H. LEMP.

SYSTEM OF FUEL SUPPLY FOR HYDROCARBON BURNERS.

APPLICATION FILED MAY 18, 1903.

903,738.

Patented Nov. 10, 1908.

Fig. 2.

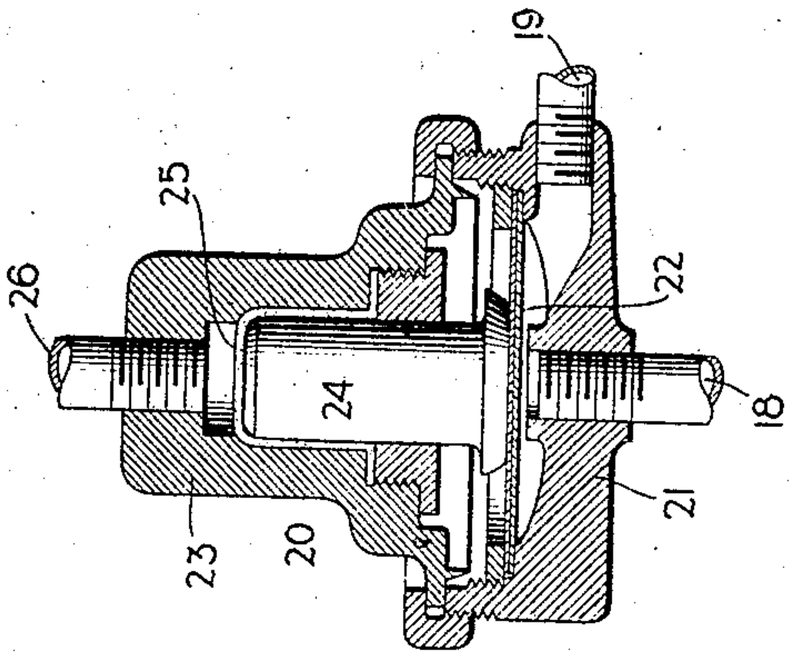
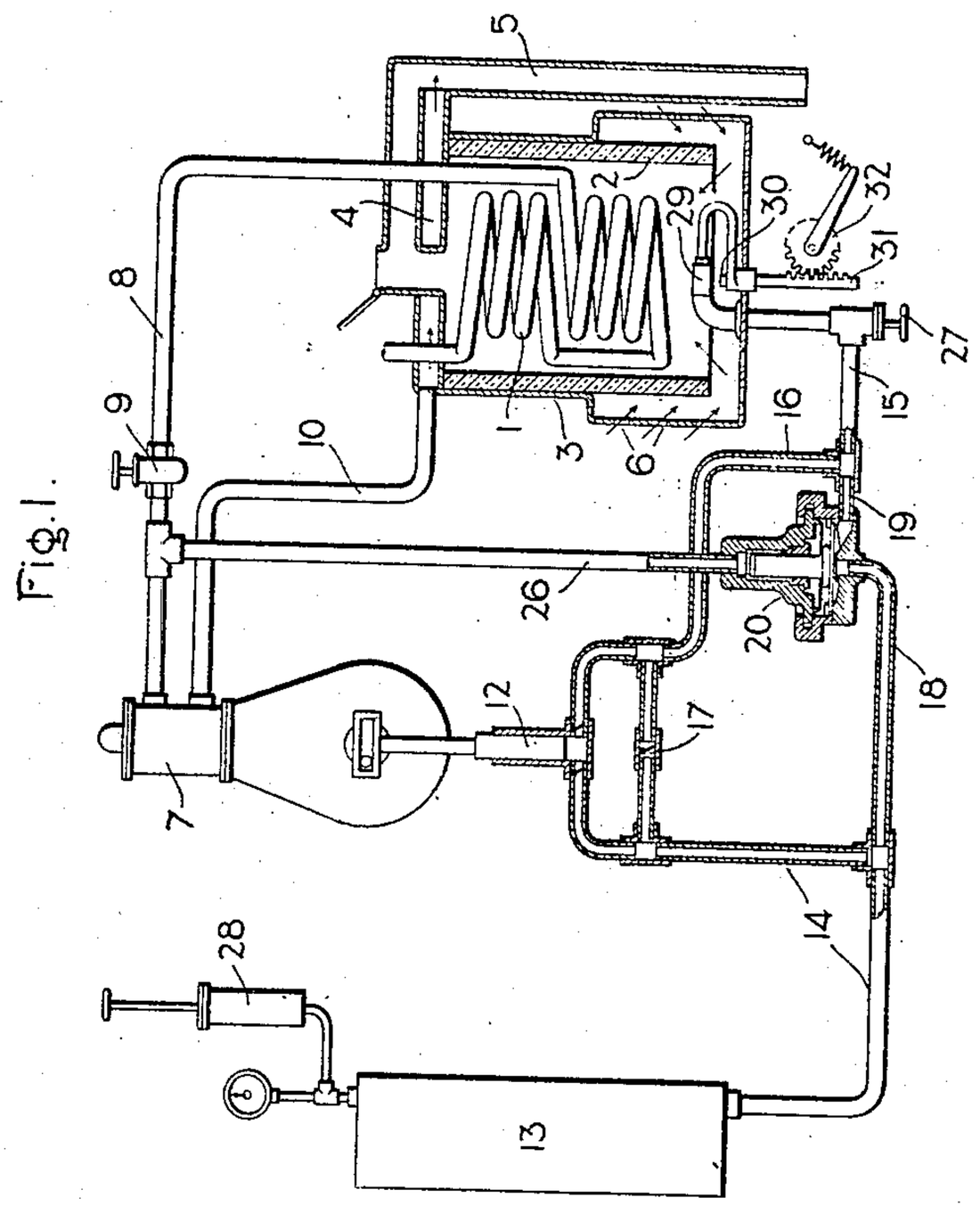


