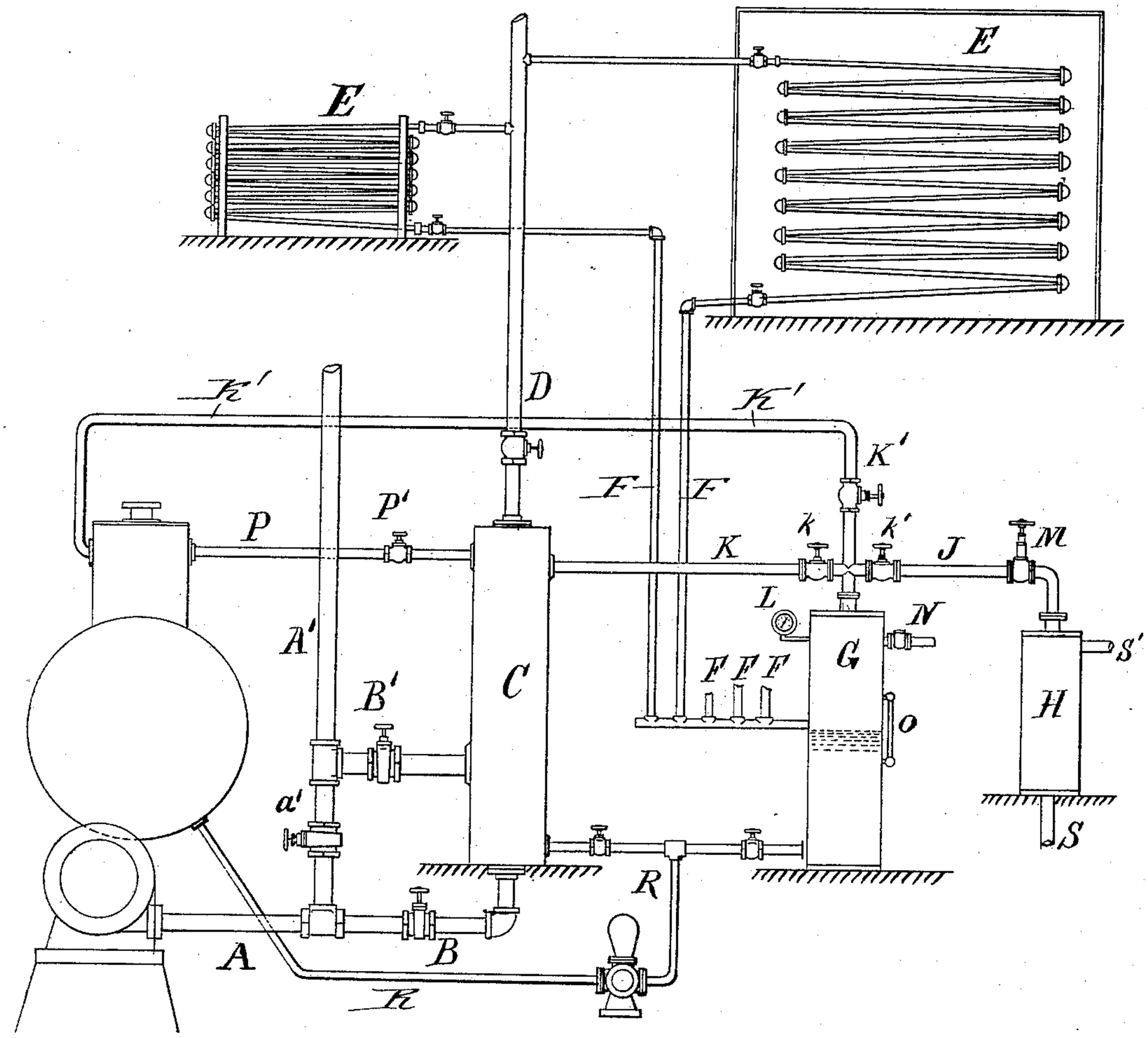
(No Model.)

G. A. BARNARD.

HEATING APPARATUS.

No. 375,593. Patented Dec. 27, 1887.



