Dec. 2, 1930. E. A. RUTENBER 1,783,309

THERMOSTATIC DEVICE

Filed Sept. 19, 1928 2 Sheets-Sheet 1

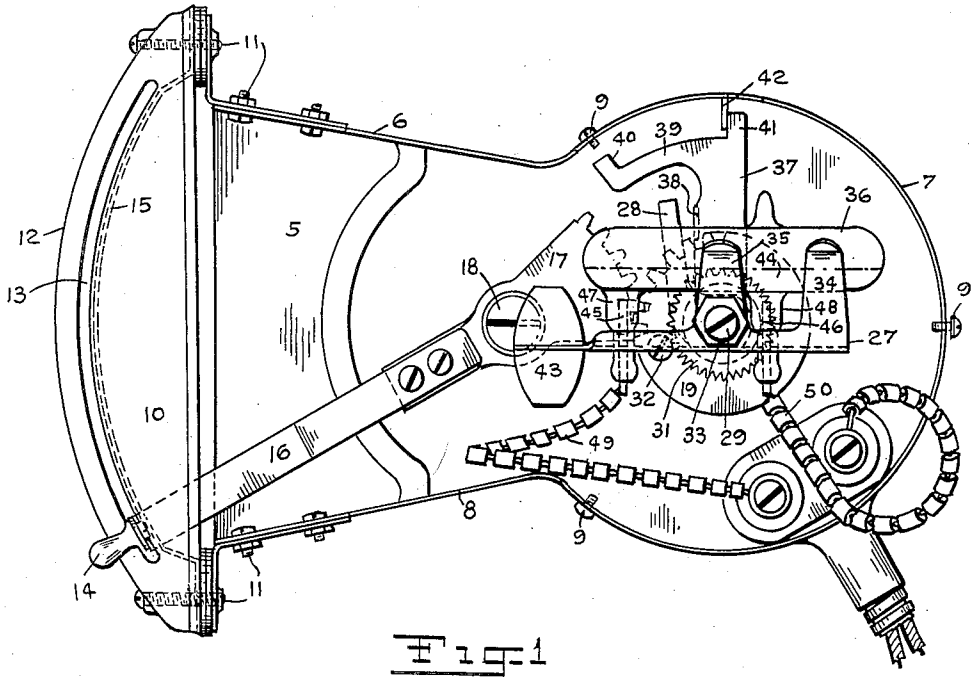


Fig. 1

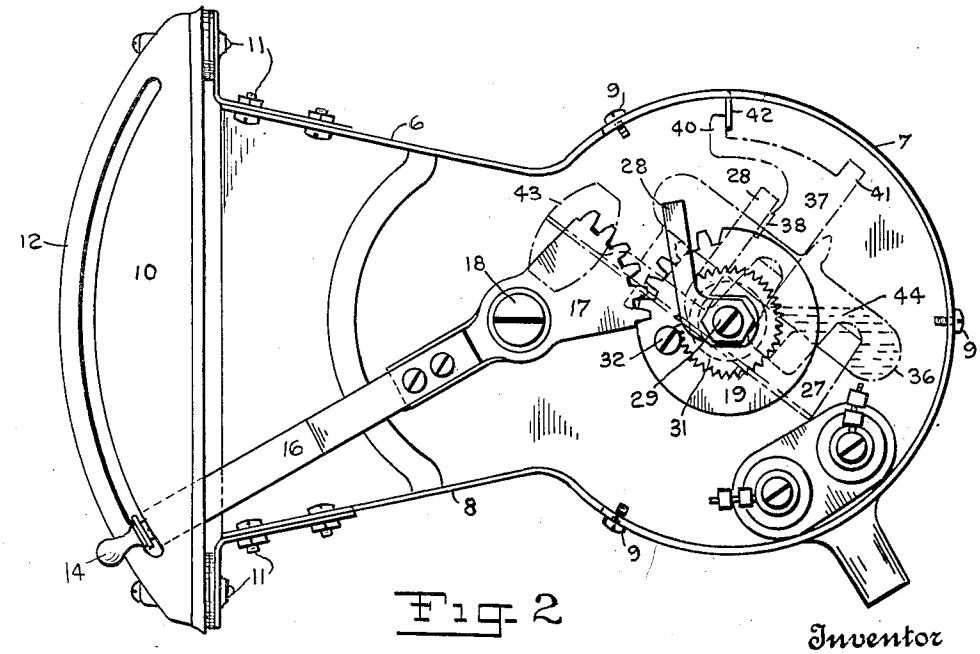


Fig. 2

Inventor
Edwin A. Rutenber
By his Attorney
S. J. Cox.

Dec. 2, 1930. E. A. RUTENBER 1,783,309

THERMOSTATIC DEVICE

Filed Sept. 19, 1928 2 Sheets-Sheet 2

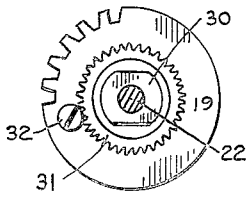


Fig-4

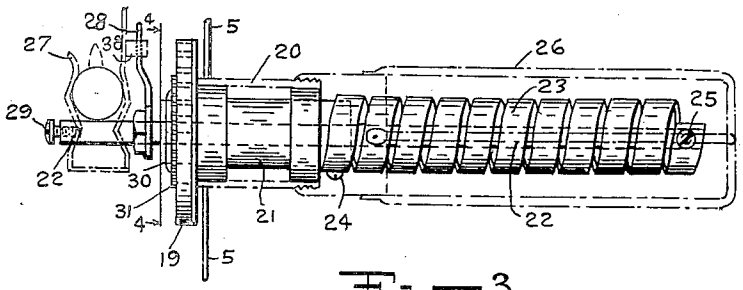


Fig-3

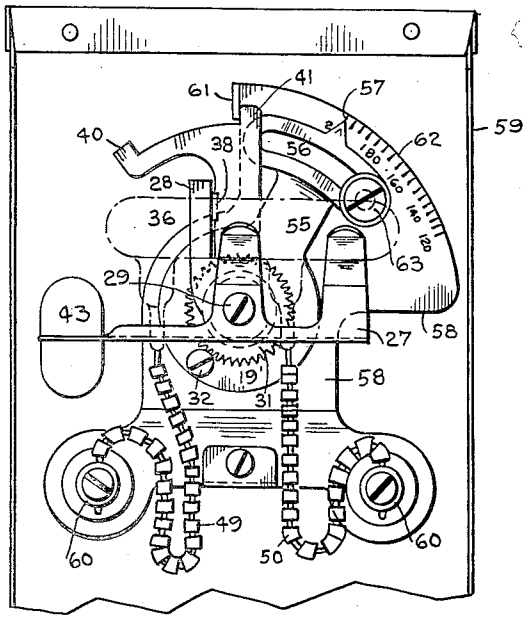


Fig-5

Inventor
Edwin A. Rutenber
By his Attorney S. J. Cox

Patented Dec. 2, 1930 1,783,309

UNITED STATES PATENT OFFICE

EDWIN A. RUTENBER, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO A. J. LINDEMANN & HOVERSON COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN

THERMOSTATIC DEVICE

Application filed September 19, 1928. Serial No. 306,885.

The improvements relate to thermally operated devices for automatically controlling the temperature of ovens, water heaters and the like, and are primarily adapted to be used in connection with apparatus of the type aforementioned which are arranged to be electrically heated, but have other applications. Their objects are, among others, the provision of a thermostatic control which may be adjusted and set so as to maintain various temperatures by acting on the heating medium and preventing it from raising the temperature above or permitting it to fall below the predetermined point and to make the mechanism whereby the control is effected, accurate and dependable in its operation.

