No. 785,194. PATENTED MAR. 21, 1905.

L. S. BURBANK.

STEAM HEATING SYSTEM.

APPLICATION FILED MAY 31, 1904.

2 SHEETS—SHEET 1.

Fig. 1.

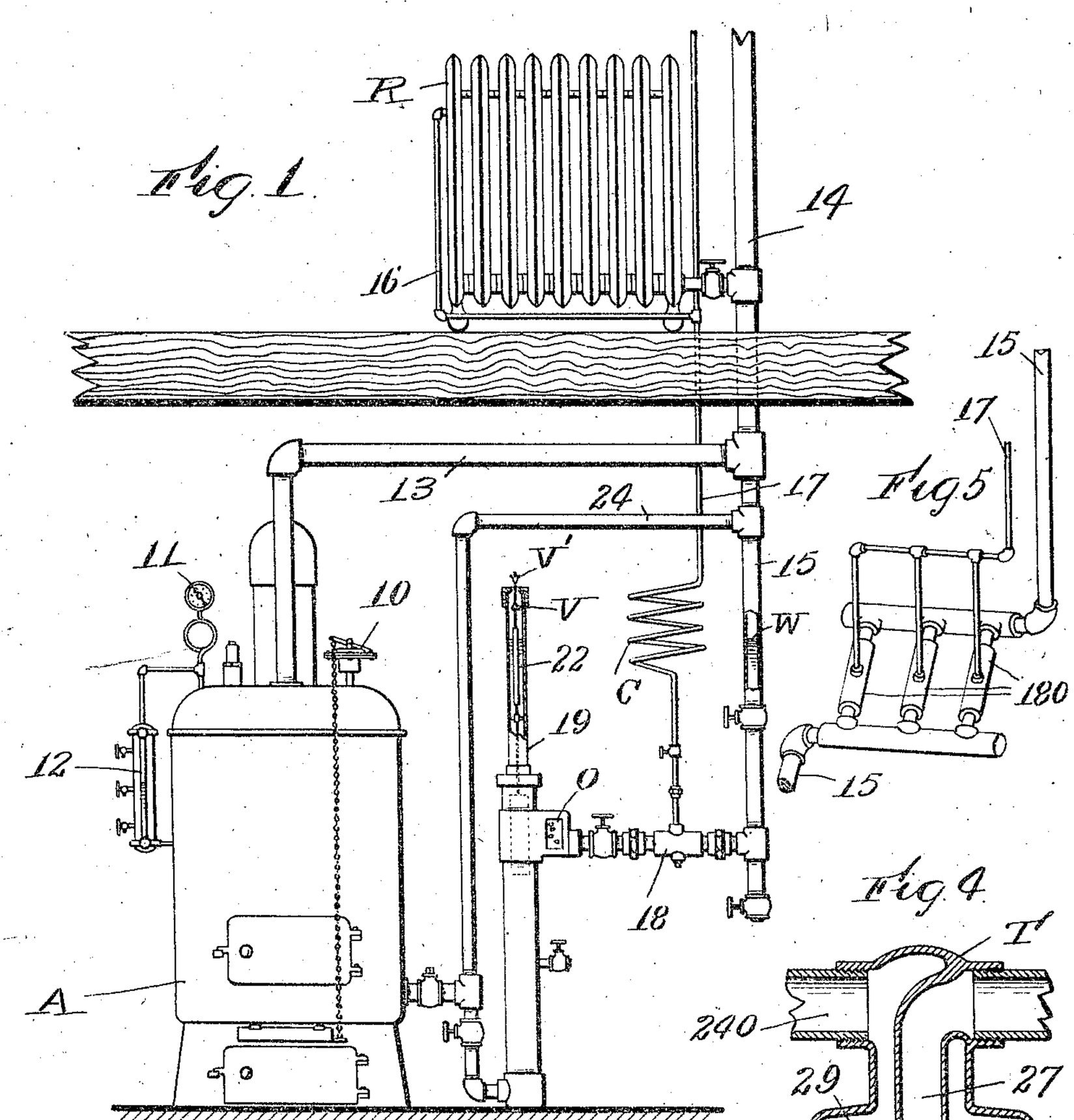

Fig. 5.

Fig. 4.

Fig. 2.

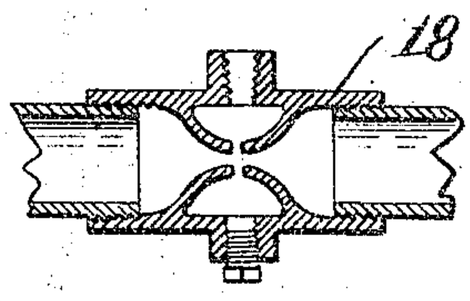

Fig. 3.

