Aug. 12, 1930. C. P. SCHUMERS 1,772,557

HEAT EXCHANGER

Filed Dec. 20, 1928

Fig. 1

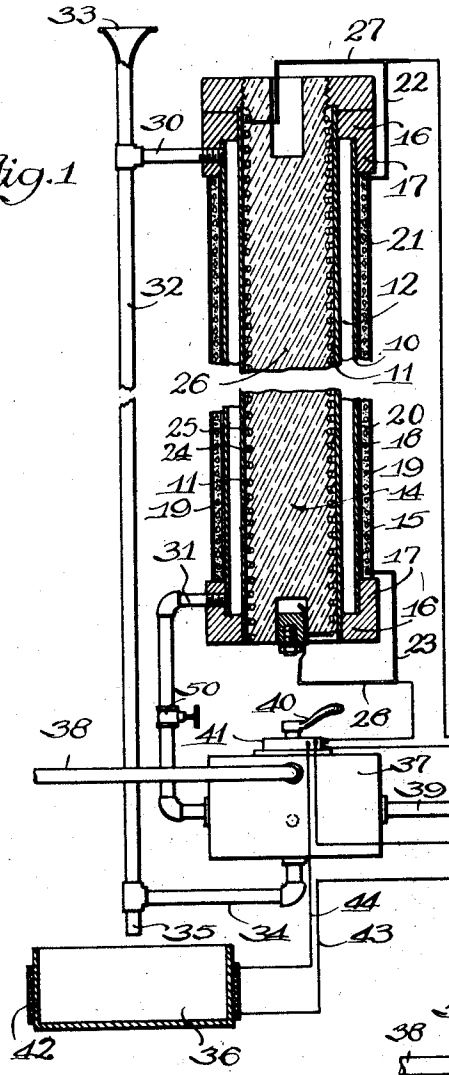


Fig. 6

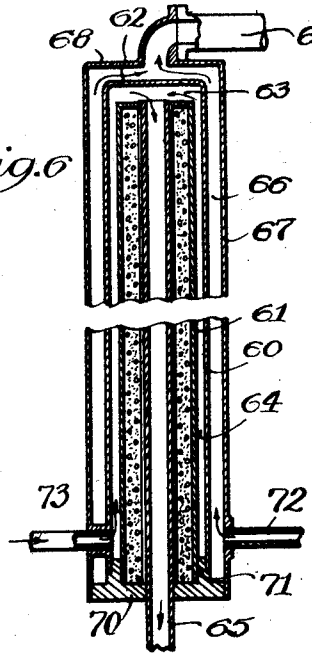


Fig. 2

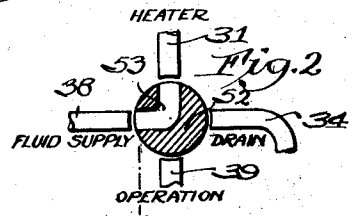


Fig. 3

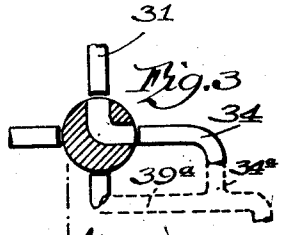
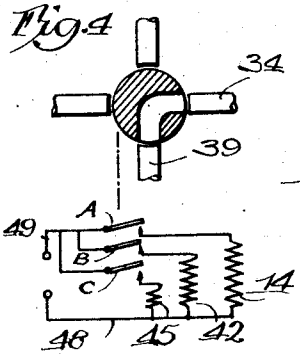
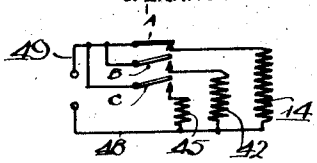


Fig. 4





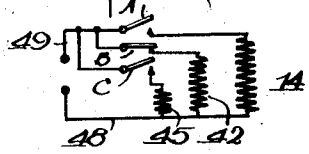
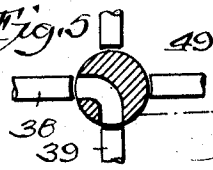
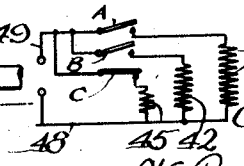


Fig. 5





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UNITED STATES PATENT OFFICE

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HEAT EXCHANGER

Application filed December 20, 1928. Serial No. 327,204.

