Dec. 27, 1927.

1,653,867

W. C. McKEOWN

LIQUID FUEL GAS RANGE

Filed June 20, 1925

2 Sheets-Sheet 1

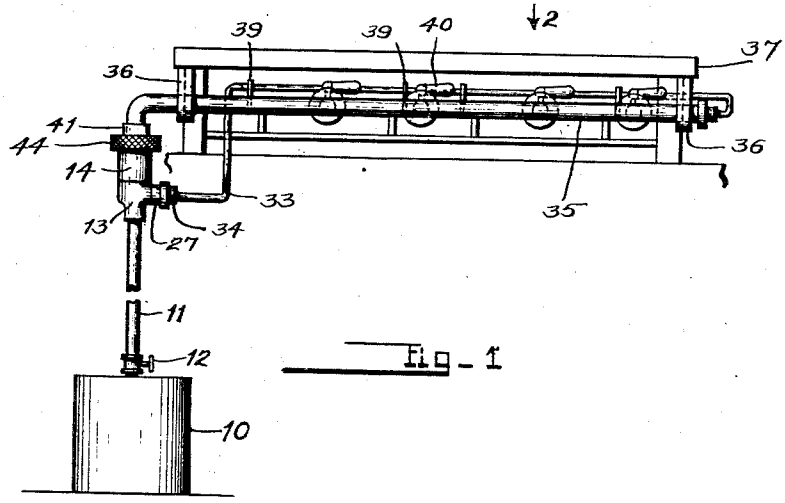


Fig. 1

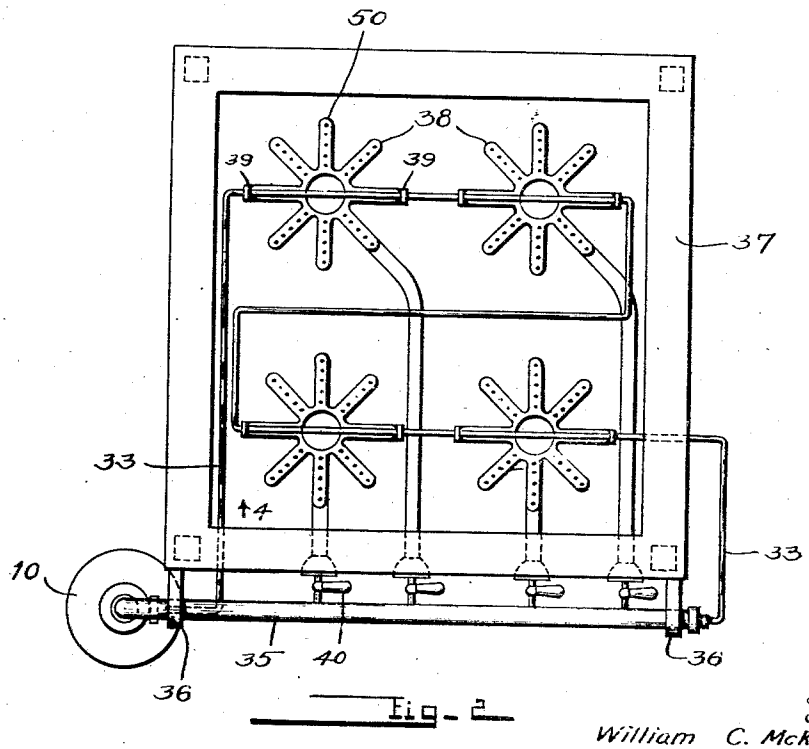


Fig. 2

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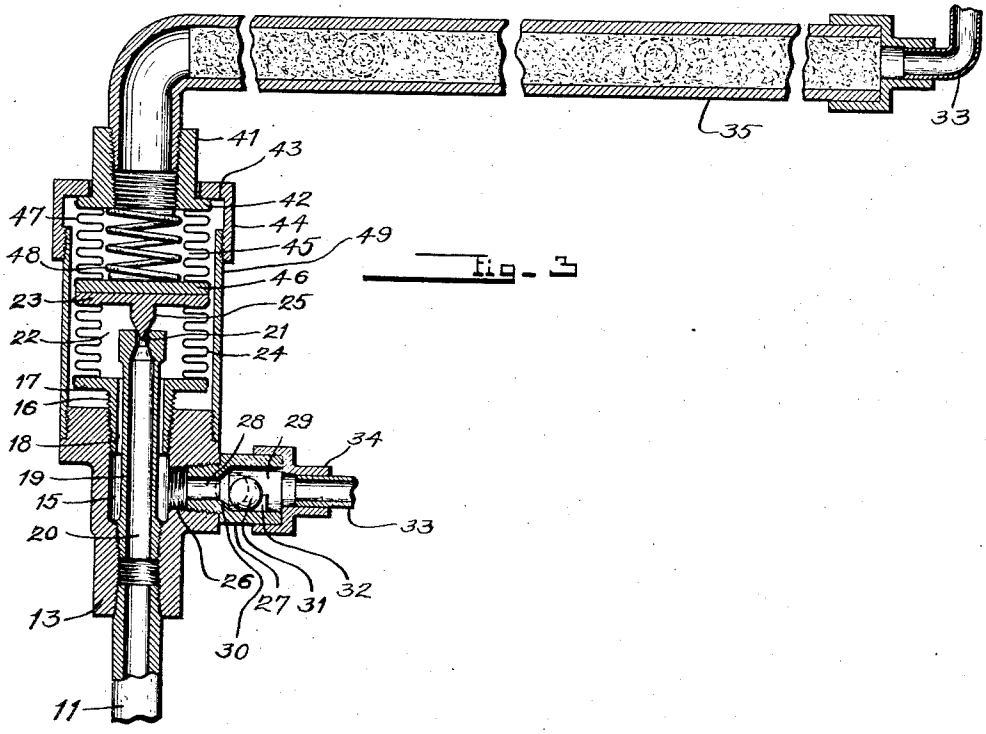


Fig. 3

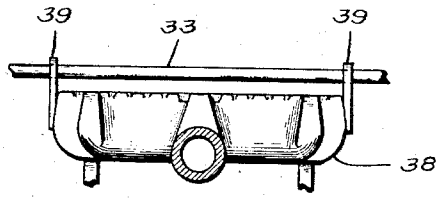


Fig. 4

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UNITED STATES PATENT OFFICE.

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LIQUID-FUEL GAS RANGE.

Application filed June 20, 1925. Serial No. 38,481.

My invention relates to liquid fuel gas ranges.

The principal object of my invention is to devise a method for utilizing natural gas as a fuel which obviates the necessity for extensive pipe line installations through transforming said gas into a liquid state and to provide a range which is adapted for the burning of this liquefied natural gas. For this purpose, I preferably employ the product known as "casing head gas" which is derived from natural gas and contains the richer and more volatile constituents thereof. Before being available for use in my improved range, I preferably liquefy the casing head gas so as to obtain an initial pressure of from thirty to forty pounds gage. Such a pressure is relatively safe to handle and renders available in a concentrated form an amount of gas which becomes extremely large by volume when expanded to a pressure slightly above that of the atmosphere.

While the preferred gas for my range compares favorably in heating value with the gas now manufactured in the cities, it is contemplated, by reason of the highly effective distribution systems existing in such localities, that my improved range will be utilized chiefly in the country districts. The cooking ranges now available in these regions, aside from those using coal and wood, are fuel chiefly by kerosene, gasoline and the like, the thermal value of which is greatly inferior to that present in liquefied natural gas. Moreover, the former are essentially and normally liquid fuels and their transformation to a gaseous state satisfactory for cooking is occasioned with some difficulty.

My invention renders possible the use of natural gas under safe conditions and, therefore, without expensive pipe line systems, the superior advantages of gas as a cooking agent are placed at the disposal of scattered houses and communities. Any standard gas range may be readily transformed to burn the fuel in question, certain additions thereto being required owing to the peculiar nature of the fuel, but no changes are required in the burners proper.

