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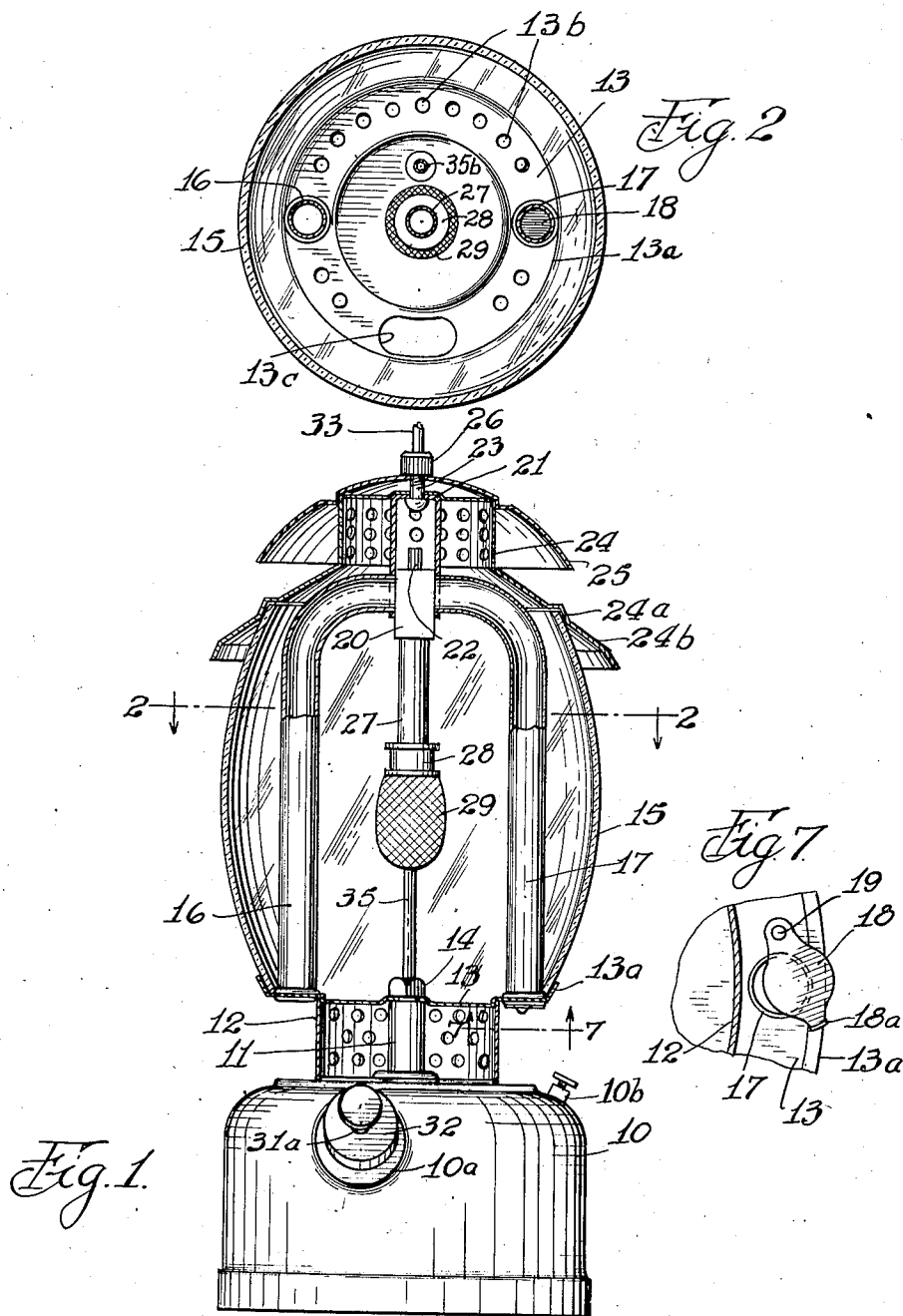
R. BAKER ET AL

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LIQUID FUEL BURNING DEVICE OF PRESSURE TYPE

Filed Feb. 19, 1942

3 Sheets-Sheet 1



INVENTORS
ROBERT BAKER
CORTLAND W. DAVIS
BY
Albert C. Bell
ATTORNEY.

