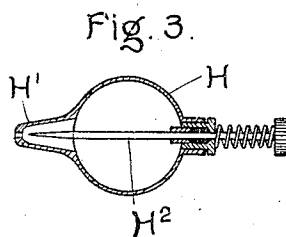
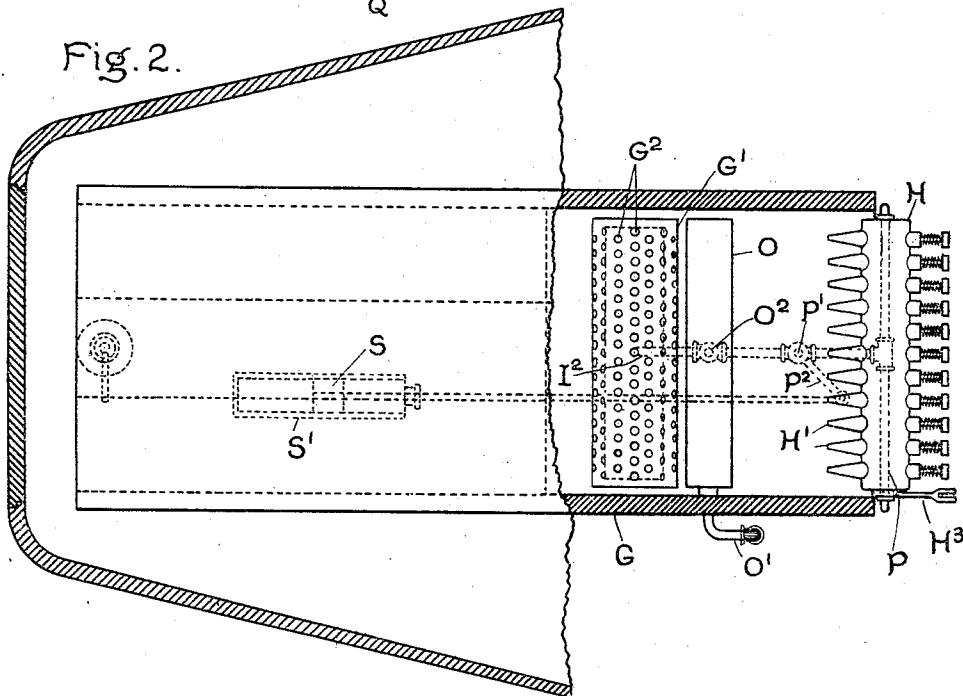
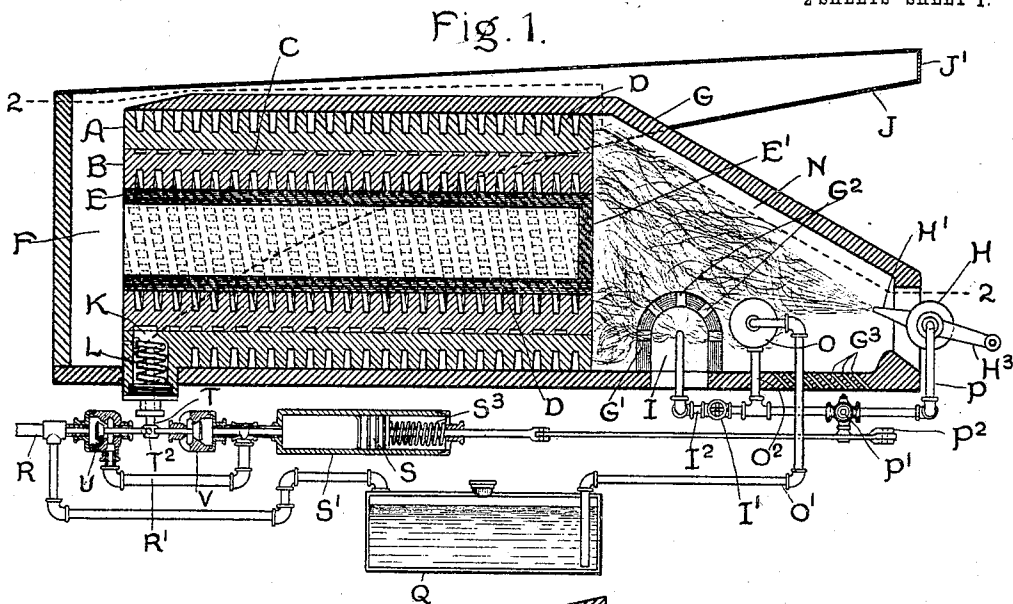


