(No Model.)

4 Sheets—Sheet 1.

W. H. THAYER.

VAPOR BURNING STOVE.

No. 505,643. Patented Sept. 26, 1893.

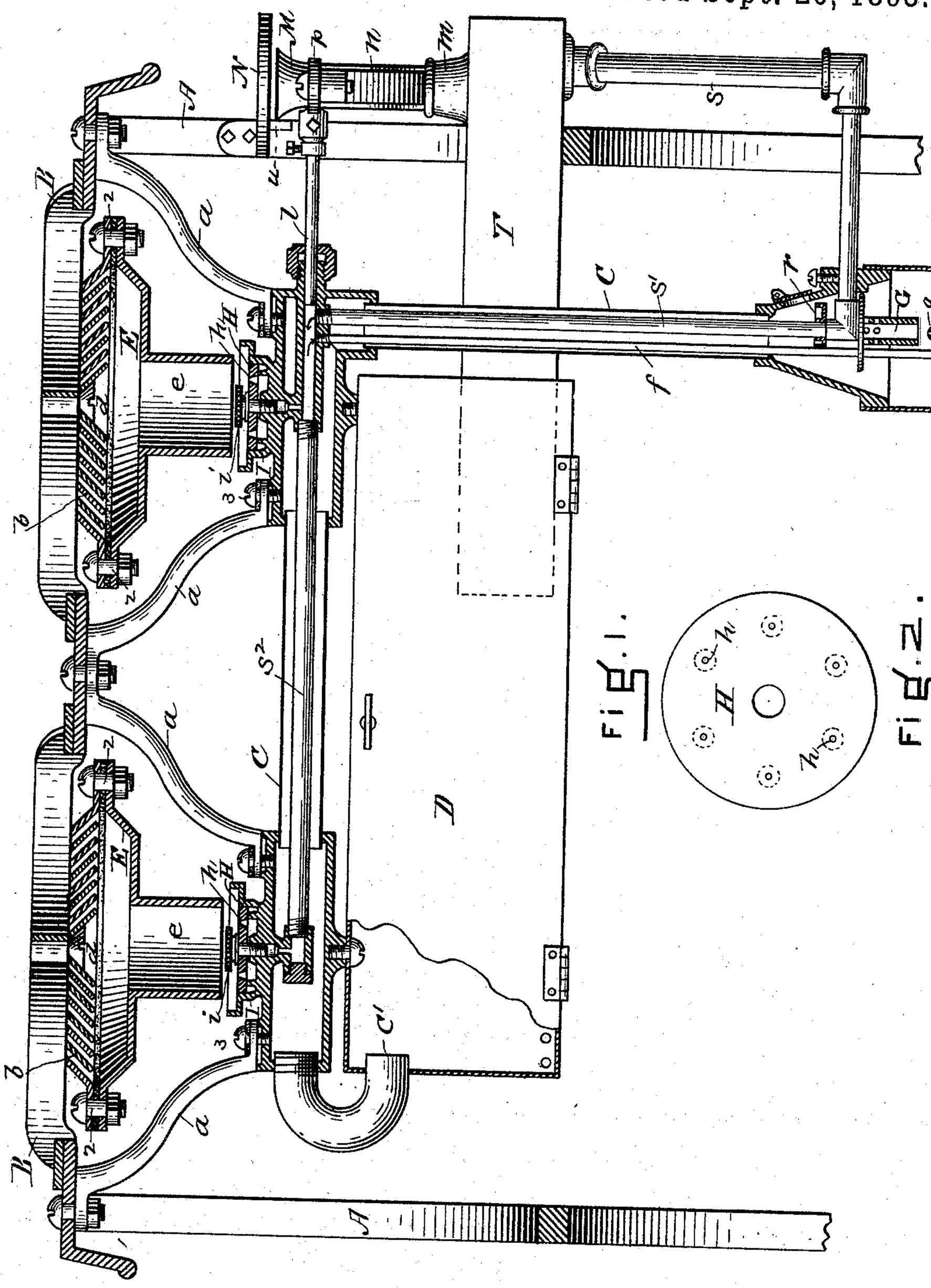

Fig. 1.

Fig. 2.

WITNESSES.

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(No Model.)