A further object is to improve the construction and arrangement of parts, including the heat responsive member, switch and their connections, rendering same more efficient, durable and strengthening as well as simplifying the construction and assembly thereof; and to reduce the number of operative parts to a minimum, to dispose them in compact and intimate relation whereby the movement of the terminal wires is substantially negligible.

The present improvements are further designed to conserve the energy of the heat responsive member and to minimize the load said member is called upon to withstand in operating the switch, and to generally preserve the life of service of all the parts.

The improvements are illustrated in the accompanying drawings, in which

Fig. 1 is a side elevation, with side cover removed, of one embodiment of the present improvements adapted for use in electric heaters;

Fig. 2 is a view similar to Fig. 1, with parts omitted and the switch and holder therefor in dotted lines;

Fig. 3 is a side view of a detail of construction, illustrating the supporting member, thermal element and switch actuating mechanism;

Fig. 4 is an end view taken on line 4—4 of Fig. 3;

Fig. 5 is a side elevation of a modified form adapted for use in water heaters.

The thermostatic device or temperature control of the present improvements is designed to be attached to or built into an oven or water heater with the indicator exposed to facilitate observation and control thereof, and the thermally responsive element exposed to the medium to be heated.

In Figs. 1 and 2, the plate 5 represents the side wall of a stationary housing defined by laterally extending walls 6, 7 and 8, having screws 9 for securing a cover plate (not shown). In the present illustration, the left hand limit of the housing is completed by segmental cover plate 10 fixed to the housing by screws 11, said plate 10 being adapted to protrude through the oven or heater wall. The plate 10 is provided with a curved window 12 and has a chord slot 13 in its side through which the handle 14 of the indicator projects and in which it moves. The scale 15 is arcuate in form and fixed in position by screws 11 as illustrated. Said scale has numbers and graduations thereon to indicate temperatures, is positioned for observation through window 12, and the pointer (not shown) on handle 14 is arranged to travel in close proximity over said scale for accurately indicating temperatures.

The handle 14 and pointer are fixed to the end of arm 16, which in turn is fixed to a segmental gear 17 pivotally mounted on wall 5 at 18. As illustrated the gear 17 is normally in mesh with the teeth of an annular collar 19 as hereinafter more fully described.

Referring now to the arrangement illustrated in Figs. 3 and 4 which extends, when assembled, at right angles and away from the structure shown in Figs. 1 and 2, the stationary wall 5 is suitably perforated to receive an inwardly extending cylindrical portion 20 suitably fixed to said wall to form a bearing. Housed in said bearing 20 is a rotatable sleeve 21 in the form of a supporting member which is axially bored to receive and loosely support an actuating element 22. Said element in the present illustration, comprises a rod protruding a substantial distance in each direction beyond the limits of supporting member 21. The right hand ends of said member and rod 22 are operatively connected by a thermostatic helical band 23, hav-

ing one end fixed at 24 to member 21 and the other end fixed at 25 to rod 22, said band forming the only connection between these two parts. This thermostatic element may have the form shown or any other desired form and may be made of material suitable for the purpose.

From the foregoing it is apparent that when the band 23 turns in response to thermal changes, the rod 22 will be correspondingly rocked. A protecting cage 26 for the thermostatic coil 23 is removably threaded on the end of bearing 20, as illustrated. As clearly seen in Fig. 3, the left hand portion of rod 22 is machined to a smooth finish where it extends through member 21 and protrudes therefrom. This smooth surface serves as a bearing for a contactor holder 27 which is loosely supported thereon in pivotal relationship. An actuating arm 28 is keyed or otherwise fixed to rod 22 between the position of said holder and the member 21, whereby said arm describes an arcuate course in response to rocking movements of said rod. A screw 29 is provided at the end of rod 22 for removably retaining the contactor holder 27 on said rod and preventing same from sliding off the rod longitudinally.

