Aug. 6, 1940. O. W. HAHN 2,210,404

HEAT CONTROL APPARATUS

Filed Dec. 14, 1935

Fig. 1.

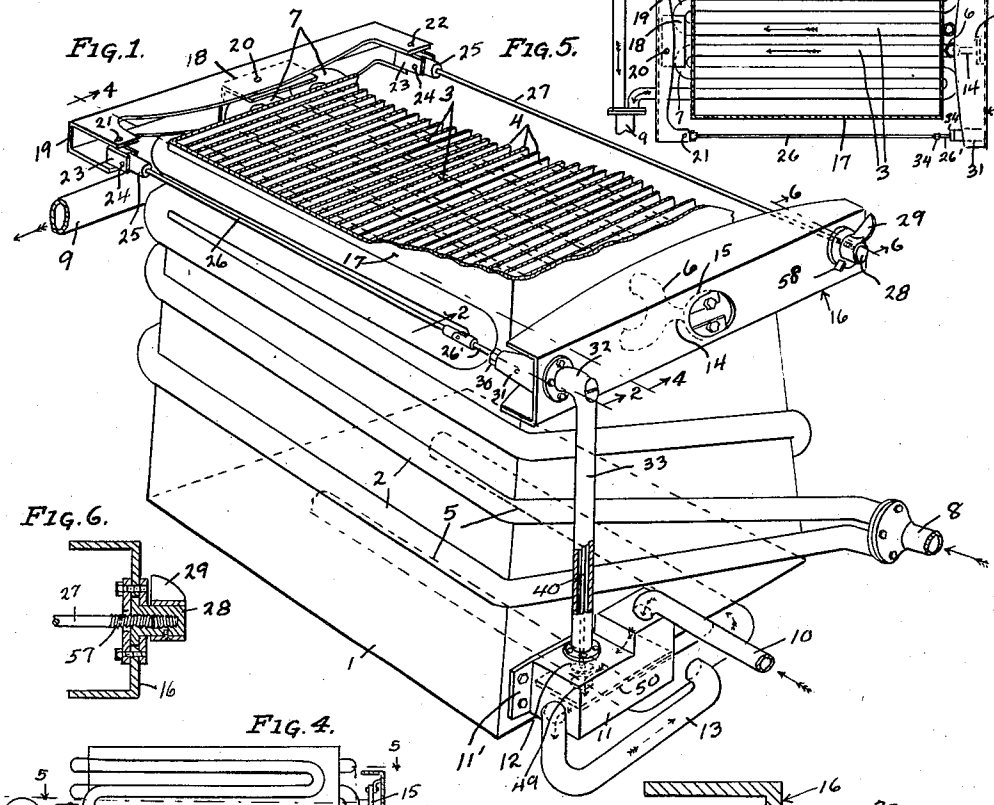


Fig. 5.

Fig. 6.

Fig. 4.

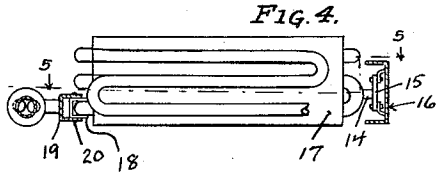


Fig. 2.

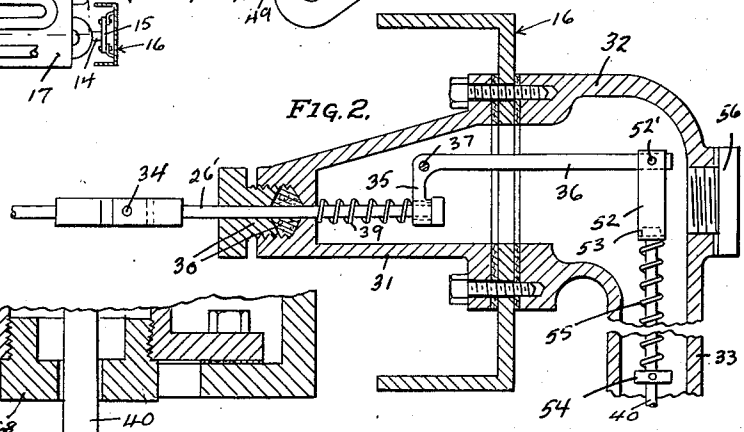
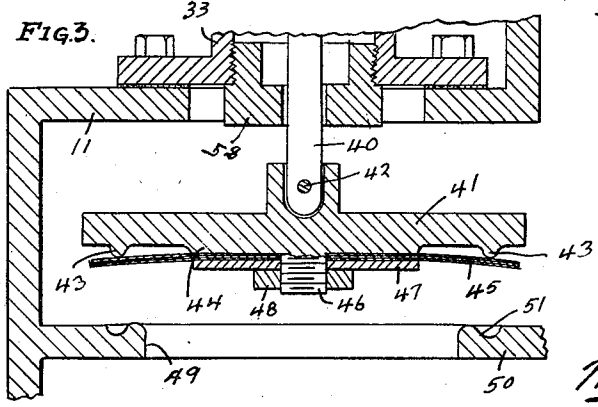


