(No Model.) 2 Sheets—Sheet 1.

V. W. BLANCHARD.

AIR AND GAS MIXER AND HYDROCARBON FURNACE.

No. 569,984. Patented Oct. 20, 1896.

Fig. 1.

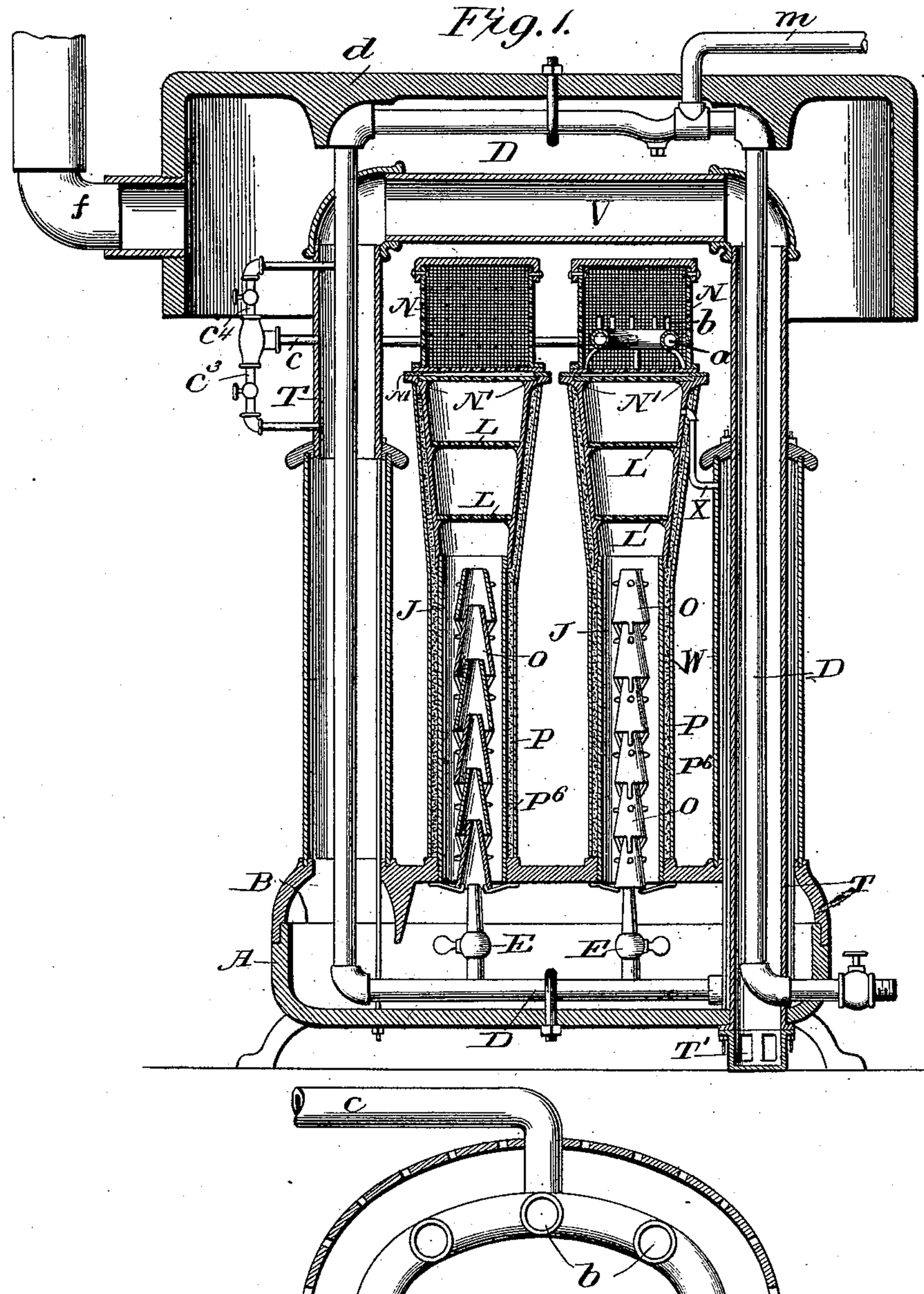
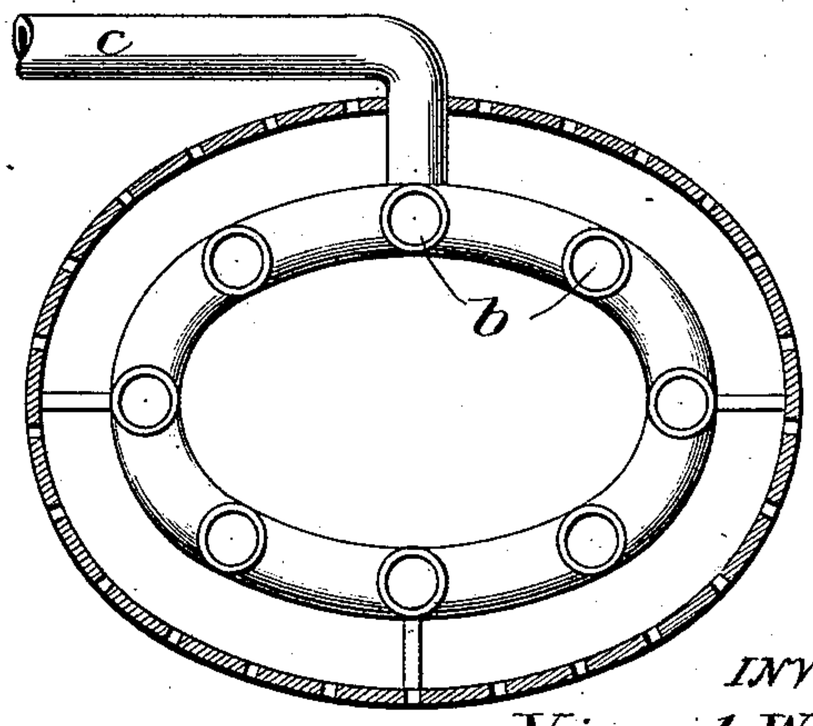


