J. N. LEACH.

FEED SYSTEM FOR HYDROCARBON BURNERS.

APPLICATION FILED FEB. 25, 1905.

938,670. Patented Nov. 2, 1909.

2 SHEETS—SHEET 1.

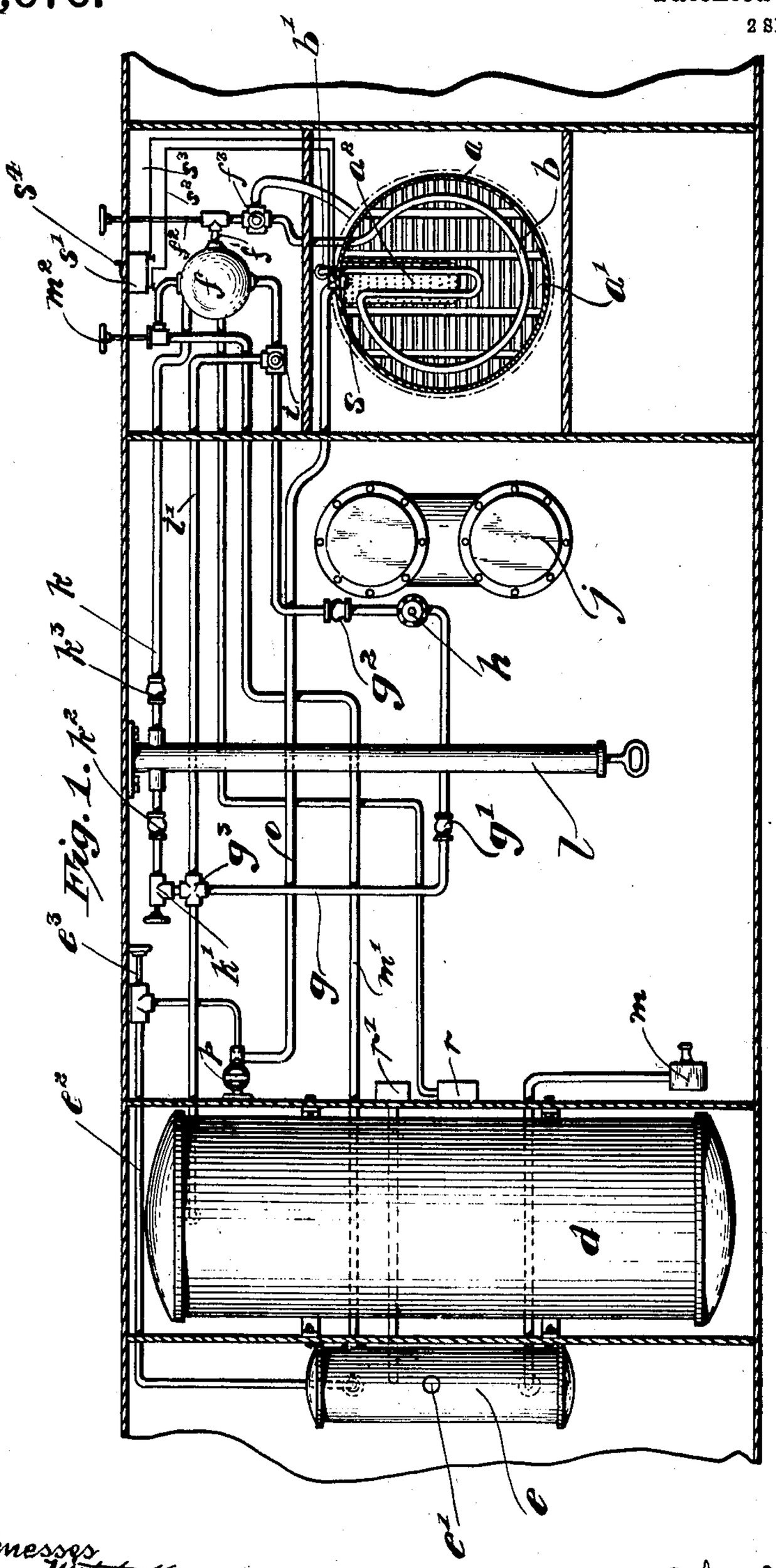

Fig. 1.

