No. 791,811. PATENTED JUNE 6, 1905.

E. F. OSBORNE.

PRESSURE VALVE FOR STEAM HEATING SYSTEMS.

APPLICATION FILED JUNE 25, 1903.

2 SHEETS—SHEET 1.

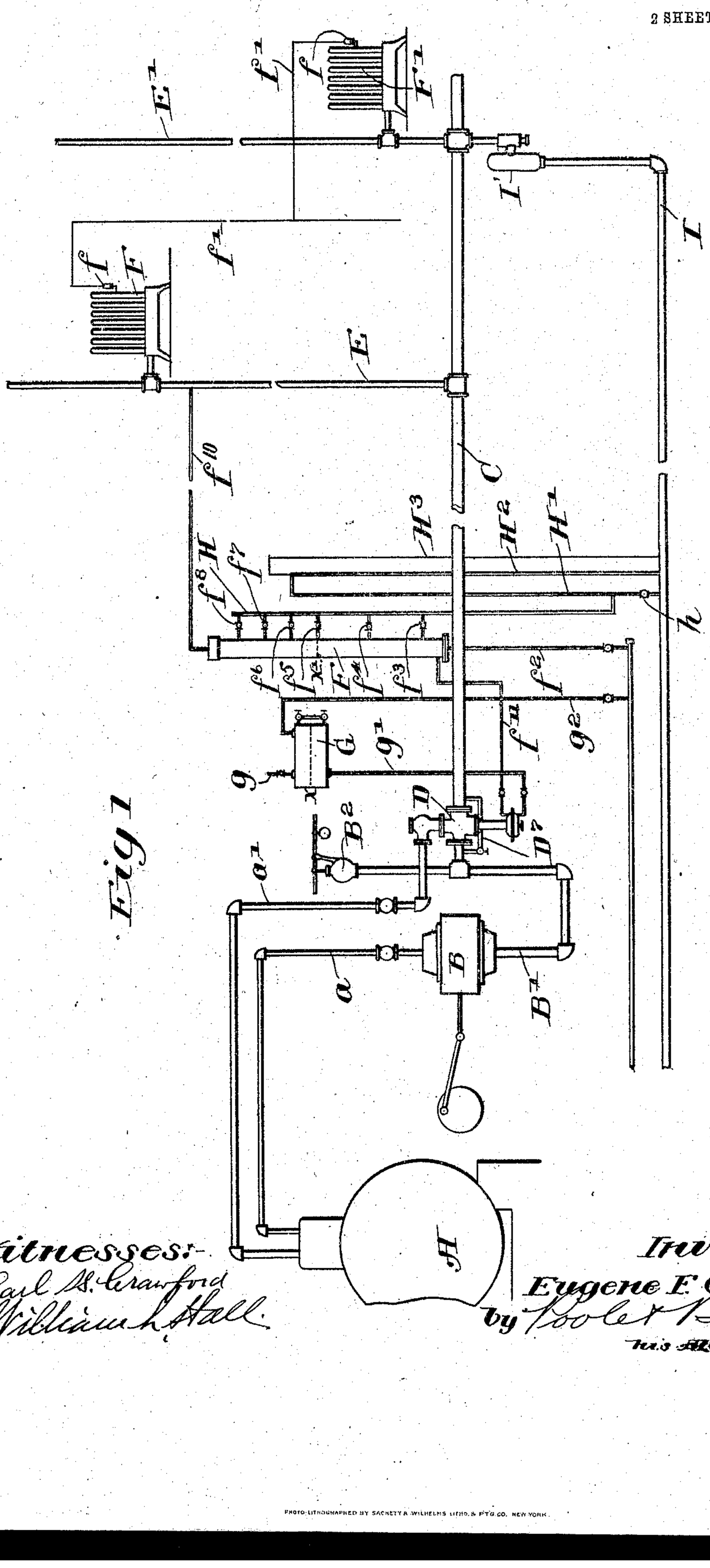


Fig 1

Witnesses:-
Earl S. Crawford
William L. Hall.

Inventor:-
Eugene F. Osborne
by Poole & Brown
his Attorneys

No. 791,811. PATENTED JUNE 6, 1905.