E. THOMSON.
THERMOREGULATOR FOR VAPOR BURNERS.

APPLICATION FILED MAY 24, 1900.

2 SHEETS—SHEET 1.



WITNESSES.

Henry Westendahl
Alex. F. Macdonald.

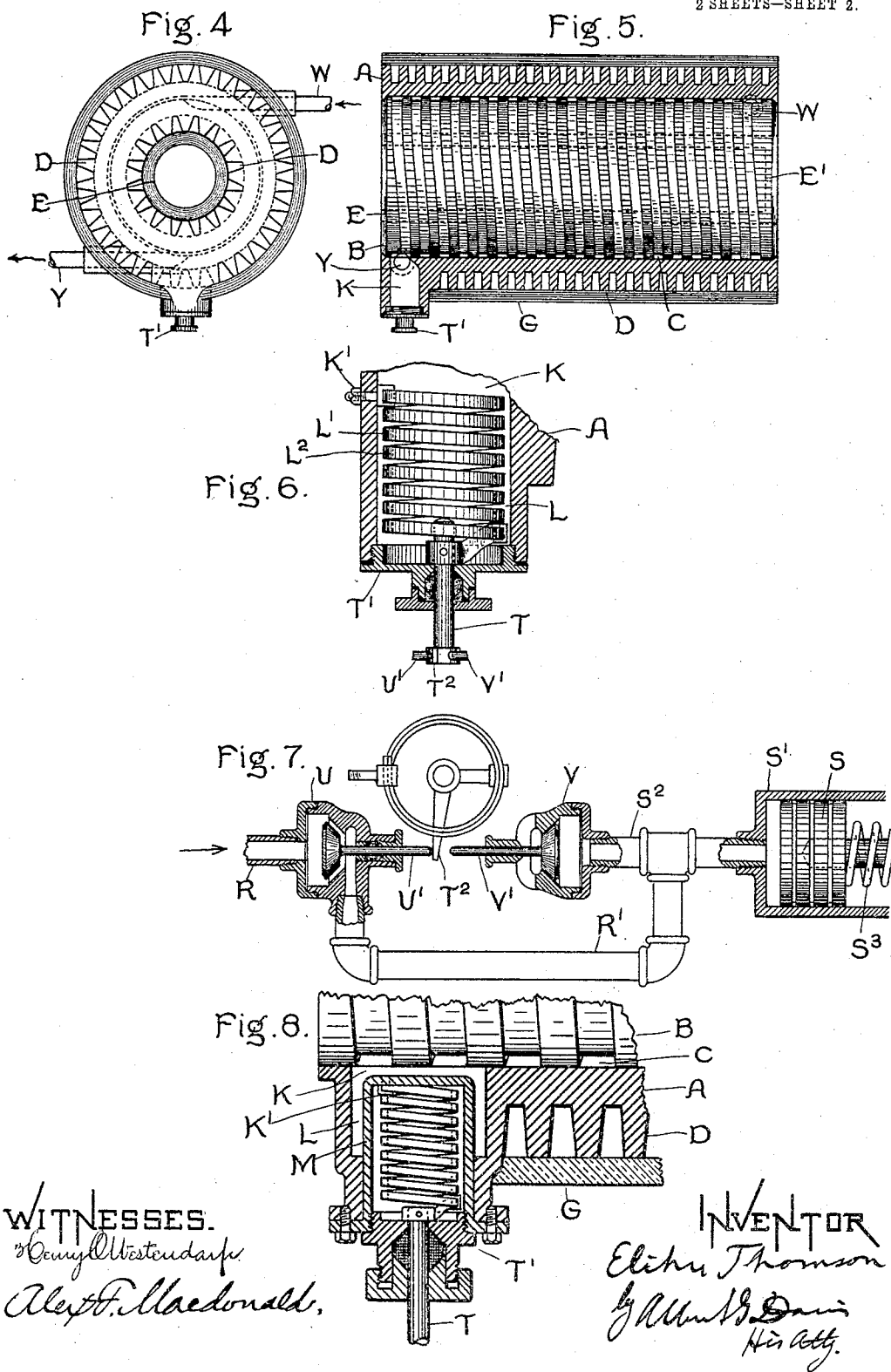
INVENTOR.