Witnesses
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2 SHEETS—SHEET 2.

Fig. 3.

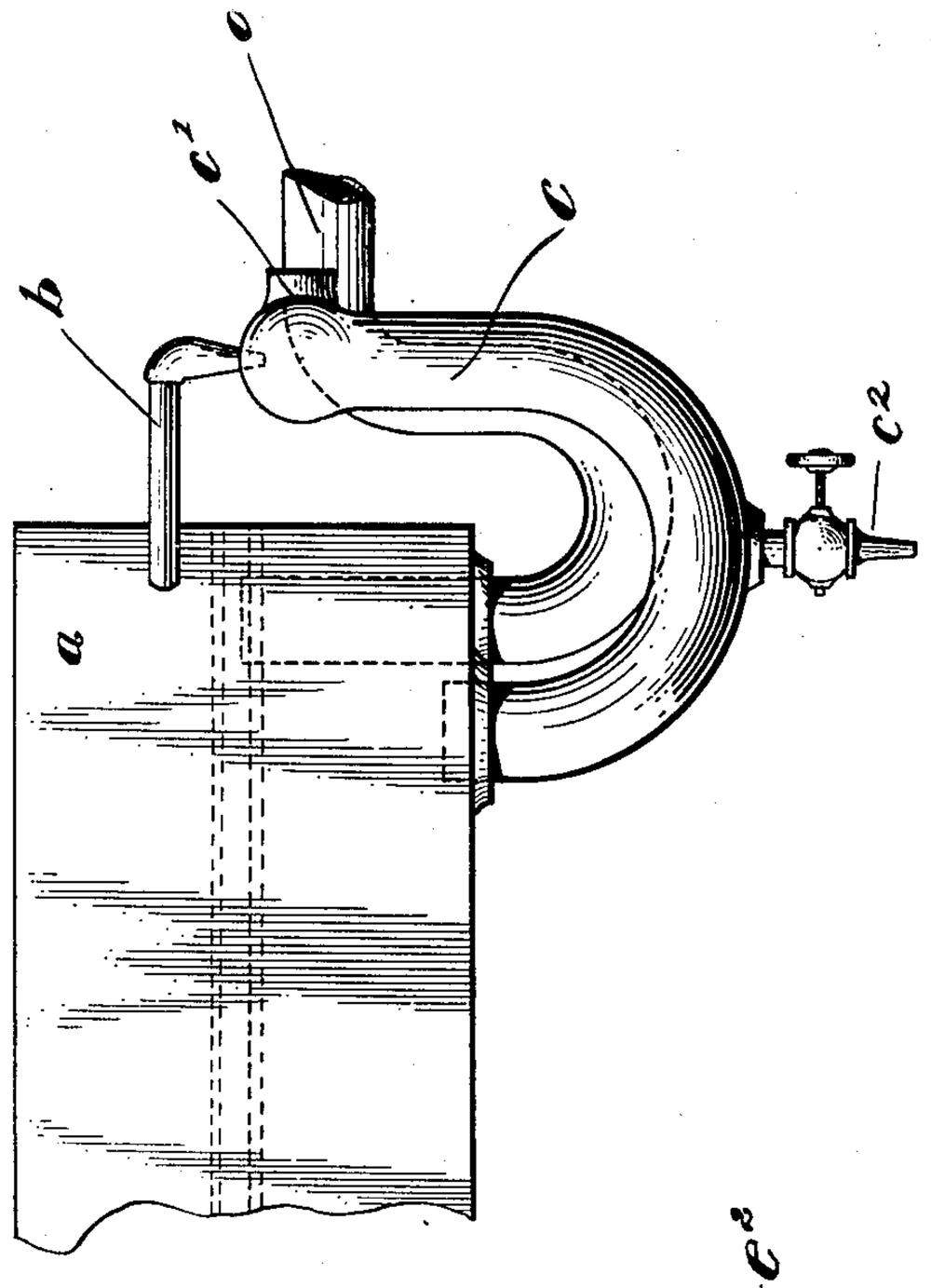
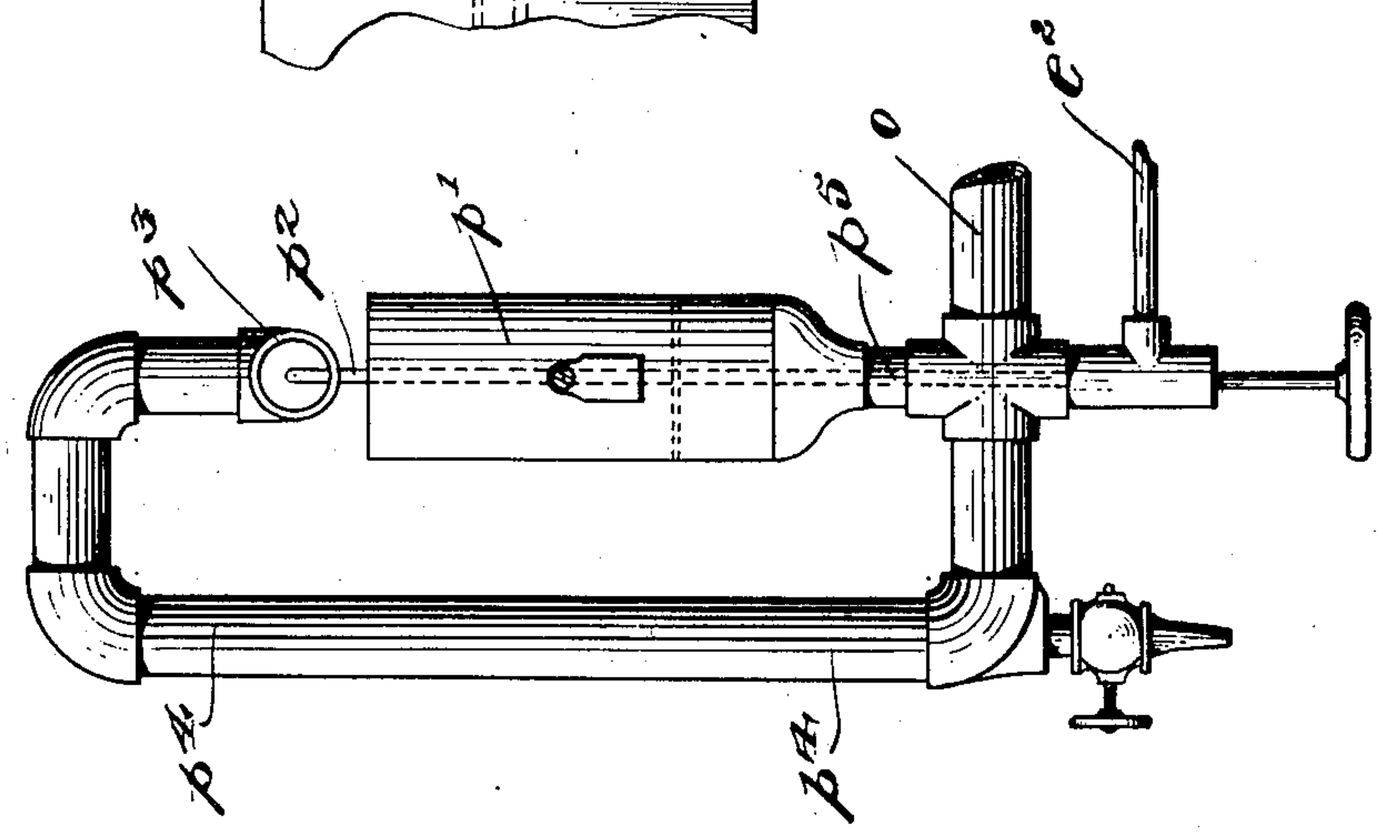


