Sept. 25, 1956 W. OTTO 2,764,026

THERMAL FUSE

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Fig. 1

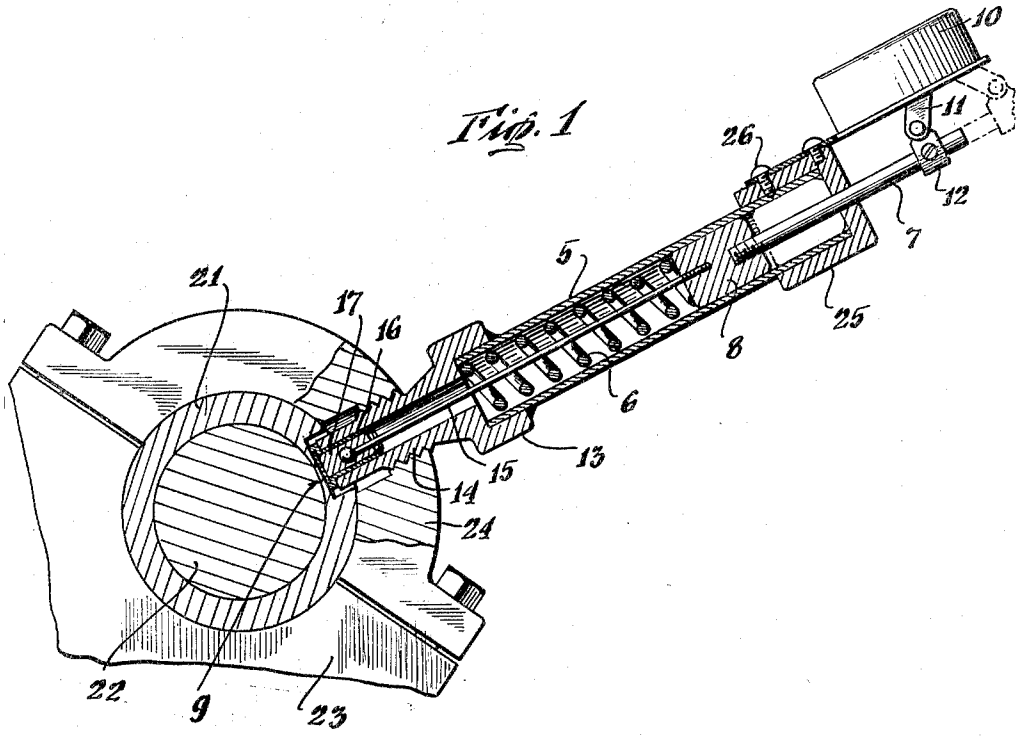
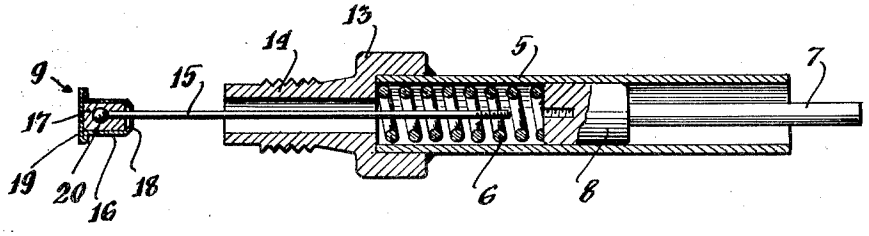