Elihu Thomson
by Allen H. Davis
His Atty.

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UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF SWAMPSCOTT, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

THERMOREGULATOR FOR VAPOR-BURNERS.

SPECIFICATION forming part of Letters Patent No. 792,087, dated June 13, 1905.

Application filed May 24, 1900. Serial No. 17,806.

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, residing at Swampscott, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Thermoregulators for Vapor-Burners, of which the following is a specification.

For certain classes of work it has been found desirable to use flash-boilers, which are commonly composed of a single tube or several tube-sections properly united or of a metal structure having a restricted passage into which water is forced under pressure and as it passes through the tube or passage is flashed into steam at some intermediate point and from this point to the outlet is gradually superheated. It has also been found desirable to use oil or vapor burners for heating the same and to regulate the amount of oil or vapor supplied to the burner in accordance with the steam-pressure—that is to say, as the steam-pressure increases the fuel-supply decreases, and vice versa. I have found, however, with systems of this class that water under certain conditions works its way through the boiler tube or passage either as a plug or as a continuous stream and affects a pressure-regulator in the same manner as the steam. In other words, the water-pressure being sufficiently high causes the regulator to decrease the amount of fuel supplied to the burner instead of increasing it, as should be done at this critical moment.

My invention has for its object to overcome the objection above pointed out and to provide a regulator which will automatically vary the supply of fuel in accordance with the demands of the system at all times.

In carrying out my invention a thermostatic regulator is provided which is so situated and arranged that it is acted upon by the steam, water, or combination of both. This regulator controls the action of a suitable power device, which in turn varies the supply of fuel to the burner.

In order to obtain the best results from flash-boilers, it is necessary to operate them at a high temperature, so that the steam is

highly superheated and attains a pressure, for example, of from four hundred to five hundred pounds. When the boilers are so operated, a considerable difference in temperature exists between the steam and any body of water which may be forced through the water and steam space either as a plug or as a continuous stream. My invention depends for its operation upon this temperature difference as distinguished from those thermoregulators wherein the regulation is due to changes in steam temperature alone.

In the present embodiment of my invention the thermoregulator regulates the opening and closing of two valves which control the action of a piston operated by compressed air. The boiler is of the flash type and is heated by a burner composed of two parts, one of said parts comprising what I term the “main” burner and is regulable, while the other I term the “auxiliary” burner and is not regulable, although it is evident that I can regulate the auxiliary burner either by means of the same or a different device than that employed for regulating the main burner.

In the accompanying drawings, which illustrate an embodiment of my invention, Figure 1 is a longitudinal section of a boiler and burner. Fig. 2 is a plan view of the same with certain of the parts in section, the section being taken on line 2 2 of Fig. 1. Fig. 3 is a cross-section of the main burner. Fig. 4 is an end view of the boiler. Fig. 5 is a longitudinal section of the same. Fig. 6 is an enlarged detail view, partially in section, of the thermostat. Fig. 7 is an enlarged view illustrating the valves for controlling the burner-regulating piston, and Fig. 8 is a detail view in section of a slight modification of the thermostat.

