No. 687,075. Patented Nov. 19, 1901.

H. F. SMITH.

VAPOR BURNER.

(Application filed July 1, 1901.)

(No Model.) 7 Sheets—Sheet 1.

Fig. 1.

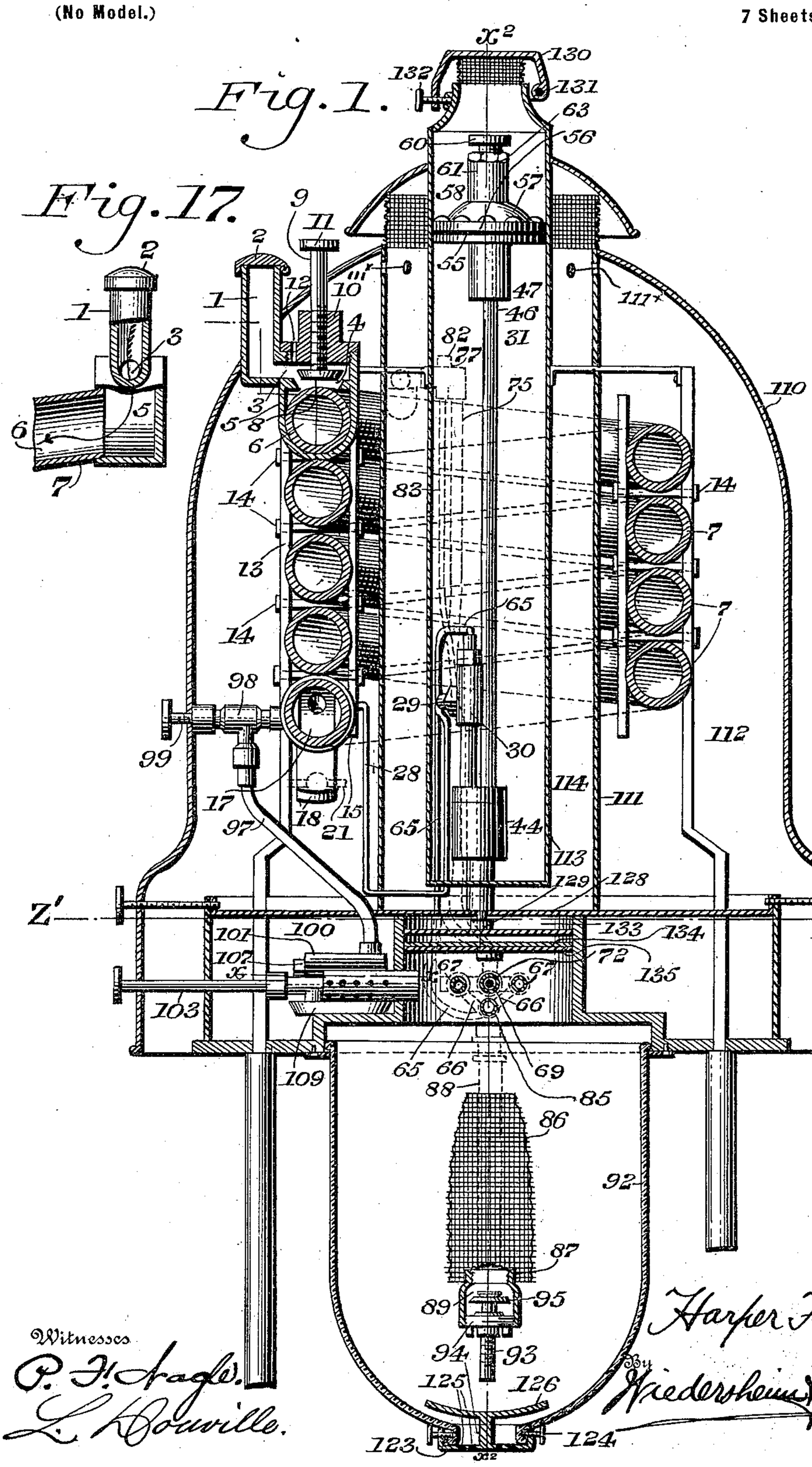


Fig. 17.

Witnesses
P. H. Eagle.
L. Bouville.

Inventor
Harper F. Smith.
By Wiedersheim & Fairbanks
Attorneys

No. 687,075. Patented Nov. 19, 1901.

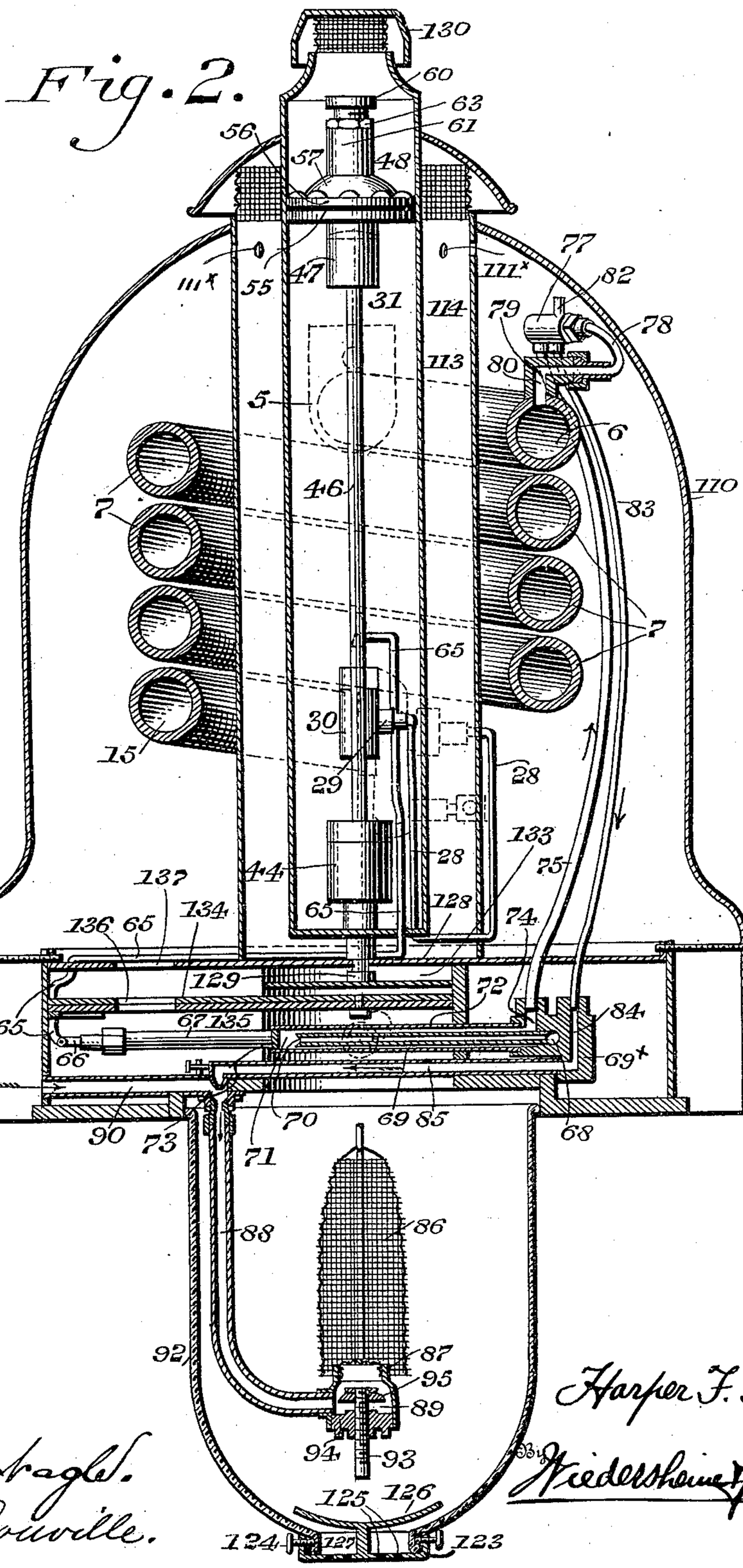
H. F. SMITH.

VAPOR BURNER.

(Application filed July 1, 1901.)

(No Model.) 7 Sheets—Sheet 2.

Fig. 2.



Witnesses

P. H. Nagle.

L. Bouville.

Inventor

Harper F. Smith.

By Wiedelsheim & Fairbanks

Attorneys

No. 687,075 Patented Nov. 19, 1901.