Fig. 3.



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HEAT CONTROL APPARATUS

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Application December 14, 1935, Serial No. 54,453

8 Claims. (Cl. 236—33)

This invention relates to heat control apparatus, more particularly of the type adapted for actuation by temperature changes in its mounting for controlling a source of heat adapted to influence said mounting, and has for its objects the provision of a simple, positive apparatus for controlling said source of heat, and which apparatus is adapted to more quickly and accurately respond to heat variations than heretofore and is easily and quickly adjustable to accurately perform its function, and is free from errors resulting from hard usage and accidental external forces to which such apparatuses are ordinarily subjected. Other objects and advantages will appear in the specification and drawing attached hereto.

Fig. 1 is a perspective view of my device installed on a water heater with a portion of the heater broken away and shown in section for clarity.

Fig. 2 is an enlarged sectional view of a portion of my device taken along the line 2—2 of Fig. 1.

Fig. 3 is an enlarged sectional view of a portion of my device taken along the line 3—3 of Fig. 1.

Fig. 4 is a reduced side view of the upper portion of a heater showing a portion of my device in section, as taken along the line 4—4 of Fig. 1.

Fig. 5 is a plan view of my device (reduced) with the top of the heater shown in section and with the fins in the top of the heater omitted for clarity.

Fig. 6 is a sectional view of a portion of my device as taken along the line 6—6 of Fig. 1.

Briefly described, my control apparatus is particularly suited to use in water heaters of the type shown in my Patent No. 1,883,733, October 18, 1932, in which there is a vertically extending shell of sheet metal open top and bottom and having a pair of liquid conduits coiled thereabout, and which conduits extend at their upper ends backwards and forwards in superposed rows across the upper open end of the shell and through a horizontal row of spaced vertical fins disposed within said upper open end of the shell. Opposite walls of the shell extend slightly convergently relatively from the bottom to the top of the shell, and gas burners are disposed below the lower open end. The liquid in both of the conduits flows upwardly in the coiled conduits and is taken for use from the last runs of the conduits that extend across the upper open end of the shell.

The radiant heat from the gas flame is transmitted to the shell and thence to the ascending conduits that are seated against its outer surface to pre-heat the water while the highly heated gases pass between the fins at the open top of the shell and across the runs of the conduits that extend thereacross. The greatest portion of the heat is therefore at the upper end of the shell where it is taken up by the vertical fins and conduits and is conducted to the conduits for heating the liquid therein.

In ordinary practice in a heater of this type it is manifest that when there is no flow of water through the conduits or a very small flow, serious damage would result from over heating if the flame were not controlled, and heretofore where attempts have been made to regulate the flame by thermostatic control, the time lag between the operation of the flame control and the reaching of the danger point in the zone most susceptible to injury is so great that the damage is done by the time there is any regulation of flame. Of course, a similar lag occurred after a reduction in heat in attempts made heretofore, which lag resulted in a material loss in efficiency.

Also, one of the causes of great trouble heretofore in water heaters is the fact that in shipment or in installation of water heaters in which there are elements whose efficiency and succesful operation is dependent upon initial accuracy of adjustment, such elements become mis-adjusted and the operation of the heater subsequently to its installation results in injury to the heater, negativing the care bestowed in making a proper adjustment and test before shipment. In applicant's apparatus, once the proper adjustment is made at the factory, it is practically impossible for such mis-adjustments to occur in transit, handling or in installation by persons of little or no experience.

