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W. S. JOHNSON.

APPARATUS FOR GENERATING STEAM.

APPLICATION FILED JAN. 11, 1907.

Fig. 3.

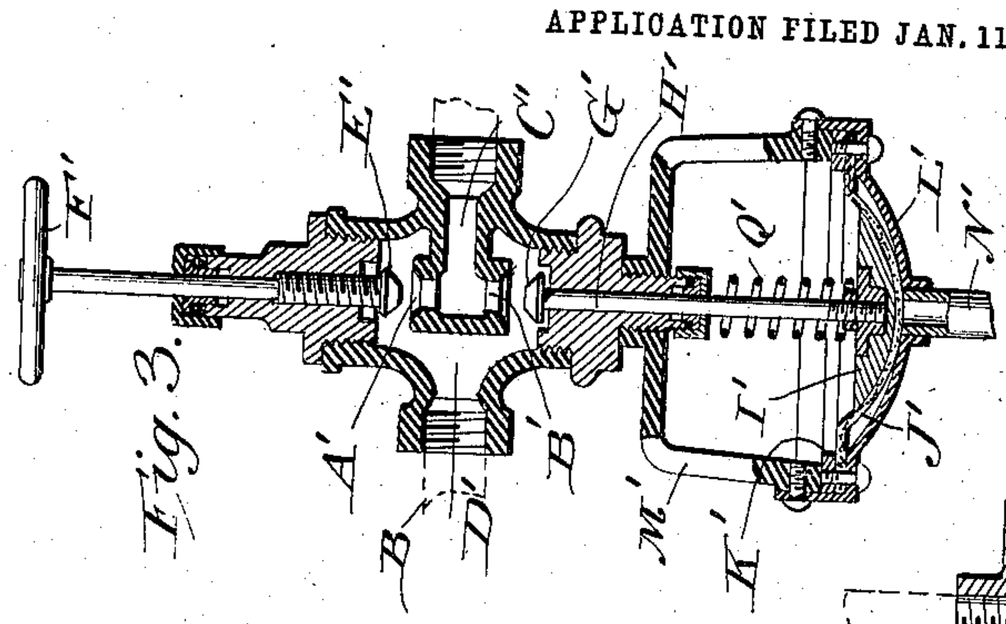


Fig. 2.

