F. I. DU PONT.

LIQUID FUEL BURNER.

APPLICATION FILED APR. 13, 1921.

1,427,449.

Patented Aug. 29, 192

2 SHEETS—SHEET 1.

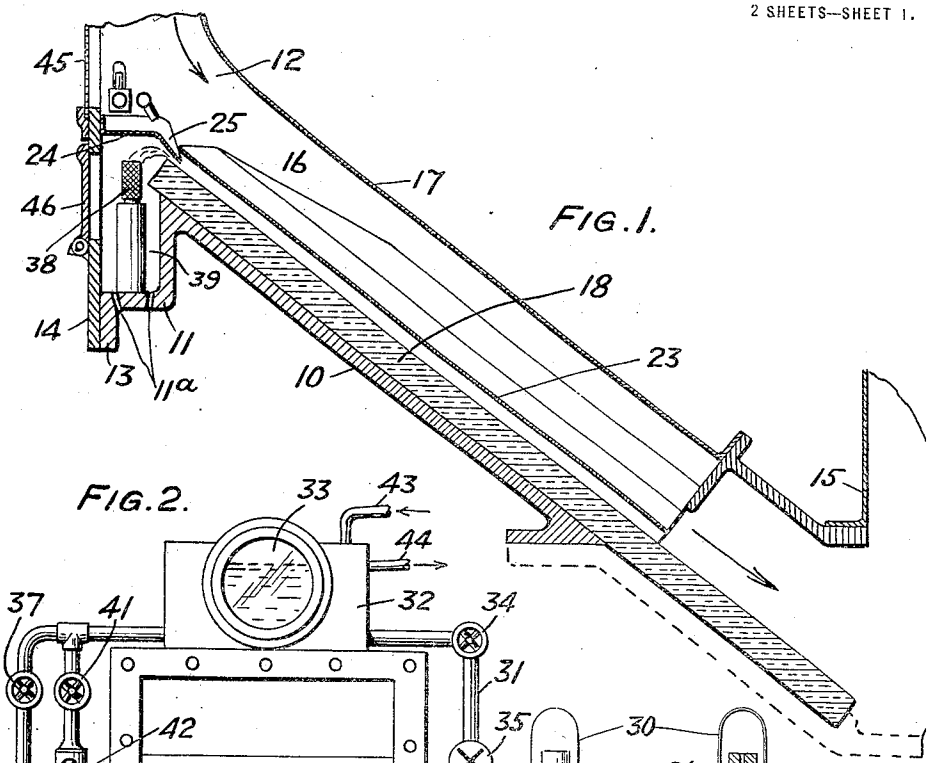


FIG. 1.

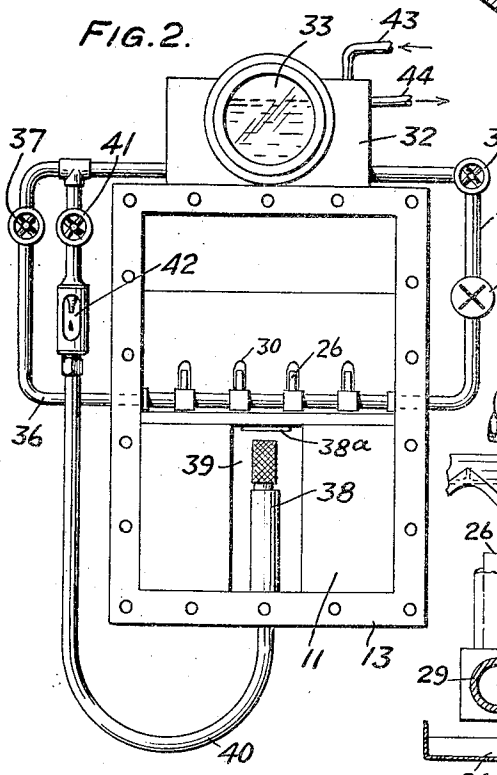


FIG. 2.

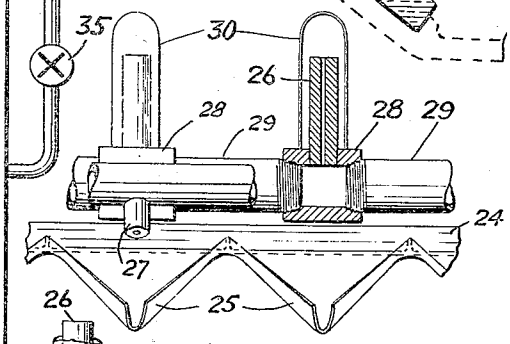


FIG. 3.

