

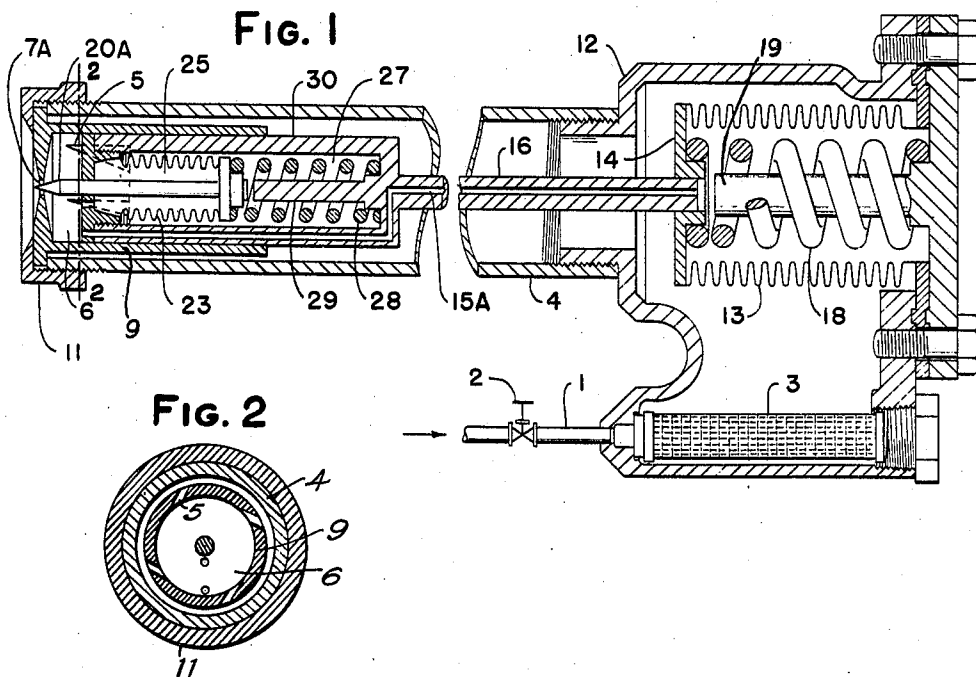
May 16, 1944.

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2,349,221

LIQUID FUEL BURNER

Filed Dec. 3, 1940



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2,349,221

LIQUID FUEL BURNER

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Application December 3, 1940, Serial No. 368,379

4 Claims. (Cl. 299—118)

This invention relates to liquid fuel burners for atomizing and injecting liquid fuel such as oil into a furnace or the combustion chamber of a boiler or the like.

By my invention it is possible to obtain a finely atomized spray of liquid fuel over a wide operating range, and furthermore to obtain a relatively small variation in the apex angle of the spray cone over the operating range.

In accordance with my invention I provide a whirling chamber to atomize the fuel; and vary the area of the slots or nozzles through which the liquid fuel is admitted to the chamber to maintain the velocity of the fuel through the slots substantially constant.

Further, in accordance with my invention I may also vary the area of the discharge orifice from the whirling chamber to maintain the axial velocity of the fuel ejected from the chamber substantially constant.

The radial velocity of the liquid fuel ejected from the whirling chamber is a function of the speed of rotation of the mass of liquid fuel in the chamber, which in turn is a function of the velocity at which the fuel is admitted to the chamber through the tangential inlet slots or ports. Likewise the axial velocity of the liquid fuel ejected from the chamber is a function of the axial velocity at which the liquid fuel is ejected through the discharge orifice. Therefore by maintaining these velocities substantially constant a finely atomized spray cone having a substantially constant apex angle may be obtained over a wide operating range.

This invention will be understood by reference to the accompanying drawing, in which:

Fig. 1 illustrates a preferred form of my invention.

Fig. 2 is a cross-sectional view along the lines 2—2 in the direction of the arrows of Fig. 1.

