H. LEMP.

FEED REGULATOR FOR HEATING SYSTEMS.

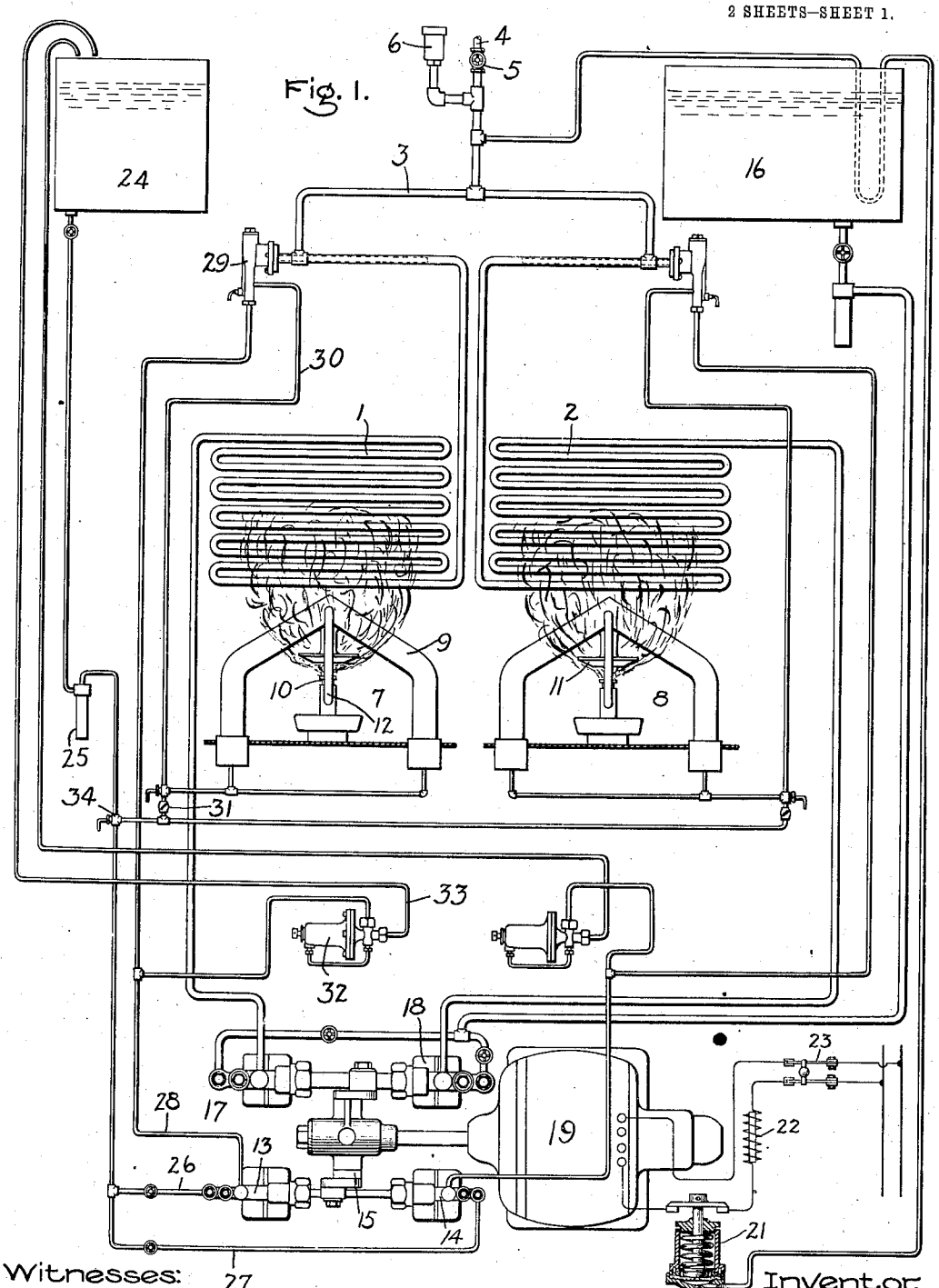
APPLICATION FILED JULY 19, 1906.

1,022,032.

Patented Apr. 2, 1912.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

J. Ellis Glen

Helen Orford

Inventor;

Hermann Lemp,

By Albert H. Davis

Att'y.

H. LEMP.

FEED REGULATOR FOR HEATING SYSTEMS.

APPLICATION FILED JULY 19, 1906.

