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Canadian Intellectual Property Office

CA 2963892 A1 2018/10/07

(21) 2 963 892

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2017/04/07

(41) Mise à la disp. pub./Open to Public Insp.: 2018/10/07

(51) Cl.Int./Int.Cl. *F24H 9/20* (2006.01), *C02F 1/02* (2006.01), *F24H 1/20* (2006.01)

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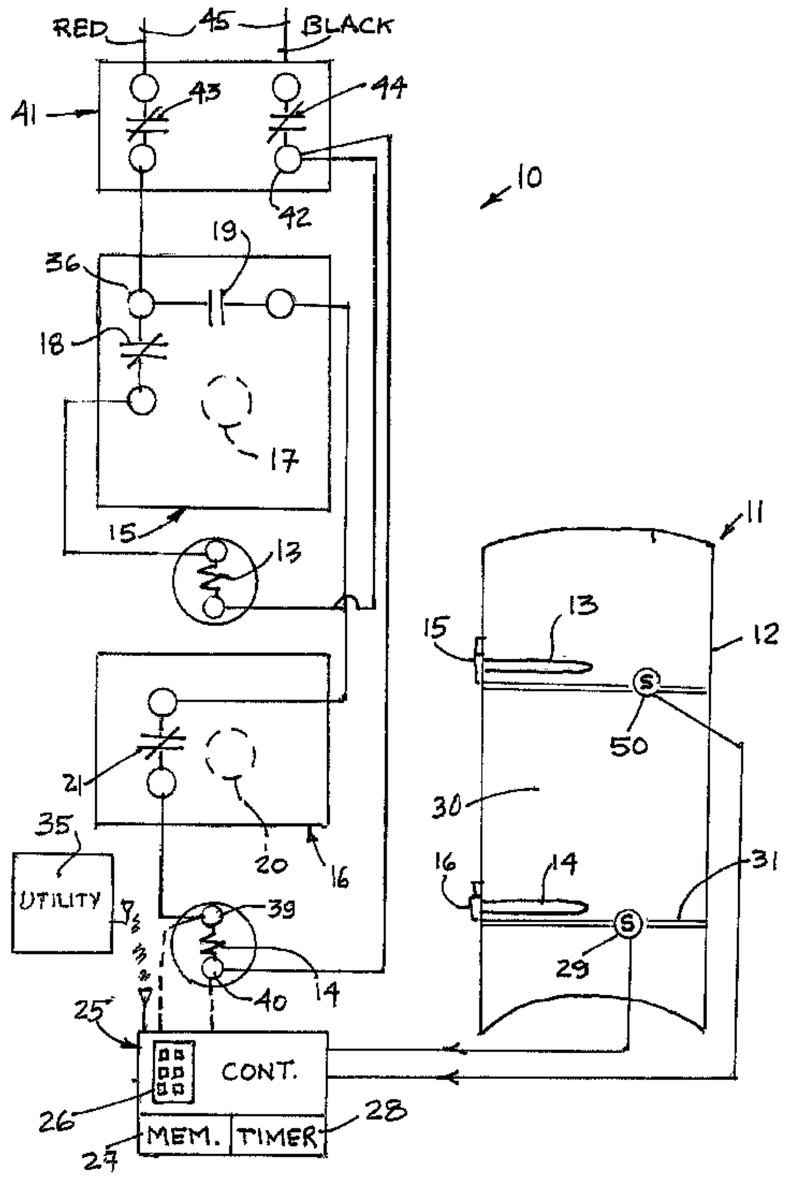
(54) Titre : SYSTEME ET PROCEDE DE COMMANDE POUR FAIRE FONCTIONNER UN ELEMENT CHAUFFANT RESISTIF INFERIEUR D'UN CHAUFFE-EAU ELECTRIQUE AFIN DE TUER DES BACTERIES

(54) Title: CONTROL SYSTEM AND METHOD FOR OPERATING A LOWER RESISTIVE HEATING ELEMENT OF AN ELECTRIC WATER HEATER TO KILL BACTERIA



(57) Abrégé/Abstract:
A controlled system and method for operating a lower resistive heating element of an electric water heater is described to kill bacteria in a lower portion of a water holding tank of an electric water heater. A controller having a timer circuit operates the lower

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(57) Abrégé(suite)/Abstract(continued):
resistive heating element bypassing the control of the thermostat associated with the upper and lower resistive heating element to maintain the lower resistive heating element active during a predetermined sanitizing time period whereby the temperature in the lower portion of the tank is maintained at a predetermined temperature sufficient to kill bacteria. The controller is programmed to override a load shedding function during the predetermined sanitizing time operiod.