The annular collar or ring 19, previously referred to, is rotatably mounted on the projecting hub 30 of the sleeve or supporting member 21, but is frictionally held to said member by a toothed disk or ring 31 keyed to said hub. A set screw 32 is provided on collar 19, which functions to secure disk 31 and collar 19 in fixed relation so that they may move together. To adjust the collar 19 therefore, with respect to the sleeve 21, it is only necessary to loosen set screw 32, thus disconnecting the two and to move collar 19 the desired extent, then tighten the screw and secure the two parts in position. It is apparent that the toothed disk 31 serves as a member for engagement by a screw driver or the like to prevent movement of hub 30 while collar 19 is being slipped relative thereto. In this simple manner the device may be calibrated when it is assembed and mounted in the oven or heater, or at any other time.

The contactor holder 27 is in the form of a cradle or carriage, with apertures 33 to receive the machined end of rod 22 on which it is loosely supported. Spaced spring clips 34 and 35 are formed on the holder for removably holding switch or contactor 36. The contactor is thus held and positioned laterally of the elements 22 and 23 so as to be spaced a substantial distance therefrom. One of said clips extends upwardly to form a member 37 having a laterally extending shoe 38 and a segmental arm 39, the latter having spaced upstanding lugs 40 and 41 which cooperate with lug 42 on wall 7 to limit the rocking movement of the holder and contactor. The center of gravity of the foregoing structure is slightly to the left of the pivotal apertures 33 by reason of the provision of energized means in the form of a weight 43 fixed to the holder 27. It is notable that the weight 43 travels in an arc slightly greater than the arc of travel of contactor 36. Obviously other energized means may be employed for normally urging the holder 27 and contactor 36 canted in a counter clockwise direction. It is apparent that the stop member 42 limits the rocking movements of the switch mechanism in both directions.

The switch mechanism employed comprises the contactor 36 consisting of a vessel of non-conductive material such as glass, having a globule 44 of conductive material therein in its horizontal bottom. The electric terminals 45 and 46 extend into said vessel and have enlarged contacts in spaced wells 47 and 48 of the vessel, so that when the vessel 36 is horizontal and the fluent conductor 44 level in the bottom thereof, it will be in contact with both terminals and will close the circuit, thus energizing the heating coils. Obviously, if the vessel is canted slightly from the horizontal, the globule will gravitate to one end of the vessel and break the circuit. The globule is preferably mercury, but may be made of any other conductive material suitable for the purpose. Terminal wires 49 and 50 connect the terminals of the switch to the heat generator, said wires being suitably insulated, relatively short in extent but sufficient to permit freedom of movement for the contactor 36. Due to the arrangement of the present improvements, the wires are practically never disturbed while the switch is functioning and therefore may be of minimum length, to facilitate housing of same without danger of having same crossed, entangled or interfering with the proper operation of the device.

The present improvements are illustrated in assembled relation in Fig. 1. The position of the rotable supporting member 21 may be adjusted by operating handle 14 by which rotary movement is transmitted to said member and to actuating rod 22 and arm 28. It is notable that during this setting movement the contactor holder 27 and contactor 36 are not moved but remain in true horizontal position as seen in Fig. 1 by reason of the weight 43 holding these parts against stop member 42. In the illustrated position the device is set to operate at a very low temperature and due to the mass and friction of the parts the member 21 is maintained in its set position against rotation. Therefore when the thermostatic coil 23 has been expanded by the heat in the oven to a sufficient extent to move the arm 28 into contact with shoe 38, which is in the path of travel of said arm 28 in a clockwise direction, and the temperature continues to rise, the rod 22 is moved and causes to rock the arm 28 and urge the shoe

38 in a clockwise direction in opposition to the energy of weight 43, thus canting the vessel 36 slightly and causing its bottom to incline away from the terminals and permit the globule 44 to gravitate away from said terminals thus breaking the circuit.

If now the temperature falls below the given point the arm 28 moving in a counter clockwise direction, will be withdrawn from the shoe 38 and the holder 27 and contactor 36 permitted to move to the left under the influence of weight 43, so that the vessel 36 is canted in the opposite direction and the globule moved to circuit closing position.