Fig. 1.



Witnesses.

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UNITED STATES PATENT OFFICE.

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SYSTEM OF FUEL-SUPPLY FOR HYDROCARBON-BURNERS.

No. 903,738. Specification of Letters Patent. Patented Nov. 10, 1908.

Original application filed July 15, 1899, Serial No. 722,900. Divided and this application filed May 18, 1903. Serial No. 157,546.

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 Systems of Fuel-Supply for Hydrocarbon-Burners, of which the following is a specification.

This application is a division of my prior pending application, Serial No. 723,900, filed July 15, 1899, which division is made at the requirement of the Patent Office under the provisions of Rules 41 and 42.

My invention relates to fuel systems, and more especially to those employed in connection with power systems, such as automobiles for example, where the variations in demand for heat vary between wide limits.

In order to successfully operate a hydrocarbon vapor burner, it is necessary to supply fuel thereto under a relatively high pressure. It is the common practice to do this by subjecting the fuel tank to an air pressure which is sufficiently high to feed the necessary amount of fuel to the burner under maximum conditions of operation, and to place between the tank and burner a suitable regulating device. This practice is highly objectionable, particularly where gasolene is employed as a fuel; because a broken pipe or connection is liable to cause the destruction of the vehicle by fire and possibly injure the operator.

My invention has for its object to overcome the objection above pointed out, and to provide a system wherein the pressure on the fuel supply tank can be made so small as to be negligible together with suitable means for supplying the fuel to the burner under such a pressure as is best adapted for the work to be performed, and further to provide a system in which the supply of fuel is automatically controlled in accordance with the pressure of the engine as distinguished from those systems in which the boiler pressure determines the regulation.

In carrying out my invention, a fuel tank or other suitable source of supply is placed under a small initial pressure by a suitable means, such as a manually-actuated air pump. This pressure is sufficient to maintain the fire under banked conditions, but is not intended for operating conditions. Between the tank and the fire chamber or burner is a power pump which receives fuel from the former and delivers it to the latter under the desired pressure. In this manner only a very small amount of fuel is under high pressure, the amount being dependent upon the capacity of the pipes, burner, etc. Also connected to the tank is a second pipe or connection which, when the fire is banked or in starting, conveys fuel to the fire chamber under the initial tank pressure, which may be small, such as five to ten pounds, for example. In this pipe or connection is a by-pass valve which is weighted or controlled by the pressure on the engine as distinguished from those systems wherein the steam pressure on the boiler is used for regulating purposes. When the engine pressure is high, showing that the burner needs a maximum amount of fuel, the by-pass valve is firmly held on its seat, and all of the oil from the pump, up to a predetermined maximum, goes into it. When the engine pressure decreases to a certain extent, the by-pass valve opens more or less and permits a local or short circuit to be created around the burner.

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

In the accompanying drawing, which represents an embodiment of my invention, Figure 1 is a diagrammatic representation of a steam engine, boiler and necessary piping of the fuel system, and Fig. 2 is a sectional view of a regulating valve.

