J. F. LINDBERG.

FLUID PRESSURE GENERATOR.

APPLICATION FILED MAR. 21, 1914.

1,126,799.

Patented Feb. 2, 1915.

3 SHEETS—SHEET 1.

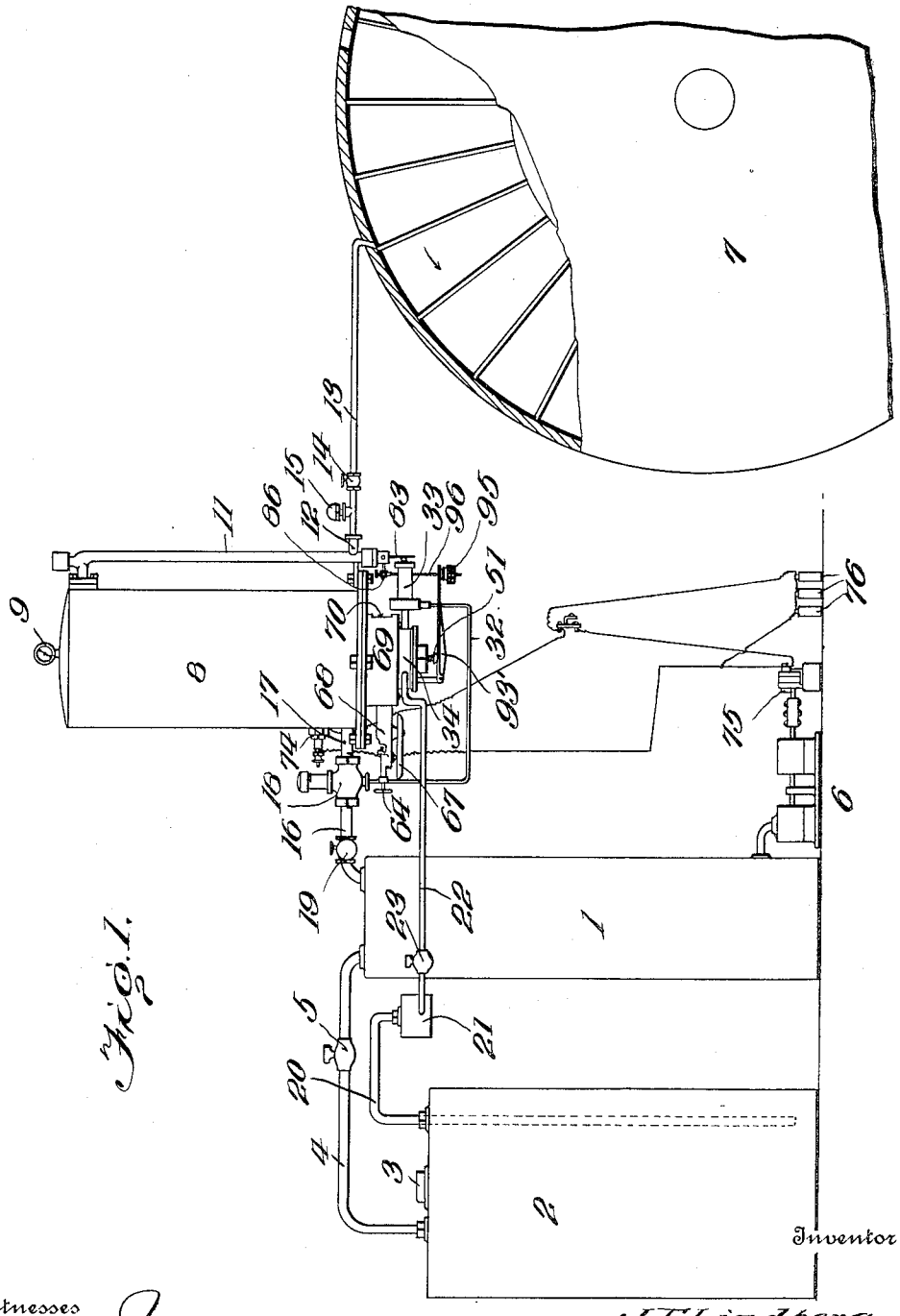


Fig. 1.