Attention is directed to the fact that the contactor is normally in operative position with the circuit closed, namely, in horizontal position, as illustrated in Fig. 1. In this position it is seen that the actuating arm 28 is but a slight distance from the shoe 38 and therefore only a short travel of the former is required to break the circuit. The position of the contactor when the circuit is broken is indicated in dotted lines in Fig. 2.

To raise the temperature of the oven the handle 14 is raised to the desired position which will rock supporting member 21 in a counter clockwise direction so as to withdraw actuating arm 28 further away from shoe 38 so that the circuit will remain closed until the temperature has risen to a point sufficiently high to bring the arm 28 in contact with the shoe 38 through the expanding of the coil 23. If it is desired to lower the temperature the handle 14 is depressed thus causing the arm 28 to approach shoe 38 and thus break the circuit, and this condition will continue until the temperature has fallen to a point sufficient to cause a contraction of the thermostatic band 23 which will withdraw arm 28 from shoe 38.

It is obvious from the foregoing that the thermostatic switch is mounted in a holder free to move on an axis without any operating levers connected thereto. The energized means 43 always tends to pull the contactor to the closed position, and the stop 42, limiting the movement of holder 27, is entirely free from any thermostatic portion of the construction. Accordingly when the temperature rises, the expansion of band 23 and rocking of arm 28 is unimpeded and unburdened for the major portion of its travel, until a predetermined position is reached, whence the arm 28 loosely pushes against shoe 38 of the holder 27, tilting same until contact is broken.

Aside from the feature of conserving the energy of the band 23 and thus preserving its life, the other distinct advantages are attained by the present improvements. Primarily, it is notable that the switch mechanism describes only a very small movement, as is obvious, and does not have to tilt the distance required were it fixedly secured to the thermostatic element 23. Especially is this true when considering that temperatures from room temperature up to 600° Fahrenheit are covered by the present improvements. Should the switch herein be required to partake in tilting movement necessitated by a temperature range of 500° Fahrenheit, the movement would be prohibitive, because, among other reasons, the terminal wires would have to be wound around, cross each other and be otherwise entangled, whereas in the present arrangement, the very small movement of the switch permits the use of shorter wires which are practically never disturbed.

A further feature of importance resides in loosely mounting the switch mechanism on the actuating rod 22. This refinement of construction not only promotes compactness, but also contributes to the conservation of energy of the coil 23 and rod 22, by location of the contactor closely adjacent the power arm 28 and shoe 38. Assembly of the parts is also greatly facilitated due to the few number of parts. It is notable that the structure illustrated in Fig. 3 is bodily removable as a whole whence it may be readily dismembered or reassembled.

The modified form illustrated in Fig. 5 is adapted for use in water heaters, and although not shown, is provided with an imperforate protective covering over band 23 in place of cage 26. The general organization is substantially the same as that previously described except that the collar 19′ has no toothed portion but is equipped with an integral arm 55, having an arcuate slot 56 and pointer 27. Furthermore the fixed bearing 20 (seen in Fig. 3 but not in Fig. 5) has a fixed support 58 on the inside of the housing 59, said support carrying terminal posts 60, stop lug 61 and a scale plate 62. As illustrated, the arm 55 is superposed in intimate relation with plate 62, whereby the thermal element and actuating mechanism may be set at the desired temperature by appropriate operation of set screw 63, which holds arm 55 to plate 62 and against unintentional rotation. Calibration of this modified structure as well as the operation of the device is the same as described with respect to the arrangement previously set forth.

The apparatus herein shown and described is primarily designed for use in connection with electrically heated ovens and the like, but may, with other small modifications, be adapted for use in connection with other heating media. Various changes in the construction and arrangement of the parts may also be made without departing from the invention.

I claim:

1. A thermostatic control for electrical apparatus comprising a supporting member, a movable actuating element supported by said member, thermally responsive means opera-

tively connected with said member and element, means frictionally secured to said member for adjusting the position thereof, an arm fixed to said element, a contactor operable by said arm, said actuating element constructed and arranged to loosely support said contactor and manually operable control means for varying the position of both said member and said element.