Fig. 2.



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By his Attorney
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UNITED STATES PATENT OFFICE.

JOHN N. LEACH, OF MELROSE, MASSACHUSETTS, ASSIGNOR TO JUDSON L. THOMSON MANUFACTURING COMPANY, OF WALTHAM, MASSACHUSETTS, A CORPORATION OF MAINE.

FEED SYSTEM FOR HYDROCARBON-BURNERS.

938,670. Specification of Letters Patent. Patented Nov. 2, 1909.

Application filed February 25, 1905. Serial No. 247,270.

To all whom it may concern:

Be it known that I, JOHN N. LEACH, a citizen of the United States, residing at Melrose, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Feed Systems for Hydrocarbon-Burners, of which the following is a specification, reference being had therein to the accompanying drawings, which form a part thereof.

My invention relates to feed systems for hydrocarbon burners and more particularly to a class of such wherein oil under pressure, is fed to vaporizing retorts.

The main object of the invention is to provide such a system wherein separate burners may be maintained independently of each other in a manner to insure a small, steady and constant flame in the one, and permit the independent control and forcing of the other to meet all the requirements of the use of such a burner.

A further object is to provide such a system wherein oil will be automatically fed to the pressure tank for the main or secondary burner fuel supply, in proportion to the quantity of oil being consumed, thus maintaining the pressure in said tank when said burner is in use.

A further object is to combine in a system having the above characteristics, means whereby oil in individual pressure tanks may be placed under pressure to facilitate the starting of both burners.

A still further object is to provide means whereby the oil supply and pressure in said low pressure tank may be replenished and raised from the high pressure tank. And a still further object is to provide a system wherein the vapors for the primary burner or torch may be generated apart from the burner, and the initial supply of vapors therefor may be ignited without manual application of a flame to the combustion chamber of said burner.

The invention consists primarily in the combination with a primary burner and a secondary burner having separate mixing chambers and a common combustion chamber, of a primary burner vaporizer, means whereby vapors generated therein are given an admixture of air and discharged into the mixing chamber of said primary burner, a secondary burner vaporizer, means whereby vapor therefrom is given an admixture of air and discharged into said secondary burner mixing chamber, an oil reservoir, a high pressure tank, a low pressure tank, oil conduits connecting said reservoir and said high pressure tank, said high pressure tank and said secondary burner vaporizer, and said low pressure tank and said primary burner vaporizer, respectively, and means whereby the feed of oil from said tanks is individually controlled; and in such other novel features of construction and arrangement of parts as are hereinafter set forth and described and more particularly pointed out in the claims hereto appended.

Referring to the drawings:—Figure 1 is a plan view illustrating the application of my invention to a steam carriage; Fig. 2 is a side elevation on a larger scale, of the primary burner generator, and Fig. 3 is a similar view of a portion of the burner showing the relation of the secondary burner vaporizer spraying nozzle, its mixing tube and the discharge end of the conduit from the primary burner generator.

Like letters refer to like parts throughout the several views.

I have illustrated my invention in connection with a type of burner comprising a outer casing *a*, divided horizontally by large or secondary burner plate *a'*, and hollow casting forming a smaller or primary burner plate a^2 and its mixing chamber, the lower portion of the casing *a* constituting a mixing chamber for the secondary burner plate *a'* and the upper portion of said casing constituting a combustion chamber common to both said burners. The said burner plates, with the exception of the burner openings therein, close the bottom of the combustion chamber so formed, thus preventing down drafts which would tend to draw the flames from said chamber. In the combustion chamber, I arrange an overlying vaporizer *b* formed as a continuous pipe arranged in two sections which are subjected to the secondary and the primary burners respectively. This vaporizer is provided with a discharge nozzle *b'* which projects a vapor jet into the mixing tube *c* drawing air therewith into in sufficient quantities through the air inlet *c'* to cause such an admixture of the

vapor or gases therewith as will develop a highly combustible, clean burning product. The mixing tube *c* is preferably shaped substantially as shown, to form an oil trap to prevent a temporary flooding of the mixing chamber when the burner is first started, due to all the parts not having yet become sufficiently hot; and this trap, I provide with a drip cock c^2 whereby it may be drained.

The feed system proper comprises an oil reservoir *d* a low pressure tank *e* and a high pressure tank *f*. The first of these is merely a source of oil supply, the second feeds the generator or vaporizer of the primary burner or torch, and the last that of the secondary or main burner.

Connecting the reservoir *d* with the high pressure tank *f* is a conduit system comprising the piping *g* having in its length an oil pump *h* with check valves *g'* g^2 on opposite sides thereof; a pressure regulator *i* between said valve g^2 and the tank *f* and a by pass pipe *i'* returning to the reservoir either through the first portion of the conduit *g* by means of a multiple way joint g^3, or by an independent connection with said reservoir, if desired. The pump *h* is operated from the engine cross head, or any other desired type of power pump may be substituted therefor.

