

June 16, 1942.

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2,286,340

ELECTRIC THERMAL SWITCH

Filed Sept. 12, 1938

FIG. 1.

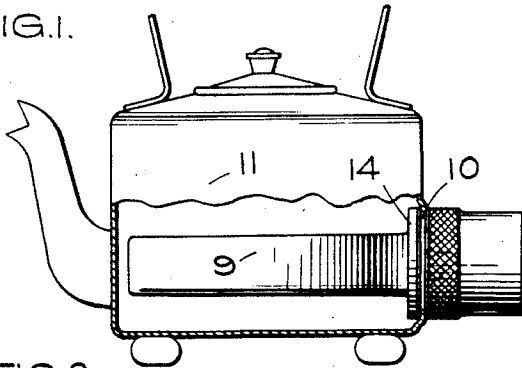


FIG. 4.

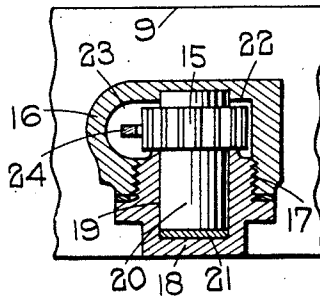


FIG. 2.

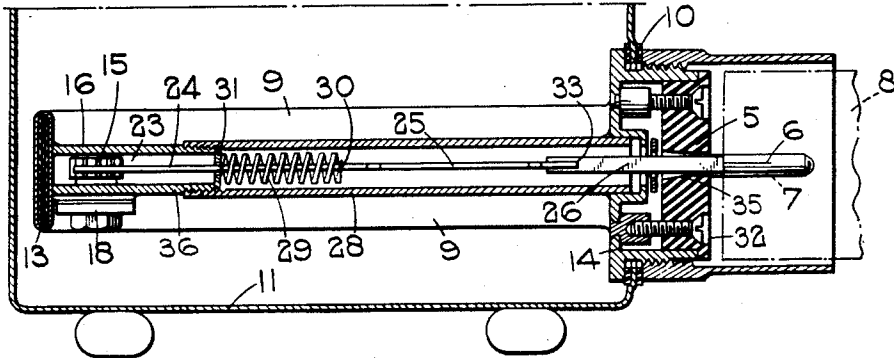
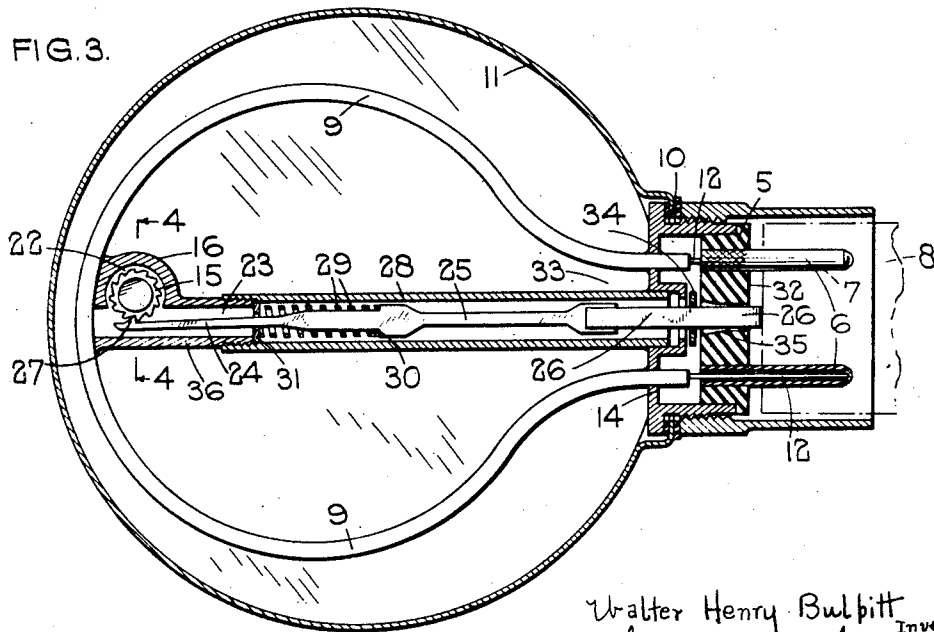


FIG. 3.



