No. 829,924. PATENTED AUG. 28, 1906.

H. LEMP.

HYDROCARBON BURNER.

APPLICATION FILED JAN. 28, 1901.

2 SHEETS—SHEET 1.

Fig. 2.

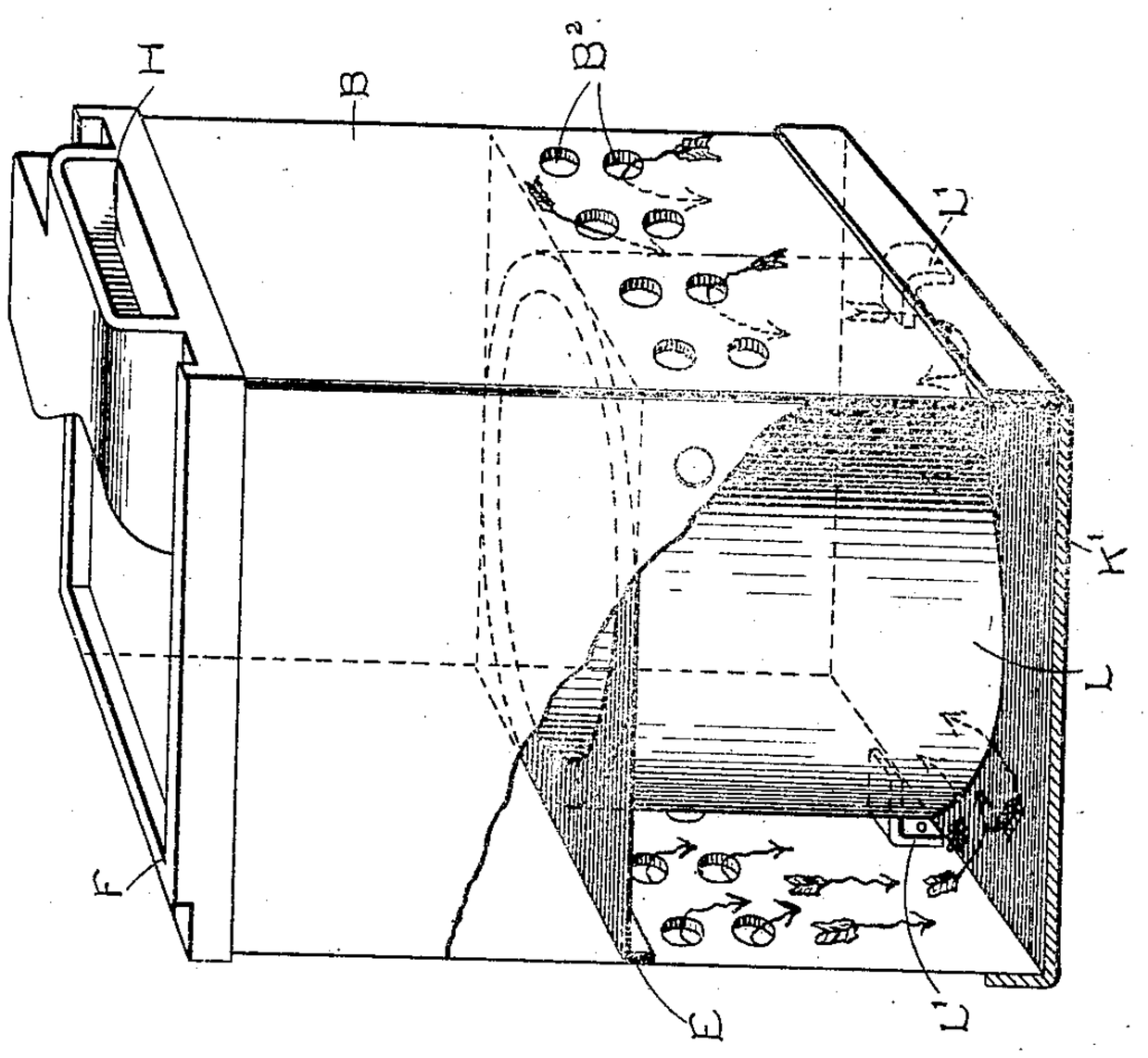
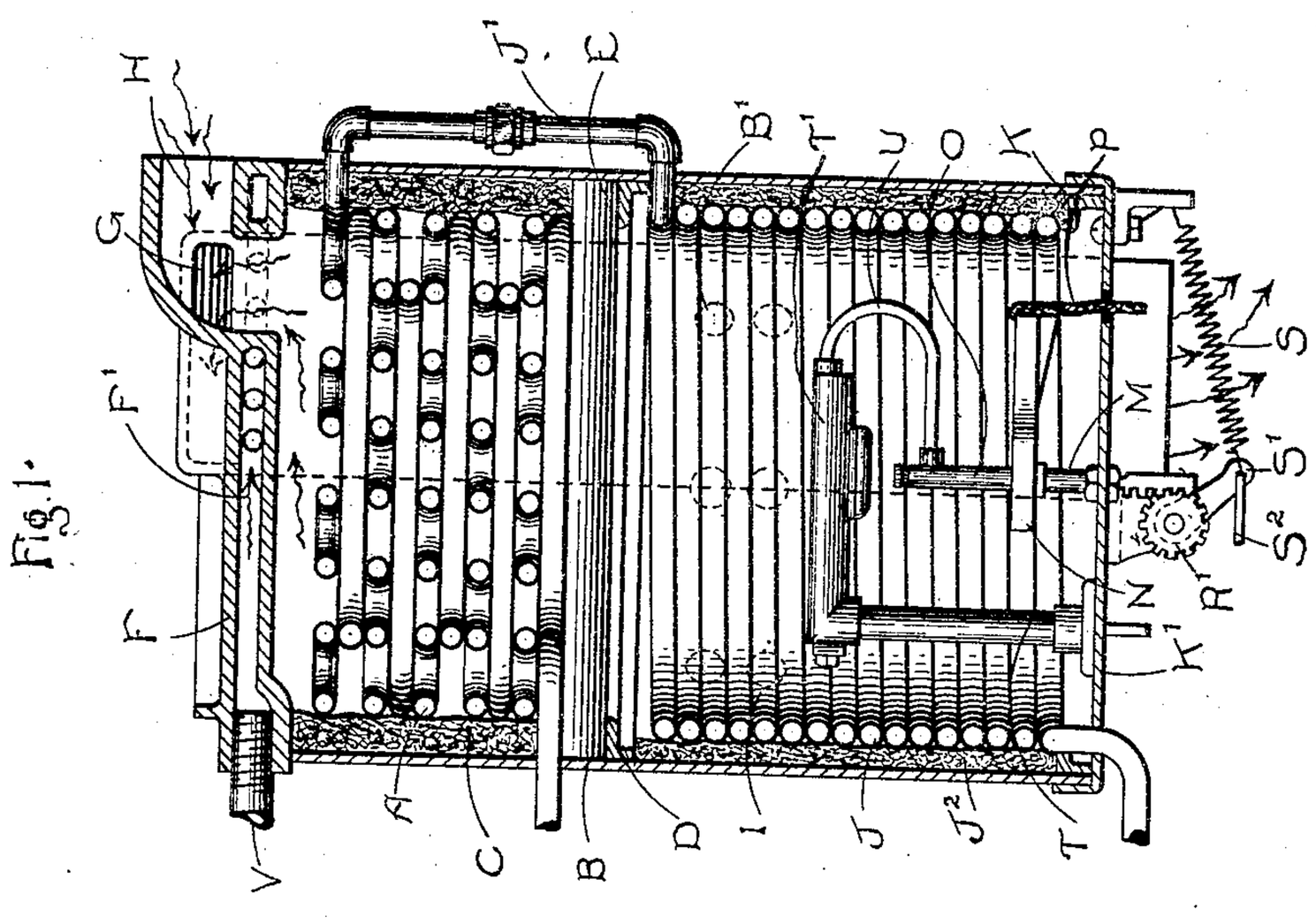