ABSTRACT

A controlled system and method for operating a lower resistive heating element of an electric water heater is described to kill bacteria in a lower portion of a water holding tank of an electric water heater. A controller having a timer circuit operates the lower resistive heating element bypassing the control of the thermostat associated with the upper and lower resistive heating element to maintain the lower resistive heating element active during a predetermined sanitizing time period whereby the temperature in the lower portion of the tank is maintained at a predetermined temperature sufficient to kill bacteria. The controller is programmed to override a load shedding function during the predetermined sanitizing time operiod.

CONTROL SYSTEM AND METHOD FOR OPERATING A LOWER RESISTIVE HEATING ELEMENT OF AN ELECTRIC WATER HEATER TO KILL BACTERIA

TECHNICAL FIELD

The present invention relates to a system and method for operating a lower resistive heating element of an electric water heater for a continuous predetermined sanitizing time period at a temperature sufficient to kill bacteria in a lower portion of the water holding tank.

BACKGROUND OF THE INVENTION

Some species of Legionella bacteria can be found in the soil, most species live in water that is stagnant and wherein such bacteria survive under a wide range of temperatures, typically 65 to 115 degrees F. According to the Centers for Disease Control and Prevention, USA, between 8,000 and 18,000 people are hospitalized with Legionnaires disease each year. It is of great public concern as its fatality rate during an outbreak ranges from 5% to 30% in those who contract the disease. Actively managing the risk of Legionella in water systems is more cost effective than responding to an outbreak. Outbreaks of Legionella pneumophila can stem from showers and potable water systems. As water from such sources aerosolized, individuals can inhale the Legionella containing droplets and the organism is aspirated into the lungs.

The formation and multiplication of such Legionella bacteria is not only promoted by the temperature in the customary hot water systems, but also by the fact that dead spaces are present in such water distribution systems in which deposits and sediment formation can arise, and typically in the bottom zone of water heater tanks. Deposits therein can represent a culture medium for bacteria proliferation.

Most electric water heaters for domestic use have its water tank constructed with a dome shaped bottom wall. Such dome-shaped bottom walls form a surrounding cavitated zone about the dome-shaped wall where sediments deposit can gather and where water is less agitated. This cavitated zone is spaced from the bottom heating element and thus water therein is less hot creating an ideal location for bacterial

proliferation. Should the bottom element fail, then the water temperature at the bottom of the tank will drop. It has also been determined by research that the Legionella bacteria does not survive at temperatures above 140 degrees F. When hot water is not drawn from a water heater, the water inside the tank becomes stagnant and the water temperature stratifies with the cooler temperature being at the bottom region of the tank. Water within the cavitated zone below the bottom element of the tank can fall to about 85 to 105 degrees F which is favorable to bacteria growth. Lowering the bottom element to place it close to the bottom wall of the tank has not proven to be a viable solution.

(0005) Reference is made to US Patents 4,940,024; 5,168,546 and 5,808,277 which disclose various methods and apparatus to prevent bacteria proliferation in electric water heaters. One method teaches adding a heating element in the form of a belt or patch on the outside of the tank against the bottom end of the outer sidewall of the tank to heat the water at the bottom end of the tank to a temperature preferably above 130 degrees F. Accordingly, this proposed solution provides an extra heating element in the form of a patch heater located in an area which is usually filled with insulating foam material and not practical to access should it fail and require replacement or repair. It is also costly and consumes more electricity. In US Patent 5,808,277 a third element is added into the tank to periodically raise the water temperature at the bottom of the tank beyond the pre-set consumption temperature, to a sanitizing temperature to destroy bacteria. This is also a costly proposition. US Patent 4,940,024 discloses a method of directing the cold water flow of all consumed drinking or domestically used water through the lower region of the tank wherein there is no stagnant water and wherein no deposits can be formed for bacteria growth. Accordingly, the lower region of the tank is continuously flushed with fresh water. This is a costly solution requiring a new tank design and cold water conduit network and therefore not a viable

SUMMARY OF THE INVENTION

It is a feature of the present invention to provide a system and a method for operating a lower resistive heating element of an electric water heater during a

continuous predetermined sanitizing time period to kill bacteria in the bottom portion of the water holding tank of the water heater.

