No. 759,034. PATENTED MAY 3, 1904.

H. F. SMITH.

VAPOR BURNER.

APPLICATION FILED APR. 30, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 2.

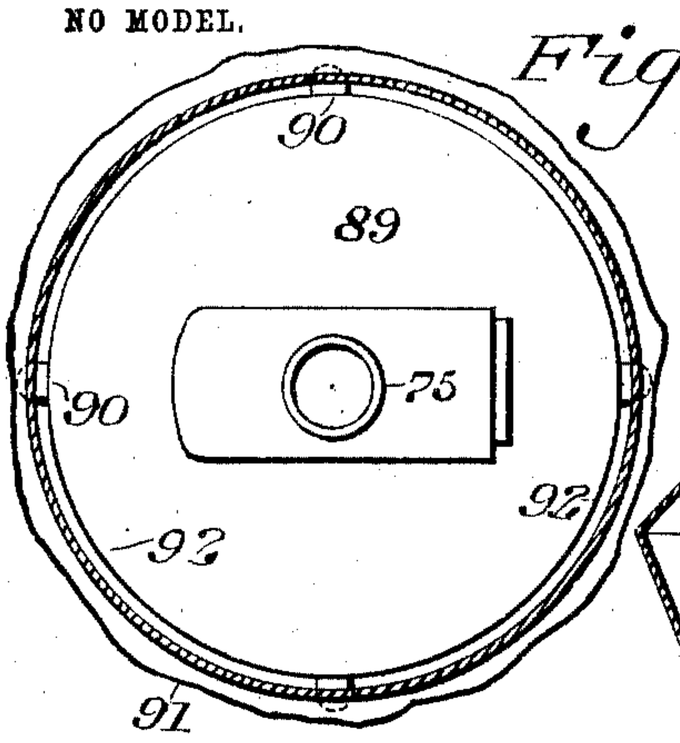

Fig. 1. Fig. 14.

Witnesses

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 11.

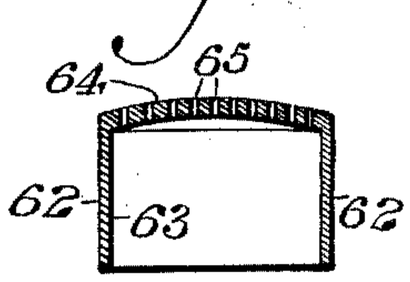
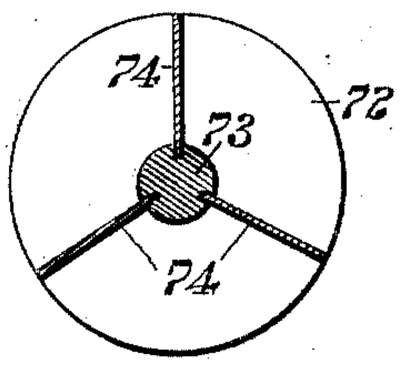


Fig. 12.

ON X²–X² FIG. 2.



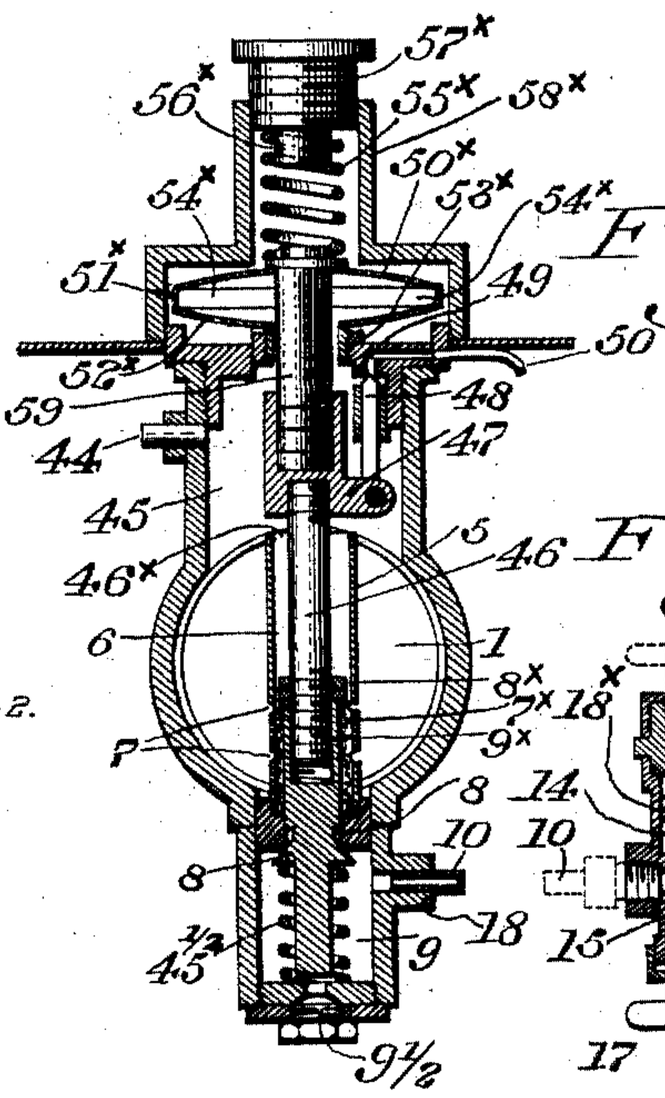


Fig. 15.