Referring to the drawings, the boiler is composed of two metal cylinders A and B, the cylinder A surrounding the cylinder B and arranged concentrically therewith. On the periphery of the cylinder B is turned a spiral groove C, which constitutes a part of the water-passage of a flash-boiler, the other part being formed by the outside cylinder A,

which fits tightly over the inner cylinder. Projecting inwardly from the inner wall of the cylinder B and outwardly from the periphery of the cylinder A are a series of small projections D, which serve to baffle the flames from the burner and absorb the heat. Mounted within the cylinder B and engaging with the internal projections thereon is a cylinder E of refractory material, such as fire-brick. The end of this cylinder E next the burner is closed by a disk E', so that the products of combustion are compelled to pass through the spaces between the projections D on the cylinder A and the outer casing and between the projections on the cylinder B on their way to the chamber F. The entire boiler is surrounded by a casing G, made of fire-brick or other similar material, which is extended at one end to form a chamber for the main burner H and the auxiliary burner I and at the other end to form a chamber F for the waste products of combustion. Connecting with this chamber and extending outward over the boiler is a long flaring funnel or chimney J, having a series of holes J' at its outer end, through which the products of combustion pass to the external air. At or about the point where the steam leaves the boiler an enlarged opening K is provided, and located therein and in direct contact with the water or superheated steam, or both, is a thermostat L, the specific construction of which will be hereinafter described. For the present it is sufficient to say that it is so arranged that it controls the opening and closing of the valves U and V.

The auxiliary burner I is composed of a suitable structure, such as a tube, having a plurality of openings through which the vapor escapes. Surrounding the burner and provided with openings G² therein is a casing G', made of fire-brick or other similar material, and from this casing the products of combustion pass through the openings G² to the main combustion-chamber.

By reason of the casing G' being open on the lower side sufficient air is admitted at all times to support good combustion, and the openings therein permit the flames to enter the chamber N and heat the boiler and also the vaporizer O. The auxiliary flame can be adjusted by the hand-valve I', but is not affected by the automatic regulator, so that no matter what the condition of the main flame may be there is always heat enough developed by it to keep the vaporizer O in operative condition.

The main burner H consists of a closed-end cylinder having a series of projecting nozzles H', each nozzle being provided with a single opening. Opposite each of the nozzles and provided with a suitable stuffing-box is a spring-pressed plunger H². These plungers are intended to act as cleaners for the holes in the nozzles. When it is desired to clean

any one of the holes, the plunger is pressed inward manually, the coil-spring serving to return it as soon as the pressure is relieved.

The bottom part of the casing G, located directly under the main burner, is provided with a series of small holes G³, which admit air to the casing and aid in supporting combustion. The casing being made of refractory and somewhat porous material, and provided with air-admitting openings, the apparatus may be started into operation by flooding the bottom of the casing with oil from the main burner H and then causing it to ignite. When this is done, the flames will heat the vaporizer O until vapor is formed and the flow of oil stops. This method of vaporizing the oil for starting may or may not be worked in connection with the auxiliary burner, as desired.

In order to change the direction of the flame—as, for example, when it is desired to increase or decrease the flames which strike the vaporizer O—the burner is mounted for oscillating movement in the ends of a U-shaped pipe P. The ends of the cylindrical burner are closed around the pipe, and suitable means are provided for preventing the escape of the vapor. Secured to one end of the cylinder is an arm H², whereby the position of the nozzles may be changed, either directly or through some system of levers.

The vaporizer O consists of a hollow cylindrical body which extends across the casing in front of the flames and may or may not be filled with asbestos or some such material for aiding in the vaporization of the fuel. One end of the vaporizer is connected by a pipe O' with the oil-tank Q, while connected to the bottom thereof is a pipe O², that unites with the pipe P, leading to the main burner, and a pipe I², leading to the auxiliary burner. The passage of vapor to the main burner H is controlled by means of the valve P', actuated by a lever P², which is connected to the piston S. The piston is mounted within a cylinder S' and is when not opposed by the air-pressure in the pipe R and cylinder moved to the extreme left under the action of the coil-spring S². Oil is supplied to the vaporizer from the tank Q, where it is maintained under a practically constant air-pressure maintained in the pipe R by a suitable pump. (Not shown.) With the valve P' fully opened it is capable of furnishing the maximum amount of vapor necessary for any load for which the apparatus is designed.

