March 10, 1942. W. C. MASON 2,275,678

LIQUID FUEL BURNER

Filed July 25, 1938

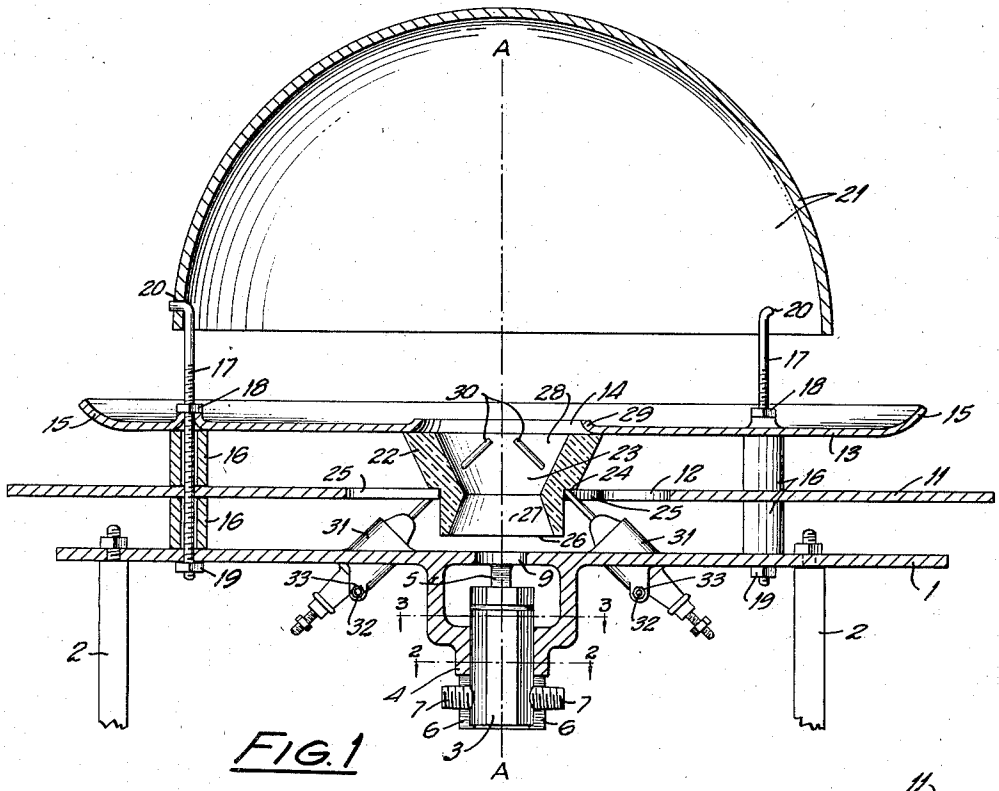


FIG. 1

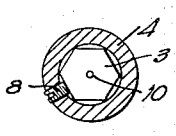


FIG. 2

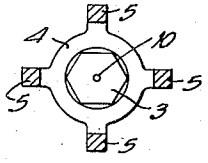


FIG. 3

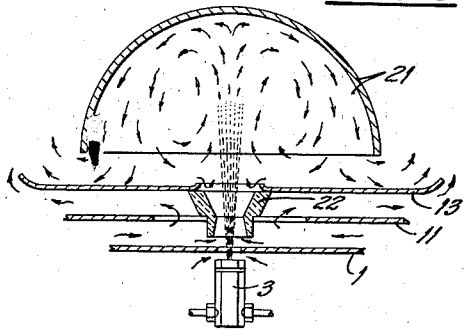


FIG. 5

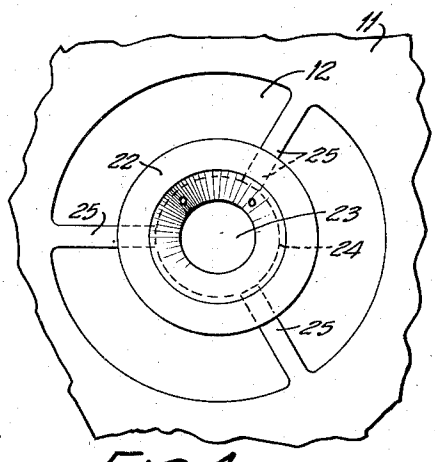


FIG. 4

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LIQUID FUEL BURNER

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Application July 25, 1938, Serial No. 221,077

8 Claims. (Cl. 158—28)

My invention particularly relates to a burner which is particularly adapted to be employed in burning ordinary fuel oil and which is characterized by its high efficiency, cleanliness, combustion without odor and with comparatively little noise.