Fig. 17.

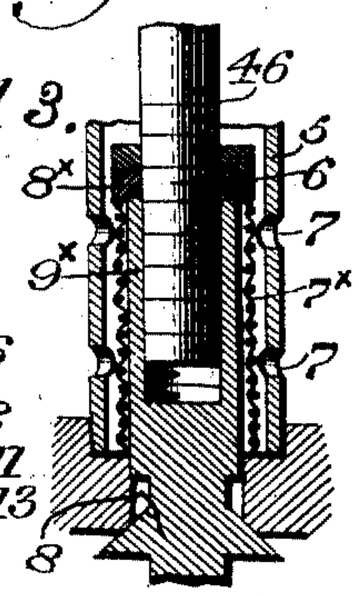


Fig. 13.

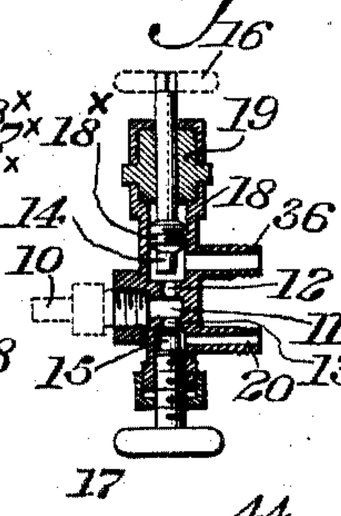


Fig. 3.

ON X–X FIG. 5.

Fig. 4.

ON Z–Z FIG. 3.

Fig. 5.

ON Y–Y FIG. 4.

Fig. 7.

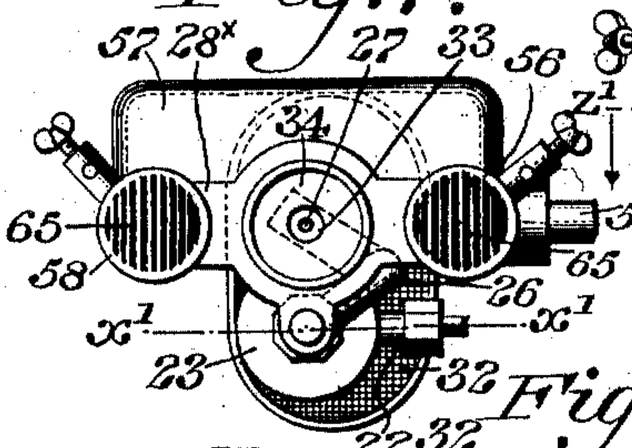


Fig. 6.

ON X¹–X¹ FIG. 8.

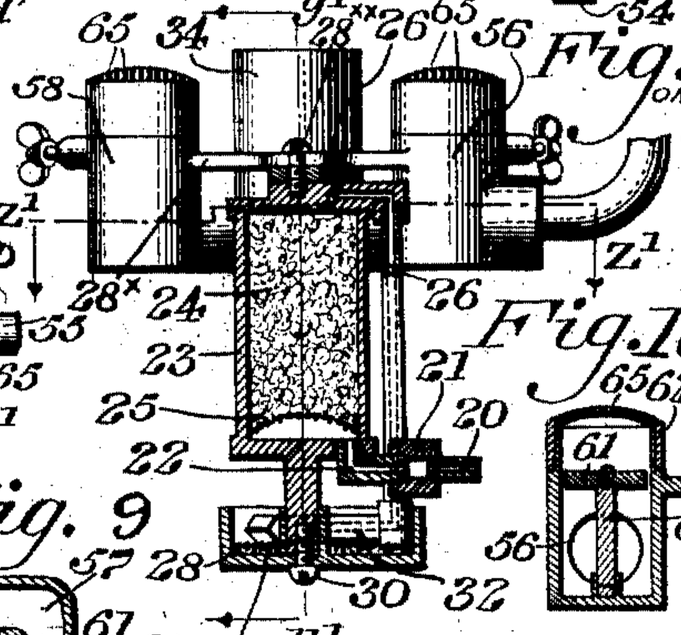


Fig. 10.