Witnesses

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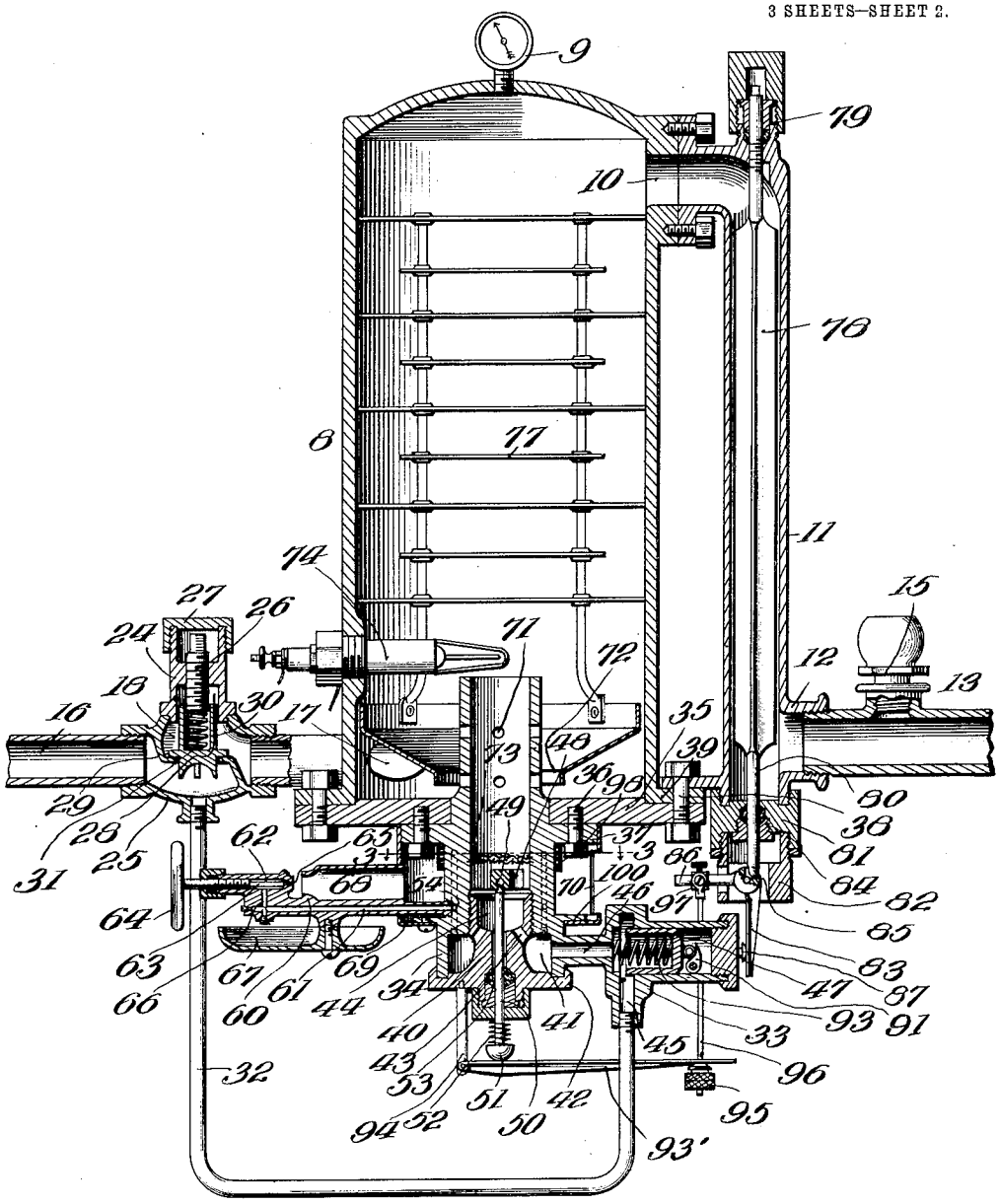


Fig. 2.

