

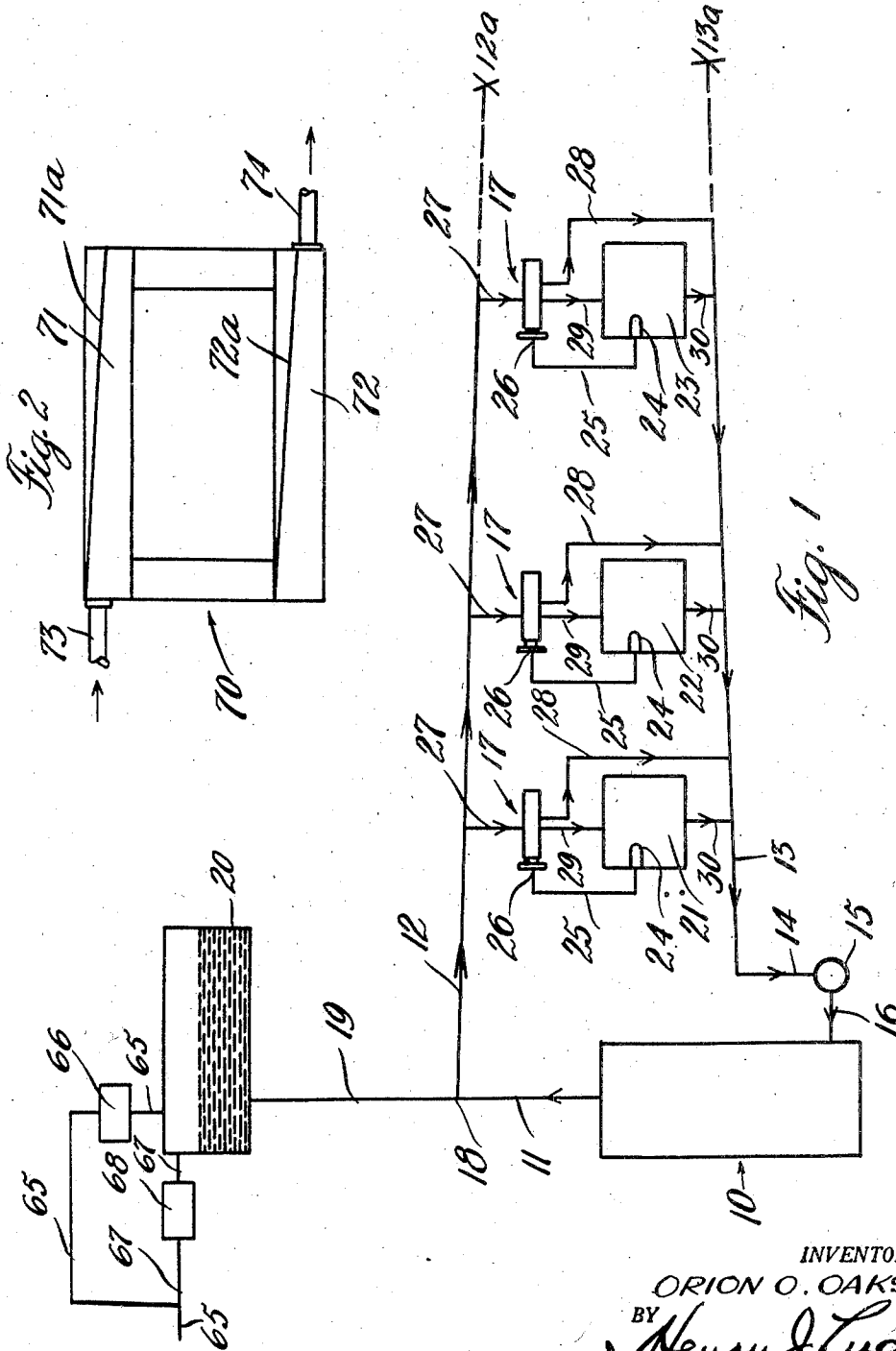
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LIQUID HEATING SYSTEM

