Nov. 29, 1960 W. T. BRAITHWAITE 2,962,090

LIQUID FUEL BURNER

Filed Feb. 27, 1956

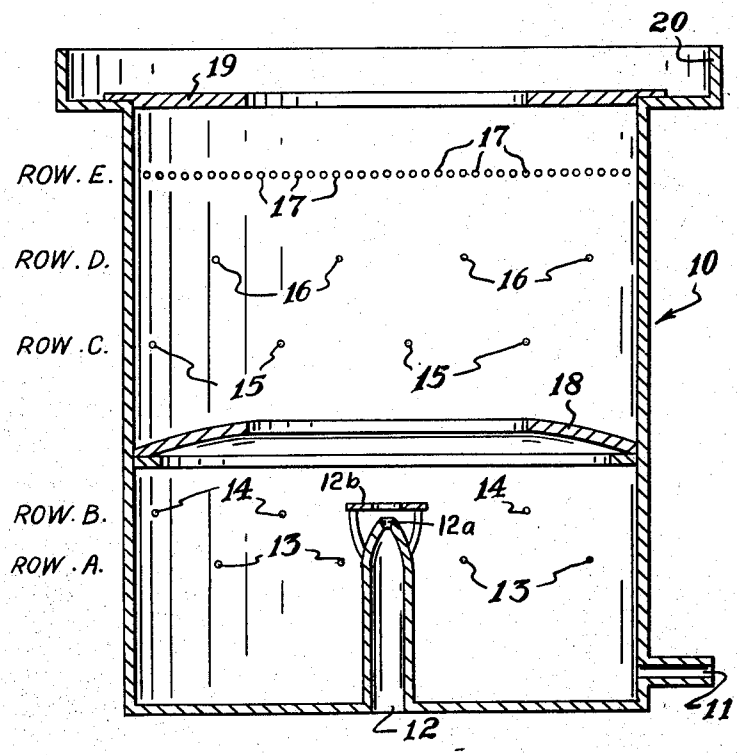


FIG. 1.

ROW	NATURE OF HOLES
A	DIRECTED TO GIVE ANTI-CLOCKWISE DOWNWARD ROTATION.
B	DIRECTED TO GIVE CLOCKWISE ROTATION.
C	DIRECTED TO GIVE CLOCKWISE ROTATION.
D	DIRECTED TO GIVE ANTI-CLOCKWISE ROTATION.
E	DIRECTED RADIALLY UPWARD

FIG. 2.

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United States Patent Office 2,962,090 Patented Nov. 29, 1960

2,962,090

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Filed Feb. 27, 1956, Ser. No. 568,094

3 Claims. (Cl. 158—91)

This invention relates to liquid fuel burners, and more particularly to an improved liquid fuel burner firepot design.

The basic design of firepots of this type provides for admission of primary and secondary air. The primary air, which is generally admitted through a number of small holes in the lower part of the vertical side of the firepot, is often insufficient to give complete combustion. Secondary air is therefore admitted through a large number of closely spaced small holes situated near the top of the vertical side wall of the liquid fuel burner.

The secondary air serves to complete the combustion of the fuel at medium to high fire. The efficiency of combustion depends on the number and disposition of the primary and secondary air holes, the nature of the primary air admission, and the amount of fuel admitted. Liquid fuel burners of this type are usually capable of adjustment so that a variation of heat output is obtainable. That is, by varying the fuel input, the amount of heat obtained is varied. However, since the efficiency of the liquid fuel burner depends on the nature and disposition of the primary and secondary air holes as well as upon the amount of fuel admitted, it has been a problem to design the firepot to give efficient combustion under all operating conditions i.e. with low fires, medium fires, and high fires. The situation is further complicated by the fact that, in this type of burner, no matter how efficient the method of mixing the vapor and air, the fuel must at all times be efficiently vaporized by application of heat. Therefore, in that portion of the body of the liquid fuel burner where vaporization takes place, a high degree of heat must be maintained at high, medium, and low fires.

When the fuel burner is operating at low fire, it is desirable to hold the fire well down in the firepot yet provide sufficient primary air to give reasonably efficient combustion. To this end my firepot employs a first row of primary air holes near the bottom of the firepot. The holes of this first row are directed so as to give a downward rotary motion to the air entering therethrough. Thus the fire is held down in the firepot so that efficient vaporization of the fuel takes place and primary air adequate to support fuel combustion is provided.

When the liquid fuel burner is operated at medium fire, it is still desirable to hold the fire low in the pot, although not as low as for low fire. Thus, in order to compensate for the downward rotary motion resulting from the first row, a second row of holes (above the first row) is provided which tends to give a rotary motion to the primary air entering therethrough opposite in direction to the motion resulting from the first row. A third row of primary air holes disposed above, and similar to, the second row may be provided. With the liquid fuel burner operated at medium fire the rotary motion obtained by the first row of primary air holes is overcome and the second row (and third row, if provided) imparts a second rotary motion such that the fire is held from rising too high in the firepot and a high efficiency of vaporization and heating is maintained.