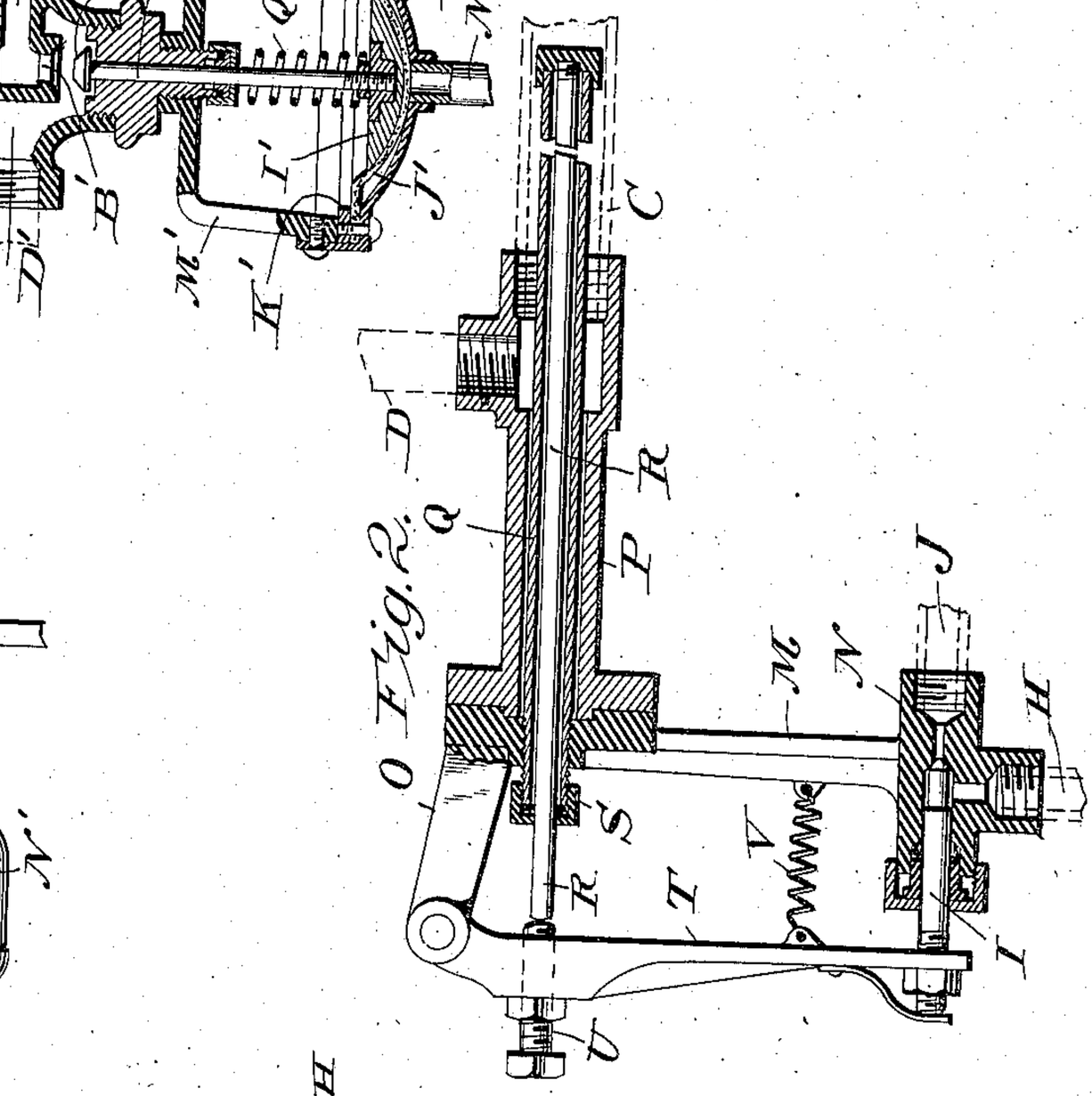


Fig. 4.

