H. LEMP & W. G. FISHER.

HEATING SYSTEM.

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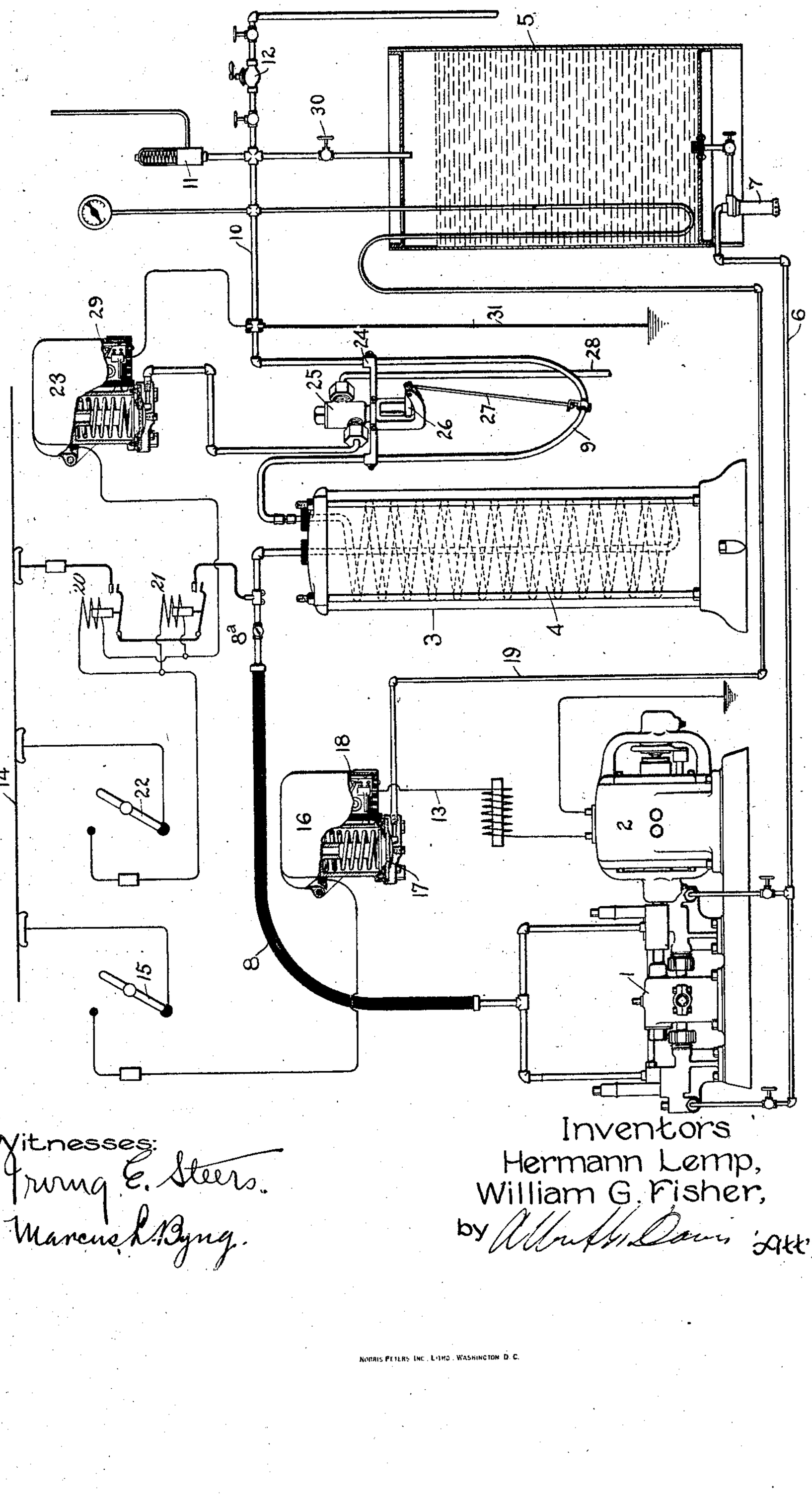
919,364. **Patented Apr. 27, 1909.**



Witnesses:
Irving E. Steers.
Marcus L. Byng.

Inventors
Hermann Lemp,
William G. Fisher,
by Albert G. Davis Att'y.

UNITED STATES PATENT OFFICE.

HERMANN LEMP AND WILLIAM G. FISHER, OF LYNN, MASSACHUSETTS, ASSIGNORS TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

HEATING SYSTEM.

No. 919,364. Specification of Letters Patent. Patented April 27, 1909.

Application filed November 17, 1906. Serial No. 343,800.

To all whom it may concern:

Be it known that we, HERMANN LEMP and WILLIAM G. FISHER, citizens of the United States, residing at Lynn, in the county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Heating Systems, of which the following is a specification.