The boiler is of the type known as a "flash boiler," and may be of any desired construction, the one shown consisting of a seamless tube 1 coiled or bent in any suitable manner so as to present a large surface to the burner flame. Surrounding the tube or tubes, and constituting a fire chamber, is a casing or lining 2, composed of fire-brick or other heat-resisting material which confines the burner flame, and at the same time shields the body of the vehicle or other support from excessive heat. Surrounding the fire-brick lining is a metallic casing 3 having a closed bottom, and a top provided with an extension containing an opening through which the products of combustion

may pass. A cover is provided for the opening, which may be closed after the apparatus is started. The top or cover is also provided with a false head or chamber 4, into which the exhaust passes from the engine. This chamber communicates with the external atmosphere through the down draft flue 5. The down draft flue is also connected to the extension, so that when the apparatus is in operation the exhaust, in passing downward through the flue 5, will take with it the products of combustion from the burner. The casing 3 is closed at the bottom, but a number of openings 6 are provided in the sides thereof, through which the air may enter, as indicated by the arrows, to combine with the fuel.

Any suitable type of engine may be employed in connection with my invention for driving the vehicle, the one shown being a single-acting vertical engine.

One end of the cylinder 7 is connected with the boiler by pipe 8, and the admission of steam thereto is regulated by the throttle 9. The exhaust from the cylinder passes through the pipe 10 to the chamber 4 over the boiler, thence to the external air by the down-flue 5.

For the purpose of supplying fuel to the burner, a pump is provided which is either directly driven by the main shaft of the engine, or through suitable gearing. So long as the action of the pump varies with the speed of the engine, or what is the same, the speed of the vehicle, the results will be satisfactory, irrespective of the particular means employed in the driving.

I prefer to use the arrangement described, on account of the economy of operation, but I do not mean to be understood as excluding from my invention structures wherein the pump is driven at a constant or approximately constant speed, either by or independent of the engine, as certain advantages will follow in these cases.

As illustrated in the drawing, 12 represents an oil pump, preferably of the displacement type. The pump is made of substantial size, requiring no careful adjustments, and is capable at all times of furnishing an excess of fuel; a suitable device being arranged to automatically take care of the excess.

One side of the cylinder of the oil pump 12 is connected to the oil tank 13 by the pipe 14, and the other side is connected to the oil feed-pipe 15 through the pipe 16. Connecting the pipes 14 and 16 is a short piece of pipe containing the check valve 17. The check valve is so arranged that it permits the liquid fuel or a portion thereof to shunt the pump and flow from pipe 14 to 16 under the action of the air or other pressure in the tank, but prevents its passage in the opposite direction under pressure from the pump. In addition to this the pipes are connected by two short sections of pipe 18 and 19 which constitute a by-pass for the pump; and between these sections is an automatic regulating valve 20. The construction of this valve is clearly shown in Fig. 2, in which 21 represents the casing or base, and mounted therein is a diaphragm 22. Secured to the casing or base is a cylinder 23, containing a piston 24 arranged to press on the diaphragm 22 and cause the latter to cover the opening leading to fuel pipe 18.

To prevent leakage around the piston an elastic packing 25 is employed, which completely surrounds the piston and is firmly seated between a nut and a shoulder on the cylinder. The ratio of area of the diaphragm and plunger are, roughly, one to six, but this ratio can, of course, be made anything else, depending upon the relative dimensions of the burner and engine: but once this ratio is determined it need not be altered, the throttle valve being used for final adjustment. Secured to the upper end of the cylinder is a pipe 26 which is directly connected to the steam pipe between the throttle 9 and the engine. Consequently the steam pressure in the pipe 26 corresponds to that on the engine. When, for any reason, the relative pressure in the pipe 26 falls below that in the pipes 15 and 19, the diaphragm rises and permits a certain amount of liquid fuel to pass from pipe 19 to pipe 18, and thence through the pipes 14 and 16, thereby forming a local circuit or by-pass for the pump. As soon as the difference in pressure between the pipes 18 and the pipe 26 ceases, oil will flow from the tank to the burner. A valve 27 is connected between pipe 15 and the burner, and is employed to cut off the supply of fuel to the burner nozzle to shut down the system. It also serves to regulate the amount of fuel delivered to the burner independently of the automatic devices. Under certain conditions of operation, as when the pump is working slowly and the by-pass regulator 20 is closed, the pressure in the pipe 16 may fall below that in the pipe 14. When this condition occurs, fuel will also pass to the burner through the connection 17.