4 Sheets—Sheet 2

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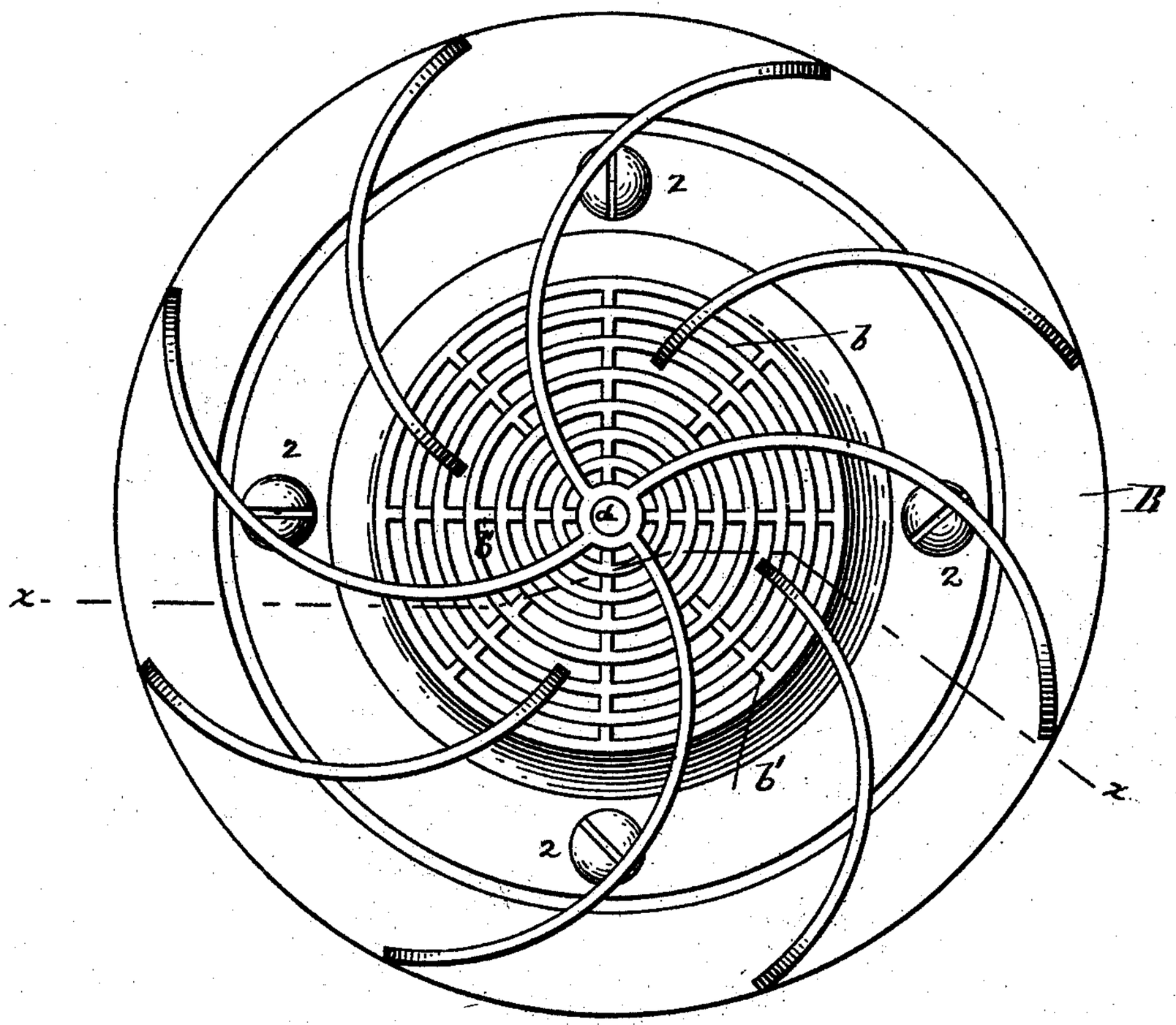

Fig. 3.

