(No Model.)

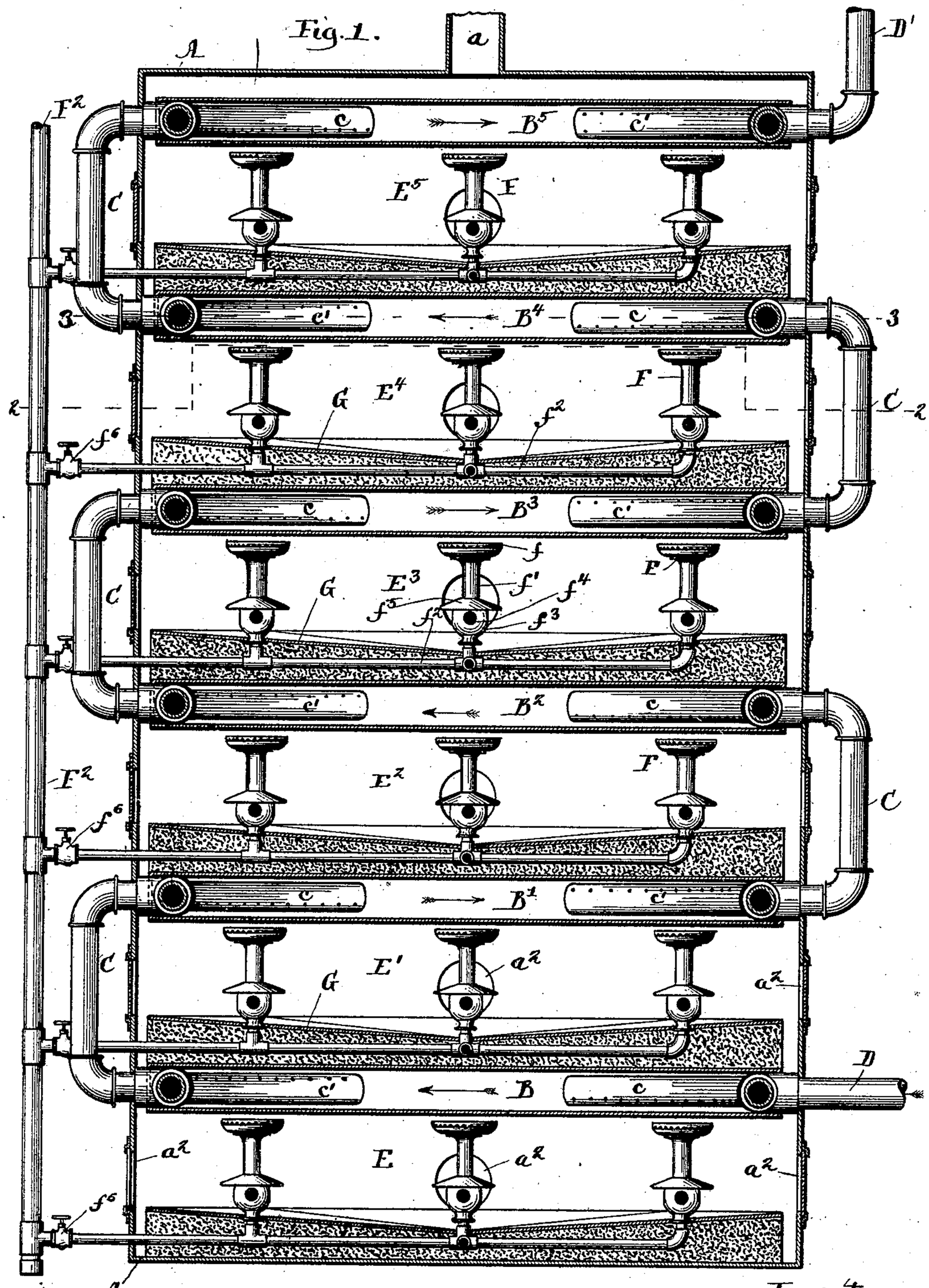
2 Sheets—Sheet 1.

