No. 798,207. PATENTED AUG. 29, 1905.

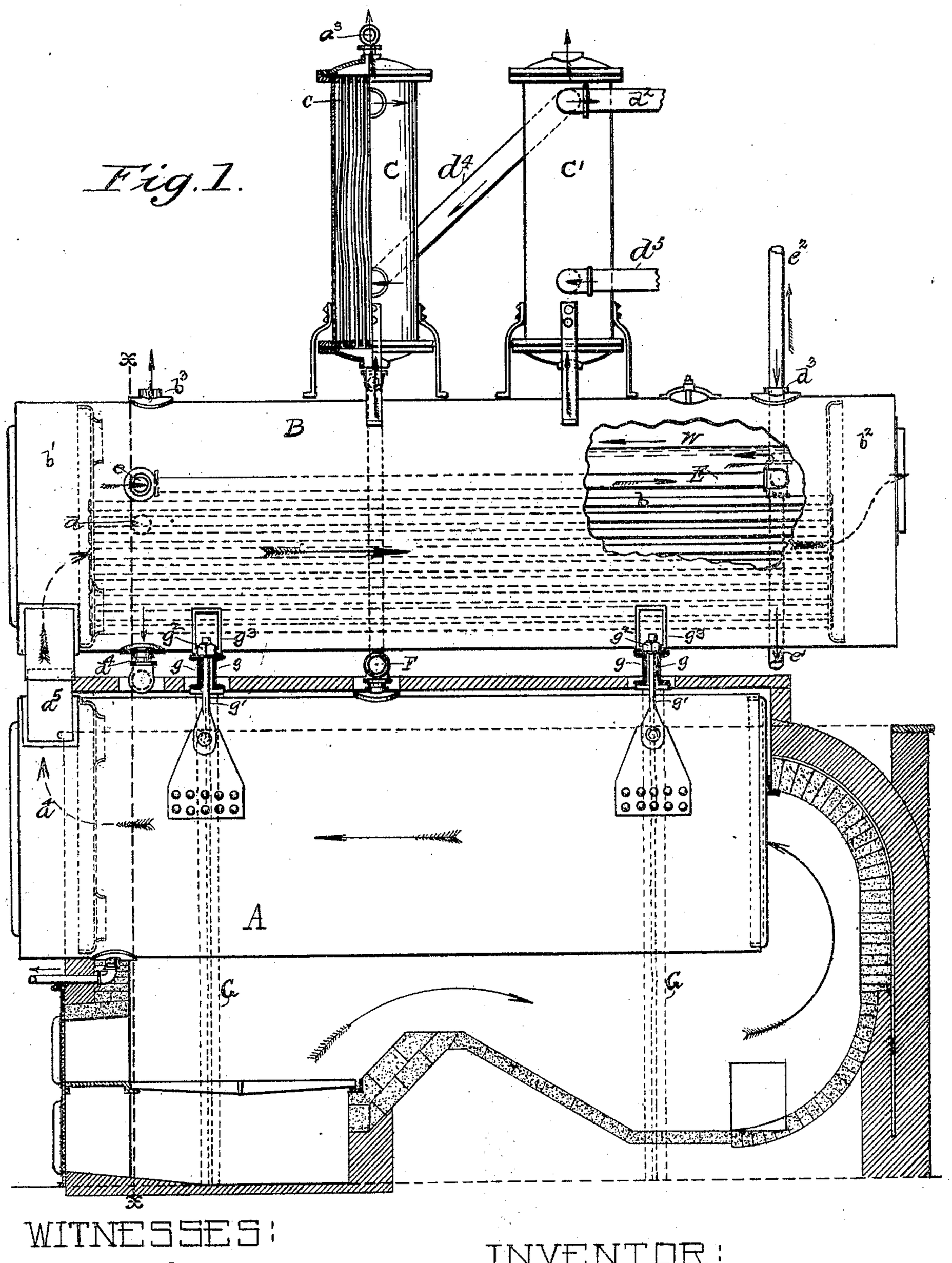
C. C. PECK.