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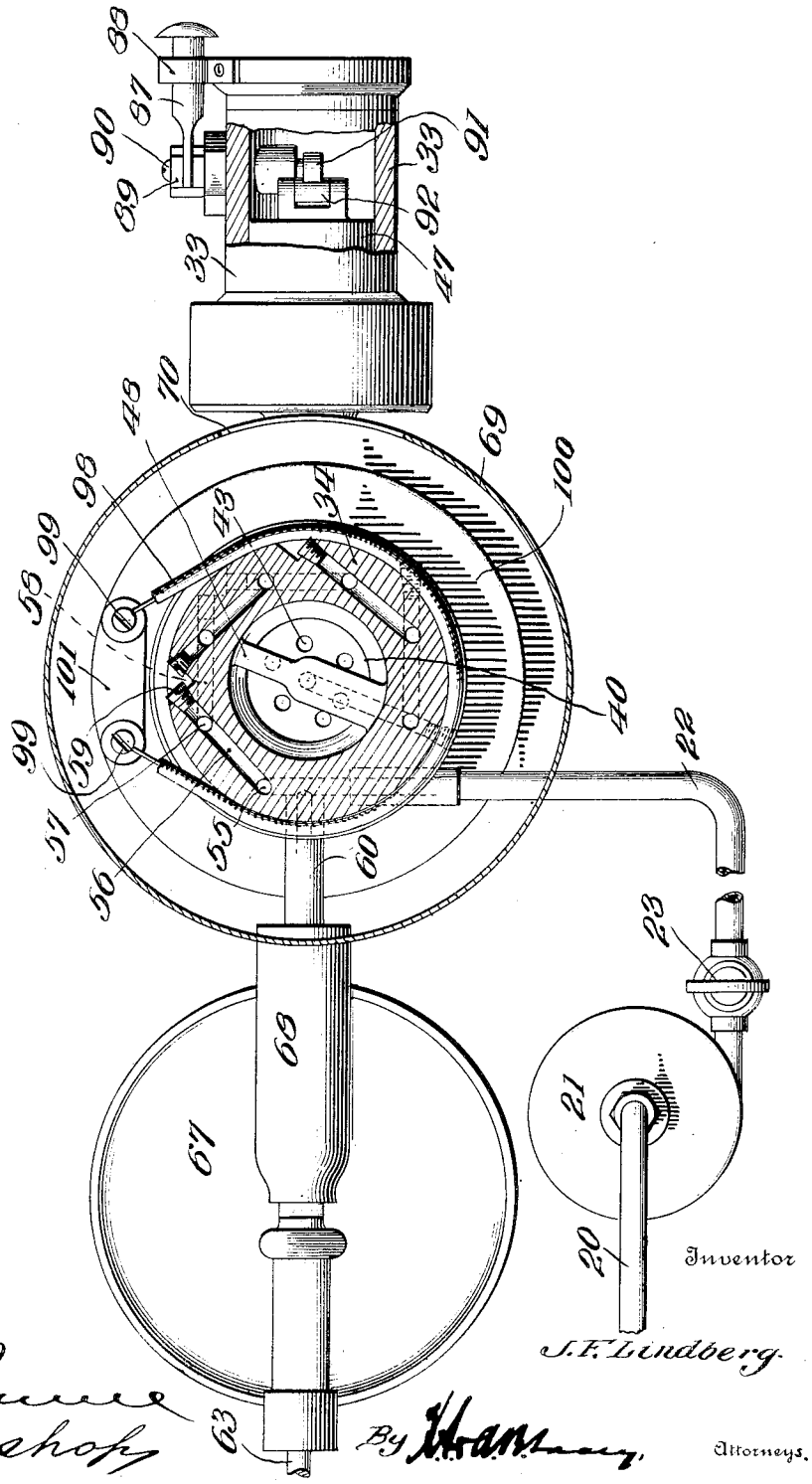
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3 SHEETS—SHEET 3.

Fig. 3.



Witnesses

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UNITED STATES PATENT OFFICE.

JOHN F. LINDBERG, OF HIBBING, MINNESOTA, ASSIGNOR OF ONE-HALF TO FRANK BANKS, OF HIBBING, MINNESOTA.

FLUID-PRESSURE GENERATOR.

1,126,799. Specification of Letters Patent. Patented Feb. 2, 1915.

Application filed March 21, 1914. Serial No. 826,386.

To all whom it may concern:

Be it known that I, JOHN F. LINDBERG, citizen of the United States, residing at Hibbing, in the county of St. Louis and State of Minnesota, have invented certain new and useful Improvements in Fluid-Pressure Generators, of which the following is a specification.

This invention relates to fluid pressure generators and its objects, generally stated, are to utilize the pressure generated by the heating or combustion of explosive gases for the operation of engines or motors, and thereby reduce the waste and increase the efficiency, reliability and ease of control of gas engines; to effect vaporization of hydro-carbon oils in a more efficient way than has been heretofore practicable; to overcome severe vibrations caused by explosive engines as now commonly operated; and to provide novel means for combining air and gas under pressure, regulating the pressure in the combustion chamber and delivering the products of combustion to the motor.

More specific objects of the invention will appear as the description of the same proceeds and the invention consists in certain novel features of construction, arrangement and combination of parts which will be particularly pointed out in the claims following the detailed description.

In the annexed drawings which illustrate what is now considered to be the preferred embodiment of the invention, Figure 1 is a diagrammatic view, partly in section and partly in elevation, showing the complete apparatus arranged to drive a turbine or rotary engine; Fig. 2 is an enlarged vertical section of the combustion chamber and the parts immediately adjacent thereto and coöperating therewith; Fig. 3 is an enlarged horizontal section taken substantially upon the line 3—3 of Fig. 2.