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2,286,340

ELECTRIC THERMAL SWITCH

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Application September 12, 1938, Serial No. 229,625
In Great Britain November 18, 1937

14 Claims. (Cl. 219—38)

This invention relates to electric switches incorporating a safety device which is normally held in a set position by means of fusible metal, said metal melting at a predetermined temperature so as to trip said device, which then operates to break the circuit associated with the switch.

The invention has particular reference to thermal switches of the type in which the safety device comprises an actuating member for the switch, a spring tending to move said member in a manner to separate the switch contacts, a ratchet wheel normally held against rotation by said fusible metal, and a pawl co-operating with said ratchet wheel, said pawl being connected with said actuating member so that the latter is maintained in its retracted position until melting of the fusible metal releases said ratchet wheel.

The chief object of the present invention is to provide an improved construction of thermal switch which is particularly suitable for use in connection with immersion heaters.

Referring to the drawing:

Figure 1 is a side elevation of a kettle provided with an immersion heater embodying the present invention.

Figures 2 and 3 are, respectively, a sectional side elevation, and a plan view of the lower part of the kettle shown in Figure 1, and are drawn to an enlarged scale.

Figure 4 is a section on the line 4—4 of Figure 3.

In the construction of thermal switch illustrated in the drawing, the switch proper is constituted by a two-part coupling, which may be a plug-and-socket coupling of known form, that is to say, it may comprise a stationary part 5 carrying contact pins 6 which co-operate with conducting sockets 7 in the movable part 8 of the coupling.

An appliance, such as an immersion heater 9 which requires to be protected against overheating, is connected across the contacts on one part of the coupling (for example, the pins 6 on the stationary part 5), which latter may be secured in an opening 10 in the wall of a kettle 11 or other vessel containing liquid to be heated. The contacts of the other coupling part 8 are connected to supply leads so that the circuit through the appliance is completed when the two parts 5, 8 of the coupling are brought together.

Associated with the two-part coupling is a safety device placed in such a position as to be subjected to a temperature which is at least that of

the immersion heater 9 or other appliance to be protected.

In the construction illustrated, the loop-shaped body of the heater 9 is of tubular metallic construction and contains a resistance wire 12 which may be wound upon a mica strip 13 or other suitable support, the ends of the wire 12 being connected to the contact pins 6. The tube forming the body aforesaid is seamless and has a flat section whose major dimension is substantially perpendicular to the plane of the loop. It will be seen that the loop is of incomplete circular shape, the terminal portions of the body being turned outwardly into substantially parallel relationship and secured to the inner end of a hollow metal plug 14 which is mounted in the opening 10 aforesaid in the vessel wall.

With an immersion heater of this type, the safety device aforesaid is preferably arranged as described in our co-pending application Serial No. 229,623 filed September 12, 1938, being mounted directly upon the body of the heater 9 at a position on the loop substantially opposite to the connection of the terminal portions of such body to the plug 14, which carries the stationary part 5 of the coupling.

The safety device includes a ratchet wheel 15 mounted in a housing 16 which is secured by soldering or otherwise in direct metallic contact with the body of the heater 9. The ratchet wheel 15 may be inserted into the housing 16 through an opening 17 in one side of the latter, and this opening 17 may be closed by a screwed plug 18 having in its inner end a central socket 19 adapted to receive a short co-axial stem 20 formed on or fixedly united with the wheel 15. The socket 19 contains a mass 21 of fusible metal, such as solder, which normally prevents rotation of the ratchet wheel 15 in its housing 16.

The ratchet wheel housing 16 is conveniently formed as a metal plug having a drum-shaped cavity 22 which accommodates the wheel 15 itself, and a tangential passage 23 which breaks through the wall of the cavity 22 aforesaid. This passage 23 is open at its inner end, into which projects one extremity 24 of a push-rod 25 whose other end 26 projects through a hole 35 in the stationary part 5 of the coupling. When the part 5 is provided with two contact pins 6 as shown, the end 26 of the push-rod 25 may be arranged mid-way between these.