1,022,032.

Patented Apr. 2, 1912.

2 SHEETS—SHEET 2.

Fig. 2.

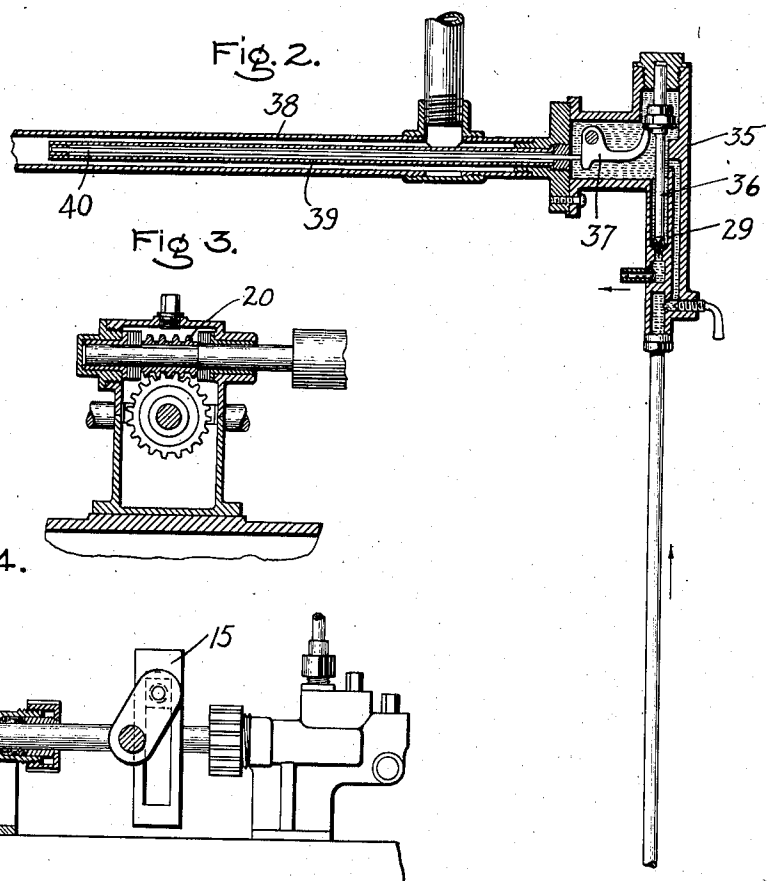
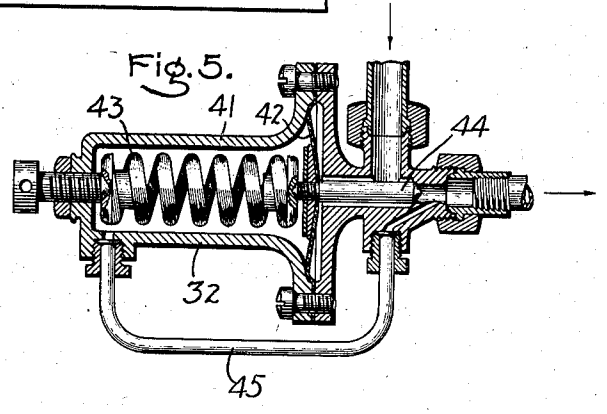


Fig. 3.

Fig. 4.

Fig. 5.



Witnesses:

J. Ellis Glen.

Helen Orford

Inventor,

Hermann Lemp,

By Albert G. Davis

Att'y.

UNITED STATES PATENT OFFICE.

HERMANN LEMP, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

FEED-REGULATOR FOR HEATING SYSTEMS.

1,022,032. Specification of Letters Patent. Patented Apr. 2, 1912.

Application filed July 19, 1906. Serial No. 326,845.

To all whom it may concern:

Be it known that I, HERMANN LEMP, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Feed-Regulators for Heating Systems, of which the following is a specification.

In connection with steam railroads running passenger trains into and out of large cities, and particularly those using tunnels, it has been proposed to use electric locomotives as a substitute for the ordinary steam locomotive for hauling the trains through the tunnels and for some distance beyond. All of the passenger coaches are now provided with steam heating apparatus, the majority being arranged to receive steam from the engine. Such being the case, it is obvious that in order to utilize the existing apparatus some means are necessary for supplying steam to the coaches during the period of time the trains are in the station and also while they are being drawn by the electric locomotive. In certain instances where the requirements are particularly severe there must be no fire on the trains while they are passing through the tunnels. Ordinarily it is impracticable to use coaches on such a railroad solely for electric service so they have to be heated by steam. Again, it would be out of the question to provide all coaches with both steam and electrical heating apparatus.