2,491,576

Filed Aug. 11, 1945

2 Sheets-Sheet 1



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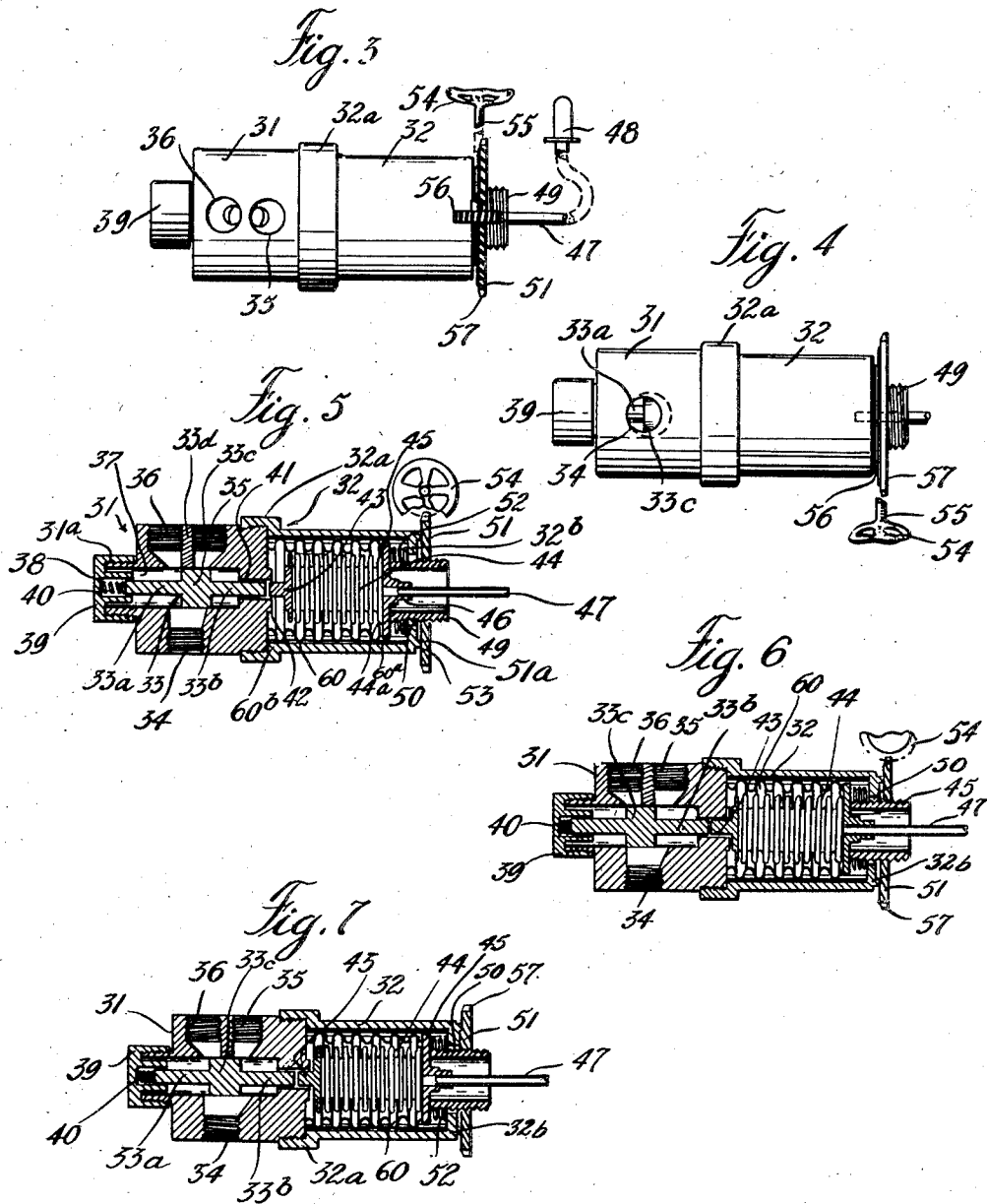
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UNITED STATES PATENT OFFICE

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LIQUID HEATING SYSTEM

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Application August 11, 1945, Serial No. 610,266

2 Claims. (Cl. 237-8)

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My invention relates to liquid heating systems.

An object of the invention is to provide a liquid heating system serving to selectively supply heat to one or more instrumentalities, utilizing preferably a liquid serving as the heating medium which remains liquid throughout the range of temperature of the operation of such one or more instrumentalities, including the range of low temperature to which the system, inclusive of such one or more instrumentalities, may be subjected due to exposure of low temperature of the outer atmosphere, as when idle and outdoors or when indoors in a non-heated building.

Most preferably, the liquid heating medium possesses the attributes of substantially nil vaporization through the full gamut of temperature range, thus affording substantially the absence of its gaseous phase throughout the operation of the system.

A particular application of the invention resides in the employment of the system as the common source of heat in serving the various heat-operated instrumentalities of a home, or similarly for an industrial plant, or for a group of neighboring homes or plants. Such heat-operated instrumentalities include, as in the instance of a home, the range for the heat preparation of food, inclusive of a toaster, the oven and other instrumentalities for cooking, the supply of heat for heating the interior of such home, the refrigerant-operated refrigerator, a steam generator for operating a pump or other mechanical operation or a dynamo of a lighting circuit or other electrically operated appliance, etc., and likewise applicable for appurtenant appliances of an industrial plant or other locale in which humans are employed.

The liquid serving as the heating medium preferably possesses the additional attributes of non-toxicity, non-poisonous and non-irritating to humans or animals, non-explosive when subjected to the air, and immunity to wood or other materials conventionally employed in the construction of a house or other building. Tetracresylsilicate is typical of such liquid heating medium, possessing the above-stated characteristics, inclusive of the attribute of remaining wholly liquid for the range of high temperature required in the servicing of instrumentalities of a home or the like, and further inclusive of minimum outer atmospheric temperature. In the employment of the system for the average home, the range of temperature required by the instrumentalities served by the system, under normal conditions, may vary from 200° F. to 600° F., a

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maximum temperature being required in the toasting of bread.