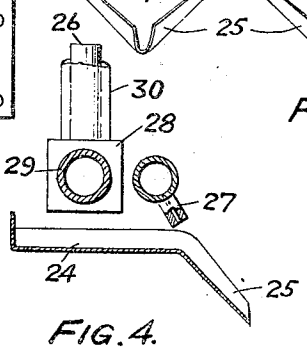


FIG. 4.

WITNESS:

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LIQUID FUEL BURNER.

APPLICATION FILED APR. 13, 1921.

1,427,449.

Patented Aug. 29, 1922

2 SHEETS—SHEET 2.

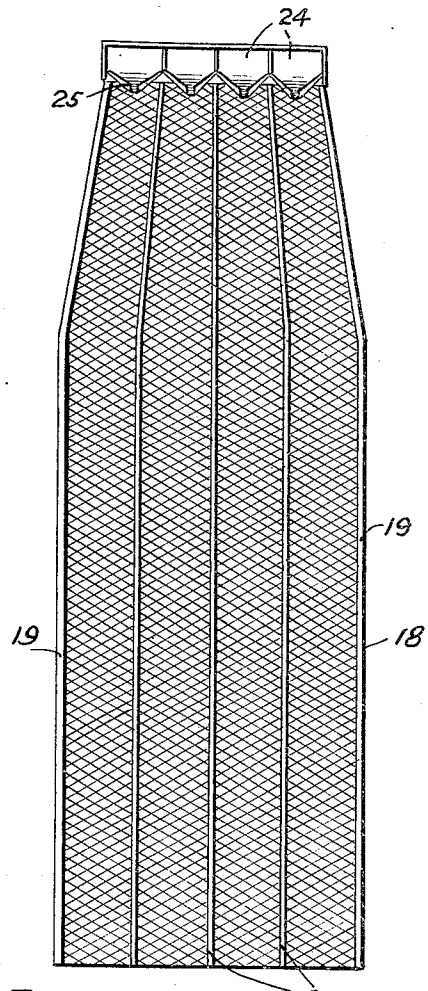


FIG. 5.

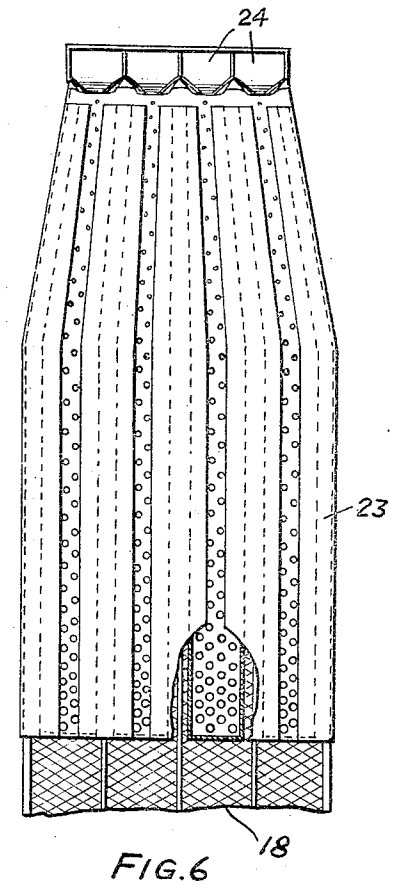


FIG. 6.

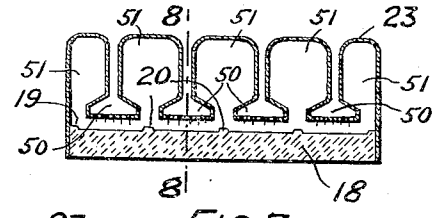


FIG. 7.

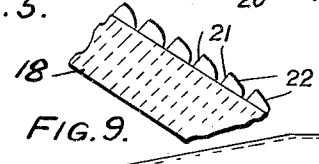


FIG. 9.