In the drawing, 1 is the shell of a heater, generally as above described, 2 are the water conduits passing around the shell, 3 the runs of the conduits across the open top of the shell, 4 the vertical fins in the top, 5 the gas burner below the lower open end of the shell, 6 one of the return bends of the runs of the conduits at the top, and 7 a pair of return bends at the opposite side of the top of the shell, 8 is the conduit inlet to the pair of coiled conduits on the shell, and 9 the conduit outlet from the lowermost row of pairs of conduits extending across the top of the shell, 10 is the gas inlet to a housing 11 in which is a valve 12, later to be described, and a gas outlet 13 from the housing to the burner.

Rigidly secured on return bend 6 is a bracket 14 having a base 15 bolted rigidly to the center of a horizontally extending channel member 16 that projects at its opposite ends beyond opposite sides of the rectangular top 17 of the shell 1. The open side of the channel 16 faces the shell, so that the base of the channel is vertical.

At the opposite end of the shell, and in opposed substantially parallel relation to channel 16 is a second channel member 19, similarly projecting at its ends beyond opposite sides of top 17. The open side of channel 19 also faces the top 17 of the shell, and is vertically pivoted at 20 intermediate its ends (about halfway) to a bracket 18 that is secured to return bends 7 of the adjacent conduits of the pair of conduits 3.

The opposite ends of channel 19 are projected in the direction of the top 17 and toward channel 16, and vertical pivots 21, 22 extend through the projecting ends and through small U-shaped members 23 respectively, which are pivotally connected by horizontal pivots 24 to members 25 respectively, which members 25 are respectively provided with tapped recesses to threadedly engage the ends of horizontally extending rods 26, 27. The members 23, 25, together with the pivots 21, 22, and 24, thus provide universal joints connecting rods 26, 27 with the ends of channel 19. It is to be noted that the vertical pivots 21, 22 are offset toward the top 17 relative to the central vertical pivot 20, to insure centralization of the pull on pivot 20 and to eliminate the tendency to longitudinal movement of channel 19 when the rods 26, 27 are under tension.

The rod 27 extends at one end through an end of channel 16 and is threaded into a nut 28 having a handle 29 thereon, said nut being rotatably mounted on the end of channel 16 as shown in Fig. 6, for turning by the handle whereby the rod may be moved in opposite directions relative to channel 16 upon turning the nut.

The rod 26 extends through a packing nut 30 into a projection 31 comprising a hollow casting that is bolted or otherwise rigidly secured to the end of channel 16 opposite the end having the nut 28. A laterally turned end 32 of a vertically extending tube 33 is bolted or otherwise rigidly secured to the end of the channel 16 so that the bore in the laterally extending end 32 is aligned over an open end of casting 31 and the lower end of tube 32 is screwed or bolted over an opening in the upper wall of housing 11, said housing being rigidly supported by brackets 11' relative to shell 1.

The rod 26 is jointed and pivoted at 34 so as to provide a flexible joint at this point and the continuation of the rod that passes through the packing nut 30 is designated 26'.

The end of rod 26' inside the casting 31 is pivotally secured to the end of a short vertically extending arm 35 of a bell crank. The long arm 36 of the crank extends horizontally into the open end of tube 33, the crank being pivoted at 37 to casting 31 as seen in Fig. 2 so as to multiply any movement of rods 26, 26' and channel 19, which movement will obviously occur upon contraction or expansion of the runs 3 of the conduit to which the brackets 18, 14 are secured, and a coil spring 39 is interposed between the packing nut and arm 35 of the bell crank to normally maintain rod 40 in tube 33 in a raised position.

The lower end of rod 40 is provided with a special disk valve that comprises an annular horizontal disk 41 loosely pivoted at 42 to the lower end of rod 40. This disk has an annular downwardly projecting ring 43 on its lower side spaced from its outer edge, and is centrally provided with a downwardly projecting boss 44 spaced around its sides from ring 43, the lower end of the boss being slightly elevated relative to the lowermost side of ring 43. A series of relatively thin spring disks 45 centrally apertured to pass a threaded boss 46 on disk 41 is positioned against the under side of the disk 41 and secured thereto by a plate 47 and nut 48, the outer edge of disks 45 terminating outwardly of ring 43.

Thus when the nut 48 is tightened, the disks 45 will be fulcrumed at the line of engagement with ring 43, and the outer edge of the disks will be turned slightly downwardly, as seen in Fig. 3.