Fig. 1.



Witnesses.

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2 SHEETS—SHEET 2.

Fig. 3.

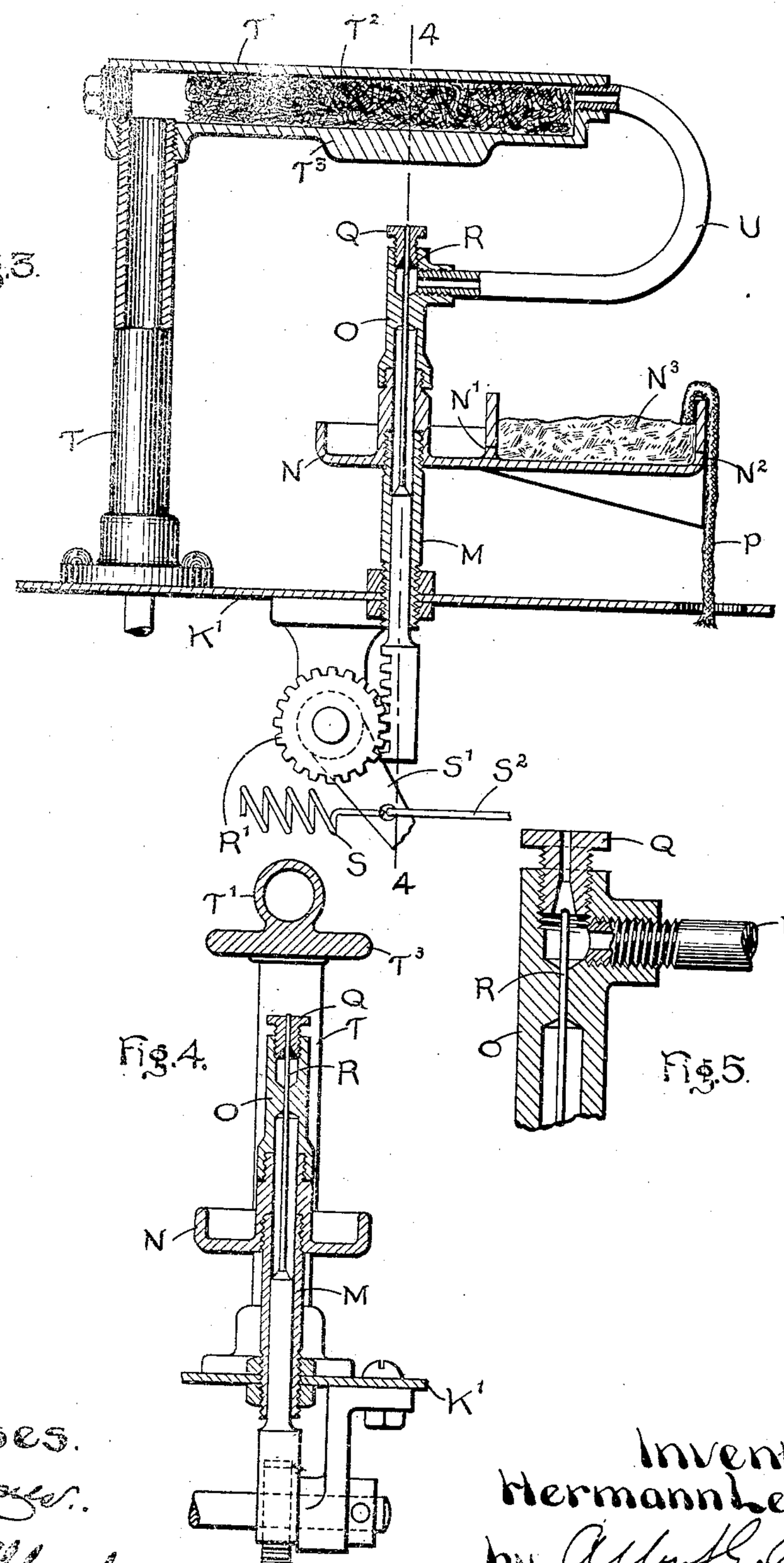

Fig. 4.

Fig. 5.

Witnesses.
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UNITED STATES PATENT OFFICE.

HERMANN LEMP, OF LYNN, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

HYDROCARBON-BURNER.

No. 829,924. Specification of Letters Patent. Patented Aug. 28, 1906.

Original application filed February 28, 1900, Serial No. 6,805. Divided and this application filed January 28, 1901, Serial No. 45,028.

To all whom it may concern:

Be it known that I, HERMANN LEMP, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Hydrocarbon-Burners, of which the following is a specification.

This application is a division of my pending application, Serial No. 6,805, which division is made in accordance with the requirements of the United States Patent Office under the provisions of Rules 41 and 42.

Kerosene-vapor burners of the jet type as distinguished from the Bunsen type found on the market at the time of my invention provided for the burning of only a comparatively small amount of oil. Hence in order to supply the required amount of heat for an automobile or similar boiler it was necessary to use a considerable number of burners, each with its own vaporizer. An apparatus of this kind is open to serious objections, the principal ones being the difficulty in starting and the continual plugging of the discharge-openings by carbonized oil or sediment. Manifestly the trouble is multiplied with an increase in the number of burners in use.

The requisites of a kerosene-burner for automobile use are a capacity for starting by kerosene as distinguished from those burners requiring alcohol or gasolene, perfect combustion under all conditions of service, which means freedom from smoke and odor, wide range of capacity and absolute freedom from back firing, simplicity in construction, reliability in operation, meaning thereby that the burner must not clog by constant service or be blown out by the wind, and be capable of relighting of itself in case the flame is accidentally extinguished. The burner must also have the necessary capacity to furnish the required amount of heat and over a wide range, so that it may respond immediately to changes in demand whether they be small or great. In other words, it must work with a low pressure, such as five pounds, (which is sufficient to maintain the fire in a banked condition,) and with a higher pressure, amounting in some instances to sixty pounds per square inch.