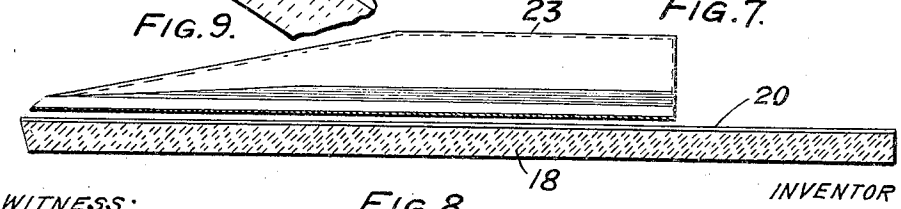


FIG. 8.

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UNITED STATES PATENT OFFICE.

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LIQUID-FUEL BURNER.

1,427,449. Specification of Letters Patent. Patented Aug. 29, 1922.

Application filed April 13, 1921. Serial No. 460,997.

To all whom it may concern:

Be it known that I, FRANCIS I. DU PONT, a citizen of the United States, residing at Wilmington, county of New Castle and State of Delaware, have invented a new and useful Improvement in Liquid-Fuel Burners, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part of this specification.

This invention comprises an improvement in liquid fuel burners for burning kerosene, and relates to burners of the type in which the liquid fuel is fed to the burner by gravity while the air for supporting combustion is fed thereto by means of a forced draft, which will also convey the hot products of combustion to the heating chamber to which the burner is connected.

One of the objects of my invention is to provide a burner of this character having a downwardly inclined hearth within the burner combustion chamber, over which the liquid fuel is arranged to flow by gravity.

A further object of my invention is to provide a hearth having a surface arranged to cause the liquid fuel fed thereto to be evenly distributed over the entire width thereof and which is also arranged to prevent the liquid fuel from flowing in a direct manner from the top to the bottom of the hearth.

A still further object of my invention is to provide a hearth which will absorb the liquid fuel and give it off in the form of gas after the burner has been heated, and which is of sufficient length to prevent liquid fuel passing to the lowest portion of the combustion chamber, as well as a hearth which is arranged to prevent the liquid fuel passing therethrough to the bottom and sides of the hearth.

A further object of my invention is to provide means for mixing air with the vapor of the fuel as it is generated, rather than mixing air indiscriminately with the flame from the burning fuel, in order to effect a more perfect combustion.

Another object of my invention is to provide means for feeding the liquid fuel evenly across the hearth at the upper end thereof as well as to feed heated air to the entire surface of the hearth to support combustion.

Another object of my invention is to provide a plurality of liquid fuel feeds one of which can be set to feed a predetermined quanitity in a predetermined time, while the other may be automatically controlled by the apparatus heated by the burner, as well as by hand.

Still another object of my invention is to maintain the liquid fuel at a constant level in an elevated reservoir to maintain the feed to the burner under a constant head.

A further object of my invention is to provide a suitably located pilot light which is arranged to first ignite the fuel fed to the hearth, and which is also arranged to be kept burning when the burner is in operation to maintain the burner lighted or to relight it if the fuel feed should be stopped and then turned on again.

Fig. 1 of the drawings is a longitudinal sectional view through one form of apparatus built in accordance with my invention.

Fig. 2 is a face view of the burner shown in Fig. 1 with the front plate removed.

Figs. 3 and 4 are detail sectional views of the liquid fuel feeding devices.

Fig 5 is a face view of the burner hearth.

Fig. 6 is a view similar to Fig. 5 with the hearth cover or division plate between the air chamber and the combustion chamber in position above the hearth.

Fig. 7 is a transverse sectional view through the hearth and cover plate shown in Fig. 6.

Fig. 8 is a sectional view on the line 8—8 of Fig. 7.

Fig. 9 is a longitudinal section of a portion of the hearth, showing the liquid fuel diverting projections between the oil grooves.

10 designates the bottom of the main burner casting, 11 a front member which extends downwardly from the bottom, and 12 the sides thereof. 13 is a flange on the front of the main casting to which is secured a front plate 14 to close up the front of the burner. Connected to the lower end of the main burner casting is the end of a suitable heating chamber 15, and connected to the sides 12 of the burner casting and the end of the furnace chamber 15 is a cover 17 of sheet iron which forms one wall of an air

chamber 16 within the burner, and which is in communication with a suitable air supply.