R. S. LAWRENCE.

APPARATUS FOR HEATING AIR.

No. 582,211. Patented May 11, 1897.

Fig. 1.



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(No Model.)

2 Sheets—Sheet 2.

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Fig. 2.

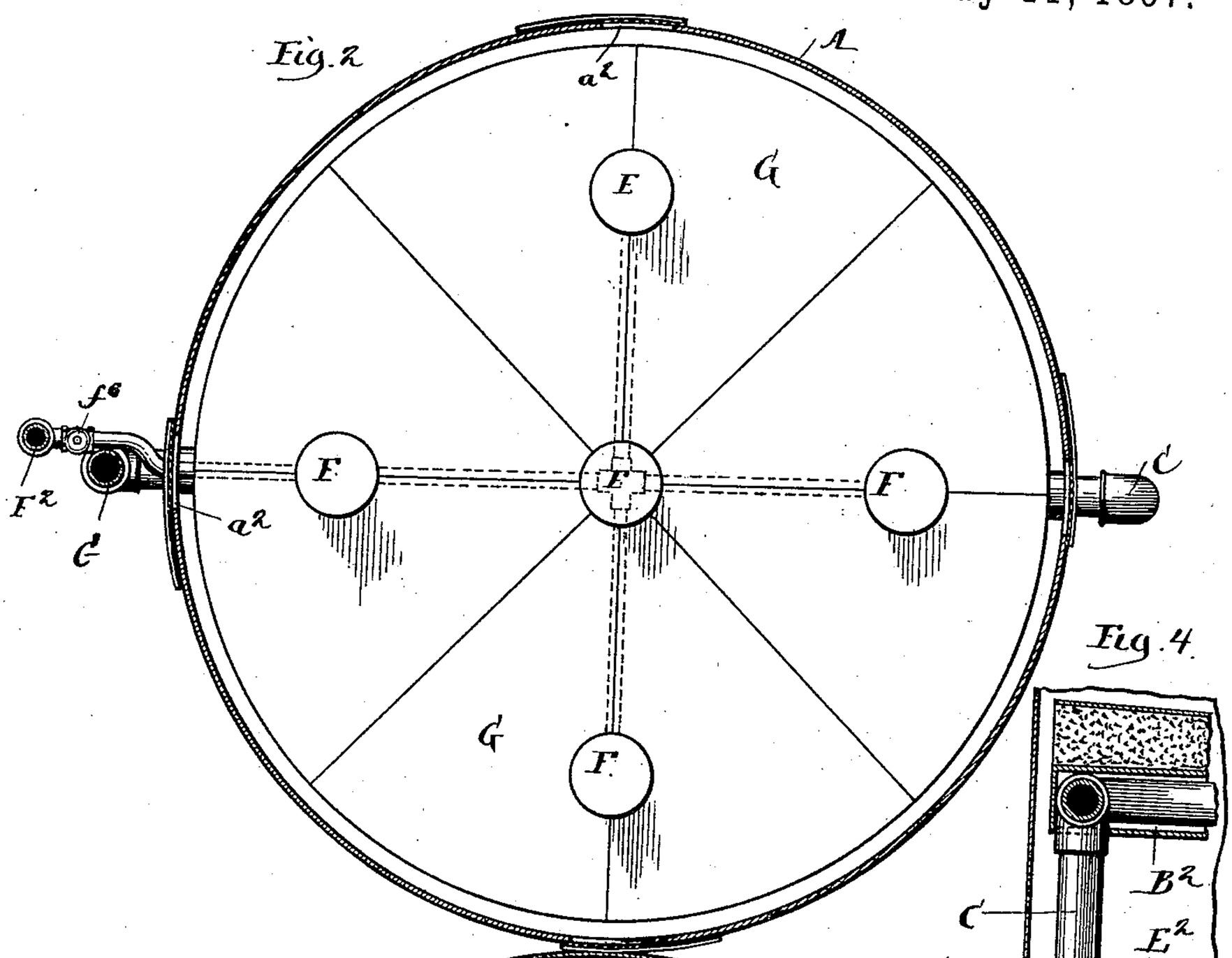
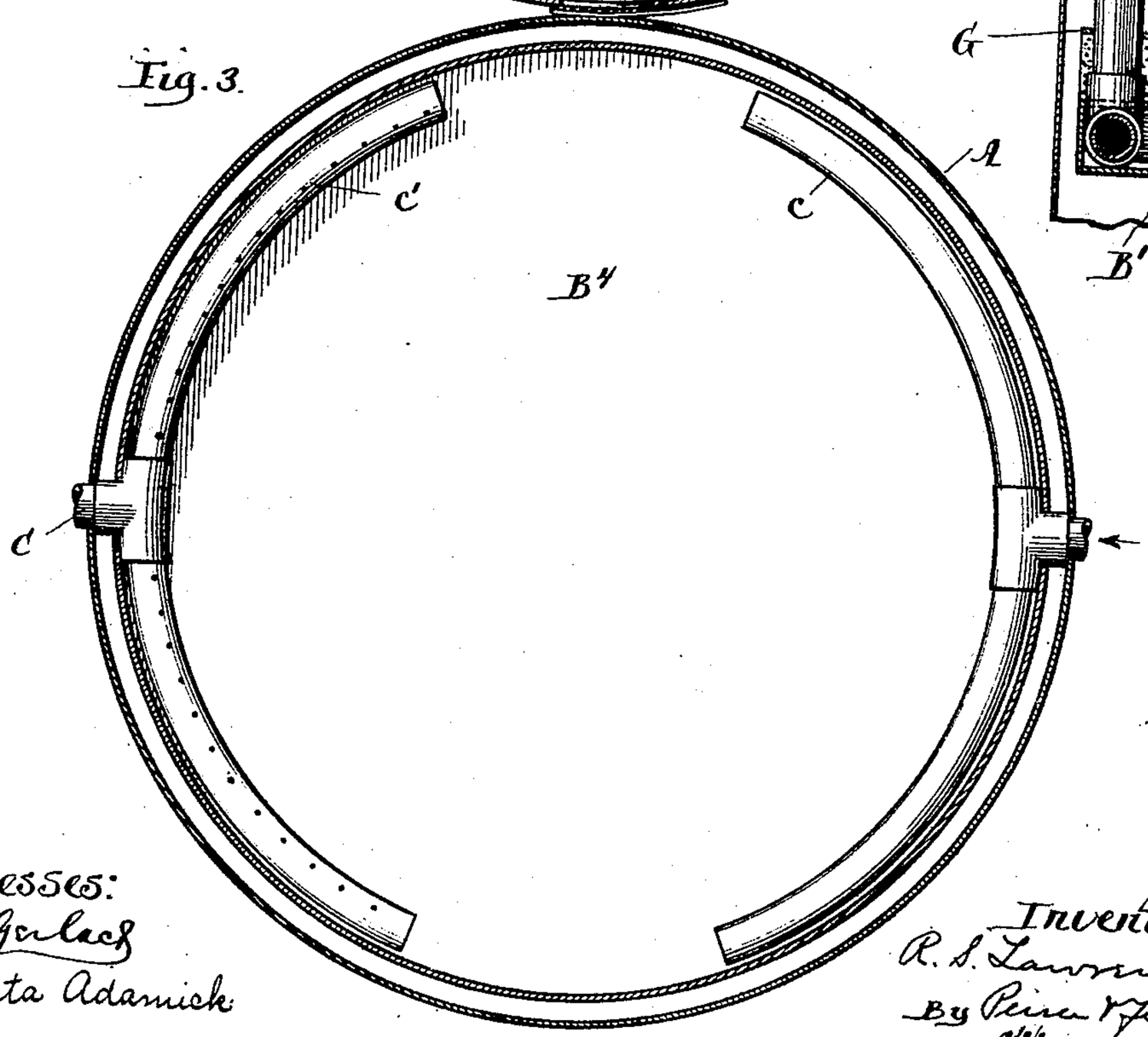


Fig. 4.