The seat for the valve is formed around an annular opening 49 in a partition 50 within housing 11, which partition separates the gas inlet thereto from the gas outlet. This seat has an upwardly opening annular groove 51 in its upper side aligned below the ring 43 of the valve, so that upon downward movement of the valve the edges of the disks 45 will first engage the face of the seat to the outer side of groove 51, and upon continued movement any possible excess pressure will be relieved by the groove, and the disks 45 are free to compensate for any irregularity in the valve or seat, the pivotal joint between the rod 40 and disk 41 also tending to permit the valve disks 45 to make a tight seat irrespective of variations in the position of rod 40.

A yieldable connection is provided between the end of arm 36 of the bell crank in casting 31 which connection comprises a U-shaped yoke 52 horizontally pivoted at its free ends at 52' to the end of arm 36, and the upper end of rod 40 passes through the base of the yoke, the rod terminating at its upper end in an outwardly directed flange 53 that engages the upper side of the base of the yoke. Below the yoke, rod 10 has a collar 54 secured thereto, and a coil spring 55 under compression is interposed between the collar and base of yoke 52 so that after disks 45 have firmly seated against the partition 50 in housing 11, any tendency of rod 40 to move downwardly will be yieldably relieved by spring 55, the upper end of rod 40 sliding through the yoke. A removable plug 56 is provided in tube 33 at its upper end to give access to the interior of the tube without disconnecting it from channel 16.

When in its initial position and ready for operation, it is seen from the foregoing description that the valve, as described, is open and gas is free to flow through the housing and aperture 49 and to the burner. Other controls for the gas are, of course, incorporated in the complete heater, but are not shown, such as a main gas valve for manually admitting gas to inlet 10, and for turning off the gas.

The initial distance that the valve 41 is from the valve seat, when the burner is not in operation, is determined by nut 28, and the threads 57 within the nut and end of rod 27 are so formed as to pitch so that a complete turn of the nut in one direction will open the valve to a desired maximum, and a full opposite turn of the nut will close the valve. A stop 58 is provided to limit the movement of the nut 28 in opposite directions. Also, the pitch of the threads on the end of rod 27 is such that at the normal safe temperature within the top 17 of the shell and at the desired maximum temperature of the water passing through conduits 3, the valve 41 will admit the proper amount of gas to the burner. However, a rise above normal temperature will immediately

reduce the flow of gas or may entirely close the gas valve. Below the safe temperature, by turning nut 28 and lowering valve 41 the flow of gas may be regulated so as to allow a flow of liquid at a regulated maximum temperature.

The foregoing results are accomplished by reason of the linear expansion of the conduits 3, since upon expansion the free end of rod 26 will move according to the degree of expansion of the conduits, and the expansion of the conduits 3 is dependent upon the combined effect of the temperature of the heated gases and the temperature of the water flowing through the conduits. The geometrical relationship of the frame that includes rods 26, 27 and channels 16, 19, and the manner in which the frame is mounted, clearly precludes any possible accidental distortion of the frame subsequently to an initial proper setting, since the parts going to make up the frame, including the valve hook-up, will always remain the same relative to each other, the pivot 20 and bracket 14 being opposite each other at opposite ends of similar conduits extending across top 17 of the shell 1 and the casting 31, tube 33 being rigid relative to channel 16.

In operation the gas flame responds immediately to changes in the volume of flow through the water conduit and, as has been mentioned, the degree of flow relative to desired water temperature is quickly regulated by turning the nut 28, but when the danger heat on conduits 3 is reached, the valve will automatically lower the flame and will fully close it if the temperature is not lowered by flow of water of lower temperature therethrough or immediate cooling of the conduits to safe temperature by reason of a lowered flame, or if there should be no flow of water or failure of initial gas valve or water valve to operate properly.

It is important to note that the bracket 18 engages each of adjacent conduits of a pair, so that if one conduit is stopped up or overheats, its excessive heating will still result in the valve 41 closing or in moving to lower the flame. Also, the brackets 16, 18 are secured at opposite ends to the lowermost runs of the conduits in the top 17, which is closest to the flame, and consequently the regulation of the flame is obtained from the point in the conduits just prior to the water leaving the heater.