Fig. 8.

ON Y¹–Y¹ FIG. 7.

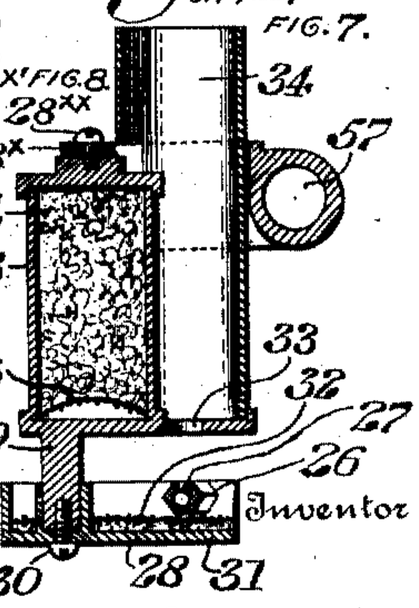
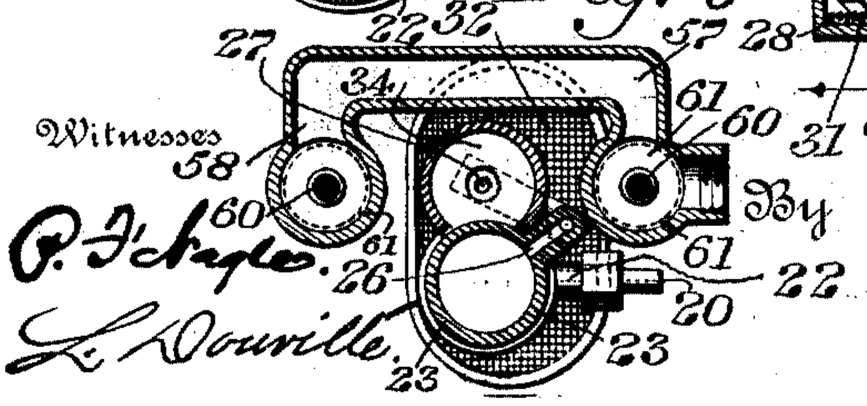


Fig. 9



Witnesses

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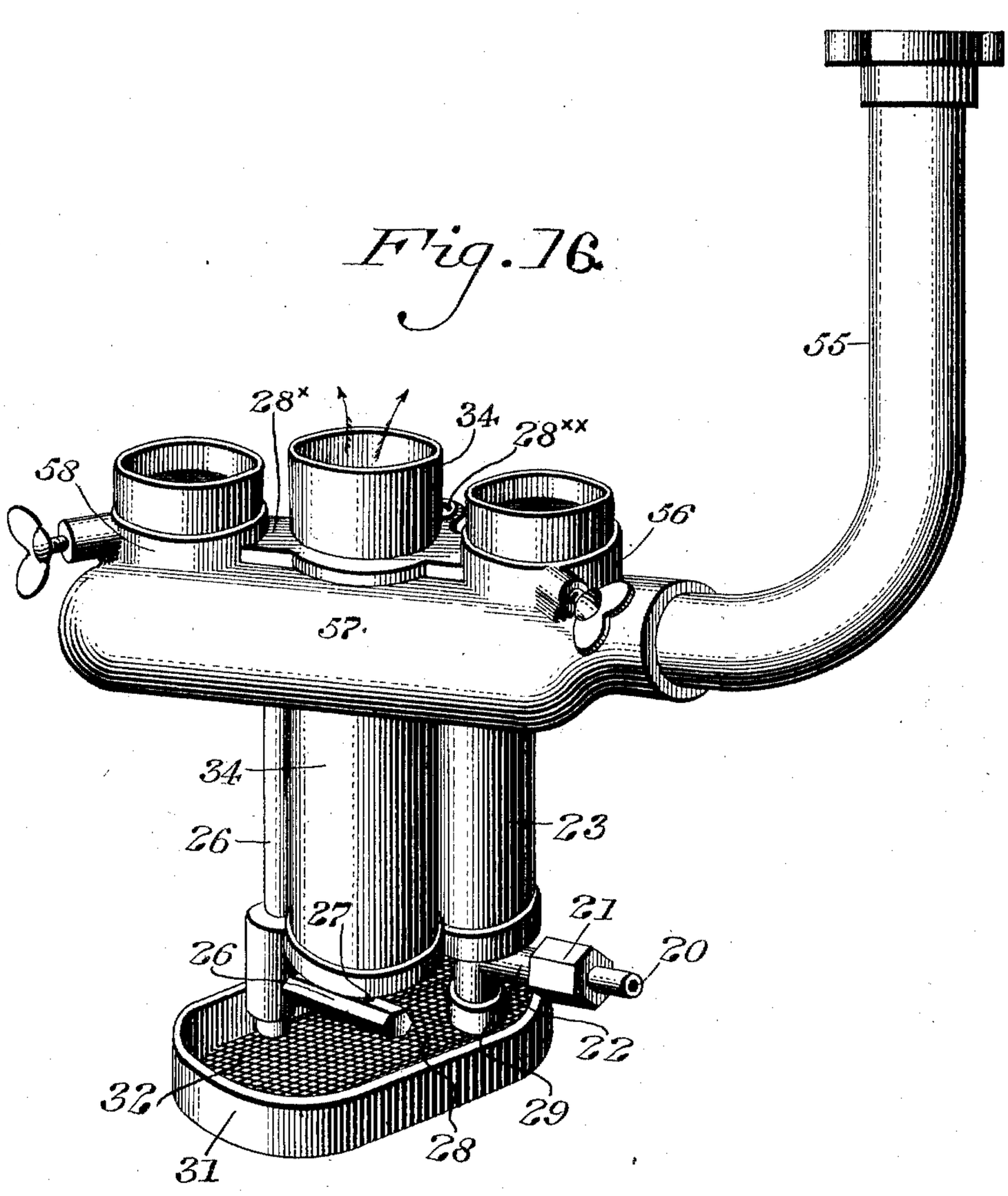
NO MODEL. 3 SHEETS—SHEET 3.