Tetracresylsilicate possesses the following attributes: specific gravity 1.12; specific heat .45; boiling point 817° F. at atmospheric pressure; liquid from -65° F. (at which it is viscous) to 750° F.; non-toxic; non-corrosive to iron, steel, brass, copper and the like; non-destructive to wood; and possesses a characteristic odor which is readily detectable and accordingly is self-policing in indicating any leak, to permit prompt repair of such leak.

Tricresylphosphate, among other like substances, is also applicable as the liquid heating medium.

Preferred embodiments of the invention utilize a valve of the type described and claimed in my copending application Ser. No. 603,056, filed July 3, 1945, now Patent No. 2,462,217, granted February 22, 1949, entitled "Valve for thermal systems," referred to therein as a modulating valve, a characteristic of which is that such valve affords at all stages of operation of the system continuous flow of the heating medium whether the instrumentality controlled by such valve calls for full heat or partial heat or non-heat.

Typical embodiments of the system comprise a boiler fired either by coal or other solid combustible material, or oil-fired or gas-fired, or by an electrical heater, the outflow of such central heating source being connected to suitable piping serving as the main supply line, a main return line suitably connected with the main supply line through such modulator or equivalent valve for each such instrumentality, such valve being connected also with piping by-passing the served instrumentality and leading to the main return line, the continuous flow of the liquid heating medium being preferably positively maintained by a pump, desirably connected between the main return line and the intake of such central heating source, and further including a tank or equivalent serving as an expansion device suitably connected with the piping leading from the outtake of the central heating source.

The expansion tank may be installed wherever desired to position its top wall sufficiently above the level of the highest point of the system as an entirety to provide for the necessary expansion of the thermal medium, as in the initial heating of the liquid medium from "cold" to the desired operating temperature, namely such high temperature effectively serving the instrumentality requiring the maximum temperature in its operation. In a home or other building it is conven-

ient to locate such expansion tank within such building at or toward the top of the building to thereby utilize otherwise unused space.

In the most preferred embodiments of the invention, the main supply line is installed to extend at an angle downwardly with respect to the horizontal, the main return line extending also downwardly with respect to the horizontal; also in each of the instrumentalities served by the system, the inflow port or ports of the coils or other heating-liquid-conveying elements are located in a plane above the plane of the outflow port or ports of such coils or other heating-liquid-conveying elements. Such manner of installation of the system as an entirety provides for the passage flow of any air, steam resulting from water, or other gaseous material perchance entrapped in the system, thereby conducting the same through the piping of the system to the expansion tank. Desirably, the expansion tank is vented to the outer atmosphere and is protected by suitable means to preclude the entry of the outer atmosphere (containing moisture, water or dust, or other foreign substances), and to maintain atmospheric pressure above the level of the liquid in the expansion tank.

In preferred embodiments of the invention, the main supply line and the main return line are not directly connected to one another, the continuity of flow of the liquid heating medium being effected through the one or more three-way valve means respectively associated with the one or more heat-operated instrumentalities served by the system.

Further features and objects of the invention will be more fully understood from the following detailed description and the accompanying drawings, in which

Fig. 1 is a diagrammatic illustration of a typical embodiment of the liquid heating system pursuant to the invention.

Fig. 2 is a diagrammatic central sectional view of an oven typical of the instrumentalities served by the system.

Figs. 3 and 4 are elevational views taken on opposite sides of valve means applicable for connection with an instrumentality served by the system.

Fig. 5 is a central sectional view of a preferred form of valve means typified in Figs. 3 and 4. The illustrated valve means is provided with suitable mechanism controlling the movable valve member and in turn controlled by suitable liquid type of thermostatic means located to be responsive to the temperature of the instrumentality served. This view illustrates the movable valve member in its position affording full flow of the liquid heating medium through the valve body from the main supply line to the main return line.

Fig. 6 is a view corresponding to Fig. 5 but showing the movable valve member in its position affording full flow of the liquid heating medium through the valve body from the main supply line to the coil or equivalent means of the instrumentality to be heated.

Fig. 7 is a view similar to that of Figs. 5 and 6 but showing the movable valve member in its position affording flow of the liquid heating medium through the valve body from the main supply line partwise to the main return line and partwise to the instrumentality thus served, and thence to the main return line.

Referring to the diagrammatic view of Fig. 1, 10 represents the boiler or other source of heating energy, to the outtake of which is connected the

pipe 11 leading to the main supply line 12. The main return line is indicated at 13 which is shown connected by the pipe 14 with the intake of the pump 15, the outtake of which is connected by the pipe 16 to the intake of the boiler 10. As appears more fully hereinafter, the valve means indicated generally 17 of the respective instrumentality served by the system affords continuity at all times of flow of the liquid heating medium from the main supply line 12 to the main return line 13, the flow being positively actuated by the pump 15, the outward end of the main supply line 12 indicated at 12a and the outward end of main return line 13, indicated at 12a, being closed to the outer atmosphere.