Fig. 2



INVENTOR.
Walter Otto
BY Kane, Dalsimer and Kane
ATTORNEYS

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Fig. 3

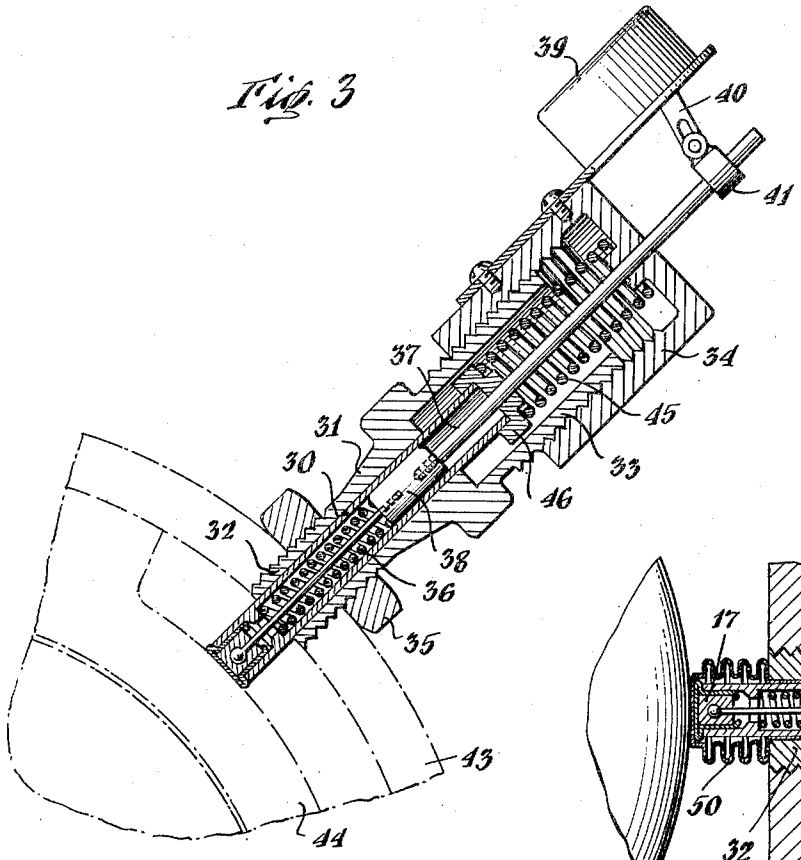


Fig. 5

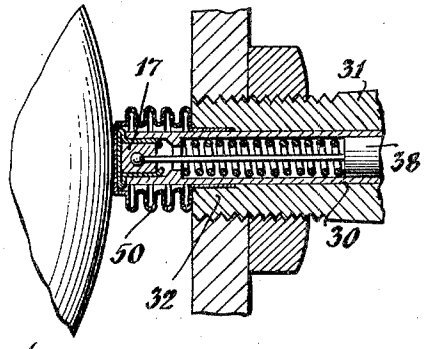
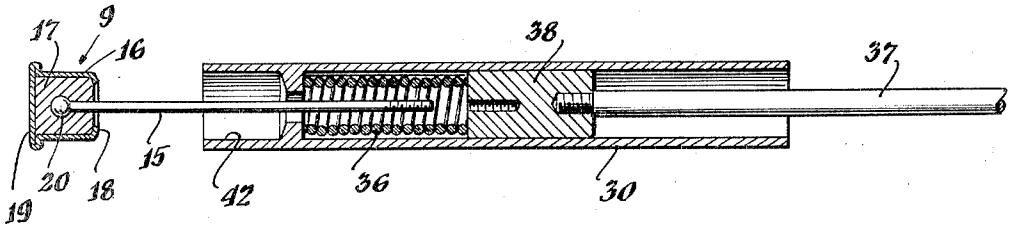


Fig. 4



INVENTOR
Walter Otto
BY Kane, Dalsimer and Kane
ATTORNEYS

United States Patent Office 2,764,026 Patented Sept. 25, 1956

2,764,026

THERMAL FUSE

Walter Otto, Forest Hills, N. Y.

Application January 7, 1954, Serial No. 402,617

3 Claims. (Cl. 74—2)

This invention relates to an improved thermal fuse of the type which will operate as a safety device or control to indicate or prevent the overheating of various types of apparatus or to initiate the operation of other apparatus.

The present invention is an improvement upon that shown in my copending application Serial No. 367,864, filed July 14, 1953. In my copending application, I disclose a thermal fuse having a unit for storing energy such as a compressed spring. Cooperating with the energy storing unit is an actuating member which is normally restrained against movement by a fusible connection or link. When the apparatus to which the thermal fuse is applied reaches a predetermined temperature it causes the fusible connection to fuse, releasing the actuating member so that it can actuate a warning signal, switch, valve or other mechanism. In my prior apparatus consideration of working conditions requiring the fuse to be impermeable to vapors and liquids at higher pressures and temperatures give it a form which makes resetting, after the fusible connection has been fused and the actuating mechanism released, a time consuming operation.

One of the objects of the present invention is to provide an improved thermal fuse of the above type having a readily replaceable fusible link or connection made cheaply available and universally applicable in a wide range of fuse temperatures so that after the apparatus has been thermally released it can be readily reset and the old fusible link or connection replaced with a new one where impermeability to vapors and liquids is not required. Where such impermeability to vapors and liquids is a requirement but at lower pressures and temperatures it is an object of the present invention to permit use of the improved and readily replaceable fusible link or connection by sealing it with a cylindrical bellows and without lowering heat conductivity appreciably or impeding direct thermal contact with the portion of the equipment to be controlled.