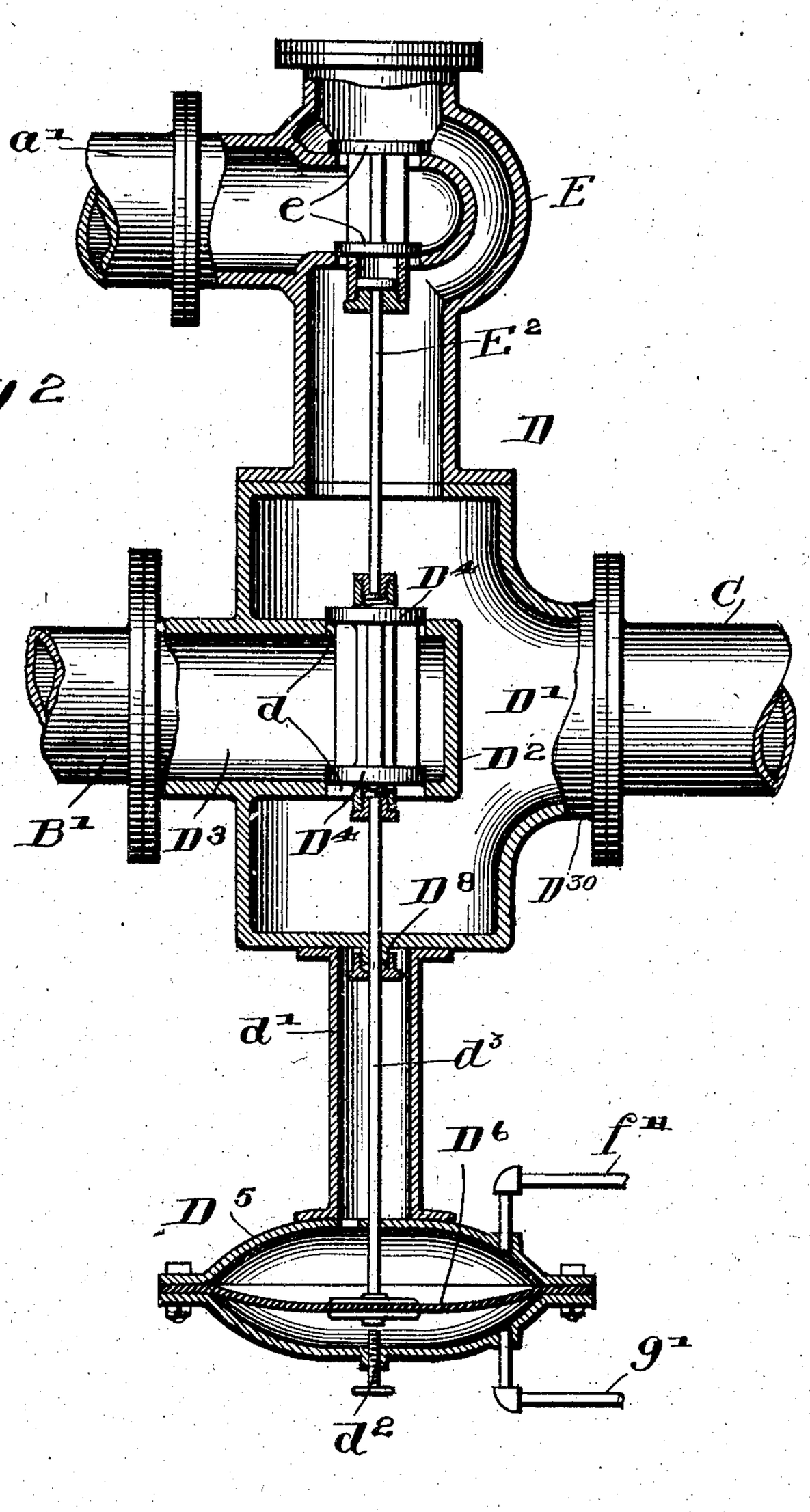
E. F. OSBORNE.

PRESSURE VALVE FOR STEAM HEATING SYSTEMS.

APPLICATION FILED JUNE 25, 1903.

2 SHEETS—SHEET 2.

Fig 2



Witnesses:-
Earl H. Crawford
William L. Hall

Inventor
Eugene F. Osborne
by Poole & Brown
his Attorneys

No. 791,811. Patented June 6, 1905.

UNITED STATES PATENT OFFICE.