Suitably connected with the system as by connection at the junction 18 of the pipe 11 with the main supply line 12, there is provided the pipe 19 leading to the expansion tank 20. As hereinbefore set forth, the expansion tank may be located at any desired or convenient position, subject to the requirement that the top wall of the expansion tank be sufficiently above the level of the highest point of the system to provide for the necessary expansion of the thermal medium, incident to the initial heating of the medium from atmospheric temperature to the desired operating temperature.

Typical of instrumentalities comprised in an installation for a home, Fig. 1 indicates at 21 a heater which may be in the form of an individual heater such as a single radiator or group of radiators, or a heater of the fan-equipped heat exchange type or a group of the same, or the instrumentality 21 may be a heat exchanger coordinated with a separate system utilizing water in the form of steam or hot water supplied to or circulated in a system of radiators or other forms of local heating units pursuant to conventional practice, etc.

The instrumentality indicated at 22 may be a refrigerator utilizing any suitable refrigerant as the source of cooling. The instrumentality indicated at 23 may be an oven for baking, broiling and like purposes. The variant number and types of such instrumentalities are selected in accord with the requirements of the particular systems to which the invention is applied, inclusive if desired of a toaster for slices of bread and the like, and/or a heater or heat exchange unit for the generation of steam in turn for operating a pump, etc., various forms of pots, griddle, dish washer, clothes washer, ad infinitum, in each of which instrumentalities there is embodied a coil or set of coils or enclosing shell or compartment provided with baffles for directing the flow of the liquid medium therethrough, or the like, whereby preferably the liquid medium at the desired operating temperature is brought directly into engagement with the material of the wall defining the whole or a part of the interior of the instrumentality, in which is placed the food to be prepared, as in the instance of food preparation instrumentalities, or in which interior is disposed water or other suitable medium for the conversion of the same into steam for a steam heating system, generation of power and the like, or for the heating of water in a hot water heating system.

Desirably, the temperature of the operating interior of each instrumentality served by the heating liquid medium at its operating temperature is controlled thermostatically, Fig. 1 indicating at 24, in the respective typical instrumentalities 21, 22 and 23, etc., such thermostatic control. Con-

veniently such thermostatic control is of the liquid expansion and contraction type, the pipe 25 indicating the conventional capillary tube connecting the interior of the thermostat bulb 24 with the inlet 26 of the bellows form of expandible and contractable container or other device responsive in displacement in accord with the expansion or contraction of the thermostatic liquid, such bellows form of expandible and contractable container or equivalent functioning to control the setting and movement of the movable valve member of the valve means 17 to provide for the continuous variant flow of the liquid heating medium from the main supply line 12 to the main return line 13 in full flow from one directly to the other or through the heating element or elements of the instrumentality or partwise through the heating element or elements of the instrumentality and partwise directly to the main return line, as will now appear.

27 indicates piping leading from the main supply line 12 to the inlet of the valve means 17. 28 indicates the piping leading from one outlet of the valve means directly to the main return line 13. 29 indicates the piping leading from another outlet of the valve means to the heating element or elements of the instrumentality 21, and 30 indicates the piping leading from the heating element or elements of the instrumentality to the main return line 13, and independently of the valve means.

A preferred form of valve means, typified by the valve means 17 in Fig. 1, is described and claimed in my copending application, Ser. No. 603,056, filed July 3, 1945, entitled "Valve for Thermal Systems." Such preferred form of valve means, which may be termed a modulator valve, is herein illustrated in Figs. 3 through 7.

Referring specifically to Figs. 3 through 7, the valve therein illustrated comprises a two-part casing 31, 32, the casing 31 enclosing the movable valve member 33, the casing 32 enclosing mechanism for actuating the movable valve member. The port 34 of the casing 31 serves as the inflow for the heating liquid led through the piping 27 from the main supply line 12. The port 35 serves as the outlet leading through the piping 28 to the main return line 13. The port 36 serves as the outlet connected by the piping 29 to the heating element or elements of the instrumentality served by the system, and in this instance to be controlled in temperature of its operating interior by the valve.

The movable valve member 33 comprises oppositely directed stems 33a, 33b, extending in opposite directions and respectively secured to a more or less centrally disposed valve plug element 33c, the outer periphery of which conforms closely to the periphery of the bore 37 which extends substantially centrally within and longitudinally of the casing 31. Desirably, the bore 37 is of circular configuration, as shown, but may be of other suitable configuration; the periphery of the plug element 33c is of corresponding configuration and dimensioned to make a close but sliding fit with the faces of the bore 37.

The stem 33a is received within and guided by the hollow recess 38 shown formed within the cap 39 and adjacent the outer end of the casing 31. The cap 39 serves to close the outer end of the casing 31. Within the recess 38 is an expansile spring 40 which serves as a return spring for the movable valve member 33. As shown, the cap 39 is sealingly secured to the outer end of the casing 31, as by mating screw-threaded connec-

tion with the extension 31a of the casing 31, thereby affording also adjustment of the pressure of the spring 40. The stem 33b of the movable valve member extends within the bore 41 which passes through the inner end of the casing 31 and serves to guide the stem 33b.