The present invention relates to heat exchangers, and particularly to those which are rapid in action and substantially instantaneous to fulfill immediate demands for small quantities of tempered liquids, such as hot water.

The invention is particularly adapted to water heaters but may be applied to water coolers, or to heating and cooling any liquid medium as may be desired.

The principles upon which the invention operates are of course old in the broadest sense, but it is my belief that the particular manner in which they are applied and the means I employ is new.

One object of the invention is to cause a liquid to flow in a thin layer defined by heat transferring walls.

A particular object of the invention is to cause a liquid to flow in a thin layer defined by heat transferring walls.

A particular object is to cause a flow of liquid upward through a thin annular space.

A further object of the invention is the automatic control of the heat or cold in timed relation to the flow of liquid to be tempered.

Still another object of the invention is the emptying of the thin space during each period of idleness.

Another object is the provision of apparatus capable of effecting each and all of the various purposes above set forth, and of carrying out other and ancillary objects for additional advantages of the invention as will appear from the following description of the apparatus illustrated in the accompanying drawings.

In the drawings:

Fig. 1 illustrates a longitudinal section of a cylindrical electric heater, including certain valve, electric, and pipe connections used in combination therewith.

Figs. 2, 3, 4 and 5 are diagrammatic representations of the valve and electric switch positions.

Fig. 6 is a modified form of heat exchanger.

Preferably, I provide an apparatus which has a thin annular space defined by walls, one or both of which may be heated or cooled.

In Fig. 1 two concentric walls 10 and 11 form the space 12, and an electrical heating unit 14 fits inside the inner wall 11 and a unit 15 surrounds the outer wall 10. The walls 10 and 11 are preferably of very thin metal such as brass, bronze or copper tubing, lengths of which are secured to suitable fittings, as by brazing or threading. An annular ring 16 provides an internal surface for the inside wall 11, and an integral annular flange 17 provides an internal surface for the inside wall 11, and an integral annular flange 17 provides an internal surface for the outer wall 10.

Between the ends of the two flanges 17 the heating unit 15 is provided in any suitable way, such as for example, the provision of a mica insulation 18 over tube wall 10, the coil 19 of resistance wire, inlaid in a cement 20 and covered by insulating substance 21. Lead wires 22 and 23 are shown.

The inner heating unit 14 may be dispensed with, depending of course upon all the other dimensions and the uses and requirements of the device. For the greatest service in heating it may be provided and employed in combination with the outside coil. It may comprise a coil 24 wound in grooves 25 in a removable core 26 which fits snugly inside the inner tube 11. Leads 27 and 28 are shown in parallel with the other leads 22 and 23.

At the top of the device there is a pipe connection 30 entering the annular space 12, and at the bottom a similar pipe connection 31. The bottom pipe 31 is preferably used as an inlet and the top one as an outlet. The outlet pipe 30 joins a pipe 32 vented to the air above the connection, at 33, which extends downwardly to a point below the bottom of the heater where it is joined by a pipe 34. The free end 35 of pipe 32 is used to deliver hot water into any receptacle such as the receiver 36 to be later described.

Inlet pipe 31 serves also as a drain pipe for water left in the heater, and the several uses of pipe 31 are controlled by a suitable valve. The valve may have other functions as will be readily apparent from the description of one form of valve I have illustrated,

this being specifically, a four-way two-port valve. It will of course be understood that the same effect and connections may be obtained by use of several valves, but I prefer to use the type described for the reason that one control may be made to effect valve and electrical connections in a desired related manner.