The present invention has for its objects to provide a kerosene-burner which eliminates all of the objectionable features specified and embraces the requisites above mentioned.

For a consideration of what I consider to be novel and my invention attention is called to the description and claims appended thereto.

In the accompanying drawings, which illustrate my invention, Figure 1 is a vertical section of a boiler and burner. Fig. 2 is a perspective view of the boiler-casing. Fig. 3 is a longitudinal section of the burner. Fig. 4 is a sectional view of the burner, taken on line 4 4 of Fig. 3; and Fig. 5 is a detail view of a plunger used for cleaning the opening in the burner.

The boiler is of the general type known as a "flash-boiler" and is composed of a series of grids A, made up of seamless tubing and preferably of small bore but large cross-section. The grids may be bent into any suitable form, providing that when they are assembled spaces or flues are formed, permitting the products of combustion to pass freely from the bottom to the top. Surrounding the boiler-tube is a metal casing B, and between the casing and the boiler is a packing of heat-resisting material C, such as asbestos, for example. Bolted to the inside of the casing is a frame D, on which rests the asbestos packing, which surrounds the boiler-tube, and also two transversely-extending tubes E, the latter being employed to support the boiler-tubes. Covering the top of the casing is a metal cover F, and in this cover is formed a chamber F′, which chamber is connected with the exhaust-pipe V from an engine. The object of this chamber is to reheat the exhaust and render it invisible at ordinary temperatures. The chamber F′ communicates with the downdraft-flue G, while the boiler-space communicates with the updraft-flue H and also the downdraft-flue G. Situated under the boiler is a fire-box I. As here shown, the casing which surrounds the boiler performs the same office for the fire-box; but, if desired, a separate casing may be employed and the two joined together. The fire-box is substantially square, and located within the box and surrounding the burner is a circular coil of pipe J for heating the feed-water as it passes from the water-tank to the boiler. The feed-water pipe

is connected to the upper end of the boiler by an external connection J'. By reason of this being located outside of the casing a screw-threaded coupling can be employed. Located between the casing and the coil of pipe and closely surrounding the latter is a packing J^2, of heat-resisting material, which is supported by a frame-piece K, that also acts to support the coil of pipe.

It is desirable to prevent the sudden entrance of large quantities of air to the burner, since it cools the hot gases and causes the burner to smoke. To obviate this, the bottom of the casing is closed by a plate K', which also acts to support the burner, and air is admitted at a point above the flame and is suitably baffled, so as to prevent sudden inrushes from any cause. Air enters the casing through holes B', located just below the boiler-supporting tube or frame E and is baffled by the feed-water coil and passes downward in the corner-spaces between the casing and the coil, and by doing so becomes more or less heated, the burner serving to assist in the circulation of air. Owing to the fact that the stream of vapor from the burner is baffled a short distance above the burner-opening, the flame spreads laterally without creating as great an upward draft as would be the case if the baffle-plate did not exist. To create a greater updraft on the burner, I employ a steam-jet, which may with advantage be the exhaust from the propelling-engine. The exhaust is discharged into the downwardly-extending flue G, and when the system is in operation the waste products of combustion escape through this flue. In other words, the flames spread horizontally, and the forced draft causes them to bend into a substantially vertical plane, so as to exert their greatest effect on the boiler-tubes.

Referring to Fig. 2, a slight modification of the boiler is shown. The boiler proper is preferably composed of grids welded together in the same manner as previously described; but in place of utilizing the coil of feed-water pipe as a fire-box I substitute therefor a fire-box L, made of some heat-resisting material, such as fire-brick, for example. The boiler-tubes are supported by a frame-plate E, which is rigidly secured to the casing. In addition to supporting the boiler the frame-plate closes the opening between the casing and the fire-box L and prevents the entering air from passing directly to the flames at a point above the fire-box. The fire-box may be of any suitable configuration. In the present instance it is shown as cylindrical and is supported from underneath by clamps L', and these clamps are secured to the casing B. The casing is perforated by a series of holes B^2 at a point just below the plate E, and air entering these holes passes downward, as indicated by the arrows, and thence upward through the interior of the fire-box. In its passage between the outside of the casing and the fire-box the air becomes more or less heated, and the action of the burner tends to aid the circulation. Owing to the casing being rectangular in shape and the fire-box and feed-water heater substantially round, plenty of space is provided at the corners of the casing to permit the air to enter.