The casing 31 is provided at its inner end, i. e., adjacent the bore 41, with a perforated boss 42, which serves to receive the plunger 43 of the bellows form of expandible and contractable container 44 or equivalent valve actuating device which is associated with suitable means responsive to temperature changes, referred to more fully hereinafter.

The casing 32 is stationarily connected with the casing 31, as by screw-threaded connection of its bell end 32a.

The movable valve element may be controlled in its position relative to the ports 35 and 36 by manually setting or otherwise as may be desired. Desirably, the control of the movable valve member is had automatically as by thermostatic control in response to the temperature desired within the instrumentality associated with the valve.

For the purpose of thermostatic control, the bellows form of expandible and contractable container 44 or equivalent valve actuating mechanism, controls the position of the plug element 33c to control in turn the flow of the liquid heating medium through the valve body 31, that is to say, the flow of the liquid heating medium through the inflow 34, then into the valve bore 37 and thence either wholly through the port 36 leading to the by-pass connected with the instrumentality served by the modulator valve, as illustrated by Fig. 5, or through the port 35 in return to the main circuit, as illustrated in Fig. 6, or partwise through both ports 36, 35, to effect partial flow through both of the ports 36, 35, as illustrated in Fig. 7. Hence, to effect full flow from the intake port 34 to either of the ports 35 or 36, the plug element 33c of the movable valve member 33 has a peripheral dimension parallel to its axis less than the corresponding dimension of the inner opening of the inlet port 34, thus insuring continuity of flow of the thermal medium through the inlet port 34; the plug element 33c has a peripheral dimension parallel to its axis greater than each of the corresponding dimensions of the individual ports 35, 36, but not exceeding the sum of the stated dimensions of ports 35, 36, plus the dimension in like direction of the partition 33d of the valve body between the ports 35, 36, to provide, as above referred to, simultaneous flow through both ports 35, 36.

The bellows form of expandible and contractable container 44 may be of any conventional construction; usually its corrugated wall of suitable brass composition defines a central interior of substantially uniform diameter. The terminal edge 44a of such wall of the bellows form of expandible and contractable container may be secured to a base plate 45, as by brazing, in this instance with sufficiently high temperature solder to withstand the maximum temperature of the heating medium of the system. Such plate 45 is shown provided with a centrally bored outwardly extending boss 46, to which is secured the end of the flexible capillary or other suitable tube 47 which is connected with the thermostatic bulb 48, see Fig. 3, the thermostatic bulb 48 corresponding to the thermostatic bulb 24 indicated in Fig. 1, or other suitable temperature responsive device. The plate 45 is shown centrally supported within the casing 32 by securement to the hollow stud

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49 which is adjustably mounted within the opening 50 at the outer end of the casing 32, as by securement afforded by screw-threaded connection with the regulating plate 51 and cooperatively with the expansile spring 52 seated between the inner face of the outer wall 32b of the casing 32 and the base plate 45 of the bellows form of expandible and contractable container 44, whereby the adjusting plate 51 is adjustably held in relative relation with respect to the casing 32. Securement of the regulating plate 51 is shown had by means of its guide ring 53, which is secured to or integral with the outer face of the outer end wall 32b of the casing 32, the ring 53 making a close sliding fit with the circular shoulder 51a on the inner face of the adjusting plate 51, and resiliently held in such position by the stated expansile spring 52.

As presently explained the adjusting plate 51 is set in position to regulate the maximum temperature to which the served instrumentality is to be heated.

The setting of the adjusting plate 51 may be had by any suitable means. Figs. 3, 4 and 5 indicate such setting means comprising an operating wheel 54, handle or the like, which is located to be readily accessible to the user, and appropriately mounted in position. To such setting wheel 54, as shown, is connected a shaft 55 or equivalent, in turn controlling a worm, indicated at 56, see Fig. 4, or other suitable gearing member; such worm is shown meshing with the skew gear, indicated at 57, or other appropriate gearing arrangement, which gear 57 is indicated as mounted at or formed on the peripheral edge of the adjusting plate 51. Associated with such setting wheel, handle or the like is an indicator bearing indications of temperature or other appropriate notations such as "Off"; "Warm"; "Medium"; "Hot"; etc.

Referring to Figs. 5, 6 and 7, preferred embodiments of the invention comprise further an expansible and retractable hollow member 60 of the general formation of a bellows form of expandible and contractable container embracing said thermostatically-responsive bellows form of expandible and contractable container 44, said hollow member 60 serving as a self-adjusting container for entrapping such portion of the heating medium which seeps through the clearances between the face of the stem 33b of the movable valve member and its guiding bore 41 in the valve body. As shown in Figs. 5, 6 and 7, such entrapping hollow member 60 is sealingly closed at its outer end 60a by brazing or the like to the inner face of the plate 45 to thereby embrace the bellows form of expandible and contractable container 44. The inner end 60b of the entrapping member 60 is suitably sealingly closed by any suitable means with respect to the interiors of the valve bodies 31, 32, as by mechanical pressure sealing at the joint afforded by the screw-threaded connection of the bell 32a of the valve body 32 with the valve body 31.