The present invention relates to heating apparatus and is adapted more especially for service on electric locomotives for supplying heated fluid to the coils or radiators on the connected railway cars or coaches.

Our invention has for its object to provide a heat producing apparatus of improved construction wherein the heat is derived from an electric circuit, which apparatus, after it is once started, will automatically continue to supply heated fluid in the form of steam or hot water at such a pressure and temperature as best suits the requirements.

For a consideration of what we consider to be novel in our invention, attention is called to the specification and claims appended thereto.

In the accompanying drawing is shown in diagram our improved heating apparatus adapted for use in connection with an electric locomotive.

1 represents a duplex pump of any approved construction, driven by the electric motor 2 through speed reducing gearing, and arranged to supply water to the heater or boiler 3. The boiler comprises one or more coils of high resistance tubing, as nickel-steel for example, which is connected to an electric circuit in such manner that the passage of electricity through the walls of the tubing heats the water contained therein to any desired temperature. One end of the tubing is connected to the source of supply, such as the trolley or third rail conductor and the other to the ground or to the other side of the system as the case may be. The coil is inclosed in a suitable casing 4 and insulated thereform and its turns from each other. The coil in the present instance is so arranged that the cool water enters at the bottom and is discharged as steam at the top. We have found this to be an efficient arrangement, but the invention is not limited thereto.

The water for the system is contained in a tank 5, the latter being connected by the pipe 6 having a strainer 7 with the suction side of the pump 1. Water is received from the tank and forced by the pump through the hose 8, made of rubber or other insulating material, into the boiler tube. The rubber hose effectively insulates the pump from the boiler tube and thereby eliminates all danger due to shocks. The resistance of the column of water in the hose is so great that there is no danger of a current of electricity flowing through it to the pump casing. Between the boiler tube and the hose 8 is a check-valve 8^a so that hot water and steam cannot be forced from the boiler into the hose and ruin it. In its passage through the heater tube the water is heated by reason of the current of electricity flowing in the walls of the tube, and is discharged as steam, or as hot water if desired, into and through the thermostat 9. From this point the heated fluid passes by the pipe 10 into the heating coils on the locomotive or on the cars drawn thereby. In the discharge pipe is a relief valve 11 set to open at a predetermined increase in pressure, and a reducing valve 12.

In a system of this character it is important to maintain the pressure and temperature of the heating fluid constant, or substantially so, irrespective of changes of load. To accomplish this we provide regulating means responsive to pressure changes on the one hand and to temperature changes on the other. The pressure responsive or regulating means will be described first. The motor 2 is connected by the conductor 13 to the trolley wire or third rail conductor 14. In the conductor 13 is a hand operated starting switch 15, a fuse, and a regulator 16 responsive to pressure changes. The regulator comprises a casing containing a diaphragm 17 that is opposed by a compression spring. The movements of the diaphragm automatically control a switch 18 in the motor circuit, the latter including a reactance to obviate the use of a starting resistance. So long as the pressure under the diaphragm is less than a certain amount the switch remains closed, but when it rises above said amount the switch opens and interrupts the motor circuit. Pressure is supplied to the underside

of the diaphragm by the pipe 19, the latter being connected to the discharge end of the boiler. The pipe 19 is looped down through the water tank so as to cool the steam and prevent it from affecting the diaphragm 17.

The circuit of the heating coil is controlled by the switches 20 and 21, arranged in series, so that if one gets burned and fails to open, the other one will. These switches are controlled by relay magnets in the well known way. The circuit of the magnets is completed by the hand operated starting switch 22. In the same circuit with the magnets is a regulator 23 that acts to open the circuit of said magnets and therefore opens the switches 20 and 21 when the temperature of the fluid delivered by the boiler exceeds a certain amount, and to complete the circuit of the magnets and to close the switches 20 and 21 when the temperature falls below a certain amount. The steam from the boiler passes through the thermostat 9, which may be of any suitable shape or construction, and is here shown as comprising a U-shaped tube attached to an insulated platform 24. Mounted on the platform is a valve 25 having a downwardly-extending stem which is actuated by a lever 26. The said lever 26 is connected by a rod 27 with the thermostat 9. The valve 25 controls the passage of air from the train pipe 28 of the air brake system to the under side of the diaphragm of regulator 23. Assuming that the temperature increases abnormally, the thermostat tube 9 will expand and in so doing draw the rod 27 downwardly and open the valve 25 and permit air to pass from the train pipe 28 to the under side of the diaphragm. The diaphragm will open the switch 29 and interrupt the circuit of the magnets controlling the switches 20 and 21 and thus permit the latter to open. The parts will remain as described until the temperature drops and the thermostat moves to a position where the valve 25 is permitted to shut off the air supply from pipe 28 and exhaust the air under the diaphragm.

