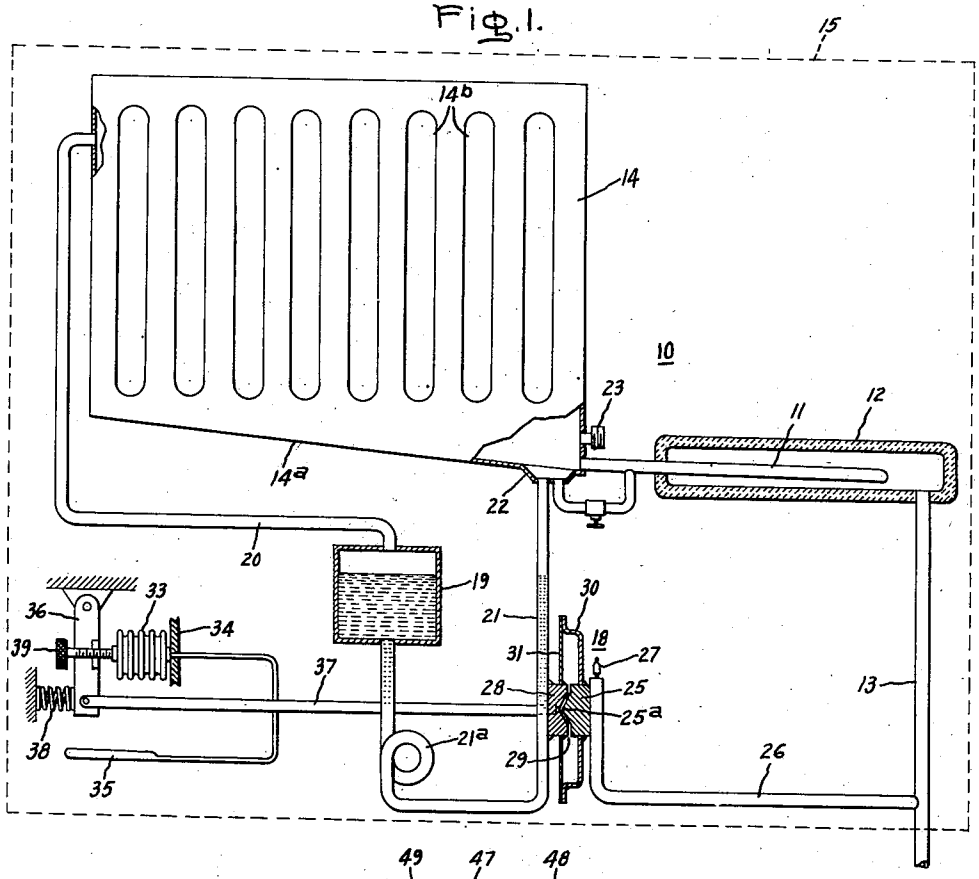
May 24, 1949. M. E. FIENE 2,471,146

THERMOMOTIVE MODULATING HEAT TRANSFER SYSTEM

Filed May 14, 1947

Fig. 1.



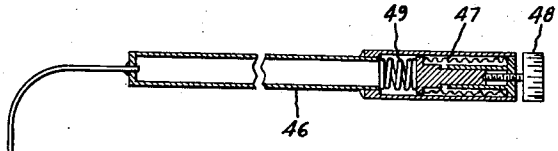
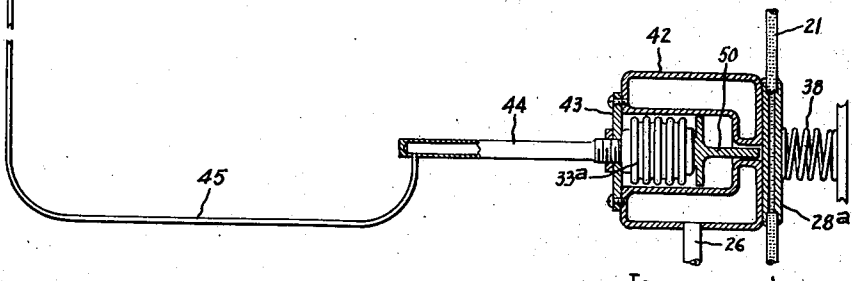


Fig. 2.



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Patented May 24, 1949

2,471,146

UNITED STATES PATENT OFFICE

2,471,146

THERMOMOTIVE MODULATING HEAT TRANSFER SYSTEM

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Application May 14, 1947, Serial No. 748,149

5 Claims. (Cl. 237—9)

1

The invention relates to heat transfer systems, particularly vapor heat transfer systems employing a liquid percolator for controlling the rate of heat transfer between the liquid vaporizer and the vapor condenser as described and claimed in the prior Fiene Patent 2,289,879.

The principal object is to provide an improved thermomotive heat exchange control for modulating the output of the liquid percolator so as to correspondingly vary the rate of heat transfer in the vapor heat transfer system.

Another object is to provide a flexible type of percolator that is relatively movable into variable heat exchange relation with a heated body for varying the heat transfer rate of the vapor heat transfer system.