Another feature of the present invention is to provide a system and a method provided with a controller having a computer which is programmed to operate the lowermost resistive heating element of an electric water heater during a continuous predetermined sanitizing time period at a temperature sufficiently high to kill the Legionella bacteria in the lower portion of the water holding tank while monitoring the temperature of the water in the lower portion of the tank.

A still further feature of the present inventi0on is to provide switching means operated by a controller to bypass the thermostats of an electric water heater to continuously energize the lowermost resistive heating element for a predetermined sanitizing time period without interruption by a load shedding signal to shut down the lower resistive heating element. .

According to the above features, from a broad aspect, the present invention provides a safety system for operating a lowermost resistive heating element of an electric water heater to kill bacteria in a lower portion of a water holding tank of the electric water heater. The system comprises a controller having a computer with a memory for receiving instructions to perform a programmed function. A timer circuit is associated with the programmed function. A temperature sensor is connected to the tank lower portion feeding temperature signals to the controller. The lowermost resistive heating element has a pair of terminals to which is secured two leads from a supply voltage to energize the lowermost resistive heating element. The controller operates switch means to energize the lowermost resistive heating element independently of thermostats associated with an uppermost resistive heating element and the lowermost resistive heating element during a continuous predetermined time period as programmed in its memory sufficient to maintain water temperature in the lower portion of the tank to a predetermined temperature sufficiently high to kill bacteria to sanitize the lower portion of the water holding tank.

According to another broad aspect of the present invention there is provided a method of operating a lowermost resistive heating element of an electric water heater to kill bacteria in a lower portion of a water holding tank of the electric water heater. The electric water heater has an uppermost resistive heating element. The lowermost and uppermost resistive heating elements are controlled by a respective thermostat control having a temperature sensor. The method comprising the steps of:

i) providing a controller having a computer with a memory for receiving instructions to perform a programmed function and having a timer circuit associated therewith;

ii) controlling a supply voltage to a pair of terminals of the lowermost resistive heating element to energize the lowermost resistive heating element;

iii) sensing the temperature of water in the lower portion of the water holding tank, and

iv) energizing the lowermost resistive heating element by said controller independently of the thermostat controls and during a continuous predetermined sanitizing time period, as programmed in the memory of the controller, sufficiently to maintain water temperature in the tank lower portion to kill bacteria to sanitize the lower portion of the water holding tank.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the present invention will now be described with reference to the example thereof as illustrated in the accompanying drawing is which:

Figure 1 is schematic diagram illustrating the system and method of operating the lowermost resistive heating element of a dual element electric water heater by the use of a controller having a computer with a programmed controlled function to control a supply voltage to the lowermost resistive heating element independently of the thermostats associated with the resistive heating elements.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to Figure 1 there is illustrated at 10 a two wire circuit for a dual resistive heating element electric water heater 11. The water holding tank 12 of the water heater 11 has an upper resistive heating element 13 and a lower resistive heating element 14. A thermostat 15 is associated with the upper resistive heating element 13 and a thermostat 16 is associated with the lowermost resistive heating element 14. Thermostat 15 has a temperature sensor 17 for sensing water temperature in the upper portion of the water holding tank 12 and a control, not shown but obvious to a person skilled in the art, to trip the normally closed contact 18 and the normally open contact 19 upon the temperature in the upper region of the tank reaching a preset temperature of its control, usually 140 degrees F. By doing so the upper resistive heating element 13 is shut down and the lower resistive heating element 14 is energized to heat water in the lower portion of the water holding tank 12. The lower thermostat 16 also has a temperature sensor 20 and a control to open the normally closed contact 21 to shut down the lowermost resistive heating element 14 upon reaching a preset temperature in its control, usually also140 degrees F in the lower portion of the water holding tank 12. As mentioned above, it is known that at this temperature the Legionella bacteria does not survive.