WITNESSES:-

Wm. H. Weightman

D. J. Morgan,

INVENTOR:-

Geo. A. Barnard

UNITED STATES PATENT OFFICE.

GEORGE A. BARNARD, OF HARTFORD, CONNECTICUT.

HEATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 375,593, dated December 27, 1887.

Application filed January 20, 1886. Serial No. 189,121. (No model.)

To all whom it may concern:

Be it known that I, GEORGE A. BARNARD, of Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Heating Apparatus, of which the following is a full, clear, and exact description, whereby any one skilled in the art can make and use the same.

My within-described improvement relates to the class of heating apparatus in which steam is used as the heat-carrying medium, in connection with a circulating system of pipes and heaters; and the object of my improvement is to provide means whereby a more perfect circulation throughout the system is insured and the steam used at the minimum pressure with greater economy.

My improvement consists in the combination of the steam-supply pipes, the radiators, the return-pipes, and a closed condenser, the said return-pipes having a pressure-reducing valve located between the last heater of the system and the condenser; and it further consists in an expanding chamber connected with the steam-supply pipe that has a pressure-reducing valve between the boiler or like source of supply and the expanding chamber; and it further consists in details of the several parts and their combination, as more particularly hereinafter described, and pointed out in the claims.

In the within-described apparatus in which my improvement is embodied I make use of a closed pipe or receiver attached to the return-pipes of a steam-heating system and in which a partial vacuum is formed in a natural manner. The vacuum thus formed produces a draft within the whole heating system connected therewith in the direction of this condensing apparatus, so that all confined air, water of condensation, and steam or vapor within the pipes or coils are caused to flow to the terminus of the discharge-pipes and into such a receiver; but in case this receiver is omitted in the system, then the flow will be directly into a condenser, which may be used in addition to the receiver-chamber, or the latter may be omitted. For most heating apparatus but a few inches of vacuum (by gage) is needed to obtain and maintain the necessary draft to properly circulate steam of low pressure. For small heating systems with comparatively short circulation an excess of vacuum would be detrimental, for by maintaining too much vacuum the steam would be rapidly withdrawn from the coils and pipes and wasted by condensation in the condenser; and even in large heating systems excessive vacuum, by reason of its comparatively low temperature, would cause rapid condensation of steam within the coils and pipes by refrigeration instead of condensation by radiation, which is the desired and natural process of heating by a system of steam-pipes.

It is necessary in a perfect working system of steam-heating pipes to maintain full control of the steam-supply in circulation; and in order to control this circulation and supply I make use of means for controlling it by the degree of vacuum maintained, which means consist of a pressure-reducing valve, usually adjustable, that is placed in the vacuum-pipe between the condenser and return-pipes from the heater. By adjusting the said reducing-valve I am enabled to regulate the vacuum to best suit the peculiar condition of each plant, and thus obtain the best results with great economy of steam.

Another feature of my improvement, that consists in devices for more economically and effectually utilizing live steam and at less pressure in heating and drying apparatus, is effected by placing a pressure-reducing valve in the supply-pipe and between the source of supply and an expansion tank or reservoir, the whole connected with a steam-heating plant having a condensing apparatus that causes the continuous flow of steam through the pipes of the system by draft, and not by pressure.

I am aware that it is a common practice to place a reducing-valve in a steam-supply pipe between the boiler and the heating system for the purpose of maintaining a lower pressure of steam in the coils than is carried in the boiler and the main supply-pipe; but this device is defective both in efficiency and in its failure to permit an economical use of the steam. This is for the reason that with a reducing-valve thus placed a sufficient volume of steam is not admitted to the pipes of the heating system after reduction of pressure to convey the required heat.

The amount of heat required in a steam-

heating system may be conveyed through the system by the circulation of steam at a comparatively low pressure—not exceeding three to five pounds; but when admitted, as from a street-main, to the steam-heating plant in a building through such a reducing-valve under the prior system referred to, there is not a sufficient volume of steam admitted to maintain the circulation economically. By my improvement in this regard the tank or reservoir affords a sufficient volume of steam expanded therein to serve as a source of supply that fully meets the demands of the heating-plant. This volume of live steam at a low pressure and exhaust-steam (where such is used) at atmospheric pressure is both effectually and economically circulated throughout any system of steam-heating plant to which my improved method of maintaining the circulation by the draft caused by a condenser on the end of the system is used.