Referring more particularly to Figs. 3 to 5, the construction of the burner will be described. I have found that in burners of this class it is desirable to have a vessel of comparatively large size for vaporizing, so as to permit free ebullition and also to permit the vapor to leave the vessel without entraining liquid particles of oil, which cause pulsation of the flame. This entraining of the fuel with the vapor is sometimes called "priming." The liquid oil should never come into contact with a red-hot surface on account of carbonizing; but once the vapor is formed it can be superheated without injury. The vaporizer should be so constructed and arranged that the liquid fuel has a tendency at all times to flow or to stay at the lower and cooler end, and the oil should be introduced into the vaporizer at its coldest point and permitted to work gradually toward the hotter and be discharged as vapor at the latter point. I have also found that it is preferable to provide some fairly quick heating-tube or part near the burner proper to insure the conversion into gas of the liquid fuel at the time of starting and also to superheat the vapor when the burner is in operation. With a quick-heating tube there is no opportunity for the vapor to condense before leaving the nozzle, and when used with a single opening, as shown, there is no tendency to "back fire."

Mounted on the base of the boiler-casing is a burner composed of three principal parts M, N, and O. The part or tube M is secured to the bottom plate of the boiler or to any other suitable support by nuts, one being located above and the other below the support. On the upper end of the tube is formed a screw-thread for supporting the tray N. The tray is divided into compartments, and connecting these compartments is an opening N'. The right-hand compartment is filled with asbestos or some similar material, which acts as a temporary burner for heating and vaporizing the fuel at starting. In other words, the temporary burner gives to the main burner the capacity for starting with the same fuel that is employed in normal operation. The fuel being kerosene there is no danger even when the tray is flooded. Secured to one of the walls of the chamber and extending past an opening N^2 in the tray is a wick P, which passes through a hole in the bottom of the boiler casing or support and is accessible when it is desired to start the apparatus into operation. By dividing the tray into compartments a suitable space is

provided for the asbestos or auxiliary starting-burner, the side walls holding the same in place. Another advantage resides in the fact that the asbestos can be much more readily renewed and fitted than is the case where it passes around the hub-like extension on the tray. By separating the asbestos from the central hub the burner can be more easily cleaned and more satisfactorily operated. The invention is designed for use in connection with automobiles, and anything which contributes to their simplicity as to care or operation is desirable.

Screw-threaded to the upper end of the hub-like projection on the tray N is the part O, which forms the burner proper, and mounted in the end thereof is a detachable screw-threaded plug or nozzle Q, having a central opening through which extends the plunger R. It is important to give the discharged kerosene-vapor stream a certain definite direction. To do this, the wall of the opening in the nozzle is made cylindrical, and I have found that where this wall is one-fourth of an inch long satisfactory results can be attained. The principal feature is to make the passage long enough to give direction to the jet, and this without premature baffling, which causes a smoky and yellow flame. The vapor-jet must not be interfered with between the time it leaves the nozzle and impinges on the baffle-plate. Otherwise a yellow flame will result. The jet should be so directed against the baffling means that it will be spread out in a thin stratum and mix with the proper amount of air to support combustion. The opening can with advantage have a diameter of from .0635 inch to .07 inch; but I do not wish to be understood as limiting myself to the specific dimensions mentioned. As a general proposition it may be stated that an opening which is too large will give a poor flame on low pressure, (light duty,) while an opening which is too small has a tendency to cause the flame to go out under high pressure, (heavy duty,) owing to the high velocity of the jet. The nozzle-opening must be very small as compared with the cross-section of the tube T. The one shown bears the relation of about one to two hundred and fifty-six. I do not wish to be understood as limiting myself to this exact relation, however, as it can be varied without departing from my invention.