Fig. 16.



Witnesses

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No. 759,034. Patented May 3, 1904.

UNITED STATES PATENT OFFICE.

HARPER F. SMITH, OF PHILADELPHIA, PENNSYLVANIA.

VAPOR-BURNER.

SPECIFICATION forming part of Letters Patent No. 759,034, dated May 3, 1904.

Application filed April 30, 1903. Serial No. 154,970. (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 consists of a novel construction of a vapor-burner wherein the hydrocarbon is supplied thereto in a simple and effective manner and novel means are provided for regulating the supply of vapor, for starting the burner, and for preventing injurious drafts.

The invention further consists in other improved features, all as will be hereinafter fully set forth, and pointed out in the claims.

Figure 1 represents a vertical section of a vapor-burner embodying my invention. Fig. 2 represents a plan view, in detached position, of the air-intake for the burner, to be hereinafter referred to. Fig. 3 represents a sectional view of the generator employed, the section being taken on line $x\ x$, Fig. 4. Fig. 4 represents a section on line $z\ z$, Fig. 1. Fig. 5 represents a vertical sectional view of the regenerator, to be hereinafter referred to, the section being taken on line $y\ y$, Fig. 3. Fig. 6 represents a side elevation of the burner employed, a portion of the starting device coacting therewith being shown in section, the section being taken on line $x'\ x'$, Fig. 7. Fig. 7 represents a top plan view of the burners, starting device, and their adjuncts. Fig. 8 represents a section on line $y'\ y'$, Fig. 6. Fig. 9 represents a section on line $z'\ z'$, Fig. 6. Fig. 10 represents a vertical sectional view of one of the burners employed. Fig. 11 represents, on an enlarged scale, a sectional view of the burner-cap in detached position. Fig. 12 represents a sectional view of a deflecting device which is attached to the bottom of the globe, the section being taken on line $x^2\ x^2$, Fig. 1. Fig. 13 represents a longitudinal sectional view of the combination-valve employed to control the flow of fluid leading from the governor to the starting device and to the generator, to be hereinafter referred to. Fig. 14 represents a perspective view showing the supporting device for the lamps and their manner of attachment to the hot-air cylinder. Fig. 15 represents a vertical sectional view of the governor employed, the same being shown in detached position. Fig. 16 represents a perspective view of the starting device, burners, and their adjuncts. Fig. 17 represents a detail view of the lower governor-valve stem.

Similar numerals of reference indicate corresponding parts in the figures.

Referring to the drawings, the hydrocarbon or other fluid is supplied to the reservoir 1 through the tube 2 upon the removal therefrom of the screw-cap 3, (seen in Fig. 1,) it being understood that the reservoir 1 is in the present instance substantially annular in shape and is inclosed within a hood or casing 4, as will be understood from Fig. 1. The reservoir 1 having been filled, it will be understood that the oil or hydrocarbon will flow through the ports or strainer-holes 7 and through the strainer $7^{\times}$ into the space 6 within the tube 5 and thence down past the valve 8 into the chamber 9, having the removable drip-plug $9\frac{1}{2}$, and thence out the pipe 10 into the chamber 11, from which lead the ports 12 and 13, which are controlled by the valves 14 and 15, respectively, which are manipulated by the handles 16 and 17, which project outside of the casing 18. It will be understood that when the valve 14 is unseated and turned into its extreme position the threaded cone or rear portion $18^{\times}$ will seat itself against the plug 19, thereby forming an efficient seal and preventing leakage.