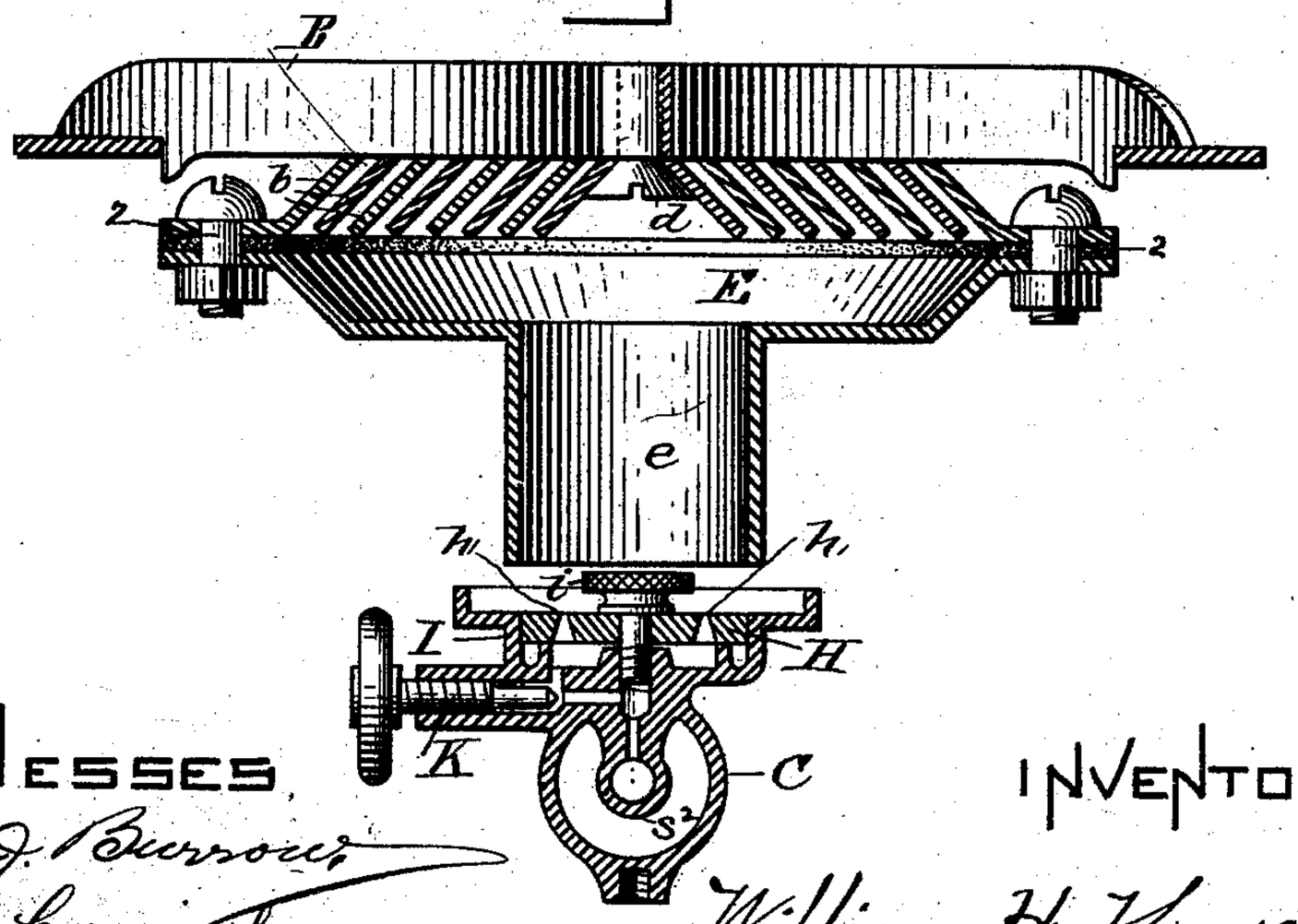

Fig. 4.

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4 Sheets—Sheet 3.

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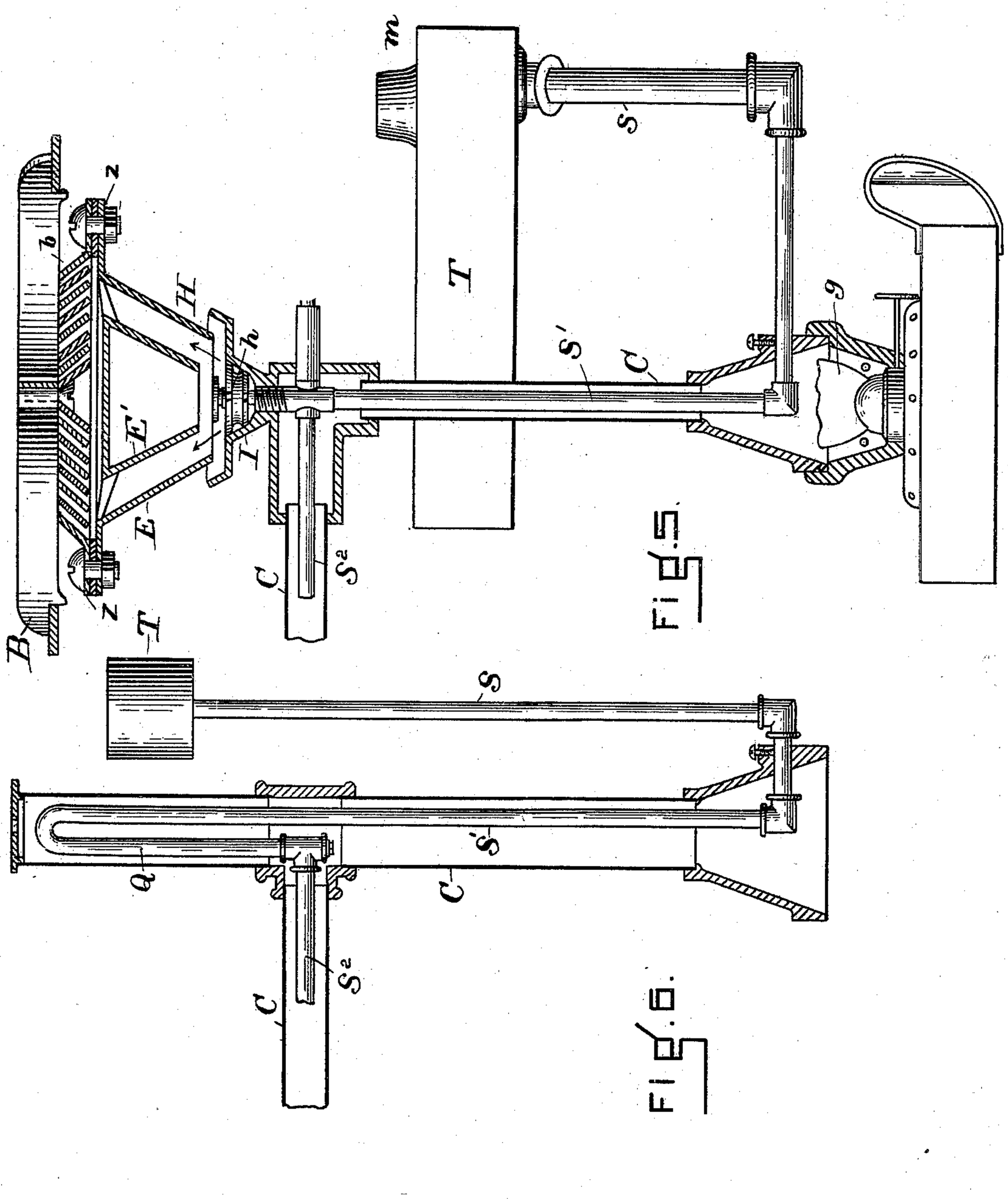

