(No Model.)

E. P. HOLLY.

WATER RETURN SYSTEM FOR STEAM GENERATORS.

No. 587,290. Patented July 27, 1897.

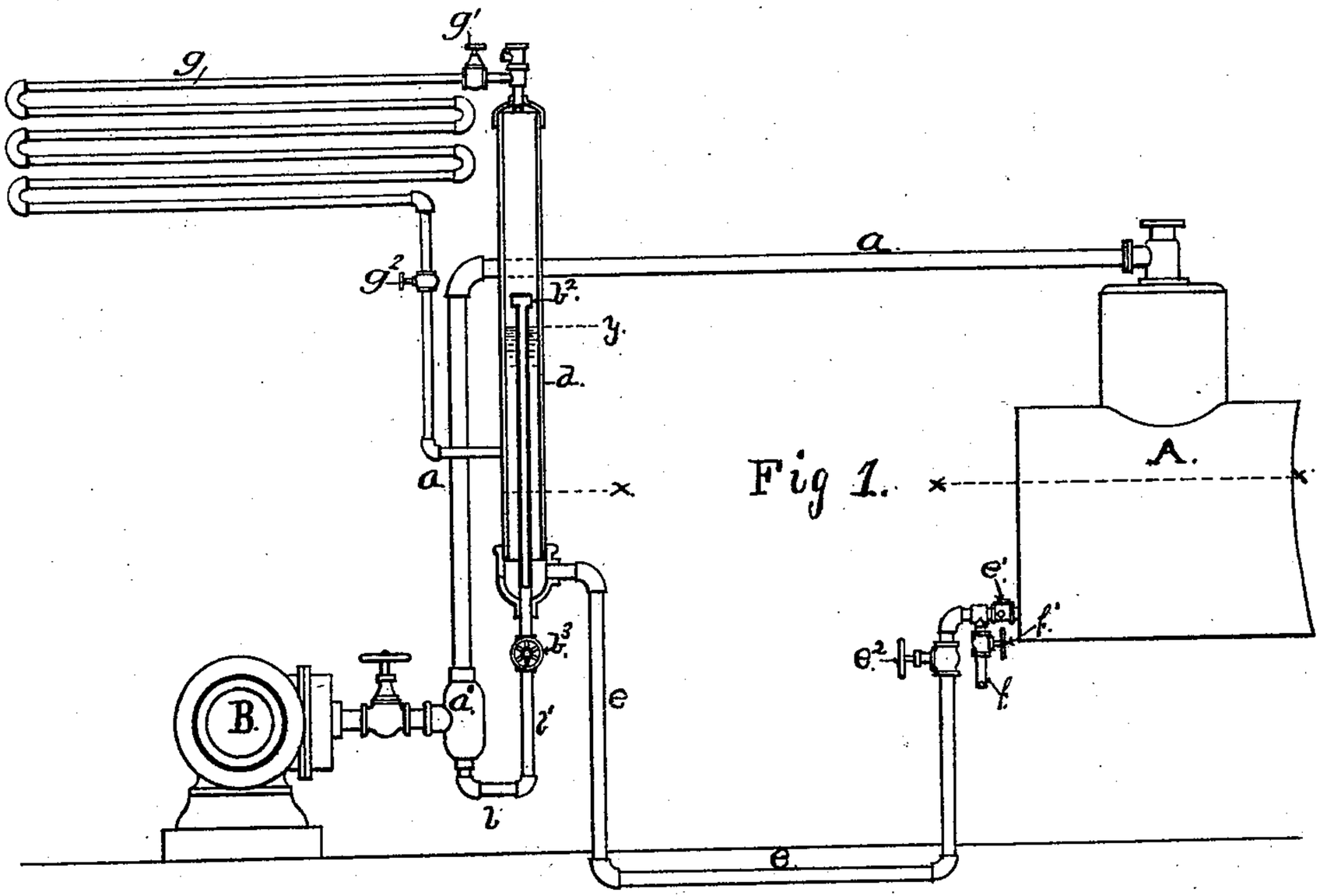

Fig 1.