In a system of this kind it is of great importance to have pressure and thermostatic controlling devices since it is possible to have a high pressure in the heater without the necessary amount of heat. For example, the pump might be started into operation without closing the circuit of the heating coil. On the other hand the circuit of the coil might be closed and the pump idle. Without a thermostatic device under this condition the coil might be overheated and ruined.

It will be noted that the pump is controlled by a regulator sensitive to steam pressure, the said regulator operating a switch and thereby controlling the motor which drives the pump. The heating coil is controlled by a thermostat which in turn controls a source of motive fluid that actually does the work of opening the circuit of the magnets, while a spring closes the circuit.

In the structure shown, the heater is intended to take water at ordinary temperatures and raise it to about 350° F., the evaporating capacity under these conditions being about 800 pounds of water per hour. The heater will commonly be subjected to a current of electricity of about 460 amperes at 650 volts. The apparatus may be started into service in the following manner. The pipe leading to the train is closed, the water pump is then started and the boiler filled with water, the heating circuit is then closed and the by-pass valve 30 opened to permit the surplus water to reënter the tank. As soon as the steam commences to pass through the by-pass, the valve 30 is closed and the train pipe opened after which the system is entirely automatic.

The construction described possesses many important advantages in that it is unnecessary to have an exact relation at all times between the amount of water supplied to the heater and the heating effect of the current of electricity passing through the walls thereof, thus making it unnecessary to compensate for load variations and changes in temperature of the feed water. Ordinarily the ratio of current to water to be evaporated would be determined as accurately as possible for normal loads and temperatures, and unless the variations therefrom were great no change in adjustment would be made. All of the regulators are, however, adjustable so that due compensation can be made for all variations. In some cases we find it desirable to interlock the thermostatic control with the pressure control. When this is done, the thermostat cannot admit electricity to the coil unless it contains water at a suitable pressure.

One of the important features of the invention resides in the way the parts are connected in circuit. It will be observed that the thermostat is located electrically between the heater proper and the ground connection 31, the latter being grounded on the car axle, motor or at any other suitable point or points. We make the tubing of the heater of 30% nickel steel and the tube of the thermostat of German silver; the latter having a considerably greater coefficient of expansion than the steel. Practice has demonstrated these metals to be satisfactory, but the invention is not to be construed as limited thereto unless it is specifically stated in the claims. As shown, the current after leaving the heater passes through the thermostat and then to the other side of the circuit. This is important because if the current of electricity did not do so, then the thermostat while still

responsive to temperature changes of the steam and acting as a regulator so long as the water supply was maintained and there was steam in the thermostat, would fail and become inoperative as soon as the water service had stopped. By including the thermostat in the electrical circuit and permitting current to pass through it at the same time shutting off the water, tests show that in less than a minute the thermostat will become so heated on account of its own resistance as to shut off the current. To state the matter in a different way, the normal flow of current through the thermostat tends to shut off the current, while the steam being at a lower temperature tends to cool the thermostat sufficiently to prevent it from acting. From this it will be observed that it is the current of electricity flowing through the heater that causes the system to shut down, and not the steam, as might naturally be supposed. To state the matter broadly, the current of electricity heats the thermostat and the steam or other vapor generated cools it.

In accordance with the provisions of the patent statutes, we have described the principle of operation of our invention, together with the apparatus which we now consider to represent the best embodiment thereof; but we desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

What we claim as new and desire to secure by Letters Patent of the United States, is,—

1. In a heating system, the combination of an electric circuit, a tubular heating coil forming a part of the circuit, the current of electricity flowing through the walls of the coil for heating a liquid contained therein, a means for forcing liquid into the interior of the coil, means controlling the passage of electricity through the walls of the coil, and means controlling the admission of liquid to the interior of the coil.

2. In a heating system, the combination of a heater, conductors conveying electricity to and from the heater, a circuit-breaker controlling the supply of electricity to the heater, means for forcing liquid into the heater, a device controlling the supply of liquid from said means to the heater, and a regulator responsive to a condition of the liquid being heated for controlling the circuit-breaker.

3. In a heating system, the combination of a heater, conductors conveying electricity to and from the heater, a pump for forcing liquid into the heater, a circuit-breaker regulating the passage of electricity through the heater, a regulator for the pump, and a regulator controlling the circuit-breaker, both of said regulators being sensitive to the condition of the fluid flowing through the heater.

4. In a heating system, the combination of a heater, conductors conveying a current of electricity to and from the heater, a pump for forcing liquid into the heater, a regulator for the pump responsive to changes in pressure in the fluid being heated, and a regulator for the heater circuit responsive to changes in temperature of the fluid being heated.