In order to ensure that bacteria does not develop in water holding tanks of electric water heaters it is desirable that the water temperature in the lower portion of the tank be raised to 140 degrees F during for an uninterrupted predetermined time period to sanitize the bottom portion of the tank, preferably during non-peak hours when there is likely very little need for hot water and when electricity on the grid is plentiful and at its lowest cost to ensure that the Legionella bacteria cannot proliferate in the bottom portion of the tank 12, particularly in the lower cavity regions of the bottom wall of the tank where sediments usually collect. To accomplish this, the present invention provides a controller 25 which has a computer inputed by a keyboard 26 and equipped with a memory 27 in which a programmed function is inputted to perform a task. A timer 28 is also associated with the controller. A temperature sensor 29 is secured to the outer surface 30 of the water holding tank 12 in the lower portion of the tank 12 by

suitable attaching means such as a strap 31. The temperatur sensor 29 feeds temperature signals to the controller to monitor the water temperature in the lower portion of the tank. The temperature of the tank outer wall is substantially the same as the water temperature in the tank on the other side of the wall. Although not illustrated , the tank is insulated from the outside by a foam insulation, as is well known.

Switch means is provided and operated by the controller 25 to connect a voltage supply directly to the lowermost resistive heating element 14. The connection to switch means can be accomplished by closing supply contacts of thermostats or a switch of the controller (not shown) to connect a power lead to terminal 39 of the lowermost resistive heating element 14. As illustrated, the other connector 40 of the lower resistive heating element 14 is connected to the other arm of the supply voltage 45 at the high limit control switch 41 located at the input end of the upper thermostat 15, herein connected to terminal 42. Thus, by controlling power directly to the bottom element 14 the upper thermostat 15 and the bottom thermostat 16 are bypassed and the lower resistive heating element 14 is energized by the controller to heat the water in the tank bottom portion to maintain a predetermined temperature during a programmed time period., for example four hours, as directed by health regulations whereby to kill any bacteria that may be present in the bottom portion of the tank where the water temperature is not has hot and sediments deposit..

As shown in the drawings, the high limit control switch 41 at the power input of the upper thermostat 15 is there to prevent water in the upper region of the tank from reaching an unsafe temperature of usually 180 degrees F. It has a pair of normally closed contacts 43 and 44 connected to the incoming power leads 45 and these contacts are tripped to an open condition if the temperature exceed 180 degrees F.

As previously mentioned, in order to ensure that the Legionella bacteria is not present in the lower region of the water holding tank it is important that the temperature be raised to at least 140 degrees F and maintained at that temperature for a predetermined period of time as prescribed by health safety regulations. In the event that the controller received a load shedding signal from the utility 35 wanting to shut down the lower resistive heating element 14 during a sanitizing period, the controller will

advise the utility that it is in a sanitizing mode and that the lower resistive heating element will be controlled thereby until the end of the predetermined sanitizing time period. Thereafter, the controller can release the lower resistive heating element to the control of the utility.

As shown, a further temperature sensor 50 is secured to the tank wall in the upper region of the tank to feed temperature signals to the controller 25 wherein the controller can be programmed to monitor the temperature in the tank upper portion in the event that the water in the lower portion cannot be heated to the desired programmed temperature for sanitization. Such temperature monitoring of the upper region of the tank could indicate that the bottom element is defective or its power connection faulty. On the other hand, this monitoring can also serve as a detection of a continuous draw of water from the upper region which needs to be attended to. In such situations, the controller would generate a signal fault condition requesting servicing of the water heater and provide an indication as to the defective area of the water heater.

It is pointed out that although the safety system of the present invention is herein disclosed in association with dual resistive heating elements wired for non-simultaneous operation, it is also intended to cover a simultaneous wiring configuration where the power switch 35 is connected to the incoming supply to energize the lowermost resistive heating element when the switch is actuated by the controller.