Referring more particularly to the drawings, the reference numeral 1 designates a tank or reservoir for holding compressed air, and the numeral 2 designates a tank or reservoir for containing fuel, such as hydro-carbon oil. The tank 2 is provided with a filling plug 3 in its top and a pipe 4 connects the tanks 1 and 2 so as to establish communication between the tops thereof, the said pipe 4 being provided with a cut-off valve 5, whereby the flow of air to the fuel reservoir may be controlled, and compressed air is supplied to the tank 1 by an air compressor, indicated generally at 6, which is operated by the motor 7.

The combustion chamber 8 may be of any suitable material and of any desired dimensions, being preferably in the form of a vertically disposed cylinder equipped with a pressure gage 9 in its top, and having an outlet 10 near its upper end, the said outlet communicating directly with a tube 11 which is equipped with an elbow 12 at its lower end, as shown. Secured in the said elbow 12 is one end of a pipe 13 which leads to the motor and may be arranged in any convenient or preferred manner as may be necessary to deliver the products of combustion into the working chamber of the motor, the accompanying drawings showing the end of the said tube 13 bent to pass through the casing of the motor at an angle to the radius thereof and discharge against the vanes or pockets of the rotor. It will be understood, however, that this showing is illustrative merely and is not intended to be restrictive in any sense, as other types of motors can be used, and the conveyer tube or pipe 13 will, of course, be so disposed as to conform to the particular type of motor in connection with which my improved apparatus is used. The conveyer tube or pipe 13 is provided with a throttle valve 14 and a safety valve 15, which may be of any preferred type so that the pressure may be relieved should it reach a dangerous degree, and the flow to the motor may be readily controlled. A supply pipe 16 leads from the upper end of the air tank 1 and enters the lower end of the combustion chamber, as indicated at 17, a reducing valve 18 being interposed in said pipe, as clearly shown. The air supply pipe 16 is provided with a cut-off valve 19 so that the supply of air may be regulated or entirely cut off, as may be necessary. An outlet pipe 20 leads through the top of the fuel tank and has its lower end disposed near the bottom of the said tank. This fuel supply pipe 20 leads into a strainer or filter 21 and from the said strainer or filter a second supply pipe 22 leads to the combustion chamber, a cut-off valve 23 being interposed at any convenient point in the said pipe 22 so that the flow of fuel may be controlled.

The reducing valve 18 comprises a plug or cylindrical guide 24 which is secured in

the upper side of the valve casing 25 and receives an adjusting screw 26. The upper end of the screw is suitably shaped to be engaged by a turning tool and a cap 27 is fitted over the upper end of the screw to prevent the collection of any foreign matter upon the same as will be readily understood. The valve proper is in the form of a plunger 28 seating upon the partition 29 of the valve casing and having an upper hollow extension 30 which receives a spring 31 bearing upon the upper side of the plunger and against the lower end of the screw 26 and the tension of which may be regulated by adjusting the said screw in an obvious manner.

