Dec. 6, 1955 J. MASSIER 2,725,929

COMBUSTION CHAMBER TYPE BURNER

Filed Nov. 24, 1951

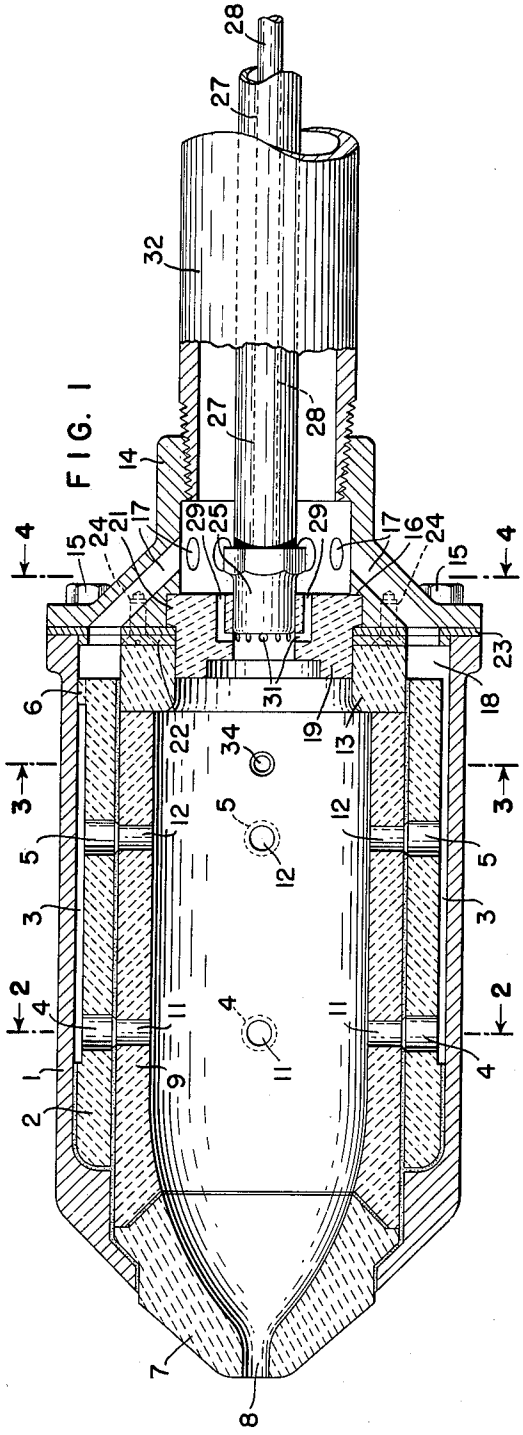

FIG. 1

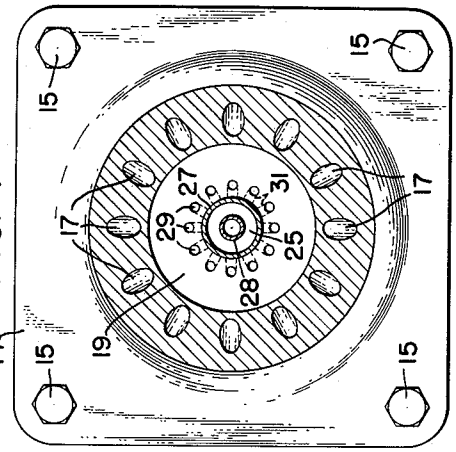

FIG. 4

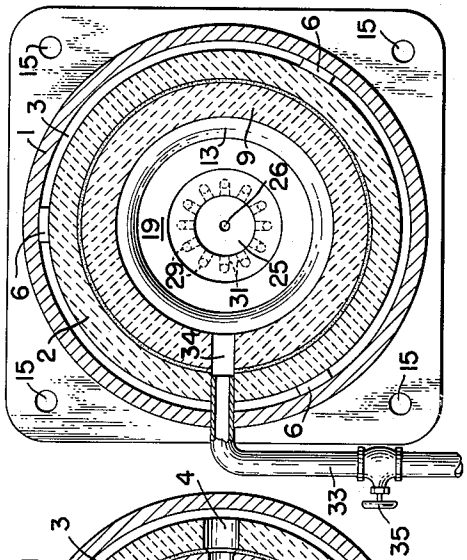

FIG. 3

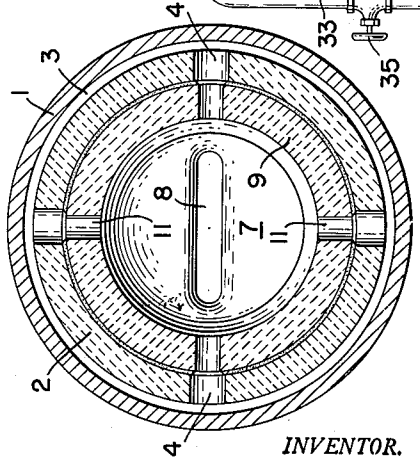

FIG. 2

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United States Patent Office 2,725,929 Patented Dec. 6, 1955

2,725,929

COMBUSTION CHAMBER TYPE BURNER

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Application November 24, 1951, Serial No. 257,998

6 Claims. (Cl. 158—28)

The present invention relates to fluid fuel burners, and more particularly to a burner having a combustion chamber in which a fluid fuel and air are burned to provide a high temperature, high velocity stream of products of combustion for various heating purposes.