Other objects include the provision of a thermal fuse which is positive in operation, which is relatively simple in design and construction, which can be readily applied to the apparatus controlled thereby and in which the fusible link or connection can be readily replaced after it has been thermally released with a wide choice of fusing temperature, changes from one to another requiring no alteration or adjustments of the apparatus.

In the accompanying drawings—

Fig. 1 is a longitudinal sectional view of one form of thermal fuse embodying my invention showing it as applied to a bearing so as to be actuated when the bearing reaches a predetermined temperature;

Fig. 2 is a longitudinal sectional view of the fuse in partially disassembled condition and showing a new fusible connection being assembled therewith;

Fig. 3 is a longitudinal sectional view of a modified form of thermal fuse embodying my invention showing it as applied to an electric motor so as to be actuated when the motor reaches a predetermined temperature;

Fig. 4 is a longitudinal sectional view of the modified fuse in partially disassembled condition and showing a new fusible connection being assembled therewith; and

Fig. 5 is a longitudinal sectional view of the inner end of the thermal fuse showing a cylindrical bellows applied over the end thereof.

In the accompanying drawings, I have shown two specific embodiments of my invention applied to two specific types of equipment with which the thermal fuses may be employed. It should be understood, however, that it is within the spirit of this invention that it may be embodied in many different forms and that the thermal fuses may be used with many different types of equipment and apparatus for the purpose of indicating when the apparatus has reached a predetermined temperature or for the purpose of initiating other operations.

Referring specifically to Figs. 1 and 2 my improved thermal fuse includes a tubular casing **5** in which is housed an energy storing member in the form of helical spring **6**, which is normally partially compressed as shown and which serves to shift the operating member in the form of rod **7** and piston **8** when the fusible connection indicated generally at **9** fuses and releases.

The actuating rod **7** is suitably connected to the piston or slide **8** as by being threaded thereto. The actuating rod is also connected to suitable mechanism such as switch **10** so as to cause the operation thereof. Thus, it may be connected to link **11** by means of an adjustable collar **12**. In normal position the actuating rod and link **11** assume the position shown in full lines in Fig. 1. When the fusible connection fuses and releases they assume the position shown in dotted lines thereby causing the operation of switch **10** which, in turn, may control the operation of a motor, valve, relay or other apparatus. The actuating rod **7** may, if desired, have a direct connection with mechanical apparatus such as a valve to cause the operation thereof without the intervention of switches, relays, etc.

The inner end of the tubular casing **5** is suitably connected, as by welding, into an enlarged recess formed in the outer end of the tubular fitting or adapter **13**. The inner end of the tubular fitting is in the form of a threaded nipple **14** so that the thermal fuse may be connected to the apparatus which it is to control.

The fusible connection assembly is a pre-assembled unit and takes the form of a plug or cap **9** for the inner end of the fitting **13** and connected by connecting rod **15** to the piston **8**. For this purpose the outer end of the connecting rod may be threaded and the piston formed with a threaded opening to receive it. The cap or plug may take the form of a metallic housing or shell **16** having a relatively high melting or fusing point filled with a relatively low fusing metal **17**. The housing or casing **16** has a cylindrical portion with a relatively low fusing metal **17**. The housing or casing **16** has a cylindrical portion with a relatively constricted opening at the inner end **18** thereof. The outer end is formed with an integral flanged cap **19**. Embedded in the fuse metal **17** is the relatively enlarged inner end **20** of connecting rod **15**. The fuse metal may be formed of a metal which will melt at the desired predetermined temperature. Thus, tin or alloys of tin or lead may be employed where it is desired to have the connection melt at a low temperature. Lead or alloys of tin and antimony should be used where it is desired to have the connection melt at medium temperatures and silver solder may be employed where it is desired to have the connection melt or fuse at higher temperatures. It should be understood, however, that thermoplastic materials may be employed for forming the connection instead of metal solder.

