

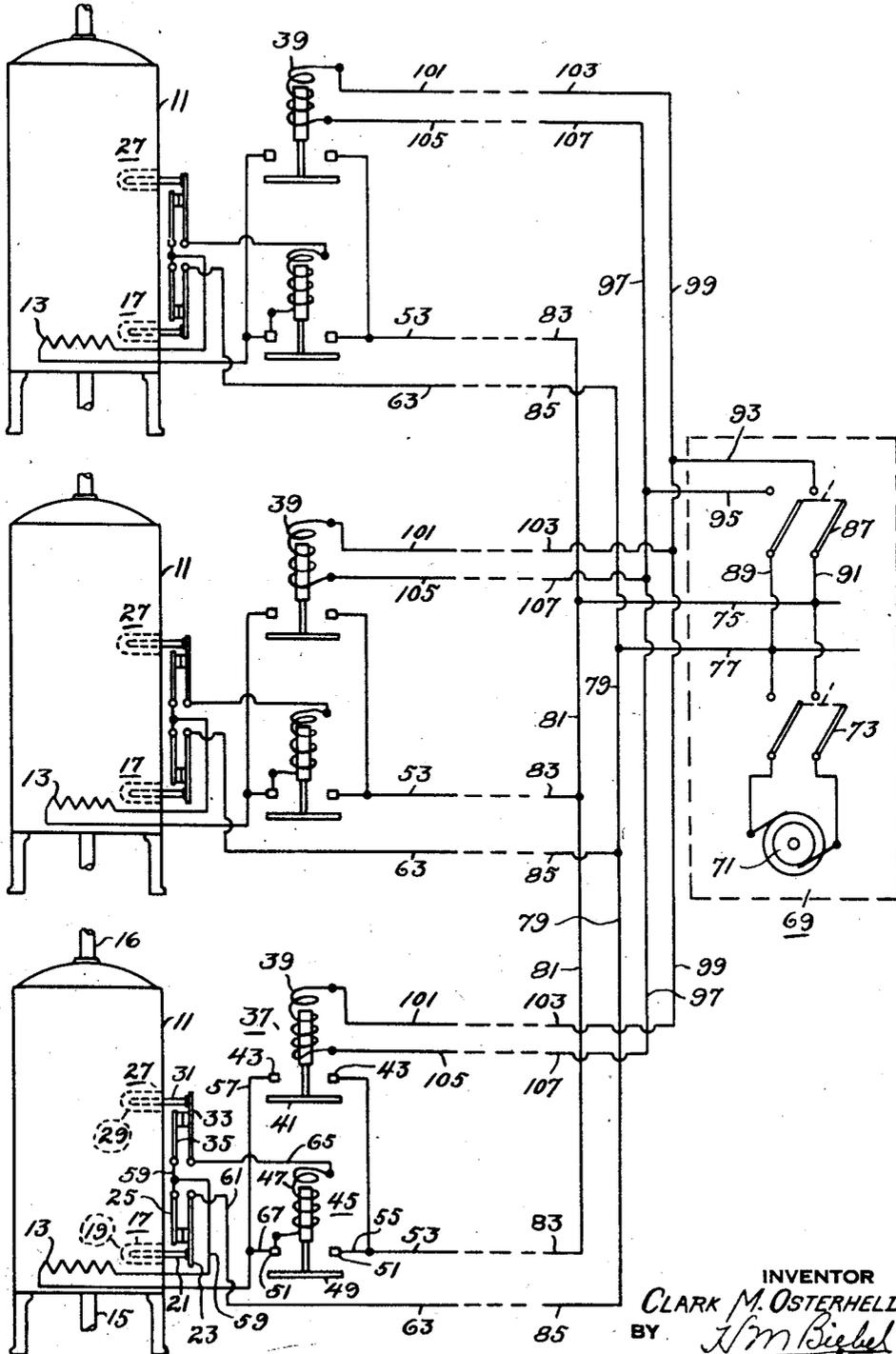
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WATER HEATING SYSTEM

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WATER HEATING SYSTEM

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My invention relates to water heating systems and particularly to off-peak electric water heating systems.

One of the objects of my invention is to provide a relatively simple system whereby an operator in an electric power station can selectively control the energization of fluid tank heaters connected to the system supplied with electricity from the power station.

Another object of my invention is to provide a relatively simple, power house-controlled means and system whereby the operator can be assured that each of the tanks contains at least a predetermined amount of hot fluid during the day and that all of the tanks have their heaters energized during the off-peak period to ensure starting the daylight hours with a substantially full tank of fluid.