Burners of the type with which the present invention is concerned have previously been used with a combustible mixture of gas and air as a fuel. In such burners, the mixture is introduced through a screen to burn in a relatively small combustion chamber having a restricted outlet. The hot products of combustion are then discharged through the restricted outlet at high velocity. The difficulty of bringing air and fuel in contact to produce complete combustion within the limited combustion space available required that a combustible mixture of fuel such as gas and air be used in burners of this type prior to the present invention.

It is an object of the invention to provide a combustion chamber type of burner in which fuel and air are introduced separately into the combustion chamber. It is a further object of the invention to provide apparatus by means of which a relatively large volume of oil can be completely burned in a small combustion space. It is a still further object of the invention to provide a burner that is capable of using oil of any grade as a fuel, and burning the oil efficiently.

In carrying out the invention, there is provided a relatively small combustion chamber that has, at its outlet end, a restricted discharge orifice through which the products of combustion are discharged at high velocity and at a temperature substantially equal to that at which combustion takes place. Fuel in the form of atomized oil is introduced into the chamber at a point opposite the discharge orifice. Air for combustion is introduced at a plurality of points around the combustion chamber in such a fashion that it mixes with the oil to form a combustible mixture that will burn completely in the combustion chamber.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

In the drawings:

Figure 1 is a longitudinal section of the burner;

Figure 2 is a section taken on line 2—2 of Figure 1 looking toward the discharge end;

Figure 3 is a section taken on line 3—3 of Figure 1 looking toward the inlet end; and

Figure 4 is a section taken on line 4—4 of Figure 1 looking toward the combustion chamber.

Referring to Figure 1 of the drawing, there is shown a cylindrical metal casing 1 in which the burner parts are enclosed. Received in the casing, is an outer refractory lining 2 which is reduced on its right end in order to form

an air space 3 between the lining and the casing. It is noted that the right end of the liner is slightly shorter than the casing. This liner is provided near its left end with a plurality of openings 4 and near its right end with a plurality of openings 5. The right end of the liner is centered in the casing by lugs 6 that extend outwardly as shown best in Figure 3.

The combustion chamber of the burner is formed by a cylindrical inner lining 9, also made of refractory material which is received within the outer lining 2. This lining is provided near its left end with openings 11 that are aligned with the openings 4 and is provided near its right end with openings 12 that are aligned with the openings 5. Also received in the left end of the casing, and beyond the outer liner, is a tip member 7 which is provided with a discharge orifice 8 that takes the form of an elongated slot. From an inspection of Figure 1 of the drawing, it will be seen that the combustion chamber formed within the interior of the inner lining is cylindrical throughout the major portion of its length. Toward the left end, however, it gradually reduces in diameter and flares out so that the interior of the burner has a smooth contour from the cylindrical portion to the exhaust or discharge opening 8. The open end of the inner lining 9 is engaged by a ring 13 of refractory material that is received in and extends slightly beyond the outer lining 2.

The linings, the tip and the ring are made of a ceramic material. The outer lining 2 is preferably made of some material such as aluminum oxide, which has good insulating properties, while the inner lining 9 and ring 13 are made of a material such as beryllium oxide which has rigidity at high temperatures. The tip 7 can be made of this material or of silicon carbide which has rigidity at high temperatures and a relatively high coefficient of heat transmission. These various parts are fastened together by means of any suitable high temperature cement, to form what is in effect, a one piece shell. The shell is then placed in the casing, and held therein by a suitable cement.

The open end of the combustion chamber is closed by a manifold 14 that is held in place on the right end of the casing 1 by suitable bolts 15. The manifold has in it means for supplying the combustion air to the combustion chamber and is provided with means to hold an oil atomizer. A plurality of air openings 17 extend from the center of the manifold diagonally outwardly to communicate with an annular air space 18 formed between the ring 13 and the right end of outer lining 2. The manifold is also provided with an annular shoulder or seat 16 which is adapted to receive a screen 19 therein. This screen is provided at its right end with a radial shoulder 21, and it is by this shoulder that the screen is held in position in the manifold. For this purpose, there is provided a plate 22 having an opening in it to pass over the small portion of the screen. A gasket 23 is placed between the manifold and the plate and these parts are held together by screws 24.