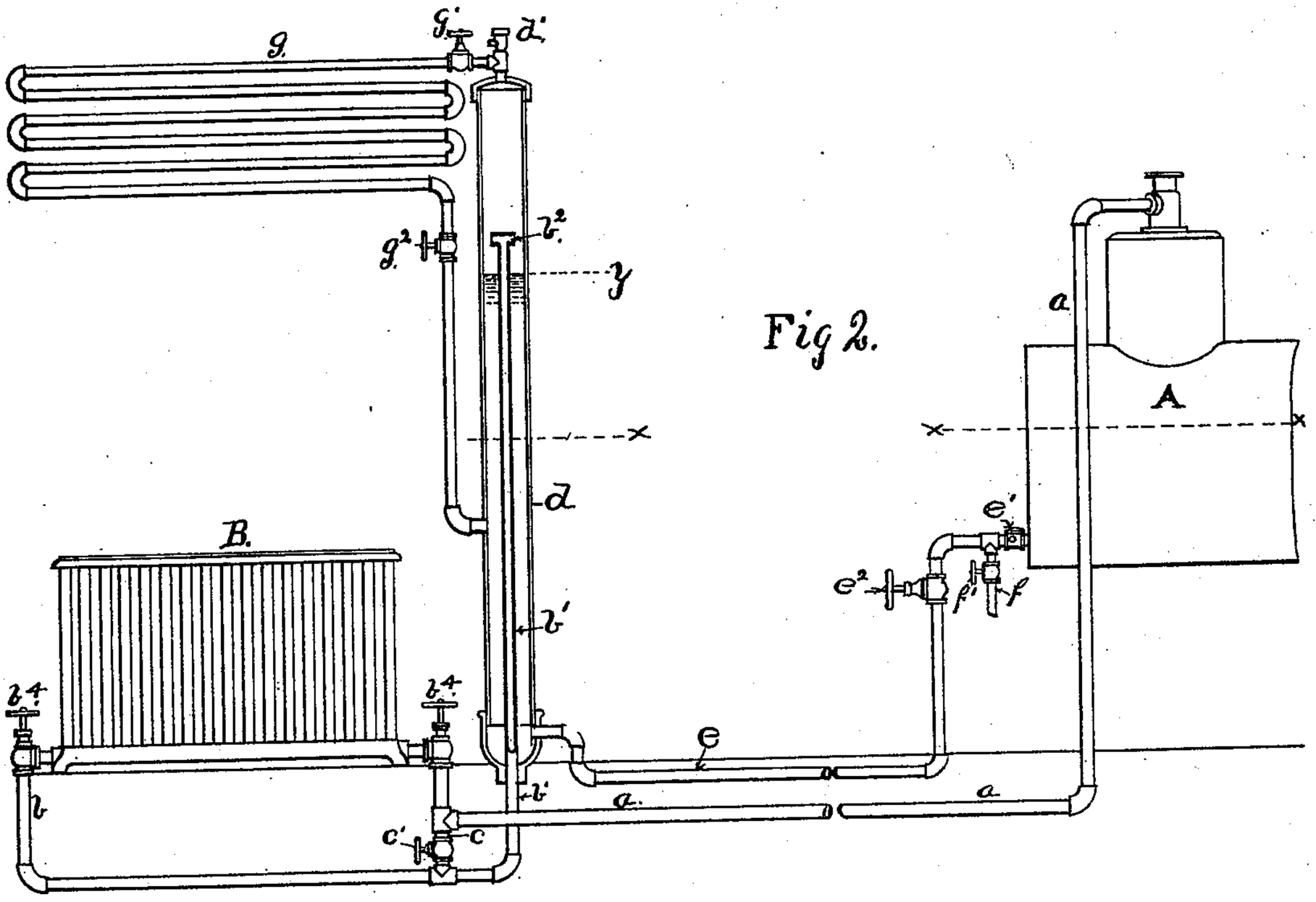

Fig 2.

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WATER-RETURN SYSTEM FOR STEAM-GENERATORS.

SPECIFICATION forming part of Letters Patent No. 587,290, dated July 27, 1897.

Application filed July 3, 1893. Renewed December 26, 1896. Serial No. 617,095. (No model.)