A first object of my invention is to provide a liquid fuel burner which is so constructed and arranged as to effect a combustion or burning of a liquid fuel or fuel oil in a flame of blue coloration which flame is quite stable in that it cannot be inadvertently extinguished very easily and, under normal operating conditions, the character of the flame therethroughout remains substantially the same. Another object is to provide a fuel burner of the foregoing character which is of high efficiency and will effect fuel combustion without the formation of carbon or carbonaceous deposits. A still further object is to provide a fuel burner, which is capable of being adjusted to comsume liquid fuel at desired rates within a comparatively wide range whereby the burner may be controlled substantially in the same facile manner as a common, illuminating gas burner or jet.

With these and other objects in view, my invention includes the novel method of producing clean and efficient combustion of a liquid fuel and the combination and arrangement of elements described below and illustrated in the accompanying drawing, in which—

Fig. 1 is a vertical, sectional view taken through a preferred form of my burner assembly;

Fig. 2 is a sectional, plan view taken in about the plane 2—2 of Fig. 1;

Fig. 3 is a sectional, plan view similar to Fig. 2 but taken in about the plane 3—3 of Fig. 1;

Fig. 4 is a fragmentary, plan view of an element comprising a Venturi-like passage and associated support therefor; and

Fig. 5 is a somewhat schematic representation of the manner in which combustion of a liquid fuel is effected with my burner.

I have illustrated and will herein describe a preferred embodiment of my liquid fuel burner wherein the various elements thereof are arranged about a vertical axis and with the liquid fuel atomizing nozzle disposed to discharge an atomized liquid fuel in substantially a vertical direction, but it is to be understood of course that the said axis may be arranged horizontally or in other directions. However, the vertical arrangement of the axis, above referred to, is preferred because combustion occurs under better control and a substantially symmetrical flame is produced.

Referring to the drawing, 1 indicates a supporting plate which may be provided with vertically extending supports or legs 2, secured to said plate in any suitable manner. A liquid fuel atomizing nozzle 3, which preferably is of a character which will produce a high degree of atomization of the liquid fuel, is inserted in a housing 4 which may be formed integral with plate 1 and suspended therebelow by means of arms 5, the spaced arrangement of which is clearly illustrated in Fig. 3. The housing 4 is preferably provided with vertically extending slots 6 within which nipples 7, which afford a means for making pipe connections to the nozzle, may pass when the nozzle body is inserted within housing 4. A set screw 8, as illustrated in Fig. 2, may be employed to retain the nozzle 3 within the housing 4. The plate 1 is provided with an opening 9 which is preferably axially aligned with the discharge orifice 10 of the nozzle and of sufficient size to permit the unrestricted passage of a jet of liquid fuel discharged from the orifice 10 of the nozzle. Under normal operating conditions when a jet of liquid fuel is discharged from the nozzle 3 and through the opening 9, air may pass between the arms 5 and pass upwardly through the opening 9 with the liquid fuel jet.

A plate 11 is preferably provided and arranged in spaced relation to and above the plate 1 and provided with a comparatively large opening 12. Above plate 11 and in spaced relation thereto is disposed a plate or baffle element 13 provided with a central opening 14 and preferably with an outwardly and upwardly curved rim 15. Plates 1 and 11 and baffle 13 may be secured in superposed, spaced relation by means of spacers 16, through which threaded rods 17 pass and nuts 18 and 19 serve to retain the respective elements in assembled relationship. For purposes of illustration, three rods and associated spacers are shown and the upper ends of said rods may be bent over at right angles and are adapted to be inserted through openings 20 in a generally concave, dome-like or hollow, semi-spherical element 21.

The axis of dome 21 is preferably arranged to coincide with the axis of the burner assembly indicated by the dot-dash line A—A and the openings 9, 12 and 14, respectively, of the plates 1 and 11 and baffle 13 are preferably arranged with their axes in substantial coincidence with the axes of the dome 21 and nozzle 3 or, in other words, with the axis A—A.