R. BAKER ET AL.

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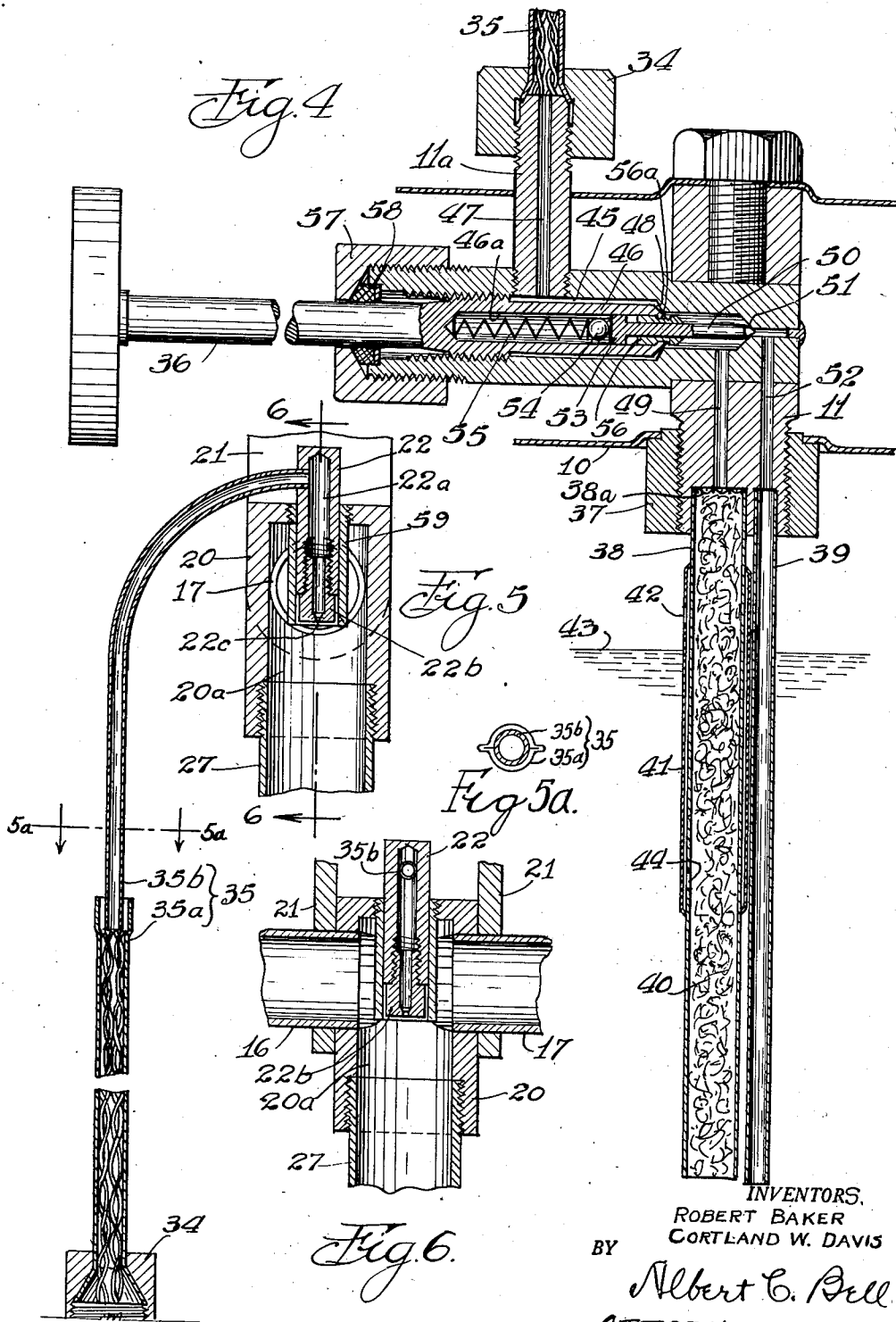
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UNITED STATES PATENT OFFICE

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LIQUID FUEL BURNING DEVICE OF
PRESSURE TYPE

Robert Baker, Alexandria, and Cortland W. Davis,
Summitville, Ind., assignors to The Mantle
Lamp Company of America, Chicago, Ill., a cor-
poration of Illinois

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This invention pertains to an improved construction of liquid fuel burning devices of the pressure type, by which the starting operation involving the requisite preheating of the generator of the device is accomplished without the use of an auxiliary starting torch or flame, by which an improved generator construction is employed which constitutes the sole passageway of the atomized or vaporized fuel to the mixing tube for both the starting and the running conditions of the device, by which an improved single control valve mechanism is employed to control both the starting and running conditions, as well as other mechanical features greatly facilitating economical construction of the device and its efficient operation. The invention is particularly applicable to different forms of pressure lighting devices of the mantle type, such as lanterns and lamps of various types, as well as to different types of liquid fuel burning devices of the pressure type, such as stoves, torches and heating devices generally.

In addition to the above, the invention includes devices for efficiently burning different kinds of liquid fuel as desired, for example gasoline at one time and kerosene at another time, by the simple expedient of changing the amount of air supplied to the mixing tube or manifold, depending upon the kind of fuel to be burned. The devices provided by the invention for efficiently realizing the starting condition and for reducing the starting condition to a short time interval, include a mechanical structure in the reservoir of the device by which the air under pressure in said reservoir is utilized during the starting condition to break up and atomize the liquid fuel then delivered by the valve mechanism to the generator tube, the atomization being so effective that the resulting fuel mixture may be lighted at once and burn without excessive smoking, to sufficiently heat the generator tube very rapidly, even when kerosene is used as the fuel, so that the valve mechanism may be turned to its running condition within a brief interval after starting the burning of the fuel.

The above stated advantages constitute the objects of the invention, which, as well as the mechanical structures involved and their mode of operation, will be best understood by reference to the accompanying drawings illustrating a preferred embodiment of the invention, as applied to a lantern of the mantle type, in which:

Fig. 1 is a vertical, central view, partially in section, through the lantern in the plane of the air tubes employed;

Fig. 2 is a horizontal, sectional view through the structure shown in Fig. 1, taken along the line 2—2 in the latter figure;

Fig. 3 is a vertical, central, sectional view taken through the lantern at right angles to the plane of section of Fig. 1;

Fig. 4 illustrates the valve mechanism employed, to an enlarged scale in vertical, central, sectional view corresponding to Fig. 3, and in Fig. 4 there is also shown in vertical, central, sectional view, the devices employed to feed the fuel to the valve mechanism for the starting and running conditions;

Fig. 5 is a vertical, central, sectional view to an enlarged scale, through the upper portion of the mixing tube or chamber, corresponding to Fig. 3, and showing also in vertical, central, sectional view the generator tube of the lantern;

Fig. 5a is a sectional view to an enlarged scale, of a part of the structure shown in Fig. 5 taken along the line 5a—5a;

Fig. 6 is a vertical, central, sectional view through the parts shown in Fig. 5, taken along the line 6—6 in the latter figure, and

Fig. 7 is a detail view to an enlarged scale of the devices employed to change the lantern from a condition for use with relatively heavy liquid fuel, to a condition for use with a relatively light liquid fuel and vice versa, this view being taken along the line 7—7 in Fig. 1.

Similar numerals refer to similar parts throughout the several views.

As shown in Fig. 1, the lantern consists of a metal reservoir 10 having centrally extending upwardly from its top wall, the valve mechanism 11, which valve mechanism is surrounded by a sheet metal sleeve 12 to support the base plate 13 of the lantern in horizontal position, the base plate being held in place by a screw or bolt 14 extending centrally through the base plate into the housing of the valve mechanism 11. The base plate 13 is provided with an upwardly extending edge flange 13a to form a seat for the lower end of the lantern chimney 15. The base plate 13 has rigidly secured thereto, the lower ends of two air tubes 16 and 17 which open without obstruction through the base plate, excepting that the air tube 17 is provided at its lower end as more clearly shown in Fig. 7, with a gate or shutter 18 pivotally connected to the underside of the base plate 13 at 19, and preferably having a projecting lug 18a by means of which the gate or shutter may be swung to a position closing the lower end of the air tube 17 or to an alternate position opening the lower end of said air tube, the closed

condition of the air tube 17 being that employed when the lantern is to be operated with a relatively light liquid fuel such as gasoline, and the open position being that employed when the lantern is to be used with relatively heavy liquid fuel, such as kerosene.