To all whom it may concern:

Be it known that I, EDGAR P. HOLLY, of the city and county of Providence, in the State of Rhode Island, have invented certain new and useful Improvements in Water-Return Systems for Steam-Generators; and I do hereby declare the following specification, taken in connection with the accompanying drawings, forming a part of the same, to be a full, clear, and exact description thereof.

The object of the invention is to provide means for returning the water of entrainment and condensation from a steam-pipe or any steam-using device from a point below the water-level in the generator back into the generator and against the pressure therein without the employment of a pump or similar device.

To that end the invention consists in the features and combinations of parts hereinafter described.

Referring to the drawings, Figure 1 is an elevation showing the invention applied for use in connection with a steam-engine, and Fig. 2 is a similar view showing the invention applied for use in connection with a radiator or steam heating apparatus.

A description of the arrangement shown in Fig. 1 will first be given.

A represents a steam-generator, which may be of any desired form or type. From the steam-dome of said generator a steam-pipe *a* leads to the steam-engine B to supply steam to the same. In connection with said steam-pipe is arranged a separator *a'*, as usual, by means of which separator the water of entrainment and condensation is separated from the steam which passes to the engine. This separator, it will be observed, is located below the water-level in the generator, and the purpose of the apparatus next to be described is to return the water of entrainment and condensation from this point back into the generator against the pressure therein. Leading from the separator *a'* is a pipe *b*, which communicates with a vertical pipe *b'*, which may be termed a "riser." This riser *b'* extends vertically to a point considerably above the water-level in the generator and terminates in an open end, and preferably in an open-ended T-piece b^2, as shown. The riser *b'* is preferably provided with a controlling-valve b^3. Surrounding the riser *b'* and extending above the top of said riser is a pipe *d* of considerably larger diameter, which may be termed a "stand-pipe." This stand-pipe *d* is closed at top and bottom, and is preferably provided at the top with an automatic air-vent *d'*. Leading from the bottom of the stand-pipe *d* is a return-pipe *e*, which extends to and enters the generator. In the drawings this return-pipe is shown as entering the generator below the water-line, and this is the preferred arrangement. Such location, however, is not necessary to the operation of the apparatus, and the return-pipe may, if desired, be made to enter the generator above the water-line. The return-pipe *e* is provided with a check-valve *e'*, preferably located at or near the generator, and, if desired, said return-pipe may also be provided with a hand-valve e^2, as shown. A short branch pipe *f*, communicating with the return-pipe *e* and provided with a controlling-valve *f'*, is also preferably employed for permitting the escape of air from the system in starting the apparatus.

The operation of the parts above described is as follows: Assuming the pressure in the generator to be, say, fifty pounds to the square inch, and assuming, in the first instance, that there is no reduction of pressure in the system due to transmission, radiation, &c., the water of entrainment and condensation will be taken from the separator *a'* in the form of detached particles intermingled with the steam and will be lifted in this condition by the steam up into and through the riser *b'*, and the intermingled water and steam will issue from the open ends of the T-piece b^2. The particles of water thus carried up with the steam as they issue from the ends of the T-piece will fall and accumulate in the stand-pipe *d*, while the steam will flow upward into the upper end of the stand-pipe, which extends for a considerable distance above the end of the riser *b'*, where it will become condensed, this extension of the stand-pipe, which is of comparatively large diameter, constituting an efficient condensing-chamber. This condensation which takes place in the upper end of the stand-pipe serves the double purpose of inducing and maintaining the necessary circulation of in-

termingled water and steam through the riser b' and also of adding to the column of water in the lower end of the stand-pipe. When now the column of water which is thus accumulated in the stand-pipe has reached the level of the water-line in the boiler, (indicated by the line x in the drawings,) the pressure upon the check-valve e', still assuming that there has been no loss of pressure by transmission, &c., will be equalized. As now the water continues to accumulate in the stand-pipe and the height of the water column therein is raised the pressure upon the check-valve will be correspondingly increased until such a pressure is reached as will serve to open the check-valve and cause the water to be forced through the return-pipe and into the generator against the pressure therein. This operation goes on continuously or intermittently, and whenever the column of water in the stand-pipe is of sufficient height to produce the necessary head the water will be forced into the generator.