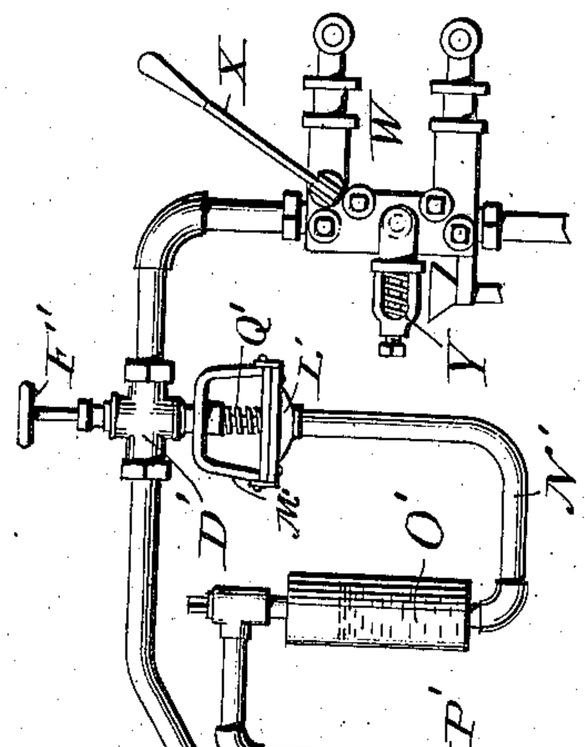
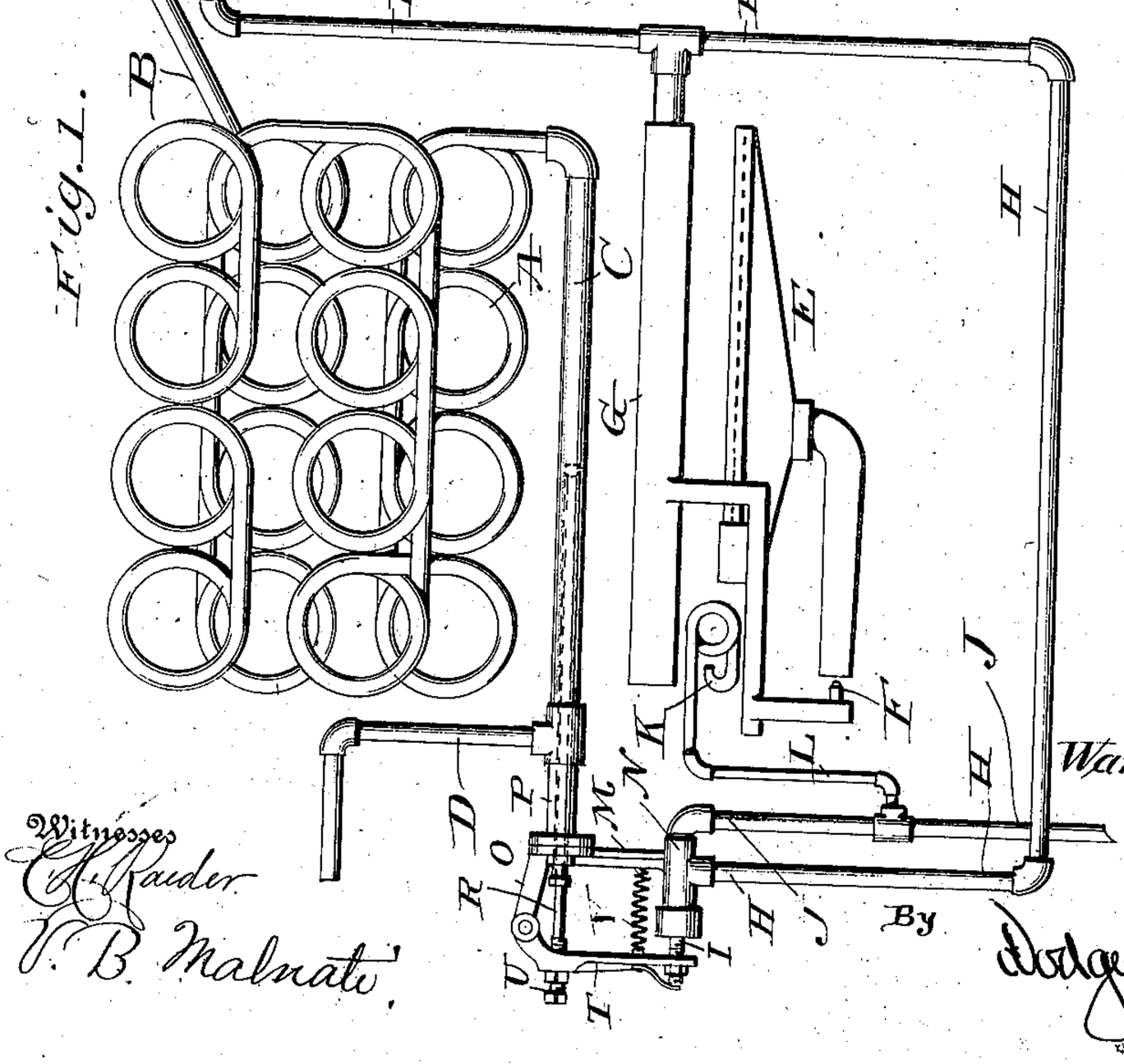


Fig. 1.



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UNITED STATES PATENT OFFICE.

WARREN S. JOHNSON, OF MILWAUKEE, WISCONSIN.

APPARATUS FOR GENERATING STEAM.

No. 858,656. Specification of Letters Patent. Patented July 2, 1907.

Application filed January 11, 1907. Serial No. 351,862.

To all whom it may concern:

Be it known that I, WARREN S. JOHNSON, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Apparatus for Generating Steam, of which the following is a specification.

My present invention relates to that class of devices which have for their purpose the control of the steam output from a steam boiler or generator.

The invention in its simplest form is illustrated in the annexed drawings, wherein:

Figure 1 is a side elevation of the complete apparatus; Fig. 2 a detail sectional view showing the thermostat and fuel-controlling valve actuated thereby; and Fig. 3 a sectional view of the valves employed in connection with the water supply pipe, and the fluid pressure motor used to control one of said valves.

