1 in which a ceramic eyelet is positioned intermediate said disk and elongated member.

8. The fuze of claim 1 wherein said biasing means comprises a helical spring having one end seated with a close fit in an elongated recess formed in said shell portion and the other end engaging said disk.

9. A thermal fuze for protecting nuclear weapons against premature arming and detonation during uncontrolled exposure to fire comprising,

a housing for a fuze and including a shell portion of electrically non-conductive material,

separate terminals mounted in said shell portion for connection respectively to a source of electrical power and nuclear weapon arming or detonating media adapted to be actuated thereby,

means normally connecting said terminals in a first electrical circuit for electrical continuity therebetween including an apertured disk of electrically conductive material,

a headed elongated member having its reduced portion extending through both said apertured disk and an opening in said shell, said reduced portion having its free end positioned exteriorily of said housing,

a monitoring spring in an electrically separate monitoring circuit and extending transversely of said elongated member,

means fusing an end of said spring to said free end of said elongated member and urging the head of said elongated member toward said disk, and

means biasing said disk toward said head in opposition to said urging means,

so constructed and arranged that when the fusing means experiences a predetermined temperature environment it will melt and said biasing means will move said disk and head away from said terminals to break electrical continuity therebetween.

10. A thermal fuze in accordance with claim 9 wherein the electrically conductive disk and terminal elements within said housing are substantially isolated from said fusion means by ceramic material.

11. A thermal fuze in accordance with claim 9 in which said housing defines an hermetically sealed chamber containing said disk, and said housing has apertured means for releasing vapors from within said chamber.

12. A thermal fuze as defined in claim 9 wherein said disk is provided with a central hub section and a plurality of radially extending cantilevered leaf-spring tabs which normally electrically connect with said terminals.

13. A thermal fuze as defined in claim 9 in which a ceramic eyelet is positioned intermediate said disk and elongated member.

14. A thermal fuze in accordance with claim 9 wherein said biasing means comprises a helical spring having one end seated with a close fit in an elongated recess formed in said shell portion and the other end engaging said disk.

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