The end 24 of the push-rod 25 adjacent the ratchet wheel 15 has a hooked portion 27 which acts upon the teeth of the wheel 15 in the manner of a pawl.

The push-rod 25 is enclosed in a tube 28 which is suitably secured to the ratchet wheel housing 16 and to the metal plug 14 carrying the coupling part 5. This tube 28 may be of circular section and may have a screwed connection with a projecting cylindrical neck 36 on the housing 16, this neck 36 being co-axial with the tangential passage 23 aforesaid. It will be appreciated that, in the case of the immersion heater shown, this tube 28 protects the push-rod 25 and associated parts from contact with the liquid in the vessel 11.

The tube 28 aforesaid is of greater cross-section than the push-rod 25 and may be contracted at a position intermediate its ends so as to provide a bearing for the push-rod 25, which bearing may be of substantial length.

A helical coil spring 29 threaded over the push-rod 25 is engaged between a shoulder 30 on the latter and the end of the housing neck 36 or a washer 31 abutting such neck. The effect of this spring 29 is to urge the push-rod 25 along the tube 28 towards the movable part 8 of the coupling.

The length of the push-rod 25 is such that when the spring 29 is compressed, the end 26 of the push-rod is flush with the face 32 of the stationary coupling part 5, or only projects slightly therefrom so that it does not prevent the two parts 5, 8, of the coupling from being connected together.

In this position of the push-rod 25, the hook or pawl portion 27 at its other end engages with a tooth of the ratchet wheel 15, and as the latter is prevented from rotating by the fusible metal 21, the device is maintained in this set position.

To allow the length of the push-rod 25 to be adjusted, the latter may be formed in two aligned parts which screw into a connecting sleeve, and the end of this sleeve may form the shoulder aforesaid against which the spring 29 acts.

In operation, when the heater 9 or other appliance associated with the safety device reaches an excessive temperature, the fusible metal 21 melts and allows the ratchet wheel 15 to rotate due to the action of the spring 29 on the push-rod 25. This allows the hook or pawl portion 27 at the end 24 of the push-rod 25 to slip past the tooth of the ratchet wheel 15 which it has been engaging, and the spring 29 then acts to project the other end 26 of the push-rod 25 through the stationary part 5 of the coupling, so that the movable coupling part 8 is forced out of engagement with the contact members 7 on the stationary part 5 and the circuit is broken. The longitudinal movement of the push-rod 25 may be limited by engagement of a second shoulder 33 thereon with a washer 34 through which the end part 26 of the push-rod passes, and which abuts against the coupling part 5.

To re-set the device, the push-rod 25 is simply forced inwards against the action of the spring 29 until the hook or pawl portion 27 aforesaid engages behind the next tooth on the ratchet wheel 15. There is no necessity, as in some types of safety device, to effect this re-setting movement whilst the fusible metal is still fluid.

To facilitate the re-engagement of the hook or pawl 27 with the teeth of the ratchet wheel 15, its end face may be rounded or bevelled, and the terminal portion 24 of the push-rod 25 is allowed considerable clearance in the passage 23 in the ratchet wheel housing 16, so that it can deflect laterally before snapping into engagement with the ratchet tooth. To increase

its resilience, this terminal portion 24 of the push-rod 25 may be reduced in cross-section.

It will be understood that, instead of forming the pawl 27 as part of the push-rod 25, it may be constructed as a separate spring detent attached thereto.

What I claim then is:

1. An electrical thermal switch comprising two coupling members one of which carries contact pins normally in engagement with sockets on the other member, a push-rod extending through one of said coupling members centrally of and parallel to said contact pins and engaging the other of said members, a spring urging said push-rod longitudinally in a direction to separate said coupling members, a pawl connected to said push-rod, a ratchet wheel co-operating with said pawl a downwardly projecting cylindrical stem on said ratchet wheel, a socket in which said stem is disposed, the cylindrical surface of said stem engaging the corresponding wall of the socket and being centralised thereby, and a mass of fusible metal disposed between the bottom of the socket and the end of the stem, said metal being adapted when solid to prevent rotation of said ratchet wheel, whereby said ratchet wheel is enabled to hold said push-rod in an inoperative position against the action of said spring, said fusible metal being adapted to melt at a predetermined temperature, so that said coupling members are separated by the resultant movement of said push-rod.