Of course in practice it is not possible that there should be no loss of pressure in the system, but, on the contrary, a greater or less reduction of pressure is necessarily caused by friction, radiation, &c. By reason of such loss of pressure, therefore, it becomes necessary to first raise the column of water in the stand-pipe to a sufficient height above the water-level in the generator to create the necessary head to counterbalance this loss of pressure before the pressure upon the check-valve e' will become equalized. For example, suppose the reduction in pressure amounts, say, to five pounds, it would then be necessary to raise the column of water in the stand-pipe to a height, say, of ten feet in round numbers above the water-level in the generator before the pressure on the check-valve will be equalized. After the column of water has been raised to a sufficient height to thus equalize the pressure on the check-valve then any further rise of the column will tend to open the check-valve until finally as the column continues to rise the requisite head is obtained to open the check-valve and cause the flow of water through the return-pipe and into the generator. The line y in the drawings indicates the effective operating height of the column of water in the stand-pipe.

Referring now to Fig. 2 of the drawings, the apparatus above described is there shown as applied to a steam-radiator located below the water-level in the generator, the arrangement being such that not only the water of entrainment and condensation in the steam-pipe which supplies steam to the radiator, but also the water of condensation from the radiator itself, is collected in the stand-pipe and from there returned to the generator against the pressure therein. As in Fig. 1, A represents the generator, from the steam-dome of which the steam-pipe a leads to the radiator B to supply the same with steam. From the exhaust end of the radiator leads an exhaust-pipe b, which communicates with the vertical riser b', terminating in the T-piece b^2. b^4 b^4 are the usual valves for controlling the flow of steam through the radiator. Extending from the steam-pipe a to the exhaust-pipe b and connecting the two is a pipe c, which may be termed an "equalizing-pipe" and which is preferably provided with a controlling-valve c'. This equalizing-pipe is not necessary and may, if desired, be omitted, in which case the water of entrainment and condensation from the steam-pipe a would be carried through the radiator and delivered with the water of condensation from the radiator itself to the riser b' through the exhaust-pipe b, and, furthermore, if said pipe c be omitted there will be a less effective pressure, by reason of the loss due to transmission through the radiator, for lifting the detached particles of water through the riser b'. By the employment of the equalizing-pipe c a shorter course for the water of entrainment and condensation from the steam-pipe is provided and a more effective steam-pressure is secured for lifting the detached particles of water through the riser b'. Surrounding the riser b' is the stand-pipe d, which is arranged to extend a considerable distance above the top of the riser and which is preferably provided at its top with the automatic air-vent d'. The return-pipe e leads from the bottom of the stand-pipe to the generator and is provided with the check-valve e', and preferably also with the hand-valve e^2 and the short branch pipe f, with its valve f', as before.

The operation of the apparatus above described in connection with Fig. 2, either with or without the employment of the equalizing-pipe c, is the same as the operation of the corresponding apparatus in Fig. 1, and a description of such operation need not consequently be repeated. While, as above stated, the equalizing-pipe c may, if desired, be omitted, several important advantages are obtained by its employment. As already pointed out, when the equalizing-pipe is employed a more effective steam-pressure is secured for raising the water in detached particles through the riser. As a result of this a better and more certain circulation both of the steam through the radiator and of the water of condensation back to the generator is secured. It is very desirable that the water of entrainment and condensation, including that from the radiator, shall be taken up and carried through the riser in the form of detached particles intermingled with the steam and that the water shall be prevented from accumulating in a column in the riser. By the employment of the equalizing-pipe, and by reason of the effective pressure thereby obtained, these desired results are more certainly and effectively secured. Again, by the employment of the equalizing-pipe a greater steam-pressure upon the top of the column of water in the stand-pipe is secured, and con-

sequently such column of water does not require to be raised to so great a height to secure such head as is necessary, in addition to the steam-pressure, to effect the opening of the check-valve and the flow of the water through the return-pipe into the generator. Thus the column of water in the stand-pipe will be raised to an effective feeding-head more quickly than would otherwise be the case, and, furthermore, the stand-pipe itself does not require to be of so great a height as would otherwise be necessary, which in many places is a matter of great advantage and convenience.