18 is the hearth which is mounted on the bottom 10 of the main burner casting and is provided with longitudinal edge ribs 19 and three longitudinal intermediate ribs 20, which ribs divide the face of the hearth into four sections or channels for the liquid fuel. I preferably form the hearth of compressed asbestos fibre or other suitable absorbing fireproof material, and thoroughly coat the back and longitudinal edges thereof with silicate of soda to prevent the liquid fuel from passing through the hearth and flowing into the secondary combustion chamber between the hearth and the castings. The longitudinal ribs 20 are not essential where the burner is maintained stationary; but where the burner is used, for example, on a vehicle or on a boat, the ribs 20 prevent the oil flowing bodily over to one side in case of rocking of the boat or the travel of a vehicle over a transversely sloping surface. The face of the hearth between the ribs 19 and 20 is provided with reversely disposed diagonal intersecting grooves over the entire surface thereof through which the liquid fuel flows by gravity in a zigzag manner from the oil feed hereinafter described. Formed between these grooves are diamond shaped projections. The two faces 21 on the sides thereof toward the upper end of the hearth are substantially normal to the plane of the hearth, while the other two faces 22 are at an angle to the first mentioned faces to form tapered grooves between the projections.

23 is a cover plate for the hearth. It is spaced therefrom and forms a division plate between the combustion chamber within the burner and the air chamber 16 therein. This plate or division between the air chamber and combustion chamber is provided with T-shaped air channels 50 arranged alternately with relatively large flame passages 51. The bottoms of these air channels are perforated from end to end, but the perforations at the upper end are smaller and somewhat less numerous than at the lower end. This is because the rate of vaporization of the liquid fuel is less rapid at the upper end and it is desired to admit air not in proportion to the fuel flowing down the hearth, but only in proportion to that part of the fuel vaporized at any given point. As the fuel travels further down it encounters zones of greater heat and a larger proportion is vaporized and therefore more air is required. Hence the provision of a more or less gradual increase in the size and number of the perforations from the upper end toward the lower end.

Since the volume of flame, that is: of burning vapors, increases as the fuel progresses down the hearth, and since it is important that this increasing volume shall not interfere with the proper mixing of fresh air with vapor being newly generated on the lower parts of the hearth, flame passages 51 of increasing size are provided. The function of these flame passages is to get the burning vapor, which already has its proper amount of air, out of the way so as not to obstruct the more delicate process of mixing the new air with the new vapor. These flame passages, particularly at their lower ends, become red hot, and as the air which has to pass into the air channels must pass along and around these flame passages, it becomes highly preheated; all of which makes for efficient combustion.

I preferably form this plate of nickel, which can be heated to a high degree without danger of fusing or oxidizing.

Mounted within the burner at the front end thereof is an oil or liquid fuel feed pan, divided into four sections 24, each of which is provided with a sloping tapered spout 25 to feed the liquid fuel to the centers of the channels on the hearth. 26 are main jets and 27 are auxiliary jets, there being four of each, and arranged in such a manner that each pair of jets, consisting of a main jet and an auxiliary jet will feed liquid fuel to one of the sections 24 of the oil pan. Each main jet 26 comprises an upwardly extending tube which communicates with a coupling 28. The couplings are connected to each other by nipples 29. Each main jet tube is covered by means of a thimble 30, preferably of glass, which rests on its coupling member to prevent the oil from squirting into space from the tubes of the main jets, which at times may be required to feed a heavy flow of liquid fuel to the oil pan; and as the bottoms of the thimbles do not fit tight on the couplings 28, the liquid fuel will flow out from under the thimbles and into the pan.

The various couplings 28 and nipples 29 form a manifold for the main jets 26. Connected to this manifold is an oil feed pipe 31 leading from an oil reservoir 32 above the burner. This reservoir is provided with a sight glass 33 in the front thereof through which the interior of the reservoir can be observed. 34 is a hand valve in the pipe 31 for shutting off the liquid fuel feed to the main jets. 35 is a check valve or regulating valve of any well known type, which may be controlled by actuating devices, which may be interiorly controlled by suitable regulating devices.

The auxiliary jets 27 are connected to a common manifold, which is connected to the reservoir 32 by means of a pipe 36 having a control valve 37 therein, and which may be arranged to feed a predetermined amount of fuel to the auxiliary jets 27 to supply suf-

ficient liquid fuel to maintain a relatively low temperature. This feed is for the purpose of maintaining a very slow fire, as, for example, when the burner is used with a steam generator, it will keep up steam without "making" steam.