APPARATUS FOR HOT WATER HEATING SYSTEMS.

APPLICATION FILED AUG. 28, 1902.

2 SHEETS—SHEET 1.

Fig. 1.



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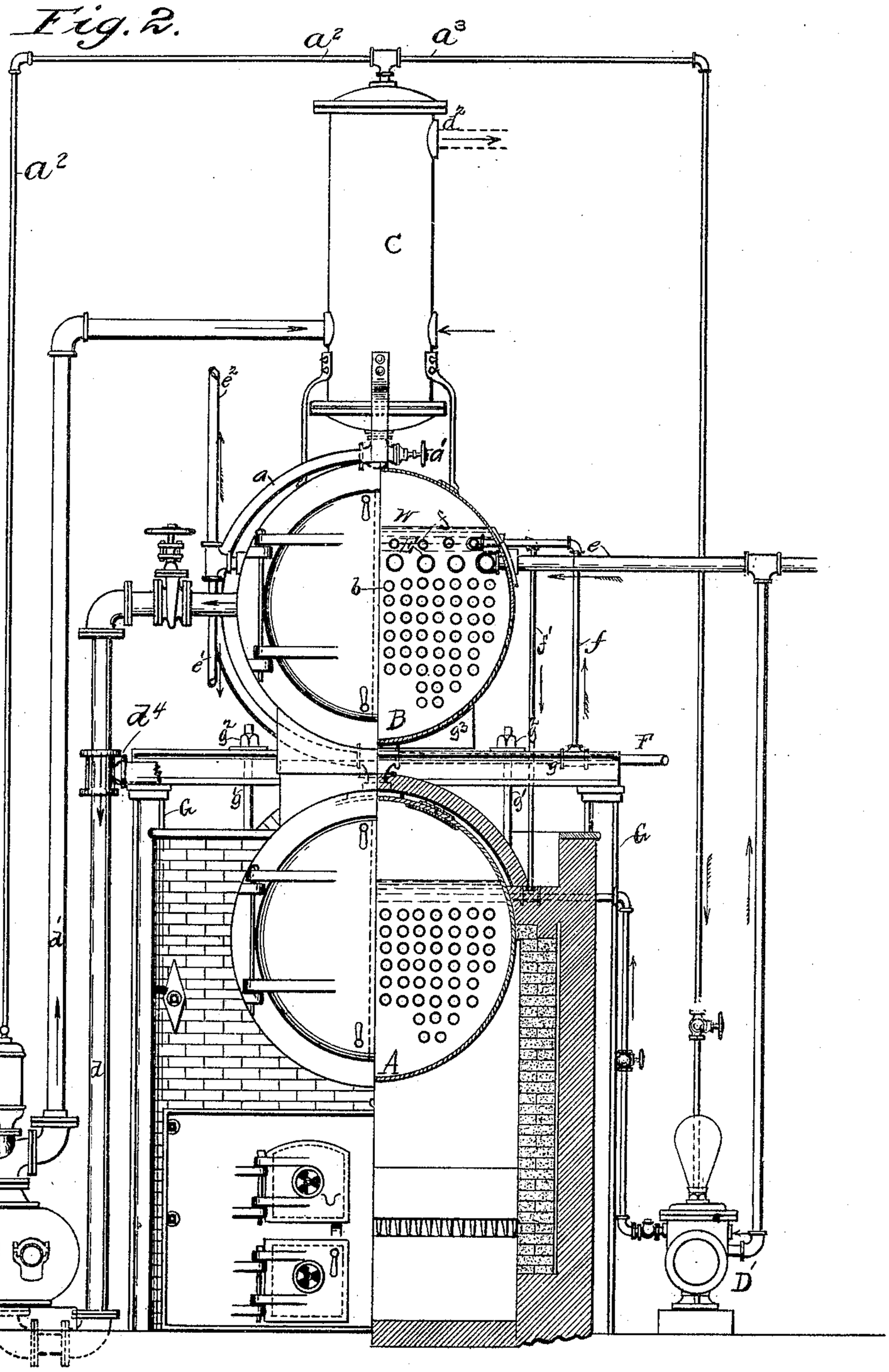
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

CASSIUS CARROLL PECK, OF ROCHESTER, NEW YORK.