FIG. 5.

FIG. 6.

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4 Sheets—Sheet 4.

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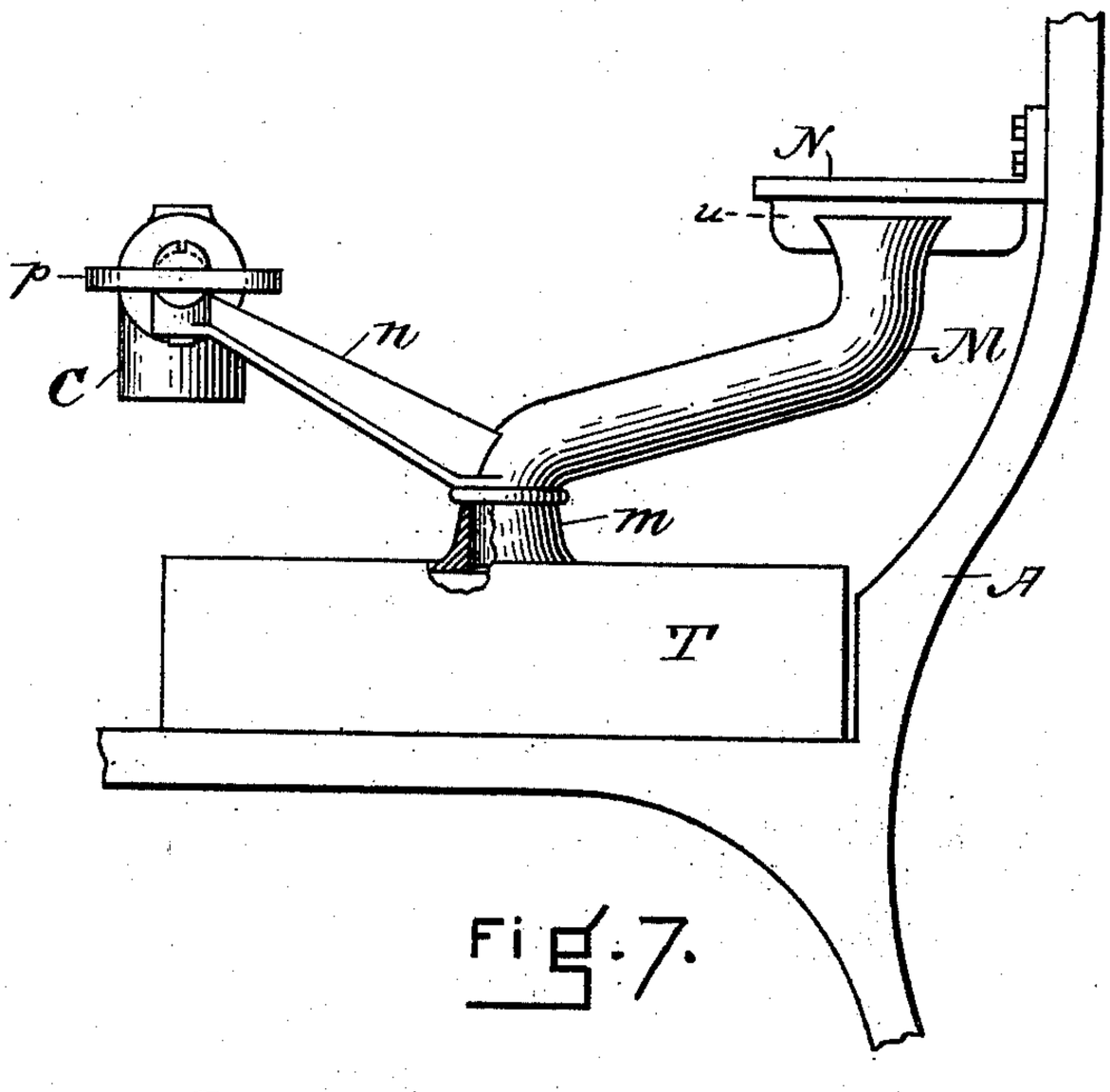

Fig. 7.