The provision of such self-adjusting entrapping container obviates the use of a gasket or equivalent, and affords shifting movements wholly free of friction of the stem 33b of the valve member, and thus of the movable valve member 33 as an entirety.

In the most preferred forms of the invention, such valve means is combined with thermostatic means which is responsive to the temperature of the instrumentality served by the heating system for automatically controlling the movable valve

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member to regulate the volume of flow of the heating medium to the heating coils of such instrumentality.

In the operation of regulating the temperature of the interior of any particular instrumentality, the regulating plate 51 is set to indicate such temperature. Prior to such setting, such regulating plate 51 is at "0°" reading, in which situation, the bellows form of expandible and contractable container effects the positioning by its plunger 43 of the movable valve member 33 as indicated in Fig. 6, namely the plunger 43 immediately abutting the righthand stem 33b of the movable valve member, thereby compressing the spring 40 and locating the plug element 33c to provide full flow of the heating medium from the intake port 34 through the valve body and thence out of the outlet port 35, namely through the pipe 30, indicated in Fig. 1 in return to the main line 12.

(Fig. 6 illustrates clearances between the free end of such plunger 43 and the free end of the stem 33b of the movable valve member and also between the face of the base of the plunger 43 and the face of the boss 42; these clearances are purely for graphical clarity.)

Recurring to the operation of setting the temperature of the desired instrumentality in a system typified in Fig. 1, the plate 41 is rotated corresponding to the maximum temperature, thereby causing the plunger 43 to recede from its position shown in Fig. 6 to its position shown in Fig. 5, whereby the movable valve member 33 is released under action of its expansile coil 40 to locate the plug element 33c in its position as indicated in Fig. 5. At this stage, and as fully set forth in connection with the description of Fig. 5, the heating medium passes from its intake port 34 through the body of the modulator valve wholly to its outlet port 36 and thence through the piping 29 to the inlet of the heating coil or coils of the desired instrumentality, and from the outlet of such coil or coils the heating medium flows through the piping 30 to the main return line 13.

In consequence of the heating of the interior of the instrumentality, the temperature of the temperature-responsive liquid of its thermostatic bulb 24 and its capillary tube 25 and within the bellows form of expandible and contractable container 44 is progressively raised and accordingly expanded, causing the bellows form of expandible and contractable container 44 to expand whereby its plunger 43 engages the free end of the stem 33b of the movable valve member and progressively shifts the plug element 33c toward the left as viewed in Fig. 6 to position the plug element intermediate of the outlet ports 35, 36. Fig. 7 indicates the position of the plug element 33c substantially equally with reference to the valve outlet ports 35, 36. As the temperature within the desired instrumentality increases further, the expansion of the bellows form of expandible and contractable container 44 continues; upon the interior of the instrumentality attaining its maximum temperature regulated by the setting of the regulating plate 51, as above described, the plug element 33c has moved to its full shutoff position with respect to the flow of the heating medium to the heating coils of the desired instrumentality, as illustrated in Fig. 6.

Upon cooling of the interior of the instrumentality, ensuing in the operation of such instrumentality, and by loss of heat radiation, the plunger 43 recedes from its position shown in Fig. 6 to some intermediate position indicated gener-

ally in Fig. 7, thus providing for partial flow of the heating medium to the heating coils of the instrumentality and partial flow in return to the main return line 13. Upon restoration of the full heat set by the regulating plate 51, the shifting of the plug element 33c is reversed to shut off either in full or partially the supply of the medium to the heating coils of the instrumentality. The above or equivalent manner of operation of the modulator valve continues until the operation within the desired instrumentality is completed.

By connecting the heating coil or heating coils of the instrumentality directly with the main return line 13, that is to say, independently of the valve means, maintenance of control of the desired range of operating temperature within the instrumentality is attained.

The temperature sensitive liquid of the thermostatic control means may be the same as employed as the heating medium of the heating system.

It will be observed that all joints of the respective modulator valves and of the system of piping are permanently sealed and without the use of packing, stuffing boxes or the like; further, the various movable parts of each modulator valve are wholly enclosed within the valve body and actuated under control without the employment of any shaft or other moved part which extends exteriorly of the valve body: in summary, all joints are self-sealed at all stages of operation, thus ensuring against leakage and consequent loss of the thermal fluid, injury to person, damage to property, etc.

The valve body and its constituent parts may be of any metal which is capable of withstanding the range of temperature employed in the system. Copper, brass, bronze, aluminum, steel, etc., are illustrative of suitable material. Preferably, the material of the valve and the valve parts is selected with respect to the material of the piping and other parts of the system which are exposed to the heating liquid, to avoid wide differences in expansion and contraction, preclude electrolytic action between different metals, and other deteriorating effects. Since present day types of bellows form of expandible and contractable container or equivalent bellow-like formations are made of brass, brass or copper is preferable for the material of the valve and its parts and the piping.