The object of my invention is to provide a heating system to coöperate with the apparatus now in service on the standard makes of passenger and other coaches or cars, the said system to be installed either on the electric locomotives or on the baggage or other cars as best suits the requirements.

The invention is also capable of use in self-propelled vehicles where the steam is utilized as the propelling medium, or in stationary plants, either for heating or power purposes.

I have found by experience that it is impracticable to use a boiler composed of a single unit for various reasons; so in carrying out my invention, two or more boilers are provided, each comprising one or more coils of pipe into which water is introduced at one end, and issues as steam at the other, which steam may be dry or superheated as desired. The boilers are suitably inclosed and flues are arranged to carry off the products of combustion. The heat is supplied by fire chambers arranged to burn hydrocarbon fuel delivered in liquid form to suitable vaporizers, which in turn vaporize it before combustion takes place. The supplies of water to the boiler and fuel to the fire chamber or burner, are delivered by electrically driven pumps, the latter being under the control of a regulator sensitive to a condition of the steam, as for example its pressure. In the conduit or conduits conveying the fuel are regulating devices, certain of which are responsive to a condition of the steam, such for example as its temperature, while others are responsive to pressure conditions of the fuel itself.

In the accompanying drawing is shown one of the embodiments of my invention, wherein—

Figure 1 is a diagrammatic view of a heating system; Fig. 2 is a detail view of a thermostatically-controlled valve; Fig. 3 is a detail view of the worm drive for the pumps; Fig. 4 is a detail view of one of the pumps, and Fig. 5 is a detail view of a by-pass fuel regulator.

1 represents a coil of pipe made of suitable form and size, and 2 a similar coil. Of these coils there may be as many as desired and inclosed in one or a number of casings or shells. The steam from the coils is discharged into a header 3 of suitable capacity. Steam from the header is discharged by a valve-controlled conduit 4 leading to the successive coaches or cars on the train. In the discharge conduit is a shut-off valve 5 and an automatic relief valve 6 that opens in response to excess pressure. Situated in operative relation to each of the coils are burners or fire chambers 7 and 8 of a type suitable to receive liquid fuel, such as kerosene, and after vaporizing it discharge the same through one or more orifices to support combustion. Each of the burners shown comprises a vaporizer 9, the parts of which are situated on opposite sides of the nozzle 10 and support the baffle plate 11. Vapor is conveyed from the vaporizer to the orifice in the nozzle by the pipe 12 that serves to superheat the vapor. Fuel is supplied to the burner 7 by the pump 13, and to the burner 8 by the pump 14. The pump plungers are rigidly united and are driven by the crank 15. The capacities of the pumps

are such that they always supply a certain excess of oil over that required for heating the boiler.

Water from the tank 16 is supplied to the boiler coils by the pumps 17 and 18, the plungers of which are rigidly united and driven by the crank 15. The pumps are of sufficient capacity to supply all of the water necessary to furnish steam for all of the coaches and cars. The crank is driven by an electric motor 19, its shaft being connected to the crank through speed reducing gearing 20, Fig. 3. The supply of water to the coils is controlled by a regulator 21, actuated by steam pressure. The pipe leading to the regulator preferably passes through the water supply tank so as to wholly or partially condense the steam and thus reduce the temperature to which the diaphragm of the regulator is subjected. The regulator completes the circuit of the electric motor when the steam pressure falls below a certain amount, and opens it when the pressure exceeds a definite amount. The motor is arranged so as to be capable of starting and operating without the use of external resistance. In order to prevent all danger from flashing over at the commutator where the potential of the supply mains is high, a reactive coil 22 may be included in the motor circuit. A double pole switch 23 is arranged to break the circuit when it is desired to shut down.