Briefly, the method of operation of the present invention comprises operating the lowermost resistive heating element 14 of the electric water heater 11 to kill bacteria in a lower portion of its water holding tank 12. The method comprises the use of a controller having a computer with a memory for receiving instructions to perform a programmed function and having a timer circuit associated therewith. A controllable switching means is associated with the controller and actuated to connect a supply voltage between the terminals 39, 40 of the lowermost resistive heating element to energize the lowermost resistive heating element 14. The temperature of water in the lower portion of the water holding tank 12 is sensed by a sensor 29 which feeds temperature signals to the controller 25 to monitor water temperature in the lower portion of the tank. The controller 25 takes full control of the bottom resistive heating

element and energizes the lowermost resistive heating element 14 independently of the thermostats 15, 16 and for a continuous predetermined sanitizing time period as programmed in the memory of the controller sufficiently to raise water temperature in the tank lower portion to kill bacteria but not exceeding a high temperature limit of heated water in an upper portion of the tank.

It is within the ambit of the present invention to cover any obvious modifications of the preferred embodiment described herein provided such modifications fall within the scope of the appended claims.

CLAIMS

1. A safety system for operating a lowermost resistive heating element of an electric water heater to kill bacteria in a lower portion of a water holding tank of said electric water heater, said system comprising a controller having a computer with a memory for receiving instructions to perform a programmed function, a timer circuit associated with said programmed function, a temperature sensor connected to said tank lower portion feeding temperature signals to said controller, said lowermost resistive heating element having a pair of terminals to which is secured two leads from a supply voltage to energize said lowermost resistive heating element, said controller operating switch means to energize said lowermost resistive heating element independently of thermostats associated with an uppermost resistive heating element and said lowermost resistive heating element during a continuous predetermined sanitizing time period as programmed in its memory sufficient to maintain water temperature in said lower portion of said tank to a predetermined temperature sufficient to kill bacteria to sanitize said tank lower portion.

2. The safety system as claimed in claim 1 wherein said predetermined temperature is in the range of 140 degrees F sufficient to kill the Legionella bacteria.

3. The system as claimed in claim 1 wherein said switch means is an open thermostat contact connected between a live lead of said supply voltage and one of said pair of terminals, said controller causing said open contact to close to energize said lower resistive heating element, the other of said terminals being connected to an associated lead of said supply voltage from a high limit switch.

4. The safety system as claimed in claim 3 wherein said thermostat of said uppermost resistive heating element will switch over said supply voltage to said

terminals of said lowermost resistive heating element through a lower thermostat of said lower resistive heating element during normal operating time periods of said water heater when said power switch is in a normally open condition.

5. The system as claimed in claim 1 wherein there is further provided a second temperature sensor connected to an upper portion of said tank to feed temperature signals of water temperature within said tank upper portion to said controller, said controller monitoring said water temperature in said upper portion of said water holding tank during a predetermined time period if said temperature signals from said temperature sensor connected to said tank lower portion does not attain said predetermined temperature sufficient to kill bacteria and generating a servicing signal indicating that the water heater requires servicing.

6. The system as claimed in claim 1 wherein said controller has a communication link with a power provider and wherein said controller will override a power shedding function from said power provider if said controller is operating said lowermost resistive heating element during said continuous predetermined sanitizing period .

7. The system as claimed in claim 6 wherein said predetermined sanitizing time period is an off-peak time period or a period dictated by local health regulations.

8. A method of operating a lowermost resistive heating element of an electric water heater to kill bacteria in a lower portion of a water holding tank of said electric water heater, said electric water heater having an uppermost resistive heating element, each said lowermost and uppermost resistive heating elements being controlled by a thermostat control having a temperature sensor, said method comprising the steps of:

i) providing a controller having a computer with a memory for receiving instructions to perform a programmed function and having a timer circuit associated therewith;

ii) controlling a supply voltage to a pair of terminals of said lowermost resistive heating element to energize said lowermost resistive heating element;

iii) sensing the temperature of water in said lower portion of said water holding tank, and

iv) energizing said lowermost resistive heating element by said controller independently of said thermostats and during a continuous predetermined sanitizing time period, as programmed in said memory of said controller, sufficiently to maintain water temperature in said tank lower portion to kill bacteria to sanitize said lower portion of said water holding tank.

9. The method as claimed in claim 8 wherein said step (iv) comprises connecting said supply voltage on and off during said predetermined sanitizing period of time to maintain the water temperature in said tank lower portion to about 140 degrees F to kill the Legionella bacteria.