The upper ends of the air tubes 16 and 17 are curved to extend horizontally towards each other, and preferably so that their upper ends have a common horizontal axis, said upper ends being secured in this position to a metal block 20, for example by brazing. A sheet metal yoke 21 is apertured at its lower ends to receive the upper ends of the air tubes 16 and 17, the spacing of the sides of the yoke 21 being equal to the lateral extent of the block 20, and the yoke 21 is rigidly secured in a position extending upwardly above the block 20, by having its lower ends secured to the upper ends of the air tubes 16 and 17 and to the block 20, for example by brazing. The upper horizontal portion of yoke 21 is sufficiently spaced from the upper end of the block 20 to permit the ready entrance and removal of the nozzle 22 into and from the block 20 for assembling and dismantling operations. The upper horizontal portion of the yoke 21 has rigidly secured thereto an upwardly extending screw 23 which projects through inner and outer annular hood members 24 and 25 to rigidly support the hood members and hold them in place relatively to the mechanical frame work of the lantern by a nut 26 threaded on the screw 23 above the hood member 25. The hood members 24 and 25 are preferably rigidly secured together, for example by brazing or welding, to constitute a unitary structure.

The inner and lower hood member 24 is cylindrical and perforated at its upper portion, to provide ready egress for the gases of combustion, below which it is conically flared outwardly and downwardly, and provided at 24a with an annular seat to receive the upper end of the chimney 15, said member 24 being continued below and outwardly from the upper end of the chimney, to constitute a weather shield 24b for the chimney. The outer hood member 25 is generally spherical in shape and extends downwardly and outwardly from the upper end of the member 24, to form an annular weather shield for the upper perforated portion of the member 24.

As shown in Fig. 1, the metal block 20 is secured, for example by screwthreads and brazing, to the upper end of a vertical mixing tube or chamber 27, which is preferably substantially coaxial with the axis of the chimney 15. The lower end of the mixing tube 27 is preferably threaded to engage a mantle support 28 containing a burner screen, not shown, which support in turn carries a mantle 29 coaxially with the mixing tube 27, so that fuel mixture delivered to the tube 27 is projected centrally thereof and downwardly into the central portion of the mantle 29.

As shown in Fig. 2, the base plate 13 is provided with perforations 13b to supply external air to the mantle 29 to assist in completely burning the fuel mixture, said base plate also being provided with an opening 13c to facilitate inserting a lighted match or taper to light the fuel at the mantle 29 at the beginning of the starting operation.

As shown in Fig. 3, the reservoir 10 is provided with an inclined flattened portion 10a in its side wall just below the top of the reservoir, to support a threaded and outwardly extending sleeve

30 having a bore which is a sliding fit on the outer surface of the barrel of an air pump 31, which pump barrel is provided at its outer end with an outwardly extending flange engaged by a flanged collar 32 having internal threads for engaging the threads on the sleeve 30. The end flange of the pump barrel is of substantially the same outer diameter as the threaded portion of the sleeve 30 and is correspondingly threaded to permit the collar 32 to pass over it to the position indicated in Fig. 3, the inner threads in the collar 32 being cut away, so that when the collar is in the position illustrated in Fig. 3, it may turn freely relatively to the pump barrel, in securing the pump in the reservoir. A suitable packing ring is preferably employed between the barrel flange and the end of the sleeve 30, to make a tight joint at that place. The collar 32 is provided with a central bore which is a sliding fit on the pump plunger rod 31a, as a result of which the collar 32 constitutes the outer end wall of the pump barrel and also a closing cap for the sleeve 30, the bore of which sleeve constitutes the filler opening for the reservoir 10. As shown in Fig. 1, the reservoir 10 is preferably provided with an air-release valve 10b of any known form, for dissipating the air pressure in the reservoir when use of the lantern is discontinued.

As also shown in Fig. 3, the lower edge portion of hood portion 24b is provided with opposite perforations to receive the lower bent ends of a bail 33, which bent ends are of a conformation cooperating with the hood portion 24b to prevent disengagement of the bail from the hood portion when the bail is in its lantern carrying position.

As illustrated in Fig. 3, the housing of the valve mechanism 11 is provided with an upwardly extending tubular branch 11a projecting through a suitable clearance opening therefor in the base plate 13, the upper and externally threaded end of said extension 11a engaging a collar 34 by which the generator tube 35 is supported and connected with said extension 11a, to hold the nozzle 22 in place in the block 20. The valve mechanism is provided with a valve rod 36 by turning which, the starting condition of the lantern is effected for a desired interval, and by further turning which the running condition of the lantern is effected, as described below.

As shown in Fig. 4, the housing of the valve mechanism 11 is provided with a downwardly extending portion projecting into the reservoir 10, and held in place by external screwthreads engaging similar internal threads in a collar 37 rigidly secured, for example by brazing, to the reservoir with the head of said collar in a recess therefor in the reservoir. Inside of the reservoir 10, the valve housing supports in vertical position two tubes 38 and 39, the tube 38 being employed to supply atomized fuel and air from the reservoir, to the valve mechanism during the starting condition of the lantern, while the tube 39 serves to supply liquid fuel only to the valve mechanism during the running condition of the lantern. The tubes 38 and 39 are rigidly secured to the housing of the valve mechanism by entering at their upper ends suitable bores in the housing of the valve mechanism, in which position they are rigidly secured, for example by brazing. The tube 39 is of smaller diameter than the tube 38 and is open throughout its length so that it may receive liquid fuel from adjacent the bottom wall of the reservoir 10. The tube 38 is packed with fibrous material 40 of any kind