The main object of the present invention is to provide a steam generator in which superheated steam will be produced at approximately a given or fixed temperature, and to cause the steam thus generated, through the action of its temperature upon certain mechanisms, to effect the regulation of the heat applied to the generator and also the amount of water supplied to the generator, in such manner and relation as to maintain the constant production of superheated steam at such given or fixed temperature.

With the apparatus hereinafter described in detail it is proposed to use a boiler of the flash or semi-flash type, and preferably a continuous-tube steam generator, the water, as will be understood by those skilled in the art, being fed or forced into one end of the tube (preferably at a point remote from the fire) and the steam issuing from the opposite end of the tube for consumption. By preference, a boiler in which the water is prevented from gravitating from the top to the bottom thereof, such for instance as that shown in my Patent No. 813,098, dated February 20, 1906, will be employed. By varying the construction and arrangement of the boiler, modifying the action of the fire and controlling the amount of water furnished to the generator, the steam which emerges from the continuous-tube water-tube boiler or generator may be saturated steam or superheated steam. Saturated steam consists of globules of water which are forced apart by the heat so as to give pressure. Superheated steam is the true gas of water, the heating having had the effect of dissociating the molecules of water in such manner that the repulsion is not between globules of water but molecules of water. Superheated steam has many advantages over saturated steam, one of which is economy in its use.

Saturated steam has a temperature corresponding to its pressure. For instance, in a certain generator or boiler with 50 pounds pressure, saturated steam will always have a corresponding temperature. Likewise, a pressure of 100 pounds or 200 pounds will have a corresponding temperature. With superheated steam the pressure and temperature are not co-ordinate. In other words, superheated steam may have a high temperature but a low pressure. Steam superheated to 700° F. may have a pressure less than saturated steam having a much lower temperature. In the use of superheated steam, while a certain pressure is essential to the production of motion through the utilization of energy through a motor, its chief factor is the thinness of the steam, as compared with saturated steam, and the temperature which does not allow of condensation in the cylinder of the engine. A steam plant adapted for the use of superheated steam will not work well with saturated steam. It is, therefore, very essential that the temperature of the steam be kept within certain limits, in order that it may be superheated to a degree which will give the best results in practice.

Heretofore many automatic devices have been used for obtaining superheated steam of the proper temperature and quantity. These automatic devices may, properly speaking, be divided into three classes: first, those in which the fire is controlled by the steam-pressure and the water-supply by the steam-temperature; second, those in which the fire is controlled by the steam-temperature and the water-supply by the steam-pressure; and, third, those in which both the fire and the water-supply are controlled by the steam-pressure. In the present case the control of both the fire and water-supply is by the steam-temperature.

It will be noted that in the first two of the three classes above indicated, there are two different governing elements, the steam-temperature and the steam-pressure. In order that the results may always be uniform, it is evident that there should be, if possible, but one governing element. This is true of the third method of control above outlined, but its governing element is steam-pressure and not steam-temperature. In a steam generator in which the steam is to be superheated, it will be seen that the temperature of the steam should be the governing element, rather than the pressure of the steam. It is, therefore, essential that the governing device which is employed to control the flow of fuel to the burner and also the flow or feed of water to the boiler should be controlled directly or primarily by the temperature of the steam, so that the apparatus will produce uniformly steam at a given temperature. In the present apparatus a single thermostat controls both the fire or heating medium and the water-supply.

In the accompanying drawings I have shown a simple embodiment of my invention, it being understood that the apparatus generically considered may be varied without departing from the spirit of the invention.

In the drawings, A denotes the boiler or generator, preferably formed of a single tube, the water entering

the upper portion thereof through a pipe or connection B and the steam passing from the generator through a pipe C and outlet or branch pipe D to the motor. The steam is superheated in the lowermost coils and in the pipe or chamber C.

E designates the burner, to which the gas or vapor of a hydrocarbon (such as gasolene or coal-oil) is fed through a nozzle F, said nozzle standing in line with and discharging into the open end of the mixing chamber of the burner and entraining the requisite amount of air to cause the proper and complete combustion of the gas or vapor. Said gas or vapor is formed in a vaporizer or generator G, to which liquid fuel is supplied through a pipe H, valve I and pipe J, fuel under pressure being constantly supplied to said pipe J by any suitable means.