The plunger R is enlarged at the lower end to form a working fit with the tube M, and at its extreme lower end is provided with teeth which engage with a pinion R′. The upper end of the plunger where it passes through the screw-threaded piece or plug Q is not intended to act as a valve except in certain cases, since it makes a loose fit therewith, but is intended to keep the opening in the burner free from foreign matter. Under normal conditions the spring S, working on the lever S′, pulls the plunger out of the opening in the nozzle, and thereby gives full opening for the vapor. The matter which collects around the opening in the nozzle is very hard, and sometimes a considerable effort is required to dislodge it. Connected to the lower end of the lever S′ is a rod or wire S^2; which extends to any convenient operating-point. By pulling this wire the plunger is forced upward into the opening, and any foreign matter which may have collected will be removed. Sufficient vapor will leak out from around the plunger at all times to maintain the flame and keep the parts hot for instant use unless the supply of fuel is entirely cut off. It is to be noted that the pin or needle R when the burner is operating normally is entirely removed from the cylindrical opening in the nozzle. This is important, as it affords a relatively unrestricted opening for the fuel, and thereby prevents the flame from being yellow. When the needle is inserted in place, as shown in Fig. 3, the size of the opening is greatly reduced, but the velocity of the vapor still remains high, and since the needle stops at a point at or below the top of the nozzle the vapor is not baffled. It is imperative with burners of this class that no controlling means or other devices be inserted between the end of the nozzle and the baffle-plate, because the character of the flame will be impaired.

In order to obtain satisfactory results with a kerosene-burner, I have found that a certain definite relation of parts is essential and that the parts must coöperate in a certain specified manner. In order to insure a blue flame and prevent disagreeable odors, the vapor should leave the nozzle-opening under high velocity and strike a baffle-plate that is situated in close proximity thereto. The pressure on the fuel service can with advantage be from forty to sixty pounds, and the baffle-plate is preferably situated at a point not less than three-fourths of an inch from the nozzle nor more than one and a half inches. When the baffle-plate is nearer than this, the vapor will not properly combine with the oxygen and the flame will be yellow and will give off a disagreeable odor, and when the plate is farther away the flame will be objectionable for the same reasons. In the latter case the flame may be extinguished, due to the high pressure on the fuel system. As the vapor-jet strikes the under side of the baffle-plate it spreads out radially and picks up the necessary amount of air. By reason of the relation that the nozzle bears to the baffle-plate in the structure shown the proper amount of air will pe picked up, whether the pressure be small or great. This takes place in the space extending from about the center of the baffle-plate to some distance beyond its periphery, which I term the "carbureting zone," as it is in this space the vapor is car-

bureted so that it will burn with an intense blue flame in the space beyond the carbureting zone and which I term the "combustion zone." Thus it will be seen the sole function of the baffle-plate is to scatter or pulverize the vapor and deflect the particles outwardly with considerable force to a distance more or less remote from the baffle-plate previously to ignition, and thereby decreasing the velocity of the vapor and producing a flame of large area.

In order to insure the proper vaporization of the kerosene-oil, I have found that it must enter the vaporizer at the coolest point and gradually increase in temperature to the point of discharge. This is accomplished by connecting the fuel-pipe leading from the tank to the lower end of the vaporizer T, and preferably this connection is made at or near the plate K′, that separates the burner from the external atmosphere, because considerable difference in temperature exists between the upper and lower sides of the plate. It is to be noted that the upper side of the plate is subjected to heat from the burner, while the lower side is subjected to the cooling effects of the external air. This is particularly noticeable when the vehicle to which the burner is applied is in operation. It will thus be seen that the plate K′ forms a shield by means of which a suitable difference in temperature is maintained between the incoming liquid fuel and the liquid and gas in the vaporizer or vessel T.

Another thing which I have discovered in connection with kerosene-vapor burners is that the amount of vapor produced by the vaporizer must automatically increase with the demand for vapor, the amount of fuel necessary to supply the vapor being supplied by a suitable pump or its equivalent. In carrying out this feature of my invention the vaporizer is placed a short distance from the burner-nozzle and so related thereto that when the flames are properly baffled they will strike it. When the burner is working under a relatively low pressure—such, for example, as is the case when the demand for heat is small—the flames are chiefly directed toward portions of the vaporizer adjacent to the baffle-plate; but as the demand increases the increased pressure causes the flames to spread and include the parts of the vaporizer at a greater distance from the baffle-plate. A greater supply of vapor energy to meet the demand results in the flames enveloping more of the vaporizer and as the supply increases the flame envelops more and more of the vaporizer. Consequently the amount of vapor produced thereby is correspondingly increased. To state this feature in a different way, the vaporizer is so constructed that its effective heating-surface increases with the increased amount of vapor delivered to the burner. From the foregoing it follows that there is a certain definite level for the oil in the vaporizer for a given condition, and when the demand for energy is increased this level is lowered. Obviously, when the demand for vapor energy is decreased and the pressure is reduced the flames will not envelop so much of the vaporizer and the amount of vapor produced will be decreased and the level of the oil will be raised, but always from a cooler to a hotter point.