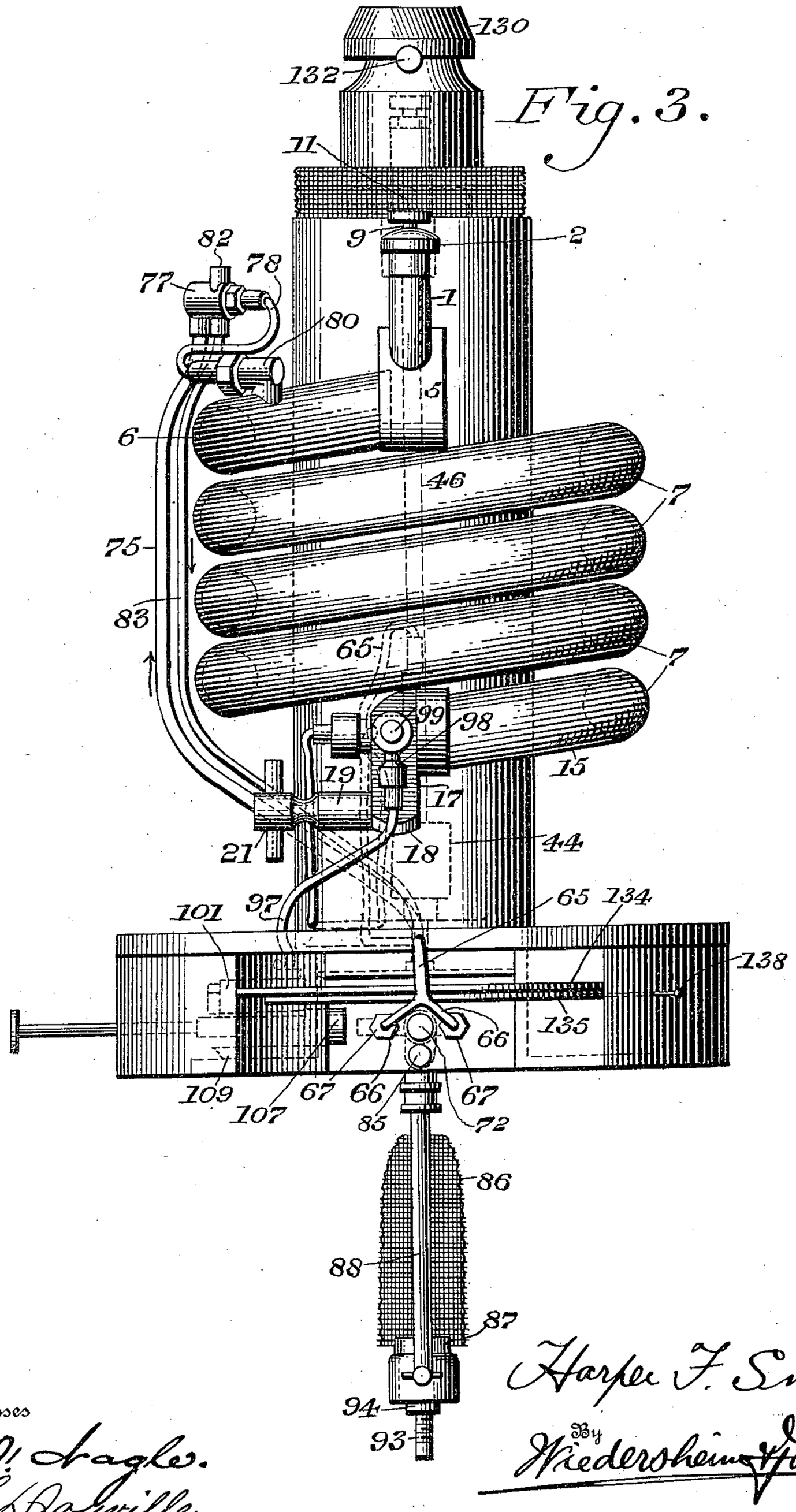
H. F. SMITH.

VAPOR BURNER.

(Application filed July 1, 1901.)

(No Model.) 7 Sheets—Sheet 3.

Fig. 3.



Witnesses

P. J. Eagles.

L. Dolville.

Inventor

Harper F. Smith.

By Wiedersheim & Fairbanks

Attorneys

No. 687,075. Patented Nov. 19, 1901.

H. F. SMITH.

VAPOR BURNER.

(Application filed July 1, 1901.)

(No Model.) 7 Sheets—Sheet 4.

Fig. 12.

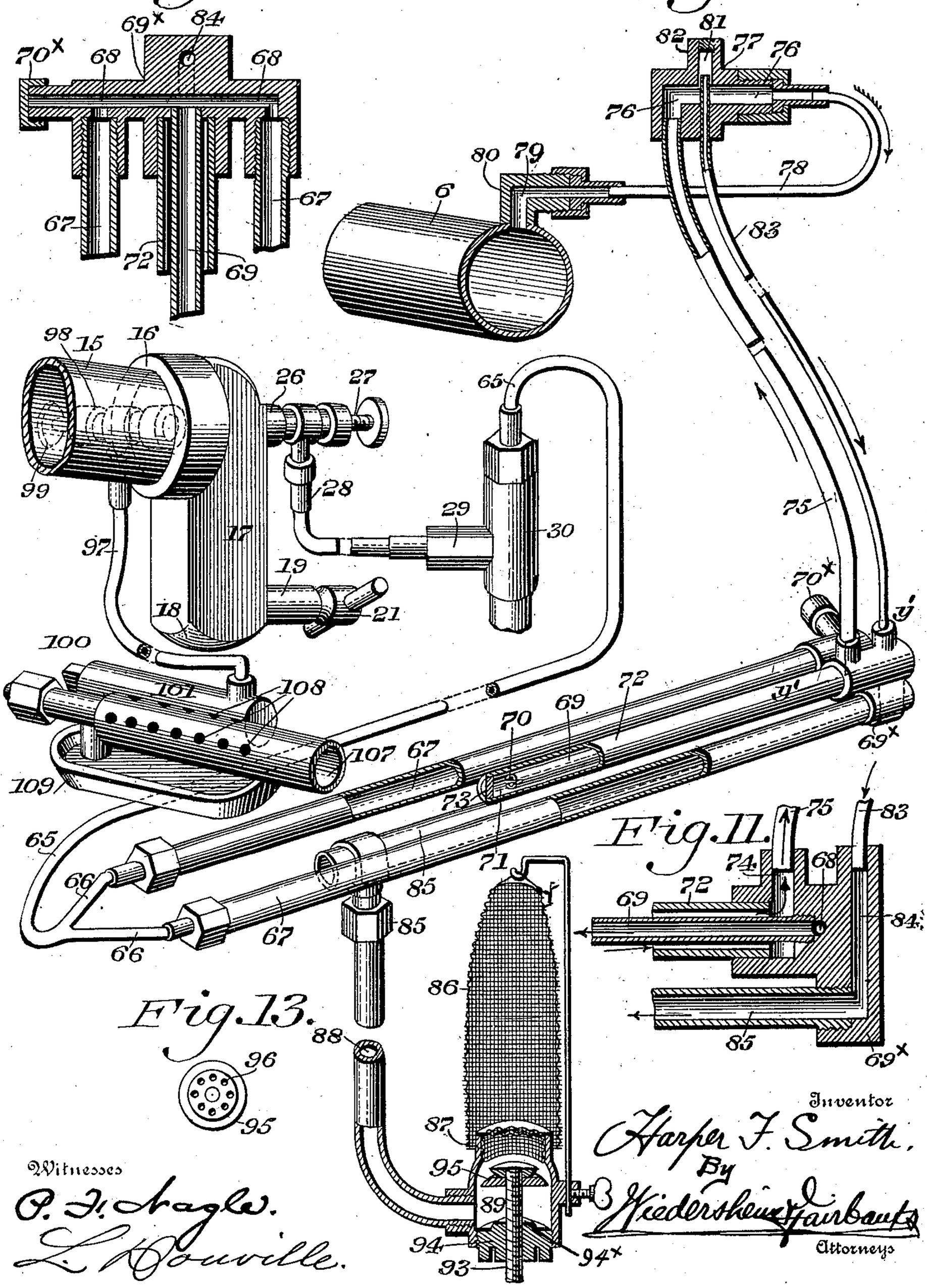


Fig. 4.

Fig. 11.

Fig. 13.

Witnesses

P. J. Nagle.

L. Bouville.

Inventor

Harper F. Smith,

By Wiederhein & Fairbanks

Attorneys

No. 687,075. Patented Nov. 19, 1901.

H. F. SMITH.

VAPOR BURNER.

(Application filed July 1, 1901.)

(No Model.) 7 Sheets—Sheet 5.

Fig. 14.