When the compressed air is permitted to flow through the supply pipe 16 it will act upon the lower side of the plunger and raise the same against the tension of the spring 31 and will then flow past the said valve and into the combustion chamber through the port 17. When the pressure of the air admitted to the combustion chamber is nearly equal to the pressure of the air flowing through the pipe 16, the valve will close and additional air cannot then flow through the port 17, the difference between the pressures on the two sides of the valve being determined by the tension of the spring 31, as will be readily understood. A by-pass 32 leads from the bottom of the valve casing 25 to the valve casing 33, which is arranged below the combustion chamber and extends laterally from the lower end of the burner body 34. The burner body 34 extends up through the lower head or closure 35 of the combustion chamber cylinder 8 and is secured to the said head by bolts or screws 36 inserted through an annular flange 37 on the burner body into the head 35, as clearly shown in Fig. 2. The said head 35 is secured to the cylinder 8 in a like manner by bolts 38 inserted through the head and an annular flange 39 on the cylinder. The lower end of the burner body is closed by a plug 40, which is threaded into the burner body and is so constructed as to provide an annular chamber 41 between itself and the lower extremity of the burner body, the plug being provided with a radial head or base plate 42 which fits against the lower end of the burner body so as to close the same and prevent the escape of fluid therefrom. Ports 43 are provided through the upper portion of the plug 40 so as to establish communication between the annular chamber 41 and the bore of the burner body through a recess 44 in the upper end of the plug. The valve casing 33 is constructed with a transverse passage 45, into which the by-pass 32 leads and discharges, and a longitudinal passage 46 which leads from the said passage 45 into the annular chamber 41. A plunger valve 47 is mounted in the valve casing 33 so as to move across the passage 45 to and over the passage 46, thereby regulating the flow of air through said passages to the burner. A bridge 48 is provided on the upper end of the plug 40 and this bridge has an outlet port, indicated at 49, in its underside, the said port being closed by a needle valve 50 which extends vertically through the center of the plug 40 and depends below the same where it is provided with a head 51, between which and the lower end of the plug a spring 52 is coiled around the stem of the valve, the stem of said valve passing through a gland 53 to prevent leakage, and this gland may be of any desired construction. The fuel supply pipe 22 passes laterally into the burner body 34 so as to communicate directly with a port or passage 54 formed in the said body. This horizontal port or passage 54 leads to a vertical passage 55 formed in the burner body, and the upper end of the said passage 55 communicates directly with a horizontal passage 56. The said passage 56 leads to a vertical passage 57, which extends downwardly therefrom and communicates with a second horizontal passage indicated in dotted lines at 58 in Fig. 3, and this arrangement of passages is continued through the burner body around the bore of the same to terminate in a horizontal passage leading into the bridge 48, and communicating with the outlet port 49 in said bridge. These several vertical and horizontal passages or ports are formed by drilling through the body of the burner at the proper points and then closing the outer ends of the several passages by plugs, indicated at 59. This arrangement of passages provides a tortuous circulation of the fuel through the burner body before it is admitted into the bore thereof and commingled with the compressed air, so that the fuel will be heated and partly vaporized before it meets the air and, consequently, the mixing of the two fluids will be quickly effected and the proper ignition of the same assured.

A burner tube 60 is secured to and projects laterally from the burner body 34, and the said burner tube has a longitudinal passage 61 which connects with the port or passage 54, so that a part of the fuel may flow through the said passage 61. The passage 61 leads to a valve chamber 62 in which is fitted a needle valve 63 provided with a hand-wheel or other operating member 64. The valve 63 controls an outlet port 65 of the valve chamber 62 and the passage 61 may lead directly into the said valve chamber, but for convenience in constructing the device a branch passage 66 is provided leading from the passage 61 to the said valve chamber. A pan 67 is secured to the inside of the burner tube 60 and is

disposed in position to receive the fuel which will escape from the port 65 when the valve 63 is moved to open the same. After a small quantity of the fuel has been caught in the pan the valve is closed and the fuel in the pan ignited, the flame arising from said fuel playing directly on the burner tube so as to quickly heat the same in a well understood manner. When the burner tube has been brought to the desired temperature, the valve 63 is again opened and fuel will then flow through the port 65 and will be immediately ignited by the heat of the burner tube, and a nozzle 68 is provided upon the burner tube in axial alinement with the valve 63 so as to direct the ignited fuel against the main burner body 34, as will be readily understood. The flame issuing from the nozzle or guide tube 68 will play directly upon the main burner body and will be held to the same by a shell or casing 69, which is secured around the burner body and the end of the nozzle 68 and is cut away, as shown at 70, at a point directly opposite said nozzle to permit the flame to escape.

As shown most clearly in Fig. 2, the burner body projects upwardly through and above the lower head 35 of the combustion chamber cylinder, and this upper projecting portion is provided with a plurality of lateral openings or ports 71. An inverted conical shield or deflector 72 is secured within the combustion chamber concentric with the upper end of the burner tube and the lower edge of the said deflector and spaced from the burner tube, as shown. It will also be noted that the said deflector is secured to the wall of the combustion chamber at a point above the port 17, while the lower edge thereof is below the said port and, consequently, the air flowing through the port 17 will be directed downwardly toward the burner body and will then escape upwardly around the same into the combustion chamber, a part thereof flowing through the openings or ports 71 into the bore of the burner. A screen 73 is secured in the burner just above the bridge 48 and a spark plug or similar ignition device 74 is secured in the combustion chamber just above the upper end of the burner. The spark plug will be connected in the usual manner with a magneto, indicated conventionally at 75, and also with a battery, indicated conventionally at 76, the magneto being connected with the motor 7 so that after the engine has commenced to operate the current necessary to operate the spark plug may be supplied through the magneto, and the battery used only in starting the engine, in the usual manner. A series of baffle-plates 77 are disposed in the upper portion of the combustion chamber so that the vapors rising from the burner and the cool air from port 17 will be caused to circulate tortuously through the combustion chamber and consequently, will be thoroughly commingled, thereby preventing overheating of the generator.