20 designates a pipe leading from the port 13 to the fitting 21 and discharging into the passage 22, which leads into the lower portion of the chamber 23, which is filled with suitable absorbent material 24, at the bottom of which chamber is located a foraminous partition, shown as the arched gauze cap 25, upon which the absorbent material rests, preventing clogging of inlet.

26 designates a passage leading from the upper portion of the chamber 23 and thence downwardly and laterally and after discharging at the blower-tip 27 overflows into the cup 28, which is secured to the stem 29 by means of the screw 30 or other suitable devices, said cup containing asbestos 31 at its

lower portion, which is held in position by the gauze 32 or by other means.

It will be understood from the foregoing that a sufficient quantity of hydrocarbon having overflowed into the cup 28 the valve 15 is closed, so that no more hydrocarbon can flow through the pipe 20. The attendant next ignites the hydrocarbon in the cup 28, whereupon the hydrocarbon in the absorbent-chamber 23 becomes volatilized under considerable pressure and flows with great force through the passage 26 and out the burner-tip 27 through the port 33 into the commingling-tube or blast-chamber 34, it being understood that the highly-heated vapor flows through the port 33 and draws into said blast-chamber a sufficient quantity of air to make a blue flame, which impinges upon the regenerator $34\frac{1}{2}$ and the generator 35, whereby these tubes are heated to an intense degree. It will be noted that both chambers 23 and 34 are located above the cup 28, so that the blast-chamber 34 is heated by the combustion of the hydrocarbon in the cup.

From the foregoing it will be understood how the starting device is operated or, in other words, how the initial heating of the generator and regenerator is effected, and the means for supplying hydrocarbon to the generator and for volatilizing the same therein will next be described, reference being first had to Fig. 13, wherein 36 designates a pipe leading from the valve-casing, it being understood that the valve 15 and port 13 are now closed. The hydrocarbon flows through the pipe 10 and port 12, since the valve 14 is now open, and thence through the pipe 36 into the pipe 37, passage 38, pipe 39, passages 40, 41, 42, and 43 out the discharge-pipe 44 into the chamber 45 of the governor $46^{\times}$, it being understood that the upper portion of this chamber 45 is now filled with vapor, which enters through the pipe 44 and exerts a pressure downwardly upon the hydrocarbon in the reservoir 1 and also upon the chamber 6. The valve 8, hereinbefore referred to, is provided with a stem 46, to which is secured the head 47, carrying the valve 48, which is pivoted thereto and adapted to open and close the port 49, from which leads the pipe 50 downwardly into the tube 51, which serves as a regenerator, it being understood that said pipe 50 terminates at the point 52 a short distance from the end of the regenerator, so that the vapor which is discharged into the regenerator 51 is compelled to flow substantially the whole length thereof backwardly to the outlet 53 and through the tip 54, at which point it discharges into the mixing-chamber 55 and flows thence into the burner-tube 56 and through passage 57 into the opposite burner-tube 58.

Referring now to Figs. 1 and 15, it will be understood that the head 47 has secured to it a rod 59, whose upper end is secured to the upper portion $50^{\times}$ of the diaphragm $51^{\times}$, the lower portion $52^{\times}$ of said diaphragm being suitably secured to a fixed point, as $53^{\times}$, it being understood that the chamber $54^{\times}$ is at all times in communication with the chamber 45. $55^{\times}$ designates a spring having one end contacting with the diaphragm member $50^{\times}$, while its upper end encircles the boss $56^{\times}$, which depends from the adjusting-screw $57^{\times}$, which engages the upper portion $58^{\times}$ of the governor-casing. It will thus be seen from the foregoing that a very practical and efficient construction of the governor is provided, the same having a hydrocarbon-fluid outlet 10 in its lower portion and a vapor-inlet 44 and vapor-outlet 50 in its upper portion. The valve 8 in the lower portion of the governor, in conjunction with the compression-spring abutting against it, serves to control the flow of hydrocarbon out through the pipe 10, while the valve 48, which is pivotally attached to the head 47, serves to control the flow of vapor out of the pipe 50 to the regenerator $34\frac{1}{2}$, and the compression-spring $55^{\times}$ on the top of the diaphragm, according to requirements, causes the two vertical rods to exert a pressure against the lower valve 8, whereupon the spring $45\frac{1}{2}$ is compressed and said valve 8 is opened, thereby allowing a requisite amount of hydrocarbon to flow out through the pipe 10. When the pressure in the chamber 45 rises to the desired point, which can be readily regulated by the spring $55^{\times}$ to the desired extent, the rods 46 and 59 and their adjuncts will be raised, thereby allowing the lower valve 8 to become seated. This causes the sleeve of the valve 8 surrounding the lower vertical rod 46 to rise by the expansion of the spring $45\frac{1}{2}$, which forces the valve 8 upward to its seat, which action will shut off the supply of hydrocarbon through the pipe 10 to the generator 35.