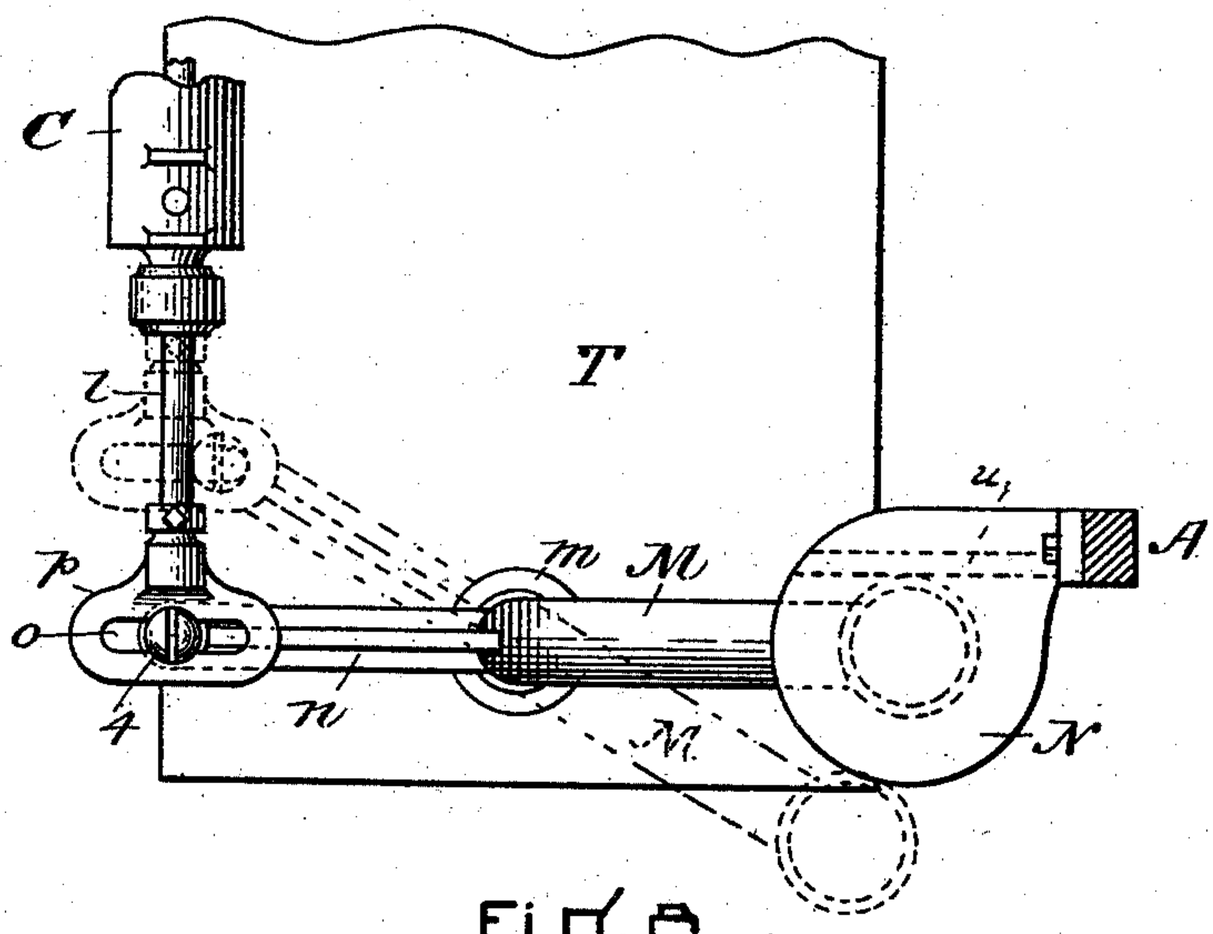

Fig. 8.

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UNITED STATES PATENT OFFICE.

WILLIAM H. THAYER, OF MELROSE, MASSACHUSETTS.

VAPOR-BURNING STOVE.

SPECIFICATION forming part of Letters Patent No. 505,643, dated September 26, 1893.

Application filed September 5, 1891. Serial No. 404,901. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. THAYER, a citizen of the United States, residing at Melrose, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements Relating to Vapor-Burning Stoves, of which the following description, together with the drawings accompanying the same, is a specification.

In vapor burning stoves heretofore in use the supply tank or reservoir which contains the hydro-carbon liquid which is to be vaporized for combustion in the stove has been placed at a considerable height above the burners so as to obtain the proper amount of pressure to force the vapor through the small injector outlet to the burner, or when the said tanks have been placed below the stoves the requisite pressure has been obtained by compressing air within them. With either of these arrangements, if the flame at the burner is accidentally extinguished and the injector valve is not closed, or if the injector valve is opened without lighting the burner, the liquid from the reservoir will run out through the injector opening until the reservoir is emptied.