Oil or other fuel is supplied to the burner from a tank 13, and in order to furnish an initial pressure at the time of starting the engine a small hand-pump 28 is employed. This pressure is ordinarily about five pounds. By constantly maintaining the fuel tank 13 under a small or initial pressure, fuel will be supplied to the burner or fire chamber at all times, whether the power fuel pump is working or not.

The construction described is also advantageous because only a relatively small amount of fuel is under high pressure, hence the danger due to broken pipes, particularly

if gasolene is employed, is reduced to a minimum. The system is so arranged that there are two connections from the tank to the burner. One of these connections includes the power-pump 12, while the other connection includes the automatic regulator 20. When the diaphragm 22 of the regulator is raised, fuel passes directly from the tank to the burner, but when the diaphragm is seated, the fuel passes through the power-pump. When the pressure due to the pump and that of the supply tank are somewhere nearly equal, both the connections will be active. If, when the pump ceases operating, the valve 20 should stick for any reason and the pressure in the pipes 18 and 19 is not sufficient to open it, the shunt valve 17 will open under the pressure of the fuel due to the tank and supply the burner so that the flame will be maintained. In case the shunt valve 17 and the connection therefor is dispensed with, as in some cases it may be, the fuel will flow from the tank through the pump to the burner should the valve 20 stick, since the valves of the pump readily open toward the burner.

I have described an automatic regulator which is well adapted to carry out my invention, but it is to be understood that in its broadest aspects my invention includes any equivalent regulating means which will permit the tank to supply fuel to the fire under banked conditions and to the pump when the system is in service.

The burner can be of any desired form. The one shown consists of a plate or vaporizer 29 against which the oil vapor is projected under pressure from a small orifice 30 at the discharge end of the vaporizer. The size of the opening can be varied by a pin or other device which is carried by the upper end of the rack 31. The rack is moved by a pinion 32 that is connected to a lever or other suitable actuating device.

Tests made with a vehicle equipped in accordance with my invention show that under various running conditions the steam pressure on the engine will vary proportionately with the work to be performed; it being greatest when running on a level at high speed, or when ascending a steep grade. The speed of the vehicle can be accurately controlled by the opening and closing of the throttle providing the boiler pressure is maintained practically constant. There exists, therefore, a definite ratio between the steam pressure necessary to turn the engine and the pressure necessary on the burner; which ratio is constant through a very wide range and covers all practical conditions.

The general operation of my invention is as follows: The burner is first heated by a torch or other auxiliary device, after which the valve 27 is opened and fuel from the tank 13 flows through the pipes 18, 19 and 15; thence through the vaporizer to the orifice 30 in the nozzle. There being no steam pressure in the pipe 26 at this time, the diaphragm 22 will rise against the weight of the piston 24, and permit the fuel to flow to the burner. But if the valve 20 were not open, the fuel would flow through the pump, or through the shunt valve 17, if such were employed, or through both. After the boiler is sufficiently warmed, water is supplied to the boiler from a suitable source, and as soon as it is turned into steam it may be admitted to the engine through the pipe 8 and throttle 9. As soon as the engine starts into operation, the fuel pump begins to act and forces oil into the burner. The more the throttle is opened, the nearer the steam pressure of the engine will be to that of the boiler, and consequently the pressure on the piston 24 will be increased. In other words, a greater pressure will be exerted on the fuel service, and more fuel will be consumed in the burner. Closing the throttle 9 will cut off the steam from the engine, the pressure on the steam side of the regulating valve 20 will fall to zero, the pressure which exists in the pipes 15 and 16, due to the pump 12, is sufficient to raise the diaphragm 22 of the regulating valve, and the liquid fuel will flow back into the tank 13 against the air pressure therein. In other words, there exists for a few moments in the pipe 15 a comparatively high pressure, even after the pump 12 has ceased to operate. As soon as the pressure drops to that of the fuel tank, the amount of fuel which is forced to the burner will be greatly reduced, but a sufficient amount due to the initial pressure on the tank will flow to maintain the vaporizer and the tubes at a temperature for immediate starting.

It will be noted that the forced draft ceases operating substantially at the time when the regulating valve opens, since the throttle cuts off the supply of steam to each simultaneously. This is an important feature for the reason that the valve permits a portion of the fuel in the connection between the pump and the burner to return to the tank so as to quickly relieve the pressure on the burner, and thus prevent combustion with considerable odor and smoke as would otherwise be the case. Without the valve operating in this manner every time the vehicle is stopped the pressure of the fuel on the burner would continue relatively high for a certain time, and under natural draft condition the supply of air to the burner would be insufficient to enable complete combustion, and therefore, the undesirable results above-mentioned would occur.