Fig. 3.



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UNITED STATES PATENT OFFICE.

ROBERT S. LAWRENCE, OF CHICAGO, ILLINOIS.

APPARATUS FOR HEATING AIR.

SPECIFICATION forming part of Letters Patent No. 582,211, dated May 11, 1897.

Application filed July 20, 1896. Serial No. 599,767. (No model.)

To all whom it may concern:

Be it known that I, ROBERT S. LAWRENCE, a citizen of the United States, and a resident of the city of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Apparatus for Heating Air, of which I do declare the following to be a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

In the construction of apparatus designed for the heating of air for the warming of buildings, the drying of lumber, fruits, or meats, and for various other industrial and domestic uses it is of the utmost importance that provision be made whereby the furnace shall be supplied continuously with fresh and pure air and that the apparatus shall be so constructed that the air-supply can be heated to any degree of temperature within wide limits and yet the regulation of the temperature be at all times readily and easily effected.

By my present invention I provide an improved apparatus by means of which a supply of fresh and pure air can be continuously admitted to the furnace and can be heated to any required degree before it is delivered to the point or points at which it is to be used; and my apparatus is of such construction that not only can the degree of temperature be at all times readily and easily controlled, but the heating of the air can be attained with the most economical use of the fuel within the combustion-chambers.

The invention consists in the various novel features of improvement hereinafter described, illustrated in the accompanying drawings, and particularly pointed out in the claims at the end of this specification.

Figure 1 is a view in central vertical section through a heating apparatus embodying my invention, parts being shown in elevation. Fig. 2 is a view in horizontal section on line 2 2 of Fig. 1. Fig. 3 is a view in horizontal section on line 3 3 of Fig. 1. Fig. 4 is an outer vertical section through two of the heating-chambers and adjacent parts with modified arrangement of connecting-pipes.

A designates the inclosing casing, from the opening *a* in the top of which a pipe will lead to the chimney or other point for carrying off the waste products of combustion.

Within the casing A is mounted a series of superposed heating-chambers B, B′, B^2, B^3, B^4, and B^5, and the adjacent chambers of the series are connected together by the elbow-pipes C, and by means of these pipes the air-supply that is delivered to the lowermost chamber B through the air-delivery pipe D will be caused to circulate through the various chambers of the series until finally it finds passage through the discharge-pipe D′, that leads from the uppermost chamber B^5 of the series.

Each of the heating-chambers B B′, &c., is preferably formed by uniting its top and bottom plates by means of a peripheral annular rim, through opposite points of which extend the elbow-pipes whereby the chambers are united. Preferably the supply of air is delivered to and discharged from each of the heating-chambers B B′, &c., by means of the curved perforated induction and discharge pipes *c* and *c′*, these curved pipes being arranged at opposite sides of the heating-chamber, so that as the air-supply passes in finely-divided currents from the induction-pipe *c* it must traverse the heating-chamber before it can be received into the discharge-pipe *c′*. It will be observed also that the heating-chambers B B′, &c., are connected at opposite sides, the purpose of this arrangement being to insure the passage of air back and forth or in sinuous course through the chambers in order to more effectively insure its becoming heated to the desired degree.