2. An electrical thermal switch comprising a pair of coupling members one of which carries contact pins normally in engagement with sockets in the other member, a push-rod extending through one of said coupling members midway between and parallel to said contact pins and engaging the other of said members, a spring urging said push-rod longitudinally in a direction to separate said contact pins from said sockets, a pawl connected to said push-rod, a ratchet wheel co-operating with said pawl a downwardly projecting cylindrical stem on said ratchet wheel, a socket in which said stem is disposed, the cylindrical surface of said stem engaging the corresponding wall of the socket and being centralised thereby, a mass of fusible metal disposed between the bottom of the socket and the end of the stem, said metal being adapted when solid to prevent rotation of said ratchet wheel, whereby said ratchet wheel is enabled to hold said push-rod in an inoperative position against the action of said spring, said fusible metal being adapted to melt at a predetermined temperature so that said coupling members are separated by the resultant movement of said push-rod, and a tube enclosing said push-rod and said spring.

3. An electrical thermal switch comprising two coupling members one of which carries contact pins normally in engagement with sockets on the other member, a push-rod extending through one of said coupling members centrally of and parallel to said contact pins and engaging the other of said members, a spring urging said push-rod longitudinally in a direction to separate said coupling members, a tube enclosing said push-rod and said spring, a pawl connected to said push-rod, a ratchet wheel, a housing for said ratchet wheel, said pawl extending into said housing and co-operating with said ratchet wheel, a downwardly projecting cylindrical stem on said ratchet wheel, a socket in which said stem is disposed, the cylindrical surface of said stem engaging the corresponding wall of the

socket and being centralised thereby, and a mass of fusible metal disposed between the bottom of the socket and the end of the stem, said metal being disposed within said housing and adapted when solid to prevent rotation of said ratchet wheel, whereby said ratchet wheel is enabled to hold said push-rod in an operative position against the action of said spring, said fusible metal being adapted to melt at a predetermined temperature so that said coupling members are separated by the resultant movement of said push-rod.

4. An electrical thermal switch comprising two coupling members one of which carries contact pins normally in engagement with sockets on the other member, a push-rod extending through one of said coupling members centrally of and parallel to said contact pins and engaging the other of said members, a spring urging said push-rod longitudinally in a direction to separate said coupling members, a pawl connected to said push-rod, a ratchet wheel, a housing for said ratchet wheel, said housing having an opening through which said ratchet wheel is introduced, said pawl extending into said housing and co-operating with said ratchet wheel, a co-axial cylindrical stem on said ratchet wheel, a hollow plug adapted to fill said opening and having a socket therein which receives said stem and engages its cylindrical surface, and a mass of fusible metal adhering within the bottom of said socket and adhering to the end of the stem and adapted when solid to prevent rotation of said ratchet wheel, whereby said ratchet wheel is enabled to hold said push-rod in an inoperative position against the action of said spring, said fusible metal being adapted to melt at a predetermined temperature so that said coupling members are separated by the resultant movement of said push-rod.

5. An electrical thermal switch for controlling an immersion heater, comprising a plug having said heater mounted thereon and adapted to be secured in the wall of the liquid container associated with said heater, contact elements carried by said plug and adapted for engagement with complementary contact elements carried by a movable coupling member to complete the circuit through said heater, a push-rod extending through said plug midway between and parallel to the contact elements associated therewith and engaging said movable coupling member, a spring urging said push-rod longitudinally in a direction to separate the two sets of contact elements, a pawl connected to said push-rod, a ratchet wheel co-operating with said pawl, a mounting for said ratchet wheel attached directly to said heater at a position remote from said plug, and a mass of fusible metal in said mounting adapted when solid to prevent rotation of said ratchet wheel, whereby the latter is enabled to hold said push-rod in an inoperative position against the action of said spring, said fusible metal being adapted to melt at a predetermined temperature so that the two sets of contact elements are separated by the resultant movement of said push-rod.