having capillary action upon the liquid fuel, so that the liquid freely entering the lower open end of the tube 38 from adjacent the bottom wall of the reservoir 10, may thoroughly wet the filling material even when the fuel in the reservoir is nearly exhausted. Cotton fiber, wool fiber, or any fibrous material having a high degree of capillary action may be employed to fill the tube 38, the only requisite being that the filling material be not so tightly packed in the tube 38 as to prevent the flow of air through the filling material under the air pressure developed in the reservoir 10 by the hand pump 31. The tube 38 is provided at its upper end with a screen 38a and said tube is surrounded by a second tube 41 having a bore somewhat larger than the external diameter of the tube 38, to form an air space between the tube 41 and the tube 38. The ends of the tube 41 are pressed inwardly to engage the tube 38 in a manner to maintain the air space between the two tubes, and the tube 41 is held in place preferably by brazing its ends to the tube 38. The outer tube 41 is provided with an air inlet opening 42 above the highest level 43 of the liquid fuel in the reservoir 10, and the tube 38 is provided with an aperture 44 for air flow, which is just above the lower end of the tube 41, and in open communication with the air space between the tubes 38 and 41, and also with the interior of the tube 38.

As shown in Fig. 4 the housing of the valve mechanism 11 is provided with a horizontal bore 45 containing a first valve member 46 having an external diameter somewhat smaller than the bore 45 to permit the flow of fuel mixture between the valve member 46 and the bore 45 to a discharge passage 47 in the extension 11a, when the lantern is in operation for the starting condition of the lantern, and to correspondingly permit the flow of liquid fuel to and through the passage 47 when the lantern is in its running condition. The valve member 46 is tapered at its inner end to engage a first valve seat 48 in the housing of the valve mechanism, to control fuel mixture flow from a passage 49 in said housing which communicates with the upper end of the interior of the tube 38, and the other end of said valve member 46 is externally threaded to engage corresponding threads in the housing bore 45, so that turning the valve member 46 will move it towards or from its seat 48 as desired. The valve member 46 carries a second valve member 50 having a tapered end engaging a second valve seat 51 in the housing of the valve mechanism, so that said second valve member 50 will control the flow of liquid fuel from a passage 52 in open communication with the upper end of the tube 39, through a clearance space around the second valve member 50 for delivery to the passage 47 for the running condition of the lantern. The valve member 50 is a sliding fit in the valve member 46, and carries at its inner end an outwardly extending flange 53 which is a sliding fit in the bore 46a in the valve member 46, in which bore the flanged end of the valve member 50 engages an antifriction ball 54 which in turn is engaged by one end of a spring 55 contained in said bore. The end of the bore 46a contains a sleeve 56 which fits said bore and has a sliding fit on the valve member 50. The sleeve 56 is externally grooved at 56a to receive the compressed end of the valve member 45, to hold said sleeve in place. The spring 55 is held in compressed condition by the inner end of the bore 46a, the tension on the spring being sufficient to positively hold the valve member 50 against its seat 51, when the valve

member 46 is moved a small distance from its seat 48, but not enough to engage the flange 53 with the sleeve 56. The housing of the valve mechanism around the valve rod 36 is closed by a threaded collar 57 and packing ring 58 in the usual manner.

As a result of the valve mechanism construction described, after liquid fuel is placed in the reservoir 10 to any operative depth below the highest permissible level 43, and when the requisite air pressure has been developed in the reservoir above the liquid fuel by the action of the hand pump 31, the starting condition of the lantern is established by turning the valve rod 36 sufficiently to move the valve member 46 from its seat 48, the amount required to permit atomized fuel and air to flow freely to the passage 47 and thus to the generator tube 35. For this condition of the valve mechanism, air under pressure flows through the aperture 42 downwardly and around the tube 38 between the tube 38 and the tube 41, into the tube 38 through the lower aperture 44, and then upwardly through the fibrous material in the tube 38 which is then wet with the liquid fuel. This subdivides the air flowing upwardly in the tube 38 and in its passage upwardly through the fibrous material, the air picks up minute particles of the liquid fuel in a manner to atomize the liquid fuel and carry it in mixed condition with the air through the passage 49 and around the valve member 46 to the delivery passage 47 where it is delivered to the generator tube 35. In a manner to be described, the fuel mixture is delivered in burnable condition to the mantle 29, where it is ignited and in a very brief interval sufficiently heats the generator 35 due to the proximity to the mantle 29, to make it feasible to supply liquid fuel to the generator instead of the atomized fuel and air mixture. To effect this change in operating condition, the valve rod 36 is further turned to move it outwardly, thereby moving the valve member 46 farther from its seat 48, the flange 53 is engaged by the sleeve 56, and continued movement of the valve rod 36 moves the valve member 50 from its seat, thereby permitting the flow of liquid fuel without obstruction or hindrance of any kind through the tube 39, through the passageway 52, around the valve member 50, around the valve member 46 and to the delivery passage 47 and thus to the generator 35. For this condition of the valve mechanism, although the path of travel from the interior of the reservoir through the tube 38 and through the passage 49 to the delivery passage 47, is still open and in the same condition as it was during the starting of the lantern, air is no longer taken from the reservoir, because the drop in pressure through the open fuel tube 39 is substantially zero, and as a result, substantially the same pressure is exerted upon the upper end of the passage 49 as is exerted upon the aperture 42, which quite as effectively stops the further flow of air from the reservoir, as would be the case if valve mechanism were employed to positively shut the passage 49. In this manner by a comparatively simple valve mechanism, the air under pressure in the reservoir is utilized during the starting condition of the lantern to supply the air required to make the fuel mixture for starting the lantern and heating the generator, and the same valve mechanism by means of a single rotary valve rod, provides for establishing the running condition of the lantern by which liquid fuel is supplied as such

to the generator tube by the air pressure in the reservoir 10, without however permitting any appreciable flow of air from the reservoir to and through the valve mechanism. It is important that the length of air travel through the fibrous material 40, determined by the vertical location of the aperture 44, the inner diameter of the tube 38, and the kind of material and degree of packing of the material 40, shall be so chosen as to produce such a degree of fuel atomization that the starting flame in the mantle will be neither too rich nor too lean; for if the atomization is too great, a rich mixture and smoky flame result, which are not adapted to starting requirements, and if the atomization is too small, a lean mixture results which it is difficult or impossible to light.