I show in Fig. 1 a valve casing 37 into which four pipes enter, pipe 31, pipe 34, a water supply pipe 38 and a water flow line 39. An operating handle 40 is illustrated for a valve member which controls communication between the ports for said four connections. In association with the valve handle there is an electric switch box 41 in which electric switches are actuated variously according to the position of the valve.

The heating elements in the heater are controlled by one switch. The receptacle 36 has a heater 42 associated with it to preserve the heated condition of the water delivered by the heater. Leads 43 and 44 are provided for the receiver heating means.

The numeral 45 indicates any other apparatus, the particular character of which is well in mind but omitted here as forming no part of this invention, in which heat and power, such as may be provided by a flow of water, is required, and in which hot water may be used. The water flow pipe 39 is indicated in connection with device 45 as well as two electrical leads 46 and 47.

All the leads 47, 43, 27 and 22 are connected to a line feed wire 48. The other leads 46, 44, 23—28 are connected to three points in the switch box containing switches A, B and C (in the diagrams) and then in common to the line feed wire 49.

In the line 31 I use a valve 50 which permits a restricted and regulated flow of water into the heater. In Fig. 2 I show the valve member 52 as having a right angular passageway 53 therein for effecting connections between the lines 38, 31, 34 and 39 as about to be described.

In Fig. 2 the connection 53 permits flow of water from supply line 38 into the heater. The switch A is arranged to be closed in this position, so that as soon as the water is permitted to flow, heat is provided. The heater being empty receives a slow rising supply of water, thus permitting the walls to become hot. By the time the water is ready to flow out it is at the desired temperature, and of course the construction and adjustment are properly related to secure this effect. No cold or cool water need be drawn away and discarded as hot water is delivered initially into receiver 36. When sufficient water is drawn off the valve is turned to position of Fig. 3, shutting off the supply of water, permitting the surplus, small in quantity, to drain from the heater into pipe 34 and hence into receptacle 36 if desired. The switch A is open so that no heat is supplied to the heater, but the residual heat will serve to raise the temperature of the water, the middle and end portion of the back-running water. In the position of Fig. 2 switch B may be closed automatically to keep the water delivered into receptacle 36 in a heated condition. If no heat is required for the receptacle the valve is turned to position of Fig. 4, opening switch B. If service is desired from apparatus 45 the valve is turned to position of Fig. 5, allowing water to flow through line 39, at the same time providing current to the device by closure of switch C.

It will be readily understood that certain undesired portions of this device may be omitted when desired without in any way departing from the spirit and scope of the invention as described in the appended claims.

The invention is not limited to heating, nor to the heater construction shown. In Fig. 6 I have shown a modified heat exchanger, which may be used as a heater or as a cooler, and which may be operated upon similar principles.

I provide a thin annular space, or it may be of any other shape, by nesting two receivers, such as elongated cups, that is, tubular members 60 and 61 with closed ends 62 and 63, to provide a thin space 64. The end 63 is provided with an outflow pipe 65 which in the present instance turns downward and emerges from within the device. Outside of the shell 60 I provide means for heating or cooling, such as the jacket space 66 formed within a third tubular member 67 having a closed end 68 with a flow-pipe 69. The tubular members are all secured to a head fitting 70, having an annular flange 71 between shells 60 and 61, and the periphery within shell 67. The jacket space 66 has a flow line 72 leading into it at the bottom, and the thin space 64 has an inlet 73 at the bottom.

Water, brine, steam, or other liquid may be circulated through the jacket, to temper the walls of the thin space, and the liquid rising in the thin space from inlet 73 is tempered, overflowing through the outlet 65. Control may be effected as in the device of Fig. 1, or in any other preferred manner.