Another object is to provide an improved variable air gap heat exchange control for modulating the percolated output under the control of a continuously heated bellows interconnected with a liquid filled bulb responsive to a predetermined temperature to be controlled by operation of the vapor heat transfer system.

Further objects and advantages of the invention will appear in the following description of the accompanying drawing in which Fig. 1 is a schematic view partly in section of a vapor heat transfer system provided with the improved thermomotive modulated percolator control of the present invention in a preferred form and Fig. 2 is a sectional view of a modified form of continuously heated bellows and bulb thermomotive control that may be used to modulate the rate of heat transfer in the vapor heat transfer system of Fig. 1 if desired.

As shown in Fig. 1, the vapor heat transfer system is indicated generally by the reference character 10 and includes the liquid vaporizer 11 surrounded by the heat insulated steam chest 12 continuously supplied with steam from the supply pipe 13 and the interconnected condenser 14 for dissipating heat from the vapor produced by the vaporizer 11. The condenser 14 is shown provided with a sloping bottom wall 14*a* so as continuously to return the condensate to be revaporized in the vaporizer 11. Thus the rate of heat transfer to the condenser 14 depends upon the amount of liquid circulating between the vaporizer 11 and the condenser 14. The condenser 14 preferably is provided with suitable fins 14*b* for dissipating the heat to the air of a room so that the condenser 14 may serve as a convector for heating the room indicated schematically by the dotted lines 15.

The amount of liquid circulating in the transfer system 10 is controlled by the improved thermomotive modulated percolator control indicated generally by the reference character 18 and including the liquid reservoir 19 having the vapor pressure equalizing conduit 20 connected with the condenser 14. When the percolator 18 is inactive all the liquid in the system is collected in the reservoir 19 since no heat transfer between the continuously heated vaporizer 11 and condenser 14 is required. The liquid accumulated in reservoir 19 is introduced as required into the vapor heat transfer system 10 by means of the flexible percolator tube 21 that extends downwardly from the bottom of reservoir 19 into a flexible loop 21*a* and thence upwardly to connect with the sump 22 formed in the bottom of the condenser 14 adjacent the connection therewith of the vaporizer 11. When all the liquid in the system is collected in the reservoir 19 to the liquid level indicated, then the liquid will rise in the percolator tube to an equal level below the sump 22. Preferably the vapor heat transfer system 10 is closed and after being properly evacuated is then filled with a predetermined amount of heat transfer liquid through the sealing valve 23.

2

The liquid in the percolator tube 21 is heated by means of a normally heated body 25 shown mounted on pipe 26 that is continuously supplied with steam from the supply pipe 13 and provided with the usual air vent valve 27. Preferably the normally heated body 25 is provided with a wedge-shaped extension 25*a* that cooperates with the complementary depression in the heat conducting element 28 carried by and in intimate heat conducting relation with the flexible percolating tube 21. Thus the rate of heating of the liquid in the percolator tube 21 may be controlled by varying the air gap 29 between the continuously heated body 25 and the percolator heat conducting element 28. To maintain the air gap 29 free of dust or dirt that might interfere with the accurate positional adjustment between the heated body 25 and the percolator heat conducting element 28, preferably the air gap is surrounded by an enclosing casing 30 sealed to the heated body 25 and provided with a readily flexible diaphragm 31 sealed to the element 28, thus totally sealing the air gap 29.

By means of the improvements of the present invention, the relative movements between the flexible percolator tube 21 and the heated body 25 may be controlled thermostatically to vary the heat output of convector 14 so as to maintain a desired room temperature. For this purpose

as shown in Fig. 1 a bellows 33 mounted on support 34 and having a bulb 35 responsive to the room air temperature adjacent the floor operates a pivoted lever 36 that is connected by the arm 37 to move the flexible percolator tube 21. A spring 38 serves to normally bias the lever 36 so as to press the percolator heat transfer element 28 firmly into good heat conducting relation with the continuously heated body 25. The bellows 33 serves to position the heat transfer element 28 away from the continuously heated body 25 a variable distance jointly dependent upon the adjustment of the manual adjusting screw 39 and the temperature of the air.

Operation of Fig. 1

With all liquid in the system accumulated in reservoir 19 as shown in Fig. 1 there is no appreciable transfer of heat from the continuously heated vaporizer 11 and the vapor condenser 14. This indicates that the room is at the desired temperature. Under these conditions the percolator heat transfer element 28 is sufficiently separated from the heated body 25 that the heat exchange therebetween is below the value required to effect percolating action of the liquid in the percolator tube 21. In case the room temperature should decrease, then bulb 35 will respond and bellows 33 will contract. Thereupon spring 38 will operate lever 36 and arm 37 to move the percolator heat transfer element 28 into closer proximity with the heated body 25. As the percolator heat transfer body 28 approaches the heated body 25 the rate of heat transfer therebetween will increase to the point where a percolating action is started in the liquid in the percolator tube 21. As a result some of the liquid is discharged from the top of the percolator tube into the sump 22 and is introduced therefrom into the vaporizer 11. The resulting vaporization of the liquid in the vaporizer 11 supplies vapor to be condensed by the condenser 14 and thus initiates a transfer of heat into the room with the rate of heat transfer dependent upon the amount of liquid introduced into the vaporizer 11 by the percolator tube 21. The vapor condensed in vaporizer 14 soon returns to the vaporizer 11 to be revaporized although some small part of the vapor may condense in the tube 20 and thus return to the reservoir 11. However, due to the modulated percolating action in tube 21 any vapor returning to the reservoir will be made up by the percolated liquid so that the heat release from the condenser 14 will always tend to balance the heating load requirements of the room.