6. An electric thermal switch for controlling an immersion heater of the looped type, comprising a plug having the ends of the looped heater secured therein and adapted to be mounted in the liquid container associated with said heater, contact elements carried by said plug and adapted for engagement with complementary contact elements carried by a movable coupling member to complete the circuit through

said heater, a push-rod extending through said plug midway between and parallel to the contact elements associated therewith and engaging said movable coupling member, a spring urging said push-rod longitudinally in a direction to separate the two sets of contact elements, a pawl connected to said push-rod, a ratchet wheel co-operating with said pawl, a housing for said ratchet wheel mounted exteriorly of said heater and in direct metallic connection with the same at a position remote from the ends thereof, and a mass of fusible metal disposed within said housing and adapted when solid to prevent rotation of said ratchet wheel whereby the latter is enabled to hold said push-rod in an inoperative position against the action of said spring, said fusible metal being adapted to melt at a predetermined temperature so that the two sets of contact elements are separated by the resultant movement of said push-rod.

7. An electric thermal switch for controlling an immersion heater of the looped type, comprising a plug having the ends of the looped heater secured therein and adapted to be mounted in the liquid container associated with said heater, contact elements carried by said plug and adapted for engagement with complementary contact elements carried by a movable coupling member to complete the circuit through said heater, a push-rod extending through said plug midway between and parallel to the contact elements associated therewith and engaging said movable coupling member, a spring urging said push-rod longitudinally in a direction to separate the two sets of contact elements, a pawl connected to said push-rod, a ratchet wheel co-operating with said pawl, a housing for said ratchet wheel mounted exteriorly of said heater and in direct metallic connection with the same at a position remote from the ends thereof, a tube connected at its ends to said housing and said plug so as to enclose said push-rod and said spring in a liquid tight manner, and a mass of fusible metal disposed within said housing and adapted when solid to prevent rotation of said ratchet wheel whereby the latter is enabled to hold said push-rod in an inoperative position against the action of said spring, said fusible metal being adapted to melt at a predetermined temperature so that the two sets of contact elements are separated by the resultant movement of said push-rod.

8. In a safety appliance for electrically heated apparatus, a metallic base adapted to support a heating element, an insulating member carried by said base, a plunger guidingly supported in said member for reciprocable movement and having a tooth at its innermost end, a spring surrounding said plunger and biasing its movement in an outward direction, a toothed ratchet wheel rotatably mounted in said base, a tooth of said wheel being engageable by the tooth on said plunger when the plunger is depressed against its spring, fusible means normally retaining said wheel against rotation at normal temperatures, but releasing it for rotation at abnormal temperatures, and a circuit plug connector arranged to depress said plunger when moved to circuit-connecting position, and to be moved to circuit-disconnecting position when the plunger is released relative to said wheel.

9. In a safety appliance for electrically heated apparatus, a metallic base adapted to support a heating element, an insulating member carried by said base, an elongated straight plunger guidingly supported in said member for reciprocable

movement and having a single laterally extending tooth at its inner most end, a spring surrounding said plunger and biasing its movement in an outward direction, a toothed ratchet wheel rotatably mounted in said base, a tooth of said wheel being engageable by the tooth on said plunger when the plunger is depressed against its spring, fusible means normally retaining said wheel against rotation at normal temperatures but releasing it for rotation at abnormal temperatures, and an externally disposed plug connector arranged to depress said plunger when moved to circuit-connecting position, and to be moved to circuit-disconnecting position when the plunger is released relative to said wheel.

10. An electrical thermal switch comprising a plug and socket connector incorporating a stationary part having a pair of contact pins, the stationary part having an axial opening disposed midway between said pins, and a movable part having a pair of sockets adapted to slide axially on and off said pins, a hollow metal plug fixed on said stationary part, a tube fixed to said plug and extending axially therefrom, a hollow housing fixed to the end of said tube remote from said plug, said hollow housing having an opening in its under side, a plug secured in this opening, said plug being formed as a socket on its inner side, a ratchet wheel within said housing, said ratchet wheel having a cylindrical stem engaging the interior of said socket, fusible metal in the base of said socket engaging the end only of said stem, a washer located in said tube adjacent the end of said housing, a second washer located in said stationary part, a push rod in said tube extending through both washers and engaging said movable part, said push rod having a hooked portion for engaging a tooth of said ratchet wheel, and a pair of shoulders spaced apart along the length of the rod, one of said shoulders engaging said second washer when the fusible metal melts, and a spring engaging between the other of said shoulders and the washer located in said tube adjacent the housing.