Other objects of my invention will either be apparent from a description of a system embodying my invention and now preferred by me or will be pointed out in the course of such description and set forth in the appended claims.

In my copending application Serial No. 365,919, filed November 16, 1940, I have disclosed and claimed a tank water heating system embodying my invention as applied to an individual hot water tank and this application covers the use of a specific form of remote control for a plurality of such hot water or fluid-containing tanks distributed over the area supplied with electric current by the electric power station.

In the single sheet of drawings, I have illustrated a plurality of individual hot water or fluid-containing tanks and the control elements associated with the individual tanks and water heaters, including a remotely controllable control means, in combination with an electric power station.

I have illustrated a plurality of hot water tanks 11, which may be of the ordinary elongated cylindrical type now so commonly used in domestic installations, each tank being provided with an electric heater 13 which, for the sake of simplicity, I have shown schematically only. It is to be understood, however, that this electric heater 13 may be of any suitable or desired construction and mounting on the tank and other details, such as cold water inlets 15 at the bottom of the tank and hot water outlets 16 at the top of the tank, are supplied in a manner well known in the art. Other details such as are usually supplied with hot water tanks or fluid-containing tanks may be used but since these form no part of my in-

vention I have deemed it unnecessary to illustrate and describe the same.

I provide a lower main thermal switch 17 here illustrated as including a tubular member 19 secured in a fluid-tight manner to the wall of the tank to be located inside of the tank. An expansion rod 21 is mounted in the tubular member and engages a resilient contact arm 23 which is normally yieldingly biased into engagement with a rigid contact arm 25 and is disengaged therefrom when the thermal switch 17 is responsive to the relatively high temperature of hot water or other fluid. I wish to point out here that while I have shown specific positions of the heater 13 and of the thermal switch 17, I do not desire to be limited exclusively thereto nor do I desire to be limited to the construction shown. Any other thermally actuatable heater control switch now available in the art may be used by me and is to operate to cause disengagement of the contact arms when substantially all of the water or fluid in the tank is hot.

I provide an upper auxiliary thermally actuatable switch 27 which includes a tubular member 29, an expansion rod 31 adapted to engage and move a resilient contact arm 33 out of engagement with a rigid contact arm 35 which it normally engages as long as the temperature of the water surrounding the tubular member 29 is relatively low or the water or fluid is "cold." It is to be understood that the auxiliary thermally actuatable switch 27 is of substantially the same general design as the lower main thermally actuatable switch 17. I provide a remotely energizable control element 37 in the form of an electromagnetic switch including a coil 39 having a magnetizable core member therein magnetically connected with a contact bridging member 41 which latter is adapted to engage with and be disengaged from a pair of fixed contact members 43. I have illustrated this electromagnetic control member and heater control switch generally only since its design and operation are already well known in the art.

I provide also a second electromagnetic switch 45 including a coil 47, a magnetizable core member therein magnetically connected with a contact bridging member 49 which latter is adapted to be engaged with and disengaged from a pair of fixed contact members 51.

A supply circuit conductor 53 is connected to one of the fixed contact members 43 and a conductor 55 connects conductor 53 and the fixed contact member 43 to one of the fixed contact members 51. The other contact member 43 is

electrically connected by a conductor 57 to the other fixed contact member 51 and to one terminal of the heater 13. The other terminal of the heater 13 is connected by a conductor 59 to contact arms 25 and 35. Contact arm 23 is connected by a conductor 61 to the other supply circuit conductors 63. Contact arm 33 is connected to one terminal of coil 47 by a conductor 65 while the other terminal of coil 47 is electrically connected to that fixed contact member 51 which is connected by a conductor 67 to conductor 57.

I have illustrated an electric power station 69 by a rectangular figure and have further illustrated generally only a suitable source of supply of alternating current electric energy by the usual symbol for an alternating current generator bearing the numeral 71. Control means for the electric energy generated by the generator 71 or by any cooperative plurality thereof, driven by any suitable power means, is indicated by a knife blade switch 73 which is adapted to energize or deenergize, in any suitable or desired manner, a bus bar system including bus bars 75 and 77. These bus bars are connected to distribution circuits indicated generally by the numerals 79 and 81 and are to be understood as being of any size and of any length and may have any number of sub-distribution current conducting wires or members connected therewith to distribute the electric energy over a given area. I have illustrated the source of current for the individual supply circuit conductors 53 and 63 as including conductors 83 and 85, and have indicated the fact that there may be some distance between the bus bar system, the distribution circuits, and the individual installations by the broken lines extending from conductor 53 to conductor 83 and from the conductor 63 to the conductor 85.

