E. THOMSON.

REGULATION AND CONTROL OF STEAM PRODUCTION.

APPLICATION FILED AUG. 2, 1897.

1,015,983. Patented Jan. 30, 1912.

Fig. 1

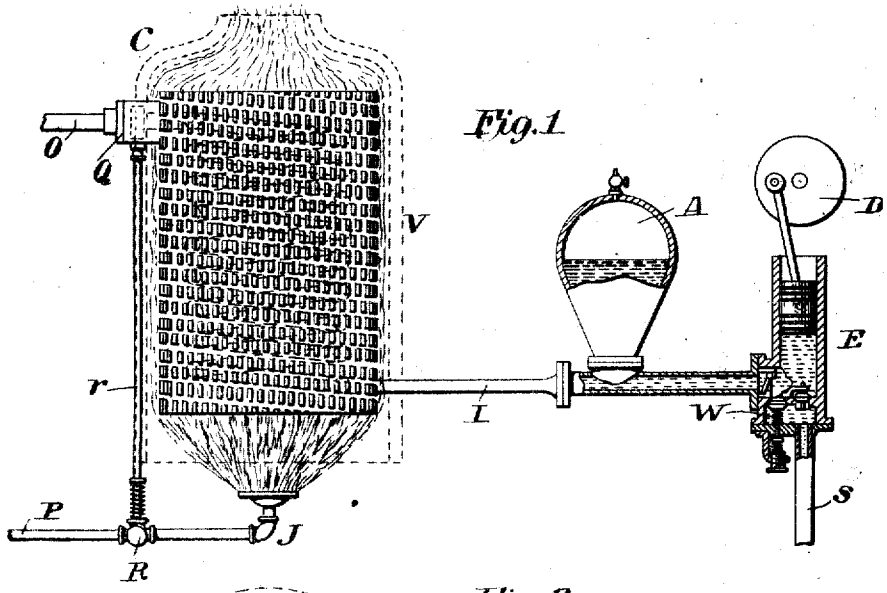


Fig. 2

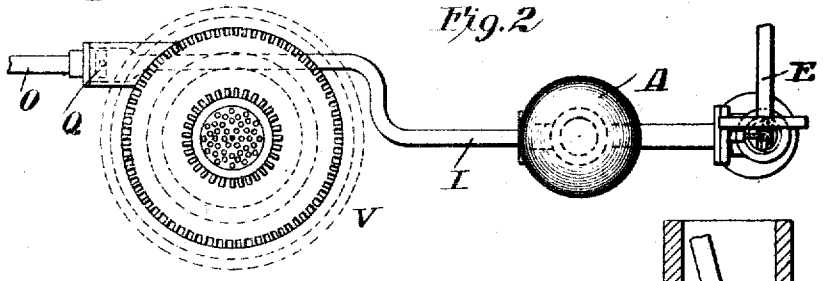


Fig. 3

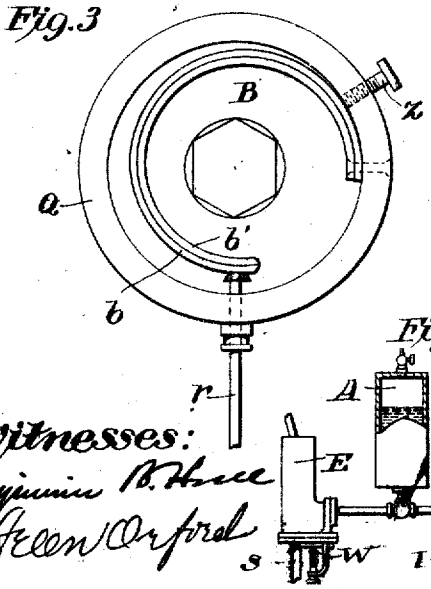


Fig. 4.

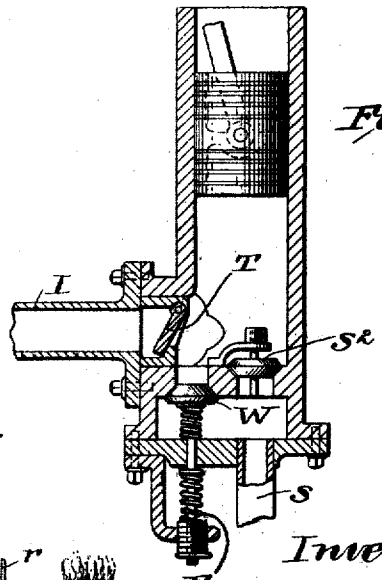
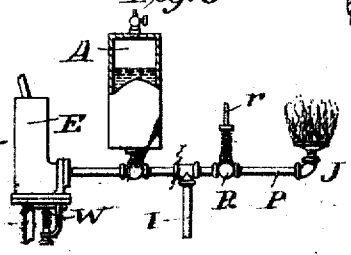


Fig. 5



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UNITED STATES PATENT OFFICE.