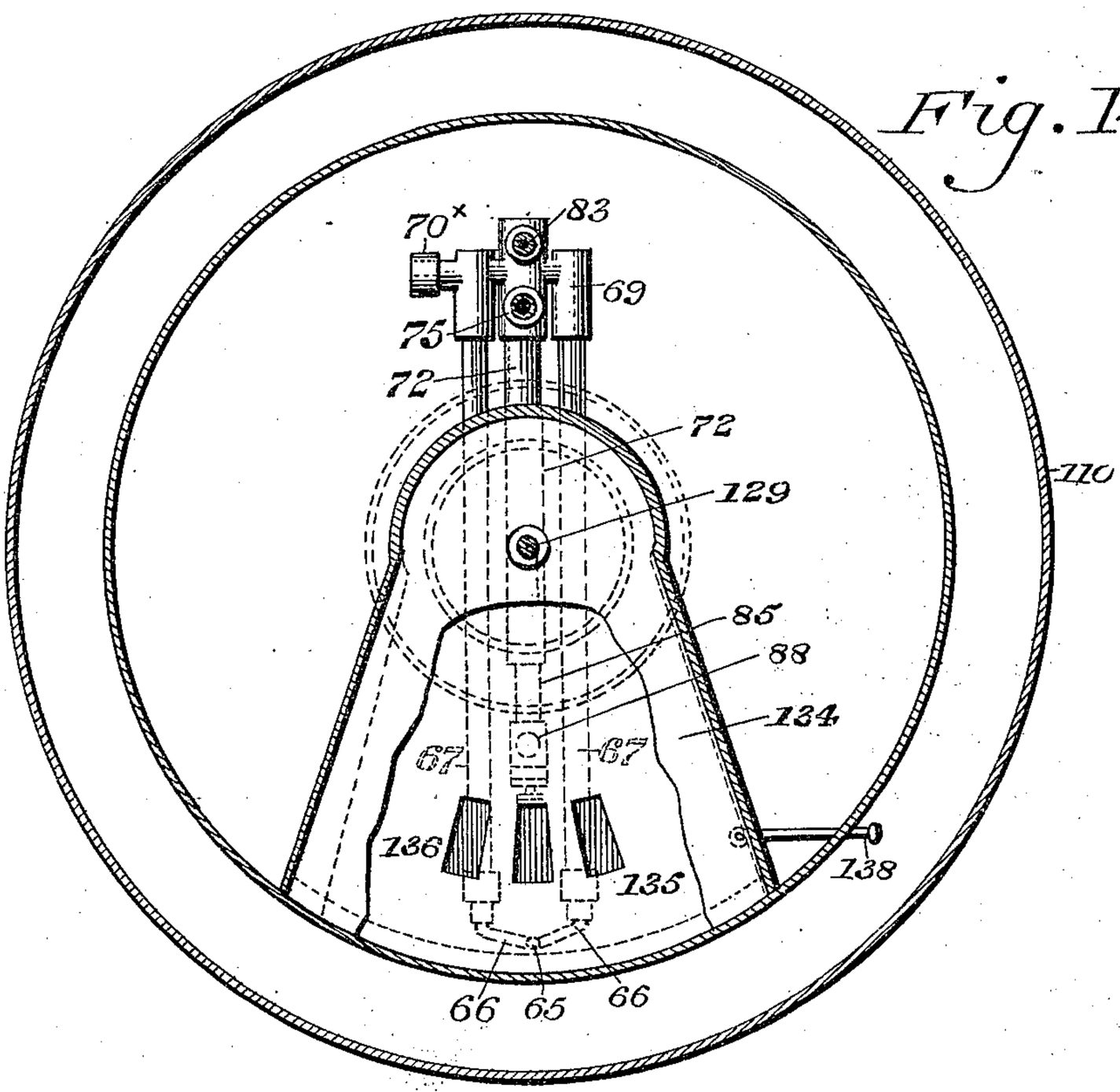


Fig. 5.

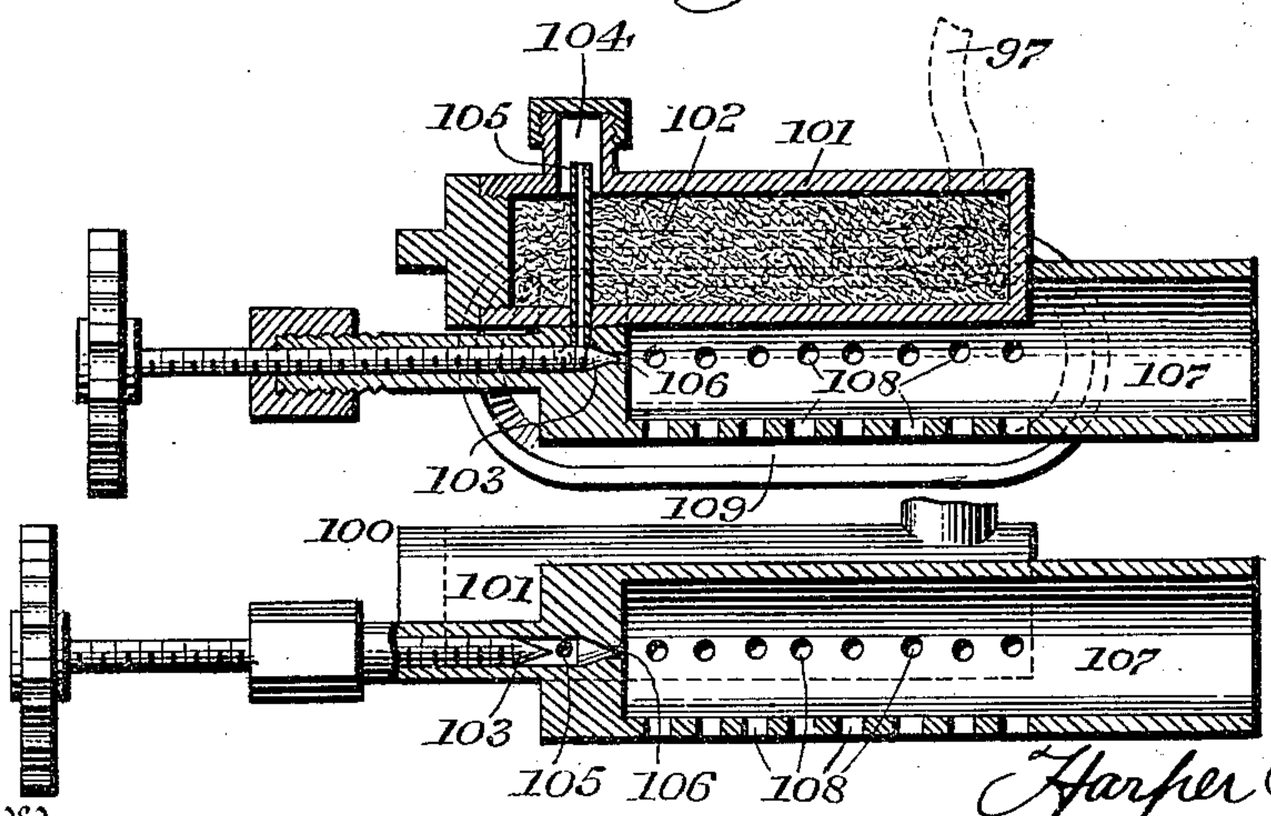


Fig. 6

Witnesses
P. F. Eagle.
L. Bouville

Inventor
Harper F. Smith.
By Wiedersheim & Fairbanks
Attorneys

No. 687,075. Patented Nov. 19, 1901.

H. F. SMITH.

VAPOR BURNER.

(Application filed July 1, 1901.)

(No Model.) 7 Sheets—Sheet 6.

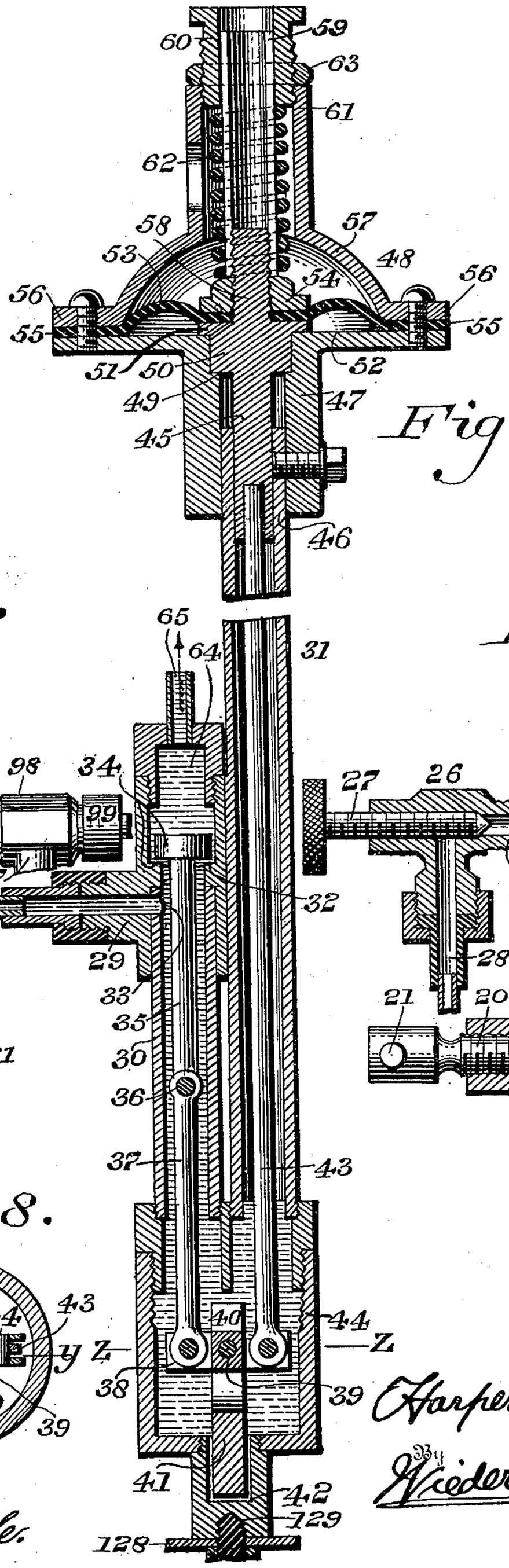


Fig. 7.

Fig. 10.

Fig. 9.