During continuous operation of the device the direction in which liquid flows in the heat exchanger has little significance, but when the device is used more or less intermittently, as it may be in homes, for cooking, etc., drawing small quantities of water intermittently, it is quite beneficial, in providing initially water (or other liquid) at the desired temperature for which it is set.

In Fig. 3, I have shown another modification (in dotted lines) where the pipe 30 is shown extended at 39ª for connection to pipe 34, extended at 34ª. By this construction, in place of operating device 45, the valve may

be made to deliver cold water directly to the heated water which has been supplied, to cool the same if initially delivered at too high a temperature.

What I claim is:

1. A heat exchanger for tempering liquids comprising in combination thin walled means forming an elongated thin walled space, closures for the ends of said space, inlet-forming means near one end, outflow means near the other end, heat tempering means for said thin walled means, a control for the tempering means, a control at the inlet for liquid supplied through said inlet, means to drain said space and common operating means for said two controls.

2. A heat exchanger for tempering liquids comprising in combination thin walled means forming a vertically elongated thin space, a closure for the bottom of said space, inlet-forming means near the bottom end, outflow means near the other end, heat tempering means for said thin walled means, a control for the tempering means, a control at the inlet for liquid supplied through said inlet, means to drain said space and common operating means for said controls.

3. A heat exchanger for tempering liquids comprising in combination thin walled means forming a vertically elongated thin space, a closure for the bottom of said space, inlet-forming means near the bottom end, outflow means near the other end, tempering means for said thin walled means, a control for said tempering means, a two-way valve control for said inlet, a source of liquid to be tempered, a drain connection, said valve being arranged alternately to connect said source and said drain connection to said inlet, and a common operating means for said two controls arranged to temper flowing liquid and to cut off tempering action during draining of the space.

4. In a heat exchanger of the class described in combination, means forming a vertically elongated thin space for a flowing liquid, tempering means for liquid in said space, a control for said tempering means, inlet-forming means to the bottom of said space, outflow means near the top of said space, a source of liquid, a drain connection, a two-way valve adapted alternately to connect the inlet to said source and to said drain connection, said tempering control means being operatively related to the valve to effect tempering of liquid flowing from the source into said inlet and to be inoperative upon flowing from the inlet through the drain.

5. In combination a heat exchanger adapted for a flow of liquid therethrough in a thin space, means for tempering the liquid flowing in said space, a liquid supply, a valved connection for controlling the flow of liquid, means to drain liquid from said space, a valve controlling said drain means, said valve and the said valved connection being associated for draining the space after cutting off the flow of liquid therethrough.

6. In combination a heat exchanger adapted for a flow of liquid therethrough in a thin space, means for tempering the liquid flowing in said space, a liquid supply, a valved connection for controlling the flow of liquid, means to drain liquid from said space, a valve controlling said drain means, said valve and the said valved connection being associated for draining the space after cutting off the flow of liquid therethrough, a control for the tempering means, said control being operatively related to the drain control valve for rendering the tempering means ineffective during draining.

7. In combination a source of liquid to be heated, an electrically operated heater for heating liquid flowing therethrough, electrically operated heating means, a delivery pipe for heated liquid, a valved drain pipe entering the delivery pipe, and a valve between said source and said heater, said valve and said valved drain connection being operatively associated to permit draining the heater into the delivery pipe after the flow from the source is cut off.

8. In combination a source of liquid to be heated, an electrically operated heater for heating liquid flowing therethrough, electrically operated heating means, a delivery pipe for heated liquid, a valved drain pipe entering the delivery pipe, a valve between said source and said heater, said valve and said valved drain connection being operatively associated to permit draining the heater into the delivery pipe after the flow from the source is cut off, and a switch control for the electric heater, said switch control being operatively related to the valved connections for supplying heat during flow of liquid from the source and to cut off heat during flow through the drain.