In the apparatus above described it will be observed that the condensing-chamber does not form a part of the return pipe or passage through which the water of condensation flows on its way back to the generator, but is instead separate from or outside of such return-passage. This is an important feature, and several important advantages are secured by this arrangement. In the first place the condensing-chamber in such arrangement is practically a surface condenser only, because the only water with which the steam in said chamber is in contact is the small body of water constituting the top of the water column in the stand-pipe, and this water does not flow through the condensing-chamber, whereas if the condensing-chamber constituted a part of the return-passage for the water the amount of surface condensation would be greatly reduced, as the water would be constantly flowing through said chamber and fill the same to a greater or less extent.

Another result which is secured by the arrangement of the condensing-chamber outside of the return-passage for the water is that a more certain and more rapid circulation is thereby obtained. If the condensing-chamber formed a part of the return-passage, all of the water of condensation would have to be lifted with the steam into the condensing-chamber, and consequently to a greater height than is necessary with the present arrangement. Moreover, as all the water to be returned to the generator would have to flow through the condensing-chamber there would always be more or less liability of the flow being checked or retarded, or even at times completely arrested. With the arrangement of the condensing-chamber outside of the return-passage this cannot happen and an operative and efficient circulation is always maintained. In such arrangement there is no flow of the water through the condensing-chamber and there is no accumulation of the water of condensation in the condensing-chamber. On the contrary, the water which issues from the upper end of the riser falls directly into the lower portion of the stand-pipe and with a velocity due to the extent of its fall, and so also with the water formed by condensation in the condensing-chamber, thereby facilitating or increasing the circulation instead of retarding it.

In addition, in the present arrangement there is always a direct and effective steam-pressure on the upper end of the water column in the stand-pipe which likewise serves to increase the circulation. Again, the arrangement of parts above described enables the column of water to be accumulated and maintained at a distance from the generator and at that end of the return-pipe which is farthest removed from the generator. This is of great importance, for thereby the head due to the column of water may be availed of to force the water through the return-pipe as well as into the generator. As a result of this the radiator, or the point from which the water of condensation is to be taken, may be located at a very considerable distance from the generator and still a proper and efficient circulation be maintained and the return of the water to the generator properly effected. The arrangement of the parts above described also enables the return-pipe to be located in a low instead of an elevated position. As the column of water is accumulated at the entrance end of the return-pipe and so that the head due to the column of water is availed of to force the water through the return-pipe, such return-pipe may be located below the generator, if desired, and still the proper circulation of the water through said pipe will always be secured and maintained. This is a matter of considerable importance, as it enables the return-pipe to be laid underground, if desired, and thus to be carried from one building to another in a convenient and unexposed position.

It is not necessary that the condensing-chamber should be formed in the upper end of or as a part of the stand-pipe, but instead the condensing-chamber may be entirely outside of or apart from the stand-pipe, but communicating therewith. Thus a radiator or coil-heater may be connected with the upper end of the stand-pipe to serve as the condensing-chamber for the system. If from any cause it be inconvenient to make use of a stand-pipe of sufficient height above the water-level of the generator to form a condensing-chamber at its upper end, a suitable condensing-chamber may be secured and an effective circulation obtained by the use of such a coil, thereby enabling the condensing-chamber in the upper end of the stand-pipe to be entirely dispensed with. In other cases such a coil may be employed, if desired, as an adjunct or auxiliary to a condensing-chamber formed in the upper end of the stand-pipe. Such an arrangement is shown in the drawings, in which *g* represents a coil of pipe constituting a radiator, the steam end of which is in communication with the upper end of the stand-pipe and the exhaust end of which enters the stand-pipe below the upper end of the riser *b'*.