APPARATUS FOR HOT-WATER HEATING SYSTEMS.

No. 798,207. Specification of Letters Patent. Patented Aug. 29, 1905.

Application filed August 28, 1902. Serial No. 121,341.

To all whom it may concern:

Be it known that I, CASSIUS CARROLL PECK, residing at Rochester, in the county of Monroe and State of New York, have invented a certain new and useful Improvement in Apparatus for Hot-Water Heating Systems, of which the following is a specification sufficient to enable others skilled in the art to which it appertains to make and use the same.

My invention relates to a central-station system of heating by means of a mechanically-forced circulation of heated water, and has for its main object the promotion of economy in heat production and utilization.

It consists in combining a heater supplementary to the boiler or boilers used for supplying the heating system with said boiler or boilers and with said hot-water-circulating system in such manner that heat from the furnace-gases which have passed through the boiler or boilers shall be taken up and imparted to the hot-water circulation; also in combining this supplementary heater with the expansion-tank required by the heating system and with the exhaust-steam heater required for utilizing exhaust-steam from pumps which effect the circulation of hot water from boiler-feed pumps and from engines used in connection with boiler-furnace draft for making electric current or other purpose.

In the accompanying drawings like parts in the two figures are indicated by the same letters.

Figure 1 is a central vertical lengthwise section of the brickwork of a return tubular boiler with a side elevation of said boiler and of my supplementary heater mounted on top of the boiler and of a live-steam heater carried on said supplementary heater. An exhaust-steam heater is also shown alongside the live-steam heater. Fig. 2 is a front elevation of the live-steam heater and of one-half of the front end of the supplementary heater, the boiler, and brickwork setting and a cross-section through broken line X X, Fig. 1, of one-half of said supplementary heater, the boiler, and the brickwork. It also shows an end elevation of the boiler-feed pump and of the circulating-pump for circulating heated water through the hot-water heating system.

In the two figures, A is the steam-boiler, which supplies heat for the heating system and also steam-power for operating the rotary pump D, which circulates the water of the heating system and boiler-feed pump D.

B is my supplementary heater.

C is a live-steam heater for bringing the circulating water of the heating system up to any required temperature.

In a system of heating where a circulation of water is relied upon for distribution of heat and where the circulation is effected by some form of pump the elements composing the station equipment are the boiler, the circulating and feed pumps, a live-steam heater, an expansion-tank, and either a separate exhaust-steam heater or else a combination of this heater with the live-steam heater.

My supplementary heater B is proportioned and arranged for serving as an expansion-tank as well as heater. It is also provided with a steam-compartment having a condensing-surface in the form of pipes E for receiving and condensing exhaust-steam from circulating and feed pumps and from any small engines used for creating furnace-draft, crushing and elevating coal, or other use directly connected with the heating system.

In operating the heating system circulating-pump D draws its supply through suction-pipe d from the combined expansion-tank and heater B and forces the water of the heat-distributing system through delivery-pipe d' into live-steam heater C, from whence it is discharged through opening d^2 into the main delivery-pipe of the heating system. This last-named pipe distributes the heated water to radiators and heaters of various users. After the water has passed through said radiators and heaters it enters the return-main, which brings it back to heater B, which it enters at opening d^3, thus completing the circuit. Pump D puts the outflowing current of the heating system under any desired pressure for forcing it through branch pipes and radiators and into the return-main. Each radiator is preferably supplied with a regulating-valve on the supply branch for controlling the amount of circulation through the radiator; but the branch from radiator to return-main does not require any valve. When the boiler or boilers of such a heating system are used for supplying steam for operating pumps, engines, and fans, it is necessary to supply a live-steam heater, as C, for furnishing the hot-water-circulating system all the heat required above that supplied by exhaust-steam from pumps and other apparatus. Hence when there is but little exhaust-steam available this heater C requires to be of considerable size and should be located as close as possible to the source of