If desired, I may employ the construction best seen in Fig. 17, wherein I have shown the lower stem or rod 46 as threaded and provided with lock-nuts $8^{\times}$, whereby upon adjusting said nuts, which rest upon the top of the sleeve $9^{\times}$, more or less adjustment of the valve may be made, it being understood that the lower end of the stem 46 slides freely in said sleeve, thereby giving an independent movement of the valve 8, which is controlled by the spring $45\frac{1}{2}$. I have shown the strainer $7^{\times}$ and these nuts $8^{\times}$ in Fig. 18 for the sake of clearness of illustration. In case the lower valve 8 should refuse to respond to the action of the upper compression-spring $55^{\times}$ and the pressure should go above or rise beyond the point set then the diaphragms $50^{\times}$ and $52^{\times}$ will further expand, and thereby cause the pivoted valve-stem 48 to become seated against its seat, thereby cutting off the supply of vapor from the pipe 50 to the regenerator and to the mixing-chamber which extinguishes the light.

It will be understood from Fig. 4 that the pipes composing the generator 35 lie on an angle with the horizontal in the hot-air cham-

ber and that the fluid-inlet 36 is at the lower end of the angle, while the vapor-outlet 44 is at the upper end of said angle, thereby causing the fluid to pass upwardly through the generator. It will be also understood that the regenerator lies directly beneath the generator, and by reason of its construction vapor is caused to pass over the entire length of the hightly-heated tube 51, whereby the regeneration takes place, from which point the highly-heated vapor passes out through the tip 54 to the mixing-chamber 55, as has already been explained.

Referring once more to the construction seen in Figs. 6 to 11, inclusive, it will be apparent that each burner, as 56, consists of a hollow chamber having an upright rod 60, to the upper portion of which is secured a disk 61, which serves to equalize the flow of vapor to the burner-cap 62, the construction of which latter can be best understood from Fig. 12, said cap consisting of the walls 63 and top 64, which is provided with parallel slots 65. It will be apparent that by this construction of burner-cap the parallel slots cause the flame to spread directly against the meshes of the superimposed mantle 66. It will be understood from Fig. 9 that the disks 61 are so situated with respect to the burners that the flow of gas to the burners is equal, it being also apparent that the disk nearest the mixing-tube, or the one seen at the right of Fig. 9, receives more pressure initially than the disk at the left of Fig. 9, and I have found by experience that it is necessary to break or equalize such pressure, so as to secure an equal distribution of gas to the point of ignition.

Referring now to Fig. 2, it will be apparent that the lamp is provided with a globe 67, which is suitably supported and which has an opening 68 in its lower portion. Above this opening is located a cup 69, which rests upon the feet 70. 71 designates a deflecting device composed of a base portion 72, an upright stem 73, and vertical blades 74, the office of said deflecting device being to deflect air up into the globe 67, which air plays a dual part—first, as a fresh-air supply for burner consumption, as already explained, and, second, to equalize any back pressure that might occur within the apparatus. It will be understood from Fig. 1 that the cup 69 and deflecting device 71 are held in engagement by a threaded stem; but as this connection or union of these two parts may be accomplished by various other means I do not deem it necessary to describe this construction in detail.

As has been explained, the products of combustion pass upwardly to the hot-air chamber $34^{\times}$, around the regenerator and generator tubes $34\frac{1}{2}$ and 35, and thence into the flue or hot-air cylinder 75 and impinge against the inverted cone 76, whereby the products of combustion are deflected over the top of the outer case or weather-cylinder 77 against the walls of the weather-hood 78, which latter is composed of the angularly-disposed upper and lower walls 79 and 80. The upper portion of the hot-air cylinder 75 has secured thereto the inverted-U or other shaped brace 81, whose top portion 82 is secured to the threaded stem 83, having an eye 84 therein, whereby the lamp may be conveniently supported. In the present instance I have shown the inverted cone 76 as supported from the brace 81, and I have shown the cone 85 as supported from the rod 83, while the weather-hood 78 is supported from said cone 85; but it is apparent that changes may be made by those skilled in the art in the manner of assembling these devices, and I do not, therefore, desire to be limited in every instance to the exact construction shown. It will thus be understood from the foregoing that the inverted cone 76 uniformly directs the products of combustion around and out of the hot-air cylinder 75. The hood 78 is provided with an opening 86 at its top and an opening 87 at its bottom, which latter surrounds the outside or weather cylinder 77. It will be understood from the foregoing that the angle formed by the junction of the inclined sides 79 and 80 cuts the air and deflects the same either upwardly or downwardly, so that there can be no improper or injurious drafts with the hot-air cylinder, since said air must past above the top of the opening 86 and below the bottom of the opening 87, it being also apparent that the hood 85 by reason of its location below the upper opening 86 also assists to prevent any improper or injurious drafts in the hot-air chamber. It will also be apparent by reason of my novel construction if the lamp should be suspended close to a wall, where the air would be deflected downwardly upon the hood 78, in case any air should pass into the upper opening 86 it would flow over the cone 85 and out at the bottom opening 87.