The needle valve 50 and the plunger valve 47 are operated automatically to control the flow of fuel and compressed air to the bore of the burner body by the temperature of the gases passing to the motor. To accomplish this result, a thermostatic bar 78 is provided in the outlet tube 11 and is secured in a packing box 79 at the upper end of said tube in any convenient manner so that the upper end of the bar will be fixed. This thermostatic bar will be of some material having a higher coefficient of expansion than the tube 11 and will be cruciform in cross-section or longitudinally grooved so as to present an extended surface to the action of the gases flowing through the tube and, consequently, respond readily to variations in the temperature of said gases. The lower end of the said thermostatic bar is formed into a pin or rod 80 passing through a plug 81, closing the lower end of the tube, and a plug 82 secured to the said plug 81 and forming a support for an angle lever 83. A packing box 84 is carried by the plug 81 so as to prevent leakage around the pin or rod 80, and the plug 82 is provided with openings through which the arms of the lever 83 extend. The said angle lever 83 is provided with a recess or socket 85 adjacent its fulcrum, which receives the end of the pin or rod 80 so that when the said rod expands the lever will be rocked upon its fulcrum and the depending vertical arm thereof swung toward the burner while the horizontally extending arm 86 will be swung upwardly. As the bar cools and contracts the angle lever will swing in the opposite direction under the influence of the parts connected therewith, as will presently appear. The depending vertical arm of the angle lever bears against a sliding bar or pin 87, which is mounted in a suitable guide 88 on the valve casing 33 and the inner end of this pin or bar is pivoted to the upper end of a crank arm 89 rising from a rock shaft 90, which is journaled in and extends through the side of said valve casing and is equipped at its inner end with an upstanding crank arm or finger 91 bearing upon the outer end of the plunger valve 47. The plunger valve may be equipped with a roller 92 to reduce the frictional wear between the plunger and the finger or crank 91, and it will be readily understood that the spring 93, which is disposed between the head of said plunger and the body of the valve casing 33, tends to hold the said plunger in its outer or open position and, consequently, maintains the outer end of the

pin or rod 89 in constant contact with the dependent arm of the angle lever 83. Therefore, when the thermostatic bar expands and the angle lever moves about its fulcrum the rock shaft 90 will be rocked so as to cause the crank 91 to move the plunger inwardly to closed position against the tension of said spring and when the thermostatic bar contracts the spring will expand and return the parts to the open position. The head 51 of the needle valve 50 rests upon the upper side of the lever 93' which is fulcrumed upon a suitable support 94 and extends beyond the burner so that its free end may rest upon a support 95 carried by a link 96, which depends from the horizontal arm 86 of the angle lever 83. In the present illustration, the support 95 is in the form of nuts which may be adjusted upon the link 96 and locked thereto so as to determine the point at which the needle valve may be fully closed. The upper end of the link 96 is secured to a bracket 97, which is adjustably mounted upon the arm 86, whereby the effective throw of the said arm may be regulated. By properly adjusting the bracket 97 a greater or less throw may be imparted to the lever 93 and, consequently, the extent of movement of the valve 50 will be varied and the fuel permitted to flow to the burner in such quantity as will establish the proper proportions of fuel vapor and compressed air. This regulation of the fuel feed permits various kinds of fuel to be used successfully in the apparatus. By adjusting the support 95 upon the link 96 the temperature at which the vapor jet will be completely closed may be determined, as by lowering the support greater expansion of the thermostatic bar will be required to raise the lever 93 sufficiently to completely close the valve 50 and, consequently, a higher temperature of the escaping gases will be required.