A pilot burner K is located beneath the generator, to one side of the burner E, the pilot burner being connected with the main supply pipe J through the medium of a branch pipe L. Pilot burner K is kept constantly lighted, and as a consequence maintains the generator G in a heated condition, so that when the valve I is open and the fuel passes through pipe H to the generator it will be immediately vaporized and pass from the nozzle F in the form of gas to the burner E, where it will be lighted by the pilot burner K.

An arm M is preferably formed integral with the shell or casing N of the valve I, the arm being provided with a threaded aperture near its upper end, and also with a bracket or lug O. The upper end of the arm M is secured to the outer end of a hollow sleeve or casting P, the inner end of which is connected to the pipe C, pipe D being likewise connected to a threaded nipple or projection extending upwardly from the casting. Mounted within said sleeve or casting P and extending into the pipe C is a tube Q, preferably formed of copper and secured at its outer end to the arm M or a fixed portion of the apparatus. The inner end of the tube is rigidly connected to the inner end of a rod or stem R mounted therein, the rod being formed of iron or other material having a lower coefficient of expansion than the tube Q. The outer end of the rod passes through a cap or stuffing-box S mounted upon the outer projecting end of said tube.

Pivotally attached to the outer end of the bracket O is a lever T, said lever being provided with an adjustable screw U, the inner end of which stands in alinement with the outer end of the rod R and is normally held in contact therewith by a spring V attached to said lever T and a fixed portion of the apparatus, as for instance the arm M.

The valve I is secured to the lower end of the lever T. Preferably the valve will be attached to the arm in such a manner that the valve may be adjusted with reference to its seat, and also in such manner that the arm or lever T may move inward to a slight extent independent of the valve after the valve is seated.

As will be noted upon reference to Fig. 2, the valve I controls the passage of fuel from the pipe J to the pipe H, and is under the direct control of and is actuated by the thermostatic device, comprising tube Q and rod R. As will be readily appreciated, the copper tube will expand and contract under the variations in temperature much more rapidly than the rod R. As a consequence, when the tube contracts as the temperature of the steam falls below the predetermined point, it will cause the rod R to move outwardly and to open the valve I, thereby allowing more fuel to pass from pipe J to pipe H and through generator G to the burner. As the steam approximates the required or fixed temperature, the rod will be drawn inwardly, owing to the expansion of the tube Q, and as a consequence the valve I will be moved to its seat.

The water is supplied to the generator by a pump, preferably a constantly-acting one. In the drawings, the pump is shown as of the double-cylinder type and is designated by W, the pistons of which will preferably be connected to a walking-beam or some other continuously-acting lever. To provide for emergencies, I preferably employ a hand-pump operated by a lever X. The pump W will be provided with a relief valve Y which will permit the water to pass therefrom should the valves controlling the passage of the water from the pump to the intake pipe B be closed, or upon the said pipe becoming stopped up or clogged. By preference the water escaping from the valve Y will flow back to the source of supply, so as to conserve such supply as far as possible.

Interposed between the pump and the intake pipe B of the boiler is a double controlling valve, shown in detail in Fig. 3. The valve-casing is provided with two ports or passages A′ and B′, which are in communication with a port C′ leading from the pump. Ports A′, B′ discharge into a common chamber D′, which is connected with and discharges into the intake pipe B. The upper port, A′, is controlled by a valve E′, said valve being operated by a hand-wheel F′, or other suitable manually-controlled actuating device, so that said port or opening A′ may be regulated as desired. The lower port or opening, B′, is controlled by a valve G′, mounted upon the upper end of a stem H′, the lower end of said stem being connected to a block or member I′ which rests upon the upper face of a diaphragm J′. Said diaphragm is clamped at its periphery between a ring K′ and the upper face of a shell or member L′, carried by the lower ends of arms M′ extending from a casting secured to the lower portion of the valve-casing.

The space or chamber formed between the diaphragm and the shell L′ is in direct communication through a pipe N′, Fig. 1, with a reservoir O′, which latter is connected at its upper end by a pipe P′ with the pipe H.