Fig. 5.



WITNESSES

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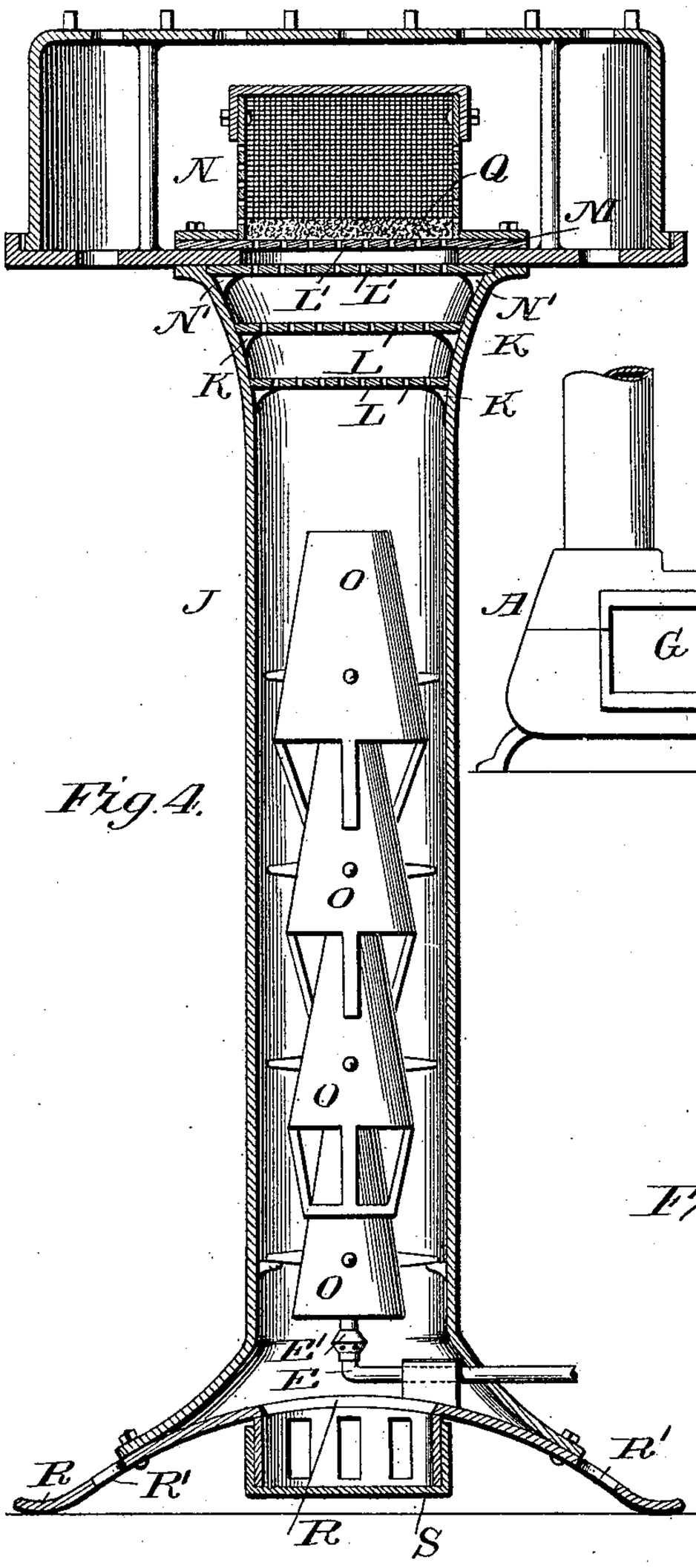