The dome 21 is preferably imperforate. With this construction, a jet of liquid fuel discharged

from the nozzle 3 will pass vertically within the dome 21 and, assuming that it is ignited, the flames will approach the inner surface of the top of the dome and be deflected or "mushroomed" and thence pass downwardly, in part impinging upon the baffle 13. The lower periphery of the dome is preferably spaced from baffle 13.

In the preferred embodiment of my invention, I propose to employ an element 22 which is formed with a Venturi-like passage 23. The element 22 is provided with a circumferential shoulder 24 which is adapted to rest upon arms 25 which may be formed integral with plate 11, as illustrated in Fig. 4 and project within the opening 12. The inlet 26 to the converging portion 27 of passage 23 is preferably spaced above the plate 1 and the upper periphery of element 22 forming the discharge end of the diverging portion 28 of said passage preferably abuts the baffle 13 adjacent the opening 14 therein. The edge of baffle 13 surrounding the central opening 14 therein is illustrated as slightly upturned as indicated at 29. This construction is provided merely to prevent liquid fuel from running over the edge of the baffle in the event of an accumulation thereof on the baffle in the event of failure of ignition, for example, or any other cause. The upwardly and outwardly curved rim 15 of baffle 13 also fulfills this function and, at the same time, directs a generally upward flow of the flames after impingement upon the baffle.

The Venturi-like passage serves to restrict spreading of the jet of liquid fuel from the nozzle and to increase its velocity as it passes therethrough with additional air which is drawn upwardly into the passage. The stream will, therefore, limit the amount of heat which is radiated downwardly to the nozzle and prevent substantial injury.

As a preferred means for igniting the combustible fuel mixture, I have provided electrodes indicated generally at 30 which pass through the walls of the element 22 and terminate in spaced relation to form a spark gap. For this purpose, element 22 is preferably formed of an electrical insulating material such as porcelain. For holding the electrodes in position, plate 1 may be cast with bosses 31 which are drilled to provide an opening through which the electrodes are passed and the insulating body portions thereof are adapted to be retained in said openings. Spaced lugs may also be cast integral with plate 1 to depend therefrom on each side of the openings in the bosses 31. Openings are provided in said lugs through which a bolt 32 may be passed to engage a shoulder on the body portion of the electrodes, when properly positioned, and thereby retain them in position and a nut 33 serves to secure the bolts 32 in place. By means of this arrangement, the electrodes may be easily withdrawn from the mountings therefor for replacement or other purposes.

As illustrated in Fig. 4, the spaced ends of the electrodes 30 are preferably arranged to lie in a vertical plane substantially tangent to the constricted zone of the Venturi-like passage so that the electrodes will not project into the jet of liquid fuel passing therethrough nor will they be subjected to the intense heat of the jet flame but a spark passing therebetween will be drawn into and serve to ignite the atomized fuel and air mixture.

The operation of and the manner in which proper combustion is produced in my burner are as follows. A pipe for conducting liquid fuel is connected to one of the nipples 7 of the nozzle 3 and a pipe for conducting air or other atomizing medium under pressure is connected to the other nipple 7, so that the nozzle 3 will discharge a jet of atomized fuel mixture from the orifice 10 thereof, through the opening 9 in plate 1 and through the Venturi-like passage 23. Electrodes 30 are connected across the secondary of a suitable ignition transformer, so that the jet of atomized fuel will be ignited by the spark so produced between the electrodes 30 and, initially, a jet of flame will be cast into the dome 21. The flame will initially impinge upon the inner top surface of the dome and thereafter will "mushroom" with a layer of a gas, containing insufficient oxygen to support combustion, between the flame and the top of the dome and the flame will then pass downwardly in a return flow toward the baffle 13. The flame will there be divided and some will pass outwardly between the lower rim of dome 21 and baffle 13 while some will curve inwardly toward the jet of flame passing upwardly from the Venturi-like passage. A portion of the inwardly curving flame will be slightly drawn into and about the discharge end 28 of the Venturi-like passage and combine with the balance of the returning flame flowing inwardly toward the jet to provide a zone of extremely high temperature about the jet and in close proximity to the point of ignition thereof. The path of the flame is illustrated by arrows in Fig. 5 and, in practice, it has been found that by causing the flame to flow in the manner above described that the small globules or particles of fuel which are suspended in the jet discharged from the nozzle are completely gasified before they impinge upon the dome 21. The atomized liquid, as a jet, is first vaporized and ultimately transformed into a substantially dry gaseous product.