For the purposes of illustration, a simple four burner type of range without an oven is disclosed, but it is to be understood that the number of burners may be multiplied or not, as desired, and that the use of an oven does not affect the efficient operativeness of my device.

These and further objects will be set forth in the following specification, reference being had to the accompanying drawings, and the novel means by which said objects are effectuated will be definitely pointed out in the claims.

In the drawings:

Fig. 1 is an elevation of a simple four burner range showing the application of my improved devices thereto.

Fig. 2 is a view looking in the direction of the arrow 2 in Fig. 1, the cooking grids being omitted for the sake of clearness.

Fig. 3 is an enlarged fragmentary, sectional elevation of the reducing and stop valve and the packed manifold utilized in my improved range.

Fig. 4 is an enlarged view of one of the burners looking in the direction of the arrow 4 in Fig. 2 and showing the manner of mounting a preheater tube on said burner.

In the drawings:—

The numeral 10 represents a tank in which is contained the liquefied natural gas, preferably under a pressure of from thirty to forty pounds gage. The natural gas is transformed into a liquid state by any suitable means, such as subjecting the gas to pressure, which forms no part of my invention and the same has therefore not been particularly illustrated or described.

One end of a feed line 11 is connected to the tank 10 and said line may contain any approved valve, such as 12 for isolating the main portion thereof from said tank. The opposite end of said line is connected to a body portion 13 provided on a reducing and stop valve 14. Said body portion is provided with a passage 15 which is coaxial with the adjacent end of the line 11 and a plug 16, having a flange 17, is mounted in the upper end of said passage.

The plug 16 is also provided with a passage 18, through which extends a stem 19, the lower end of which is mounted in the passage 15 adjacent the end of the line 11. Said stem comprises a duct 20 which is coaxial with the duct in the line 11 and which is

contracted near the upper portion of said stem into an orifice 21. The mouth of said orifice is disposed above the flange 17 and within an extensible chamber 22, one end of which is formed by a disk 23 and the lateral surface of which by the superimposed folds 24 whose ends are secured respectively to the disk 23 and the flange 17. Said folds are preferably made from any suitable thin and flexible material which is impervious to liquids and gases and so that the disk 23 may be made to approach the flange 17, or recede therefrom, without setting up any destructive crystalline action in the curved portions of said folds.

The disk 23 carries a valve plug 25 which registers with the orifice 21, normally closing the same, and therefore a movement of said plug relative to the orifice 21, produced as hereinafter described, will govern the extent of flow of the liquid through said orifice. A passage 26 is provided in the body 13 which connects the passage 15 to one side of said body, said passage being disposed approximately at right angles to the passage 15. A nipple 27 is mounted in the passage 26 and is provided with a pair of axially aligned ducts 28 and 29, respectively, the diameter of the latter being larger than that of the former. The adjacent ends of said ducts form a valve seat 30 which is adapted for the reception of a ball 31 that normally rests on the bottom of the nipple 27 against a stop 32. One end of a preheater line 33 is connected to the nipple 27 by a coupling 34. From the foregoing, it will be understood that a fluid entering the valve 14 through the feed line 11 will reach the line 33 through the stem 19, the chamber 22, and passages 18, 15 and 26, successively, thence through the nipple 27.

The preheater line 33 is connected at its opposite end to one end of a manifold 35 which is supported in appropriate arms 36—36 on a frame 37. Between the coupling 34 and its junction with the manifold 35, the line 33 passes successively over a plurality of burners 38, being supported thereon by ears 39—39 at a suitable distance above a pair of aligned arms of each of said burner. The burners 38 are supported in any approved manner by the frame 37 and are of any standard construction. Said burners are connected to the manifold 35 by means of the usual gas cocks 40.