In Figs. 1 and 2 I have shown the base 89 of the hot-air chamber 93 consisting of a disk having a plurality of ears 90 projecting therefrom, which are adapted to be secured to the annular strip or ring constituting the protecting-hood 91 so as to form an annular opening 92, whereby the air is supplied to the mixing-chamber 55 and is also supplied to a sufficient extent to the fresh-air-draft chamber 93, so as to carry off the radiant heat from the exterior of the hot-air chamber, passing up through the weather-cylinder 77 out of the hood 78 at the top thereof.

It will be apparent from the construction seen in Figs. 6 to 10 and especially in Fig. 16 that in practice I construct the burners 56 58 and the passage 57 in a single casting and that said burners are further connected by a plate $28^{\times}$ and that from said plate is supported the chamber 23 of the starting device by means of the screw $28^{\times\times}$, so that it will be seen that the parts seen in Fig. 6, comprising the burners, starting device, blast-chamber, and commin-

gling-tube, may be considered as an integral part of the burner and can be all simultaneously removed therefrom upon the disconnection of the commingling-tube 55 for the purpose of inspection or repairs.

It will be apparent that I have not described in detail the precise manner of assembling and securing together the various parts of the apparatus, as it will be understood that the same may be varied and that various changes may be made by those skilled in the art which may come within the scope of my invention, and I therefore reserve to myself the right to make all such changes as come within the scope of the same.

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, a generator consisting of a plurality of substantially parallel tubes lying in different horizontal and vertical planes and a regenerator beneath and adjacent said generator, said regenerator being connected to receive vapor from said generator and provided with a vapor-jet orifice.

2. In a vapor-burner, a reservoir, a generator consisting of a plurality of substantially parallel tubes lying in different horizontal and vertical planes, a regenerator beneath said generator connected to receive vapor therefrom and provided with a vapor-jet orifice and connections from said reservoir to the lowermost of said generator-tubes and from the uppermost of said generator-tubes to said regenerator.

3. In a vapor-burner, a reservoir, a generator, a starting device, a connection leading from said reservoir to said generator and said starting device and means interposed in said connection for controlling the flow of hydrocarbon therethrough operated by the pressure of the generated vapor.

4. In a vapor-burner, a reservoir, a generator, a starting device, a connection leading from said reservoir to said generator and said starting device, means interposed in said connection for controlling the flow of hydrocarbon therethrough operated by the pressure of the generated vapor and means for separately cutting off the flow to said generator and said starting device.

5. In a vapor-burner, a reservoir, a governor in communication with said reservoir, a valve-casing, a pipe leading from said governor to said valve-casing, a plurality of valves in said casing, said casing having a plurality of outlets controlled by said valves, a starting device, one of said outlets having a connection for conveying hydrocarbon from said valve-casing to said starting device, a generator located above said starting device, and a pipe leading from the other of said outlets to said generator, in combination with a pipe leading from said generator to the upper portion of said governor, a regenerator below said generator to which said last-mentioned pipe is connected, burners below said regenerator, and a mixing-tube leading from said regenerator for conveying the commingled air and gas to said burner.

6. In a vapor-burner, a reservoir, a governor in communication with said reservoir, a valve-casing, a pipe leading from said governor to said valve-casing, a plurality of valves in said casing, said casing having a plurality of outlets controlled by said valves, a starting device, one of said outlets having a connection for conveying hydrocarbon from said valve-casing to said starting device, a generator located above said starting device, a pipe leading from the other of said outlets to said generator, a pipe leading from said generator to the upper portion of said governor, a regenerator below said generator to which said last-named pipe is connected, a burner below said regenerator, a tip in said regenerator, and a mixing-tube for conveying commingled gas and air from said tip to said burner.

7. In a vapor-burner, a reservoir, a generator, a regenerator, a connection leading from said reservoir to said generator, a casing in said connection, means in said casing controlling the flow of hydrocarbon in said connection operated by the pressure of the generated vapor, a starting device, a connection leading from said casing to said starting device, connections leading from said generator to said casing and from said casing to said regenerator and a valve in said casing controlling the flow of hydrocarbon through said last-named connection.