Fuel for the system is stored in a tank 24 located above the burner nozzles so as to feed the same by gravity when for any reason it is desired to do so and the pumps are not working. Fuel flows from the tank through the strainer 25 thence through the pipes 26 and 27 to the pumps 13 and 14. Following now the course of the fuel from pump 13, it flows through the pipe 28 to the valve 29, the said valve being governed by a thermostat composed of a copper tube and an iron rod located in the discharge end of the boiler coil. After passing through the valve, assuming the temperature of the steam to be low enough to permit of this, it flows through the pipe 30 to a point below the vaporizers where it divides, one half going to one side of the vaporizer and the remainder to the other. Situated below this connection, and in the pipe 30, is a check valve 31, set so as to close when the flow of oil under pump pressure is toward the burner 7 and open when the tank pressure is superior to that in the other parts of the system; in other words, it provides for a gravity feed of the fuel. Connected to the discharge pipe of the fuel pump 13 is a by-pass regulator 32 that opens in response to excess pressure and returns or discharges fuel into the supply tank by the pipe 33. In the present system the boiler is arranged to vaporize 1000 pounds of water per car hour, while the burner is capable of efficiently handling up to about 100 pounds of kerosene per car hour. The by-pass valve may be of any well-known type and is commonly set to open at 60 pounds pressure. In practice I have found that the system works very satisfactorily with the amount of fuel and water noted above, but I do not wish to be understood as limiting myself to them or to any other specific figures or ratios since they can be widely varied. The right hand burner and the pump and coöperating parts being the same in construction and operation, further description is unnecessary.

By means of the various valves and pipes it will be seen that one water pump or the other can be cut out of service, and also its companion fuel pump in event of damage to either of the boiler coils, burners or other parts. This will, of course, reduce the output of steam, but at the same time it permits of the apparatus being kept in service, which is of the greatest importance.

In Fig. 2 is shown by way of illustration a thermostatic valve. It comprises a valve casing 35 containing a valve 36 actuated by the lever 37. In the conduit 38 is a copper tube 39 that is fastened to a fixed abutment on its right hand end. To the left hand end is secured an iron rod 40 that engages the valve actuating lever: As the tube contracts or expands it causes the rod to raise the valve or permit it to drop.

In Fig. 5 is shown by way of illustration a by-pass valve comprising a casing 41, a diaphragm 42, a compression spring 43, and a valve 44. If for any reason the diaphragm breaks the fuel will flow through it into the spring chamber, and by the pipe 45 to the point of discharge, thus cutting off the fuel supply to the fire chamber.

Assuming the system to be cold and the hand valves closed, the operation is as follows:—The valve 34 is opened which permits fuel to flow by gravity to the burner 7 and to the pumps. The fuel is then vaporized and ignited by a suitable torch or other means. If current is on the conductors, the motor 19 may be started to operate the pumps. Assuming the motor and pumps to be in operation, water is forced through the coils and issues as steam into the header 3 from which it is delivered to the heating coils on the coaches by the pipe 4. Fuel is received by the pumps, and after having its pressure increased flows through the pipe 28, thermostatic valve 29 and pipe 30, to both sides of the vaporizer and on through them to the burner nozzle. The vapor leaves the nozzle under high velocity, and after striking the baffle plate is spread and caused to mix with the necessary amount of air to support combustion.

The fuel pumps are designed to supply somewhat more fuel than is necessary for

maximum conditions. Assuming the motor to be running at full speed, the excess is by-passed by the regulators 32 back to the supply tank. If the temperature of the steam rises above the desired point, the thermostatic valves 29 will close wholly or in part, thereby decreasing the fuel supply to the burner. This closing of the valves is accompanied by an increase in pressure on the system resulting in the by-pass regulators opening by a corresponding amount.

In the operation of my invention I prefer to have a very nearly proportional feed of the fuel and water, the fuel supply, however, gaining slightly so as to insure a sufficient amount of heat. By using a substantially proportional feed I reduce to a minimum the danger of the boiler being flooded with water, or in other words, being provided with an amount of water at a given time greatly in excess of the capacity of the burner to vaporize. The flooding of a boiler of the type shown is not an uncommon occurrence where the pump is capable of supplying at all times an amount of water in excess of the requirements.

If for any reason the temperature of the steam in the boiler rises above a certain amount, it is desirable to decrease the fire at once because the steam from the boiler has to pass through a rubber hose to the next car of the train, and if its temperature is too great, the hose will be injured or destroyed. It may also happen that for some reason the water supply fails wholly or in large part resulting in the burning out of the coils unless special means are provided to prevent it. I overcome the objections above noted by providing each burner with a thermostatic valve which acts to decrease or shut off the fire as soon as the temperature of the steam increases abnormally. The thermostatic valve may, therefore, be termed a primary regulator, and the by-pass valve or pressure relieving means, a secondary regulator.