9. In a device of the class described, in combination, an electrically operated liquid heater, a fluid source, a heater drain, an inlet for liquid to said heater, a receiver for heated liquid, an electric heater for said receiver, a valved connection between said source and said heater, a valved connection from said heater to said drain, an electric switch for the liquid heater, an electric switch for the receiver, said two valved connections and said electric switches being operatively associated for closure of the liquid heater switch only during flow of liquid through the heater, and for closure of the receiver heater during establishment of the open drainage connection from the heater.

10. In a device of the class described, in combination, an electrically operated liquid heater, a liquid source, an inlet for liquid to said heater, a valved connection between said source and said inlet, an electric switch for

said heater, said valved connection and said switch being operatively associated to close the switch only when liquid flows from the source through the heater, a receiver for heated liquid, a liquid operated device, and a valved connection between said liquid source and said device, said valved connection being operatively related to the first mentioned valved connection for permitting flow from the source through but one valved connection at any one time.

11. In a device of the class described, in combination, an electrically operated liquid heater, a liquid source, an inlet for liquid to said heater, a valved connection between said source and said inlet, an electric switch for said heater, said valved connection and said switch being operatively associated to close the switch only when liquid flows from the source through the heater, a receiver for heated liquid, a liquid operated device, a valved connection between said liquid source and said device, said valved connection being operatively related to the first mentioned valved connection for permitting flow from the source through but one valved connection at any one time, an electrical means, and a switch for said means operatively associated with said second valved connection for closure during operation of said liquid operated device.

12. In a device of the class described, in combination, an electrically operated liquid heater, a liquid source, an inlet for liquid to said heater, a valved connection between said source and said inlet, an electric switch for said heater, said valved connection and said switch being operatively associated to close the switch only when liquid flows from the source through the heater, a receiver for heated liquid, an electric heater for said receiver, a switch for said heater operatively associated with said valved connection for closure of the switch after closure of the valved connection to stop flow of water through the heater, a liquid operated device, a valved connection between said liquid source and said device, said valved connection being operatively related to the first mentioned valved connection for permitting flow from the source through but one valved connection at any one time, an electrical means, and a switch for said means operatively associated with said second valved connection for closure during operation of said liquid operated device.

13. In a device of the class described, in combination, an electrically operated liquid heater, an inlet for liquid to said heater, a liquid source, a drain for said heater, a liquid operated device, a four-way two-port valve having its four ways connected (1) to said source, (2) to said inlet, (3) to said device and (4) to said drain, and having its ports adapted to establish the following connections: (*a*) said source to said inlet, (*b*) said source to said device, (*c*) said inlet to said drain, and (*d*) all other positions being a non-operating or off-position, a receiver for heated liquid, an electrically operated means associated with said liquid operated device, a switch for said means, said switches being operatively associated with said valve for operation therewith to close the liquid heater switch only during flow of water through the heater, to close the switch of the electrically operated means only during the establishment of the connection from the liquid source to said liquid operated device, and to open all switches in the off-position of the valve.

14. In a device of the class described, in combination, an electrically operated liquid heater, an inlet for liquid to said heater, a liquid source, a drain for said heater, a liquid operated device, a four-way two-port valve having its four ways connected to (1) said source, (2) to said inlet, (3) to said device and (4) to said drain, and having its ports adapted to establish the following connections: (*a*) said source to said inlet, (*b*) said source to said device, (*c*) said inlet to said drain, and (*d*) all other positions being a non-operating or off-position, a receiver for heated liquid, a heater for said receiver, a switch for said receiver heater, an electrically operated means associated with said liquid operated device, a switch for said means, said switches being operatively associated with said valve for operation therewith to close the liquid heater switch only during flow of water through the heater, to close said receiver heater switch only during establishment of the drainage connection, to close the switch of the electrically operated means only during the establishment of the connection from the liquid source to said liquid operated device, and to open all switches in the off-position of the valve.

In witness whereof I have hereunto affixed my signature.

CLARENCE P. SCHUMERS.