8. In a vapor-burner, a reservoir, a generator, a regenerator, a connection leading from said reservoir to said generator, a casing in said connection, a starting device adjacent said generator, a connection leading from said casing to said starting device, connections leading from said generator to said casing and from said casing to said regenerator, a valve in said casing controlling the flow of hydrocarbon to said generator and to said starting device, a second valve controlling the flow of hydrocarbon to said regenerator and means in said casing operating both said valves controlled by the pressure of the generated vapor.

9. In a vapor-burner, a reservoir, a generator, a regenerator, a connection leading from said reservoir to said generator, a casing in said connection, a starting device adjacent said generator, a connection leading from said casing to said starting device, connections leading from said generator to said casing and from said casing to said regenerator, a valve in said casing controlling the flow of hydrocarbon to said generator and to said starting device, a second valve controlling the flow of hydrocarbon to said regenerator, means in said casing operating both said valves controlled by

pressure of the generated vapor, a burner and a mixing-tube interposed between said regenerator and said burner.

10. In a vapor-burner, a reservoir, a generator, a plurality of burners, a mixing-tube supplying commingled air and vapor to all of said burners, a starting device comprising means for vaporizing hydrocarbon and a blast-chamber, said blast-chamber being located between said burners beneath said generator.

11. In a vapor-burner, a reservoir, a generator, a regenerator adjacent said generator, a plurality of burners, a mixing-tube leading from said regenerator and supplying commingled air and vapor to said burners and a starting device comprising means for vaporizing hydrocarbon and a blast-chamber located between said burners beneath said generator and regenerator.

12. In a vapor-burning device, a reservoir, a generator, a connection between said reservoir and said generator, a valve in said connection arranged to control the passage of the hydrocarbon, a diaphragm connected with said valve to operate the same, means for conveying vapor from the generator to actuate said diaphragm, a valve-casing in said connection between the reservoir and the generator, a starting device, a connection from said casing to said starting device and a plurality of valves in said casing controlling the flow of hydrocarbon to the generator and the flow to the starting device.

13. In a vapor-burning device, a reservoir, a generator, an integral casting comprising a plurality of burner-tubes and a passage connecting said tubes, a starting device attached to said burner-tubes and comprising a blast-chamber located beneath said generator, a vaporizing-chamber located adjacent said blast-chamber, the lower portion of said vaporizing-chamber having fluid connection with said reservoir and an igniting-cup beneath said vaporizing-chamber, means providing a passage through the upper portion of said vaporizing-chamber to said cup, and a tip on said means located beneath said blast-chamber, whereby said passage is adapted to first convey liquid hydrocarbon to said cup and afterward to convey vaporized hydrocarbon to said blast-chamber.

14. In a vapor-burner, a reservoir, a generator, an integral casting comprising a plurality of burner-tubes and a passage connecting said tubes, a starting device attached to said burner-tubes and comprising a blast-chamber located beneath said generator, a vaporizing-chamber located adjacent said blast-chamber, the lower portion of said vaporizing-chamber having fluid connection with said reservoir and an igniting-cup beneath said vaporizing-chamber and blast-chamber, means providing a passage from the upper portion of said vaporizing-chamber to said cup and a tip on said means located beneath said blast-chamber, whereby said passage is adapted to first convey liquid hydrocarbon to said cup and afterward to convey vaporized hydrocarbon to said blast-chamber.

15. In a vapor-burning device, an integral casting comprising a plurality of burners and having an offset passage connecting said burners in combination with a starting device consisting of a blast-chamber and a burner-tip beneath said blast-chamber, said blast-chamber being located between said burners.

16. In a vapor-burning device, an integral casting comprising a plurality of vertically-extending burner-tubes and a passage connecting said tubes in combination with removable gas-emitting caps on said tubes, the tip of each of said caps being formed of a plurality of straight parallel bars.

17. In a vapor-burning device, an integral casting comprising a plurality of burner-tubes, an offset passage and a plate connecting said tubes in combination with a starting device having a blast-chamber located between said tubes, said starting device being secured to and supported by said plate.

18. In a vapor-burning device, a reservoir, a generator, a burner, a starting device, connections leading from said reservoir to said generator and to said starting device and a valve automatically operated by the pressure of the generated vapor for cutting off the flow of hydrocarbon to said generator and said starting device.

19. In a vapor-burning device, a flue for carrying off the heated products of combustion, an annular reservoir surrounding said flue and an annular wall interposed between said flue and said reservoir and spaced away from both.

20. In a vapor-burning device, a flue for carrying off the heated products of combustion, an annular reservoir surrounding said flue and an annular hood covering said reservoir and spaced away from said flue.

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