As will be noted, the inlet to the Venturi-like passage is preferably spaced from the plate 1 whereby, as also indicated by arrows in Fig. 5, air is drawn into the Venturi-like passage from the space between the plates 1 and 11. Some of the air passing between these plates and toward the jet will pass upwardly through opening 12 in plate 11 and thence outwardly and upwardly about the curved rim of baffle 13 mixing with the unconsumed gases flowing adjacent the inner surface of the dome and issuing from beneath the dome whereby to effect substantially complete combustion thereof. Furthermore, air is initially admitted through the space between the discharge end of the nozzle and the edge of opening 9 in plate 1 to the jet issuing from the discharge orifice of the nozzle.

By burning a liquid fuel in the foregoing manner a flame which is characterized by a completely blue coloration is produced. Substantially uniform temperatures are found to exist throughout a flame of this character and it is extremely stable. By the term "stable," I mean that it cannot be blown out very easily and the general character of the flame remains the same under normal operating conditions. For example, the flame may be subjected to a comparatively strong blast of air in a direction crosswise thereof or across the jet without extinguishing it. Furthermore, the burner will not produce carbonaceous deposits of any character and this is true even though the flames are caused to strike a chilled, highly polished metallic surface. In operation, combustion will occur with practically no noise and this feature is very desirable

where the burners are to be used in kitchens and like places.

It is to be noted that the baffle 13 and dome 21 are so arranged as to create sufficient pressure in the zone defined therebetween that the velocity of the jet from the nozzle, after issuing from the Venturi-like passage, is very quickly reduced and, furthermore, the amount of air admitted to the space beneath the dome is limited. Hence, under normal operating conditions and after the burner has been put in operation, a layer of substantially non-burning gases flows adjacent the interior surface of the dome acting substantially as a "cushion" for the jet thereby preventing flames from impinging on the dome or at least insulating to a considerable extent the dome from the flames and, also, effecting a comparatively quiet burner operation.

The over-all height of the assembled burner, assuming a vertical jet arrangement, may be very limited because, to produce the desired results, above referred to, the respective elements should be relatively closely associated. Hence, the burner may be employed in many installations where it is impossible for practical purposes to use other types of burners because of the comparatively great height of space required in their design to provide complete combustion without impingement of oil on the surface disposed above the flame.

It should also be noted that due to the substantially uniform temperatures of the flames objects to be heated may be directly subjected thereto without causing burned out areas in the object which might otherwise occur due to non-uniform flame temperatures.

It should also be noted that due to the character of the combustion which occurs in my burner it may be regulated within limits to consume fuel at different rates and the flame may be regulated or adjusted, or, in other words, turned up and down substantially in the same manner and with the same facility as an ordinary illuminating gas flame.

Though I have referred to the element 21 as a generally concave, dome or dome-like element, it is to be understood that the term "dome" as employed herein and in the appended claims is intended to designate an element which is so shaped as to cause a return flow of hot gases or flames about the jet of fluid issuing from a nozzle directed toward said element.

While I have described my invention in its preferred embodiment, it is to be understood that the words which I have used are words of description and not of limitation and that changes within the purview of the appended claims may be made without departing from the true scope and spirit of my invention in its broader aspects.

What I claim is:

1. In a liquid fuel burner, the combination with a hollow dome open at the bottom of a fuel atomizing nozzle having its discharge orifice arranged vertically beneath and substantially axially aligned with said dome, a substantially horizontal plate element disposed between said dome and nozzle and placed sufficiently close to said dome to be impinged upon by the flame deflected by said dome when the jet of atomized fuel issuing from said nozzle is ignited, said plate element being provided with an opening through which a jet of atomized fuel discharged from said nozzle may pass, and a second plate spaced below said first place and provided with an opening of sufficient area to permit the unrestricted passage of said jet of atomized fuel therethrough.

2. In a liquid fuel burner, the combination with a hollow dome open at the bottom of a fuel atomizing nozzle having its discharge orifice arranged vertically beneath and substantially axially aligned with said dome and a substantially horizontal plate element disposed between said dome and nozzle and placed sufficiently close to said dome to be impinged upon by the flame deflected by said dome when the jet of atomized fuel issuing from said nozzle is ignited, said plate element being provided with an opening through which said jet may pass.