Referring to Fig. 1, I therein show in cross-section a liquid fuel burner, or more specifically an oil burner, to which oil is supplied through a supply pipe 1. Usually, as well known in the art, a battery of burners such as illustrated in Fig. 1, are installed on a furnace and connected in parallel to the supply pipe so that all are operated at substantially the same rating. Any suitable means may be employed to control the oil pressure in the supply pipe 1, and hence the rate of delivery to the burner or burners connected thereto. By way of illustration I have shown a manually operable valve 2 for controlling the pressure. It is evident that other forms of manual

or automatic control devices may be employed.

The oil upon entering the burner first passes through a strainer 3, thence through a barrel or passageway 4, thence through tangential V-shaped ports or slots 5 into a whirling chamber 6, from which it is ejected into the combustion chamber through an axially located discharge orifice 7a. The chamber 6 is formed as shown in a burner tip having a cylindrical wall section (9) in which the V-ports are formed and a disc-like skirt or flange adapted to be secured, when the parts are assembled as shown in Fig. 1, to the end of the barrel 4 by a cap 11.

As shown, the V-ports 5 are arranged in the cylindrical wall substantially tangential to the wall section of the chamber 6, so that the impact of the oil entering the chamber serves to maintain the mass of oil therein in rotation. The oil upon being discharged from the axially located orifice 7a is therefore thrown radially outwardly in the form of a cone by virtue of the centrifugal force developed by such rotation. The centrifugal force and hence the radial velocity of the oil upon leaving the discharge orifice 7a is essentially a function of the angular velocity of the mass of oil in the chamber 6. Thus if the velocity of the oil through the slots 5 is materially altered, changing the angular velocity of the oil in the chamber 6, a corresponding change in the radial velocity of the oil upon leaving the discharge orifice 7a will occur.

The rate of oil discharged through the orifice 7a is essentially a function of the pressure differential thereacross; and therefore the amount of oil discharged per unit of time may be varied by changing the pressure of the oil in the whirling chamber 6, which may be accomplished by manipulation of the control valve 2 as heretofore described. From the fact that the oil discharged from the orifice 7a has an axial and radial velocity component, it is evident that to maintain a relatively small apex angle of the spray cone throughout the operating range a change in pressure within the chamber 6 should not materially change the velocity at which oil is discharged through the V-ports 5 into the chamber 6. In the embodiment of my invention shown in Fig. 1, means are provided for varying the area of the V-port slots to maintain a constant pressure drop thereacross, which will now be described.

Secured to the barrel 4 at its outer end is a housing 12 in which is disposed a metallic Sylphone 13 having a movable head or abutment 14. The pressure of the oil in the barrel 4 acts

against the exterior of the head and urges the same to the right, as shown in the drawing. The pressure within the chamber 6 is transmitted through a passageway 15A in a push rod 16 to the interior of the Sylphon 13 and urges the head 14 to the left, as shown in the drawing. Also acting on the head 14 and urging the same to the left as shown in the drawing is a coil spring 18.

In the preferred form of my invention, I show a burner arrangement wherein the push rod 16, positioned as heretofore described by the Sylphon 13, carries a plunger 30 for controlling the area of the V-ports 5. The interior of the Sylphon 13 is connected by a passageway 15A to the whirling chamber 6, so that the plunger 30 will be positioned to maintain a substantially constant or progressively increasing differential across the V-ports 5. The plunger 30 carries the Sylphon 23 dividing the interior thereof into chambers 25 and 27. The former is at the pressure of the whirling chamber, whereas the latter is at atmospheric pressure, so that the valve member 20A will be positioned to maintain a substantially constant or progressively increasing differential across the discharge orifice 7A. It will be apparent that inasmuch as the pressure differential across the V-ports 5 and discharge orifice 7A may be maintained constant or progressively increasing with rate of oil discharge, it follows that the embodiment of my invention shown will operate to maintain a substantially constant apex angle of the spray cone over the entire range of operation of the burner.

Within the Sylphon 13 is shown a post 19 adapted to limit the travel of the push rod 16. In some instances it may be desirable to have the push rod 16 engage the post 19 when the plunger 17 has opened the V-ports 5 the maximum amount, that is when the maximum capacity of the burner is reached. In other instances it may be desirable to have the post 19 engage the push rod 16 before the maximum capacity of the burner is reached, so that up to the point where the push rod 16 engages the post 19 the oil will issue from the orifice 7 with a substantially constant radial velocity component, and beyond that point with an increasing radial velocity component because of the increase in pressure drop across the V-ports 5.