EUGENE F. OSBORNE, OF CHICAGO, ILLINOIS, ASSIGNOR TO OSBORNE STEAM ENGINEERING COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

PRESSURE-VALVE FOR STEAM-HEATING SYSTEMS.

SPECIFICATION forming part of Letters Patent No. 791,811, dated June 6, 1905.

Application filed June 25, 1903. Serial No. 163,017.

To all whom it may concern:

Be it known that I, EUGENE F. OSBORNE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Pressure-Valves for Steam-Heating Systems; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in steam-heating systems, and refers more specifically to a pressure-regulating device located in the main steam-supply pipe of the system and designed to maintain the pressure of the steam in the system to correspond with variable conditions under which it is desired to operate the system.

The valve herein shown is generally like that shown in my prior application for United States Letters Patent, Serial No. 69,202, filed on the 22d day of July, 1901.

A pressure-controlling valve made in accordance with my invention is designed to be operated or controlled by the hydrostatic head of two columns of liquid, one of which is subject to the influence of the pressure or vacuum existing in the system, the whole being arranged to maintain an approximately given pressure of steam in the distributing-pipes of the system.

The invention consists in the matters hereinafter set forth, and more particularly pointed out in the appended claims.

In the drawings, Figure 1 is a diagrammatic view of a steam-heating system embodying my invention. Fig. 2 is a view of the pressure-controlling valve, shown principally in axial section.

First referring to the construction shown in Fig. 1, in which my invention is shown as embodied, A designates a steam-generator. B designates an engine-cylinder to which steam is supplied from the generator A through a pipe *a*, the power derived from which is adapted to be applied to any useful purpose. C designates the main steam-supply pipe of the circulatory system, which, as herein shown, receives exhaust-steam from the exhaust-pipe B′ of the engine and is adapted to receive live steam from the boiler A through a pipe *a*′. Said pipe B′ and *a*′ communicate with the steam-pipe C through the medium of a pressure-controlling valve D, made in accordance with my invention, said pressure-controlling valve being in open communication with the main steam-supply pipe C. Said exhaust-pipe B′ is extended beyond the valve D and is provided at its outer end with an air-check and release valve B^2, which is set to permit excess of exhaust-steam not required for the heating system to escape into the atmosphere, but closes when the pressure in the exhaust-pipe is diminished to or below atmospheric pressure to prevent the admission of air into the exhaust-pipe and therethrough to the valve D when the exhaust-steam is insufficient to supply the system. The main steam-supply pipe C is connected with risers E E′, with which are connected steam-heating devices, as the radiators F F′. Said risers may of course be made of any desired number and length and as many radiators connected therewith as desired. The radiators are provided with automatic air-valves *f f* of a familiar type, through which the air is discharged from the radiators when the steam is admitted thereto. Connected with said air-valves are air-discharge pipes *f*′ *f*′, through which the air is conducted from the radiators. The pipes of adjacent radiators are desirably connected with each other, so as to conduct the air to a common discharge. In case the radiators operate under a partial vacuum the pipes *f*′ *f*′ are connected with a suitable vacuum device, as a vacuum-pump; but in the event of the operation of said radiators under a pressure greater than atmospheric pressure the pipes *f*′ *f*′ may be open to the atmosphere.

The system shown diagrammatically in Fig. 1 operates under pressure either above or below atmospheric pressure. The reducing-valve D is so constructed as to maintain a certain pressure in the circulatory system regardless of the pressure of the steam when delivered

to said valve. The valve is adjusted when first installed with respect to the condition of pressure desired, and it is intended that when once adjusted for a given pressure it will remain in such adjustment until it is intentionally changed, and such adjustment may be varied to correspond with a different condition of pressure. Said valve is also constructed to admit either exhaust or live steam or a mixture thereof to the circulatory pipes. It will be understood that the exhaust-steam, when the system is supplied principally from the exhaust side of the engine and when available in sufficient quantities, is the source of the steam-supply, and live steam is used only when the exhaust-steam becomes insufficient to supply the demand. Steam may, however, be supplied to the valve D wholly from the primary generator A. The valve is held closed when not in use by the differences of hydrostatic heads of two columns of liquid, one of said heads acting with the weight of the movable parts of the valve and the other acting in opposition thereto. In starting the system in operation air is discharged from the radiators and circulatory pipes, thereby reducing the pressure in the system to such extent that the weight of one of the columns of liquid plus the pressure acting therewith is sufficient to overcome the weight of the other column of liquid plus the pressure in the system and to thereby open the valve to admit steam to the system.