My improved construction and arrangement entirely obviates this difficulty, and consists in locating the fuel supply tank below the injector, or jet orifices; or entirely below the highest portion of the burner supply-pipe, if that should be arranged to project above the burner, and employing no artificial pressure in the tank, but leaving the liquid at atmospheric pressure, that is, normally in a state of equilibrium in the reservoir and pipes leading therefrom. Thus it will be understood that the liquid will never rise in the supply-pipe above the level of the liquid in the tank, and that level always being below the injector outlet or below the highest portion of the supply-pipe, an overflow of the volatile liquid through the outlets at the burners cannot occur. Further, in order to obtain sufficient pressure in the supply-pipe to force the vapor generated from the liquid, through the small jet orifices into the chamber below the burner where the hydro-carbon vapor is mixed with oxygen, before it is ignited, I extend the supply-pipe from the reservoir downward as far as the height of the stove will conveniently permit and then upward, to the horizontal pipe from which the burner injector tubes lead, and then apply sufficient heat to the supply-pipe below the normal level of the liquid therein and in the tank, to convert the liquid in the pipe into vapor. Preferably I apply a gas or oil flame to the lower end of that portion of the supply-pipe which extends upward to the said horizontal portion of the pipe, thus obtaining the greatest benefit from the heat. As soon as the liquid in this part of the supply-pipe is converted into vapor a pressure will be produced thereon equivalent to the statical pressure of a column of liquid of the same height as that which has been vaporized, by reason of the liquid in the reservoir and pipes leading therefrom constantly tending to establish its normal equilibrium.

A further improvement which is especially applicable to this arrangement of the supply-tank and generator of vapor, is in providing an injector plate which has the number of its jet outlets varied, as the height of the column of liquid vaporized is varied.

I have found that for the best results it is not practicable to make the jet orifices, or injector outlets, through which the vapor is injected into the "mixing chamber" of the burner, larger than one fiftieth of an inch in diameter, for if materially larger than that, when the gas is ignited at the burner a luminous flame will be produced which is a very objectionable feature in the use of vapor stoves, because of imperfect combustion and consequent deposit of unconsumed carbon upon the burner and utensils. Heretofore in stoves of this kind it has been customary to use an injector with a single jet outlet for each burner, but under such conditions it has been necessary to hold the liquid in the supply-pipe under pressure of from one to two pounds, in order to force a sufficient quantity of vapor through one small jet outlet to properly supply the burner. This was accomplished as heretofore explained; but always with the liability to overflow at the injector outlets.

The preferable construction of tank is with large superficial area and small depth, by which the variation of pressure is small as the liquid is used, the requisite pressure being obtained by extending the supply-con-

duit down below the tank to increase the height of a column; but as I thereby lose the pressure which would be produced upon the vapor in the supply-pipe by the old arrangement, I compensate for consequent diminution in the quantity of vapor delivered by the jet orifice to the burner, by providing an injector plate in which I make a sufficient number of jet outlets to supply the requisite amount of vapor to properly feed the burner.

To give an illustration of the requisite number of jet outlets to be used in practice when the column of liquid vaporized is within the limit of three feet, which is the height of column usually employed for one outlet, I have found that the ratio between the number of jet outlets and the height of the column which produces pressure, should preferably be substantially in the proportion of one outlet for each six inches in variation of height; adding outlets as the height is reduced and reducing the number of outlets as the height of the column is increased. Or again if one jet outlet in the injector plate will supply sufficient vapor to the stove burner to produce a flame of the accepted standard number of units of heat, when the tank is three feet above the vapor generator, it will require six jet outlets to properly supply the same burner when the tank is but six inches above the generator flame.

Small variations in the ratio of the height of column to each jet outlet will not materially affect the result, but for practical purposes in order to keep the flame constant, or always with the same number of units of heat, I have found that one outlet for about six inches of height of column of liquid is a safe proportion.

It will be readily understood that if a flame of double the size, or heating capacity, is desired, it can be produced by adding an outlet for each three inches of reduction in the statical pressure, always bearing in mind the fact that the size of the jet outlets cannot be increased beyond the practical limit above mentioned, that is, a size which will permit only sufficient vapor to issue, under a predetermined unit of pressure to produce a transparent or colorless flame when it is ignited, and the number of these outlets should correspond inversely in arithmetical progression to the number of such units of pressure employed to force the vapor to the burner.

I have also improved the construction of the burner so as more successfully to meet the conditions of the improved construction and operation of the other parts; and the improvement consists in the use of a series of frusto-conical rings suitably separated and successively varying in diameter, by which the flame will be concentrated beneath the utensil.

I provide the usual valve at each burner, as also a safety valve hereinafter described.