The multiple jet 26 and also the multiple jet 27 are not required where the burner is in a stationary position. One jet would distribute perfectly well throughout the entire hearth, provided the ribs 20 were eliminated, but on a vehicle or boat, where the burner would frequently be tilted sidewise, making it advisable, as hereinbefore explained, to provide such ribs, the provision of a jet for each channel formed between adjacent ribs is required.

38 is a pilot light in a recess 39 in the front portion 11 of the main burner castings. The pilot light is so located that the flame therefrom will be drawn over the upper end of the hearth into the combustion chamber through a slot 38ª and between the two intermediate spouts 25.

Liquid fuel is fed to the pilot light from the oil reservoir 32 through pipe 40, and the feed is controlled by a valve 41 in the pipe 40. 42 is a sight tube in the feed pipe 40, through which the oil fed to the pilot light may be observed.

43 is a liquid fuel feed pipe through which a supply of oil is delivered to the reservoir when the burner is in operation, and which is delivered at a rate in excess to the greatest demand for the burner. 44 is an overflow pipe from the reservoir 32, the inlet end thereto being in the plane at which it is desired to maintain the oil level in the reservoir.

The burner front plate 14 is provided with a transparent plate 45 through which the action of the burner may be observed. 46 is a door hinged to the front plate 14. This door closes the front of the recess 39. There are provided draught holes 11ª in member 11 of sufficient size to admit just enough air for the pilot light, the flame from which is sucked in through the slot 38ª by the suction fan. This fan is usually placed in the outlet for the waste products of combustion, so that the flame from the pilot will be sucked over the end of the hearth to the surface thereof.

In the operation of the device the valve 41 is first opened to feed oil to the pilot light 38, which is then ignited. The valve 34 or the valve 37, preferably the valve 34, is then opened to feed liquid fuel to the pan sections 24 and the channels on the hearth, and the forced draft apparatus is set into motion to cause air to be drawn into the combustion chamber from the air chamber 16.

The forced draft apparatus will also draw the flame from the pilot light over the hearth and ignite the fuel in the combustion chamber between the hearth and the cover plate 23. The valve 34 is then opened and the jets 26, which are really tubes of a predetermined calibre and length, admit evenly an amount of fuel depending on the predetermined conditions, that is: head due to height of reservoir 33 and dimensions of jets 26.

The liquid fuel will flow from the various spouts 25 of the oil pan to the four channels on the surface of the hearth, and as the oil is broken up into a plurality of tiny streams which are constrained to flow in a zigzag manner back and forth across the surface of the hearth by the intersecting diagonally disposed grooves, the liquid fuel will all be vaporized or absorbed by the hearth, so that no fuel in liquid form will reach the lower end of the hearth.

As the burner heats up, the cover plate 23 will be heated, and when the burner is in full blast the plate will be heated to a high degree, which will in turn heat the air for supporting combustion before it is delivered to the combustion chamber. This passing of the air over the cover plate and through the openings therethrough will also continuously cool the cover and prevent its heating to a fusing point.

The hot products of combustion will pass from the main combustion chamber into what may be termed a secondary combustion or heating chamber in the casing 15.

The advantages of my invention result from the provision of a liquid fuel burning furnace having a downwardly sloping hearth over which the liquid fuel is fed by gravity, together with means to feed liquid fuel to the upper end thereof, and from the provision of means for feeding air to the vaporizing fuel at the point of vaporization and substantially in the amount required at each zone of vaporization.

A further advantage results from the provision of a hearth which is arranged to absorb liquid fuel fed to the burner and give off the fuel in the form of gas, as well as the provision of means for breaking the liquid fuel fed to the hearth into tiny streams and for causing said streams to flow in a zigzag manner back and forth across the hearth to evenly distribute the liquid fuel across the face of the hearth, and also to retard the flow and provide long courses over which the streams flow to assure the absorption of all the liquid fuel fed to the hearth and its conversion into vapor before the streams reach the end of the hearth.

A further advantage results from the provision of an unoxidizable cover plate for the hearth or combustion chamber wall having T-shaped grooves therein for conducting the air for supporting combustion along the length of the hearth adjacent to the hearth

so that the air and gas generated from the oil will mix and form a combustible mixture and at the same time provide sufficient flame space in the combustion chamber.

Another advantage results from the provision of a pilot light which is so situated that the heat and flame therefrom will be continually sucked over the edge of the hearth into the combustion chamber of the burner.

The burner specifically claimed herein is disclosed in a companion application filed by me on even date herewith.