Referring to the accompanying drawing, the figure represents a steam-heating system, and also illustrates the means and the method by which live steam directly from the boiler may be used, or in place thereof the exhaust-steam from an engine. These and the source of supply of steam are shown as connected to the system, but are not necessarily intended to be used together.

In the drawings, the letter A denotes the exhaust-pipe from an engine, and A′ the outlet-connection therewith directly to the air, a steam-gate, *a′*, being located in the latter and below its connection with a branch pipe, B′. The exhaust is continued by a connecting-pipe, B, leading into the steam-reservoir or expanding chamber C. This latter may be simply a cylinder of suitable capacity as compared with the supply-pipe of the steam-heating system to which it is connected, or it may contain any device that serves as a feed-water heater for the boiler. From this reservoir a leader-pipe, D, connects it with radiators or coils E of a steam heating or drying system, the water of condensation being led therefrom by means of the drip or return pipes F, that lead into the receiver G for the water of condensation. This receiver is provided with a water-gage, O, vacuum-gage L, and air-valve N, of ordinary construction and arrangements. It is also connected by a pipe, J, with a condensing apparatus, H, that is used for forming a vacuum or aiding the formation of a vacuum in the receiver G. The condensing apparatus H may be of ordinary construction, with an inlet and outlet, S and S′, for injection-water.

A reducing-valve, M, is placed in the pipe J and on the side of the condensing apparatus toward the return-pipes of the system, for the purpose of controlling the draft and flow through the pipes of the system and the degree of vacuum at the end of the system.

A direct communication between the boiler and the receiver is formed by the pipe K′, while the pipe K serves as a direct means of communication between the receiver and the reservoir C, and the latter is directly connected with the boiler by means of the pipe P, in which is placed a reducing-valve, P′. The valves *k k′* are placed in the pipes K and J, respectively, for the purpose, primarily, of controlling the supply of steam for condensation and obtaining a vacuum to draft the air and water from coils of the system. The water that accumulates in the receiver G may be conveyed directly to the boiler by means of a pump to which the pipe R leads and is connected.

When my improved heating apparatus is intended to be used with exhaust-steam as the heat-carrying element, the boiler and the connecting-pipe P are of course not present, and connections from the pipes A and B to reservoir C are opened, and also from the pipe K to the receiver G and pipe J to condensing apparatus H, in order to start a vacuum in G. As soon as such a vacuum is formed the valve *k* is closed and the valve opened in the riser D, that permits the flow of steam through the supply-pipes and the coils of a heating, drying, or similar system, the return through such a system being through the pipes F to the receiver G. The exhaust-steam passing into the reservoir C may be used, as before stated, to heat feed-water for a boiler, or for a similar purpose, and from the reservoir C it flows through the riser D, through the heating or drying system and the return-pipes thereof to the receiver G, in which a partial vacuum is maintained by the condensation of the steam or vapor in the condenser H, into which it flows from the connecting-pipe J. If, for any reason, there is not enough remaining steam at the end of the system for condensing, a vacuum may be created by the condensation of a supplemental supply of steam led directly from a boiler through the connecting-pipe K′.

The condensing apparatus H is one in which a supply of cold water forms the cooling element for the formation of a vacuum, the existence of which at the end of the system causes a circulation of steam and water from the system and through the whole of the connected portion of the heating or drying system through the drip or return pipes into the receiver G. By the maintenance of a circulation in this manner the back-pressure on the engine and any waste of steam are prevented; and on the maintenance of the vacuum the thorough circulation of the steam through the system depends, so that it is important that there shall be no outlet (as is the case in my improved apparatus) from the condenser through which steam or vapor, as such, can pass.