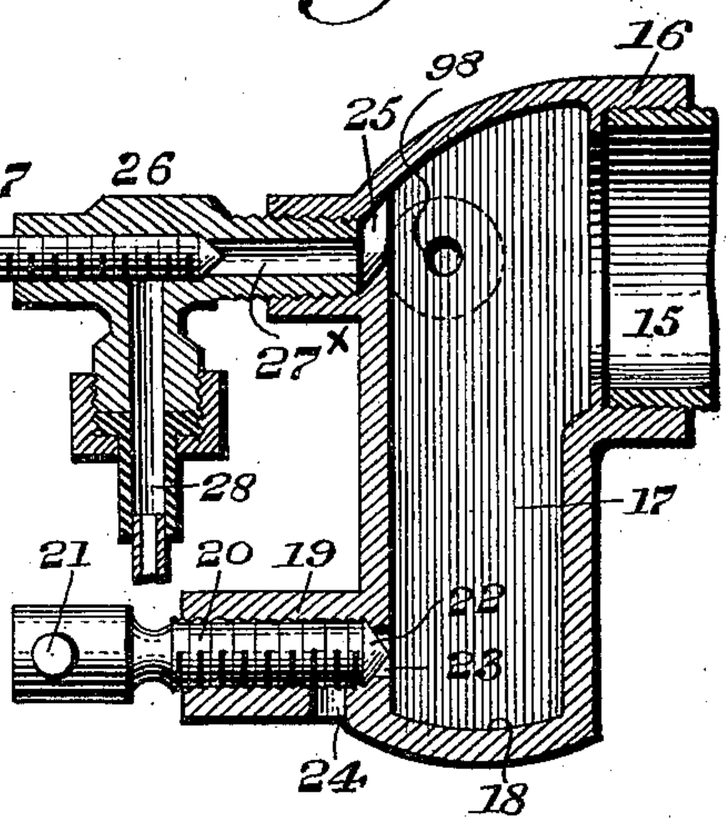


Fig. 8.

Witnesses
P. J. Hagle.
L. Bouville.

Inventor
Harper F. Smith.
By Wiedersheim & Laubach
Attorneys

No. 687,075. Patented Nov. 19, 1901.

H. F. SMITH.

VAPOR BURNER.

(Application filed July 1, 1901.)

(No Model.) 7 Sheets—Sheet 7.

Fig. 15.

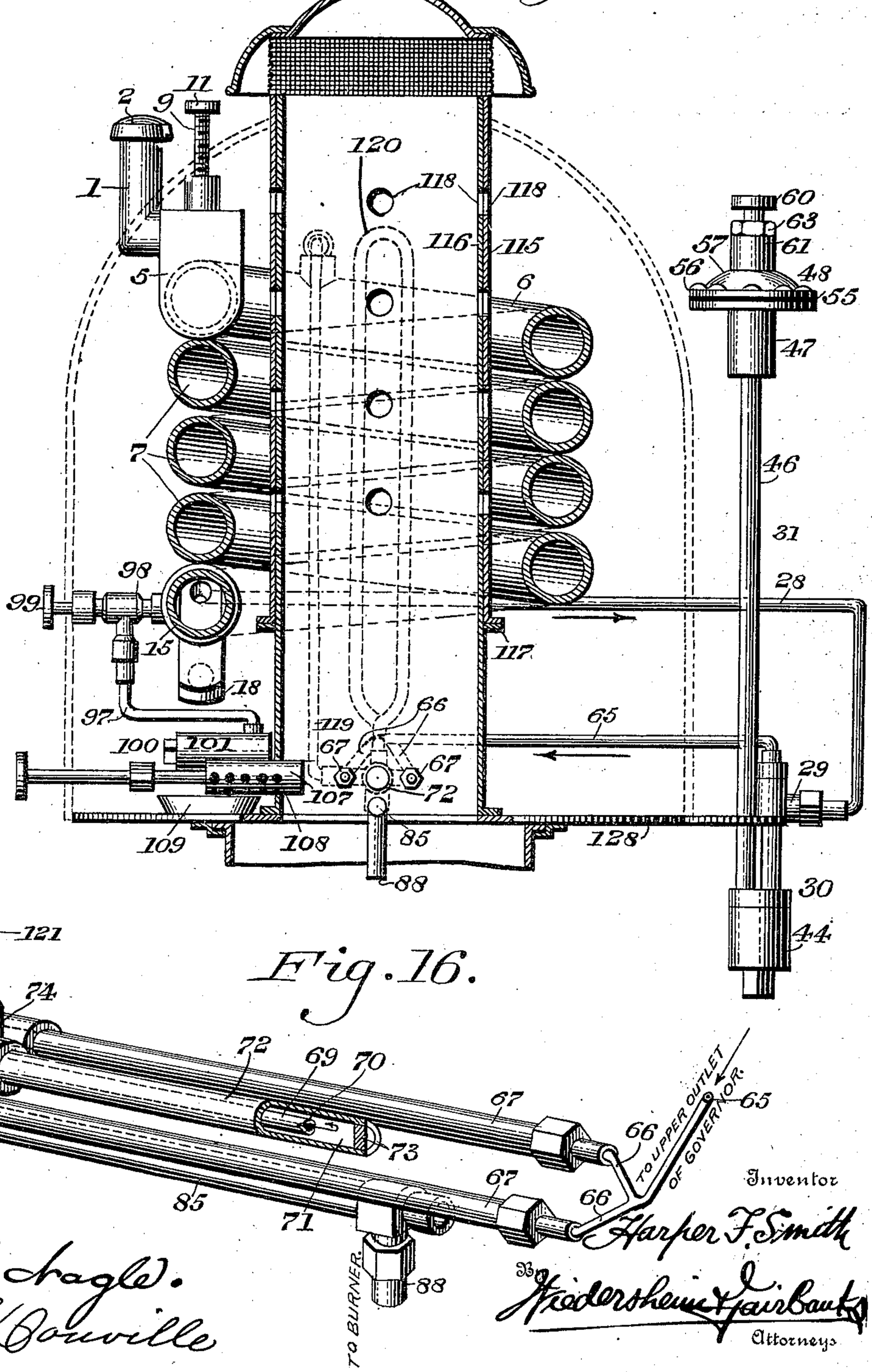


Fig. 16.

Witnesses
P. H. Eagle.
L. L. Bonville

Inventor
Harper F. Smith
By Fredershein & Fairbanks
Attorneys

UNITED STATES PATENT OFFICE.

HARPER F. SMITH, OF PHILADELPHIA, PENNSYLVANIA.

VAPOR-BURNER.

SPECIFICATION forming part of Letters Patent No. 687,075, dated November 19, 1901.

Application filed July 1, 1901. Serial No. 66,650. (No model.)

To all whom it may concern:

Be it known that I, HARPER F. SMITH, a citizen of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented a new and useful Improvement in Vapor-Burners, of which the following is a specification.

My invention relates to incandescent hydrocarbon-burners; and my object is to improve vapor-burners of this character in various particulars.

To the above end I provide my novel construction of burner with a reservoir consisting of a coil and a novel construction of valve which is attached to the upper end of the coil or reservoir and is so constructed as to permit of the pouring of the hydrocarbon very rapidly into said coil by reason of the vent being in proximity to the filling-cap, which latter acts as a seal and prevents any foreign or extraneous matter from entering the filling-chamber.

Another feature of my invention is a novel construction and location of the drip-chamber, which communicates with the lower end of the coil-reservoir above described, said drip-chamber being adapted to receive and retain any extraneous or foreign matter that might pass by the filling-valve, said drip-chamber also acting as a feeder to the starter and to the vaporizing devices.

Another feature of my invention is an improved construction of a vaporizer which receives the hydrocarbon, said vaporizer permitting of the vaporization, the heating, and expansion of the vapor as it passes to the desired point.

Another feature of my invention is a novel construction of a burner which has an internal disk, either perforated or solid, and capable of being readily adjusted or set in any desired position, whereby the outlet-space is either increased or diminished by the adjustment of said disk, which may be moved to or from the walls of the burner, the function of said disk being twofold and serving, first, to regulate the supply of air to the perforated outlet of the burner, and, second, to reduce the extreme violence of the pressure which arises in the mixing-tube, thereby permitting the vapor to pass through the outlet of the burner with less force than it passes through the mixing-chamber, owing to the check or resistance said vapor receives by its contact with said disk or regulator, thereby insuring and prolonging the life of the mantle.

Another feature of my invention is the provision of a heating-chamber attained by surrounding the reservoir-coil by an external hood or casing, which also incloses an inner wall which is located within said coil, whereby a heating-chamber for the latter is created.

It further consists of other novel details of construction, all as will be hereinafter fully set forth, and particularly pointed out in the claims.

