Dec. 16, 1941. C. M. OSTERHELD 2,266,255

WATER HEATING SYSTEM

Filed March 31, 1941

FIG. 1

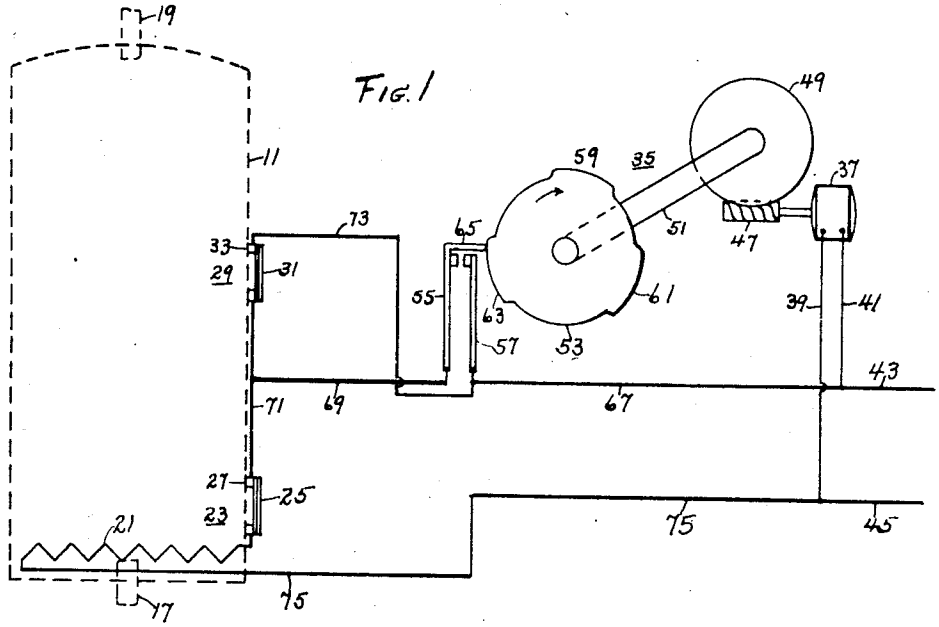
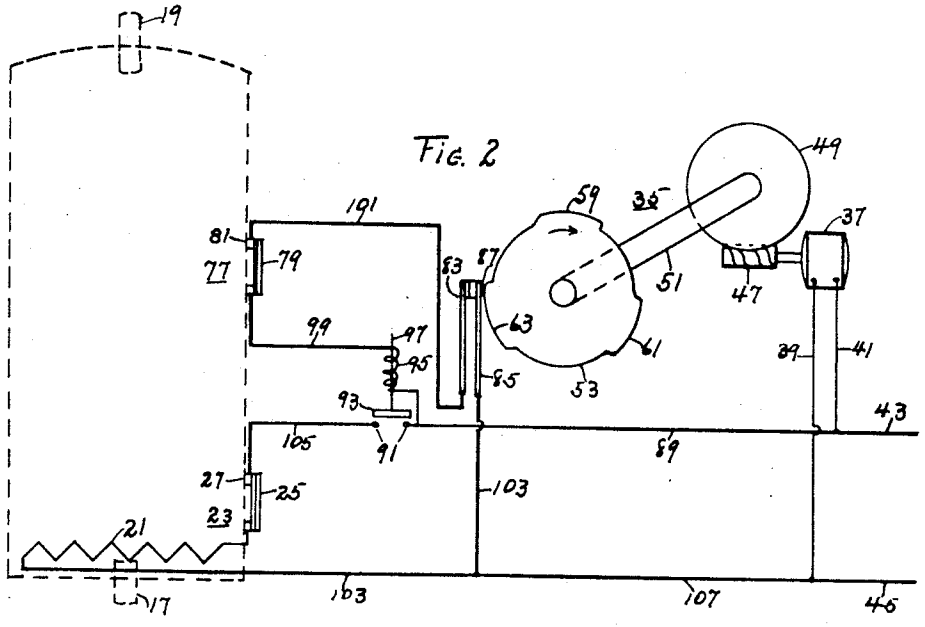


FIG. 2



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WATER HEATING SYSTEM

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5 Claims. (Cl. 219—39)

My invention relates to water heating systems and particularly to all-day electric water heating systems.

An object of my invention is to provide a water heating system applicable particularly to domestic installations in which time-controlled means are used during periods of high station loads to effect deenergization of the electric heater under certain conditions as to the amount of hot water in the tank.

Other objects of my invention will either be apparent from a description of several modifications embodying my invention or will be pointed out in the course of such description and set forth in the appended claims.