A spring Q′ encircles the valve-stem H′ and acts to withdraw the valve G′ from its seat, said spring working in opposition to the motor, which is under the direct control of or responds to variations in the pressure of the fuel in the pipes H and P′, reservoir O′ and pipe N′. By preference the pipe N′ will be filled and the reservoir O′ partially filled with water, so that the hydrocarbon which is used as a fuel will not come into contact with the diaphragm J′, and thus tend to destroy the same.

The valves E′ and G′, may be termed the governor valves for the water-supply to the generator, and the valve G′, with its diaphragm, may be called specifically a motor-controlled valve. As will be readily appreciated, the position of the valves E′ and G′ will control the flow of water from the pump to the generator through the intake pipe B. The manually-controlled or positioned valve E′ may be set so as to allow a re-

stricted amount of water to pass to the generator at all times, valve G′ moving toward and from its seat as the pressure of the liquid fuel in the pipes or system which supplies the fuel to the burner increases or diminishes. Inasmuch as this pressure of the fuel is controlled by the thermostat acting upon the valve I, it will be seen that the flow of water to the generator is controlled by said thermostat. As the heat increases and the thermostat elongates, the needle-valve I is closed, and consequently the pressure which is exerted upon the diaphragm by the liquid fuel is decreased so that the valve G′ is opened under the action of spring Q′ and a greater amount of water may be forced into the generator. As the tempertaure of the steam begins to fall, the thermostat contracts and opens the valve I to permit a greater or increased flow of liquid fuel through the valve and consequently to the burner and to the fluid-pressure motor. The supply of water will then be reduced, inasmuch as the valve G′ is moved to its seat or substantially so. It will, therefore, be seen that the apparatus is responsive to the temperature of the steam and is unaffected by the pressure thereof, the control of the fuel and of the water being both determined by the temperature of the generated steam.

The operation of the apparatus may be stated as follows assuming to begin with that the temperature of the steam is below the predetermined point: The burner E being in action, steam will be generated and at the same time the valve G′ will be closed. The hand-valve E′ has been previously opened to an extent that will allow a certain quantity of water to enter the generator through pipe B. As the pressure in the generator rises, the amount of water which will pass in through the opening or port A′, past the valve E′, will decrease, owing to the back pressure of the steam, the temperature thereof meanwhile gradually increasing. When the steam-temperature reaches the predetermined point, the thermostat, acting through the rod R and lever T, will permit the spring V to gradually close the valve I and consequently the fire will be diminished. As this takes place, pressure in the pipes H and P′, reservoir O′ and pipe N′ will decrease, and as a consequence the valve G′ will be opened, permitting a larger quantity of water to enter the generator. The additional quantity of water will tend to reduce the temperature of the steam. This will again bring the thermostat into action so as to renew or increase the fire. As this takes place, the water-supply valve G′ will be closed, owing to the increased pressure of the fuel in the system, and the water supply restricted to the amount which will pass through the manually-adjustable valve E′. Said manually-adjustable valve is so regulated as to allow such an amount of water to enter the generator as will, by means of the heat, produce a pressure adequate for all demands, unless the pressure of the steam rise to a higher point, when the supply will be shortened, the fire shut off and an additional supply of water admitted, to again reduce the temperature of the steam and bring the burner into action. The apparatus will produce superheated steam at the proper temperature and at a sufficient pressure to meet the demands of the motor being operated thereby. Any great excess of pressure above that desired is prevented by reason of the fact that excess of pressure produces excess in temperature, and such rise of temperature would result in the cutting off of fuel to the burner and a consequent reduction of the temperature, both by reason of the lowering of the fire and the introduction of a greater amount of water into the boiler. Thus by the action of the thermostat alone both the fuel supply and the water supply are controlled.

It is evident that other means than the diaphragm-motor may be used for actuating the valve which controls the water-supply, provided such means are primarily controlled by the temperature of the steam.

Having thus described my invention, what I claim is:

1. In combination with a steam generator; a thermostat subject to the temperature of the steam generated thereby; a valve for controlling the supply of fuel to heat the generator; a valve controlling the supply of water to the generator; and means controlled by the thermostat for directly opening and closing the fuel-controlling valve and in turn through the control of the fuel causing adjustment of the water-supply valve.