Fig. 4.

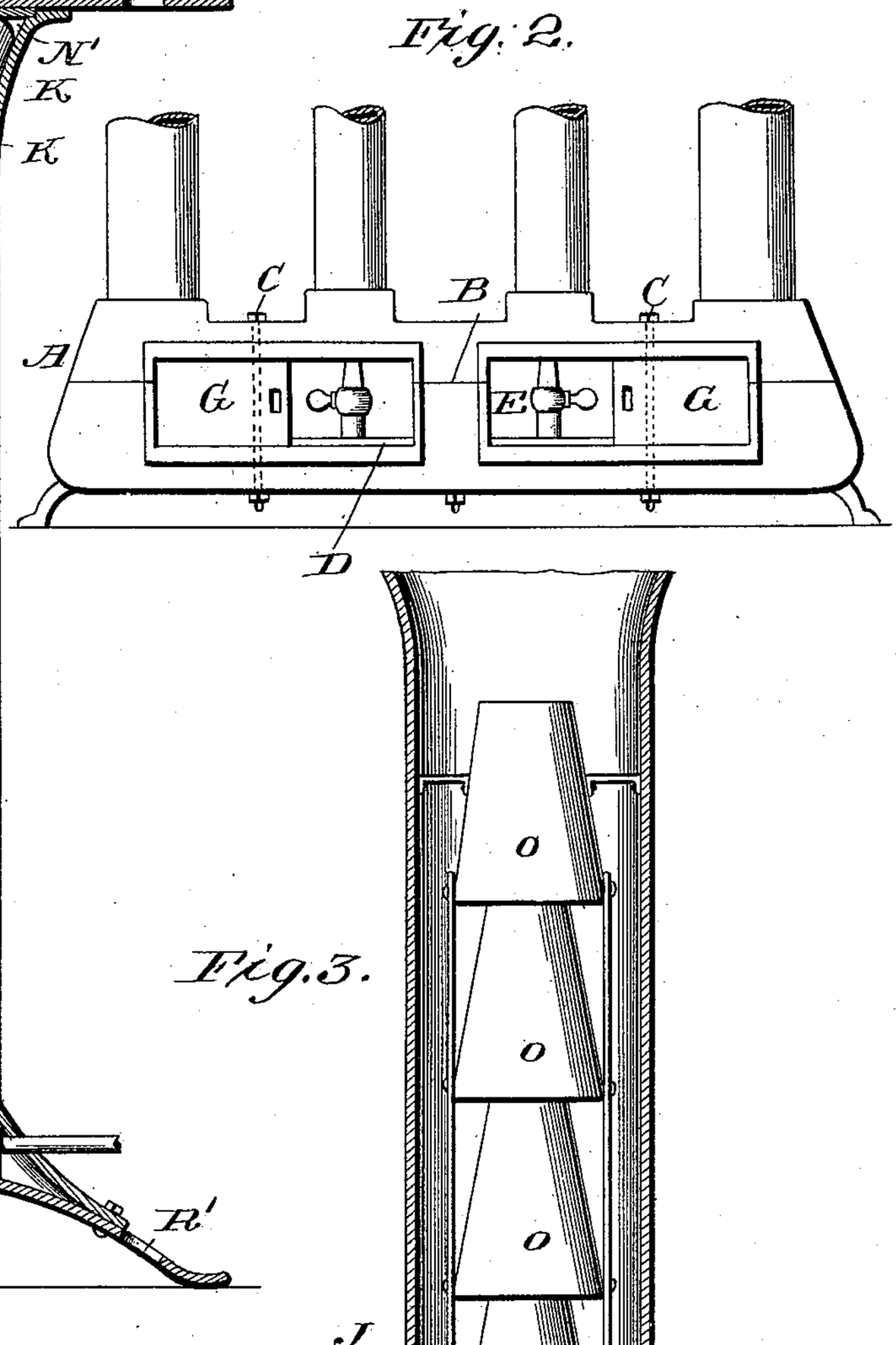

Fig. 2.

Fig. 3.

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UNITED STATES PATENT OFFICE.

VIRGIL W. BLANCHARD, OF NEW YORK, N. Y.

AIR AND GAS MIXER AND HYDROCARBON-FURNACE.

SPECIFICATION forming part of Letters Patent No. 569,984, dated October 20, 1896.

Application filed September 22, 1896. Serial No. 606,641. (No model.)

To all whom it may concern:

Be it known that I, VIRGIL W. BLANCHARD, of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Air and Gas Mixers and Hydrocarbon-Furnaces; and I hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

This invention is an improved gas stove or heater, and its object is to obtain the greatest possible heat from the burning gases by the thorough oxidation of the latter.

To this end the invention consists in, first, novel apparatus for heating air and gaseous fuel to a high temperature to assist in the process of combustion of the latter; second, novel devices for mixing air and gaseous fuel whereby they are brought to a condition favorable for the complete combustion of the latter; third, in certain novel details of construction and combination of parts hereinafter described in detail.

This invention is best defined and summarized in the claims, and the following is a description of the best form of apparatus now known to me.

Referring to the accompanying drawings, Figure 1 represents a vertical longitudinal section through a heater embodying my invention. Fig. 2 is a detail elevation view of the lower portion of my improved heater, as shown in Fig. 1. Fig. 3 is a vertical section of a modified form of the air and gas mixers and burners. Fig. 4 is a vertical section of a modified form of heater in which a single "torch" is shown. Fig. 5 is a detail plan view of the pipe for delivering air and gas within the trap in my heater.

The base of the heater is a two-part oval casing A, jointed on the line B, the upper and lower portions being firmly held together by the bolts C. Within the casing is a gas-pipe D, provided with the valved gas-tips E E. The front of casing A is provided with openings opposite the gas-tips, closed by the slides G, if desired. Gas-pipe D is closed at one end within the casing and at the other end passes out of the casing and is bent into a rectangular frame, the other end of the pipe entering the casing again next the closed end thereof and passing out of the casing again, as shown.

J J represent upright air-pipes or torches on top of casing A and having flaring or expanding top sections provided interiorly with ledges K K for sustaining perforated mixing and diffusing plates L L, said torches (see Fig. 4) being closed at their upper extremities with the perforated jets or firing-plates L′ L′, as shown, held in place by collars M.