In assembling the burner, the tip 7 and the liners 2 and 9 and ring 13 are assembled as a unit and placed in the casing 1. The screen 19 is fastened in the manifold 14 by plate 22 and gasket 23 and the manifold assembly is then moved to bring the screen into the opening of ring 13. The parts are then bolted together as shown in Figure 1. Suitable cement can be used between the shoulders 21 of the screen and the seat 16 of the manifold in order to insure a pressure tight connection between these parts.

As noted above, the screen is annular in shape, and the center opening thereof receives an oil atomizer 25 that is provided with an opening 26 through which the oil is discharged into the combustion chamber. This atomizer is supplied with oil through a pipe 27 and with atomiz-

ing air through a pipe **28**. These pipes are received within the main air supply pipe **32** that is threaded to the manifold. Suitable connections are used between these pipes in order to bring them out so that they may be supplied with the proper fluid. Air for combustion passes through the pipe **32** and through the holes **17** to annular chamber **18**. From here, it flows through the space **3** where it is preheated by contact with the hot walls of the burner and into the combustion chamber by the plurality of radial orifices or ports **11** and **12** in the liner. A small percentage of the combustion air also passes through a plurality of openings **29** formed in the screen **19** and surrounding the oil atomizer. It is noted that the left ends of these openings bend in a radial direction, as shown at **31** in the drawings, so that the air discharged from them will sweep across the face of the atomizer.

When using oil as a source of fuel, it is necessary to have a pilot flame in the combustion chamber to ignite the oil. This flame can be supplied with gas from a suitable source of supply through a pipe **33** that extends into the combustion chamber. As best shown in Figure 3, this pipe extends through a casing **1** and into the lining **2** where it is suitably fastened in place, as by cement. The pipe is received in a radially extending opening **34** in the liners **2** and **9**. A valve **35** is placed in the pipe so that the supply of gas may be cut off when the burner has been started. It is noted that each of the pipes **32**, **27** and **28** is also provided with a valve, not shown, so that the supply of fuel and air to the burners can be adjusted as desired.

In starting the burner in operation, valve **35** is opened to permit gas to flow into the combustion chamber. At the same time, a small supply of air is permitted to flow through pipe **32** in sufficient proportion to form a combustible mixture with the gas. As the mixture is discharged through the orifice **8**, it is ignited to burn at the mouth of the combustion chamber. The pressure of the air is then reduced so that the flame will backfire into the combustion chamber and burning will take place in the chamber. At this time, the supply of oil can be turned on and the supply of air can be increased. The flame of the burning gas will ignite the oil and the burner is in operation. Thereafter, the volume of air and oil can be increased in the proper proportions either manually or automatically to form a combustible mixture until the maximum for which the burner is designed has been reached. The gas supply is preferably cut off after the burner is in operation, although no harm will be done if the gas continues to be supplied to the combustion chamber.

A typical burner of the type disclosed herein can have a combustion chamber about 12 inches long and 4½ inches in diameter. With a burner of this type, using number 6 or bunker-C oil as a fuel, the burner has been operated to deliver approximately 800,000 B. t. u. per hour. In order to produce this amount of heat, between 5 and 6 gallons of oil were supplied through the atomizer at between 35 and 40 pounds pressure. 8,000 cubic feet of air was supplied per hour at about 78 inches water column. This produces a pressure in the combustion chamber of 54 inches water column. While it is impractical to measure the temperature in the combustion chamber, it is estimated that this temperature is very close to that of theoretical flame temperature, or in the neighborhood of 3400° F. The temperature in the combustion chamber will be lower than the theoretical temperature due to convection and radiant heat losses through the burner components. An important characteristic of this burner is that combustion is completed within the combustion chamber so that only hot products of combustion are discharged through the outlet orifice 8. The temperature of these gases has been measured and has been found to be between 3,000° F. and 3,100° F. with a velocity in the neighborhood of 1,300 feet per second.

In the operation of a burner of this type, it has been found that the best performance is obtained when the oil atomizer has a discharge angle of approximately 20°. When this is the case, the oil is delivered so that there is no impingement upon the side walls. As the oil moves through the combustion chamber, the streams of air entering through ports **11** and **12** mix intimately with the atomized oil so that combustion is taking place simultaneously throughout the entire chamber. Because of this fact and the high temperature of the chamber, it is possible to burn the large quantities of oil that have been noted above. It is for this reason that the temperature of the exhaust gases is so high and at such a high velocity. The majority of combustion air is delivered to the chamber through the ports **11** and **12**. It has been found advantageous to make these ports of such a size relative to the total area of the ports **29**, that the latter deliver approximately 10 percent of the air. The air flowing through the ports **29** and across the face of the atomizer, seems to create a slight high pressure area that prevents an accumulation of oil at this point. Therefore, no coke is built up, even when using an oil as thick as bunker-C.