steam-supply and sufficiently above the boiler water-level so that the water of condensation formed in heating the circulating water of the heating system will return by gravity as directly as possible to the boiler. In order to make the conditions as favorable as possible as to economy of space, convenience of access, easy action of the heater, and loss of heat by radiation as small as possible, I mount the heater C on my supplementary heater B, as shown in Figs. 1 and 2. This allows of connecting steam-pipe *a* very directly with the steam-space of the boiler and with the heater, said pipe being provided with a valve *a'* for shutting off steam from heater C whenever needful. Pipe *a* may serve to return the water of condensation from the heater to the boiler, provided the pipe is properly proportioned for the double service, or the water of condensation may be returned by a separate pipe. In such a heater it is important that provision be made for removal of air and for some circulation of the steam in order to give maximum efficiency to the heating condensing-surfaces, as otherwise air would gradually accumulate and proportionately reduce the effectiveness of the heater. I provide for this condition by taking the steam-supply for pumps D D' and any other apparatus which it is desired to supply from the top of heater C by pipes a^2 a^3, thus drawing steam from boiler A through the bent tubes *c* of heater C. While I make no claim to this heater, I do claim the feature of maintaining circulation of steam through it in the manner described, and in this do not confine myself to the exact form of heater shown, as this may be variously modified to suit conditions without departing from the essential feature of maintaining circulation of steam through the heater by connecting same with some steam-using apparatus operated by live steam passing through the steam-compartment of the heater.

My supplementary heater B, as shown in the drawings, is constructed in general like the return tubular boiler immediately beneath it. The shell of heater B does not require to be so thick as that of boiler A, inasmuch as the heater is subjected to only light internal pressure when used as shown. If, however, it be used not as an expansion-tank, but as a closed heater and subjected to the pressure of circulating-pump D, the thickness might need to be increased from one-fourth-inch steel to five-sixteenths-inch or even three-eighths-inch in large-sized shells. The tubes *b* are preferably charcoal-iron boiler-tubes expanded at each end into a head in the usual manner of constructing boilers. These tubes should be sufficient in number and internal area to correspond with the amount of boiler-furnace gases which have to pass through them—that is, the total internal area of all the tubes should be sufficient for draft purposes. While the amount of heating-surface in tubes *b* may properly be varied considerably to correspond with cost of coal and conditions of setting and use, it may be said in general that it will usually pay to use from one-half to the full amount of surface used in the boiler or boilers connected with heater C. Tubes *b* connect at the front end with smoke-box *b'*, which in turn connects with smoke-box a^4 of boiler A by neck a^5, while at the rear end tubes *b* discharge the furnace-gases into smoke-box b^2, whence they escape to a stack or inducing-fan for rejection to the atmosphere. It should be noted that the course of furnace-gases, as indicated by arrows feathered on both sides, is opposite to that of the circulating water of the heating system in passing through heater B, water circulation being indicated by unfeathered arrows, the cooled water from the return-main of the heating system delivering into the heater at d^3, Fig. 1, and the water for recirculation being withdrawn from the heater by pipe *d*, Fig. 2, connected to the heater near the front end at the point *d*. (Shown by the broken-line circle, Fig. 1.) This movement of gases and water in opposite directions provides best conditions for transferring heat from the former to the latter. The suction-pipe *d* usually has a valved connection with the shell of heater B at the bottom of the shell. This is shown at d^4, Fig. 1, but for the sake of clearness is omitted in Fig. 2. This latter connection is used only in case the water-level in the heater should for a short time fall below the level of the upper connection and also when it is desired to drain the heater. The usual water-level in the heater is shown at W; but this varies more or less, depending on how fast the circulating water of the heating system returns to the heater. The variation is not much, as the pump D cannot push the water through the outflow-pipe much faster than it comes back through the return-pipe. One or more water-columns fitted with water-glasses and gage-cocks serve for showing the water-level in heater B, these fittings not being shown. In such a heating system as here described and shown the forced circulation of water through the system is sufficiently large to rapidly renew the water in the combined heater and expansion-tank B. The return water of the heating system is at its lowest temperature as it enters the heater at d^3, this temperature being under average ordinary conditions 150° to 155° Fahrenheit. The volume of water flowing through heater B is so large as compared with the amount of heat in the gases which pass through tubes *b* of the heater that under ordinary working conditions the temperature of the circulating water is not greatly increased by passage of the gases, although the total number of heat units transferred from gases to water may be quite large. As the gases do not highly heat the circulating water, it is available for condens-