Figure 1 represents a vertical sectional view of a vapor-burner embodying my invention, certain of the parts being shown in elevation. Fig. 2 represents a vertical section on line $x^2\ x^2$, Fig. 1. Fig. 3 represents a side elevation of the apparatus seen in Figs. 1 and 2, the outer casing being removed. Fig. 4 represents a diagrammatic view showing the general relative position of the lower extremity of the hydrocarbon coil-reservoir, drip-chamber, governor, starting device, vaporizing devices, and their adjuncts. Fig. 5 represents, on an enlarged scale, a horizontal sectional view of the starter, the same being taken on line $x\ x$, Fig. 1. Fig. 6 represents a vertical sectional view of the starter, the section-line being taken on a different plane. Fig. 7 represents, on an enlarged scale, a vertical sectional view of a governor employed, the section being taken on line $y\ y$, Fig. 8. Fig. 8 represents a section on line $z\ z$, Fig. 7. Fig. 9 represents a vertical sectional view of the drip-chamber and its adjuncts, the section being taken on line $x'\ x'$, Fig. 10. Fig. 10 represents an end elevation of the drip-chamber seen in Fig. 9. Fig. 11 represents, on an enlarged scale, a section on line $y'\ y'$, Fig. 4. Fig. 12 represents a horizontal sectional view showing the relative positions of the parts seen at the right of Figs. 4 and 11. Fig. 13 represents a plan view of a perforated disk which may be employed within the burner, if desired. Fig. 14 represents a sectional view on line $z'\ z'$, Fig. 1. Fig. 15 represents a vertical sectional view, partly in elevation, of another embodiment of the principle of my invention. Fig. 16 rep-

resents a perspective view of the generator, supergenerator, and superheater employed in the structure seen in Fig. 15. Fig. 17 represents a sectional view showing the upper portion of the coil-reservoir and its adjuncts.

Similar numerals of reference indicate corresponding parts in the figures.

Referring to the drawings in describing my invention, I shall for convenience refer in detail to the filling-valve, coil-reservoir, drip-chamber, governor, vaporizing devices, burner, and starting device in substantially the order named.

The hydrocarbon, which may be either gasolene or any other of the lighter or heavier petroleum products, is first poured into the pipe 1, which has the cap or cover 2 hinged or otherwise secured thereto. The hydrocarbon flows down through the opening 3, valve-seat 4, and chamber 5 into the upper convolution 6 of the reservoir 7. The valve-seat 4 is adapted to be closed by the valve 8, which is carried by the stem 9, which is in threaded engagement with the plug 10, said stem being provided with a head or finger piece 11, whereby the valve 8 can be readily manipulated.

12 designates a port or vent whereby air is admitted into the space above the valve 8. The convolutions of the coil or reservoir 7 are supported in position by means of the rods 13, which are held in place by the bolts or other fastening devices 14, although it will of course be understood that other supporting devices may be employed without departing from the spirit of my invention.

It will be seen from the foregoing that the coil or reservoir 7 serves as a receiver for the hydrocarbon, and since it is provided with a large surface it permits of the heating of the hydrocarbon before it passes into the vaporizing devices below; secondly, the coil or reservoir reduces the surface of the hydrocarbon upon which the pressure, hereinafter referred to, lies; thirdly, the coil is of such form that but a small portion of vapor is required to maintain a pressure, and, fourthly, as the hydrocarbon is gradually consumed the coil above the oil-level retains its heat and causes the highly-heated vapor to retain its aeriform state and with the additional supply of vapor to maintain a pressure on the oil to the point of ultimate consumption. It will also be seen that the construction of the filling device is such as to permit of the pouring of the liquid very rapidly into the coil 7, since the outlet from the filling device leads directly to said coil, while the filling-cap acts as a seal and serves to prevent any foreign or extraneous matter from entering the filling-chamber, and it will be apparent that when the valve 8 is seated the inlet to the upper portion of the coil or reservoir is effectively sealed. The lower portion or convolution 15 of the coil 7 leads to the threaded portion 16 of the drip-chamber 17, which is provided with a base or bottom 18, which receives and retains any extraneous or foreign matter which might have passed the filling-valve 8.

19 designates an internally-threaded boss projecting from the lower part of the drip-chamber and having therein the threaded stem 20, which is provided with the head or finger piece 21, whereby said stem 20 can be readily manipulated, it being noted that the extremity 22 of said stem serves as a flush-valve and controls the port 23, wherefrom it will be apparent that when the stem or flush-valve is screwed outwardly or to the left of the position seen in Fig. 9 a communication is formed between the ports 22 and 24. It will be seen from the foregoing that since the drip-chamber receives all of the hydrocarbon previous to its distribution to the starting device and vaporizing devices, to be hereinafter referred to, any foreign matter in the hydrocarbon must settle to the bottom 18 of the drip-chamber, and consequently upon opening the flush-valve 22 any sediment at the lower end of the drip-chamber will escape therefrom.

25 designates a port at the upper portion of the drip-chamber 17, whereby a communication is had with the fitting 26, which has the valve 27 therein, said valve controlling the flow of the hydrocarbon from the passage $27^{\times}$ to the pipe 28, which leads to the inlet-boss 29 of the member 30 of the governor or governing device 31.

The construction of the governor will be best understood from the enlarged view seen in Figs. 7 and 8, where it will be seen that the part 30 is a hollow cylindrical or tubular chamber having the valve-seat 32 located above the inlet-port 33 in the boss 29.

34 designates a valve which is adapted to seat downwardly and is secured to the valve-stem 35, which is pivotally connected at 36 to the rod 37, which is pivotally connected to the rocking lever 38, which is fulcrumed at the point 39 in ears 40 to a suitable support, as 41, which is located in the seat 42 below the seal-chamber 44.

43 designates a rod having its lower extremity pivotally attached to the extremity of the lever 38 on the opposite side of the fulcrum 39, the upper portion of said rod 43 engaging the plunger 45, whose lower portion is adapted to move in the upper portion of the casing 46, to which is secured the lower member 47 of the diaphragm-chamber 48.

It will of course be understood that the support 41 fits sufficiently tightly in the seat 42, so that when the rod 43 rises the support 41 binds in its seat, and is thus prevented from improper disengagement therefrom.

49 designates a shoulder in the member 48, upon which the bottom of the head 50 is adapted to rest when the parts are in the position seen in Fig. 7.

51 designates a flange carried by the head 50 and adapted to rest upon the inner wall 52 of the upper member 47.

53 designates a diaphragm the middle portion of which is held upon a flange 51 by means of the nut 54, while the outer portion 55 of said diaphragm is retained between the lower wall of the flange 52 and the flange 56 of the upper member 57 of the diaphragm-chamber 48.

58 designates a threaded stem projecting upwardly from the head 50 and provided with a tubular extension 59, the upper portion of which latter is contained within the hollow screw or nut 60, which is in threaded engagement with the extension 61, within which is contained the spring 62, the lower portion of which latter contacts with the nut 54, while the upper portion of said spring contacts with the lower extremity of the upper screw or nut 60, which latter is held in position by means of the lock-nut 63. It will thus be seen from the foregoing that by manipulating the screw or nut 60 the tension of the regulating-spring 62 can be delicately adjusted according to the required pressure desired.

64 designates an outlet-chamber in the governor, which is located above the valve 34, said outlet-chamber communicating with the pipe 65, which leads to the branches 66, which conduct the hydrocarbon to the pipes 67, which in the present instance are two in number and are arranged substantially parallel to each other, as will be understood from Fig. 4. The extremities of the pipe 67, which constitute the generator, discharge into the passage 68 of the fitting $69^{\times}$, the extremity of the passage 68 being provided with the closure or cap $70^{\times}$ or other equivalent device. The hydrocarbon-vapor passes from the passage 68 (best seen in Figs. 2, 11, and 12) into the inner pipe 69, as will be understood from said figures, the vapor passing through the outlet 70 into the chamber 71 in the extremity of the supergenerator 72, which is of greater diameter and has its end closed by the plug 73, the vapor passing backwardly around the exterior of the pipe 69 into the chamber 74, (best seen in Figs. 2 and 11,) and thence upwardly through the pipe 75 into the chamber 76 of the fitting 77, a portion of the vapor passing outwardly through the passage 76, through the pipe 78, and thence to the passage 79 of the fitting 80 to the upper convolution 6 of the coil or reservoir 7, as will be best understood from the upper portions of Figs. 2 and 4.

The fitting 77 has a chamber 81 formed within the extension 82, with which communicates the extremity of the pipe 83, which leads downwardly to the passage 84 of the fitting $69^{\times}$, the vapor passing from said passage 84 through the superheater 85, it being understood that I designate the pipe 72 and the inner concentric pipe 69 as a "supergenerator," wherefrom it will be seen that a vapor of very high tension is produced by the employment of the vaporizer composed of the generator 67, the supergenerator, and the superheater, the latter being located in relatively close proximity to the mantle 86 of the burner 87, so as to receive the whole impact of the heat therefrom. The highly-heated vapor after passing through the superheater 85 passes downwardly through the pipe 88 to the chamber 89 of the burner 87, comprising a tubular body portion having a closed base and having an inlet-port for the pipe 88 in the side of said body portion, it being understood that said pipe 88 serves as a commingling-tube for the vapor and air, the latter being drawn in through the pipe 90, which communicates with the air-chamber 91, said commingling-tube being contained within the shade 92, of glass or other similar material.