The burner of this invention was designed primarily for the use of oil as a fuel. The introduction of oil and air, in the manner disclosed, permits such mixing that combustion is practically instantaneous. The burner can, however, be used equally as well when gas is used as a fuel. When this is done, the oil atomizer is removed and a gas pipe is inserted in the center of screen **19** in place of the atomizer. The discharge of gas into the combustion chamber under a suitable pressure is such that a complete mixture of the gas and air is also accomplished and complete combustion of the mixture is obtained so that only products of combustion are discharged through the port **8**.

From the above, it will be seen that I have provided an oil burner in which the oil and combustion supporting air are introduced into a relatively small combustion chamber. Combustion takes place in this chamber so that only hot products of combustion are discharged therefrom. The arrangement is such that any grade of commercial fuel oil, including bunker-C, can be burned with equal facility. The burner is easily ignited and starts off from cold without any priming other than a production of a flame in the chamber to ignite the atomized oil.

While in accordance with the provisions of the Statutes, I have illustrated and described the best form of embodiment of my invention now known to me it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit and scope of the invention, as set forth in the appended claims, and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. In a burner, the combination of a substantially cylindrical casing, a refractory lining received in said casing with a space between said lining and casing, the interior of said lining forming a combustion chamber, a plurality of radially directed and unlined orifices extending substantially perpendicularly in said lining between said space and said chamber, a refractory part having a restricted opening therein received in one end of said lining, the other end of said lining being closed by a screen having a central opening and a plurality of smaller openings around said central opening, a manifold to hold said screen in position, an oil atomizer having an end in the central opening of said screen and directed toward said chamber, said plurality of small openings being so directed that air discharged therefrom will sweep across the end of said atomizer, means forming passages in said manifold leading to said space, means

to supply oil to said atomizer, and means to supply air under pressure to said manifold.

2. In a burner, the combination of structure forming a substantially cylindrical chamber, means closing one end of said chamber and provided with a restricted opening therein forming an outlet for said chamber, a member closing the other end of said chamber, said member being provided with a central opening and a plurality of small openings around said central opening, an oil atomizer received in said central opening having an end through which oil is discharged into said chamber said small openings being so directed that air flowing therethrough will sweep at right angles across the discharge end of said atomizer, said structure being formed with an annular space around said chamber and a plurality of radially directed orifices around an intermediate portion of said chamber and extending substantially perpendicularly between said space and said chamber, means to supply air to said space and said plurality of openings, the air mixing with a high degree of turbulence in said chamber with the oil from said atomizer to form a combustible mixture to be burned therein.

3. The combination of claim 2 in which said means to supply air includes an annular member attached to said structure with the interior thereof in communication with said plurality of openings, said member being provided with passages extending from the center thereof to said space.

4. In a burner, the combination of structure forming a substantially cylindrical combustion chamber and including a refractory lining and a metal shell with an annular space between the two, said lining being provided with a plurality of radially extending openings connecting said space with said chamber, means forming a restricted outlet for one end of said chamber, a screen extending across the opposite end of said chamber, said screen being provided with a first axially extending opening of one diameter and a plurality of smaller axially extending openings surrounding the first opening, the chamber end of each of said plurality of openings terminating in a radially directed portion in said first axially extending opening adjacent to said chamber, an oil atomizer received in said first axially extending opening

with the discharge end thereof adjacent to said radially directed portions whereby air flowing through said plurality of openings will sweep across the discharge end of said atomizer, means to supply oil to said atomizer to be discharged into said chamber, and means to supply air to said plurality of openings in said screen and to said space to flow through the openings in said liner, the air passing through all of said openings mixing turbulently with the oil in said chamber to promote complete combustion thereof, the hot products of combustion leaving said chamber through said restricted outlet.

5. In a burner, the combination of structure forming a cylindrical chamber, means forming a plurality of rows of openings directed radially through said structure and terminating flush with the interior surface thereof, means forming a restricted outlet at one end of said chamber, a screen across the other end of said chamber, said screen being provided with an axially extending opening and a plurality of openings terminating adjacent to the inner end of said axially extending opening and at right angles thereto, an oil atomizer received in said axially extending opening and located so that the discharge end thereof is outwardly of the terminating end of said plurality of openings in said screen, means to supply oil to said atomizer to be discharged into said chamber, and means to supply air under pressure through all of said openings into said chamber, the air mixing with the oil therein to burn, the air flowing through the plurality of openings in said screen sweeping across the discharge end of said atomizer at right angles thereto.

6. The combination of claim 5 including means to supply a jet of gas to the interior of said chamber, the gas acting as a pilot for the oil.

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