Another important feature to note is that the operating parts of my valve, with the exception of the outer end of the single small rod 26' are wholly enclosed within the gas chamber or within a portion accessible to the gas, so that the valve rod 40 and pivotal connections thereto are all free of any frictional resistance from packing glands and valve 41 is flexible to accommodate any variations relatively between the valve seat and valve. An apertured nut 58 in the bottom of tube 33 acts as a guide for rod 40, but the aperture in the nut through which the rod passes is large enough to permit slight movement laterally of the rod. By reason of the small movement of rod 26 upon contraction and expansion of the conduits, I have been unable to find that any other type of valve than that shown in the drawing will positively insure against leakage of gas when the same is closed by reason of movement of rod 40. The reaction to varying temperatures in the conduits and shell is so rapid that the flame will instantly respond to opening and closing the water valve (not shown) on outlet 9.

Having described my invention, I claim:

1. In a water heater having a water conduit, a source of heat and means providing a restricted zone of relatively high temperature over said source of heat, said conduit having a portion thereof extending backward and forward over said restricted zone with return bends at opposite sides of the restricted zone, a device positioned outside the influence of heat from said source of heat, said device being secured to return bends of the conduit at points on opposite sides of the restricted zone arranged and adapted to respond to linear expansion of the portion of the conduit in said restricted zone for controlling said source of heat, said device including a flexible connection between the points of securement of the device to the return bends.

2. Heat control apparatus for controlling a source of heat including a coil of pipe made up of straight runs of pipe connected at their opposite ends respectively by return bends adapted to be positioned within a zone of heat generated by said source of heat and to change its linear dimensions proportional to changes of temperature in said zone, a frame having spaced end bars and spaced side rods connected at their opposite ends to ends of the end bars, one of said end bars being pivotally secured at a point intermediate its ends to the return bends at one end of said runs and the other end bar being secured to the return bends at the opposite ends of said runs, and one of said rods being movable relative to one of said end bars and a control member secured to said last mentioned side rod.

3. A water heater comprising a vertically disposed generally tubular shell open at its upper and lower ends, a conduit for water comprising a plurality of pipes extending across the upper open end of the shell, said pipes being connected by return bends at their ends, in series, to form a continuous passage therethrough for the water, a fuel burner disposed at the lower open end of said shell arranged and adapted to cause heating of the said pipes and water therein when the burner is ignited, a valve for controlling the flow of fuel to said burner, valve actuating means disposed externally of said shell and pipes, said valve actuating means connecting between at least one of the said return bends at opposite ends of said pipes and connecting with said valve and arranged and adapted to respond, for movement, proportionally to linear expansion and contraction of said pipes to thereby automatically actuate said valve for controlling the flow of fuel to said burner upon said linear expansion and contraction of said pipes by reason of variations in the temperature thereof.

4. In a construction as defined in claim 3, said return bends being disposed outwardly of said shell at opposite ends of the pipes.

5. In a construction as defined in claim 3, said valve actuating means including brackets secured to said return bends at opposite ends of the pipes and a rod connecting between said brackets and means connecting one end of said rod with said valve.

6. A water heater comprising an open ended tubular shell, a water conduit extending backward and forward across one open end of said shell, a fuel burner at the opposite end of said shell arranged and adapted to generate heat for passing through the shell and across said conduit for heating the conduit and the water therein, a valve for controlling flow of fuel to said burner and valve control means disposed externally of said shell and out of the direct influence of heat from the burner connecting between

spaced points on said pipe at opposite sides of said shell, said valve control means being automatically responsive for movement upon linear expansion and contraction of said conduit, and means connecting between said control means and valve movable with said control means for opening and closing said valve upon said linear expansion and contraction of said conduit.

7. A water heater comprising a vertically disposed generally tubular shell open at its upper and lower ends, a pair of water conduits coiled around the outer sides of said shell from its lower to its upper ends provided with a water inlet at their ends adjacent the lower end of the shell and said pipes extending at their ends adjacent the upper end of the shell across said upper open end from side to side of the shell and outwardly, a fuel burner below the lower open end of the shell adapted to generate heat for heating the water conduits and the water passing therethrough, a valve for controlling the flow of fuel to the burner, valve control means disposed outwardly of said shell at its upper end connecting between said conduits at said upper end of the shell at points at opposite sides thereof, said valve control means being automatically responsive for movement upon linear expansion and contraction of the portions of the conduits between said points, and means operatively connecting between said valve control means and valve for for causing movement of the valve upon movement of said valve control means.

8. In a construction as defined in claim 7, the portions of said conduits extending across the upper open end of said shell being in the form of coils made up of a plurality of straight runs of the conduits connected at their ends in series by return bends and disposed to form a horizontal row of said straight runs, and said valve control means being connected to return bends of the said portions of the conduits.

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