Beneath the heating-chambers B B′, &c., are arranged the series of superposed combustion chambers or spaces E, E′, E^2, E^3, E^4, and E^5, within which are held the burners F, that serve to supply the fuel whereby the air within the chambers B B′, &c., will be heated. Each of the burners F is shown as consisting of an expanded top *f*, having openings around its rim for the discharge of gas, and from the top *f* the tubular body *f′* of the burner leads to and is connected with the gas-pipe f^2. The tubular part *f′* of each burner is shown as provided with an annular expanded portion f^3, having holes f^4 therein to admit air that will pass with the gas up into the flaring top

f of the burner. The construction of burner as thus far defined is not of my invention, and therefore I do not wish to be understood as making claim thereto. I have improved the construction of burner, however, by providing the same above the air-holes f^4 with a hood or shield f^5, the purpose of which is to insure a better draft through the holes f^4. Any suitable number of burners may be employed and the style of burner may be varied without departing from the spirit of the invention. The gas-pipes f^2, whereon the burners are mounted, extend outside the inclosing casing, as shown, and are connected to a common gas-supply or trunk pipe F^2, that will lead to the city main or other source of supply.

It will be observed that the heating-chambers B B′, &c., are of somewhat smaller diameter than the diameter of the casing A, and by reason of this construction a free passage for products of combustion is allowed around the outer edge of the heating-chambers, so that not only are the combustion-chambers E E′, &c., in free communication with each other from bottom to top of the casing, but all parts of the heating-chambers are exposed to the products of combustion. At the bottom of each of the combustion-chambers E E′, &c., is placed a mass of asbestos or other suitable non-combustible material, and upon the top of this mass is arranged a reflector consisting, preferably, of reflecting-plates G, the purpose of which is to cause the heat to be reflected upward and against the bottom of the superposed heating-chambers B B′, &c.

It will be observed that the gas-pipes f^2 extend within and are covered by the mass of asbestos packing H, which serves not only to protect the pipes, but as well also to insure the more perfect efficiency of the reflecting-plates G.

In order to permit access to the interior of the combustion-chambers E E′, &c., I provide the casing A with a series of openings a^2, and through these openings the cleaning of the reflectors can be readily effected, and the burners can be easily reached in case repairs or renewal is required. So, also, by adjusting the position of the slides that control the openings a^2 the quantity of air admitted to the combustion-chamber can be increased or diminished in order to insure the perfect combustion of the gas.

From the foregoing description it will be seen that the supply of air admitted to the lowermost chamber B by the pipe D will be diffused uniformly through the perforations of the curved pipe *c* and will pass in finely-divided currents from side to side of the chamber B, being at such time subjected to the heat created by the burning of the gas in the subjacent combustion-chamber E. From the heating-chamber B the air-supply will pass in the direction of the arrow through pipe C into the next superposed heating-chamber B′, and so on throughout the series of heating-chambers until it is led away to the point of use by the pipe D′, that connects with the uppermost chamber. The products of combustion will pass from the lower chamber E around the edge of the annular heating-chamber B and into the next combustion-chamber E′, and not only will the heat from the lowermost chamber be in a measure utilized in aiding to heat the air within the chambers above it, but the heated air, being admitted to the burners, will insure a much more perfect combustion of the gas.

From the foregoing description it is manifest that by my improved apparatus the air-supply is progressively heated as it passes through the several series of heating-chambers, and by arranging the heating-chambers and the corresponding combustion-chambers in superposed series I utilize in most effective manner the products of combustion, since the products of combustion from the lower chambers are caused to regeneratively heat the air-supply in the upper chambers. So, also, by providing the bottoms of the combustion-chambers with reflecting-plates the heat from the burners is caused to be reflected against the bottoms of the heating-chambers above and is thus most effectively utilized. Not only is my improved apparatus most efficacious in that it enables the air-supply to be progressively heated as it passes from bottom to top of the furnace, but it is manifest that the apparatus affords a most convenient and effective means whereby the degree of heat to be imparted to the air-supply can be increased or diminished with the greatest ease, since by the proper manipulation of the valves f^6, by which the supply of gas to the burners is controlled, any one or more of the combustion-chambers E E′, &c., may be thrown out of service or the intensity of heat generated therein may be more or less modified. The air-supply pipe D may be led to any desired elevation in order that pure, fresh air may be taken above the strata of dust and dampness and decomposition, and, if desired, purifying apparatus may be connected with the air-supply pipe, and by means of a blower the supply may be increased or controlled, as desired.