93 designates a threaded stem passing through the lower portion 94 of the burner and having attached thereto a disk 95, which may be solid, as seen in Figs. 1, 2, and 4, or, if desired, said disk may be provided with the perforations 96, as seen in Fig. 13. The base portion of said burner is provided with an elevated portion $94^{\times}$, which serves to normally hold said disk slightly above the inlet-port in the side of the burner portion. It will thus be seen from the foregoing, reference being had to the governor and vaporizing devices above described in detail, that the governor controls the flow of oil to the vaporizing devices and also automatically governs the supply of the pressure to the coil. The hydrocarbon after leaving the drip-chamber enters the governor below its valve 34 by means of the port 33 and fills the seal-chamber 44 of the governor, the latter being the chamber containing the lower extremity of the rods 37 and 43, (seen in Fig. 7,) said hydrocarbon after the governor is sealed passing to the vaporizing devices when the valve 34 permits.

It will be understood that the hydrocarbon passing to the governor is held in the sealed chamber in the lower portion thereof by the air-cushion contained in the pipe 46, so that when the pressure becomes unduly raised the hydrocarbon from the seal-chamber 44 is forced into the air-cushion chamber, which in turn forces the air against the under or pressure surface of the diaphragm 53, whereby said diaphragm is raised against the tension of the regulating-spring 62, said spring being readily regulated, as has been explained, whereby the exact tension and resistance desired can be attained. The rod 43, connected to the diaphragm 53, passes through the air-cushion chamber to the seal-chamber in the lower portion of the governor and is connected therewith by a suitable joint through the intermediate connections to the valve 34, whereby the latter opens and closes in accord with the action of the diaphragm.

I have found after various experiments that the best results are obtained in governing devices for lamps of this character by constructing the governor with the seal in the lower portion thereof and the air-cushion located above said seal, whereby the oil is prevented from ever coming in contact with the

diaphragm by reason of the existence of said air-cushion between the hydrocarbon-seal and the diaphragm, which materially prolongs the life of the diaphragm, since the same would be liable to rot or disintegrate if ever subjected directly to the action of the oil or hydrocarbon.

By reason of the length of the vaporizing-passages the vapor in its travel through said passages is exposed to a maximum degree to the heat, and by reason of the arrangement of the vapor being carried through the connections 75, 76, 81, and 83, which are located above the level of the hydrocarbon in the reservoir, it is impossible for the oil to flow into the superheater 85.

By the construction of the fitting situated above the coil-level vapor is distributed in a positive manner to the tubular connections which lead to the coil and to the superheater, it being apparent that the tubular connection leading to said superheater in said fitting, as seen at the upper right-hand portion of Fig. 4, is above the level of the passage in said fitting leading to the coil 7.

The tubular connection 75, leading from the fitting $69^{\times}$ to the fitting 77, conveys the vapor upwardly from the vaporizing devices and thence downwardly through the pipe 83 to the pipe 85, wherein said vapor is expanded and superheated before passing to the outlet leading to the mixing or commingling tube 88.

By the employment of the disk 95 within the burner 89 it will be seen that I can either increase or diminish the distance from the top of the disk to the outlet of the burner by adjusting said disk upwardly or downwardly, whereby it is brought nearer to or farther from the walls of the burner. The function of this disk is twofold, since the same serves, first, to control and regulate the supply of air to the mixing-chamber, and, secondly, it permits the gas to pass through the outlet-perforations of the burner with less force than it passes through said mixing-chamber or commingling-tube, owing to the check said gas receives by its impact with the disk or regulator, thereby insuring the life of the mantle.

The space between the mixing-tube and the disk forms a chamber into which the gas from the mixing-tube flows and deploys itself uniformly around the circumference of the disk 96 or through such perforations 96 in the disk of the character seen in Fig. 13.

The operation of the starter will next be explained, reference being had to the pipe 97, leading from the fitting 98, which is secured to the drip-chamber 17, said fitting being provided with a valve 99, whereby the flow of hydrocarbon from the drip-chamber to the starting device 100 is adjusted according to requirements, the details of the construction of the starter being best understood from the enlarged views seen in Figs. 5 and 6. A portion of the hydrocarbon flows down the pipe 97 into the chamber 101, which is filled with asbestos or other suitable absorbent material 102. A sufficient quantity of hydrocarbon having been received in the chamber 101, the valve 99 is closed, and the valve 103 being unseated it will be seen that a portion of the hydrocarbon can flow from the chamber 104 through the connection 105, thence through the port 106 into the blast-chamber 107, and thence through the openings 108 to the pan 109 below, which being ignited creates a vapor in the absorbent-chamber 101, which vapor is conducted to the blast-chamber 107, which is perforated to admit sufficient air to create a blue flame of great heat and intensity. After exhausting the vaporized fluid of the absorbent-chamber the burner or starter is extinguished. The capacity of the starter is so regulated that the flame which impinges against the generator is of sufficient strength to so heat the generator and place the lamp in condition to heat the gas in the mantle below it, which continues the vaporization in constant and uniform regularity. The coil or reservoir 7 is surrounded by a head or covering 110, which incloses the entire apparatus, said reservoir being contained within said head 110 and the wall 111, whereby a heating-chamber 112 is formed in which said coil is located, it being of course understood that the heat ascends through the space under said coil. The governor when situated in the center of the lamp is insulated by being inclosed within the wall 113, which surrounds said governor, and the air-passage 114 is formed between the walls 111 and 113. In the construction seen in Fig. 15 I have placed the governor at one side of the lamp instead of in the center thereof, the hydrocarbon being conducted through the inlet-boss 29 of the governor by the pipe 28, as already described, and the requisite quantity of hydrocarbon being conducted to the vaporizing devices by the pipe 65 in the manner already explained. In the construction seen in Fig. 15, however, I have shown a heat-chamber occupying the center of the lamp, which latter is provided with the adjustable concentric tubes 115 and 116, the outer tube 115 being supported upon the ledge or flange 117, and both of said tubes being provided with the perforations 118, which are adapted to be in alinement when the parts are in the position seen in Fig. 15. It will be apparent that when the parts are in the position seen the heat which ascends in the center of the lamp can pass into, out of the top, and through the sides of the tubes 115 and 116, through the openings 118 therein, whereby the heat may be regulated and caused to play against all sides of the coil 7, if so desired, it being understood that the outer of said tubes is rotatively supported, or, if desired, the inner tube can be adapted to rotate.

In the modified construction of burner seen in Figs. 15 and 16 I may connect with the fitting $69^{\times}$ the pipe 119, which is led to the

upper convolution of the coil-reservoir, it of course being understood that the cap 70× (seen in Figs. 4 and 12) has been removed, so that the connection between the pipe 119 and the passage 68 will be readily made. In the construction seen in Fig. 16 I employ the fitting 69×, constructed as seen in Figs. 11 and 12, but connect the passages 74 and 84, as seen in Fig. 11, by means of the loop or similar connection 120, it being of course understood that the hydrocarbon vaporized in the tube 67 on the side where the cap is used passes through the tube 119 therefrom direct to the top of the coil and there forms the pressure, while part of the hydrocarbon passes through the other pipe 67, opposite or on the other side from the capped pipe 67, into the passage 68, and thence through the inner tube 69 of the superheater, and thence backwardly on the outside of said tube 69 or inside of tube 72 to the passage 74, and thence upwardly over the top of the coil through the loop 120 to the chamber 84, and thence through the regenerator 85 and commingling-tube 88 to the burner, as already explained.

The advantage of having the tubular connection 120 extend above the coil 7, as seen in Fig. 15, is that being beyond the hydrocarbon-level said hydrocarbon cannot at any time find its way to the regenerator 85 and flood the burner. I prefer, however, in practice to use the method by which the same vaporization forms the pressure directly upon the oil and the burner, as has been already described in detail.

In practice I close the lower portion of the shade 92 with the cap 123, which is secured in position by the screws 124 and has the perforations 125 therethrough, through which air flows to the lower portion of the shade and is deflected by the plate 126, which is supported on the post 127, whereby breakage of the shade 92 is prevented. The governor may be supported in any desired manner upon the plate 128, located in the lower portion of the hot-air-chamber, as by means of a screw or bolt 129, as seen in Fig. 7, although it will be apparent that other supporting means may be employed, if desired. The chamber within the walls 113 which contain the governor is closed at its top by the cap 130, which is hinged at the point 131 and held in position by the screw 132.

133 designates an air-chamber below the plate 128, below which chamber are located the plates 134 and 135, which have openings 136 therethrough whereby when the parts are in the position seen in Fig. 2 heat can pass upwardly through the openings 136 and 137, one of said plates being movable and adjusted according to requirements by the handle 138.

It will be seen that the removable cap 130 (best seen in the upper part of Fig. 1) permits of the manipulation of the regulating-screw 60, which controls the pressure of the governor without removing the lamp from its fixed position. It will also be seen that an air-chamber is formed above the plate 134 and below the chamber 133, thus completing the insulation of the bottom of the governor and preventing the action of the heat upon the seal-chamber of the governor.

In starting the lamp sufficient oil descends by gravity to the generator 67, so that when the starting device 100 is operated such oil is vaporized and is carried to the burners and lighted, after which the vapor is generated in the generator by heat from the burners, the supply of oil being kept up by the pressure of part of the vapor generated, such pressure acting through the oil on the governor to control the supply of oil to the generator.