The manifold 35 is packed tightly with an absorbent material, such as raw cotton, and, at the end opposite its connection with the line 33 is connected to a nipple 41 disposed at the upper end of the valve 14. Said nipple comprises a flange 42 which is adapted to coact with an interior shoulder 43 formed on a hollow nut 44, through which the nipple 41 passes. An extensible chamber 45 is disposed adjacent the flange 42 and within the nut 44, and is closed at its lower end by a disk 46 which abuts on the disk 23, the lateral surface of said chamber being composed of folds 47 which are similar in construction to and formed of material similar to the folds 24. The upper end of the folds 47 is secured to the flange 42 and the lower end thereof to the disk 46. A coil spring 48 is disposed in the chamber 45 between the flange 42 and the disk 46 and in order to produce any desired tension in said spring, the nut 44 is threaded upon one end of the sleeve 49, the opposite end of which is threaded on the body 13. It will be obvious that the sleeve 49 encloses the extensible chambers 22 and 45, but that the latter are spaced therefrom for a purpose hereinafter explained, and that the spring 48 normally maintains the disk 46 in contact with the disk 23, thereby serving to normally maintain the plug 25 in closing engagement with the orifice 21.

The operation of my improved range is as follows:

The tank 10 having been filled with the liquefied gas under pressure, the nut 44 will be adjusted to permit a maximum movement of the plug 25 that, dependent upon the pressure obtaining in said tank and the maximum demands of the burners 38 for fuel, when said pressure operates on said plug, the latter will be moved a sufficient distance to permit the passage of a quantity of fuel adequate for the maximum demand of said burners. Suitable indicia may be provided on the nut 44 so that the user of the range may readily make the adjustment required.

The foregoing adjustment having been made, the liquid then passes successively through the feed line 11, the stem 19 and the orifice 21, and, acting upon the end of the plug 25, will move said plug and its attendant disk 23 upward against the pressure exerted by the spring 48. In passing through the orifice 21, the liquid is throttled and reduced in pressure to such an extent as to transform the same into a gaseous condition, the relation between the orifice 21 and the plug 25 in respect of size and shape being such as to obtain the above noted gasification. The total pressure, therefore, acting upon the end of the chamber 22 and tending to extend the same against the pressure of the spring 48 is that due to the pressure of the liquid against the end of the plug 25 and the pressure of the gas against the under surface of the disk 23.

The gas in the chamber 22 then passes through the pasages 18 and 15 to the preheater line 33, the ball 31 being in the position shown in Fig. 3. After entering the line 33 the gas passes successively above each of the burners 38 and next to the manifold 35, from which it may also enter the chamber 45. For present purposes, it will be assumed that the four cocks 40 are full open

so that the burners 38 may receive a maximum amount of fuel. Under the foregoing conditions, it will be observed that the pressure which obtains in the chamber 22 is substantially the same as that prevailing in the line 33, manifold 35 and the chamber 45, but since the spring 48 has been adjusted for a maximum flow through the orifice 21, the disk 23 will move upwardly until a condition of equilibrium is reached. At such time, the plug 25 will have opened the orifice 21 to permit the flow of that amount of fuel required.

If now one or more of the gas cocks 40 are fully or partly closed, the supply of fuel which had been established to meet the maximum demand of the burners 38 exceeds the new requirement and, therefore, the pressure in the manifold 35 rises. This rising pressure operates upon the disk 46 to cause a downward movement of the same and thereby moves the plug 25 to close a sufficient amount of the orifice 21 in order to reduce the flow of fuel therethrough and to establish a new condition of equilibrium in accordance with the changed requirement. Hence, a fluctuation in the demand of the burners 38 will produce movements of the plug 25 in order to obtain the supply of fuel commensurate with the changing requirements, and it will also be understood that when the demand for fuel entirely ceases, i. e., when the cocks 40 are fully closed the pressure will rise sufficiently high to effect a complete closure of the orifice 21 by the plug 25.

It is also to be understood that, while the fluid pressure per square inch operating on the under surface of the disk 23 is the same as that acting upon the upper surface of the disk 46, since the interiors of the chambers 22 and 45 are both connected through the line 33 and the manifold 35, yet the total forces exerted at any instant on said disk by said pressure are not equal, due to the smaller area of the under surface of the disk 23. The various elements, including the spring 48 and plug 25 are so proportioned, however, as to obtain the varying conditions of equilibrium as just described, and therefore to govern the supply of fuel by the demand existing in the burners 38.