It is desirable to allow the fire to rise somewhat above the firepot when operated at high fire. Therefore, a further row of primary air holes is provided which is disposed above and similar to the second row (and third row, if provided), except that the rotary motion imparted thereby is opposite in direction. This fourth row acts as a "brake" to the rotary motion resulting from the second and third rows.

A row of secondary air holes is also provided, said row consisting of a larger number of smaller holes directed upward and towards the center of the firepot. Thus, on high fire, the flames are caused to project somewhat above the top of the firepot to give a maximum of heat.

It will be understood that the combined action of the several rows of primary air holes gives a large amount of turbulence at all fires whereby an efficient mixing of air and fuel results.

A further feature of the invention is a centrally located air delivery means which extends axially upwardly from the base of the cylindrical firepot to a point somewhat above the lowermost row of holes. The primary air holes described above cause a slow rotary motion of the gases within the pot, the axis of rotation of the gases roughly coinciding with the longitudinal axis of the air delivery means. Any tendency for the fire to lie too low in the bottom of the pot when operating at low fire conditions is offset by said air delivery means which lifts the flame up and also assists ignition of any unburnt fuel vapour in the central part of the firepot.

Summarizing the foregoing, my present invention may be generally defined as a liquid fuel burner comprising a firepot having a generally flat base and a generally cylindrical wall, means adjacent said base for delivering liquid fuel into said firepot, and an air delivery means mounted on said base and extending axially upwardly in said firepot, said firepot having a plurality of horizontal rows of small passages extending through its cylindrical wall, the small passages of the uppermost of said rows being directed radially upwards, the small passages of the second-uppermost row being directed generally horizontally but at angles to radii drawn through them which induce a rotary motion of the combustion gases generally concentrically of said air delivery means, the small passages of the lowermost row being directed downward and at angles to radii drawn through them which induce rotary motion of the combustion gases generally concentrically of said air delivery means in the same direction as the passages of said second-uppermost row, and, intermediate said second-uppermost row and said lowermost row, at least one additional row, the small passages of said additional row or rows being directed generally horizontally but at angles to radii drawn through them which encourage rotary motion of the combustion gases generally concentrically of said air delivery means, the direction of rotation being opposite to that induced by the passages of said lowermost and second-uppermost rows.

The features of the invention will be apparent from the following detailed description taken in conjunction with the attached drawing, in which:

Figure 1 is a central vertical section of a preferred embodiment, and

Figure 2 is a legend serving to show the nature of the air holes of the several rows.

In Figure 1, **10** represents a firepot according to the invention having a flat base and a cylindrical sidewall. The firepot is provided with a fuel inlet at **11** and a centrally located air delivery means **12** extending axially upwardly from the base of the pot. The air delivery

means 12 has an outlet 12*a* at its free end within the firepot 10 and carries a dispersal ring 12*b* adjacent outlet 12*a*. The pot is designed to admit primary air through holes 13, 14, 15, and 16 arranged in horizontal rows A, B, C, and D, respectively, and secondary air through holes 17 of row E. Additional primary air is supplied via air delivery means 12.

In the operation of liquid fuel burners of this general type, the liquid fuel enters the bottom of the firepot through the inlet 11 and is caused to vaporize. This fuel vapor mixes with the air entering the firepot and the fuel is then allowed to burn. A primary supply of air is usually available through the side wall of the firepot and the air admitted therethrough aids the combustion to the extent that the fuel is more completely vaporized and burned. In the case of the present invention, the primary air serves a further function. The primary air, which enters through holes 13, 14, 15, and 16 arranged in horizontal rows A, B, C, and D respectively, is drawn into the firepot in such a way as to aid in the controlling of the fire, and thereby the heat output.

Primary air holes 13 which comprise the lowermost row (Row A) of holes are directed inwardly at a horizontal angle to the radius of the firepot. These holes 13 are also directed downwardly. The net effect is that the primary air entering through the holes 13 of Row A is given both a downward motion and a slow rotary motion generally concentrically of the air delivery means 12. This tends to hold the flames in the firepot down when the liquid fuel burner is operated on low fire. In the illustrated embodiment this rotary motion is, by way of example, anti-clockwise as viewed from above.