Referring more particularly to Figs. 4 to 7, inclusive, the thermostat is made up of two pieces L' and L², of dissimilar metals, such as brass and iron or copper and iron, and these pieces are riveted together and held in place within the receptacle K of the boiler by a clamp K' at the upper end. The lower ends are connected to the shaft T, which passes through a stuffing-box in the plate T', that closes the bottom of the boiler-opening K.

The outlet-pipe for the steam enters the opening K, so that the thermoregulator is in a position to instantly receive the benefit of any change in temperature.

5 I have shown and described the thermostat as being located in direct contact with the steam or combination of water and steam as it passes to the steam or outlet pipe Y; but it may be located in a suitable support separate
10 from the steam-passage, in which case it should either be very sensitive to changes in temperature or the wall separating it from the steam-passage should be as thin as possible consistent with strength. A good form
15 of this last-mentioned type consists in mounting the thermostat in a shell and passing the steam around the shell, as shown in Fig. 8. The thermostat is shown as being located at what is virtually the outlet end of the boiler; but it may be located at a point somewhat
20 nearer the other end, if desired. It must, however, be located at such a point that it will be acted upon by the steam and water. Referring to that figure, M represents a tubular shell or thimble which contains the thermostat and is bolted to the flange formed on the cylindrical portion A of the boiler. In all essential features the details of construction of the thermostat are the same as shown
30 in the other figures and will not be further described. The thimble fits into the chamber L, which is slightly larger, thereby leaving an opening for the steam to pass around the thimble on its way to the steam or outlet
35 pipe Y.

Secured to the lower end of the shaft T and extending between the puppet-valve stems U' and V' is an arm T², which opens the valves U and V, the air-pressure closing them when
40 relieved by the arm.

Each of the valves is provided with a proper seat, and the valve V is arranged to exhaust into the open air. The valve U is connected to the pressure-pipe R and controls the passage of fluid through the pipe R' to the cylinder, while the valve V is connected to the pipe S², which is also connected to the cylinder S'.

The action of my invention is as follows:
50 Assuming that the boiler is hot and that a suitable supply of water is forced into it from the pipe W, the flame in the auxiliary burner I is maintained constant and the vaporizer O is heated to a certain temperature and supplies vapor to the main burner. The rise in temperature above a certain point has its effect on the thermostat L, and it slowly unwinds and in so doing presses the valve-stem U' to the left, and air under pressure
55 is admitted to the pipe R'. This insures the closing of the exhaust-valve V, and the pressure forces the piston S against the action of the coil-spring S³ and partially or wholly closes the valve P' through the lever P². Assuming that for any cause the temperature of

the superheated steam drops below a predetermined point—such, for example, as would be occasioned by the passage of a plug or stream of water—the arm T of the thermostat will move in a clockwise direction, thereby relieving the valve U and permitting it to
70 shut, at the same time opening the valve V and exhausting the air from the cylinder S' and the pipes R' and S². As soon as this is done the coiled spring S³ will open the valve
75 P' and permit an amount of fuel to flow to the main burner which varies from minimum to maximum in accordance with the demand. It will be seen that between the ends of the two valve-stems is a dead-space, where
80 the arm T can be cut out of engagement with either. When the apparatus is operating under normal conditions, the arm will occupy this space more or less of the time and the opening of the valves will generally be very
85 slight.

By constructing and arranging the parts as shown I provide a regulator which is very sensitive, and when for any reason the water passes through the tube or passage in the
90 boiler without being converted into steam it will quickly chill the thermostat and the latter will cause an increase in the fuel supplied. With this arrangement the regulation is most sensitive, for the controlling means is located
95 directly in the path of the outgoing steam and any change in temperature is instantly detected and compensated for.