When the liquid is expanded into the chamber 22, the gas thus formed is not in the most desirable condition for combustion, due to the entrainment therein of raw particles of the liquid. It is the purpose of the preheater line 33, therefore, to thoroughly superheat and dry this moist gas and accordingly, as has been described, said line passes successively over the burners 38 in order to effect such drying. The diameter of the line 33 and the portion thereof disposed above each of the burners 38 are of such dimensions that a drying surface is formed which will produce an amount of dried gas sufficient for one burner. Means are thus provided for insuring the preheating of only that amount of gas required.

The purpose of the cotton packing in the manifold 35 is to promote and assist further vaporization of the gas when the burners 38 are first ignited. At such time, the portions of the line 33 above the burners are not warmed and hence are not capable of performing the function above described. The gas, however, is in a more or less raw condition and some time would elapse before the burners would be operating with the most efficient combustion, a factor of great importance in domestic ranges. To overcome this difficulty, I have ascertained that packing the manifold as described produces highly effective results. While the cottom is tightly packed, the gas is of such a penetrating quality that the former does not offer any appreciable resistance to the flow of the gas when the preheating line is in operation.

Under certain conditions of operation, as when all burners 38 being in use, three are suddenly extinguished, leaving the burner 50 ignited, the pressure in the line 33 would rise sharply and as said burner is closer to the chamber 22 than to the chamber 45, there might be a tendency to produce an increased flow through the orifice 21 when a contrary condition is required. The ball 31 prevents such a contingency and insures that as long as the pressure in the chambers 22 and 45, and the manifold 35 is the same, said ball will remain in the full line position shown in Fig. 3, but that under the special condition noted above, it will close the duct 28 and thereby cause the desired movement of the metering plug 25. The check valve shown is intended to be representative of any type of valve for accomplishing the same purpose.

I have therefore not only devised a method for utilizing natural gas as a fuel which dispenses with the necessity for pipe line systems, but also a range for efficiently burning said gas. Said range may be readily constructed from the usual standard range by the addition of the elements hereinbefore described and places at the disposal of country districts a means for effectively using the high thermal content of natural gas.

While I have shown one set of elements and combinations thereof for effectuating one preferred form of my invention, it is to be understood that I do not desire to be restricted to the exact combinations and forms shown, for many changes may be made therein without departing from the scope of my invention.

I claim:

1. The combination with a source of fluid fuel, of means for burning said fuel, and a valve disposed in the fuel line for regulating the flow of said fuel, said valve comprising a casing provided with an inlet port,

an exhaust port, an auxiliary port adapted to be connected to the fuel line on the exhaust side of said valve, an orifice communicating with said inlet and exhaust ports, a chamber, surrounding the orifice end of said means closed at one end and open to said exhaust port at the opposite end, the closed end of said chamber having a valve plug registering with said orifice and the lateral surface of said chamber being formed of a plurality of extensible folds, a second chamber similar to said first named chamber having the closed end thereof abutting the closed end of said first named chamber and the opposite end thereof open to said auxiliary port, and a spring interposed between the closed end of said second named chamber and the adjacent end of said casing, whereby the pressure in said line by varying the lengths of said chambers determines the extent of flow through said orifice.

2. The combination with a source of fluid fuel, of means for buring said fuel, and a valve disposed in the fuel line for regulating the flow of said fuel, said valve comprising a casing provided with an inlet port, an exhaust port, an auxiliary port adapted to be connected to the fuel line on the exhaust side of said valve, an orifice communicating with said inlet and exhaust ports, a pair of abutting extensible chambers positioned in said casing, one of said chambers communicating with said exhaust port and having a valve plug registering with said orifice and the other of said chambers communicating with said auxiliary port, whereby variations in the pressure in said line, operating through said auxiliary port, changes the lengths of said chambers and governs the flow through said orifice.