The fuel atomizing or carbureting devices illustrated in Fig. 4 as a starting means for a pressure lantern, are equally applicable as a means for supplying an atomized or carbureted mixture from liquid fuel, to any desired liquid fuel burning devices, for example, stoves, torches and similar devices.

As shown in Fig. 5, the generator tube 35 preferably but not necessarily consists of a lower portion 35a, and an upper portion 35b of relatively small diameter, the lower end of the portion 35b entering the upper end of the lower portion 35a and being tightly secured to the lower portion after pressing the upper end of the lower portion around it, for example by brazing the parts together. The lower portion 35a is packed or filled with material to prevent surging of the fuel mixture delivered to the mantle, said packing or filling material being preferably of a nature involving long filaments of minute diameter, the filaments preferably extending the entire length of the filling material and being of a nature that will not readily break and produce small separate pieces of the material. The said filling material may advantageously consist of glass filaments of minute diameter and a large number of said filaments being used either in twisted condition to form a yarn or not as preferred, a sufficient quantity of said filaments being employed to suitably fill the portion 35a. The filler described has the advantage that each of its filaments may be continuous from end to end of the filler material, and that it is sufficiently flexible and pliable so that it does not readily break and produce small pieces of the material that might find their way through the generator tube to the nozzle supported thereby and clog the outlet opening of the nozzle. A further advantage of this filling material is that the surface of the filaments is smooth and presents a minimum opportunity for the deposit of carbon particles formed by the vaporization and distillation of the fuel, to engage and lodge on the filling material. At the same time, the filling material serves as an effective filtering agent as to relatively large particles of foreign matter that may be carried by the liquid fuel, to prevent their finding their way to the nozzle, without interfering with the passage through the generator tube of minute and infinitesimal particles of carbon developed in the vaporization of the fuel, which as a result of having no place to lodge or accumulate, find their way in separated condition to and through the nozzle without clogging the latter. The portion 35b of the generator is unobstructed in any way and provides for free flow of the fuel through it during the operation of the lantern. At the beginning of this flow and during the starting condition of the lantern,

the liquid fuel flowing through the portion 35b is finely atomized and mixed with air so that when delivered from the nozzle to the mantle, the mixture is in burnable condition, and immediately that the burning of the fuel is begun in the mantle, on account of the proximity of the generator to the mantle, the generator is rapidly heated so that in a remarkably short interval the generator is hot enough to begin the vaporization of the atomized particles of fuel, which continues until the heat of the generator is sufficient to vaporize the liquid fuel if supplied to it in liquid condition and without atomization, as is done during the running condition of the lantern.

The upper end of the generator portion 35b is curved from vertical position to horizontal position where it engages and is rigidly secured, for example by brazing, to the upper end of the nozzle 22, said nozzle having a cylindrical outer surface, and provided with an axial and longitudinal bore 22a held with its axis in vertical position by a guiding and supporting tube 59 carried by the block 20. The bore 22a is closed at its upper end and at its lower end is internally threaded to engage the correspondingly threaded nozzle tip 22b provided at its lower end with a minute discharge aperture 22c communicating with the bore 22a, the discharge aperture 22c being coaxial with the nozzle 22. The nozzle 22 fits and is freely movable vertically in the supporting tube 59, to facilitate assembly of the generator 35 and to facilitate replacement of the generator when and if such a course becomes desirable.

As shown in Figs. 5 and 6, the block 20 is provided with a central axial bore 20a of substantially larger diameter than the external diameter of the tube 59, which latter tube is coaxial with said bore. The bore 20a is closed at its upper end, and the tube 59 is supported in said bore by threaded engagement with the top wall of the block 20, which connection may be further secured if desired, for example by brazing. The air tubes 16 and 17 open into opposite sides of the bore 20a above the lower end of the tube 59, as a result of which the rapid flow of fuel mist or vapor as the case may be, from the nozzle tip 22b downwardly and coaxially with the bore 20a, produces an aspirating effect on air delivered into the bore 20a by the air tubes 16 and 17, which aspirating or bunsen effect is accurately determined and adjusted by the location of the lower end of the tube 59 relatively to the discharge ends of the air tubes 16 and 17. It frequently occurs in manufacturing devices such as the generators 35, that it is difficult to accurately make them in all respects, duplicates of each other, and the manner of mounting the nozzle 22 in the tube 59 as just described, permits inaccuracies within reasonable tolerances, of the location of the nozzle 22 relatively to the lower end of the generator 35 because the nozzle tip 22b may have one position or another vertically in the tube 59, as long as the tip 22b does not project below the tube 59, for any of which positions the efficient and optimum aspirating effect of the fuel vapor discharge on the inflowing air from the tubes 16 and 17, is maintained.

The lower end of the bore 20a is internally threaded to engage corresponding external threads on the upper end of the mixing tube 27, and in this manner the mixing tube 27 and the mantle 29 are supported coaxially with the bore 20a with the result that the stream of atomized or vaporized fuel as the case may be, delivered from the aperture 22c, is centrally maintained in

the mixing tube 27 and discharged centrally into the mantle 29, with little or no engagement between said fuel stream and the inner wall of the mixing tube 27, the mixing tube being relatively short to facilitate this result, which is also facilitated by constructing the aperture 22c in the nozzle tip, so that the atomized or vaporized fuel stream delivered from the said aperture, will have but a small amount of "spread" or divergence, as it passes downwardly through the mixing tube 27. It will be noted that the bore 20a in the block 20 is of substantially the same diameter as the bore of the mixing tube 27, as a result of which the bore 20a and the mixing tube 27 together determine a compartment into which air is delivered by the air tubes 16 and 17 around the tube 59, the function of this compartment being to mix the air so delivered by the air tubes with the fuel projected downwardly from the nozzle 22, in view of which the said compartment is referred to in the claims as a mixing chamber.