11. An electrical thermal switch comprising a plug and socket connector incorporating a stationary part having a pair of contact pins, the stationary part having an axial opening disposed midway between said pins, a movable part having a pair of sockets adapted to slide axially on and off said pins, a hollow metal plug fixed on said stationary part, a tube fixed to said plug and extending axially therefrom, a hollow housing fixed to the end of said tube remote from said plug, said hollow housing having a socket disposed at its lower side, a ratchet wheel within said housing, said ratchet wheel having a cylindrical stem engaging the interior of said socket, fusible metal in the base of said socket engaging the end only of said stem, an abutment in said tube, a push rod extending through said tube into said housing and having one end engaging said movable part, said push rod having a shoulder and a hooked portion for engaging a tooth of said ratchet wheel, and a spring on said push rod acting between said shoulder and said abutment.

12. An electrical thermal switch comprising a plug and socket connector incorporating a stationary part having a pair of contact pins, the stationary part having an axial opening disposed midway between said pins and a movable part having a pair of sockets adapted to slide axially on and off said pins, a hollow metal plug fixed

on said stationary part, a tube fixed to said plug and extending axially therefrom, a hollow housing fixed to the end of said tube remote from said plug, a metal tube of loop form having its ends secured to said hollow metal plug, said metal tube containing a resistance winding the ends of which are secured to said contact pins, said hollow housing being secured to said loop form metal tube, said hollow housing having a socket disposed at its lower side, a ratchet wheel within said housing, said ratchet wheel having a cylindrical stem engaging the interior of said socket, fusible metal in the base of said socket engaging the end only of said stem, an abutment in said tube, a push rod extending through said tube into said housing and having one end engaging said movable part, said push rod having a shoulder and a hooked portion for engaging a tooth of said ratchet wheel, and a spring on said push rod acting between said shoulder and said abutment.

13. In a safety appliance for electrically heated apparatus, a base adapted to support a heating element, an insulating member carried by said base, a plunger bar guidingly supported in said member for reciprocable movement and having a tooth at its innermost end, a spring for biasing the movement of said plunger in an outward direction, a toothed ratchet wheel carried on a shaft, a tooth of said wheel being engageable by the tooth of said plunger when the plunger is depressed against its spring, a compartment in the region of said shaft, means including fusible material in said compartment for normally preventing rotation of the ratchet wheel when the material is in solid form but permitting rotation of the wheel when the material is in liquid condition at abnormal temperatures, and a manually operable externally positioned circuit controller arranged in connecting position to depress the plunger and to be moved to disconnecting position when the plunger is released relative to the ratchet wheel.

14. In a safety appliance for electrically heated apparatus, a base adapted to support a heating member, a two-part coupling forming an electric switch for said heating member and carried by said base, said coupling comprising stationary and movable elements which when moved with respect to one another serve to open the switch and to deenergize said member, a push rod slidably supported in the stationary coupling element and contacting the movable coupling element, said rod having a tooth at its innermost end, means for biasing the movement of said rod in an outward direction to push the movable coupling element from the stationary coupling element, means for restraining the movement between the coupling elements, said means comprising a toothed ratchet wheel carried on a shaft and having one of its teeth engageable with the tooth of the push rod when the rod is depressed against its biasing means, means including fusible material cooperating with said shaft for preventing the rotation of the ratchet wheel under normal temperatures but permitting rotation of the wheel when the temperature is abnormal and the material is in melted condition whereby when the wheel is rotated the tooth of the push rod is disengaged from the wheel and the rod is forced outwardly by said biasing means against the movable coupling element to break the circuit of the heating member.

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