To fill the tank *f* with oil under the requisite pressure, I provide a branch pipe *k* controlled by a valve *k'* having in its length a hand pump *l* arranged between the check valves k^2 k^3, the opposite ends of the said pipe *k* respectively tapping the section *g*, and feeding directly into the said tank.

j indicates the engine.

The tank *e* may be filled in any desired manner, as through the normally closed opening *e'*, and oil therein is placed under pressure through the valve *m* and an ordinary detachable hand air pump not shown. Preferably, however, after the burner system has been once run, I fill this tank through a pipe connection *m'* between it and the tank *f*, which contains a valve m^2 in its length. In case of the said tank *e* containing a large quantity of oil with a small air cushion, the valve *m* is preferably used to avoid the elimination of this cushion. The air cushion in this tank is not subject to the variation of that of the high pressure tank, inasmuch as the flow of oil from this tank is very slow, the flame maintained thereby, while constant, being comparatively small and of uniform force.

The piping heretofore described, as well as all other oil feed piping hereinafter referred to, is of small gage, being from 1/16 to 1/8 inch piping.

The drawings are merely a conventional showing of the invention, it being impracticable with so small a scale to preserve the proper proportions of the various parts, and permit a photographic reproduction of the drawings.

Having described the feed system as to furnishing oil to the pressure tanks, I will now describe the system whereby oil therefrom is fed to the separate generators or vaporizers.

The primary burner a^2, which I so term for convenience of expression as representing the burner which not only is first started, but which is of the first importance in the maintenance of the entire burner, irrespective of its function in generating vapors or gases, or producing calorific force, is in the form of the invention shown, fed through a vapor conduit *o* with gases generated in a remote generator *p*. This generator having been made the subject matter of another application pending concurrently herewith, I will not describe it in detail beyond enumerating its various parts and designating them by reference letters. It comprises a burner plate having a mixing chamber contained within a cylindrical casing *p'* which casing extends considerably above said burner to form an inclosed combustion chamber. An upright vaporizer p^2 passes through this plate, and its mixing and combustion chambers, and projects above the casing into a mixing tube p^3, wherein the vapors generated in said vaporizer are admixed with air and fixed. Suitable connections p^4 p^5 are provided by which a portion of the gas is diverted to maintain a flame above said burner plate, the greater portion of these gases, however, being conveyed through the conduit *o* to the primary burner. Oil is fed to the vaporizer p^2 from the the tank *e* through the small feed pipe e^2 having in its length the controlling valve e^3. The feed of oil to the vaporizer *b* is through the small feed pipe *f'* having in its length a controlling valve f^2 and a pressure regulator f^3 which is also connected with the boiler indicated in dotted lines in Fig. 1 so as to automatically cut out the oil feed to the secondary or main burner vaporizer *b* when the boiler pressure has reached a predetermined point below the blow out.

I provide suitable pressure gages *r r'* connected respectively with the high and with the low pressure tank, and arranged at a point convenient for inspection. Preferably these gages, as well as the generator *p* are mounted on the foot board in front of the chauffer's seat.

To insure the ignition of the gases passing through the burner a^2 at starting, I provide within the casing *a* a spark plug *s* and connect same with a suitable Ruhmkorff coil and battery *s'* by wires s^2 s^3, a switch s^4 being arranged to permit the said coil being put out of circuit except when the burner is to be ignited. The valves m^2 and f^2 and the switch s^4 are preferably mounted so as to be

accessible from the outside of the chauffeur's seat, being what are termed "seat control" mechanisms.