In case the room heating demand increases, then bulb 35 will respond and bellows 33 further contracts so as to move the heat transfer element 28 into closer proximity with the heated body 25. As a result the percolating action in tube 21 will be increased so as to introduce a greater amount of liquid into the vapor heat transfer cycle. As a result the rate of heat transfer from vaporizer 11 to the condenser 14 will increase to meet the heating demand. In this way the improved thermomotive percolator control of the present invention enables the modulation of the amount of liquid active in the vapor heat transfer system so as to balance the heat output thereof with the heating demand.

When no heating is required and the percolator becomes inactive, then all the condensate in condenser 14 drains through sump 22 and tube 21 into reservoir 19.

Where it is desired to locate the room temperature responsive bulb above the level of the expansible bellows, the modified thermomotive operating structure shown in Fig. 2 may be used. In this modification the bellows 33*a* is located in the interior of the annular steam chest 42 that is continuously supplied with steam from the pipe 26. The percolator tube 21 is provided with a heat transfer section 28*a* that is biased by the spring 38 into intimate heat conducting relation with the normally heated steam chest 42. The bellows 33*a* is mounted on the plate 43 and is provided with a tubular extension 44 connection by the capillary tube 45 with the liquid filled room temperature responsive bulb 46 that may be located at any desired height above the level of the bellows 33*a*. The room temperature responsive bulb 46 is shown provided with an internal volume adjusting bellows 47 operated by the manual adjusting screw 48 against the bias of spring 49 to vary the amount of liquid contained within the bulb 46 with a corresponding variation in the amount of liquid supplied due to the room temperature to the continuously heated bellows 33*a*.

The bellows 33*a*, upon its resulting expansion, operates through the push-rod 50 to move the percolator heat exchange section 28*a* away from the continuously heated steam chest 42 against the bias of spring 38 when the room temperature increases. This reduces the rate of heat transfer between the steam chest 42 and the percolator tube 21 with a corresponding decrease in the percolating action of the liquid in tube 21. Thus it will be apparent that the thermomotive operating mechanism shown in Fig. 2 may replace that shown in Fig. 1 so as to modulate the rate of heat transfer between the vaporizer 11 and condenser 14 as previously described but with the bulb 46 located as desired above the level of bellows 33*a*.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In combination, a vapor heat transfer system including a liquid vaporizer and a vapor condenser, means including a normally heated body and a liquid percolator having liquid exchange connections with said system and having an element relatively movable into variable heat transfer relation with said body for variably heating said percolator to vary the amount of liquid circulating in said heat transfer system, and thermostatic means controlling relative movement between said body and said element.

2. In combination, a vapor heat transfer system including a liquid vaporizer, a vapor condenser, and a source of heat for said vaporizer, means including a body normally supplied with heat from said source and a liquid percolator having liquid exchange connections with said system and having an element relatively movable into variable heat transfer relation with said body for variably heating said percolator to vary the amount of liquid circulating in said system, and thermomotive means for effecting relative movement between said element and said body.

3. In combination, a vapor heat transfer system including a liquid vaporizer and a vapor condenser, a liquid reservoir having a percolator flexible tube connection with said system to supply liquid to said vaporizer, a normally heated body, and thermostatic means including an expansible bellows for moving said percolator flexible tube into heat transfer relation with said

body for variably heating said tube to vary the amount of liquid circulating in said system.

4. In combination, a vapor heat transfer system including a liquid vaporizer and a vapor condenser, said vaporizer having heat supply means for continuously supplying heat thereto, a liquid reservoir having a flexible percolator tube connected with said system to supply liquid to said vaporizer and a pressure equalizing tube connected with said condenser, a heated body having a connection with said heat supply means for continuously supplying heat to said body, means including a spring for normally biasing said percolator tube into heat transfer relation with said body, and thermomotive means including an expansible bellows for moving said percolator tube away from said body.

5. In combination, a vapor heat transfer system including a liquid vaporizer and a vapor condenser, means including a percolator having liquid exchange connections with said system and a normally heated body relatively movable into variable heat transfer relation with said liquid

percolator for heating said percolator to vary the amount of liquid circulating in said system, thermostatic means including a bellows disposed in heat transfer relations with said body for controlling the heat transfer relation between said percolator and said body, and a liquid filled bulb responsive to a predetermined temperature condition connected to supply vaporizable liquid to said bellows.

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Administratrix of the Estate of Marcus E. Fiene, Deceased.

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