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2 SHEETS—SHEET 2.

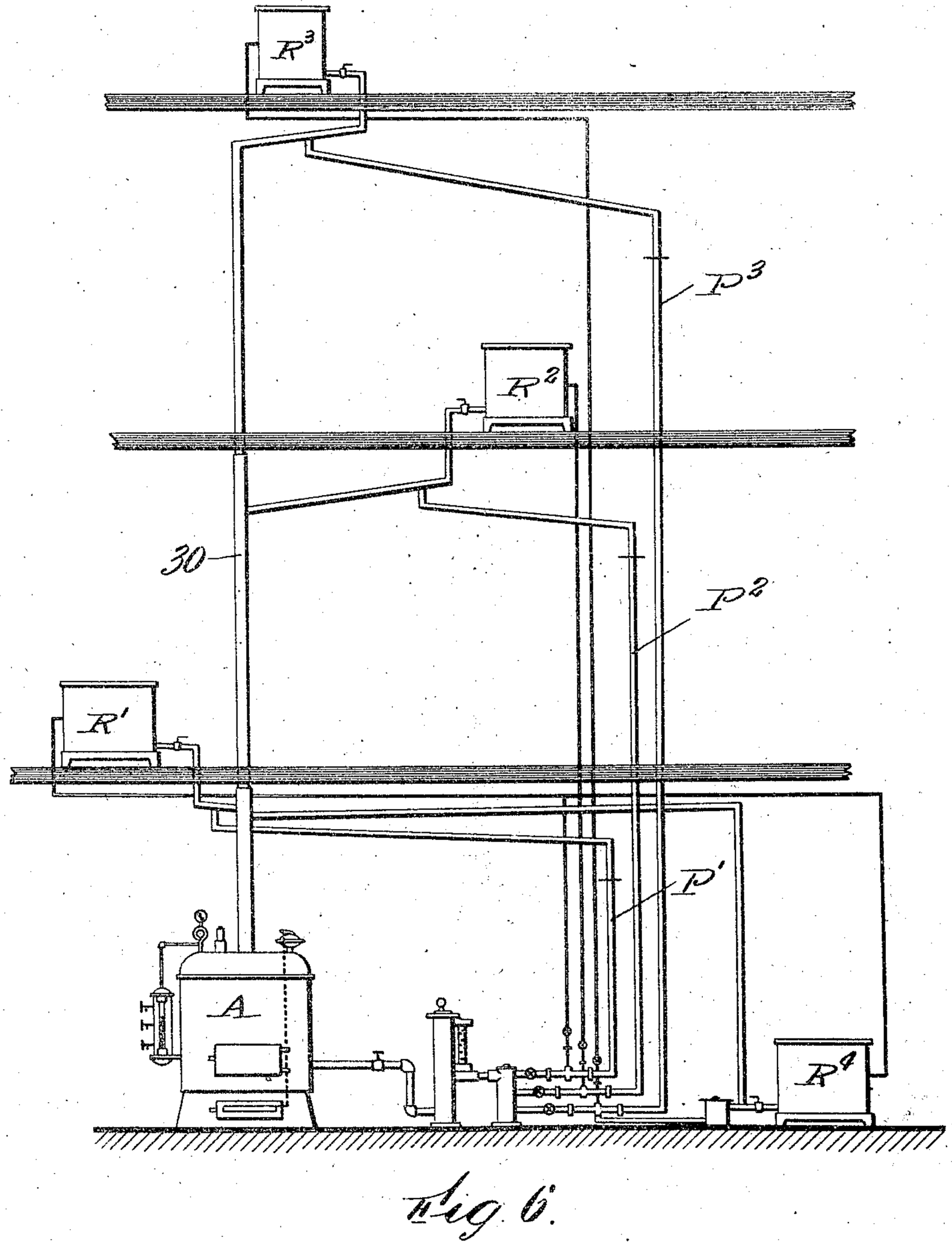

Fig. 6.

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UNITED STATES PATENT OFFICE.

LOUIS S. BURBANK, OF WORCESTER, MASSACHUSETTS.

STEAM-HEATING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 785,194, dated March 21, 1905.

Application filed May 31, 1904. Serial No. 210,521.

To all whom it may concern:

Be it known that I, LOUIS S. BURBANK, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented a new and useful Steam-Heating System, of which the following is a specification.

This invention relates to steam-heating systems which are employed for heating buildings and for other purposes.

The especial object of this invention is to provide a heating system with means for automatically exhausting air from the radiators and for the circulating-passages.