In the single sheet of drawings,

Figure 1 is a view of a water heating system embodying my invention as applied to a domestic hot water tank, and,

Fig. 2 is a view of a modified form of system embodying my invention.

I have found in actual installations of this kind where the electric heating element applied to a hot water tank is permitted to remain connected to the supply circuit conductors all the time, that it may happen that the central station would prefer to have the water heaters disconnected from the supply circuit during certain hours of the day when the other load on the circuit may be relatively heavy.

I have elected to show two modifications of systems embodying my invention as applied to a usual domestic hot water tank 11. The tank is provided also with a cold water inlet pipe 17 and a hot water outlet pipe 19, all in a manner now well known in the art. I provide an electric heater 21 which, if only a single electric heater is to be mounted in or on the tank 11, I prefer to mount on or have the heater extend into the tank adjacent the lower end thereof. It is to be understood that the tank may be heat insulated, as is usually done in such installations.

I provide a thermally actuable switch 23 which is connected in series circuit relatively to the heater 21 and for illustrative purposes I have illustrated such thermal switch schematically only as including a bimetal bar 25 having one end thereof in heat-receiving relation to either the outside of the tank or to the water in the tank. The free end of the bimetal bar 25 is adapted to engage with and be disengaged from a fixed contact member 27. I provide further an auxiliary thermal heater control switch 29 which may be of the same general design as the lower main thermal switch and may include a bimetal bar 31 in heat-transmitting relation relatively to the tank at a desired upper point therein or thereon. The switch 29 includes a fixed contact member 33. While I have illustrated a bimetal type of thermal switch, I do not desire to be limited thereto but may use any other type of thermal switch now known in the art.

A continuously operative timing means designated generally by numeral 35 may include an electric motor 37 the terminals of which are connected through conductors 39 and 41 with supply circuit conductors 43 and 45. I provide a worm gear 47 on the shaft of the motor 37 which worm gear is adapted to mesh with a worm wheel 49 to be driven thereby.

The worm wheel 49 is mounted on a shaft 51 and while I have not shown any bearings or other supporting means for the shaft, it is to be understood that such details will be supplied.

I provide a cam disk 53 on the shaft 51 fixedly supported thereby and adapted to rotate through one complete revolution in a twenty-four hour day. While I have shown a relatively simple means for driving the shaft 51 and the cam disk 53 thereon, I do not desire to be limited thereto since any other form of gear train or other drive may be utilized by me so long as I obtain one full revolution of the cam disk 53 in a twenty-four hour day.

I provide a pair of switch or contact arms 55 and 57 the design and construction of which is such that under certain conditions arm 55 will be in engagement with arm 57, that is, the arm 55 is normally yieldingly biased into engagement with contact arm 57 but may be moved out of engagement therewith, as will be hereinafter described.

The cam disk 53 has portions of its periphery of greater outer radius than the other portions intermediate the raised portions and I have shown three such portions 59, 61 and 63 each of the same outer radius but possibly of different peripheral extents. These portions are so positioned relative to the disk 53 that they will respectively engage a projection 65 at the outer end of contact arm 55 at those times during a twenty-four hour day when the load on the central station supplying current to the supply circuit conductors 43 and 45 will usually be relatively large or during what may be called peak load periods.

Supply circuit conductor 43 is connected to contact arm 57 through a conductor 67. Contact arm 55 is connected by a conductor 69 to a conductor 71 which connects the fixed end of the bimetal bar 31 of the upper thermal switch 29 to the fixed contact 27 of the lower main thermal switch. The fixed contact member 33 of the upper switch 29 is connected to conductor 67 and to contact arm 57 by a conductor 73. One terminal of the electric heater 21 is connected to the fixed end of bimetal bar 25 while the other terminal of heater 21 is connected by

a conductor 75 to the other supply circuit conductor 45.

The operation of the system shown in Fig. 1 of the drawing may be stated as follows: The position of the cam disk 53 of the continuously operative timer is that shown at the start of a peak period or of a period of heavy load on the central station. It will be noted that contact arm 55 has been moved out of engagement with contact arm 57 so that an energizing circuit through the lower main thermal switch 23 and the heater 21 will be interrupted. It is, of course, to be understood that the circuit through the lower thermal switch and the heater would normally have been as follows, assuming that the main thermal switch 23 was subject to cold water: from conductor 43 through conductor 67 and engaged contact arms 57 and 55, through conductors 69 and 71, through the lower thermal switch 23, heater 21 and from there through conductor 75 to the other supply circuit conductor 45. This circuit would have been operative just before the projection 65 engaged the portion 63 on the cam disk 53. The heater 21 will therefore be deenergized at the time of engagement of any one of the peripheral portions 59, 61 and 63 with projection 65 in case the upper auxiliary thermal switch 29 was subject to hot water.