It is thought the operation and advantages of my improved apparatus will be readily understood from the foregoing description taken in connection with the accompanying drawings. The several parts being connected up, as shown and described, and a supply of compressed air having been established, the valve 19 is opened so as to permit air to flow into the combustion chamber. When the pressure in the combustion chamber has reached the point where the pressure applied to the plunger 28 by the air in the combustion chamber and the spring 31 is equal to the pressure applied to the plunger by the air flowing from the air supply, the plunger will be seated and the further flow of air to the combustion chamber will be effected through the by-pass 32 and the valve casing 33. Consequently, the air then flowing into the combustion chamber will pass into the annular chamber 41 and thence through the ports 43 upwardly past the bridge 48 to mingle within the burner tube or bore of the main burner body with the fuel vapor escaping from the port 49. When the pressure in the combustion chamber and the pressure from the air tank have been equalized, the valve 5 is opened so as to permit a flow of compressed air into the fuel tank 2 until the pressure in the two tanks has been equalized. If the valve 23 be then opened, the pressure within the fuel tank will tend to cause a flow of liquid fuel from the tank through the pipe 20 and filter 21 into the pipe 22, whence it may pass into the several ports of the burner body. As the pressure throughout the apparatus, however, has been equalized and the fuel reservoir is below the outlet ports 49 and 65 and the outlet 65 is closed, no fuel will flow from the fuel reservoir until the pressure in the combustion chamber is reduced or unless the port 65 be opened. If the valve 63 be adjusted to open the port 65, some of the fuel will escape and drip into the pan 67 where it is set on fire. When sufficient fuel has been thus burned to heat the burner tube to the vaporizing degree, the valve 63 is again opened and the fuel will then be ignited immediately upon issuing from the port 65 and the flame thus produced will be inclosed by the nozzle 68 and directed against the main burner 34. When the main burner 34 has been thus heated to the degree necessary to vaporize the fuel contained in the several passages in the body of the burner, the valve 65 is again closed and the fuel will then escape from the port 49 directly into the bore of the burner tube. If the fuel used is of a heavy grade, the pan 67 may be filled with some light oil so as to heat the nozzle of the initial burner to the desired degree. After the main burner or body 34 has been heated sufficiently to vaporize the fuel, the throttle valve 14 may be opened so as to allow the compressed air in the combustion chamber to flow to the motor and thus rapidly reduce the pressure in the combustion chamber to the degree determined by the tension of the spring 31 in the reducing valve 18. Air will then flow through the valve casing 33, the chamber 41 and the ports 40 into the main burner, inasmuch as the full pressure from the air reservoir is on these ports and will, consequently, overcome the reduced pressure in the combustion chamber. The mixed air and vapor flowing upwardly through the main burner body will be ignited by the spark from the plug 74 and the flame thus produced will extend back to the screen 73 which will prevent its reaching the inlet ports and acting upon the vapor which has not been mixed with the proper proportion of air. The products of combustion or highly heated gases passing beyond the

spark plug will rise through the combustion chamber and pass out through the outlet tube 11 and the motor-supplying pipe 13, the air and vapor continuing to flow into the burner and to burn with full force as long as the throttle is left open, or until the gases have reached a temperature where the thermostatic bar 78 will be expanded and will close the valves 47 and 50 in the manner previously described. When the temperature of the gases reaches the point where the thermostatic bar 78 is expanded and the supply to the combustion chamber consequently reduced or cut off to such an extent that the outflow through the pipe 13 exceeds the supply to the combustion chamber, the pressure in the combustion chamber will drop to the point determined by the reducing valve 18 and the pressure from the air reservoir will then overcome and open the said valve and flow through the port 17. The air escaping from the said port 17 will be deflected downwardly to and around the burner by the cone 72 and will escape from under said cone or deflector evenly around the main burner tube and will flow upwardly into the combustion chamber. On the upward flow of this air a portion of the same will pass through the ports 71 into the burner and will be heated directly by the flame in the burner and will complete the combustion of any unburnt gas. The air rising around the burner will mix with the flame and with the rising gas, and flowing tortuously around and through the baffle plates, will take up heat from the flame and from the said plates and will tend to restore the balance of temperature and pressure to the generator. As the supply of heated gases is reduced, the thermostatic bar will cool and contract and the valves 47 and 50 will then open so as to increase the supply of air and fuel to the burner and, consequently, the pressure will be quickly restored to the proper working degree. Should the throttle be completely closed the generation of the pressure fluid will cease as soon as the pressure in the combustion chamber becomes equal to the pressure in the air reservoir and the flame will then be completely subdued, but when the throttle is reopened so as to reduce the pressure in the combustion chamber the gas will again flow through the combustion chamber and will then be reignited upon coming into contact with the spark of the plug 74. Should the stop, however, be of sufficient duration to allow the combustion chamber to cool below the temperature required to vaporize the fuel, the main burner must be reheated and the operation repeated, as previously described.

Where ample electric current is available the heating of the main burner may be accomplished by the use of a winding 98 of high resistance wire which is wrapped around the burner body and has its ends secured to binding posts 99 secured on the lower annular flange at 100 of the burner body, the shield 69 being also secured to the same flange. These binding posts and the winding will, of course, be suitably insulated and layers of mica will generally be found preferable for this purpose, a plate or block of such material being indicated at 101 to insulate the binding posts from the base flange of the burner. When this electric winding can be used the pan 67 and the initial burner tube 60 will be unnecessary, but in those localities where an ample electric current is not available the initial burner and pan will be found very satisfactory.