Suitable provision of means is made for the outflow of air from the expansion tank incidental to the expansion of the heating liquid, as by providing a pipe 65 which, as shown in Fig. 1 may be connected with the interior of the expansion tank towards its top and leading to the outer atmosphere, a one-way valve 66, opening solely outwardly. It is also desirable to provide a vacuum breaker connection between the pipe 65 and the top of the expansion tank as by the pipe 67 incorporating the vacuum breaker 68 connected with the pipe 65 between its outer free end and the valve 66 and communicating with the top of the expansion tank; the vacuum breaker 68 may be a one-way valve opening solely in the direction toward the interior of the expansion tank, the outward end of the pipe 65 is the sole opening of the thermal system which communicates with the outer atmosphere. Such one-way valve for the pressure relief valve 66 and the vacuum breaker valve 68 conventionally is of the spring biased type, the pressure relief valve 66 being biased to its closing position in the direction inwardly of the system, and the vacuum breaker valve 68

biased toward its closing position in direction outwardly of the system.

Preferably, the main supply line and the main return line and including the piping respectively connected thereto leading to the intakes of the respective valve means and from the outlets thereof through the heating element or elements of the respective instrumentalities and leading directly to the main return line are arranged to incline downwardly with respect to the horizontal in the direction of flow of the liquid heating medium; such provision of means ensuring the escape of air or other gas or gases by the travel of such air or other gas or gases in an upward direction through the system counter to the flow of the liquid heating medium, whereby such air or other gas or gases is conveyed eventually by the main supply line to the expansion tank, through the pipe 19, and discharged into the outer air through the valve 66 and its piping 65.

For the purpose of minimizing the entrapment of air in the individual respective coil or coils or other heating element or elements of the several instrumentalities served by the system, the walls of such coil or coils or other heating element or elements are formed and/or positioned to provide a path extending upwardly with respect to the horizontal in direction counter to the direction of flow of the heating medium, to provide similarly for the positive scavenging of such gaseous matter.

Fig. 2 illustrates the application of such principle with respect to an oven designated generally 70, shown as provided with an upper heating element 71 and a lower heating element 72, which are illustrated in the form of compartments which may be provided with baffles (not shown) for directing the flow of the liquid heating medium therethrough. In the instance of an oven, the sides of the oven are also provided with similar baffle-provided heating-liquid conducting compartments connected respectively with the upper compartment 71 and leading to the lower compartment 72. The piping 73 as indicated by its appended arrow corresponds to the piping 29 indicated in Fig. 1 and accordingly is connected with the intake of such heating element 71; the piping 74 connected to the outlet of the lower heating element 72 corresponds to the piping 30 indicated in Fig. 1. The heating element 71 has its upper wall 71a slanted upwardly with respect to the horizontal in direction counter to the flow of the liquid heating medium. The upper wall 72a is similarly inclined, and in furtherance of such positive scavenging of gaseous matter the intake piping 73 makes connection with its heating element 71 at the highest point of the wall 71a of the heating element 71, as indicated in Fig. 2.

Desirably, as indicated in Fig. 2, the interior of such oven 70 is rectangular. For the purpose of appearance the exterior of the oven may also be rectangular, both of which features are indicated in Fig. 2.

Similar provision of inclination of the heating coil or coils and connections of their individual inflow piping is carried out with respect to the several instrumentalities served by the system.

It will be particularly observed in the instance of toasting, baking, broiling, frying and boiling of raw food, that the raw food material is subjected to radiant heat of the temperature of the liquid heating medium, notwithstanding that the operating temperature of the interior of the instrumentality in which the food is subjected to is at controlled lower temperature. The results derived

from actual tests under commercial operation, demonstrate that such radiant heat treatment of raw food results not only in the reduction of operating time period but also imparts a quality to the final prepared food not attainable by conventional methods of preparing food.

A further characteristic of the matter of heat treatment of food, applicable particularly in the operation of an oven or like enclosed cooking utensil, is that the door of such oven or like utensil may be constructed to be sealingly closed, and no provision whatsoever made for the escape of air otherwise from the interior of such oven or like utensil, resulting in the heating throughout the entire interior of the utensil, inclusive of the air therein, at all stages substantially uniformly at the controlled temperature.

From the above it is apparent that the heat supplying system, pursuant to the invention, provides for the heating of one or more heat operating instrumentalities by the provision of a central source of heat, main supply piping connected to the outflow of such source, main return piping connected to the inflow of such source, valve means for the respective served instrumentalities, each valve means having inlet means and a plurality of outlet means, piping connecting such inlet means with the main supply piping, piping connecting one of said outlet means with the heating element or elements of the served instrumentality, piping connecting another of said outlet means with the main return piping and piping connecting the heating element or elements of such instrumentality with the main return piping, whereby upon manual and/or automatic regulation of the movement of the movable valve element of such valve means continuity of flow of the heating medium is maintained from the source and in return to the source, the valve means affording continuity of flow and the sole passage of flow from the main supply piping through to the main return piping during the stages of non-operation and full heating of such instrumentality and full or partial flow through the heating element or elements of the served instrumentality during the stage of supply of heat energy to such instrumentality.