It is important to prevent oil from being trapped between the vaporizer and the burner-opening, because it causes pulsation of the flame, and to prevent this a means in addition to the arrangement described is provided which is more easily heated than the other parts of the burner and which is placed in series with and between the vaporizer and the burner-nozzle. By reason of the construction described there is a gradual increase in temperature of the oil from the time it is delivered to the vaporizer until it issues as superheated vapor from the nozzle. By arranging the parts so that there is a gradual increase in temperature of the vapor from start to finish and by delivering the same at the highest temperature I am enabled to prevent carbonization. I am also able to prevent condensation of the vapor, which is highly objectionable. If the flame is accidentally extinguished, it will be immediately relighted, because the parts are in close proximity to the vapor-stream and are red hot, or nearly so. I may carry out these features of my invention by the following means: Situated on one side of the central stem of the burner is a vessel T, of considerable size, forming a vaporizer and also a reservoir and connected by a pipe extending from its lower end to the oil-reservoir proper. Mounted on the upper end of the vessel or otherwise connected therewith is a second vessel T′, which may or may not be filled with asbestos T^2 for assisting in the vaporizing of the fuel. On the under side of the vessel T′ is formed or secured a baffle-plate T^3 for spreading the vapor from the nozzle, so that it will mingle with the air in the proper manner. Connecting the right-hand end of the vessel T′ with the burner is a curved tube U, which tube is easily heated. This insures the proper vaporization of the fuel before it enters the burner at the time of starting. Later on after the parts have been heated the tube U still continues to carry vapor from the vaporizer to the burner, and it may or may not assist in the vaporizing of the fuel. It is preferable that it should, however, because it prevents condensation and insures the proper temperature of the vapor.

It will be noted that the main vaporizer rises from the point of oil admission, one of the reasons for this being that it reduces to a minimum the liability of liquid oil being entrained with the vapor, which entrained oil

gives a smoky yellow flame and causes pulsation. In the vaporizer shown there is always a body of oil at the base which gradually gets hotter and hotter as it ascends, the top being entirely filled with vapor which is entirely free from entrained oil. The arrangement of parts shown causes the oil to be uniformly heated and only the hottest and driest vapor to be delivered to the nozzle. This also prevents any surging or pulsation of the flame. The vapor as it is discharged under relatively high pressure strikes the baffle-plate T^3 and mingles with the proper amount of air to support good combustion. As the pressure increases the flames spread over a greater area and include more and more of the tube U and the vessels T and T'. This means that the vessel T instead of being hot merely at the upper end is hot to a point considerably lower than that, thereby causing a greater amount of vapor to be formed. The increased pressure on the fuel system, due to increased demand, is directly responsible for the spreading of the flames, and as the flames spread the effect of the vaporizer is automatically increased by an amount corresponding to the increase in demand. Conversely, when the demand decreases the flames envelop a smaller portion of the vaporizer, and this decrease is in accordance with the demand.

Assuming that it is desired to start the boiler into operation, the plunger R is withdrawn, oil under pressure is admitted to the vessel T by means of a controlling-valve, and the parts being cold it passes through the vessel T', tube U, and burner in a liquid state and more or less floods the tray N. The oil works into the asbestos-burner N^3, thence through the openings N' and N^2, and down the wick P. As soon as oil begins to drip from the wick the supply is cut off, a match is applied, and the flame travels up the wick to the asbestos burner. In practice I have found that when the oil begins to drip from the wick P it is time to cut off the supply to the burner. In a short time after the wick takes fire the parts become heated, the fuel is changed to vapor and ceases to flow into the tray, even though a certain amount of fuel be admitted to the receptacle T. When this occurs, the asbestos burner stops for want of fuel. As soon as the curved tube U gets hot the oil changes to vapor, and after a few moments burning the receptacles T and T' get so hot that all of the oil in T' and a portion of that in T is vaporized and the apparatus is in readiness for operation. Under ordinary working conditions the plunger R is withdrawn from the screw-threaded plug and the tube or receptacle T is about one-half full of liquid, the balance being vapor. This arrangement constitutes, in effect, a reservoir containing vapor in sufficient quantity to provide for any sudden demand on the burner.

The arrangement of the inclosing casing, with its flues, air-admitting openings, deflectors, &c., is not claimed herein, since it forms the subject-matter of a companion case, Serial No. 143,314, filed February 14, 1903, as a division of Serial No. 43,510, filed January 16, 1901.

In accordance with the provisions of the patent statutes I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is merely illustrative, and that the invention can be carried out by other means.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a burner, the combination of a nozzle, a vaporizer having a vertical portion extending above and below the nozzle so as to retain liquid fuel at its lowest and coolest part, a main portion extending horizontally over and in close proximity to the nozzle and provided with a baffle-plate which causes the vapor from the nozzle to be deflected horizontally below said main portion of the vaporizer, and a relatively thin vapor-conducting portion connecting the main portion of the vaporizer with the nozzle.