No claim is made in this application to the governor or fluid-pressure regulator or the same in combination with other elements of the burner, as the same will form the subject-matter of a separate application filed by me October 31, 1901, Serial No. 80,628.

It will be understood that the upper portion of the wall 111 is in practice provided with the openings 111×, which permit the egress of the hot air from the chamber 112 to the exterior of the burner.

It will be apparent that various changes may be made by those skilled in the art which will come within the scope of my invention, and I do not therefore desire to be limited in every instance to the exact construction I have herein shown and described.

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

1. In a vapor-burner, a reservoir composed of a coil, a filling device having a passage leading therefrom into said coil, a valve in said passage through which the hydrocarbon flows to said coil, a cover for said filling device, and means for admitting air to the space above the valve.

2. In a vapor-burner, a coil adapted to serve as a reservoir for the hydrocarbon, a plurality of upright rods located on either side of the convolutions of said coil, fastening devices common to said rods and passing between the convolutions of said coil whereby the latter is supported, a drip-chamber in communication with the lower convolutions of said coil, and a connection from said drip-chamber to the burner proper.

3. In a vapor-burner, a filling device comprising an angularly-shaped body with filling-opening, a cover therefor, a chamber into which said filling device discharges, a valve controlling the flow of the hydrocarbon to said chamber, means for admitting air into the space above the valve, a coil serving as a reservoir for the hydrocarbon, a drip-chamber in communication with the lower part of said coil, a burner and vaporizing devices intermediate said drip-chamber and burner.

4. In a vapor-burner, a filling device comprising a pipe with filling-opening, a cover therefor, a valve controlling the flow of the hydrocarbon from said filling device, a coil

serving as a reservoir for the hydrocarbon, a drip-chamber in communication with the lower part of said coil, a burner and vaporizing devices intermediate said drip-chamber and burner.

5. In a vapor-burner, a central heat-chamber, a reservoir comprising coils surrounding said heat-chamber, a drip-chamber communicating with said reservoir, vaporizing devices supplied from said drip-chamber, and a burner arranged below said vaporizing devices and heat-chamber.

6. In a vapor-burner, the combination of a reservoir for the reception of the hydrocarbon, means for supporting said reservoir, the latter being composed of a coil subjected to the action of the heat generated by the burner, a drip-chamber into which the lower convolution of said coil discharges, a flush-valve located in proximity to the bottom of said drip-chamber, a vapor-generator, a connection from the upper portion of said drip-chamber leading to said vapor-generator, a starting device located to heat said vapor-generator, a connection from said drip-chamber to said starting device, and a burner supplied from the generator.

7. In a vapor-burner, the combination of a reservoir in the form of a coil, means for supporting said reservoir, a drip-chamber, into which the lower convolution of the said coil discharges, a valve controlling the discharge of sediment and extraneous matter in the bottom of said drip-chamber, a starting device, a valved connection leading from the upper part of said drip-chamber to said starting device, a vaporizer located in position to be heated by said starting device and supplied from said drip-chamber, and a burner supplied from and arranged below said vaporizer.

8. In a vapor-burner, the combination of a coil adapted to serve as a reservoir, a drip-chamber into which all of said hydrocarbon is discharged and received, a vaporizing device, a connection leading from the upper portion of said drip-chamber to said vaporizing device, a starting device located in proximity to said vaporizing device, a connection leading from the drip-chamber to said starting device, a burner arranged below said vaporizing device, and a connection from said vaporizing device to said burner.

9. In a vapor-burner, vaporizing devices comprising a plurality of tubes, a fitting having a passage into which said tubes discharge, a tube projecting from said fitting and communicating with said passage and having a discharge-port at its outer end, a larger tube engaging said fitting and inclosing said last-mentioned tube, said fitting being provided with a second passage into which said larger tube discharges, a second fitting having a passage, a connection from the second passage in the first fitting to the passage in said second fitting, a tube leading from the latter to said first-mentioned fitting, a tube projecting from the latter and located so as to be subjected to heat of the burner, and a connection from said last-mentioned tube to said burner.

10. In a vapor-burner, the combination of a generator, comprising a plurality of pipes, a fitting into which said pipes discharge, and having a passage in communication with said pipes, an inner pipe into which said passage discharges, an outer pipe inclosing said pipe, said fitting having a chamber into which said outer pipe discharges, a second fitting having a chamber, a pipe leading from said chamber in the first fitting into the chamber of the second fitting, a pipe leading downwardly from said chamber in the second fitting to a passage in the first fitting, a pipe leading from said fitting, said last-mentioned pipe serving as a superheater, a burner located below said superheater, a pipe leading from the latter to the burner, and a reservoir, said second fitting being located above the highest possible level of oil in the reservoir.

11. In a vapor-burner, the combination of a generator comprising a plurality of pipes, a fitting into which said pipes discharge, and having a passage in communication with said pipes, an inner pipe into which said passage discharges, an outer pipe inclosing said pipe, said fitting having a chamber into which said outer pipe discharges, a second fitting having a chamber, a pipe leading from said chamber in the first fitting into the chamber of the second fitting, a pipe leading downwardly from said chamber in the second fitting to a passage in the first fitting, a pipe leading from said fitting, said last-mentioned pipe serving as a superheater, a burner located below said superheater, a pipe leading from the latter to the burner, and a reservoir in the form of a coil, said second fitting being located above the highest possible level of oil in the reservoir.

12. In a vapor-burner, the combination of a generator comprising a plurality of pipes, a fitting into which said pipes discharge, and having a passage in communication with said pipes, an inner pipe into which said passage discharges, an outer pipe inclosing said pipe, said fitting having a chamber into which said outer pipe discharges, a second fitting having a chamber, a pipe leading from said chamber in the first fitting into the chamber of the second fitting, a pipe leading downwardly from said chamber in the second fitting to a passage in the first fitting, a pipe leading from said first fitting, said last-mentioned pipe serving as a superheater, a burner located below the vaporizer and in such position that the hot gases from the burner ascend within the coils of the reservoir, a pipe leading from the burner to said superheater, and a reservoir in the form of a coil, said second fitting being located above the highest possible level of oil in the reservoir.

13. In a vapor-burner, the combination of a generator comprising a plurality of pipes, a

fitting into which said pipes discharge, a passage in said fitting in communication with said pipes, an inner pipe into which said passage discharges, an outer pipe inclosing said pipe, a chamber in said fitting into which said outer pipe discharges, a second fitting, a pipe leading from said chamber into a chamber of the second fitting, a pipe leading downwardly from said chamber in said second fitting to a passage in the first fitting, a pipe leading from said latter passage in the first fitting and serving as a superheater, a burner located below said superheater, and a pipe leading from the latter to said burner, combined with a reservoir in which the hydrocarbon is primarily received, a connection from said reservoir to said generator, and a connection from the chamber of the second fitting to the upper portion of said reservoir, whereby a vapor-pressure is maintained in said reservoir for feeding the hydrocarbon into said generator.

14. In a vapor-burner, the combination of a generator comprising a plurality of pipes, a fitting having a passage into which said pipes discharge, an inner pipe into which said passage discharges, an outer pipe inclosing said pipe, a chamber in said fitting into which said outer pipe discharges, a second fitting, a pipe leading from said chamber into a chamber in the second fitting, a pipe leading from said first fitting and serving as a superheater, a pipe leading downwardly from the chamber in the second fitting and connected to said superheater, a burner located below said superheater, a pipe leading from the latter to the burner, a reservoir in which the hydrocarbon is primarily received, a connection from said reservoir to said generator, a connection from the chamber of the second fitting to the upper portion of the said reservoir above the highest possible level of the oil therein, and a drip-chamber into which the lower portion of the reservoir discharges.

15. In a vapor-burner, vaporizing devices comprising a plurality of tubes, a fitting having a passage into which said tubes discharge, said passage being extended to one side and having a removable closure, a tube projecting from said fitting and communicating with said passage and having a discharge-port at its outer end, a larger pipe engaging said fitting and inclosing said last-mentioned pipe, said fitting being provided with a second passage, and a connection from the second passage in said fitting to said last-mentioned pipe and a pipe provided with a vapor-jet orifice attached to said fitting in communication with said second passage.

16. In a vapor-burner, a reservoir for the hydrocarbon, means for transforming the latter into a vapor, said means comprising a generator composed of a plurality of tubes, a fitting in which the extremities of said tubes are received, a supergenerator supported by said fitting and comprising a plurality of concentric tubes, a superheater also projecting from said fitting, a burner located directly under said superheater, a hot-air chamber, a commingling-pipe leading from said superheater to said burner, and means for conducting the air from said hot-air chamber to said commingling-pipe.

17. In a vapor-burner, a reservoir for the hydrocarbon, comprising a coil, a drip-chamber in communication with the lower extremity of said coil, a generator comprising a plurality of tubes each connected to a supply-pipe leading from said drip-chamber, a fitting having a first passage into which the ends of said tubes discharge, a supergenerator comprising tubes one within the other attached to said fitting, said inner tube leading from said inner passage and said fitting having a second passage in communication with the outer tube, a superheater-tube attached to said fitting and having a vapor-jet orifice and means for conveying a portion of the vapor from the second passage in the fitting to the upper portion of the coil and the remainder of said vapor to said superheater, a burner and a commingling-tube affording a connection from said superheater to said burner.