To this end this invention consists of the heating system and of the combinations of parts therein, as hereinafter described, and more particularly pointed out in the claims at the end of this specification.

In the accompanying drawings, Figure 1 is a diagrammatic view, partly in section, of sufficient parts of a steam-heating system to illustrate the application of my invention thereto. Fig. 2 is an enlarged sectional view showing a form of inspirator which may be employed for using the energy of the returning stream of water for exhausting air from the system. Fig. 3 is a diagrammatic view of part of a steam-heating system, illustrating a modified construction. Fig. 4 is a detail view of a mercury-trap which may be used in the overflow pipe. Fig. 5 represents a perspective view of a portion of the apparatus, showing a plurality of injectors; and Fig. 6 is a diagrammatic view showing separate return-pipes for different floors of a building.

The efficiency of steam-heating systems depends in a great measure upon the exclusion of air from the radiators and from the circulating-passages. This is particularly true of the single-pipe steam-heating systems, which operate at comparatively low pressures.

In an ordinary single-pipe steam-heating system the steam is admitted at one end of a radiator, and when a considerable volume of air is trapped or confined by the steam at the other end of the radiator it forms, in effect, a dead-air space diminishing the heating-surface of the radiator and seriously interfering with the desired operation. To overcome this objection, different forms of air-valves have been employed, and in some systems it has been proposed to connect the air-valves to a common pipe.

This invention relates to a steam-heating system having the radiators connected to an air-exhaust passage.

The especial object of this invention is to utilize part of the circulating energy of the boiler to create positive suction in the air-exhausting passage. This is done by utilizing the flow of the stream of water returning to the boiler to produce a suction or exhausting action.

Referring to the accompanying drawings for a detail description of a steam-heating system constructed according to this invention, A designates the boiler.

As herein illustrated the boiler A is of a type commonly employed for heating dwelling-houses and is provided with a damper-regulator 10, a steam-gage 11, and a water-glass 12.

Extending up from the boiler A is a steam-pipe 13, which connects to a riser 14, which supplies the radiators R with steam and through which pipe the water of condensation returns, as in the ordinary single-pipe steam-heating systems. Extending down from the riser 14 is a return-pipe 15, which return-pipe 15 is restricted or choked to maintain a head of water therein, as shown at W. At the opposite end from its steam-pipe each of the radiators R is connected to an air-pipe 16, all of said air-pipes preferably connecting to a common air-exhausting pipe 17. The air-exhausting pipe 17 is connected to the return-pipe 15 in such a way that the stream of water returning to the boiler will act to create a suction therein.

In the construction illustrated in Fig. 1 the air-exhausting pipe 17 is provided with a cooling or condensing coil C and is connected to the casing of an inspirator which is located in the return-pipe 15. As shown most clearly in Fig. 2, this inspirator 18 comprises coöperating injector-nozzles, and the air-exhausting pipe 17 is so connected to the casing of the

inspirator that the stream of water passing through the nozzles will serve to create a positive suction in the air-exhausting pipe 17.

Connected to the return-pipe, between the air-exhausting pipe 17 and the boiler, is an air-escape pipe 19. The stream of water is preferably admitted at an intermediate point in the air-escape pipe 19 by means of a fixture containing openings or windows O, through which the action of the stream of water in exhausting air can be observed.

By the use of an air-escape pipe 19 of considerable height and by introducing the mixed stream of air and water from the inspirator near the center of the water-column ample opportunity will be given for the air to escape up through the top of the pipe 19 instead of being carried along with the stream of water on its way back to the boiler.

Mounted in the upper end of the air-escape pipe 19 is a float 22, carrying valves V and V'. When the water is at its normal level in the air-escape pipe 19, the valves V and V' will be opened, permitting a free escape of air from the top of the pipe. When the water rises, the valve V will be closed, preventing the overflow of water from the top of the air-escape pipe 19. The valve V will remain closed until a sufficient amount of air is collected at the top of the air-escape pipe 19 to permit the float to fall. When the float 22 falls to an abnormally low position—for example, at night, when there is very little, if any, fire maintained and there is a tendency to create a vacuum in the boiler itself from the condensation of steam—the valve V' will close, which will prevent the vacuum in the boiler from drawing the water back, so that air could be drawn into the air-escape pipe 19.

In some cases—for example, in very cold weather—steam may condense in the radiators more rapidly than the same can flow back to the boiler through the return-pipe 15. To prevent the system from flooding when this takes place, I provide an overflow-pipe 24 for returning water to the boiler whenever the same rises above the desired height in the ordinary return-pipe 15.