The operation of the heretofore described feed system is substantially as follows: In starting the whole system including both burners, the low pressure tank *e* having been partially filled with oil, kerosene being preferably used, an air cushion of preferably from 20 to 30 pounds is placed thereon by a hand pump in conjunction with the valve *m*, the gage *r'* indicating when the desired pressure is reached. The vaporizer p^2 is then heated to a dull red heat by a hand torch, the valve e^3 thereafter being slowly opened and closed several times. The Rumhkorff coil is then placed in circuit and the valve e^3 is opened and left so, thus maintaining a permanent flame in the generator *p* as well as providing a constant flow of gas to the primary burner through the conduit *o*. These gases are instantly ignited from the spark plug *s* when they enter the combustion chamber, thus avoiding a possible accumulation of such in the combustion chamber about the boiler. When the primary burner is ignited, the said coil is again put out of circuit. The hand pump *l* is then used to fill the high pressure tank *f*, the valve *k'* being temporarily opened for this purpose. When the pressure as indicated by the gage *r*, in this tank is about 120 pounds, the valve f^2 may be opened at any time to start the main fire, a portion of the vaporizer *b* being constantly heated by the flame from the burner a^2 to a degree to insure the instant volatilization of the oil therein or of the greater part thereof. The ignition of the admixture of said vapor and air occurs immediately when it enters the combustion chamber, from said flame also. In case of the blowing out of an oil spray prior to the complete volatilization of the oil passing through the said vaporizer, such will accumulate in the trap formed by the mixing tube *c* and prevent the flooding of the mixing chamber as well as the fumes which ordinarily arise from burning oil. Pressure in the said tank is maintained by the hand pump *l* until a sufficient head of steam is obtained to run the car, whereupon the valve *k'* is closed and the pump *h* thereafter relied upon to keep up said pressure through the running of the engine *j*. The regulator *i* is set at the pressure desired in the high pressure tank *f* and when the pressure reaches this maximum point, the oil is by-passed through the piping *i'* to the reservoir *d* or pump *h*. When the boiler pressure reaches the desired maximum pressure, which ordinarily is from 400 to 500 pounds, the regulator f^3 immediately cuts out the main fire automatically. It will thus be observed that under all conditions, oil is fed to the vaporizer *b* under substantially the same pressure, insuring an even quantity of feed, variable only under the control of the valve f^2, and a resulting uniform production and consumption of gases. The conditions of use of the primary burner are substantially the same at all times, as the consumption of oil from the tank *e* is so small as to not appreciably reduce the pressure therein in several hours, thus maintaining a low, constant flame from the burner a^2 which not only acts continuously upon the vaporizer *b* to initiate at all times the generation of vapors therein, and as an ignition torch within the combustion chamber, but to maintain a low boiler pressure when the engine is not running and the main burner is cut out, it having been determined that in a small fire tube boiler, this flame alone will hold the pressure at about 350 pounds for several consecutive hours. If at any time, when oil under pressure is in the tank *f* and the pressure in the tank *e* is found to have dropped below that desired, oil may be transferred from the high pressure to the low pressure tank to raise the pressure in the latter, by simply opening the valve m^2.

While particular advantage accrues from the type of burner herein shown and described, I do not describe such, as the combination of this burner is made the subject matter of other applications for Letters Patent pending concurrently herewith.

I have described this system in connection with a detached primary burner generator, but I do not desire to limit my feed system to this particular location of the primary generator as it may be located in any usual or desired relation with the main burner.

It is sometimes found that the pump *h* will become air bound when the by-pass *i'* is completed through the pipe section *g*, under which conditions it is necessary and desirable to discharge said by-pass section directly into the tank *d*.

It is not my intention to limit my invention to the precise details herein shown and described, as the same may be varied to adapt the system to different models of steam carriages, and other uses without departing from the spirit and scope of my invention.

Having described the invention, what I claim as new and desire to have protected by Letters Patent is:—

1. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom, oil conduits connecting said reservoir and said high pressure tank, said high pressure tank and said main vaporizer and said low pressure tank and said pilot vaporizer, respectively,

and means whereby the feed of oil from said tanks to said vaporizers is separately controlled.

2. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom, oil conduits connecting said reservoir and said high pressure tank, said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said vaporizers is separately controlled, and means whereby oil is automatically fed to said high pressure tank to maintain the pressure therein.

3. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom, oil conduits connecting said reservoir and said high pressure tank, said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said vaporizers is separately controlled, and a pressure regulator and by-pass system in conjunction with said means, whereby the maximum pressure in said high pressure tank may be regulated.

4. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom, oil conduits connecting said reservoir and said high pressure tank, said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of the oil from said tanks to said vaporizers is separately controlled, and an oil pump having suitable check valves in connection therewith arranged in the conduit connecting said high pressure tank and said reservoir.

5. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom, oil conduits connecting said reservoir and said high pressure tank, said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of the oil from said tanks to said vaporizers is separately controlled, an oil pump having suitable check valves in connection therewith arranged in the conduit connecting said high pressure tank and said reservoir, a pressure regulator, and a by-pass system arranged in and in conjunction with said conduit connecting said high pressure tank and said reservoir.

6. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom, oil conduits connecting said reservoir and said high pressure tank, said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said vaporizers is separately controlled, means whereby oil is automatically fed to said high pressure tank to maintain the pressure therein, and a branch pipe drawing oil from said reservoir and discharging into said high pressure tank having arranged therein a controlling valve and a hand pump provided with suitable check valves.

7. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom, oil conduits connecting said reservoir and said high pressure tank, said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said vaporizers is separately controlled; an oil pump having suitable check valves in connection therewith, a pressure regulator, and a by-pass system arranged in and in conjunction with the conduit connecting said high pressure tank and said reservoir; said means for controlling the oil feed from said high pressure tank comprising a controlling valve and a pressure regulator arranged in the conduit between said high pressure tank and said main vaporizer; a boiler receiving its heat from said apparatus, and connections between said last-named regulator and said boiler.

8. The combination with a hydrocarbon burning apparatus having a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank, oil conduits connecting said reservoir and said high pressure tank, said high pressure tank and said

main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said vaporizers is separately controlled, and a pipe connection between said high pressure tank and said low pressure tank having in its length a controlling valve.

9. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom, oil conduits connecting said reservoir and said high pressure tank, said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said vaporizers is separately controlled, and means whereby oil in said low pressure tank may be placed under pressure.

10. The combination with an apparatus for generating and burning gas from hydrocarbons comprising a main burner having a main vaporizer, a pilot burner, and a generator including a pilot vaporizer remote from said pilot burner; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank, oil conduits connecting said reservoir and high pressure tank, said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said main vaporizer and said pilot vaporizer is separately controlled, and means whereby the feed of oil from said high pressure tank to said main vaporizer and said pilot vaporizer is separately controlled.

11. The combination with an apparatus for generating and burning gas from hydrocarbons comprising a main burner having a main vaporizer, a pilot burner, and a generator including a pilot vaporizer remote from said pilot burner; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank, oil conduits connecting said reservoir and high pressure tank, said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said main vaporizer and said pilot vaporizer is separately controlled; an oil pump having suitable check valves in connection therewith, a pressure regulator, and a by-pass system arranged in and in conjunction with the conduit connecting said high pressure tank and said reservoir; said means controlling the oil feed from said high pressure tank comprising a controlling valve and a pressure regulator arranged in the conduit between said high pressure tank and said main vaporizer; a steam boiler heated by said burners, and connections between said boiler and said last-named regulator.

12. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom, oil conduits connecting said reservoir and said high pressure tank, said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said vaporizers is separately controlled; an oil pump having suitable check valves in connection therewith, a pressure regulator, and a by-pass system arranged in and in conjunction with the conduit connecting said high pressure tank and said reservoir; said means for controlling the oil feed from said high pressure tank comprising a controlling valve and a pressure regulator arranged in the conduit between said high pressure tank and said main vaporizer; a boiler receiving its heat from said apparatus, connections between said last named regulator and said boiler, and a branch pipe drawing oil from said reservoir and discharging into said high pressure tank having arranged therein a controlling valve and a hand pump provided with suitable check valves.

13. The combination with an apparatus for generating and burning gas from hydrocarbons comprising a main burner having a main vaporizer, a pilot burner, and a generator including a pilot vaporizer remote from said pilot burner; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank, oil conduits connecting said reservoir and high pressure tank, said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said main vaporizer and said pilot vaporizer is separately controlled, an oil pump having suitable check valves in connection therewith, a pressure regulator, a by-pass system arranged in and in conjunction with the conduit connecting said high pressure tank and said reservoir, said means controlling the oil feed from said high pressure tank comprising a controlling valve and a pressure regulator arranged in the conduit between said high pressure tank and said main vaporizer, a steam boiler heated by said burners, connections between said boiler and said last-named regulator, and a branch pipe drawing oil from said reservoir and discharging into said high pressure tank having arranged therein a controlling valve and a hand pump provided with suitable check valves.