I regard it as being important to provide each boiler coil with its own pump since by so doing one coil cannot rob the other of water as would be the case if they were connected in multiple with a common source of supply.

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

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

1. In a vapor producing system, the combination of a vapor generator, comprising independent conduits discharging in multiple to a common receptacle, fire chambers, pumps for supplying liquid to the generator conduits and fuel to the fire chambers, a motor for driving the pumps, devices responding to a condition of the vapor in the generator for varying the supply of fuel to the fire chambers, and means responding to a different condition of the vapor in the generator for controlling the motor.

2. In a vapor producing system, the combination of vapor generators arranged in multiple to discharge vapor to a common conduit, heating means for the generators, pumps for supplying liquid to the generators and fuel to the heating means, a motor for driving the pumps, fuel controlling means arranged between a fuel pump and the heating means that is responsive to a condition of the vapor in the generators, means for relieving the pressure on the fuel system when said controlling means reduces the supply to the heating means, and means responsive to a condition of the vapor in the conduit for controlling the motor.

3. In a vapor producing system, the combination of a vapor generator, a fire chamber, pumps for supplying liquid to the generator and fuel to the fire chamber, an electric motor for driving the pumps, a thermostatic device for varying the supply of fuel to the fire chamber, a by-pass regulator for the fuel system which opens under conditions of excess pressure, and a controller for the motor which is sensitive to a condition of the vapor generated.

4. In a vapor producing system, the combination of generators arranged in multiple to discharge vapor to a common conduit, a separate fire chamber for each of the generators, fuel and liquid pumps, a motive power agency for actuating the pumps, regulators for the fuel supply systems which are responsive to a condition of the vapor in the generators, and an automatically acting regulator responsive to another condition of the vapor in the generators for controlling the motive power agency.

5. In a vapor producing system, the combination of generators arranged in multiple to discharge vapor to a common conduit, a separate fire chamber for each of the generators, fuel and liquid pumps, a valve responsive to the temperature of the vapor generated for controlling the effective discharge of one of the pumps, a secondary regulator for the pump so controlled as to take care of the excess discharge, a motive power agency for driving the pumps, and a means responding to the pressure of the vapor generated for controlling the motive power agency.

6. In a vapor producing system, the combination of generators each comprising a

coil of pipe, a conduit into which the coils discharge in multiple, a separate water pump for each generator, a fire chamber for each generator, a separate fuel pump for each fire chamber, a motive power agency common to and driving all of the pumps, and regulators for controlling the effective discharges of the pumps which are responsive to the temperature and pressure of the vapor in the generator.

7. In a vapor producing system, the combination of a vapor generator, a heating agency for the generator, a pump for supplying liquid thereto, an electric motor for driving the pump, an automatic controller for the motor that is sensitive to a condition of the vapor produced and regulates the supply of said liquid to the generator by the motor-driven pump, and a reactive coil placed in circuit with the motor to permit it to respond at once with its maximum effort without flashing when the circuit of the motor is closed by the controller in regulating the operation of the system.

8. In a vapor producing system, the combination of a vapor generator, a heating agency, a pump for supplying liquid thereto, a motor for driving the pump, a controller for the motor sensitive to a condition of the vapor generated, and a means for cooling the vapor acting on the controller to prevent injury thereto.

9. In a vapor producing system, the combination of a generator comprising conduits arranged to receive liquid from separate sources and discharge vapor in multiple to energy consuming means, independent pumps for supplying liquid to the generator conduits, heat producing means for the generator, means supplying fuel to the heat producing means, the relation between the pumps and the fuel supplying means being such that the latter gains on the former, means for taking care of the excess fuel supply and devices each responsive to a different condition of the vapor in the generator for regulating the supplies of liquid and fuel to said generator.

10. In a vapor producing system, the combination of a generator, a heating device therefor, pumps for supplying water to the generator and liquid fuel to said device, an electric motor for driving the pumps, means responsive to the steam pressure for controlling the motor and thereby controlling the delivery of the pumps, means responsive to the temperature of the steam for also controlling the fuel supply from the pump to said heating device, and a device responsive to the fuel pressure for bypassing fuel around the pump when said pressure rises above a certain value.

In witness whereof, I have hereunto set my hand this sixteenth day of July, 1906.

HERMANN LEMP.

Witnesses:

JOHN A. McMANUS, Jr.,

HENRY O. WESTENDARP.