10. The method as claimed in claim 8 wherein said step of sensing comprises securing a temperature sensor on an outer surface of said water holding tank at said lower portion thereof and establishing a connection with said controller to receive temperature signals therefrom to monitor the temperature of water in said tank lower portion.

11. The method as claimed in claim 8 wherein there is further provided the step of securing a further sensor on an outer surface of said water holding tank at an upper portion of said water holding tank to sense the water temperature in said upper portion to monitor the operating condition of said water heater and to detect proper operation of said resistive heating elements

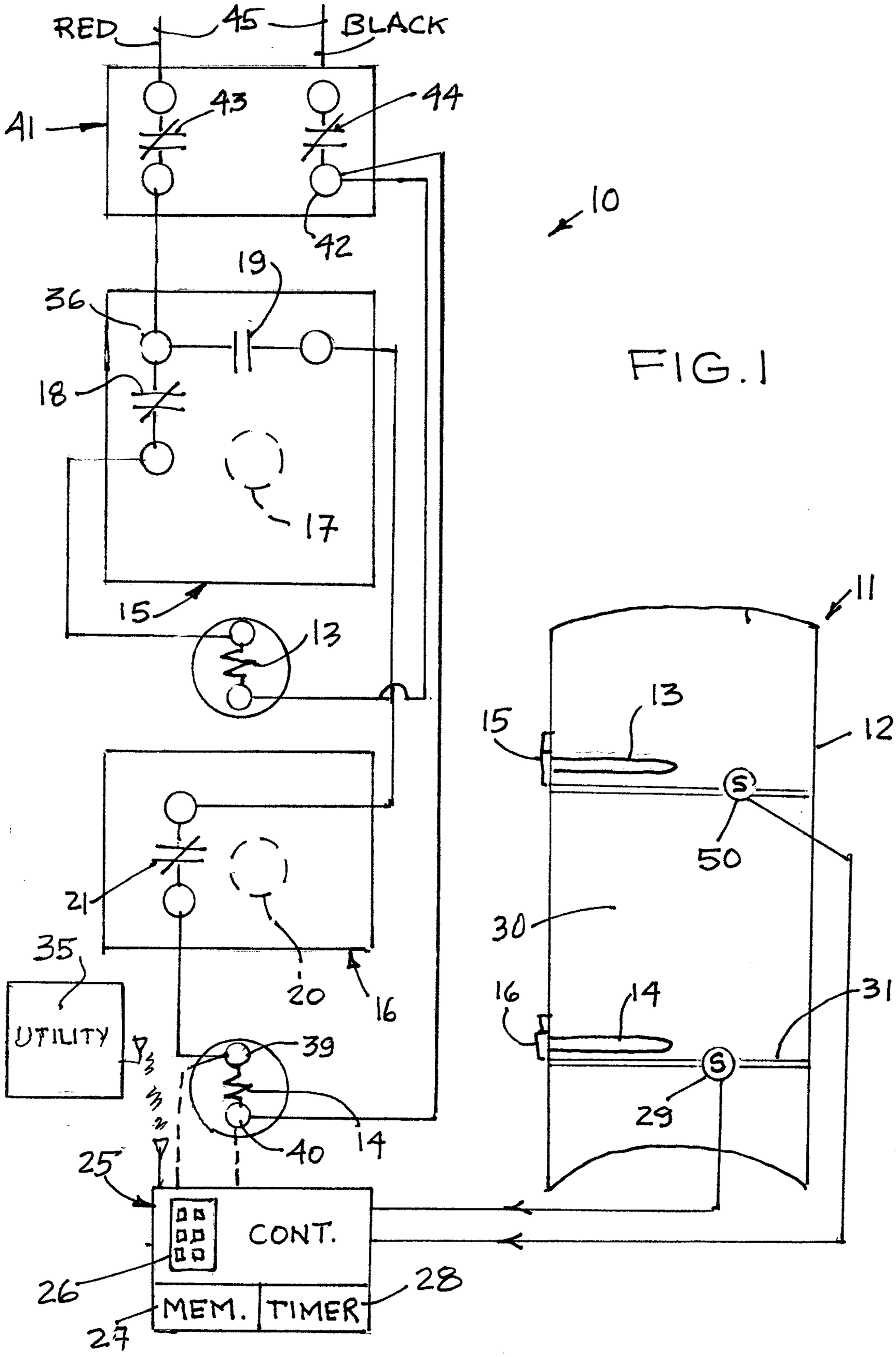
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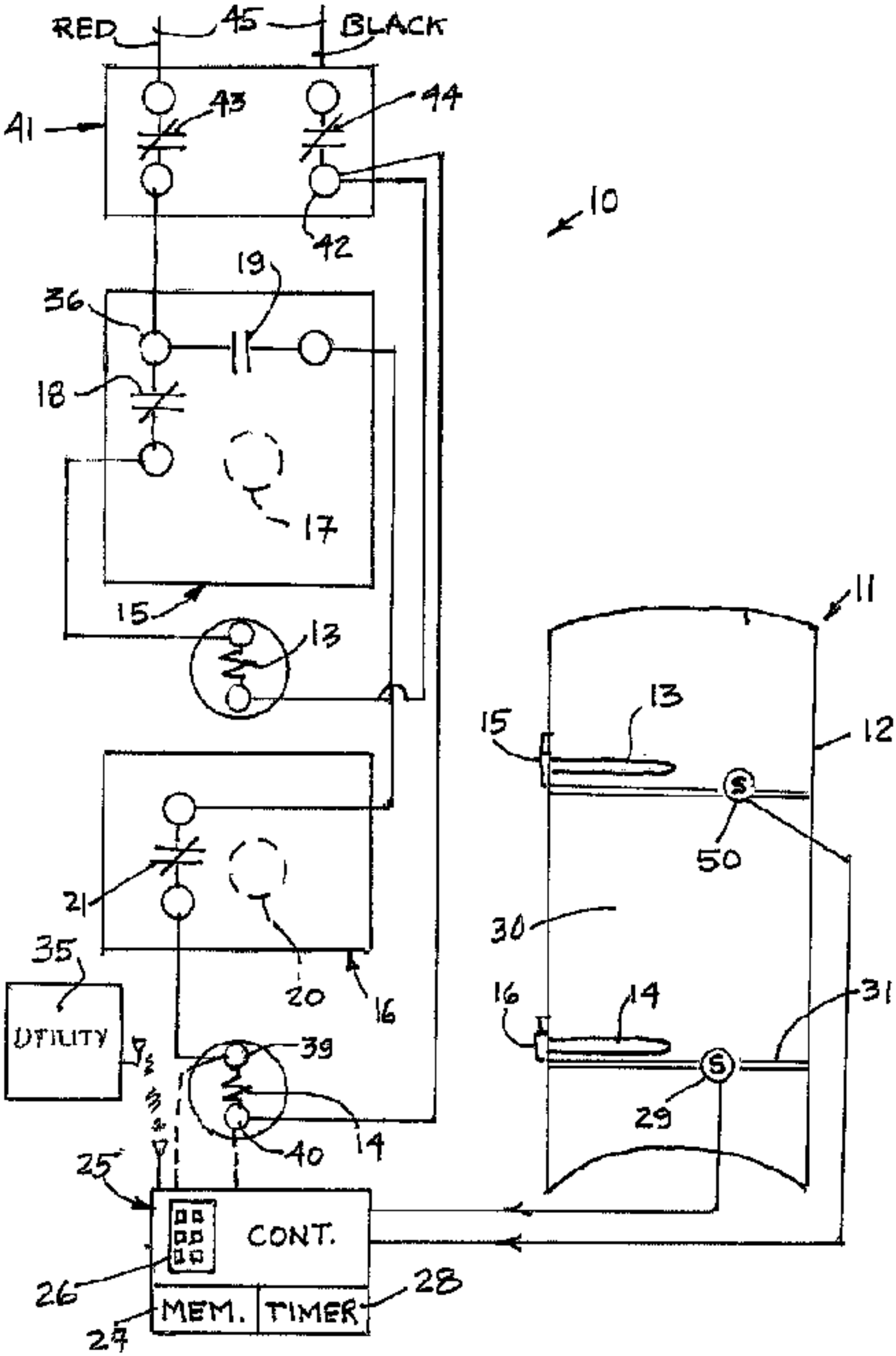
FIG. 1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