5. In a heating system, the combination of a heater, conductors conveying electric current to and from the heater, a supply pump, an insulated conduit receiving liquid from the pump and discharging it into the heater, a motor for driving the pump, a regulator responsive to pressure changes for starting and stopping the pump, a regulating means, and a thermostat acting through the regulating means to interrupt the flow of electricity through the heater when the temperature becomes abnormal.

6. In a heating system, the combination of a heater, conductors for conveying electricity to and from the heater, a pump supplying liquid to the heater, an electric motor for driving the pump, a pump governor for starting and stopping the motor, which is responsive to changes in a condition of the fluid being heated, a pressure-actuated governing means for the heater circuit, and a device responsive to a condition of the fluid being heated for admitting fluid under pressure to said governing means.

7. In a heating system, the combination of a heater, conductors for conveying electricity to and from the heater, a pump supplying liquid to the heater, a supply tank, an electric motor for driving the pump, a pressure-actuated pump governor, a conduit which conveys fluid under pressure to the governor and passes through the tank for cooling the fluid, and means for regulating the passage of current through the heater.

8. In a heating system, the combination of a heater, conductors for conveying electricity to and from the heater, a pump supplying liquid to the heater, a pump governor, a pressure-actuated regulator for controlling the passage of current through the heater, a source of fluid under pressure, and a means sensitive to changes in a condition of the fluid being heated for admitting fluid from said source to the regulator for actuating it.

9. In a heating system, the combination of a heating coil through which electricity flows, one end of said coil being connected to the supply circuit and the other to the return, a pump for forcing liquid through the coil, an insulated conduit between the pump and coil for insulating one from the other, and of such length as to prevent a current of electricity from passing through the column of liquid to the pump, a non-return valve between the pump and heating coil, and means

for controlling the passage of electricity and liquid through the heating coil.

10. In an electric heating system, the combination of a coil of high resistance tubing through the walls of which electricity flows for heating a body of liquid contained in the bore, a source of liquid under pressure for supplying the coil, a source of electricity for the coil, and means regulating the flow of electricity and liquid in accordance with the demand for vapor energy.

11. In a heating system, the combination of a coil of tubing through the walls of which a current of electricity flows for heating purposes, a pump forcing liquid through the bore of the tubing, and automatic regulating devices for the electricity and the liquid which increase or decrease the effective supplies of both as the demands for vapor energy changes.

12. In a heating system, the combination of a heater, a thermostat heated by the same current as the heater and cooled by the vapor from the heater for controlling the supply of current, conductors for conveying current to and from the heater and thermostat, and a source of liquid supply for the heater.

13. In a heating system, the combination of a heater comprising a coil of tubing through the wall of which a current of electricity flows, a thermostat in series therewith through which the same current flows for controlling the supply of current, conductors for conveying current to the heater tubing and to the thermostat, a conductor receiving current from the thermostat, and a pump for supplying liquid to the heater.

14. In a heating system, the combination of a heater comprising a coil of tubing through the wall of which a current of electricity flows, a tubular thermostat through the wall of which the current from the heater flows and through the bore of which the vapor from the heater passes, conductors for connecting the heater and thermostat to the supply and return mains, a source of liquid supply, and a circuit-breaker controlled by the thermostat.

15. In a heating system, the combination of a supply main, a heater connected thereto, a circuit-breaker between the main and heater, a thermostat connected electrically with the heater and between it and the opposite side of the circuit, the said thermostat controlling the circuit-breaker, a conduit receiving vapor from the heater after it passes through the thermostat, a pump for forcing liquid into the heater, and a means sensitive to a condition of the liquid being heated for controlling the effective discharge of the pump.

16. In a heating system, the combination of a source of electrical energy, a heater comprising a coil of tubing through the walls of which said source causes electricity to flow, a thermostat arranged in such relation to the coil that said electricity flows in series through the coil and thermostat, a device controlled by the thermostat for regulating the supply of electricity to the heater, and means for supplying liquid to the heater.

17. In a heating system, the combination of a source of electrical energy, a heater comprising a coil of tubing through the walls of which said source causes a current of electricity to flow to heat a liquid within the coil, a conduit leading to the apparatus to be heated, a tubular thermostat so arranged between the coil and conduit that heated fluid from the coil passes through the thermostat to said conduit and said current of electricity flows in series through the coil and the thermostat, a device supplying liquid to the heater, and means controlled by the thermostat for regulating the supply of electricity to the heater.

In witness whereof, we have hereunto set our hands this fifteenth day of November, 1906.

HERMANN LEMP.
WILLIAM G. FISHER.

Witnesses:

JOHN A. McMANUS, Jr.,
HENRY O. WESTENDARP.