As shown herein, the reducing-valve D consists of a shell or casing inclosing a chamber D′, which is provided interiorly thereof with a hollow horizontally-arranged casing D^2, constituting an inlet-chamber for the exhaust-steam. The casing D^2 is closed, except for upper and lowered alined openings d, constituting valve ports or openings. Said casing terminates outside of the shell of the valve in an inlet-branch D^3, with which the exhaust-steam pipe B′ is connected. The valve-casing at the other side of the valve is formed to provide an outlet branch D^{30}, to which the pipe C is attached. D^4 D^4 designate upper and lower rigidly-connected downwardly-closing valve-disks which close the port-openings d of the steam-inlet chamber and which are raised to permit the steam to pass into the circulatory pipe C. The stem d^3 of said valves extends downwardly through the lower end of the chamber D′ and through a neck d', opening from the lower end thereof into a diaphragm-chamber D^5 at the lower end of the neck. D^6 is a diaphragm in said diaphragm-chamber, with which the lower end of the valve-stem is connected. The diaphragm supports a column of liquid, the weight or head of which column acts, together with the weight of the movable parts of the valve and pressure in the system, to hold the valve closed. The diaphragm is acted upon at its lower side by a second liquid column and atmospheric pressure, tending to open the valve. The valve-stem d^3 extends through a stuffing-box D^8 at the top of the neck d' of the casing, which prevents the liquid in the upper part of the diaphragm-chamber from flooding the valve and the stem in the valve-chamber from finding its way to the diaphragm-chamber.

As before stated, means are provided for directing live steam into the circulatory system if the exhaust-steam be insufficient to meet the requirements. Such means consist of an extension-casing E, attached to the upper end of the casing of the main valve and provided with a valve mechanism which is substantially the same as the mechanism of the main valve. Said upper or auxiliary valve receives live steam from the pipe a', to which reference has already been made. The valve-closures e of the auxiliary valve are connected with the closures of the main valve through the medium of a connecting rod or stem E^2. Said stem E^2 is connected with the valve-closures e by means permitting of lost motion, whereby said upper valve is not opened to admit live steam until the lower valve is fully or partially opened, the admission of live steam to the distributing-pipe C not being required so long as the exhaust-steam is sufficient to supply the system. When the pressure of the exhaust-steam in the exhaust-pipe falls below atmospheric pressure, the back-pressure valve B^2 closes to prevent the admission of air into the system through the exhaust-pipe.

A valved by-pass pipe D^7 connects the pipe B′ with the pipe C around the reducing-valve, whereby steam may be admitted to the pipe C under the pressure of the exhaust-pipe B′ when desired. The by-pass may be used in this manner when steam is first admitted to the system in order that the steam may be forced through the circulatory pipes at a velocity to quickly clear the system of air. In lieu of the by-pass described for the purpose mentioned I may employ means for positively raising the valve-closures from their seats to permit steam under the pressure of the pipe B′ to pass through the valve D into the pipe C. The means herein shown for this purpose consists of a screw d^2, threaded through the lower wall of the diaphragm-chamber and adapted to bear at its upper end against the diaphragm.

The liquid-columns acting positively against the diaphragm and controlling the valves D^4 and e are supplied from liquid contained in a stand-pipe F and a tank G and pipes connecting said stand-pipe and tank with the two parts of the diaphragm-chamber. The tank G is open to the atmosphere through a vent-pipe g, and the stand-pipe is subject to the pressure or vacuum of the feed side of the circulatory system through a pipe f^{10}. Said tank is made considerably shallower than the stand-pipe and is located at a level between the ends of said stand-pipe. The stand-pipe communi-

cates at its lower end with the upper part of the diaphragm-chamber D^5 above the diaphragm by means of a valved pipe f^{11}. The stand-pipe is provided with a valved water-supply pipe f^2, leading into the bottom of the stand-pipe. The liquid-tank G is connected, by means of a valved pipe g', with the lower part of the diaphragm-chamber D^5 below the diaphragm, said pipe g' entering the bottom of said diaphragm-chamber. The tank G is filled through a valved water-supply pipe g^2, connected with the supply-pipe f^2 for the stand-pipe before referred to.