While the generator of the invention is not restricted to any particular sizes or measurements, one practical construction has been found effective in which the portion 35a of the generator is a brass tube having an external diameter of about $\frac{3}{8}$ " and a wall thickness of about $\frac{1}{64}$ ", and in which the portion 35b is a brass tube having an inner diameter of about $\frac{1}{8}$ " and a wall thickness of about $\frac{1}{64}$ ", the discharge aperture 22c for this construction being only a few thousandths of an inch in diameter, for example from six- to eight-thousandths of an inch. It is desirable that the two portions of the generator shall be made of highly heat conductive material such as brass, and with the construction described, the moment heat is produced at the mantle 29 by the initial burning of the fuel, the generator is very rapidly heated so that in a few seconds vaporization of the fuel in the generator begins, and that in, for example, forty seconds from the beginning of the burning operation with kerosene as the fuel, the generator is sufficiently heated to properly vaporize the liquid fuel for the running condition of the lantern, the starting interval being much less where gasoline is used as fuel. It has been found that with the generator constructed as described, there is no need for the use of any devices to clean the nozzle aperture 22c, notwithstanding its minute size, a possible explanation for this being the small diameter of the generator portion 35b and the corresponding high velocity of flow of the vaporized fuel through said tube, which velocity is maintained through the bore 22a and through the nozzle tip 22b, thereby affording little if any opportunity for minute impurities or carbon particles to lodge in the burner tip and clog the same. A lantern constructed as described, has been operated continuously with gasoline for over 1800 hours without clogging the generator tube or nozzle aperture.

Another feature that is important, is that the upper portion of the generator, where the destructive distillation of the fuel occurs, and from there to the nozzle, should be very highly heated, which is found to prevent the building up of objectionable carbon masses in the generator. The small exposed surface of the generator tubes, keeps the upper portion of the generator very hot, which materially contributes to the effective generator action described.

It will further be observed that the atomized or vaporized fuel stream delivered from the nozzle 22b is projected through the mixing tube 27 co-

axially therewith and without change of direction of any kind, so that the entire kinetic energy of the fuel stream is available to project the atomized or vaporized fuel into the mantle 29, thus avoiding appreciable engagement of the atomized or vaporized fuel with any metallic surfaces of the structure, and thereby avoiding appreciable collection of the atomized fuel particles and condensation of the vaporized fuel on said surfaces with resulting dripping of the collected fuel from said surfaces. In other words, the lantern in operation is substantially free from appreciable undesirable fuel collection, condensation and dripping.

The generator, nozzle and mixing devices illustrated in Figs. 5 and 6, may be used with advantage, wholly or in part, with liquid fuel burning devices generally, whether for lighting purposes or not, and particularly where it is desirable to avoid clogging and surging, and where the use of extraneous preheating devices is undesirable.

In connection with the operation of the lantern described, several important considerations are involved as follows.

In a pressure lantern using kerosene as the fuel it is necessary to preheat the generator to a higher temperature than that required for a more volatile fuel such as gasoline. It is therefore desirable when kerosene is used, to reduce to a minimum the weight of metal in the generator that must be heated, in order to reduce as much as possible the length of time required for preheating the generator.

We have found it very advantageous to employ a generator including two different sizes and weights of tubing, with the larger size at the lower end suitable in size for housing a packing material adapted to prevent surging during the lantern operation, and with the smaller size at the upper end.

The small upper portion of the generator has a greatly reduced internal volume per unit of length and the resulting rate of movement of vaporized fuel therethrough is correspondingly increased. We have found in practical tests that when the generator includes an upper section made from a very small tube, this small section may be preheated in a short time and that the deposit of carbon, produced by the destructive distillation of the fuel during vaporization, is greatly reduced and that a generator of this design will have greatly increased hours of usefulness, than larger diameter generators. Vaporizing liquid fuel by generators of the kind under consideration, is always accompanied to some degree by the destructive distillation of the fuel and the corresponding formation of free carbon particles. These particles at the instant of forming, are extremely minute, but in the presence of any favorable condition or structure thereto, they rapidly conglomerate to form appreciable and sizable masses, which rapidly clog any filters or screens employed, as well as the discharge apertures of the nozzles used. By our invention, instead of attempting to cope with these conglomerate carbon masses after they are formed, we prevent appreciable conglomeration of the minute carbon particles, by highly heating the generator of small cross-section, and we believe, what is equally important, we produce in the manner described, in the portion of the generator where most if not all of the destructive distillation of the fuel occurs, such an extremely high velocity of flow of the gases of volatilization, that the instant the minute carbon particles are

formed, they are picked up and carried by the gas stream as such, to and through the nozzle and its discharge aperture, with no opportunity to conglomerate into larger masses. Immediately upon being discharged from the nozzle, the minute carbon particles are intimately mixed with air in the mixing tube and are thus delivered to the mantle in an ideal condition for effective and uniform combustion.

When kerosene is used as the fuel in this class of pressure lanterns, the discharge orifice of the generator nozzle must be correctly positioned relative to the air supply tubes and to the manifold or mixing tube, to ensure sufficient free air intake for the proper combustion of the kerosene fuel containing a relatively large number of heat units, it being necessary to produce a combustible mixture having a correct flame propagation and consequent flame size, to establish uniform heating and incandescence of the mantle. When gasoline is used in the lantern without any change in the generator nozzle, the air supply tubes and the manifold or mixing tube, and their relationship to each other, the flame propagation of the gasoline mixture will be more rapid, because of the lesser heat units in such fuel and consequently the flame will be more oxidizing in character and shorter in length and will not properly heat the same mantle.

To cure the difficulty just referred to, and to make the same lantern equally effective with both kinds of fuel, we have found that a shutter may be employed to close the intake end of one of the air supply tubes, and that when this tube is closed the air intake into the mixing tube will be reduced to a degree to lessen the flame propagation and re-establish a flame of the necessary character and size for the proper incandescence of the mantle with the lighter fuel, without impairing the effectiveness and efficiency of the lantern for operation with the heavier fuel when the shutter is opened.