N N represent traps superimposed above the firing-plates L L, their upper portion having thick inverted metallic cups at top and walls of reticulated metal, as clearly shown in Figs. 1 and 4. The collar M may be extended laterally into a perforated flanged shelf N′, as shown in Fig. 4, if desired.

O O represent a series of hollow conical air and gas mixing tubes superimposed one above the other within the inclosing pipes J. Owing to the arrangement of tubes O in the pipes J a gaseous current under pressure is discharged into the center of the expanding extremity of the lowest tubes O will traverse each one successively, being alternately contracted and expanded in its upward journey, and at the same time the jet will draw or suck air into it from the surrounding air within the inclosing pipes J at each point when one tube O discharges into the next tube O. The tubes gradually increase in size from below upward, so that the entire volume of air contained in the pipe J will be utilized in the upward passage of the mingled gas and air. By this means fresh air supplied by the inclosing pipe J may be repeatedly drawn into and intimately mixed with gases discharged under pressure into the lowest mixing-tube O, as is evident.

The tubes O may be formed of cast metal with thick walls, as shown in Fig. 4, or of fire-bricks, or of thin metal and connected together by being riveted to slight bars, the latter being supported at their base, as shown in Fig. 3.

The inclosing pipe J may have a flaring or gradually-expanding base, as shown in Fig. 3, and when the gas is fired at the tip E the plates L L′ could be dispensed with.

P represents a layer of non-heat-conducting material surrounding the tubes or torch J and inclosed within a jacket P^6, as shown,

Q represents a layer of granulate fire-bricks or other suitable granulated refractory material applied to the upper surface of the firing-plate L′.

R represents a circular base provided with perforations R′, as shown in Fig. 4, for sustaining the tube or torch J.

S, Fig. 4, represents a valve for admission of air into the tube or torch J through the opening R′.

T, Fig. 1, represents an air-pipe provided with a calendered valve T′, said pipe passing through the casing and inclosing part of the gas-pipe D, as shown in Fig. 1.

V represents a tube connecting upper extremities of pipe T within the casing *d* and forming substantially a continuation of pipe T, as shown.

W represents a pipe communicating with the interior of casing exterior to pipe T. X represents a gas-pipe connecting the upper portion of the pipe W with the upper extremity of the adjoining tube or torch J, as shown.

a, Fig. 5 or Fig. 1, represents an annular air and gas delivery pipe inclosed within the trap N and supported on legs, as shown, said pipe being provided, preferably, with the short upright delivery-tubes *b*, as shown.

c represents a pipe connecting *a* with two pipes c^3 c^4, provided with valves and respectively connected with pipe T and gas-pipe D, as shown in Fig. 1.

d represents a cover or supplementary trap superimposed over the trap N. The trap *d* is supported by the gas-pipe D.

If desired, hydrocarbon oils or water-gas may be introduced into pipe D through pipe *m*, as indicated in Fig. 1, and where gas is not convenient the apparatus may be provided with a hydrocarbon-gas-making apparatus of any suitable construction, such as is shown in my application, Serial No. 533,566.

Operation: In burning ordinary illuminating or heating gas the gas-pipe D should be connected with a supply-pipe and the slides G G in the casing A opened. Then by opening the valve I and the valves in the gas-tips E E jets of gas will be delivered into the lower mixing-tubes O O, which jets such air into the lower tube O in passing therethrough. The resultant mixing and mingling of air and gas goes on through the entire series of tubes. At each tube a fresh quota of air is drawn into the gaseous current and mixed therewith until the current finally enters the flaring extremity of the pipe J, as is evident. By this means gas and air may be mixed so as to insure, under proper conditions, their almost instantaneous and approximately perfect combustion and also by these means, under proper conditions, I find I am able to produce in practice the almost instantaneous combustion of gaseous fuel without the presence of either odor, smoke, or flame.