The stand-pipe F is provided at vertically-separated points with a plurality of valved overflow-pipes f^3, f^4, f^5, f^6, f^7, and f^8, and said overflow-pipes are connected with a common drain-pipe H, which discharges in a return-pipe I, into which the water of condensation from the radiators is discharged. The feed and return pipes C and I, respectively, have differential pressures, and a suitable trap is interposed between the overflow drain-pipe H and the return-pipe. Said trap embraces, as herein shown, a vertical pipe H', into the lower end of which the overflow-pipe H empties, and an overflow-pipe H^2, into the upper end of which the upper end of the pipe H' discharges, which pipe H^2 discharges at its lower end into the return-pipe I, and an equalizing-pipe H^3, which communicates at its lower end with the return-pipe I and at its upper end with the upper end of the overflow-pipe H^2. The pipe H^3 is made small and serves to prevent siphoning of the water from the pipe H' through the pipe H^2. In installing the system the pipe H' needs to be made somewhat longer than the maximum difference in pressures, counted as feet of water, between the inlet and outlet sides of the system and constitutes the differential-pressure pipe of the trap, the liquid therein being subjected to the two pressures of the system. A suitable trap I' is inserted in the return-pipe I, whereby is maintained the desired difference in pressures between the feed and return sides of the system. The pipe H' is provided with a drain-valve h, which is normally closed and opened to drain the water from the stand-pipe F and pipe H.

By opening the valve of either of the overflow-pipes of the stand-pipe the level of the water in the stand-pipe may be brought to the level of said open pipe, whereby means are afforded for varying the force of the hydrostatic head of the liquid in the stand-pipe F. The liquid in the chamber G remains at approximately the same level, so that the head of the liquid column in the tank and its pipe g' is maintained approximately constant.

If no account be taken of the weight of the movable parts of the valve D and the diaphragm D^6 when the levels of the water in the tank G and the stand-pipe F are equal, the pressure on both sides of the diaphragm will be equal, so that the valve-closures will be held in equilibrium or in balance, and the parts are so arranged that such balanced positions of the valve-closures are their closed positions. As a matter of fact, however, account must be taken of the weight of the movable parts of said valve and diaphragm, so that a slightly-greater pressure need be exerted on the under side of the diaphragm than its upper side to bring the valve-closures in equilibrium. The difference in the levels of the liquid in the stand-pipe and tank when the valve-closures are thus in equilibrium is indicated in Fig. 1 of the drawings as that between the lines X and X'.

With this construction if it be desired to operate the system as a vacuum system one of the overflow-pipes f^6 f^7 f^8 above the liquid-level in the tank G is opened, while all of the overflow-pipes below said open pipe are closed. The stand-pipe and tank having been previously filled through their supply-pipes, the liquid will find its level in the stand-pipe at the level of the lowermost open overflow-pipe f^6 f^7 f^8. Consequently owing to the fact that the column of liquid in the said stand-pipe plus the pressure of the circulatory system exerts, through the pipe f^{11}, a downward pressure on the diaphragm D^6 greater than that exerted upwardly on the diaphragm by the column of water in the tank G and pipe g' plus atmospheric pressure the superior pressure of the stand-pipe column acts to hold the valve-closures in their closed positions.

The operation of the valve after the adjustment mentioned is substantially the same as that of the valve described in my aforementioned prior application, with the exception that the liquid column plus the pressure in the system acting downwardly on the diaphragm is opposed by the liquid column plus atmospheric pressure acting upwardly on said diaphragm instead of being opposed by atmospheric pressure alone. Another difference in the operation of the two valve mechanisms, due to the different constructions, is that the pressure in the system is exerted through the pipe f^{10} upon the top of the water column in the stand-pipe instead of upon the top of the water column in the valve-casing itself, as in the construction described in my said prior application.

If it be desired to operate the system under a greater vacuum than that afforded by the adjustment described, the overflow-pipe, which has been previously open, will be closed, and the collection of the water of condensation in the upper part of the stand-pipe will serve to fill the stand-pipe to the level of a higher overflow-pipe. Thereafter the liquid-head of the stand-pipe column acts with greater force to close the steam-valves, thereby increasing the vacuum in the circulatory pipes necessary to open said valves.