I provide a suitable source of control means for the coil 39 of the respective and individual control elements 37 by providing a secondary current distribution system including a manually actuatable switch 87 adapted to be electrically connected with bus bars 75 and 77, by conductors 89 and 91 and adapted to energize an auxiliary set of bus bars or conductors 93 and 95 which are connected to a secondary distribution circuit, shown generally only as including two conductors 97 and 99 which are also to be understood as extending over the area served by the power station. One terminal of each of the coils 39 is connected by a conductor 101 to a distribution circuit conductor 103 which is shown as being connected to conductor 99. The other terminal of coil 39 is connected by conductor 105 with conductor 107 which, in turn, is shown as being connected to the conductor 97 of the secondary distribution circuit. I have shown conductors 101 and 103 and conductors 105 and 107 as connected by broken line connections to point out that any desired distance may be present between the supply circuit conductors 101 and 105 of any individual hot water or fluid installation and the conductors 103 and 107 providing electric energy to such system.

A system of this kind is effective by relatively simple operation in the power station itself to maintain at least a predetermined amount of hot water or fluid in each of the tanks connected to the system during the daytime period of a twenty-four hour day and by slightly different operation of the control means during the usual off-peak hours, to ensure starting the daylight hours of a

twenty-four hour day with substantially each tank full of hot water or fluid.

It may be assumed, merely for illustrative purposes, that the operator in the power station 69 will cause momentary closing of the secondary control switch 87, which he may do manually or by any other suitable control means in accordance with the type of control switch provided. This will momentarily energize each coil 39 of the control element 37 of the respective tank heating systems. Let it be assumed further that this energization is effected several hours after the end of an off-peak period, say 10:00 A. M., and that in a given tank selected merely for illustrative purposes, the auxiliary thermal switch 27 is surrounded by cold water, that is, that withdrawals of hot water from the tank have been enough as to remove such an amount of the original hot fluid content of the tank between the time of ending of the off-peak period and the time of first closure of the control switch 87 as to subject the auxiliary thermal switch 27 to the temperature of cold water. An energizing circuit is momentarily closed as follows: from supply circuit conductor 53 through engaged contact members 43 and 41, through conductor 57, through heater 13, through conductor 59, through engaged contact arms 25 and 23 and from there through conductor 61 to the other supply circuit conductor 63. It is, of course, to be understood that sufficient hot water has been withdrawn from the individual tank to subject the main thermal switch 17 to the temperature of cold water and it is to be further noted that if no hot water had been withdrawn from the individual tank being considered, contact arms 23 and 25 would be out of engagement with each other and no such energizing circuit through the heater 13 would be closed.

A secondary or auxiliary circuit is closed through the coil 47 as follows: from supply circuit conductor 53, through engaged contact members 43 and 41, through conductors 57 and 67, through coil 47, through conductor 65, through engaged contact arms 33 and 35, through conductor 59, through engaged contact arms 25 and 23 and from there through conductor 61 to the other supply circuit conductor 63. This causes energization and upward movement of the core in coil 47 and therefore of the contact bridging member 49 which latter then engages fixed contact members 51. This closes an auxiliary circuit through the heater as follows: from supply circuit conductor 53 through conductor 55, through the engaged contact members 51 and 49, through conductors 67 and 57, through heater 13, through conductor 59, through the engaged contact arms 25 and 23 and from there through conductor 61 to conductor 63. A holding circuit is also established for coil 47 independently of the control element 37 as follows: from supply circuit conductor 53 through conductor 55, through engaged contact members 51 and 49, through the coil 47, through conductor 65, through engaged contact arms 33 and 35, through conductor 59, through engaged contact arms 25 and 23 and from there through conductor 61 to the other supply circuit conductor 63. It is evident that this holding circuit is independent of the control element 37 and since, as hereinbefore stated, the coil 39 was energized momentarily only by the remotely located control means 87, opening of the electromagnetic control element will have no effect upon the energization of the heater 13 through the circuit hereinbefore described which energization

will, of course, continue until the auxiliary thermal switch 27 is subject to the temperature of hot water when contact arm 33 will be caused to disengage from contact arm 35 with resultant interruption of the holding circuit through the coil 37 and therefore deenergization of the heater 13.