In prior heating systems that in general features most nearly resemble my within-described improvements there is, at the end of the system of return-pipes, located a standpipe or an equivalent outlet-pipe, not intended for the passage of the water of condensation, but to be used as what may be properly called a "vapor-exhaust pipe," and its

purpose and function in such prior devices are to permit surplus steam or vapor to flow from the condensing tank or chamber freely to the outer air. In such prior devices the flow of steam through the system of pipes depends on the initial pressure in the main supply-pipe.

Under certain conditions it is desirable to create and continue a vacuum at the end of the system that shall draw with full power upon the said system, and means are necessary for controlling the draft by the vacuum; and this I provide by the reducing-valve M, that is placed in the pipe J.

In the use of live steam instead of exhaust-steam as a heating medium I establish direct communication with the apparatus above described by first creating a vacuum in the receiver G and condenser by opening the valve *k'*, so that steam may flow direct from the boiler to the receiver G, or through the pipes P and K to the receiver G and condenser, until a satisfactory vacuum is established, when the valves in the pipe K or K' are closed, and the steam flows through the supply-pipe P to the reservoir C, and thence through the riser D and the heating system flowing through the drip-pipes F and the receiver G, and thence through the pipe J to the condenser H. It is obvious that the water of condensation and drip from the system may be returned to the boiler in any convenient way.

In case the reservoir C contains a heater for the boiler feed-water the device may be used as such, without using at the same time the heating system, by closing the valves in the connections between the reservoir and the heating system. If desired, the receiver G and condenser H may be used by partially opening the valve B' to allow the escape of part of the steam to the atmosphere, while the balance is drawn through the pipes K and J to receiver G and condenser H, whence it may be condensed and returned to the heater or boiler; or the valve B' may be closed and a complete vacuum forming or condensing system established.

The reducing-valve, that is placed in the supply-pipe P and on the boiler side of the reservoir C, is used for the obvious purpose of reducing the steam from boiler-pressure to a suitable pressure for its economical use in the heating system; but in order to do this it must first pass into the reservoir or expanding chamber C, so that sufficient volume of steam is assured to answer the demands caused by the continual circulation that is maintained by the draft or pulling of the vacuum end of the system. The use of this reservoir or expanding chamber, in combination with the reducing-valve P' thus located, forms an important feature of my improvement.

It will be observed that by the use of the reducing-valve adjacent to the condenser H, I secure further and complete control of the circulation of steam through the system, and effectually adapt my improvement to any type of steam-heating plant.

By the term "closed," as used in the following claims with reference to the condenser, I mean to be understood as describing one in which there is no stand-pipe, valve, vent, or outlet of any nature that will serve as a means of communication with the outer air by which the steam may find exit other than after it has been condensed into water.

I claim as my improvement—

1. In a steam-heating apparatus, in combination with a source of steam-supply, a supply-pipe, the radiators, the return-pipes, the closed tank, and the closed condensing apparatus located at the end of the system, whereby a vacuum is produced and maintained at the end of the circulatory system, all substantially as described.

2. In a steam-heating apparatus, in combination with a source of steam-supply, the steam-supply pipe P, the reservoir C, the riser D, the radiators E, the return-pipes F, the closed tank G, the pipe J, connecting said tank with the closed condenser H, the closed condenser H, and the reducing-valve M, located in the pipe J, all substantially as described.

3. In combination with a source of steam-supply, the steam-pipe B, the reservoir C, the supply-pipe D, the radiators E, the return-pipes F, the receiver G, into which the return-pipes lead, the vacuum-pipe J, the condenser H, the pipe K, connecting the reservoir and the receiver, and the several steam-valves in the pipes D, K, and J, all substantially as described.

4. In combination with a steam-boiler, the steam-reservoir C, the connecting-pipe P, having therein a reducing-valve, P', the steam-supply pipes, the radiators, and the return-pipes, the receiver G, into which the return-pipes lead, the condenser H, the vacuum-pipe J, the pipe K', connecting the boiler and the receiver, and the reducing-valve M in the vacuum-pipe, all substantially as described.

GEORGE A. BARNARD.

Witnesses:
W. J. MORGAN,
WM. H. WEIGHTMAN.