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...ULATION AND CONTROL OF STEAM PRODUCTION.

1,015,983. Specification of Letters Patent. Patented Jan. 30, 1912.

Application filed August 2, 1897. Serial No. 646,752.

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, State of Massachusetts, have invented certain new and useful Improvements in the Regulation and Control of Steam Production, of which the following is a specification.

My present invention relates to a means for controlling or limiting the temperature to be attained by a steam generating device or boiler, and also for limiting the pressure which can at any time be produced therein by vaporization of a fluid pumped into the vaporizing spaces.

The invention is particularly applicable to a vaporizer or boiler made of a massive piece of metal in accordance with other cases filed by me, or such a structure as consists of a metallic body having passages through which the vapors of a fluid are to be sent. The metallic body in this case is assumed to be sufficiently massive to acquire a sensibly uniform temperature by heat conduction, or at least not to differ very greatly in temperature at different portions.

The object of the invention is to make the temperature of the boiler attained at some one part or parts of its structure control any increase beyond a certain limit in such temperature, and at the same time control the pressure which may be developed in the vapor stream by regulating the water or fluid supply.

Figure 1 represents an elevation, partly in section, of a structure embodying my invention. Fig. 2 is a plan of the parts shown in Fig. 1. Figs. 3 and 4 are enlarged details. Fig. 5 is a modification adapting the invention to a particular use.

In Fig. 1, V represents a massive vaporizer whose exterior surfaces are covered with projections for absorbing heat and which has inside a series of passages such as would be formed, for example, by casting a coiled pipe therein.

O is the outlet for vapor and I the inlet pipe for the liquid to be vaporized.

J is the jet or burner which furnishes the combustible for heating the boiler; C the chimney or stack which forms an expanded casing around the boiler, as usual.

The fuel supply is usually oil, either liquid or vaporized, reaching the jet J through a pipe P from any suitable reservoir, under sufficient pressure to cause it to flow.

R is a valve which can be opened and shut by a motion of the valve rod *r* to regulate the flow of vapor or oil to the burner J.

Q is a portion of the mass of the boiler V, extended to contain the temperature regulating arrangement, which may be constructed in various ways. One of these ways is typified in Fig. 3; here the extension Q of the boiler mass (which may, of course, be a metallic piece attached to the mass having thorough heat-conducting connection therewith), contains a compound bar B of two metal strips *b* and *b'* having different coefficients of expansion by heat, fixed at one end, and adjusted by a proper screw Z so that it will press upon the valve rod *r*, Fig. 1, and allow full flow of the fuel to heat the vaporizer. On the increase of temperature of the vaporizer V and the boss Q, in sympathy therewith the compound bar B bends so as to relieve the rod *r* and close the valve R, Fig. 1; gradually, upon the attainment of a certain temperature, the valve closes, either nearly or completely, as may be desired. In this arrangement, if the valve R be opened by the spring and closed by the flexure of the compound bar, the temperature of the metal mass of the vaporizer V will be limited or controlled irrespectively of its duty or vapor output. The compound bar B might, of course, be replaced by an expansible fluid contained in a flattened tube, as in the Bourdon pressure gage, or by any suitable heat responsive devices capable of controlling the valve R and the fuel supply, the chief object of the arrangement being to check the fire or the heating agent in its action in heating the vaporizer V in accordance with the increased temperature of said vaporizer, irrespective of the pressure of the vapor developed or the amount of vapor developed in the heater.

With the devices so far described I combine the automatic control of the pressure of the liquid to be vaporized, and thereby I am enabled to control not only the temperature of the vapor which leaves the boiler, but also and simultaneously the pressure of the vapor. The vaporizer then

cannot produce either an excessive pressure of vapor, nor can it produce it at an excessive temperature. It is, in fact, preferred to locate the boss Q at or near the outlet O so as to more perfectly accomplish the result just stated. The object of my vaporizer is to supply steam to engines under regulated pressure and at such a temperature as will not injure the moving parts. At the same time the object is to utilize when desired massive vaporizers with practically no water therein, or with so little water that no similarity exists between it and an ordinary steam boiler filled with boiling water. For securing vapor at a pressure limited in amount therefore I employ a feed pump D (Fig. 1) worked by a crank and plunger within a cylinder E in the ordinary way. This feed pump has the usual system of valves between its outlet pipe I and its inlet or suction pipe S (see Fig. 4), opening from the suction pipe inward to the pump cylinder and from the pump cylinder outward to the pipe I, as usual. An air chamber A, with air under pressure, is preferably located between the pump and the vaporizer. The suction pipe S communicates with a supply of liquid to be vaporized, which may be water, oil or other liquid. The pump is worked at such a rate as will give an excess of liquid over any possible demand or up to that amount which the vaporizer V under full work is capable of converting into vapor. Should however the outlet pipe O be closed (as by a valve between the vaporizer and an engine using the vapor) the pump D need not stop, because a valve is provided at W, held by a spring and allowing under a certain excess of pressure the liquid taken into the pump cylinder E through the valve S^2 to pass back into the suction space or pipe S, instead of passing the outlet valve T into the pipe I. Upon the valve W bears a spring F which may be adjusted by any suitable means on the stem of the valve W, so as to cause it to open under a certain pressure, which is to be the maximum pressure to be generated in the vaporizer. The slip-valve W being located in the suction space gives freedom from the leakage which might otherwise exist if it were located on the pipe I or elsewhere where the pressure is high.