ing steam from boiler-feed and hot-water-circulating pumps, fan-engines, and any other engines not using large amounts of steam. Condensing-pipes E are therefore placed in heater B and connected by pipe *e* with the exhaust-steam pipe from said pumps and engines. The water of condensation formed in condenser-pipes E is usually delivered through pipe *e'* to a hot well or tank, whence it is pumped into the boiler supplying the steam for pumps, &c. A vent-pipe e^2 provides for conducting to the atmosphere any uncondensed steam.

Where it is necessary to provide for condensing large volumes of exhaust-steam, as in case of use at the central station of engines for operating electric generators, it is preferable to use a separate exhaust-steam heater C', as shown in Fig. 1, as compared with placing a sufficient amount of condensing-surface in heater B, for if the temperature of water in this heater were brought to 200° Fahrenheit or over its efficiency as an economizer of the heat in the furnace-gases would be greatly reduced. When heater C' is used, the construction being practically the same as in case of heater C, circulating-pump D forces the circulating water first through pipe d^5 into heater C' and then through pipe d^4 into live-steam heater C, which is connected to the outflow-main of the heating system. If, however, there should be sufficient heat in the exhaust-steam to raise the temperature of the circulating water of the heating system to the required point, then the live-steam heater would be thrown out of use and the circulating water would go direct from heater C' to the outflow-main d^2.

In a small heating system, where economy of fuel is not of great importance, heaters C and C' can be omitted and the condensing-surface E in heater B can be made sufficient for heating the circulating water. If the exhaust-steam available is not sufficient in amount for raising the circulating water of the heating system to the required temperature, then the live-steam compartment in the tank B, represented by the coil *f*, supplied from steam-pipe F, is brought into use, and the requisite supply of steam to this pipe can be automatically regulated by a thermostat in communication with the water in heater B. This makes a very compact and convenient arrangement for small installations. Water of condensation formed in coil *f* returns by gravity to boiler A through pipe *f'*. The water passes through both the heaters C and C' or through either, and either of these heaters may therefore be dispensed with.

For clearness heater B is shown as connected with only one boiler; but it is equally well adapted for use with a pair of boilers, in which case it is usually mounted between and above the boilers, being carried on the boiler-supports and receiving the gases from both boilers through short necks connecting with the smoke-boxes of the boilers in the same general way as in the case of one boiler. Heater B may also be connected with more than two boilers; but in general a pair of boilers connected with one heater, the whole being made of proper size for supplying a set of heating-mains, constitutes the most advantageous arrangement. While the form of heater B is suitable in most cases, various conditions of situation and service require modifications of form and location. Thus where head room does not permit mounting it on the boiler or boilers it may be set at the side of the boilers or at the rear. Its form may also be changed to suit requirements so long as its essential feature as a heater for imparting to the circulation of a hot-water heating system residual heat from furnace-gases which have passed through the boilers which supply the system is not departed from.