14. The combination in a feed system for a hydrocarbon burner apparatus embodying a main and a pilot vaporizer; of an oil

reservoir, a high pressure tank connected to said oil reservoir to receive its supply therefrom, a low pressure tank adapted to receive its supply from said reservoir, conduits connecting said tanks and said vaporizers, respectively, and means whereby the feed of oil from said tanks is separately controlled.

15. The combination with an apparatus for generating and burning gas fram hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom through said high pressure tank, oil conduits connecting said high pressure tank and said main vaporizer and said low pressure tank and said pilot vaporizer, respectively, and means whereby the feed of oil from said tanks to said vaporizers is separately controlled.

16. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom through said high pressure tank, oil conduits connecting said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said vaporizers is separately controlled, and means whereby oil is automatically fed to said high pressure tank to maintain the pressure therein.

17. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom through said high pressure tank, oil conduits connecting said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said vaporizers is separately controlled, and a pressure regulator and by-pass system in conjunction with said last-named means, whereby the maximum pressure in said high pressure tank may be regulated.

18. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom through said high pressure tank, oil conduits connecting said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of the oil from said tanks to said vaporizers is separately controlled, and an oil pump having suitable check valves in connection therewith arranged in the conduit connecting said high pressure tank and said reservoir.

19. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom through said high pressure tank, oil conduits connecting said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of the oil from said tanks to said vaporizers is separately controlled, an oil pump having suitable check valves in connection therewith arranged in the conduit connecting said high pressure tank and said reservoir, a pressure regulator, and a by-pass system arranged in and in conjunction with said conduit connecting said high pressure tank and said reservoir.

20. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom through said high pressure tank, oil conduits connecting said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said vaporizers is separately controlled, means whereby oil is automatically fed to said high pressure tank to maintain the pressure therein, and a branch pipe drawing oil from said reservoir and discharging into said high pressure tank having arranged therein a controlling valve and a hand pump provided with suitable check valves.

21. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom through said high pressure tank, oil conduits connecting said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said vaporizers is separately controlled; an oil pump having suitable check valves in connection therewith, a pressure regulator, and a by-pass system arranged in and in conjunction with the conduit connecting said high pressure tank and said reservoir; said means for controlling

the oil feed from said high pressure tank comprising a controlling valve and a pressure regulator arranged in the conduit between said high pressure tank and said main vaporizer; a boiler receiving its heat from said apparatus, and connections between said last-named regulator and said boiler.

22. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom through said high pressure tank, oil conduits connecting said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said vaporizers is separately controlled, and means whereby oil in said low pressure tank may be placed under pressure.

23. The combination with an apparatus for generating and burning gas from hydrocarbons embodying a pilot vaporizer and a main vaporizer; of a fuel feed system comprising an oil reservoir, a high pressure tank, a low pressure tank connected to said reservoir to receive its supply therefrom through said high pressure tank, oil conduits connecting said high pressure tank and said main vaporizer, and said low pressure tank and said pilot vaporizer, respectively, means whereby the feed of oil from said tanks to said vaporizers is separately controlled; an oil pump having suitable check valves in connection therewith, a pressure regulator, and a by-pass system arranged in and in conjunction with the conduit connecting said high pressure tank and said reservoir; said means for controlling the oil feed from said high pressure tank comprising a controlling valve and a pressure regulator arranged in the conduit between said high pressure tank and said main vaporizer; a boiler receiving its heat from said apparatus, connections between said last-named regulator and said boiler, and a branch pipe drawing oil from said reservoir and discharging into said high pressure tank having arranged therein a controlling valve and a hand pump provided with suitable check valves.

In witness whereof, I have hereunto affixed my signature this 24th day of February, 1905, in the presence of two subscribing witnesses.

JOHN N. LEACH.

Witnesses:

N. L. FROTHINGHAM,

A. A. ASHMAN.