To maintain correct fuel and air mixing action, we have provided a sleeve with an open lower end adjacent the delivery ends of the air supply tubes and the manifold or mixing tube, and we have positioned the discharge orifice of the generator nozzle within this sleeve. We find that when the open lower end of this sleeve is fixed in a predetermined optimum location, the position of the discharge orifice of the nozzle may be varied within the limits of the sleeve without appreciably affecting the said mixing action, which sleeve therefore permits the use of generators of slightly different lengths without modifying the mixing action, as long as the discharge orifice is within the stationary sleeve. This conveniently accommodates small differences in length of the generators, usually incident to manufacturing operations, it obviates the need for accuracy in assembling the generators in the lanterns, and it makes the assembling and replacement of the generators a simple operation readily and successfully effected by unskilled persons.

An important part of the invention consists of means for using a relatively non-volatile liquid fuel such as kerosene (coal-oil), from which a suitable preheating flame is produced for heating the generator of a lantern of the class described. The problem to be solved required means for producing a mixture of atomized kerosene and air of a desired richness, and the delivery of this mixture to a burner without change as to the atomized or finely divided condition of the fuel component.

Many successful devices are known for producing a carbureted mixture of liquid fuel and air for use in preheating a lantern generator, when the liquid fuel used is relatively volatile, such as gasoline.

Generally in this latter class of preheating devices the air from the top of the lantern reservoir is mixed in the reservoir with a very small amount of gasoline to produce a carbureted mixture from the readily volatile gasoline, which mixture is a substantially stable, combustible gas mixture that, when discharged from a nozzle, may be conducted through cold manifold tubes and if desired changed in direction by such tubes, without the fuel vapor condensing on the cold manifold tube walls, the success of this class of preheating devices being dependent almost entirely upon the high volatility of the fuel.

In the present invention means for producing an air and fuel mixture are provided that consist of devices for conducting air from the top of a lantern reservoir (above fuel level) into a wick laden with kerosene by its capillarity, and allowing this air to pass through a predetermined length of this wick to atomize a part of the kerosene and produce a combustible mixture, which, when discharged from a nozzle orifice, is directed to a burner screen with little or no contact with the walls of the manifold tube being permitted, to thereby deliver to the burner a combustible mixture for a preheating flame.

A critical part of the invention consists in a wick having a desired density and capillarity and in the length of the passage of the air through the kerosene laden wick. When this distance is too long, the combustible mixture produced will be too rich in fuel and the preheating flame therefrom will be very smoky and not suitable for generator preheating purposes; on the other hand, if the length of the air passage through the wick is too short, the combustible mixture will be too lean and it will be very difficult if not impossible to ignite it at the burner.

In an illustrative practical embodiment of the starting carbureting devices referred to, we used for the tube 38, a brass tube having an outside diameter of $\frac{1}{4}$ of an inch and an inside diameter of $\frac{1}{8}$ of an inch, and of a length to reach nearly to the bottom of the reservoir 10, the filling material 40 consisting of 20 strands of $\frac{8}{8}$ ply cotton yarn inserted in and extending substantially from end to end of the tube; the inner diameter of the tube 41, which is not critical, was selected of a size to provide for free air flow between the tubes 38 and 41, for example, a radial space of about $\frac{1}{64}$ to $\frac{1}{32}$ of an inch; the air inlet opening 42 was positioned vertically of the tube 41 to be well above the highest level 43 of the liquid fuel in the reservoir 10, the position of this opening being not otherwise critical; and the aperture 44 was positioned vertically of the tube 38, to provide a vertical length of travel of substantially $1\frac{1}{8}$ inches through the filling material 40 laden with relatively non-volatile liquid fuel such as kerosene, for air entering the said filling material through said aperture 44, this length of travel for optimum results being rather critical for the illustrative construction described. With the construction just described, the air and atomized fuel mixture lighted readily, there was but little smoke produced even at the instant of lighting, and the generator was heated very rapidly to establish the running condition of the lantern. We further found that the richness of the air and

fuel mixture was substantially constant, independent of the height of the fuel level in the reservoir.

While we have described our invention as applied to a lantern, it will be understood that the novel described features of the invention may be advantageously used with other forms of pressure lighting devices of the mantle type, such as mantle lamps of various kinds, and that some or all of said features of the invention may be effectively used in liquid fuel burning devices of the pressure type that are not primarily intended for lighting purposes, such as stoves, torches and heating devices generally.

While the invention is disclosed in the particular embodiment above described, it is understood that it is not limited thereto, as equivalents thereof may be employed without departing from the scope of the appended claims.

Having thus described our invention, what we claim is:

1. In a pressure lighting device of the mantle type for operation with liquid fuel and including a generator tube and nozzle, and an air tube, aspirating means including the combination of a nozzle-supporting device having fixed support and having a bore supporting said nozzle with a sliding fit axially and for containing the discharge end of said nozzle, and supporting means imparting fixed support to said nozzle-supporting device and holding the discharge end of said bore in fixed relation relatively to the discharge end of said air tube for optimum aspirating effect on air from said air tube by fuel projected from the discharge end of said bore, whereby the discharge end of said nozzle may have different positions axially within said bore and produce substantially the same aspirating effect on air from said air tube for said different positions.

2. In a pressure lighting device of the mantle type for operation with liquid fuel, the combination including an air tube, a stationary tube having its discharge end in optimum aspirating relation to air delivered from said air tube, and a fuel nozzle supported with its discharge end in said stationary tube and directed towards the discharge end of said stationary tube, said nozzle being movable axially in said stationary tube, whereby substantially the same aspirating effect is produced for different positions of the discharge end of said nozzle within said stationary tube.

3. In a pressure lighting device of the mantle type for operation with liquid fuel, the combination including a block having a bore therein, an air tube having its discharge end secured to said block and opening into said bore, a stationary tube rigidly secured to said block in and substantially coaxial with said bore, said stationary tube having an outer diameter substantially less than the diameter of said bore, and a fuel nozzle supported in said stationary tube with a sliding fit, the discharge end of said stationary tube being in optimum aspirating relation to air delivered from said air tube, whereby substantially the same aspirating effect is produced for different positions of the discharge end of said nozzle within said stationary tube.