If it be desired to operate the system under pressure, one of the overflow-pipes below the

level of the liquid in the tank G is opened, whereby the pressure of the column of liquid exerted on the lower side of the diaphragm plus atmospheric pressure will be greater than that exerted on the upper side thereof by the liquid-head in the tank F plus the pressure of the system, thereby tending to hold open the valve-closures to a greater or less extent, depending upon the difference between the heads of the liquid columns and coacting pressures. When the system is operated under a pressure greater than atmospheric, and when, therefore, the water in the stand-pipe is below the upper end of the equalizing-pipe H′, the difference in pressure between the feed and return sides of the system directs the overflow from the stand-pipe through the trap consisting of the pipes H H′ H^2 to the return side of the system. It will be obvious that the action of the liquid columns on the valve-closures will be the same if the column of the stand-pipe acts on the lower side of the diaphragm and the column of the tank operates on the upper side thereof; but in that event the operation of the valve-closures will be reversed or arranged to close upwardly instead of downwardly.

An important advantage of the means described for controlling the action of the pressure-controlling valve is that the movement of the steam-valve closures upon a variation of pressure in the circulatory system or in the steam delivered to said system is gradual, so that such variations will not manifest themselves in abrupt variations of pressure in the system between wide ranges. The tendency of the seals between the parts of the system operating under differential pressures to blow out is therefore minimized. Furthermore, the consumption of the steam is more economical, as by the use of the apparatus herein shown there is little or no tendency of wastage of steam, which is likely to occur when the working pressure varies abruptly between wide ranges.

The usefulness of an apparatus wherein the system may be operated under a pressure or vacuum in connection with a system which operates under usual conditions as a vacuum system will be made apparent from the following: In starting the system in operation and at a time when the circulatory pipes and the radiators are filled with air it is desirable that means be provided for promptly forcing the steam under pressure through the circulatory system for the purpose of driving or forcing the air from the circulatory pipes and radiators. In starting the system, therefore, one of the overflow-pipes of the stand-pipe below the level of the liquid in the tank G may be opened, so that the differences of head between the two columns of liquid will act to hold open the steam-valves and permit steam to be admitted to the circulatory system under sufficient pressure to quickly drive the air from the system. When the pipes and radiators are filled with steam and the steam condenses therein, the valved overflow-pipe theretofore opened will be closed and one of the valved overflow-pipes above the liquid-level in the tank G opened. Thereafter the collection of water of condensation in the stand-pipe F from the drip-pipe f^{10} fills the stand-pipe to the level of the upper overflow-pipe just opened, after which the system will operate as a vacuum system. The system may be, if desired, operated for a longer time as a pressure system than the temporary starting period mentioned. Moreover, the valve mechanism and its controlling means are useful, as it enables the same mechanism to be used with either a pressure or vacuum system with the same parts and without substantial changes therein.

In lieu of the flexible form of diaphragm D^6 employed to transmit the pressure of the liquid columns to control the action of the valve-closures in the manner described I may employ other forms of diaphragm, such as a piston fitting closely and reciprocating in a cylinder, for such purpose. The term "diaphragm" herein employed is not to be restricted, therefore, to the particular form illustrated. Other changes may be made in the structural details of the apparatus, and I do not wish to be limited to such details except as hereinafter made the subject of specific claims.

I claim as my invention—

1. In a steam-heating system, the combination with the circulatory pipes thereof, and a source supplying steam, of a valve between said circulatory pipes and said source and means whereby said valve is controlled by two opposing columns of liquid, one acting in a direction to open the valve and the other in a direction to close said valve, and one of which is subject to the pressure of the circulatory pipes.

2. In a steam-heating system, the combination with the circulatory pipes and a source supplying steam, of a valve between said circulatory pipes and said source, means whereby said valve is controlled by two opposing columns of liquid, one of which is subject to the pressure of the circulatory pipes, and means whereby the heads of said columns of liquid may be relatively varied to control the valve to produce a pressure or vacuum in said circulatory pipes.

3. In a steam-heating system, the combination with the circulatory pipes thereof and a source supplying steam, of a valve between said circulatory pipes and said source, means whereby said valve is controlled by two opposing columns of liquid, one of which is subject to the pressure of the circulatory pipes, and means for varying the liquid-head of the column which is so subject to the pressure of the circulatory pipes.