By the means described I can obtain a perfectly uniform current of air and gas of any desirable proportions, ranging from a small per cent. of air to a volume where its mixture with gas ceases to be a combustible compound. The commingled gas and air eventually pass through the gas mingling and diffusion plates L L and ascend and pass through the firing-plates L′ L′, as shown in Fig. 4, at which point the mixture should be fired. The gases of combustion (see Fig. 1) rising above the plate L′ ascend into the trap N and thence, passing in a lateral direction through a reticulated wall, rise and envelop the transverse portions of pipes T and D. Heating the transverse portion of the air-pipe L to a high temperature causes a circulation of air in the entire length of said pipe upon opening valve S, the air flowing through the pipe T and Z to the jet-openings in the casing A. Slides G G being closed, the whole surface of my heater is highly heated by the circulating hot air and forms an efficient radiator of heat, while the tubes or torches J J are supplied with air-currents heated to a high temperature, which facilitates the combustion of gaseous fuel. The gas-pipe D is inclosed in a heated air-jacket, except its upper transverse portion, which is exposed directly to the heated products of combustion. Thus gas-tips E E are supplied with highly-heated gas, the heat of said gas increasing its buoyancy and force in communicating motion to the volume of heated air into which it is injected and with which it is mixed, as heretofore set forth.

In the presence of cold air and gas, as shown in Fig. 4, I prefer to use two or more firing-plates L′, and the effect or result is heightened, especially in a spectacular sense, by the use of a layer of granulated fire-brick or other suitable refractory material applied to the surface of the upper one, as shown. The layer of granulated refractory material obstructs the passage of the highly-heated fuel-gases, giving more time for the combustion of this oxidizable element. For firing-plates I prefer to use thin perforated metallic plates coated with a layer of fire-brick, the perforations passing through the fire-brick layer that protects the metallic support below it. Any gas leaking into the pipe W will be discharged through pipe X into the upper portion of the torch.

The trap N assists in the combustion of hydrogen. By it the rising gases, after their ignition above the firing-plate L′, are held in check and delayed in their upward journey in the presence of intense heat, giving more time for their perfect oxidation. By means of the pipe *a* air or gas may be delivered through the pipe *c* into the trap N, so as to supply fuel gas or air, or both, if desired, to

the gases undergoing the process of combustion therein. By the addition of gas alone the intense heat present will instantly raise the unoxidized free carbon present in them as a component element to a condition of dazzling incandescence, thereby producing light as well as heat. By means of the supplementary hydrogen-trap *d* any unconsumed hydrogen that might possibly escape from the trap N is caught and retained till its oxidation is effected, and this trap also serves a valuable purpose in delaying the heated products of combustion in contact with and compelling them to communicate a high temperature to the air-pipe T and the gas-pipe D. This trap, by forming a roof above the firing-plates L′ L′, serves as an admirable radiator of heat and also supplies the uptake *f* for the transmission of the heated gases to a pipe for a further utilization of their heat.

The office of the perforated gas mixing and diffusion plates L L is to prevent separation of the intimately-mingled gas and air after leaving the mixing-tubes O O and to compel the gaseous current to assume a uniform movement through the firing-plates L′ L′, thereby obviating the tendency to a central current through said firing-plates. By means of the projecting ledge, provided interiorly with a sharp edge, the rising gaseous current in the pipe J is prevented from becoming cooled by extensive contact with a large surface of metal that is radiating heat exteriorly, thereby hindering the process of combustion at or near the circumference of the firing-plate L′. The annular collars M M, for securing the firing-plates L′ L′ in a proper working position, should be fitted accurately to said firing-plates with preferably a thin layer of fire-clay between them to establish absolutely gas-tight joints. Ordinary gas-tips may be substituted for the firing-plates, as is evident.