In Fig. 1, I have shown the thermal fuse assembly applied to a bearing **21** so as to be operated when the bearing reaches a predetermined temperature. A shaft **22** is

journaled in the bearing and a frame 23 and bracket 24 serve to support the bearing. The bracket, and preferably a portion of the bearing, are drilled as shown and the outer end of the aperture in the bracket is tapped to receive the threaded nipple 14. The thermal fuse is applied in place wih the flanged end 19 of the fusible connection in contact with the surface at the base of the aperture in the bearing so as to be immediately responsive to any changes in temperature in the shaft and bearing. Switch 10 may be connected to the mechanism for operating shaft 22 so as to stop the operation of the shaft when the thermal fuse is released. If preferred, it may be connected to signaling mechanism or to other apparatus for giving a warning or for initiating other operations.

When the apparatus is assembled in the manner shown, the spring 6 is partially compressed and is held in that position by connecting rod 15 extending between the slide or piston 8 and the fuse metal cap or plug. When thus constrained the switch is in the position shown in full lines in Fig. 1. When the bearing and shaft reach a predetermined temperature the fuse metal is fused causing the connecting rod to release therefrom under the force exerted by spring 6. The spring thus shifts the actuating rod outwardly to the position shown in dotted lines causing the actuation of the switch 10.

After the thermal fuse has thus been released and operated it may be reset in a quick and simple manner by replacing the fusible connection assembly 9 in the manner shown in Fig. 2. Thus, the cap 25 which supports switch 10 is released from the end of the casing 5 by loosening set screws 26 and the apparatus is disassembled from the bearing. The expended fusible connection is removed and is replaced by a new assembly as shown in Fig. 2. The new assembly consists of the connecting rod 15 having its enlarged inner end embedded in the plug of fuse metal 17 inside the metallic housing. In applying the fusible connection assembly to the thermal fuse the actuating rod 7 is shifted inwardly in the casing 5 beyond its normal position so the connecting rod can be inserted through fitting 13, casing 5, spring 6 into engagement with the threaded aperture in the slide 8. When it has been tightly threaded in place the actuating rod 7 is released so that the plug 9 is tightly engaged in the end of fitting 13. The cap and switch assembly is then applied to the outer end and the thermal fuse is ready to be re-applied to the bearing or other apparatus.

It will be understood that the fused expended fusible connection assembly can be re-assembled by heating the fused metal and adding any additional metal that may be required with the head 20 of the connecting rod embedded therein. It will also be understood that spare thermal fuses may be maintained in stock for immediate replacement while the expended fuse is being re-assembled.

In Fig. 3, I have shown a modification of my invention in which the casing 30 is encased for the greater portion of its length in the housing-like tubular fitting 31 which has a threaded nipple 32 whereby the fuse may be applied to the equipment to be controlled and also a threaded, outer end 33 for receiving the cap 34. A lock nut 35 may be applied to the threaded nipple 32 as shown which when tightened secures the thermal fuse against accidental release by vibration or other causes. Housed inside of casing 30 is the helical spring 36 which in normal operating position is partially compressed as shown and engages against the actuating mechanism which takes the form of actuating rod 37 having threaded engagement with the slide or piston 38. The outer end of the actuating rod serves to operate the switch 39 and is connected thereto by means of link 40 and adjustable collar 41. The switch 39 as shown is mounted on the threaded cap 34.

When the apparatus is in the position shown in Fig. 3 the switch is inoperative. When the thermal connection fuses and releases, spring 36 shifts the slide 38 and

actuates rod 37 outwardly, pivoting link 40 outwardly and causing the operation of switch 39.

The fusible connection is similar to that shown in Figs. 1 and 2 and is in the form of a pre-assembled unit 9 consisting of connecting rod 15 having an enlarged head 20 embedded in the fuse metal 17 inside the casing 16. The casing, in turn, has a restricted opening at its outer end 18 and a flanged closure at its inner end 19. The fuse metal and casing form a cap or plug which fits snugly into the chamber 42 in the inner end of casing 30 and the connecting rod 15 has threaded connection with the slide 38 so as to hold helical spring 36 in partially compressed position.

The thermal fuse, as illustrated, is applied to an electric motor shown in dotted lines. The housing of the motor shown at 43 is drilled and tapped so as to receive the threaded nipple 32 and the inner end of the fusible connection assembly engages the stator 44 of the motor so as to be responsive to changes in the temperature thereof.

In order to insure good engagement and direct thermal conduction between the stator and the fusible connection, I preferably provide a helical spring 45 inside of cap 34 and concentric with the actuating rod. The spring extends between the outer end of the cap and a follower 46 engaging the end of casing 30. The force exerted by the spring can be varied by adjusting the position of cap 34. It is normally adjusted so as to insure direct thermal contact between the fusible connection assembly and the portion of the equipment whose temperature is to be controlled.