The embodiment of my invention shown further provides for the possibility of causing the radial velocity component of the fuel oil discharged to the orifice 7A to progressively increase as the rate of discharge increases, which may be desirable in certain instances. I may accomplish this, in the embodiment shown in Fig. 1, by providing a spring 18 having a relatively high rate so that as the rate of flow to the burner is increased an appreciably higher pressure differential is progressively maintained across the V-ports 5. I may also accomplish the same result by varying the effective length of the spring 18 and hence changing the rate of a given spring. The burner illustrated in Fig. 1 therefore provides a flexible unit which may be arranged to meet the exigencies of any particular installation.

As the plunger 30 is positioned the ports 5 will be progressively opened, thereby maintaining a substantially constant or progressively increasing differential across the slots 5 as may be preferred. The exact number of slots or ports employed may be varied to obtain a desired maximum burner capacity or burner characteristic.

Generally speaking as the rate of discharge through the orifice 7A decreases, the axial component of the velocity of the oil discharged likewise decreases. At extremely low rates of flow the axial component may be so small that a finely atomized spray will not be obtained, causing the oil to issue from the orifice in a solid sheet. Even if satisfactory atomization of the oil is obtained the apex angle of the spray cone becomes so large as to preclude the possibility of obtaining satisfactory and efficient combustion. Therefore, by progressively decreasing the effective area of the orifice 7A at low rates of oil discharge the axial component of the oil velocity is maintained more nearly constant, so that a satisfactory spray may be maintained at extremely low rates of flow.

Further the arrangement may be such that a constant ratio will be maintained between the radial and axial components of the velocity of the oil discharged from the orifice 7A, so that a substantially constant apex angle of the spray cone will be maintained over the entire operating range.

Obviously my invention is easily adapted for maintaining a substantially constant or progressively increasing pressure differential across the discharge orifice so that each component of the velocity of the oil discharged is maintained constant or varied in predetermined manner.

While in accordance with the patent statutes I have illustrated and described certain specific embodiments of my invention, it is understood that these are not to be considered as limiting, as it is evident that my invention may be embodied in other forms.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A liquid fuel burner comprising a hollow member having tangential openings there-through and forming a whirling chamber, a discharge orifice in one end of said chamber, said tangential openings admitting fluid into the chamber, valve means for varying the area of the discharge orifice, said means being responsive to variations in the pressure across said discharge orifice, and valve means to control the area of said tangential openings, said last-mentioned means being responsive to variations in the pressure across said tangential openings.

2. A liquid fuel burner comprising a whirling chamber having a discharge opening and a tangential V-shaped inlet port, valve means responsive to the pressure in the whirling chamber for progressively varying the area of the discharge opening, and means responsive to the difference in pressure variations across said V-shaped inlet port for varying the area thereof during the entire period of operation of the burner.

3. A liquid fuel burner comprising a liquid fuel supply pipe, means for controlling the pressure of the liquid fuel in said supply pipe, means at one end of said pipe forming a single whirling chamber provided with an immovable fuel discharge orifice in the end of said chamber, a passageway connecting the interior of the chamber with said pipe, a valve member for varying the area of said passageway, a Sylphon having a movable head, said Sylphon in axial alignment with said valve member and connected to the opposite end of said pipe to form a chamber, a spring in said chamber urging the movable head of the Sylphon towards said single fuel whirling chamber, a hollow rod connecting said valve member to said movable head, said rod forming

a fluid pressure transmitting connection between the interiors of said single fuel whirling chamber and Sylphon whereby the latter is positioned and said passage area varied in accordance with the difference between the pressure in the fuel supply pipe and whirling chamber.

4. A liquid fuel burner comprising a whirling chamber having a discharge orifice and tangen-

tial inlet ports; means responsive to the differential pressure across said inlet ports for progressively varying the area thereof, and valve means responsive to the pressure differential across said discharge orifice for varying the area thereof during the entire period of operation of the burner.

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