If the wall of the tube or torch J and the mixing-tubes O O O O are formed of sufficiently refractory material, the gas-jet may be fired at the valved gas-tip E, fresh air being drawn into the burning fuel-gases and mixed and mingled with them in their upward journey through said tube, as already described. In such case I prefer to use the perforated tube E′ in combination with the tip, as shown in Fig. 4. In such case the plates L L and the firing-plates L′ L′ could be dispensed with; but I prefer to fire the gas above the firing-plates, as I am thereby enabled to more intimately mix a larger quantity of air with the cold gas and obtain much better results.

I would not be understood as confining myself to any number of mixing-tubes O O O combined with the pipe J, as the results obtained are dependent in a degree on their length and the variation of the diameter of their base and the thickness of the air-space between them and their inclosing pipe J.

By the means set forth the propelling force in the jet of gas injected into the lower mixing-tube *o* is gradually and uniformly communicated to the entire gaseous current in the upper portion of the inclosing pipe J, so that at the firing-plate L′ there is a uniform passage of intimately-mingled air and gas through its entire superficial area, thereby resulting in a uniform high temperature of combustion over said superficial era. By this means it is impossible for gas to escape without being entirely consumed or oxidized. By means of the expanded upper extremity of the pipe J the process of combustion, as set forth, is diffused over a larger superficial area of surface in the firing-plate L, and hence a longer period of time is occupied in a given area of its surface for the combustion of a certain volume of the combustible compound passing through it, which facilitates the process of combustion and avoids an undue high temperature, as is evident.

What I do claim as the actual results realized in practice by my invention is approximately a perfect reduction of gaseous fuel to heat in the manner set forth; a process of combustion carried on without the presence of flame, smoke, or noxious odors and one in which the theoretical value of gaseous fuel in heat units is, in the presence of proper construction of the apparatus, approximately realized.

By means of the calendered air-valves a proper volume of air is allowed to enter the inclosing pipe J to insure perfect combustion of the gaseous fluid discharged from the gas-tip E. If too great a volume of air is supplied to a gas-jet of a given volume, a non-combustible mixture of air and gas will be supplied to the firing-plate L. If too small a volume is supplied, imperfect combustion of the mixture will be realized. By means of this valve a proper volume of air is apportioned to the gas-jet issuing from the gas-tip E, which may be readily determined by the disappearance of flame and the presence of intense heat on the upper surface of the firing-plate L. It is by means of the mixing and remixing of the air and gaseous fuel carried on by means of the series of tubes O in the inclosing tube J, as set forth, that these gaseous elements of differential specific gravity are so intimately mixed and commingled as to insure the result realized—perfect combustion devoid of odor or flame and of the presence of diffusible poisonous carbonic-oxid gas.

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

1. In a gas heating-stove the combination of a series of injector-tubes superimposed one above the other and all inclosed within an air-supply chamber, whereby gas passing through said tubes is successively charged and mixed with quotas of air before it escapes from the inclosing chamber, substantially as described.

2. In a gas heating-stove the combination

of a series of injector-tubes superimposed one above the other within an inclosing air-supply chamber, whereby gas passing through said tubes is successively charged and mixed with quotas of air before it escapes from the inclosing chamber, with a gas-supply jet for the first tube, and a burner or firing-plate through which the mixed air and gas is discharged, substantially as described.

3. The combination of an air-pipe, a burner at one end thereof, a gas-jet at the other end, and a series of injector-tubes arranged in said pipe between the jet and the burner, substantially as and for the purpose described.

4. The combination of an air-pipe, a burner at one end thereof, a gas-jet at the other end, and a series of injector-tubes arranged in said pipe, with means for heating the air supplied to said pipe, substantially as described.

5. The combination of an air-pipe, a burner at one end thereof, a gas-jet at the other end, and a series of injector-tubes arranged in said pipe, and means for supplying air or gas to the burner, substantially as described.

6. The combination of the casing, the air-pipes connected therewith, the tubes in said pipes, the perforated gas-trap on said pipes, and the gas-jets below the tubes, substantially as specified.

7. The combination of the casing, the gas-pipe therein and rising thereabove, having jets in the casing, the air-pipe partly surrounding the gas-pipe and communicating with the interior of the casing, and the air and gas mixers and burners on said casing over the jets and the air-pipes inclosing said mixers and supporting the burners substantially as set forth.