The piping inclusive of the main supply line and the main return line and wherever practicable are protected against heat losses by insulating material such as fiber glass insulation or other suitable covering. Slip or telescopic joints may be employed in the connections of the various piping, and brazed at temperature exceeding the maximum temperature possible under all circumstances, as by employing a silver solder capable of withstanding the temperature of, say, 1300° F.

The system is started with the liquid heating medium "cold" which may be fed directly into the heating compartment of the boiler forming a part of the heating system, or through a plug-provided opening in the expansion tank. At such initial stage, the system is filled with air which eventually must be ejected from the system, inclusive of the sub-piping, the valve component parts and the coil or coils or other heating elements of the various instrumentalities served by the system. When the system is installed to provide for the upward flow of the air or other gaseous medium in direction counter to the flow of the heating medium, the ejection of such foreign gaseous substances is greatly facilitated. In the circumstance that the system is not in-

stalled to provide for such automatic outflow of air or other foreign gaseous substances, air-release valves may be provided at variant positions of the system and its component parts as by connection with the piping and sub-piping and other liquid conducting parts of vertically extending nipples, having valves of the one-way type, opening outwardly toward the outer atmosphere and automatically held in closed position by suitable thermostatic responsive means to thereby preclude the escape therethrough of the heated liquid medium.

In the operation of the system employing tetracresylsilicate or equivalent, such liquid heating medium is circulated preferably at substantially atmospheric pressure, hence the installation of the expansion tank may be in the manner above referred to, namely to provide that the highest level of the liquid medium within the expansion tank at its operating temperature lies substantially in the same horizontal plane as the level of the liquid heating medium at the highest vertical level in the system and its component parts, provision being made that the upper wall of the expansion tank be in a plane higher than the highest level of the liquid. Such manner of carrying out the invention is practical in the employment of tetracresylsilicate or equivalent for the reason that such liquid heating medium does not give rise to any appreciable vaporization at atmospheric pressure at the ranges of temperature contemplated for installations for operating instrumentalities for homes, industrial plants, and the like. In the instances of use of a liquid heating medium which does give rise to appreciable vaporization at atmospheric pressure, such vaporization may be reduced or precluded by locating the expansion tank to dispose the level of the liquid heating medium therein sufficiently higher than that of the highest level of the liquid heating medium in the system and its component parts so as to produce a static pressure sufficient to reduce or preclude vaporization of the liquid heating medium.

As indicated in Fig. 1, typical of preferred embodiments of the invention, the main supply line and main return line are not directly connected to one another, the continuity of flow of the liquid heating medium being afforded at all times and stages of the operation of the system through the one or more multiple-way valves, typified by the three-way valves indicated 26, the flow of the liquid heating medium being positively effected by the pump 15, which is desirably of the variable speed type. The rate of operation of the pump 15 is determined by the particular conditions of heat requirements of any given heat supplying system depending, as a factor, upon the nature of the instrumentalities served by the system at a given circulating temperature of the liquid medium, as for example, a fan-operated heat exchanger unit, say for heating the interior of a room or other space in a building, may require a higher rate of flow of the liquid heating medium in order to develop the desired number of B. t. u. at such given circulating temperature of the liquid medium. In general, another factor is the total number of instrumentalities served by the system, in which respect the greater the number of instrumentalities served at a given circulating temperature of the liquid heating medium, the greater the speed of operation of the pump in inducing the corresponding greater speed of flow of the liquid heating medium.

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Whereas, I have illustrated and described my invention by reference to typical preferred embodiments of the invention, it will be understood that changes and modifications of the invention may be made without departing from the invention as defined by the appended claims.

I claim:

1. In a system for utilizing organic silicates as a heat transfer medium, heating means for the organic silicates, a substantially vertically disposed supply conduit leading from said heating means, a normally closed expansion tank connected to the upper extremity of said supply conduit, pressure and vacuum relief means for said expansion tank, supply piping connected to said supply conduit between said heating means and said expansion tank and sloping downwardly with respect to the horizontal away from said supply conduit, a return pipe connected to the return side of said heating means and sloping upwardly with respect to the horizontal away from said heating means, at least one heat transfer means, pipes connecting said heat transfer means across said supply and said return pipes, a three way thermostatically controlled valve for each of said heat transfer means subject to the

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temperature thereof and connected in the pipe between said heat transfer means and said supply pipe and a by-pass around each of said heat transfer means connected to its respective valve and to said return pipe.

2. A system as defined in claim 1 in which a circulating pump for the organic silicates is located in said return pipe adjacent said heating means.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,437,189	MacDonald	Nov. 28, 1922
1,440,926	MacDonald	Jan. 2, 1923
1,915,805	Sutcliffe	June 27, 1923
2,065,481	Thulman	Dec. 22, 1936
2,067,063	Pabst	Jan. 5, 1937
2,146,148	Knipper	Feb. 7, 1939
2,255,292	Lincoln	Sept. 9, 1941
2,262,194	Newton	Nov. 11, 1941
2,335,012	Johnston	Nov. 23, 1943