4. In a steam-heating system, the combination with the circulatory pipes and a source supplying steam, of a valve between said circulatory pipes and said source comprising a casing provided with a port and a closure which seats against said port, of a diaphragm connected with said closure, a chamber in which said diaphragm is contained, said chamber being connected on opposite sides of said diaphragm with two pipes containing two independent columns of liquid, the heads of which columns oppose each other, and one of said columns being subject to the pressure of the circulatory pipes.

5. In a steam-heating system, the combination with the circulatory pipes and a source supplying steam, of a valve between said circulatory pipes and said source, comprising a casing provided with a port, a valve-closure seating against said port, a diaphragm connected with said closure and contained in a closed chamber, a stand-pipe for containing liquid communicating with said chamber on one side of said diaphragm, a liquid-receptacle communicating with said chamber on the other side of said diaphragm, whereby the heads of the liquid columns of said stand-pipe and receptacle act in opposite directions against said diaphragm to control said closure, said stand-pipe being subject to the pressure in said circulatory pipes and a liquid seal between the said stand-pipe and the return-pipe of the system.

6. In a steam-heating system, the combination with the circulatory pipes and a source supplying steam thereto, of a valve between said circulatory pipes and said source comprising a casing provided with a port, a closure seating against said port, a diaphragm connected with said closure and inclosed in a chamber, a stand-pipe for containing liquid and subject to the pressure within the circulatory pipes and communicating with said chamber on one side of said diaphragm, a liquid-receptacle communicating with the chamber on the opposite side of the diaphragm, valved overflow-pipes leading from said stand-pipe at different heights and a common overflow-pipe communicating with all of said valved overflow-pipes.

7. In a steam-heating system, the combination with the circulatory pipes thereof and a source supplying steam, of a valve between said circulatory pipes and said source, means whereby said valve is controlled by two opposing columns of liquid, one of which is subjected to the pressure of the circulatory pipes, and a valved by-pass extending around said valve from said source of supply to the circulatory pipes.

8. In a steam-heating system the combination with the circulatory pipes thereof and an engine-cylinder, an exhaust-pipe leading from said engine-cylinder and provided with a back-pressure valve, a pressure-controlling valve between said circulatory pipes and said exhaust-pipe through which exhaust-steam is supplied to the circulatory pipes and means whereby said valve is controlled by two opposing columns of liquid, one of which is subject to the pressure of the circulatory pipes of the system.

9. The combination with a valve and its closures, of a diaphragm connected with said closure, a chamber in which said diaphragm is inclosed, a stand-pipe for containing a liquid column communicating with said chamber on one side of said diaphragm, a liquid-receptacle communicating with said chamber on the other side of said diaphragm, and means for varying the relative levels of liquid in said stand-pipe and receptacle to vary the relative heads thereof which act in opposite directions against said diaphragm.

10. The combination with a valve and its closure, of a diaphragm connected with said closure, a chamber in which said diaphragm is inclosed, a stand-pipe for containing a liquid communicating with said chamber on one side of said diaphragm, a liquid-receptacle communicating with said chamber on the other side of said diaphragm, and valved overflow-pipes leading from said stand-pipe at different vertical heights.

11. In a steam-heating system, the combination with the steam-circulatory pipe thereof and a source supplying steam, of a valve between said circulatory pipe and said source, the movable part of which is connected with and operated by a diaphragm, and means whereby said diaphragm is subjected on the opposite sides thereof to the action of two columns of liquid, one acting in a direction tending to open the valve and the other acting in a direction tending to close the same, and one of which is subjected to the pressure within the steam-circulatory pipe.

12. In a steam-heating system, the combination with a supply and return pipe, a source supplying steam to said supply-pipe, and heating devices receiving steam from said supply-pipe, the return-pipe operating under a pressure lower than that of the supply-pipe, of a valve between said supply-pipe and said source of steam, means whereby said valve is controlled by two opposing columns of liquid, one of which is subjected to the pressure of the supply-pipe, and the liquid of which latter is discharged into the return-pipe, and a trap between the space containing said latter column and the return-pipe.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two witnesses, this 20th day of June, A. D. 1903.

EUGENE F. OSBORNE.

Witnesses:
WILLIAM L. HALL,
GERTRUDE BRYCE.