In the drawings boiler A is shown as being carried on steel **I**-beam posts G, which support horizontal steel channels *g*, which receive the weight of the boiler through suspension-rods *g'*, having adjustable nuts g^2 at the upper ends. Heater B rests in cradles g^3, which in turn are carried on channels *g*. The whole weight of boiler A and of heater B is thus carried on **I**-beams G independent of the brickwork setting of the boiler. In case a pair of boilers is connected to one heater the horizontal channels *g* are simply made long enough and strong enough to carry two boilers with a properly-proportioned heater and posts G strengthened correspondingly, the heater being set midway between the two boilers. In case of large boilers **I**-beam horizontals can be substituted for channels.

Arrows feathered on one side show the course of steam circulation.

I am aware that in United States Patent No. 604,046 J. C. Henderson has proposed to pump "any suitable material having a high boiling-point, such as linseed, whale, or petroleum oil," through a series of pipes located in a smoke-flue and through a coil in a "receiver, melting-pan, or the like to be heated" and then back again in a closed circuit of pipes to the aforesaid series of pipes located in the smoke-flue, a pump being used at each end of the circuit. Such a plan neither contemplates nor provides for indispensable conditions involved in heating buildings by either gravity or artificial circulation of hot water and does not anticipate my invention of a secondary heater and expansion-tank combined wherein water for heating buildings is directly heated through the medium of metallic walls by otherwise waste gases from a primary heater or boiler.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a hot-water house-heating system, a

pipe-circuit, a heater in said pipe-circuit having a shell which contains water of the circuit and constitutes an expansion-tank and has fire-tubes in said water, a steam-boiler having a fire-space and connections from the fire-space through said fire-tubes for the passage of the waste products of combustion.

2. In a hot-water house-heating system, a pipe-circuit, a heater in said circuit having a shell for the water of the circuit and a space above said water constituting an expansion-tank and fire-tubes in said water, a steam-boiler having a fire-space and connections from said fire-space to said tubes for the passage of waste products of combustion therethrough.

3. In a hot-water heating system, a pipe-circuit, a heater having a shell in said circuit and fire-tubes adapted to be submerged in the water of the circuit in the shell, a steam-boiler having a fire-space and connections from said fire-space to said tubes for the passage of the waste products of combustion therethrough, a steam-tube in said water and connections therefrom to steam-using apparatus and from said steam-using apparatus to said heater for heating the water in said circuit.

4. In a hot-water heating system, a pipe-circuit, a heater having a shell in said circuit and fire-tubes adapted to be submerged in the water of the circuit in the shell, a steam-boiler having a fire-space and connections from said fire-space to said tubes for the passage of the waste products of combustion therethrough, a steam connection from said boiler to a tube in the water in said shell for the passage of live steam thereto, a steam-tube in said water and connections therefrom to steam-using apparatus and from said steam-using apparatus to said heater for heating the water in said circuit.

5. In a hot-water house-heating system, a pipe-circuit and a heater together constituting a closed circuit, means adapted to produce a constant circulation in said circuit, a steam-boiler having a fire-space and means for conducting the waste products of combustion from said fire-space through said heater for heating water therein, said heater constituting also an expansion-tank.

6. In a hot-water house-heating system, a pipe-circuit and a heater together constituting a closed circuit, means adapted to produce a constant circulation in said circuit, the said heater having a shell and fire-tubes adapted to be submerged in the water of the circuit, a steam-boiler having a fire-space and connections from said fire-space through said fire-tubes for the waste products of combustion, the said shell having also a space free of water whereby the said shell forms an expansion-tank.

7. In a hot-water heating system, the combination with a heating-circuit of a steam-boiler, a heater C for the water of said circuit having a water-chamber and a steam-compartment adapted for receiving and heating water of the heating-circuit in said chamber by live steam supplied to said compartment by said boiler, and steam-using apparatus connected to said heater and operated by live steam supplied by said boiler and passing through the steam-compartment of the heater in its course from the boiler to said steam-using apparatus, for the purpose of creating a continuous circulation of steam above atmospheric pressure through the steam-compartment of the heater, substantially as shown and described.

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Witnesses:
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