3. In a liquid fuel burner, the combination with a hollow dome open at the bottom of a fuel atomizing nozzle having its discharge orifice arranged vertically beneath and substantially axially aligned with said dome, means forming a venturi-like passage substantially axially aligned with said dome and disposed between said dome and nozzle for the passage therethrough of a jet of atomized fuel issuing from said nozzle and a substantially horizontal plate extending about said venturi-like passage and placed sufficiently close to said dome to be impinged upon by the flame deflected by said dome when the jet of atomized fuel issuing from said nozzle is ignited.

4. In a liquid fuel burner, the combination with a hollow dome open at the bottom of a fuel atomizing nozzle having its discharge orifice arranged vertically beneath and substantially axially aligned with said dome, means forming a venturi-like passage substantially axially aligned with said dome and disposed between said dome and nozzle for the passage therethrough of a jet of atomized fuel issuing from said nozzle, a substantially horizontally disposed baffle surrounding said venturi-like passage substantially in the plane of the discharge mouth thereof and placed sufficiently close to said dome to be impinged upon by the flame deflected by said dome when the jet of atomized fuel issuing from said nozzle is ignited, and a plate spaced below said baffle, said plate being provided with an opening substantially axially aligned with said venturi-like passage and with the walls thereof spaced from the discharge orifice of said nozzle whereby to permit air to pass through said opening.

5. In a liquid fuel burner the combination of a fuel atomizing nozzle, a deflector positioned in the path of a jet of fuel issuing from said nozzle and sufficiently close thereto to cause the stream of hot gases formed by combustion of said fuel to impinge thereon and so shaped as to cause the said stream to thereby be deflected back upon itself, and a second deflector, provided with an aperture through which the jet of atomized fuel issuing from said nozzle may pass, positioned between the first deflector and the nozzle, and sufficiently close to the first deflector to cause the stream of gases deflected by and flowing from said first deflector to impinge thereon and so shaped as to cause the said impinging stream to thereby be divided into two streams, one flowing inwardly toward the jet issuing from said nozzle, and the other away from said jet and out from between the two deflectors.

6. In a liquid fuel burner the combination of a fuel atomizing nozzle adapted to direct a jet of atomized fuel substantially vertically upward, a deflector positioned in the path of a jet of fuel issuing from said nozzle and sufficiently close thereto to cause the stream of hot gases formed

by combustion of said fuel to impinge thereon and so shaped as to cause the said stream to thereby be deflected back upon itself, and a second deflector, provided with an aperture through which the jet of atomized fuel issuing from said nozzle may pass, positioned between the first deflector and the nozzle, and sufficiently close to the first deflector to cause the stream of gases deflected by and flowing from said first deflector to impinge thereon and so shaped as to cause the said impinging stream to thereby be divided into two streams, one flowing inwardly toward the jet issuing from said nozzle, and the other away from said jet and out from between the two deflectors.

7. In a liquid fuel burner the combination of a fuel atomizing nozzle, a deflector having a concave face positioned in the path of a jet of fuel issuing from said nozzle and sufficiently close thereto to cause the stream of hot gases formed by combustion of said fuel to impinge on the concave face thereof and thereby be deflected back upon itself, and a second deflector, comprising a substantially flat plate, provided with an aperture through which the jet of atomized fuel issuing from said nozzle may pass, positioned between the first deflector and the nozzle substantially at right angles to the path of the jet of fuel issuing from said nozzle, and sufficiently close to the first deflector to cause the stream of gases deflected by and flowing from said first deflector to impinge thereon and thereby be divided into two streams, one flowing inwardly toward the jet issuing from said nozzle, and the other away from said jet and out from between the two deflectors.

8. In a liquid fuel burner the combination of a fuel atomizing nozzle adapted to direct a jet of atomized fuel substantially vertically upward, a deflector having a concave face positioned in the path of a jet of fuel issuing from said nozzle and sufficiently close thereto to cause the stream of hot gases formed by combustion of said fuel to impinge on the concave face thereof and thereby be deflected back upon itself, and a second deflector, comprising a substantially flat plate, provided with an aperture through which the jet of atomized fuel issuing from said nozzle may pass, positioned between the first deflector and the nozzle in a substantially horizontal plane, and sufficiently close to the first deflector to cause the stream of gases deflected by and flowing from said first deflector to impinge thereon and thereby be divided into two streams, one flowing inwardly toward the jet issuing from said nozzle, and the other away from said jet and out from between the two deflectors.

WILLIAM C. MASON.