Let it be assumed, however, that at the time when switch arm 55 is disengaged from arm 57 that the upper auxiliary thermal switch 29 is subject to cold water, in which case bimetal bar 31 would be in engagement with fixed contact 33. In this case an energizing circuit through the heater 21 would be established as follows: from supply circuit conductor 43 through conductors 67 and 73, through the closed upper thermal switch 29, through conductor 71 and the lower closed thermal switch 23, through heater 21 and from there through conductor 75 to the other supply circuit conductor 45.

This condition of operation, at the start of one of the periods of heavy load on the central station, would mean that there was only a relatively small quantity of hot water in the tank insufficient to subject the upper auxiliary thermal switch 29 to hot water. In case enough hot water was in the tank to subject the upper switch 29 to hot water, the bimetal bar 31 would be flexed so as to be out of engagement with fixed contact 33, so that the heater 21 would be deenergized during at least the initial part of one of the periods of heavy load on the central station.

It is further obvious that should withdrawal of hot water occur during one of the heavy load periods, say when projection 65 engages at about the midpoint of the peripheral extent of portion 63, such withdrawal subjecting the upper thermal switch to cold water, then bimetal bar 31 would engage fixed contact 33 and the hereinbefore described energizing circuit for heater 21 would be established with attendant heating of a predetermined greater quantity of water in the tank, that is, until the upper thermal switch 29 is subject to hot water.

I have shown three such periods of peak or heavy-load periods in a twenty-four hour day but I do not desire to be limited either to the number of such peripheral portions of greater radius nor to their positions on the periphery of the disk 53. The engineers in the central station supplying current to distributing systems can very easily determine the times of day both as to the number of times as well as to the duration of such periods when they would like to have the water heaters deenergized provided that each such tank contained at least a predetermined amount of hot water, all as hereinbefore described.

Referring now to Fig. 2 of the drawing, I have there illustrated a hot water heating system slightly modified from that shown in Fig. 1 of the drawing and all parts shown in Fig. 2 which are substantially the same as those shown in Fig. 1 have been provided with the same numerals.

In addition to the continuously operative timing means 35, I provide a like electric heater 21 and a lower main thermal switch 23. I provide an upper auxiliary switch 77 of the same general type as thermal switch 29 but including a bimetal bar 79 which operates in a manner substantially opposite to that of the lower main thermal switch 23. The bimetal bar 79 is normally out of engagement with a fixed contact member 81 when the bimetal bar is cold and is in engagement with contact 81 when the bimetal bar is hot.

I provide a timer-actuated switch comprising a substantially rigid contact arm 83 and a resilient contact arm 85 which is normally yieldingly biased out of engagement with contact arm 83 but is adapted to be moved into engagement therewith when a lug 87, of electric-insulating material, on the movable end of arm 85 engages any one of the peripheral portions 59, 61 or 63 during the rotation of the cam disk 53.

Supply circuit conductor 43 is connected by a conductor 89 with one of two fixed contact terminals 91 of a contactor or relay including a contact bridging member 93 and a coil 95. The coil 95 is adapted to energize a movable armature core 97 connected with contact bridging member 93 in a manner well known in the art to move the bridging member out of engagement with fixed contact members 91 when coil 95 is traversed by an electric current. One terminal of coil 95 is connected to conductor 89, while the other terminal of coil 95 is connected by a conductor 99 with the fixed end of bimetal bar 79. The contact member 81 is connected by a conductor 101 with contact arm 83. Contact arm 85 is connected by a conductor 103 with one terminal of heater 21, the other terminal of which is connected to the fixed end of bimetal bar 25. Contact 27 is connected by a conductor 105 with the other fixed contact member 91. Conductor 103 is connected by a conductor 107 with the other supply circuit conductor 45.

Let it be assumed that the parts of the continuously operative timer are in the position shown in Fig. 2, that is, a peak or a period of heavy load on the central station has just begun and that contact arms 55 and 83 are in engagement with each other. Let it be further assumed that the upper part of the tank is filled with hot water to such an extent that the upper thermal switch 77 is subject to hot water with the result that bimetal bar 79 is in engagement with contact 81. Under these conditions the coil 95 of the contactor will be traversed by an electric current through a circuit substantially as follows: From supply circuit conductor 43 through conductor 89, coil 95, conductor 99, through bimetal bar 79 and contact 81, through conductor 101 through the engaged contact arms 83 and 85 and then through conductors 103 and 107 to the other supply circuit conductor 45. The contact bridging member 93 will therefore be held in its raised

position so that the circuit through heater 21 will be deenergized.