On account of the exhaust passing through the chamber 4 and the down-flue 5, any increase in the amount of exhaust will correspondingly increase the draft for the

burner. As the amount of steam admitted to the engine is decreased, the draft on the burner is simultaneously and correspondingly decreased. This means that the draft on the burner is automatically varied to meet the conditions of service. Hence there will be no choking of the fire gases within the boiler under any condition.

When the system is running, it is evident that the pressure on the steam side of the regulating valve 20 must vary due to momentary changes in steam pressure on the engine, caused by changes in speed or load. Consequently the amount of oil which flows from the pump to the burner is varied. If the pressure is low, the diaphragm will rise and there will be a local oil circulation, but as soon as more steam is admitted to the engine by opening the throttle, the diaphragm is more or less firmly seated over the end of pipe 18, and more oil is forced to the burner.

When the vehicle is coasting down the hill or on the level, without steam being supplied to the engine, the regulator 20 is open so that the pump sets up a local circuit or by-pass for the pump through the by-pass 18 and 19 and the pipes 14 and 16; or in other words, the pump is doing no useful work under such running conditions. When the steam is cut off from the engine, but the vehicle is moving, the regulator opens and permits the pressure on the burner to quickly fall to a pressure substantially equal to that on the source, thereby maintaining the fire in banked condition and the continuity of the flame, and upon steam being again supplied to the engine the regulator 20 immediately closes and prevents the fuel from passing from the pump through the by-pass 18 and 19 so that the pressure on the burner is abruptly brought up to normal and the intensity of the flame increased to equal the demand for heat.

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 only 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 fuel supply system, the combination of a source of fuel under a small head, a fire chamber in which the fuel is burned, a pump for imparting service pressure to the fuel, fuel conduits between the source and the pump and between the pump and the chamber, a conduit receiving fuel from the source and having a connection with said fuel conduits between the pump and fire chamber so that the source may deliver fuel thereto when the service pressure falls below that of the source, and a regulator in the last mentioned conduit which normally prevents delivery of fuel from the pump back to the source.

2. In combination, a burner, a source of liquid fuel supply, means for imparting an initial pressure thereto so as to feed fuel to the burner, a pump for further increasing the pressure of the fuel supplied to the burner, connections shunting the pump, and a check valve therein which permits fuel to flow around the pump to the burner under the pressure on the source.

3. In combination, a burner, a tank containing liquid fuel, a pump for placing the contents of the tank under initial pressure, a fuel pump for further increasing the pressure of the fuel supplied to the burner, pipes connecting the tank and pump with the burner, connections shunting the pump, and a check valve therein which permits fuel to flow to the burner under the pressure in the tank.

4. In a system of burner regulation, the combination of a fuel tank, a manually actuated pump for placing the contents of the tank under an initial air pressure, a power-driven pump for increasing the pressure of fuel supplied to the burner, a burner, fuel-carrying pipes between the tank and pump and the burner, connections which shunt the pump, a check valve therein which permits fuel to flow to the burner under the pressure in the tank, and a by-pass valve for controlling the supply of fuel to the burner.

5. In a fuel-supply system, the combination of a burner, a source of fuel under a small head sufficient to supply the burner for conditions of light duty, a pump which receives fuel from and at the pressure of said source, imparts service pressure to the fuel and delivers it to the burner, supply and discharge conduits between the source and the pump and between the pump and the burner respectively, a conduit receiving fuel from the source and having a connection with said conduits between the pump and the burner for conveying fuel to the burner when the service conditions are such that the pressure of the source is superior to that due to the pump, a controlling valve in the last-named conduit that is normally closed against the pump pressure and when opened permits fuel to flow from the source to the burner, a conduit between the supply and the discharge conduits which shunts the pump, and a check valve in said conduit which prevents a flow of fuel back to the pump when said pump is operating under service pressure but which permits fuel to flow from the source to the burner when said controlling valve is closed and the pump is not operating.

6. In a fuel-supply system, the combination of a fire chamber, a tank and conduit for supplying fuel to the fire chamber at

low pressure, a pump which receives fuel from the tank, increases its pressure to a point sufficient for working purposes and delivers it to the fire chamber, a boiler for producing vapor heated by the fire chamber, and a regulator responsive to a condition of the vapor produced by the boiler which normally holds said conduit closed to prevent the pump from discharging back to the source and which opens when the duty is light to permit the source to supply the fire chamber.