A further improvement is in providing a casing or jacket for the generator of vapor and the supply-pipe which conveys the vapor to the injector, whereby the heat of the generator flame may be utilized in preventing condensation of the vapor generated which is not a fixed gas and finally for other heating purposes.

The safety valve heretofore mentioned, I find it convenient to apply to the end of the horizontal part of the supply-pipe, which extends beneath the stove, and a convenient construction of valve is that shown in the drawings. The generator flame may be from a lamp placed beneath the supply-pipe as shown in Fig. 5 or from a vapor jet as shown in Fig. 1. In the latter instance the vapor is supplied through a feed tube, preferably as shown, leading out from the horizontal part of the supply-pipe above the liquid level near the point where the perpendicular portion above the generator joins it. When the generator feed tube is thus located it can be closed by the same safety valve which cuts off the gas in the supply-pipe.

Instead of employing the heat retaining jacket and vapor generator mentioned, a small tube for the vapor may be placed along beneath the two horizontal portions of the supply-pipe and beside the perpendicular portion of the supply-pipe between them and then by making a series of small holes in the side of this tube next to the supply-pipe furnish jets of vapor which when ignited will not only serve to generate vapor within the supply-pipe but also to keep it sufficiently hot to prevent condensation therein.

I find the most economical and convenient form of injector plate to be the disk illustrated, either cylindrical or conical, so that it may be dropped into a cup like socket and readily held by a single thumb screw through the center, and as readily removed for the purpose of cleaning, &c.; and as illustrated in Figs. 4 and 5, the edges of the injector plate socket may project a little above the plate so as to catch and hold any small amount of liquid which might be thrown out. Another benefit in making the injector plate in the form of a disk to fit into a socket rather than a cap to fit over the end of a supply pipe is that in the event of leak of gas at the joints it will be directed upward into the mixing chamber rather than out horizontally or downward where it would escape unconsumed into the room.

Referring to the drawings accompanying this specification, Figure 1 is an elevation of my improvements attached to a vapor stove, with the burner and its attached parts; the injector, portions of the burner supply-pipe and the heat conducting jacket therefor, shown in section. Fig. 2 is a plan view of the injector plate showing a series of jet orifices. Fig. 3 is a plan of the top of the burner and the grate to which it is attached. Fig. 4 is a sectional elevation on line *x*—*x* Fig. 3. Fig. 5 is an elevation of the liquid reservoir, the supply-pipe leading therefrom, the oil lamp for generating gas, the heat retaining

casing, the burner with modified form of injector plate and mixing chamber, the casing and parts mentioned thereafter being in section. Fig. 6 is an elevation of a supply tank and pipe with heat casing in section, and showing the supply-pipe extended above the injector outlets. Fig. 7 is an end elevation of the supply tank, with its filling spout and connection with the safety valve, looked at from the right of the position shown in Fig. 1. Fig. 8 is a plan view of the same parts as shown in Fig. 7.

Indicating the same or similar part of the apparatus by the same letter or figure wherever shown in the drawings, the several parts are designated as follows, to-wit:

A is the frame of the stove; B, the grate resting upon the top of the stove; T, the liquid reservoir or supply tank; *s*, the portion of the supply-pipe between the tank and the vapor generator; *s'*, the perpendicular portion of the supply-pipe between the generator and the horizontal part of the supply-pipe; s^2, the horizontal part of the supply-pipe beneath the burners; G, the generator of gas placed at the lower end of the perpendicular portion *s'*, of the supply-pipe; *g* the outlet of the feed tube for the gas jet of the generator in Fig. 1.

In Fig. 5 the generator flame is supplied by an oil lamp. *f*, is the generator feed tube; C, is the heat retaining or conducting casing or jacket around the vapor generator, supply-pipe and generator feed tube; *c* is the gauze or perforated metal safety cover over the bottom of said casing which surrounds the vapor generator; *c'* is the open opposite end of the heat jacket which leads into a hot air chamber D; *b* are the frusto-conical rings which constitute my improved burner; *b'* in Fig. 3, the ribs or lugs which separate the rings *b*; *d* the screw which holds the rings *b* to the grate B; E, the dish shaped disk which constitutes the mixing chamber for the burner and is held to the outer rim thereof by screws 2; *e*, the tubular projection extending downward from said disk over the separable vapor injector plate H, which latter is held in a dish shaped socket I by a clamping screw *i*.

In Fig. 4, K is a screw with a hand wheel, which operates the valve to control the flow of vapor from the supply-pipe to the chamber beneath the vapor injector plate. The vapor injector, the horizontal portion s^2 of the supply-pipe and its surrounding heat casing are held to the frame of the stove by bent arms *a*; and to prevent heat from being readily conducted from the heat casing through the arms *a* I may form small projections on the casing where the arms rest upon it and place a washer of some non-conducting substance under the heads of the screws 3, by which they are fastened together; *h*, are the jet orifices in the injector plate; the number of such orifices shown being six, the proper number for use when the portion *s*, of the supply-pipe is six inches long.