2. In a vapor-burner, the combination of a base, a vaporizer mounted on the base, a connection for delivering oil to the vaporizer at a point under the base, a nozzle having a single opening which is much smaller in cross-section than the vaporizer, a tube that is more easily heated than the vaporizer and connected thereto for conveying vapor therefrom to the nozzle and superheating it, and a flat-bottom baffle-plate which is situated between the vaporizer and said tube with its periphery separated by a space therefrom, the said plate being in close proximity to the nozzle-opening for deflecting the vapor and causing it to burn in the space intermediate the vaporizer and the tube and at the same time heat them, substantially as set forth.

3. In a vapor-burner, the combination of a base, a vapor-receptacle, a nozzle, a tray or receiver comprising two connected compartments and located in such manner that one compartment will receive oil from the nozzle, a burner in the other compartment which is supplied from the oil-receiving compartment, and a wick communicating with the burner, which passes through an opening in the base and is accessible from underneath.

4. In a vapor-burner, the combination of a base, a nozzle supported by the base, a fuel-conveying tube connected with the nozzle, a tray mounted under the tube and the nozzle, which tray is divided into communicating

compartments, one of said compartments being located adjacent to and extending parallel with the fuel-conveying tube, the other compartment being arranged to receive liquid fuel from the nozzle and convey it to the first compartment, a burner located in the first compartment, and a wick which extends from the burner through the base and receives fuel from the burner.

5. In a vapor-burner, the combination of a nozzle, a vaporizer, a tray for receiving oil from the nozzle, said tray comprising a compartment concentric to the nozzle and a communicating compartment extending to one side thereof and under the vaporizer, a burner made of asbestos or similar material in the second compartment, a casing for the burner, and a wick extending downward from the burner to a point outside of the casing whereby the burner may be started into operation.

6. In a burner, the combination of a baffle-plate, a nozzle in close proximity thereto which discharges a jet of vapor fuel in a definite direction against the plate at such velocity as to prevent ignition before the jet strikes the plate and to cause the vapor to be deflected in a different direction from that of the jet at reduced velocity to permit burning thereof in a combustion zone beyond the edge of the plate, and a fuel-carrying conduit connected with the nozzle, which has a vaporizing portion located in the combustion zone on one side of the baffle-plate, a superheating portion on another side of said plate also in the combustion zone, and a connecting portion between the vaporizing and superheating portions.

7. A burner of the jet type, comprising a vapor-discharging nozzle, a baffle-plate arranged adjacent to the nozzle and having a vapor carbureting zone and a combustion zone entirely surrounding its periphery, a vaporizer connected with the nozzle and located beyond the carbureting zone and in the zone of combustion, a part of said vaporizer being above the nozzle-orifice and a part below so that the coolest fluid will always collect at the bottom, a shield for the lower end of the vaporizer, and a conduit for supplying fuel to the vaporizer on the cooler side of the shield.

8. In a burner, the combination of a baffle-plate which is surrouned by a carbureting and a combustion zone, a nozzle in close proximity to the baffle-plate, which delivers a jet of vapor in a definite direction directly upon the baffle-plate at such velocity as to cause substantially all the vapor to be deflected over a relatively wide area for causing it to mix with air in the carbureting zone and to burn in the combustion zone, a fuel-carrying conduit connected with the nozzle, which comprises an upwardly-extending vaporizing portion, a transversely-extending connecting portion, and a downwardly-extending superheating portion connected with the nozzle.

9. In a vapor-burner, the combination of a nozzle for discharging the vapor in the form of a single stream or column at relatively high velocity, a vaporizer having a part which occupies a vertical position and extends above and below the nozzle so that liquid fuel will collect at the bottom, which is the coolest point, the bore of the nozzle being materially smaller than that of the vaporizer, a conduit connecting the vaporizer and the nozzle which has a bore smaller than the vaporizer and larger than the nozzle for conveying vapor to the nozzle and at the same time superheating it, and a baffle-plate situated in close proximity to the nozzle-orifice so that it will receive the stream or column of vapor and spread it outwardly into the surrounding combustion zone where it ignites and heats the vertically-disposed vaporizer and the said vapor-superheating conduit.

In witness whereof I have hereunto set my hand this 25th day of January, 1901.

HERMANN LEMP.

Witnesses:
DUGALD McK. McKILLOP,
JOHN A. McMANUS.