The fusible connection assembly may be readily replaced in the modified form of thermal fuse as shown in Fig. 4. Thus, the fuse is disassembled and the whole fusible connection is removed. Actuating rod 37 is shifted inwardly beyond its normal operating position and a new fusible connection assembly is applied thereto by first inserting the connecting rod 15 through the casing and spring 36 into threaded engagement with slide or piston 38. The actuating rod is then released and the plug of fuse metal and its casing are tightly engaged in the chamber 42 of casing 30.

In Fig. 5, I have shown a modification of the thermal fuse shown in Figs. 3 and 4 in which a cylindrical metallic bellows 50 closed at one end in the form of a cap is applied over the fusible connection assembly and the adjacent portion of the casing and is brazed to fitting 31 to form a sealing connection. This arrangement makes the inner end of the thermal fuse liquid tight so that it can be used in boilers and the like to indicate or control the temperature thereof. The bellows will efficiently transfer the heat from the contacted surface to the fusible connection. It also allows for thermal expansion and contraction without destroying the seal.

It will thus be seen that I have provided an improved thermal fuse having a readily replaceable fusible link or connection so that after the thermal fuse has been released it can be readily reset and the old fusible link or connection replaced with a new one.

It will also be seen that the thermal fuse is positive in operation, relatively simple in design and construction, and can be readily applied to the apparatus to be controlled thereby.

Modifications, may of course be made in the illustrated and described embodiments of my invention without departing from the invention as set forth in the accompanying claims.

I claim:

1. A thermal fuse comprising: means providing an elongated tubular casing open at its inner end; an actuating member mounted in said casing and shiftable between a normal inactive position and a released actuating position; energy storing means in the form of a spring disposed in said casing in operative relation to said actuating member to exert force upon it when in its normal in-

active position to shift it to its released actuating position; a replaceable pre-assembled fusible connection assembly removably applied to said open inner end of the casing and having a plug-like fusible portion removably fitted into the end of the casing and a connecting rod embedded at one end in the fusible portion and having separable threaded connection with the actuating member adjacent its opposite end whereby said actuating member is normally held in inactive position but is released when said fusible portion melts; a tubular support with an open inner end disposed around the tubular casing; spring means between the support and the casing so as to urge the casing towards the open end of the support; and a tubular bellows closed at its outer end having sealing engagement with the open inner end of the tubular support and encasing the replaceable fusible connection assembly and the inner end of the casing and providing for limited movement thereof with respect to the tubular support.

2. A thermal fuse comprising: an elongated tubular casing open at its inner end; an actuating member mounted in said casing and shiftable between a normal inactive position and a released actuating position; energy storing means including a spring disposed in said casing in operative relation to said actuating member to exert force upon it when in its normal inactive position to shift it to its released actuating position; a replaceable pre-assembled fusible connection assembly comprising a hollow plug removably fitted into the open end of the casing and having means limiting the amount of insection of the plug therein, a fusible mass in said hollow plug and a connecting rod embedded in said fusible mass at one end and having separable threaded connection adjacent its opposite end with the actuating member whereby said actuating member is normally held in inactive position but is released when said fusible mass melts; a tubular support with an open inner end disposed around the tubular casing; spring means between the support and the casing so as to urge the casing towards the open end

of the support; and a tubular bellows closed at its outer end having sealing engagement with the open inner end of the tubular support and encasing the replaceable fusible connection assembly and the inner end of the casing and providing for limited movement thereof with respect to the tubular support.

3. A thermal fuse operating in response to the increase in temperature of apparatus of the type having a casing and a heated wall which are relatively shiftable under thermal expansion and contraction, said thermal fuse comprising: a support cooperable to be fixedly mounted on the casing of the apparatus; thermally responsive means carried by said support and shiftable relative thereto and cooperable to thermally engage the wall of the apparatus, said thermally responsive means including actuating mechanism disposed in a normal inactivated position under normal operating temperatures and being shiftable to an activated position when a predetermined elevated temperature is reached; force applying means operatively connected to the thermally responsive means so as to bias it into thermal engagement with the wall of the apparatus; separate force applying means operatively connected to the actuating mechanism for shifting the actuating mechanism into activated position when said predetermined elevated temperature is reached; and an impervious longitudinally expandable cap encasing the end of the thermally responsive means which engages the wall of the apparatus, said cap having sealing engagement with the support.

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