I have herein shown and described certain new and useful improvements in vapor-burners, but have not claimed them, since they form the subject-matter of a divisional application, Serial No. 65,520½, filed June 21, 1901.

What I claim as new, and desire to secure by Letters Patent of the United States, is—
105

1. In combination, a flash-boiler designed to supply superheated steam, a hydrocarbon-burner, a source of fuel-supply, means for maintaining the fuel-supply under pressure, a regulator for controlling a supply of fluid-
110 pressure and which is governed by the temperature of the steam in the boiler, and a fluid-pressure motor which is under the control of the regulator, and itself controls the supply of fuel to the burner.
115

2. In combination, a flash-boiler arranged to supply superheated vapor, a vaporizer, a hydrocarbon-burner for heating the vaporizer, a source of fuel-supply for the burner, a means for maintaining said fuel-supply under pressure, a regulator for controlling the supply of fuel from the source to the burner, a connection between the pressure-maintaining means and the regulator for subjecting the latter to pressure, and a thermostat exposed to the
125 steam in the boiler and arranged to control the action of the regulator.

3. In combination, a flash-boiler, a hydrocarbon-burner, a source of fuel-supply under pressure, a thermostat, a support for the ther-
130

mostat whereby the latter is maintained in position to be acted upon by the fluid passing through the boiler, a source of air under pressure, a piston for controlling the fuel-supply, 5 a valve for regulating the effect of air from said source on the piston which valve is controlled by the thermostat, and a second valve independent of the first which is also controlled by the thermostat for relieving the 10 pressure on the piston.

4. In combination, a steam-generator, a furnace, a fuel-tank containing a body of liquid fuel, a valve for controlling the admission of fuel to the furnace, and a source of air-pressure which actuates the valve and also furnishes a pressure for the fuel delivered to the 15 burner.

5. In combination, a boiler, a thermostat located in such a manner that it is acted upon 20 by either water or steam, as the case may be, a source of fuel-supply under pressure, a source of pneumatic power, a fuel-regulating valve controlled thereby, and two independent valves actuated by the thermostat for controlling the 25 source of pneumatic power.

6. In combination, a flash-boiler, a spiral thermostat, a shaft connected thereto, a piston for regulating the fuel supplied to the burner, and oppositely-disposed valves controlling the 30 piston and acted upon by said shaft through a lost-motion connection.

7. In combination, a boiler, a burner, a source of fuel-supply under pressure, a regulator responding to variations in condition of 35 the vapor in the boiler for regulating the passage of fluid from said source to the burner, a source of air which maintains the fuel-supply under pressure and also actuates the regulator, valves which control the action of the 40 source of air-pressure on the regulator, and a

single means for controlling the operation of the valves.

8. In combination, a burner, a source of fuel-supply, a regulator for regulating the admission of fuel to the burner from said source, a 45 source of air under pressure which maintains the fuel-supply under pressure and actuates the regulator, separately-actuated valves for controlling the action of the source of air-pressure on the regulator, each of the said 50 valves having a stem, and a device for actuating the valves so as to take up a certain amount of lost motion before it can move the valve-stems.

9. In combination, a boiler, a thermostat, a 55 source of air under pressure, a burner, a regulating-valve therefor, a piston and cylinder for actuating the valve, a source of fluid under pressure, an arm connected to the thermostat, and valves on opposite sides of the arm, 60 but normally out of engagement therewith, for controlling the supply of fluid-pressure to the piston.

10. In combination, two oppositely-disposed 65 and oppositely-acting valves, the stems thereof extending toward each other, and separated by a space, a movable arm separate from the valves and arranged to make a lost-motion connection therewith, the said arm being 70 arranged to open the valves, and a piston and cylinder so arranged that one of said valves acts to admit air into the cylinder and the other to exhaust it.

In witness whereof I have hereunto set my hand this 21st day of May, 1900.

ELIHU THOMSON.

Witnesses:

DUGALD MCKILLOP,
HENRY O. WESTENDARP.