4. In a pressure lighting device of the mantle type for operation with liquid fuel, the combination including a metal block having a vertical and downwardly opening bore therein, two air tubes having their discharge ends substantially horizontally and coaxially disposed and opening into opposite sides of said bore, a stationary

tube rigidly secured at its upper end to said block in and substantially coaxial with said bore, said stationary tube having an outer diameter substantially less than the diameter of said bore, and a downwardly discharging fuel nozzle supported in said stationary tube with a sliding fit, the lower and open end of said stationary tube being in optimum aspirating relation to air delivered into said bore by said air tubes, whereby substantially the same aspirating effect is produced for different positions vertically of the discharge end of said nozzle within said stationary tube.

5. A generator for liquid fuel burning devices of the pressure type, including the combination of a generator tube, and packing material in said tube consisting of glass filaments of minute diameter.

6. A generator for liquid fuel burning devices of the pressure type, including the combination of a generator tube having lower and upper portions of respectively larger and smaller internal diameters, and packing material in said lower portion, said lower portion having an external diameter of the order of five thirty-seconds of an inch and a wall thickness of the order of one sixty-fourth of an inch and said upper portion having an internal diameter of the order of one sixteenth of an inch and a wall thickness of the order of one sixty-fourth of an inch.

7. A generator for liquid fuel burning devices of the pressure type, including the combination of a generator tube having lower and upper portions of respectively larger and smaller internal diameters, and packing material in said lower portion, said packing material comprising glass filaments of minute diameter.

8. A generator for liquid fuel burning devices of the pressure type, including the combination of a generator tube having lower and upper portions of respectively larger and smaller internal diameters, and packing material in said lower portion, said smaller internal diameter being of the order of one-sixteenth of an inch.

9. A generator for liquid fuel burning devices of the pressure type, including the combination of a generator tube for directing fuel flow in a first direction, and a nozzle connected with said tube and having a discharge orifice opening in a second direction substantially the reverse of said first direction, said generator tube containing packing material comprising glass filaments of minute diameter.

10. In a pressure lighting device of the mantle type for operation with liquid fuel, the combination of a base plate, two air tubes secured at their lower ends to said plate and extending perpendicularly therefrom in the same direction on opposite sides of the axis of the device, said tubes having curved upper ends extending horizontally towards each other, a hollow block in the axis of said device and connected with the curved ends of said tubes, the hollow in said block being vertically disposed and closed at its upper end and open at its lower end, a nozzle support in the hollow in said block and held by the upper end of said block in vertical position, a straight and vertical mixing tube connected at its upper end with the open lower end of the hollow in said block and extending downwardly from said block coaxially with said nozzle support, and means at the lower end of said mixing tube for supporting an inverted mantle coaxially with said mixing tube and with said nozzle support.

11. In a pressure lighting device of the mantle

type for operation with liquid fuel, the combination of a base plate, two air tubes secured at their lower ends to said plate and extending perpendicularly therefrom in the same direction on opposite sides of the axis of the device, said tubes having curved upper ends extending horizontally towards each other, a hollow block in the axis of said device and connected with the curved ends of said tubes, a mixing tube connected at one of its ends with said block and communicating with the hollow therein and disposed in the axis of said device for supporting a mantle at its other end, said air tubes supplying air to the hollow in said block, and said block having a support for a fuel nozzle, a U-shaped yoke of bent sheet metal having its ends adjacent opposite sides of said block and secured to the ends of said air tubes respectively and to said block, the mid-portion of said yoke being above said block and providing a clearance space vertically between said yoke and said block permitting the insertion of a fuel nozzle into said nozzle support and also the removal of said nozzle from said nozzle support, and a hood resting upon and removably secured to the mid-portion of said yoke.

12. In a pressure lighting device of the mantle type for operation with liquid fuel, in combination, a vertical mixing chamber, a mantle to be supplied with combustible mixture from said chamber, a fuel nozzle extending coaxially downwardly into said mixing chamber, means for supplying a hydrocarbon fuel under pressure to said nozzle, an air tube having one end permanently open to atmosphere and its other end opening laterally directly into said mixing chamber above the outlet of said nozzle so that air leaving said air tube and turning downwardly will be in direct aspirating relation to said nozzle, said air tube being fixedly dimensioned to determine the amount of air supplied thereby to said mixing chamber for mixing with a light hydrocarbon fuel issuing from said nozzle, a second air tube

leading from the atmosphere and having its discharge end disposed in similar relation to said mixing chamber and said nozzle, said second air tube being fixedly dimensioned to determine an additional amount of air to be supplied thereby to said mixing chamber when fully opened for mixing with said air from said first-named air tube and with a heavy hydrocarbon fuel issuing from said nozzle, and means for manually placing said second air tube either in fully open or fully closed condition.

13. In a pressure lighting device of the mantle type for operation with liquid fuel, in combination, a vertical mixing chamber, a mantle to be supplied with combustible mixture from said chamber, a fuel nozzle extending coaxially downwardly into said mixing chamber, means for supplying a hydrocarbon fuel under pressure to said nozzle, an air tube having one end permanently open to atmosphere and its other end opening laterally directly into said mixing chamber above the outlet of said nozzle so that air leaving said air tube and turning downwardly will be in direct aspirating relation to said nozzle, said air tube being fixedly dimensioned to determine the amount of air supplied thereby to said mixing chamber for mixing with a light hydrocarbon fuel issuing from said nozzle, a second air tube leading from the atmosphere and having its discharge end disposed in similar relation to said mixing chamber and said nozzle, said second air tube being fixedly dimensioned to determine an additional amount of air to be supplied thereby to said mixing chamber when fully opened for mixing with said air from said first-named air tube and with a heavy hydrocarbon fuel issuing from said nozzle, and a valve operating in a plane intersecting said second air tube for alternately fully opening or fully closing the same to the atmosphere.

ROBERT BAKER.
CORTLAND W. DAVIS.