18. In a vapor-burner, a reservoir for the hydrocarbon consisting of a coil, a drip-chamber in communication with the lower extremity of said coil, a generator comprising a plurality of tubes each connected to a supply-pipe leading from said drip-chamber, a fitting having a first passage into which the ends of said tubes discharge, a supergenerator comprising tubes one within the other attached to said fitting, said inner tube leading from said inner passage and said fitting having a second passage in communication with the outer tube, a superheater-tube attached to said fitting and having a vapor-jet orifice and means for conveying a portion of the vapor from the second passage in the fitting to the upper portion of the coil and the remainder of said vapor to said superheater, a burner and a commingling-tube leading from said superheater to said burner, in combination with a hot-air chamber located above said burner and a connection leading from said hot-air chamber to the commingling-tube between said superheater and burner, whereby the gas and air are thoroughly commingled prior to their admission to said burner.

19. In a vapor-burner, the combination of a generator, a supergenerator, and a superheater having a jet-orifice, a fitting for supporting and connecting said parts, a hot-air chamber, a burner, means for supplying hydrocarbon to said generator, a commingling-tube leading from said superheater to said burner, and a connection from said hot-air chamber to said commingling-tube.

20. The combination of a generator, a supergenerator, a superheater, a hot-air chamber, a burner, means for supplying hydrocarbon to said generator, a commingling-pipe leading from said superheater, to said burner, and

a connection from said hot-air chamber to said commingling-pipe, in combination with a threaded stem passing through the bottom of said burner and a disk carried by said stem and adapted to be moved toward or away from the top of the burner so as to enlarge or decrease the chamber in which the commingled air and vapor is initially received.

21. The combination of a generator, a superheater, a hot-air chamber, a burner, means for supplying hydrocarbon to said generator, a commingling-pipe leading from said superheater to said burner, and a connection from said hot-air chamber to said commingling-pipe, in combination with a threaded stem passing through the bottom of said burner, and a perforated disk carried by said stem and adapted to be moved toward or away from the top of the burner so as to enlarge or decrease the chamber in which the commingled air and vapor is initially received.

22. The combination of a vapor-burner, a hot-air chamber located above the same, vaporizing devices located above said burner, a commingling-pipe for the hot air and vapor leading to said burner, a mantle carried by the latter, a threaded stem passing through the lower portion of said burner, and a disk carried by said stem and adapted to be adjusted relatively to the inlet to said burner, whereby the force of the incoming vapor and air can be checked and the life of the mantle thereby prolonged.

23. In a vapor-burner, a fitting, a plurality of pipes connected to said fitting and arranged to receive oil from the oil-supply, concentric pipes connected to said fitting and arranged to provide a space between the two, and a pipe projecting from said fitting below said concentric pipes and provided with a vapor-discharge jet-opening.

24. In a vapor-burner, a fitting, a plurality of pipes connected thereto and arranged to receive oil from the oil-supply, concentric pipes connected to said fitting and arranged to provide a space between the two, a pipe projecting from said fitting below said concentric pipes and provided with a vapor-discharge jet-opening, and a starter arranged to receive oil from the oil-supply and to heat said vaporizer.

25. In a vapor-burner, a fitting, a plurality of pipes connected thereto and arranged to receive oil from the oil-supply, concentric pipes connected to said fitting and arranged to provide a space between the two, a pipe projecting from said fitting below said concentric pipes and provided with a vapor-discharge jet-opening, a starter arranged to receive oil from the oil-supply and to heat said vaporizer, a drip-chamber and a reservoir discharging into said drip-chamber, and a plurality of pipes connected to said drip-chamber to receive oil therefrom and supply the same to said starter and vaporizer.

26. A reservoir provided with a drip-chamber, a vaporizer, a starter comprising a chamber adapted to contain absorbent material, a second chamber connected to said first chamber, a blast-chamber connected to said second chamber and a valve controlling said connection between the blast and second chambers, and valved connections leading from said drip-chamber to said vaporizer and starting device, said starting device being located to heat said vaporizer.

27. A reservoir in the form of a coil, a drip-chamber connected to the lower convolution of said coil, a vaporizer, a starter comprising a chamber adapted to contain absorbent material, a second chamber connected to said first chamber, a blast-chamber connected to said second chamber, a valve controlling said connection between the blast and second chambers, a valved connection leading from said drip-chamber to said vaporizer and a valved connection leading from said drip-chamber to the starting device, said starting device being located to heat said vaporizer.

28. The combination of a vapor-burner, a glass shade inclosing said burner and having an opening in the lower portion thereof, a perforated cap for said opening, a post projecting upwardly from said cap, and a curved deflector-plate supported at its center on said post and above the opening in the bottom of the glass shade and extended beyond the edges of said opening.

29. In a vapor-burner, the combination of a hot-air chamber, a hydrocarbon-reservoir located therein, a drip-chamber into which said reservoir discharges, a starting device in communication with said drip-chamber, a burner, a pipe leading from said vaporizing devices to said burner, a central hot-air chamber and a cap mounted on the top of said central hot-air chamber.

30. The combination of a hydrocarbon-reservoir consisting of a coil, the latter being located within a hot-air chamber, a central hot-air chamber surrounded by said coil, a drip-chamber, a vapor-generator and a connection from said drip-chamber to said vapor-generator.

31. The combination of a hydrocarbon-reservoir consisting of a coil, the latter being located within a hot-air chamber, a central hot-air chamber surrounded by said coil, a vapor-generator, a connection from said drip-chamber to said vapor-generator, and a burner supported from said generator and located in position to heat said hot-air chambers and said vapor-generator.

32. In a vapor-burner, a reservoir for the hydrocarbon consisting of a coil, a vapor-generator, a valved connection between said vapor-generator and coil, said generator comprising a plurality of tubes receiving oil from said connection, a plurality of tubes, one within the other and a pipe located below said last-mentioned tubes provided with a vapor-jet

orifice, a commingling-tube, and a burner supplied from such commingling-tube and located to heat said generator.

33. In a vapor-burner, a reservoir comprising a coil, a vapor-generator comprising parallel pipes, a plurality of pipes one within the other located between said first pipes, a pipe located below said plurality of pipes and provided with a vapor-discharge opening and a fitting supporting said pipes and having passages connecting said pipes, a connection from the reservoir to said parallel pipes, a commingling-tube arranged to receive the discharge from said vapor-discharge opening, and a burner supplied by such tube and located in position to heat said vapor-generator.

34. In a vapor-burner, a reservoir comprising a coil, a vapor-generator comprising parallel pipes, a plurality of pipes one within the other located between said first pipes, a pipe located below said plurality of pipes and provided with a vapor-discharge opening and a fitting supporting said pipes and having passages connecting said pipes, a connection from the reservoir to said parallel pipes, a commingling-tube arranged to receive the discharge from said vapor-discharge opening, a burner supplied by such tube and located in position to heat said vapor-generator, and a connection leading from one of the passages in said fitting to the upper part of the coil.

35. In a vapor-burner, the combination of a reservoir, a hot-air chamber inclosing the same, a plate in the lower portion thereof having a port therethrough, a plurality of plates located below said first-mentioned plate and having openings therein, means for moving one of said plates, vaporizing devices located below said plates, means for conveying hydrocarbon to said vaporizing devices, a burner located below said vaporizing devices, and means for conveying vapor to said burner.

36. A burner consisting of a tubular body portion with a closed base, a commingling-tube leading into the side of said body portion, a threaded stem passing through said base, a disk secured to said stem to move therewith, whereby the chamber between the top of said disk and the top of the burner can be enlarged or diminished.

37. A burner consisting of a tubular body portion with a closed base, a commingling-tube leading into the side of said body portion, a threaded stem passing through said base, and a perforated disk secured to said stem to move therewith, whereby the chamber between the top of said disk and the top of the burner may be enlarged or diminished.

38. A burner having a tubular body portion having an inlet-port in the same and a closed base, a threaded stem passing through said base, a disk carried by said stem within said body portion and arranged to be always normally slightly above said inlet-port, whereby the chamber between the said inlet-port and the top of the burner can be increased or diminished according to requirements.

39. A burner having a tubular body portion having an inlet-port in the same and a closed base, a threaded stem passing through said base, and a perforated disk carried by said stem within the body portion and arranged to be always normally slightly above said inlet-port whereby the chamber between the said inlet-port and the top of the burner may be increased or diminished according to requirements.

40. In a vapor-burner, a reservoir, a vapor-generator comprising a generator receiving its supply from said reservoir, a supergenerator, a superheater and a connection from said supergenerator to said superheater, said connection having a portion extended above the highest possible level of oil in said reservoir.

41. In a vapor-burner, a reservoir, a vapor-generator comprising a generator receiving its supply from said reservoir, a supergenerator, a superheater and a connection from said supergenerator to said superheater, said supergenerator having one pipe within the other with a space between the two, and said connection having a portion extended above the highest possible level of oil in the said reservoir.

HARPER F. SMITH.

Witnesses:
E. HAYWARD FAIRBANKS,
C. D. MCVAY.