In Fig. 1 I have illustrated a boiler check-valve and a number of blow-out and shut-off valves which may be employed for cutting off the several pipes and passages and by means of which the various pipes and passages may be cleaned out when required. It is to be understood, however, that such valves are not essential and may be differently located, according to the judgment of the engineer installing the plant.

In the operation of the steam-heating system as a whole it will be seen that the flow of the stream of water returning to the boiler is utilized to create suction in the air-exhausting passage. This will remove air from the radiators and the steam-heating passages of the entire system sufficiently to prevent the radiators from becoming air-bound, and in addition to this this suction will tend to the creation of a vacuum, whereby the entire system may be successfully operated at pressures even below that of the atmosphere.

In some cases instead of employing the usual form of inspirator the air-exhausting passage may be connected into the return-pipe at such a point that the flow of the stream of water will create a suction in the air-exhausting passage by means of an action similar to that in an ordinary mercury-pump. In some cases also it is not necessary to use an overflow-pipe above the normal level of the water. A system embodying these modifications is illustrated in Figs. 3 and 4.

As shown in Fig. 3, the exhausting-passage may be directly connected to the return-pipe by a pipe 26. This pipe 26 is located in such position with respect to the water-level that the flow of water down the return-pipe 15 will draw in bubbles or bodies of air, which will be carried along with the flowing stream of water in the same manner that air may be exhausted by the movement of a column of mercury—for example, such as used in exhausting air from electric-light bulbs. In Fig. 3, also, instead of having an overflow-pipe 24 I may employ an overflow-pipe 240, controlled by a mercury-trap T or any other back-pressure valve.

As shown in Fig. 4, the mercury-trap T comprises an inlet-passage 27, which extends down into a body of mercury 28. When the head of water in the return-pipe rises high enough to create pressure in the passage 27 sufficient to displace the mercury, so that the same will be pushed out into the expanded chamber 29, the water will be permitted to return to the boiler through the return-pipe 240, and this construction permits me to maintain a considerable head of water in the return-pipe without the use of an elevated overflow-pipe.

By experiment I have found that the efficiency of the exhausting action is dependent to a considerable extent upon the head of water maintained in the return-pipe, and in order that I may maintain a head of water extending up through two or more stories of a building I may, if desired, supply the radiators of the first floor or of any number of the lower floors with separate steam-risers and may use the flow of water in a return-pipe going to the higher floors to create the necessary suction, or by supplying a separate return-pipe for each floor I may separate the water of condensation into a number of different returning streams, which may be maintained with heads of different levels. In any such construction all the radiators should be connected to one exhaust system, such as that above described.

In Fig. 6 I have illustrated this invention applied to a system where separate return-

pipes are employed for different floors of a building. As shown in this figure, the radiators $R' R^2 R^3$ are supplied by separate steam-pipes from a common main steam-pipe, and extending down from the radiators on the several floors are separate return-pipes P', P^2, and P^3, in which the returning water of condensation can be maintained at different levels. The air-pipes from the several radiators are connected to be exhausted by the inspirators of the returning streams of water, the several inspirators having a combined pumping effect for one common exhaust system. In this construction also the pumping action may be strong enough to exhaust a trapped return from a radiator R^4, so that the same will be operated on a level with or below the level of the boiler A.

In some heating systems—for example, such as are operated under pressure—it has been proposed to use one or more injectors to assist the circulation of the heating medium. As distinguished from this, however, my invention results in the use of the flow of the stream of water returning to the boiler to exhaust the air from the circulating-pipes and radiators.

In case the air-escape pipe 19 is extended upwardly twenty feet, more or less, above the water-level in the boiler, so that the column of water therein will act against the boiler-pressure and prevent the escape of water through said air-escape pipe, the valve V may be omitted.

In case the air-escape pipe is extended upwardly, as last described, the return-pipe is extended downwardly, as indicated at 20 21, Fig. 3, thirty feet, more or less, below the water-level in the boiler, so that the column of water in the return-pipe below said level will be unaffected by any vacuum that may exist in the boiler. The valve V' and float 22 may also be omitted.

In Fig. 5 I show a plurality of inspirators 180, each of which may be a duplicate of the inspirator 18, above described. These are connected with the return-pipe 15 and with the air-exhausting pipe 17, as shown, so that the currents of return-water and exhaust-air are subdivided. This subdivision results in a greater efficiency of operation under certain conditions.

I do not wish to be limited to any particular arrangement of parts or details of construction; but

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

1. In a steam-heating system, the combination of a boiler supplying steam to radiators, a return-pipe for water of condensation, and means for utilizing the energy of the returning water of condensation to exhaust air from the radiators.