g' g² are valves for controlling the flow of steam through the coil. This coil or radiator *g* need not be located near to the stand-pipe,

as shown in the drawings, but may be located in any desired position in the building at a distance from the stand-pipe, it being only necessary that it shall be so connected to the stand-pipe as to take steam from the stand-pipe and return the steam and water back into the stand-pipe. This coil *g* constitutes an efficient condensing-chamber to secure the proper operation of the apparatus, and by its use the condensing-chamber in the upper end of the stand-pipe may be entirely dispensed with, thereby enabling the stand-pipe to be shortened to that extent. Even where a stand-pipe can be employed of sufficient height to form a condensing-chamber in the upper end thereof it is still advantageous to make use of the coil *g* in addition thereto, as thereby what is practically a variable condensing-chamber is secured. Thus in ordinary weather, for instance, the valves g' g^2 may be kept closed and the coil *g* thereby shut off and the condensing-chamber formed in the upper end of the stand-pipe be alone availed of. Then in very cold weather, for instance, when the loss from radiation is greatest and it becomes desirable to increase the circulation, this may be accomplished by opening the valves g' g^2 and turning on the coil, which results in increasing the capacity of the condensing-chamber and thereby increasing the circulation.

Whenever the coil *g* is employed, whether without the condensing-chamber in the upper end of the stand-pipe or as an auxiliary thereto, such coil serves a double purpose—that is, it not only constitutes a condensing-chamber to induce and maintain the necessary circulation, but it also serves to furnish an additional heating-surface which may be utilized in any desired portion of the building.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination with a steam-generator and a steam-pipe leading therefrom, of a riser communicating with said steam-pipe, a stand-pipe communicating with said riser, a condensing-chamber communicating with said stand-pipe, an auxiliary condensing-chamber communicating with said former condensing-chamber, and means for controlling the communications between said condensing-chambers, substantially as described.

2. The combination with a steam-generator and a steam-pipe leading therefrom, of a riser communicating with said steam-pipe, a stand-pipe communicating with said riser, a condensing-chamber communicating with said stand-pipe, an auxiliary condensing-chamber communicating with said former condensing-chamber, means for controlling the communications between said chambers and a return-pipe leading from said stand-pipe to said generator, substantially as described.

3. The combination with a steam-generator and a steam-pipe leading therefrom, of a riser communicating with said pipe, a stand-pipe communicating with said riser and extending above said riser to form a condensing-chamber in the upper end of said stand-pipe, an auxiliary condensing-chamber communicating with the upper part of said stand-pipe, means for controlling the communication between said stand-pipe and condensing-chamber, and a return-pipe leading from said stand-pipe to said generator, substantially as described.

4. The combination with a steam-generator and a steam-pipe leading therefrom, of a riser communicating with said steam-pipe, a stand-pipe communicating with said riser, a condensing-chamber communicating with said stand-pipe, and a steam-using device communicating with the condensing-chamber, substantially as described.

5. The combination with a steam-generator, of a steam-using device, a steam-pipe for conveying steam from said generator to said steam-using device, an exhaust-pipe leading from said steam-using device, an equalizing-pipe connecting said steam and exhaust pipes, a return-passage from said exhaust-pipe, to said generator and embodying a riser, and means for inducing a flow of steam through said riser, substantially as described.

6. The combination with a steam-generator, of a steam-using device, a steam-pipe for conveying steam from said generator to said steam-using device, an exhaust-pipe leading from said steam-using device, an equalizing-pipe connecting said steam and exhaust pipes, a riser communicating with said exhaust-pipe, a stand-pipe communicating with said riser, and a condensing-chamber communicating with said stand-pipe, substantially as described.

7. The combination of a steam-generator, a radiator or other steam-using device, a steam-pipe for conveying steam from said generator to said steam-using device, an exhaust-pipe leading from said steam-using device, an equalizing-pipe connecting said steam and exhaust pipes, a riser communicating with said exhaust-pipe and terminating in an open end, a stand-pipe communicating with said riser, a condensing-chamber communicating with the upper end of said stand-pipe, and a return-pipe leading from said stand-pipe to said generator and provided with a check-valve, substantially as described.

8. The combination, with a steam-generator and a steam-pipe leading therefrom, of a riser communicating with said steam-pipe and terminating in an open end, a stand-pipe communicating with said riser, a coil connecting with the upper end of said stand-pipe and constituting a condensing-chamber, and a return-pipe leading from said stand-pipe to said generator and provided with a check-valve, substantially as described.

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