Having thus described my invention, what I claim is:

1. An apparatus for the purpose set forth comprising an air supply, a fuel supply, a combustion chamber, a connection between the fuel supply and the combustion chamber, a connection between the air supply and the combustion chamber, a supplemental connection between the air supply and the combustion chamber, means controlled by the products of combustion to regulate the admission of fuel to the combustion chamber, and means also controlled by the products of combustion to regulate the flow of air through said supplemental connection.

2. An apparatus for the purpose set forth comprising a combustion chamber, means for supplying fuel to said chamber, means for supplying air to said chamber, means for combining the air and the fuel to create pressure within the combustion chamber, and means for supplying additional air upon excessive reduction of said pressure.

3. The combination of a combustion chamber, a deflector secured within the combustion chamber and extending downwardly and inwardly toward the lower end of the same, and an air supply opening into the combustion chamber below said deflector.

4. The combination of a combustion chamber, a burner extending upwardly through the bottom of the same, a fuel supply connected with the said burner, and means external to the burner and the fuel supply for automatically regulating the flow of fuel into the burner.

5. The combination of a combustion chamber, a burner body extending upwardly through the lower end thereof and provided with tortuous passages for the flow of fuel, means for supplying fuel to said passages, means for heating the burner, and means for controlling the flow of fuel from the said passages through the burner.

6. The combination of a combustion chamber, a burner extending upwardly through the bottom of the same, a bridge

across the bore of said burner and provided with an outlet port in its lower side, a tortuous series of passages within the burner leading to the said port, a fuel supply connecting with said passages, a valve controlling the said outlet port, and means external to the burner for adjusting said valve.

7. The combination of a combustion chamber, a burner extending upwardly through the bottom thereof, a bridge extending across the bottom of said bore and having an outlet port in its underside, means for supplying fuel to the said port, a valve to control the said port, means for yieldably holding said valve in an open position, and means controlled by the products passing from the combustion chamber to close said valve.

8. The combination of a combustion chamber, a burner extending upwardly through the bottom thereof, a bridge extending across the bore of said burner and having an outlet port in its underside, means for feeding fuel to said port, a valve arranged to close the said port and normally held in an open position, a thermostat exposed to the products of combustion flowing from the combustion chamber, a lever bearing against the said valve, and connections between the thermostat and said lever whereby to close the valve.

9. The combination of a combustion chamber, a burner extending upwardly through the bottom thereof, a bridge extending across the bore of said burner and having an outlet port in its underside, means for feeding fuel to said port, a valve arranged to close the said port and normally held in an open position, a thermostat exposed to the products of combustion flowing from the combustion chamber, a lever bearing against the said valve, and adjustable connections between the thermostat and said lever whereby to close the valve.

10. The combination of a combustion chamber, a burner tube extending thereinto, a bridge extending across the bore of said burner and having an outlet port in its underside, means for feeding fuel to said port, a valve arranged to close said port, means for holding said valve yieldably open, a lever bearing upon the said valve, a thermostat exposed to the products flowing from the combustion chamber, a rocking arm engaged by said thermostat, and adjustable connections between said rocking arm and the said lever.

11. The combination of a combustion chamber, a burner extending thereinto, an air supply leading into the combustion chamber, a reducing valve in said air supply, a by-pass leading from the air supply to the burner, means for supplying fuel to the burner, and means in the by-pass for controlling the flow through the same.

12. The combination of a combustion chamber, a burner extending thereinto, means for feeding fuel to the burner, an air supply leading into the burner, a valve arranged to control said air supply, a by-pass from the air supply around said valve into the burner, a valve in the by-pass, and means operated by the products flowing from the combustion chamber to close the said valve in the by-pass.

13. The combination of a combustion chamber, a burner extending thereinto, means for feeding fuel to said burner, an air supply leading to the burner, a normally open valve arranged to control said air supply, a rock shaft adjacent said valve, a crank on said rock shaft bearing upon the valve, and means controlled by the products flowing from the combustion chamber to rock said shaft and close the valve.

14. The combination of a combustion chamber, a burner extending thereinto, means for feeding fuel to the burner, an air supply leading into the burner, a normally open valve controlling said air supply, a thermostat exposed to the products flowing from the combustion chamber, and means actuated by said thermostat for closing said valve.

15. The combination of a combustion chamber, a burner extending thereinto, means for feeding fuel to the burner, an air supply leading into the burner, a normally open valve controlling said air supply, a rock shaft arranged to close said valve, a sliding pin connected with said rock shaft, a vibratory arm bearing upon said pin, and a thermostat engaging said arm and exposed to the products flowing from the combustion chamber.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN F. LINDBERG. [L. S.]

Witnesses:
T. A. EVERY,
ERNEST HOSKINS.