The operator in the central station may, therefore, either manually or by any other suitable means effect energization of the secondary distribution circuit controlling the remotely controllable means 37 in each of the heater systems connected to the distribution circuit to thereby pick out, if it may be so termed, those tanks which contain less than a predetermined amount of hot water and ensure that within a reasonable length of time, they will contain at least such predetermined amount of hot water. For purposes of illustration I may mention that it may be desirable to have the control means 87 in the central station closed every two or every three hours during the day and it is evident that only those heaters will be continuously energized for a length of time varying with the amount of hot water in the tank, that is, the greater the amount of hot water already in the tank at the time of a momentary energization, the shorter will be the resultant continuous energization of the heater, which, as hereinbefore stated, will be interrupted by thermally controlled means closely associated with the tank.

It is further desired to ensure that all of the tanks having electric heaters connected to the system shall be full of hot water at about the end of an off-peak period which, for purposes of illustration, may be considered to end at 6:00 A. M. In order to ensure this continuous operation of all of the heaters connected to the system individually associated with hot water tanks, where all of the water in the tank is not hot, the operator merely closes the control switch 87 at some preselected time such as 1:00 A. M. or 2:00 A. M. and leaves it in closed position until say a short time before the end of the off-peak period which, as stated hereinbefore, may be considered to end at or about 6:00 A. M. As is well known, the extreme dip or valley in the load curve on the central station occurs during the late night and a continuous energization of all those heaters associated with tanks not completely full of hot water from say 1:00 A. M. or 2:00 A. M. to just before 6:00 A. M., will ensure that at the end of an off-peak period when the total load on the station begins to rise sharply, all or substantially all of the tanks having heaters connected to the supply system will have their fluid contents in a heated condition. It is to be understood, of course, that the main thermal switch 17 in each of the individual installations will cause interruption of the energization of the heater 13 and of the holding circuit of the coil 47 as soon as all or substantially all of the fluid in the tank is hot.

My invention thus provides a relatively simple means for power house control or for remote control of a plurality of electric heaters applied to hot water or fluid tanks whereby relatively simple control means in the power house closed momentarily at spaced times during a part of the day and closed continuously during another part of the day, namely the off-peak period, will ensure the start of the daylight period with tanks full or substantially full of hot water or fluid and will maintain at least a predetermined fractional part of the fluid content of each tank hot during the daylight hours and during the early evening hours as well.

I have shown the usual domestic hot water tank in the drawing but have used the term "fluid" to indicate that my heating system may be used for fluids other than water. Thus it is possible to use my improved heating system on tanks containing, for example, fuel oil which it is desired to heat before being used, or for heating any other fluid where it is desired to start off at some predetermined time when low power rates become effective or are effective to heat all of the tank content during the off-peak period and then to maintain in a heated condition a predetermined fractional part of the tank content.

I desire it further to be understood that I may use any of the other control systems mentioned in the copending application Serial No. 365,919, filed November 16, 1940, instead of the particular one illustrated in the drawing and described in the specification.

Various modifications may be made in the system embodying my invention without departing from the spirit and scope thereof and I therefore desire that all such modifications as are clearly covered by the appended claims shall be included as a part of my invention.

I claim as my invention:

1. An electric current distribution system energized by an electric power station and comprising a plurality of distributed electric water tanks each having an electric heater near the lower end of the tank adapted to be energized from said system, heater-circuit control means for the individual electric heaters each including a main and an auxiliary electromagnetic switch, electric circuit connections between the power station and the individual heater-circuit control means and manually-actuatable means in the power station for optionally energizing said main electromagnetic switches momentarily to effect energization through the auxiliary electromagnetic switch of those heaters associated with tanks in which less than a predetermined fractional part of the water content is hot and continuously to effect energization through the main electromagnetic switch of all heaters associated with tanks in which less than all of the water content is hot.

2. An electric current distribution system adapted to be energized by an electric power station and comprising a plurality of distributed electric water tank heaters adapted to be energized from said system, heater-circuit control means for the respective electric heaters each including a main and an auxiliary electromagnetic switch, a main and an auxiliary thermally actuatable switch responsive to tank water temperature at different points in the tank, electric circuit connections between the electromagnetic and thermally actuatable switch of each heater and between the main electromagnetic switches of all heaters and the power station and manually-operable means in the power station for effecting energization of all of the main electromagnetic switches momentarily at selectively spaced intervals of a day to cause energization of the heaters of those tanks in which less than a predetermined fractional part of the water content is hot until said predetermined fractional part of the water content is hot.