2. A thermostatic control for electrical apparatus comprising a rotatable support normally fixed against rotation, an actuating rod extending loosely through said support, a thermal element having one end secured to said support and its other end fixed to said rod, an actuating arm fixed to said rod, a contactor loosely mounted on said rod and positioned for movement in one direction by said arm, said contactor having means for constantly urging same in a direction opposite to said first named direction, and means limiting the movements of said contactor.

3. In a thermal control device, the combination of an axially bored supporting member, a rod loosely housed in the bore of said member and protruding from each end thereof, a thermal coil connecting adjacent ends of said member and rod, an arm fixed to said rod adjacent the opposite protruding end thereof whereby movements of said coil in response to thermal variations actuate said arm, a holder loosely mounted on said rod adjacent said arm, said holder having means positioned in the path of travel in one direction of said arm, a contactor mounted on said holder, and energized means opposing the aforementioned travel of said arm.

4. In a thermal control device, the combination of an axially bored supporting member, a rod loosely housed in the bore of said member and protruding from each end thereof, a thermal coil connecting adjacent ends of said member and rod, an arm fixed to said rod adjacent the opposite protruding end thereof whereby movement of said coil in response to thermal variations actuate said arm, a holder loosely mounted on said rod adjacent said arm, said holder having means positioned in the path of travel in one direction of said arm, a contactor mounted on said holder, energized means on said holder opposing the aforementioned travel of said arm, and means for limiting the movement of said holder.

5. A thermostatic control for electrical apparatus comprising a supporting member, a movable actuating element supported by said member, thermally responsive means operatively connected with said member and element, adjustable means for varying the position of said supporting member, a contactor loosely mounted on said actuating element, energized means for normally holding said contactor in circuit closing position in all positions of adjustment of said supporting member and an actuating arm fixed to said actuating element, positioned for moving said contactor and breaking the circuit in opposition to said energized means in response to a thermal variation of said first named means.

6. In a device of the character described, a switch mechanism comprising a holder having means for pivoting same, a weight mounted on said holder on one side of said pivoting means, a laterally extending lug adapted to be contacted by a moving element, upstanding spaced lugs adapted to limit the arcuate travel of said holder, spring clips on said holder and a mercury tube removably disposed in said clips.

7. A thermostatic control for electrical apparatus comprising a supporting member, a movable actuating element supported by said member, a vessel having fluent conductive material therein, electric terminals extending into said vessel and into the path of said fluent material, said vessel being loosely mounted on said actuating element whereby said vessel may be canted to cause the said fluent material to move to and from the electric terminals, automatic means for normally maintaining said vessel in a given position and causing it to return to said position after being moved therefrom comprising an energized element associated with said last named means and thermostatically controled and adjustable means for moving said vessel from such position, said last named means operatively connecting said supporting member and said actuating element, said fluent conductive material being in the form of a globule and said vessel having a bottom in approximately horizontal position, but arranged to assume positions slightly angular thereto when the vessel is canted and to cause the said conductive material to flow from one portion to another of said bottom.

8. A thermostatic control for electrical apparatus comprising a supporting member, a movable actuating element supported by said member, thermally responsive means operatively connected with said member and element, a normally closed contactor fulcrumed on said actuating element, means for transmitting movement induced by temperature rise from said element to said contactor whereby the latter is rendered inoperative and means independent of temperature variations for restoring said contactor to operative position.

9. A thermostatic control for electrical apparatus comprising a supporting member, a movable actuating element supported by said member, thermal means operatively connecting said member and element, an actuating arm operatively associated with said element, a contactor fulcrumed on said element, movable relative thereto and posi-

tioned for movement in one direction by said arm, and weighted means associated with said contactor for moving same in an opposite direction.

Witness my hand this 10 day of September, 1928, County of Milwaukee, State of Wisconsin.

EDWIN A. RUTENBER.