In Fig. 5, a modified form of conical injector plate or plug is designated H'; E, being the outer casing and E' the inner shell which define the passage for the vapor to the mixing chamber of the burner; *l* is the plug of the safety valve working in the end of the horizontal portion s^2 of supply-pipe; M is the filling spout of the tank which is seated and swivels in the projecting part *m* of the tank; N is the fixed guard or cover, for the mouth of the filling spout, provided with a stop *u*, for the spout when it is swung beneath the guard; *n* is an arm projecting from the spout in a direction opposite to its mouth and connected with the valve stem by a screw 4 working in the slot *o* in a metal piece *p* at the end of the valve stem, *l*.

In Fig. 6, Q is the loop of the supply-pipe extending above the level of the injector outlets; which form might be used under certain conditions; but I prefer the arrangement illustrated in Fig. 1. The heat retaining casing over the loop Q should have a small hole in the top to create a circulation therein.

When a gas jet is employed for the flame which supplies heat to convert into vapor the liquid in the perpendicular portion *s'* of the supply-pipe, and it is desired to start the stove, I place a small annular dish *r* near the bottom of that portion of the supply-pipe, and obtain the requisite heat with alcohol ignited therein. As soon as the supply-pipe above the dish *r* has been filled with vapor it will also follow down and fill the feed tube *f* and escape into the lower part of the casing C, where it will be ignited by the flame in dish *r* and thus furnish heat for generating vapor in the supply-pipe when the alcohol in the dish *r* has been consumed. When the valve stem *l* is in the position shown in Fig. 1 the mouth of the filling spout M will be beneath the guard N and both the supply-pipe *s'* and the tube *f* will be open into the horizontal portion s^2 of the supply-pipe. When the filling spout M is pulled from beneath the guard N as indicated by dotted lines in Fig. 8, the valve stem *l*, will have been pushed into the portion s^2 of the supply-pipe and thus close the upper end of the portion *s'* and also that of the tube *f*. The supply of vapor to the generator flame being thus cut off the flame will be extinguished and will cease to generate vapor in the portion *s'* of the supply-pipe, and at the same time the supply of vapor to the burner being thus cut off the flame will be extinguished so that there will be no possibility of accident from fire caused by gas arising from liquid spilled during the process of filling the tank. And even when the generator flame is burning the wire gauze *c* which covers the opening in the casing surrounding the generator will prevent that flame from communicating fire to any gas which might be formed from liquid spilled upon the floor.

I claim—

1. In a vapor burning stove, the combination of a burner supply-conduit leading from

a fuel reservoir which is located below the highest part of said conduit, said reservoir and conduit containing liquid normally in equilibrium, a vapor generator applied to said conduit below the normal level of the liquid therein and an injector plate for the burner provided with a plurality of outlets, substantially as described.

2. The combination of a Bunsen burner having a plurality of jet openings for vapor; a supply reservoir for liquid at atmospheric pressure, located below the plane of the jet openings; a conduit leading from said reservoir to the jet openings and a heater for vaporizing liquid, applied to said conduit between the reservoir and jet openings, substantially as described.

3. In a vapor-burning stove, the combination of a Bunsen burner a feed pipe between the burner and a reservoir situated entirely below the highest point of said pipe and in which the liquid is normally in equilibrium with that in the pipe and a heater to vaporize liquid in said pipe, and thereby produce pressure upon the vapor by destroying said equilibrium substantially as described, and for the purpose specified.

4. In combination with a vapor burning stove, an independent generator of vapor applied to the burner supply-pipe below the level of the liquid in the supply tank, a generator feed tube leading from the said supply-pipe above the generator, and a heat conducting casing surrounding the said supply-pipe, generator and its feed tube, substantially as described.

5. In a vapor burning stove, the combination of a vapor generator applied to the burner supply-pipe below the level of the liquid in the supply tank and a heat conducting tube which surrounds the said supply-pipe and generator and terminates in a heating chamber connected with the stove, substantially as described.

6. In combination with a vapor burning stove, a supply tank provided with a swiveling filling spout, a fixed guard or cover for the mouth of said spout, a safety valve and mechanism substantially as described to connect the said valve and spout, whereby the removal of the mouth of the spout from beneath its guard will close the said valve and cut off the supply of gas and the return of the spout beneath the guard will open the said valve, substantially as described.

7. In a vapor burning stove, the combination of a Bunsen burner and injector plate H, having a plurality of jet openings, a socket I, for said plate, beneath the burner, and a screw, as *i*, to readily secure the plate in said socket or release it therefrom substantially as described.

8. In a vapor burning stove, the combination of a liquid reservoir situated lower than the jet outlets a liquid conduit between the reservoir and injector, an injector-plate having a plurality of openings, and a Bunsen burner composed of a series of concentric frusto-conical rings to concentrate the flow of gas substantially as described.

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