3. An electric current distribution system adapted to be energized by an electric power station and comprising a plurality of distributed electric water tank heaters adapted to be energized from said system, heater-circuit control means for the respective electric heaters each in-

cluding a main and an auxiliary electromagnetic switch, a main and an auxiliary thermally actu-
able switch responsive to tank water temperature
at different points in the tank, electric circuit
connections between the electromagnetic and
thermally actuatable switches of each heater and
between the main electromagnetic switches of all
heaters and the power station and manually-op-
erable means in the power station for optionally
effecting energization of all of the main electro-
magnetic switches momentarily at selectively
spaced intervals of a day to energize the heaters
of those tanks in which less than a predetermined
fractional part of the water content is hot until
said predetermined fractional part of the water
content is hot and continuously over a prede-
termined length of time to energize the heaters
of all of the tanks in which less than the full
water content is hot.

4. An electric current distribution system
adapted to be energized by an electric power
station and comprising a plurality of distributed
electric water tank heaters adapted to be ener-
gized from said system, heater-circuit control
means for the respective electric heaters each in-
cluding a main and an auxiliary electromagnetic
switch, a main and an auxiliary thermally actu-
able switch responsive to tank water temperature
at different points in the tank, electric circuit
connections between the electromagnetic and
thermally actuatable switches of each heater and
between the main electromagnetic switches of all
heaters and the power station and manually-op-
erable means in the power station for effecting
energization of all of the main electromagnetic
switches momentarily at selectively spaced inter-
vals of a day to cause energization of the
heaters of those tanks in which less than a pre-
determined fractional part of the water content
is hot, the respective auxiliary thermally actu-
able switches causing deenergization of their
electric heaters when said predetermined frac-
tional part of the water is hot.

5. An electric current distribution system
adapted to be energized by an electric power sta-
tion and comprising a plurality of distributed
electric water tank heaters adapted to be ener-
gized from said system, heater-circuit control
means for the respective electric heaters each in-
cluding a main and an auxiliary electromagnetic
switch, a main and an auxiliary thermally actu-
able switch responsive to tank water tempera-
ture at different points in the tank, electric cir-
cuit connections between the electromagnetic
and thermally actuatable switches of each heater
and between the main electromagnetic switches
of all heaters and the power station and means
in the power station for optionally effecting en-
ergization of all of the main electromagnetic
switches momentarily at selectively spaced inter-
vals of a day to energize the heaters of those
tanks in which less than a predetermined frac-
tional part of the water content is hot until said
predetermined fractional part of the water con-
tent is hot and continuously over a predetermined

length of time to energize the heaters of all of
the tanks in which less than the full water con-
tent is hot, thermal deenergization of the elec-
tric heaters energized by momentary energiza-
tion of all of the main electromagnetic switches
connected to the system being effected by the
auxiliary thermally actuatable switches connected
with the energized heaters when said predeter-
mined fractional part of the water content of any
tank is hot and thermal deenergization of elec-
tric heaters energized by continuous energization
of the main electromagnetic switch being ef-
fected by the main thermally actuatable switches
connected with the energized electric heaters
when substantially all of the water content is
hot.

6. An electric current distribution system
adapted to be energized by an electric power sta-
tion and comprising a plurality of distributed
electric water tank heaters adapted to be ener-
gized from said system, heater-circuit control
means for each of the respective electric heaters
including an electromagnetic switch having a
coil, an electric circuit from said coil to the
power station and manually-actuatable means in
the power station to selectively energize the coil
circuit momentarily and continuously, momen-
tary energization of the coil circuit effecting en-
ergization of the heaters on tanks in which less
than a predetermined fractional part of the wa-
ter content is hot and continuing energization of
the coil circuit effecting energization of the heat-
ers on tanks in which less than the full water
content is hot.

7. An electric current distribution system
adapted to be energized by an electric power
station, a plurality of distributed hot water
tanks, each having a single electric heater at the
lower end of the tank and current-distribution
circuits connecting the electric heaters and the
electric power station, heater-circuit control
means for the respective heaters including a
main and an auxiliary electromagnetic heater
control switch, a main and an auxiliary thermal
heater control switch located at different heights
of the tank, electric connections between the
heater and the switches for each tank and manu-
ally operable means at the power station for
selectively energizing the coil of the main elec-
tromagnetic switch of each heater momentarily
and continuously at different times of a day,
momentary energization of the coil of the main
electromagnetic switch of each heater causing
energization through the auxiliary electromag-
netic switch and the auxiliary thermal switch of
the heaters of those tanks in which the auxiliary
thermal switch is subject to cold water and con-
tinuous energization of the coil of the main elec-
tromagnetic switch of each heater causing en-
ergization through the main electromagnetic
switch and the main thermal switch of the heat-
ers of those tanks in which the main thermal
switch is subject to cold water.

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