2. In a steam-heating system, the combination of a boiler supplying steam to radiators, a return-pipe for water of condensation, and an air-exhausting passage connected with the return-pipe to utilize the energy of the returning water of condensation to exhaust air from the radiators.

3. In a steam-heating system, the combination of a boiler supplying steam to radiators, a return-pipe having a head of water maintained therein, and an air-exhausting passage connected to the return-pipe below the water-level, whereby the energy of the return stream of water will create suction in the air-exhausting passage.

4. In a steam-heating system, the combination of a boiler supplying steam to radiators, a return-pipe having a head of water maintained therein, an air-exhausting passage connecting to the return-pipe below the water-level, whereby the energy of the return stream of water will create suction in the air-exhausting passage, and an air-outlet pipe opening from the return-pipe between the air-exhausting passage and the boiler.

5. In a steam-heating system, the combination of a boiler supplying steam to radiators, a return-pipe having a head of water maintained therein, an injector in the return-pipe below the water-level, and an air-exhausting passage connected to the injector-casing, whereby the energy of the returning stream of water will create suction in the air-exhausting passage.

6. In a steam-heating system, the combination of a boiler supplying steam to radiators, a return-pipe having a head of water maintained therein, an injector in the return-pipe below the water-level, an air-exhausting passage connected to the injector-casing, whereby the energy of the returning stream of water will create suction in the air-exhausting passage, and an air-outlet pipe opening from the return-pipe between the injector and the boiler.

7. In a steam-heating system, the combination of a boiler supplying steam to radiators, a return-pipe having a head of water maintained therein, an air-exhausting passage connected to the return-pipe below the water-level, whereby the energy of the returning stream of water will create suction in the air-exhausting passage, and an overflow-pipe for returning surplus water of condensation to the boiler to prevent the system from flooding.

8. In a steam-heating system, the combination of a boiler supplying steam to radiators, a return-pipe having a head of water maintained therein, an injector in the return-pipe below the water-level, an air-exhausting passage connected to the casing of the injector, whereby the energy of the returning stream of water will create suction in the air-exhausting passage, and an overflow-pipe connected to the return-pipe above the normal level of water therein for returning surplus water of condensation to the boiler to prevent the system from flooding.

9. In a steam-heating system, the combination of a boiler supplying steam to radiators, a

return-pipe having a head of water maintained therein, an injector in the return-pipe below the water-level, an air-exhausting passage connected to the injector-casing, whereby the energy of the returning stream of water will create suction in the air-exhausting passage, an air-outlet pipe between the injector and the boiler, and a float-valve for closing the upper end of the air-outlet pipe to prevent water from overflowing therefrom.

10. In a steam-heating system, the combination of a boiler supplying steam to radiators, a return-pipe for water of condensation, and an air-exhausting passage connected with the return-pipe to utilize the energy of the returning water of condensation to exhaust air from the radiators, said passage having means for cooling its contents.

11. In a steam-heating system, the combination of a boiler supplying steam to radiators, a return-pipe for water of condensation, an air-exhausting passage connected with the return-pipe to utilize the energy of the returning water of condensation to exhaust air from the radiators, and an air-outlet passage extending upwardly from the return-pipe between the air-exhausting passage and the boiler.

12. In a steam-heating system, the combination of a boiler supplying steam to radiators, a return-pipe for water of condensation, an air-exhausting passage connected with the return-pipe to utilize the energy of the returning water of condensation to exhaust air from the radiators, an air-outlet extending upwardly, and a float-valve for controlling the upper end of the air-outlet.

13. In a steam-heating system, the combination of a boiler supplying steam to radiators, a return-pipe for water of condensation, an air-exhausting passage connected with the return-pipe to utilize the energy of the returning water of condensation to exhaust air from the radiators, an air-outlet extending upwardly, a float in said air-outlet pipe, and a pair of valves connected with said float, one valve closing upwardly and the other downwardly.

14. In a steam-heating system, the combination of a boiler supplying steam to radiators, a return-pipe for water of condensation, an air-exhausting passage connected with the return-pipe to utilize the energy of the returning water of condensation to exhaust air from the radiators, an air-outlet extending upwardly, and a float in said air-outlet having a downwardly-closing valve, the said return-pipe having a downward extension below the water-level in the boiler.

15. In a steam-heating system, the combination of a boiler supplying steam to radiators, a return-pipe having a head of water maintained therein, a plurality of injectors in the return-pipe below the water-level, and a branched air-exhausting passage connected to the injector-casings.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

LOUIS S. BURBANK.

Witnesses:
LOUIS W. SOUTHGATE,
PHILIP W. SOUTHGATE.