2. In combination with a steam generator, a valve for controlling the supply of fuel under pressure to heat the generator; a thermostat subject to the temperature of the steam produced by the generator for regulating the fuel-controlling valve and permitting the fuel to exert a greater pressure as the valve is opened; and a valve controlling the supply of water to the generator, said valve being closed through the action of the increased pressure exerted by the fuel, and vice versa.

3. In combination with a steam generator; a thermostat subject to the temperature of the steam generated thereby; a source of liquid fuel under pressure for heating the generator; a valve for controlling the feed of such fuel; a source of water for the generator; a valve for controlling the feed of the water to the generator; and a motor for operating said last-named valve, said motor being actuated by and subject to the pressure of the fuel which passes the first-mentioned valve.

4. In combination with a steam generator; a thermostat subject to the temperature of the steam generated thereby; a source of water for the generator; a motor-actuated valve for controlling the feed of water to the generator; a burner; a source of liquid fuel under pressure communicating with the burner and also with the motor of the motor-actuated valve; and a valve for controlling the feed of the liquid fuel to the burner and likewise controlling the pressure exerted by the fuel on the motor, said valve being actuated and controlled by the thermostat.

5. In combination with a steam generator; a thermostat subject to the temperature of the steam generated thereby; a source of water for the generator; a valve for controlling the feed of water to the generator; a spring for opening the valve; a motor for closing the valve; a burner; a source of liquid fuel under pressure, said source being in communication with said motor and the burner; and a valve for controlling said liquid fuel, the valve being in turn controlled by the thermostat.

6. In combination with a steam generator; a thermostat subject to the temperature of the steam generated thereby; a burner; a source of liquid fuel under pressure; a valve controlling the passage of the fuel to the burner; connections between said valve and the thermostat; a source of water for the generator; a valve for controlling the feed of the water; and a motor actuating said valve, said motor being actuated by and responsive to the pressure of the fuel which passes to the burner.

7. In combination with a steam generator; a burner; a thermostat subject to the temperature of the generated steam; a fuel feeding system; means for supplying fuel thereto under pressure; and a water feed system, the feed of the fuel being directly responsive to the action of the thermostat and the water feed directly responsive to the pressure exerted by the fuel passing to the burner.

8. In combination with a steam generator; a thermostat subject to the temperature of the steam generated thereby; a burner; a source of liquid fuel under pressure

leading to the burner; a valve for controlling the passage of the fuel to the burner; a motor-operated valve for controlling, in part, the feed of the water to the generator, the motor being responsive to and actuated by the pressure of the fuel passing to the burner; and a manually-adjustable by-pass valve also located in the feed water line.

9. In combination with a steam generator; a thermostat subject to the temperature of the steam generated thereby; a burner; a source of liquid fuel under pressure leading to the burner; a valve for controlling the passage of fuel to the burner; connections intermediate the valve and the thermostat for closing the valve as the temperature of the steam approximates the desired or predetermined temperature; a water-supply line for the generator; a motor-operated valve located in said line, the motor being responsive to and actuated by the pressure of the fuel passing to the burner and serving as the pressure increases to close the valve; and a manually-controlled valve also located in the water-supply line.

10. In combination with a steam generator; a thermostat subject to the temperature of the steam generated thereby; a burner; a source of liquid fuel under pressure leading to the burner; a valve actuated by the thermostat for cutting down the supply of fuel as the temperature of the steam rises; a water-supply line; a valve located in the line; means controlled by the pressure of the fuel passing to the burner for actuating said valve, the valve opening as the fuel-controlling valve closes, and vice versa; and a manually-adjustable valve also located in said water-supply line.

11. In combination with a steam generator, a burner; a thermostat subject to the temperature of the generated steam; a fuel-feeding system; means for supplying fuel thereto under pressure; a water-feed system, the feed of the fuel being directly responsive to the action of the thermostat and the water-feed directly responsive to the pressure exerted by the fuel passing to the burner; and a manually-adjustable by-pass valve located in the water-feed system.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WARREN S. JOHNSON.

Witnesses:
BERNARD ALTMEIER,
PAUL F. JOHNSON.