It will be understood, of course, that the number of heating-chambers and combustion-chambers will be varied as the requirements of the case may demand, and in practice the furnaces will be so constructed that any desired number of these chambers may be set together, it being simply necessary to increase the height of the inclosing casing.

I have not deemed it necessary in the accompanying drawings to show the air-delivery pipe as provided with means for creating a forced draft of air, although it will be understood that any suitable provision, such as a blower or the like, may be employed for such purpose, if desired, nor have I shown the discharge-pipe at the top of the furnace as leading to the point at which the heated

air will be used, since it will be understood that a pipe of proper length will conduct the heated air to such point or points as it may be required for heating purposes, for the drying of lumber, fruit, or the like, or for domestic uses, such as cooking food or the like.

It will be understood that any suitable gaseous fuel may be used in the combustion-chambers. For example, in cities the gas-supply pipe may be connected with the city main, or where this is not available such pipe may be led to a suitable carbureting apparatus or the like. It is manifest also that the details of structure above set out may be varied by the skilled mechanic without departure from the spirit of the invention. Thus, for example, in Fig. 4 of the drawings I have shown two of the heating-chambers B′ and B^2 between the top and bottom of the series and the intermediate combustion-chamber E^2, the heating-chambers B′ and B^2 being united by a pipe C, that passes directly through the asbestos mass at the bottom of the heating-chamber B^2 and through the reflector G. From this modified form of the invention it will be apparent that it is not necessary to extend the pipe C outside of the inclosing casing.

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

1. In apparatus of the character described, the combination with a series of heating-chambers connected together for the passage of air therethrough, and with suitable air delivery and discharge ports or pipes, of a series of combustion-chambers arranged beneath said heating-chambers, said combustion-chambers being provided with suitable burners and having their bottoms covered with reflectors, substantially as described.

2. In apparatus of the character described, the combination with a suitable inclosing casing, of a series of superposed heating-chambers arranged within said casing and connected together for the passage of air therethrough, perforated curved induction and discharge pipes at opposite sides of each of said heating-chambers and a series of burners arranged beneath said heating-chambers, substantially as described.

3. In apparatus of the character described, the combination with a suitable inclosing casing, of a series of superposed heating-chambers arranged within said casing and connected together for the passage of air therethrough, a port or pipe for admitting air to the lowermost chamber and an air-discharge pipe leading from the uppermost chamber, a series of superposed combustion-chambers each arranged beneath its respective heating-chamber, said several combustion-chambers being connected together and suitable burners within said combustion-chambers, substantially as described.

4. In apparatus of the character described, the combination with a suitable inclosing casing, of a series of superposed heating-chambers arranged within said casing and connected together for the passage of air therethrough, a port or pipe for admitting air to the lowermost chamber and an air-discharge pipe leading from the uppermost chamber, a series of superposed combustion-chambers each arranged beneath its respective heating-chamber, said several combustion-chambers being connected together, suitable burners within said combustion-chambers and reflectors at the bottom of said combustion-chambers, substantially as described.

5. In apparatus of the character described, the combination with a suitable inclosing casing, of a series of superposed heating-chambers arranged within said casing and connected together for the passage of air therethrough, a port or pipe for admitting air to the lowermost chamber and an air-discharge pipe leading from the uppermost chamber, a series of superposed combustion-chambers each arranged beneath its respective heating-chamber, each of said combustion-chambers being connected together, suitable burners within said combustion-chambers and reflectors at the bottoms of said combustion-chambers and a suitable packing of asbestos or the like beneath said reflectors, substantially as described.

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