My invention may be so combined that the pressure regulating part and the temperature regulating part work together, as when the vaporizer V is used to vaporize oil, which is used to supply the jet J, and which may also be vaporized for working an engine, the oil being condensed after passing the engine and returned to a proper reservoir from which the suction pipe S takes it. In this case (see Fig. 5) S would be a suction pipe for oil from a suitable tank or reservoir. The valve W would be set, as before, to limit the pressure which the pump would exert in forcing said oil forward. The chamber A would exist as an equalizer and steadier of the pressure, as well as a reservoir for liquid under pressure. The valve R would be controlled, as in Fig. 1, by the temperature of the vaporizer, and thereby the flow of compressed oil to the jet J would be governed. A side pipe I may take a portion of the pumped oil, under pressure, and carry it through the vaporizer, as in Fig. 1, and the vaporized oil would pass to the outlet pipe O where it may be used for working a vapor engine and afterward suitably condensed and returned to the reservoir from which the pipe S takes it.

Other modifications of my invention can readily be made, its essential features consisting in so combining the regulation for temperature of the vaporizer and the pressure of the vapor generated as to secure a flow of vapor of limited temperature and pressure, but varying in amount according to the demand, while the fuel which produces the vaporization is also varied in amount or rate of combustion automatically according to the demand for heat. To state the matter in a different way, means are provided for supplying water to the boiler and fuel to the combustion chamber or burner in such quantities as will furnish the desired amount of superheated steam or vapor under varying conditions of load up to the capacity of the system. As the demand for superheated steam or vapor varies the thermostat and pressure regulator automatically vary the amounts of water and fuel which are respectively supplied to the boiler and burner, and this in a definite quantitative relation to said variation in demand and in substantially the same degree. In this manner the temperature and pressure of the vapor are constantly maintained at the proper points and under economical and satisfactory conditions.

The generator being of the flasher type, the water as it enters is gradually heated until it flashes into steam, and from this point to the end is gradually superheated. This means that only a small amount of water is at the temperature of vaporization. As the demand on the generator for vapor changes the point of vaporization changes slightly. In one case it may be midway between the ends of the tube, and in another before or after the midway position.

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.

Having thus described my invention, what

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

1. The combination, of a steam-generator of the flasher type with a regulator for the fuel-supply governed by the temperature of the steam in said generator, and a regulator for the water-supply governed by the pressure of steam in said generator, substantially as and for the purpose specified.

2. The combination of a steam-generator of the flasher type, a burner for heating the same, means for supplying fuel to the burner, means for supplying water to the generator, a thermostatic regulator for governing the fuel-supply which regulator is inclosed in the generator, and a regulator for governing the water-supply which regulator is connected with the generator and operated by the steam-pressure therein, substantially as and for the purpose specified.

3. The combination of a steam-generator of the flasher type, a source of water-supply, means for forcing the water from the supply to the steam-generator, a hydrocarbon-burner for heating the steam-generator, a source of hydrocarbon supply connected with the burner, a thermostatic regulator and a pressure-regulator connected with the steam-generator, the thermostatic regulator governing the supply of hydrocarbon to the burner and the pressure-regulator governing the supply of water to the boiler, substantially as described.

4. In combination, a flash boiler, a water pump, a regulator for the water-supply that is controlled by the pressure of the vapor in the boiler, an air chamber that is connected to the pump and the boiler, a burner, and a regulator for the burner which is governed by the temperature of the vapor in the boiler.

5. In combination, a boiler for generating vapor pressure, a means for delivering fluid thereto, a fire chamber, a means for delivering fuel thereto, and automatic means for regulating the supply of fluid to the boiler and fuel to the fire chamber, the said means acting to correlate the said supplies in accordance with the demands made on the boiler.

6. In combination, a flash boiler, a pump, a connection leading from the pump to the boiler, a by-pass valve that is acted upon automatically by the boiler pressure, a means for supplying fuel to a fire chamber, and an automatic regulator therefor.

In witness whereof I have hereunto set my hand this 30th day of July, 1897.

ELIHU THOMSON.

Witnesses:

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