Let it now be assumed that during the time that contact arm 85 is held in engagement with contact arm 83 by reason of its engagement with portion 63 of disk 53, withdrawal of hot water from the tank occurs with resultant flexing of bimetal bar 79 out of engagement with fixed contact 81. This would deenergize the circuit through coil 95 with resultant drop of contact bridging member 93 into engagement with the fixed contact members 91 and attendant energization of heater 21 through the following circuit: from supply circuit conductor 43 through conductor 89, cooperating contact members 91 and 93, through conductor 105, through the closed lower thermal switch 23, through heater 21 and through conductors 103 and 107 to the other supply circuit conductor 45.

The two above described conditions of deenergization and of energization of the heater 21 therefore mean that in case the tank contains less than a predetermined amount of hot water at the start of a peak period or period of heavy load, the heater 21 would be energized but if the tank contains more than a predetermined amount of hot water, the heater would not be energized during such period of on-peak or heavy load on the central station.

Let it now be assumed that the lug 87 on arm 85 is out of engagement with say portion 63; then the possible energizing circuit, hereinbefore described, for coil 95 would be impossible to establish because at that time contact arm 85 would be out of engagement with contact arm 83. In this case the heater 21 would be energized through the contact members of the contactor in case the tank was not entirely full of hot water.

The systems shown in Figs. 1 and 2 of the drawing therefore are effective to ensure that any customer or user of hot water heated by a system of the kind shown in the drawing will have available for use at least a predetermined minimum amount of hot water, at all times during a twenty-four hour day. Further, as soon as the periods of heavy or peak load, as determined by the engineers of the operating company, have passed by, the heater will be energized in case the tank contains an appreciable amount of cold water or at least enough to subject the switch 23 to cold water.

While I have shown a particular position for heater 21 and a certain relative position of thermal switch 23, I desire to have it understood that this is for illustrative purposes only and that the main lower thermal switch 23 is effective to open the heater circuit as soon as substantially all of the water in the tank is hot.

Various other modifications may be made in the systems embodying my invention and all such modifications clearly coming within the scope of the appended claims are to be considered as being covered thereby.

I claim as my invention:

1. A water heating system for a hot water tank having a single electric heater near the lower end of the tank, comprising a thermally-responsive heater control switch effective to normally cause energization of said heater in case less than all of the water in the tank is hot and means including a timer-controlled switch and a thermally-actuable switch subject to the temperature of the water at a predetermined upper part of the tank for causing deenergization of the heater at predetermined periods of a day in case the tank contains more than a predetermined amount of hot water at the start of and during said periods of time.

2. A water heating system for a hot water tank having a single electric heater near the lower end of the ank, comprising a plurality of switches controlled respectively by time and by tank water temperature at different selected points on a tank adapted to cause energization of said heater at predetermined periods of day in case less than all of the water in the tank is hot, to cause deenergization of said heater during said predetermined periods of day when substantially all of the water in the tank is hot and to cause energization of said heater during the other periods of day only in case less than a predetermined fractional part of the water in the tank is hot.

3. A water heating system for a hot water tank having a single electric heater near the lower end of the tank, comprising a plurality of switches controlled respectively by time and by tank water temperature at different selected points on a tank adapted to cause energization of said heater at predetermined periods of day in case less than all of the water in the tank is hot, to cause deenergization of said heater during said predetermined periods of day when substantially all of the water in the tank is hot and to cause energization of said heater during the other periods of day only in case less than a predetermined fractional part of the water in the tank is hot and to cause deenergization of said heater during said other periods of day when more than said predetermined fractional part of the water in the tank is hot.

4. An all-day water heating system for a hot water tank having a single electric heater near the lower end of the tank, comprising a plurality of thermally-actuable heater-control switches located at different selected points on a tank and a time-controlled switch to cause energization of the heater during off-peak periods of a day in case less than substantially all of the water in the tank is hot and to cause energization of the heater during on-peak periods in case less than a predetermined fractional part of the water in the tank is hot.

5. A water heating system for a hot water tank having a single electric heater near the lower end of the tank, comprising a lower thermal heater control switch effective to cause deenergization of said heater when substantially all of the water in the tank is hot, a second thermal heater control switch subject to tank water temperature at a predetermined upper part of the tank and effective to cause deenergization of said heater when it is subject to cold water and a timer-controlled switch adapted to selectively cause energization of said heater through only the lower thermal heater control switch and through both said thermal heater control switches at different periods of a day in case the tank contains less than predetermined different amounts of hot water during said different periods of a day, said energization continuing until said predetermined different amounts of water are hot.

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