8. The combination of the casing, the gas-pipe therein and rising thereabove, having jets in the casing the air-pipe partly surrounding the gas-pipe and communicating with the interior of the casing, the air-pipes over the jets also communicating with the interior of the casing, and the series of air and gas mixing tubes in said pipes, substantially as described.

9. The combination of the casing, the gas-pipe therein and rising thereabove, having jets in the casing, the air-pipe partly surrounding the gas-pipe and communicating with the interior of the casing, the air-pipes over the jets also communicating with the interior of the casing, and the series of air and gas mixing tubes in said pipes, the perforated plate above said tubes, and the perforated gas-trap above the plates, substantially as described.

10. The combination of mixing-tubes O, O, the pipe J, gas-diffusion plates L, and firing-plate L′ and the gas-jets below the tubes, substantially as described.

11. The pipe J having a flaring extension in combination with a series of mixing-tubes O inclosed in said pipe below its extension, a gas-jet E and an air supply substantially as and for the purpose set forth.

12. The combination of a gas-jet with superimposed mixing-tubes O, the inclosing pipe J, the firing-plate, and trap N, substantially as and for the purpose specified.

13. The combination of mixing-tubes O, the inclosing pipe J the firing-plate L on said pipe, with the trap N above said plate and the air and gas delivery pipe *c*, substantially as and for the purpose described.

14. The combination of a gas-jet, mixing-tubes O, the inclosing pipe J, the firing-plate L′ superimposed on said pipe, having a layer of granulated fire-brick Q, substantially as and for the purpose described.

15. The combination of the casing, the air-pipe T, and gas-pipe D, with the tubes O, the inclosing pipe J, the plates L, L, in said pipe above the tubes, and the trap N, substantially as described.

16. The combination of the casing, the pipes J, the tapering mixing-tubes O, and the firing-plate L′ within said pipes with the trap N and the supplementary trap *d*, substantially as and for the purpose specified.

17. The combination of the inclosing pipe, with superimposed mixing-tubes O having studs or projections formed on their external surface and also provided at their base with depending arms, substantially as shown and described.

18. The combination of the pipe J having an upper flaring extremity in combination with mixing-tubes O, and their firing-plates L, substantially as and for the purpose described.

19. The two-part casing A in combination with the pipe J and mixing-tubes O, and pipes D and V for heating and supplying gas and air respectively to the tubes and pipe, substantially as and for the purpose specified.

20. The combination of the casing A, the air-pipe T, the pipe D, the gas-tip E, a series of mixing-tubes O above the tip, and the inclosing tube J, substantially as and for the purpose described.

21. The combination of the casing A with the gas-pipe D the gas-tip E, a series of mixing-tubes O above the tip and the inclosing pipe J, substantially as and for the purpose set forth.

22. The casing A the air-pipe T the pipe V and the gas-pipe D provided with gas-tips E in combination with one mixing-tube O inclosed within the pipe J, substantially as and for the purpose described.

23. The casing A, the air-pipe T, the pipe V, the pipe W, in combination with the gas-pipe D, the gas-tip E and the burners above the tip but below the pipe V, all substantially as and for the purpose set forth.

24. The combination of a series of injector-tubes superimposed one above the other within an inclosing air-supply chamber, whereby

gases passing through said tubes are successively charged and mixed with quotas of air, with the air-valve for regulating the admission of air, the gas-supply jet below the tubes, and the firing-plate above the tubes, substantially as described.

25. The combination of a series of injector-tubes superimposed one above the other within an inclosing air-supply chamber, whereby gases passing through said tubes are successively charged and mixed with quotas of air, with a gas-supply jet for the first tube, and a burner or firing-plate above the tubes through which the mixed air and gas is discharged and fired, with the air-valve for regulating the admission of air, substantially as described.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

VIRGIL W. BLANCHARD.

In presence of—
JOSEPH V. FLYNN,
F. W. BARKER.