Primary air holes 14 (Row B) are directed horizontally inwards at a horizontal angle to the radius of the firepot so as to give the air entering therethrough rotary motion generally concentrically of the air delivery means 12. The purpose of holes 14 is to provide primary air to the firepot when the burner is operating at low to medium fire. As stated above, it is desirable to hold the flames down in the firepot, but, as the combustion approaches medium fire, it is desirable to allow the fire to rise up a little higher. Thus it is necessary to "brake" or counteract the action of Row A. The holes 14 are horizontally directed so as to give a rotary motion opposite in direction to that induced by holes 13; thus, if holes 13 result in an anti-clockwise rotary motion, holes 14 will be directed so as to give in a clockwise rotary motion. Actually, it is desirable that Row B "overbrake" Row A so that a gentle resultant rotary motion in the same direction as that induced by Row B results. The provision of this braking effect is very valuable when operating at low fire during very windy or gusty days. If it were absent, a high wind or a sudden gust of wind might increase the speed of rotation to the extent that the fire is put out.

As a further aid in holding the flames down in the firepot, a lower flame ring 18, disposed slightly above Row B, may be provided. The lower flame ring 18 may be flat, or slightly concave as shown in Figure 1.

A third row (Row C) of primary air holes 15 may be provided above the lower flame ring 18. It is preferred that holes 15 be similar in size and direction to holes 14, so as to augment the rotary motion of the combustion gases initiated by row B.

Row D is comprised of horizontally directed holes 16 which are similar to holes 14 of Row B except that they are directed in the opposite direction. That is, when holes 14 result in a clockwise rotary motion, holes 16 tend to give an anti-clockwise rotary motion. When the burner is operated at high fire it is desirable to "brake" the rotary motion resulting from Row B (and Row C, if provided), and direct the flames inwardly and upwardly. The holes 16 of Row D provide the braking action, and secondary air holes 17, which are directed radially and upwardly, fulfill the second function. An upper flame ring 19 is provided which serves to aid the holes 17 in directing the flames inwardly and upwardly into the main body 20 of the burner.

If the cylindrical side wall of fire pot 10 is of sufficient thickness it will impart to the holes the desired direction. If the side wall is relatively thick, the desired direction of the air holes may be obtained by distorting the side wall about each hole, for instance by inserting and pivoting a metal bar.

It will be understood from the foregoing description of a preferred embodiment of the invention that the liquid fuel burner is capable of obtaining good combustion and efficient heat output whether the burner is operated on low fire, medium fire, or high fire. It will be further understood that while the angularly directed primary air holes have been described as imparting rotary motion to the primary air entering therethrough, these rotary motions will immediately be imparted to the flames and the combustion gases within the firepot.

I claim:

1. A liquid fuel burner comprising a firepot having a generally flat base and a generally cylindrical wall, means adjacent said base for delivering liquid fuel into said firepot, and an air delivery means mounted on said base and extending axially upwardly in said firepot, said firepot having a plurality of horizontal rows of small passages extending through its cylindrical wall, the small passages of the uppermost of said rows being directed radially upwards, the small passages of the second-uppermost row being directed generally horizontally but at angles to radii drawn through them which induce a rotary motion of the combustion gases generally concentrically of said air delivery means, the small passages of the lowermost row being directed downward and at angles to radii drawn through them which induce rotary motion of the combustion gases generally concentrically of said air delivery means in the same direction as the passages of said second-uppermost row, intermediate said second-uppermost row and said lowermost row one additional row, the said passages of said one additional row being directed generally horizontally but at angles to radii drawn through them which encourage rotary motion of the combustion gases generally concentrically of said air delivery means, the direction of rotation being opposite to that induced by the passages of said lowermost and second-uppermost rows, and a flame ring located between said one additional row and said second-uppermost row, the said air delivery means terminating at a point intermediate said lowermost row and said flame ring.

2. A liquid fuel burner comprising a firepot having a generally flat base and a generally cylindrical wall, means adjacent said base for delivering liquid fuel into said firepot, and an air delivery means mounted on said base and extending axially upwardly in said firepot, said firepot having a plurality of horizontal rows of small passages extending through its cylindrical wall, the small passages of the uppermost of said rows being directed radially upwards, the small passages of the second-uppermost row being directed generally horizontally but at angles to radii drawn through them which induce a rotary motion of the combustion gases generally concentrically of said air delivery means, the small passages of the lowermost row being directed downward and at angles to radii drawn through them which induce rotary motion of the combustion gases generally concentrically of said air delivery means in the same direction as the passages of said second-uppermost row, intermediate said second-uppermost row and said lowermost row at least two additional rows, the small passages of said additional rows being directed generally horizontally but at angles to radii drawn through them which encourage rotary motion of the combustion gases generally concentrically of the air delivery means, the direction of rotation being opposite to that induced by the passages of said lowermost and

second-uppermost rows, and a flame ring located between the lowermost pair of said additional rows, said air delivery means terminating at a point intermediate said lowermost row and said flame ring.

3. A liquid fuel burner as defined in claim 2, which includes a second flame ring, said second flame ring being disposed above the uppermost of said plurality of horizontal rows of small passages.

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