7. In a fuel system, the combination of a fuel tank subjected to an initial pressure, a fire chamber to which fuel may flow under the pressure in the tank, a steam generator, means for suplying fuel to the chamber at an increased pressure, and an automatic controlling valve working under steam pressure for regulating the supply of fuel at the different pressures to the fire chamber.

8. In a fuel system, the combination of a fuel tank adapted to be maintained under an initial pressure, a pump for placing the fuel tank under pressure, a burner which may receive fuel at the pressure in the tank, a second pump which is power driven and connected to the fuel tank for increasing the pressure of the fuel supplied to the burner, and an automatic regulator for regulating the supply of fuel at the different pressures to the burner.

9. In a fuel system, the combination of a fuel tank maintained under an initial pressure, a fire chamber which may receive fuel at the pressure in the tank, means supplying fuel from the tank to the chamber under a high pressure, and an automatic controlling valve which causes more or less of the fuel supplied by said means to pass to the chamber and the remainder to be by-passed.

10. The combination of a burner, means for supplying air to the burner, separate fuel supply connections, means arranged to supply fuel through one connection to the burner at relatively low pressure for light duty conditions, a device for supplying fuel through the other connection to the burner at a relatively high pressure for normal operating conditions, and means actuated independently of the air supply which cuts one fuel supply into service while cutting the other out of service.

11. The combination of a burner, separate supply pipes connected therewith, a tank under a relatively low initial pressure for supplying fuel to the burner through one pipe to maintain the flame in banked condition, a pump for supplying fuel through the other pipe at a pressure to maintain the flame in normal working condition, and a valve located in one of the supply pipes for permitting the pressure on the burner to be lowered to that on the source and to be raised to that due to the pump.

12. In a system of fuel regulation, the combination of a low-pressure supply tank, a fire chamber, a connection leading from the tank to the fire chamber for supplying fuel under conditions of light duty, a second connection receiving fuel from the tank and discharging it into the fire chamber under conditions of heavy duty, a pump included in the second connection for increasing the pressure of the fuel before discharging it to the fire chamber, and a valve which is on the high pressure side of the pump for quickly cutting down the pressure by discharging fuel back to the tank when the demand for heat is greatly reduced.

13. The combination of a burner, a tank maintained under a relatively low initial pressure, a connection between the tank and the burner, a pump in the connection which supplies fuel at relatively high pressure, a second connection which is connected to the first connection between the pump and the rank at one end and between the pump and the burner at the other end and through which fuel is adapted to by-pass around the pump or to pass from the tank to the burner under the pressure in the former, and a valve in the second connection which permits the fuel to by-pass around the pump or to flow to the burner when open and prevents fuel from by-passing when closed.

14. The combination of a burner, a liquid fuel tank maintained under a relatively low pressure, a pump connected with the tank and the burner which supplies fuel to the burner at a relatively high pressure for normal operation, a valve-controlled connection arranged in shunt relation to the pump through which fuel feeds to the burner under the pressure in the tank when the pump is idle for preserving the continuity of the flame.

15. The combination of a burner, a liquid fuel tank maintained under a relatively low pressure, a pump and connections between the tank and the burner for supplying fuel to the latter at a relatively high pressure for normal operation, a connection arranged in shunt relation to the pump, and a valve in the said shunt connection through which fuel passes to the burner when the pump is idle and arranged to permit fuel from the pump to by-pass when the demand for heat is light and to prevent the fuel from by-passing when the demand for heat is heavy.

16. The combination of a burner, a liquid fuel tank maintained under a relatively low pressure, a pump and connections between the tank and the burner which supply fuel to the latter at a relatively high pressure, a connection arranged in shunt relation to the pump, a valve in said connection which permits fuel to feed to the burner under the pressure in the tank when the pump is idle, and means adapted to close the valve si-

multaneously as the pump begins to operate and to open it simultaneously as the pump ceases to operate.

17. In combination, a burner, independent means for supplying fuel to the burner at different pressures respectively, and means which when it checks the operation of one of said supplying means permits the other to come into operation so that an uninterrupted supply of fuel to said burner is maintained.

18. The combination of a steam generator, a burner, means for delivering a main supply of fuel to the burner, means for delivering an auxiliary supply of fuel to the burner, the main and auxiliary supplies discharging different amounts of fuel per unit of time, and means whereby the main supply and auxiliary supply are respectively cut into and out of service while preserving the continuity of the flame.

In witness whereof I have hereunto set my hand this fifteenth day of May, 1903.

HERMANN LEMP.

Witnesses:

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HENRY O. WESTENDARP.