Having now fully described my invention, what I claim and desire to protect by Letters Patent is:

1. A liquid fuel burner having a hearth formed of fireproof liquid fuel absorbing material and having a sloping upper face over which liquid fuel is fed by gravity, means for feeding liquid fuel to one end thereof, and means for feeding air to the burner.

2. A liquid fuel burner having a hearth formed of fireproof liquid fuel absorbing material and having a sloping upper face provided with grooves extending downwardly and across the face thereof along which the liquid fuel passes by gravity, means for feeding liquid fuel to the hearth, and means for feeding air to the burner.

3. A liquid fuel burner having an inclined hearth formed of fireproof liquid fuel absorbing material over which liquid fuel is arranged to flow by gravity, the surface of the hearth being roughened to spread the liquid fuel over the surface thereof, means for feeding fuel to the burner, and means for feeding air to the burner.

4. A liquid fuel burner having a casing, a sloping hearth in the casing, a perforated plate within the casing over the hearth, dividing the casing into a combustion chamber and an air chamber, means for feeding liquid fuel across the face of the hearth at the upper end thereof, an air feed opening communicating with the air chamber, and a pilot light at the top of the hearth.

5. A liquid fuel burner having a casing, a combustion chamber and an air chamber, a division plate between the combustion chamber and the air chamber having a T-shaped slot therein forming an air heating chamber, there being perforations through the bottom of the slot to permit the air to pass from the heating chamber to the combustion chamber, means to feed air to the air chamber, and means to feed liquid fuel to the combustion chamber.

6. A liquid fuel burner having a casing, a sloping hearth therein of fireproof material, a plurality of longitudinal channels on the surface of the hearth, a division plate in the casing dividing the casing into a combustion chamber and an air chamber, said division plate having openings for feeding air from the air chamber to the combustion chamber, means for feeding air to the air chamber, means for feeding oil to each of the channels on the hearth at the upper end thereof, and means for controlling said feed.

7. A hearth for a liquid fuel burner formed of compressed asbestos fibre, the surface of the hearth being roughened, to spread the fuel over the hearth when flowing over the surface thereof.

8. A hearth for a liquid fuel burner fromed of compressed asbestos fibre, the front face of the hearth being roughened to cause the liquid fuel to spread across the face thereof, and a fluid-proof coating on the back of the hearth.

9. An asbestos fibre hearth for a liquid fuel burner having diagonal grooves in one face thereof.

10. An asbestos fibre hearth for a liquid fuel burner having intersecting reversely disposed diagonal grooves in one face thereof.

11. An asbestos fibre hearth for a liquid fuel burner having a plurality of separated flow channels along one face, the bottoms of said channels having intersecting reversely disposed grooves therein.

12. A cover plate for a liquid fuel burner hearth having T-shaped slots therein, there being openings through the bottom walls of some of the slots.

13. A cover plate for a liquid fuel burner hearth having T-shaped slots extending in a longitudinal direction in both faces thereof, there being openings through some portions of the walls of at least one set of slots.

14. A liquid fuel burner comprising a combustion chamber and a superposed air chamber, means to deliver air to the air chamber and liquid fuel at one end of the combustion chamber, there being perforations in the dividing wall between the two chambers, said perforations increasing in aggregate area away from the oil supply end toward the hotter zones, thereby approximately proportioning the supply of air to the combustion chamber in accordance with the rate of vaporization of the fuel.

15. A liquid fuel burner comprising a hearth, a division plate above the hearth forming between them a combustion chamber, a cover forming between it and the division plate an air chamber, and means to introduce liquid fuel at one end of the combustion chamber so that the same will be gradually vaporized as it flows forward, the division plate being provided with longitudinally extending air channels having narrow necks and enlarged bodies extending relatively close to the hearth, there being formed in the combustion chamber between said channels similar channels constituting relatively large flame passages.

16. A liquid fuel burner comprising a combustion chamber and a superposed air chamber, expanded longitudinally extending channels opening from the main air space and extending relatively close to the bottom of the combustion chamber, similar relatively inverted flame passages in the combustion chamber between the air passages, there being perforations in the air channels whose aggregate area increases away from the oil supply end of the burner so as to increase the supply of air to the combustion chamber as the rate of vaporization of the oil increases.

In testimony of which invention, I have hereunto set my hand, at Wilmington, Delaware, on this 28th day of March, 1921.

FRANCIS I. DU PONT.