3. The combination with a source of fluid fuel, of means for burning said fuel, and a valve disposed in the fuel line for regulating the flow of said fuel, said valve comprising a casing provided with an inlet port, an exhaust port, an auxiliary port adapted to be connected to the fuel line on the exhaust side of said valve, an orifice communicating with said inlet and exhaust ports, a pair of abutting extensible chambers positioned in said casing and spaced therefrom, one of said chambers communicating with said exhaust port and having a valve plug registering with said orifice and the other of said chambers communicating with said auxiliary port, whereby variations in the pressure in said line, operating through said auxiliary port, changes the lengths of said chambers and governs the flow through said orifice.

4. The combination with a source of fluid fuel, of means for burning said fuel, and a valve disposed in the fuel line for regulating the flow of said fuel, said valve comprising a casing provided with an inlet port, an exhaust port, an auxiliary port adapted to be connected to the fuel line on the exhaust side of said valve, an orifice communicating with said inlet and exhaust ports, a pair of abutting extensible chambers positioned in said casing, one of said chambers communicating with said exhaust port and having a valve plug registering with said orifice, and the other of said chambers communicating with said auxiliary port, and means positioned adjacent said exhaust port for preventing an inadvertent admission of a pressure higher than that obtaining in the chamber opening to said exhaust port.

5. The combination with a source of fluid fuel, of means for burning said fuel, and a valve disposed in the fuel line for regulating the flow of said fuel, said valve comprising a casing provided with an inlet port, an exhaust port, an auxiliary port adapted to be connected to the fuel line on the exhaust side of said valve, an orifice communicating with said inlet and exhaust ports, a pair of abutting extensible chambers positioned in said casing, one of said chambers communicating with said exhaust port and having a valve plug registering with said orifice and the other of said chambers communicating with said auxiliary port, and a check valve positioned adjacent said exhaust port for preventing an inadvertent admission of a pressure higher than that obtaining in the chamber opening to said exhaust port.

6. The combination with a source of fluid fuel, of means for burning said fuel, and a valve disposed in the fuel line for regulating the flow of said fuel, said valve comprising a casing provided with an inlet port, an exhaust port, an auxiliary port adapted to be connected to the fuel line on the exhaust side of said valve, an orifice communicating with said inlet and exhaust ports, a pair of abutting extensible chambers positioned in said casing, one of said chambers being open to said exhaust port and having a valve plug registering with said orifice and the other of said chambers being open to said auxiliary port, and means for adjusting the lengths of said chambers to obtain a predetermined maximum flow through said orifice.

7. The combination with a source of fluid fuel, of means for burning said fuel, and a valve disposed in the fuel line for regulating the flow of said fuel, said valve comprising a casing provided with an inlet port, an exhaust port, an auxiliary port adapted to be connected to the fuel line on the exhaust side of said valve, an orifice communicating with said inlet and exhaust ports, a pair of abutting extensible chambers positioned in said casing, one of said chambers being open to said exhaust port and having a valve plug registering with said orifice and the other of said chambers being open to said auxiliary port, and manually operated means for adjusting the lengths of said chambers to ob-

tain a predetermined maximum flow through said orifice.

8. The combination with a source of fluid fuel, of means for burning said fuel, and a valve disposed in the fuel line for regulating the flow of said fuel, said valve comprising a casing provided with an inlet port, an exhaust port, an auxiliary port adapted to be connected to the fuel line on the exhaust side of said valve, an orifice communicating with said inlet and exhaust ports, a chamber, surrounding the orifice end of said means, closed at one end and open to the exhaust port at the opposite end, the closed end of said chamber having a valve plug registering with said orifice and the lateral surface of said chamber being formed of a plurality of extensible folds, a second chamber similar to said first named chamber having the closed end thereof abutting the closed end of said first named chamber and the opposite end thereof open to said auxiliary port, and a spring adjustably interposed between the closed end of said second named chamber and the adjacent end of said casing, whereby the pressure in said line by varying the lengths of said chambers determines the extent of flow through said orifice.

In testimony whereof, I affix my signature.

WILLIAM C. McKEOWN.