Nov. 9, 1937. E. J. LATTNER 2,098,455

FLUID FUEL BURNER

Filed April 27, 1934 2 Sheets-Sheet 1

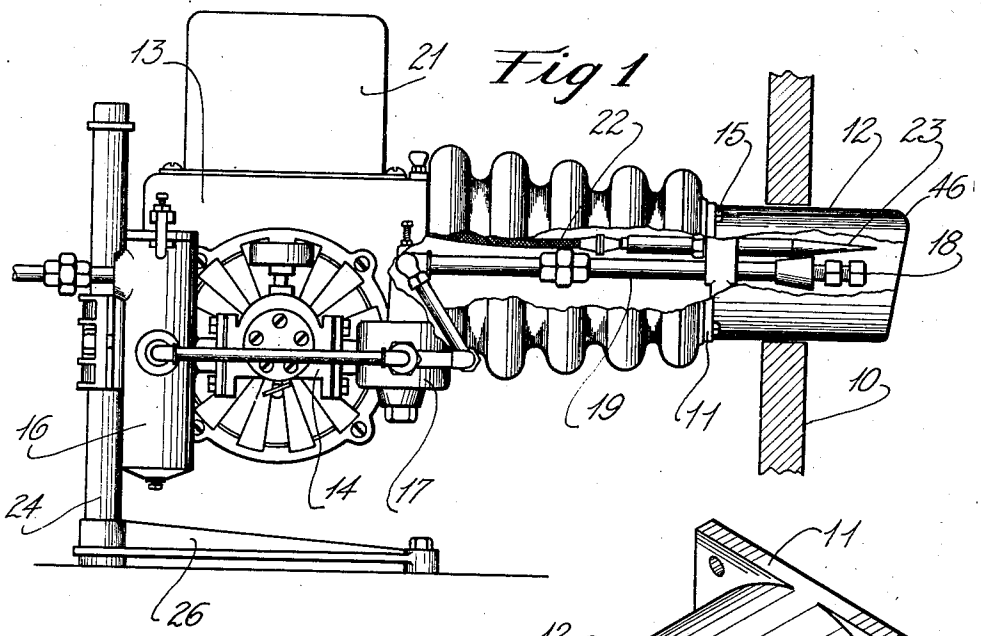

Fig 1

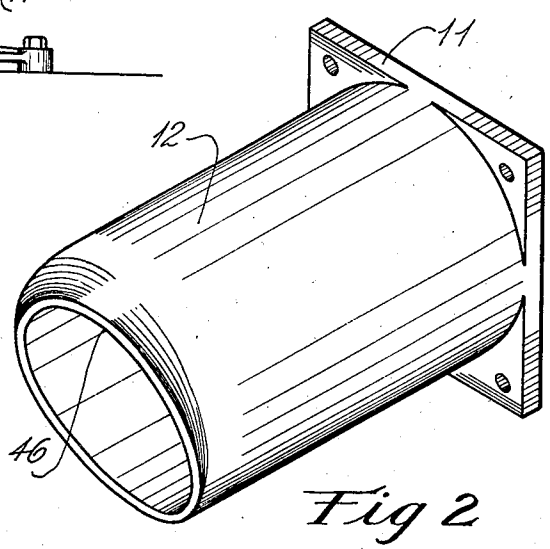

Fig 2

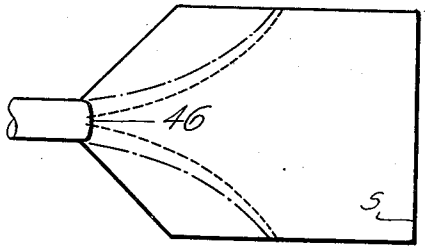

Fig 3a

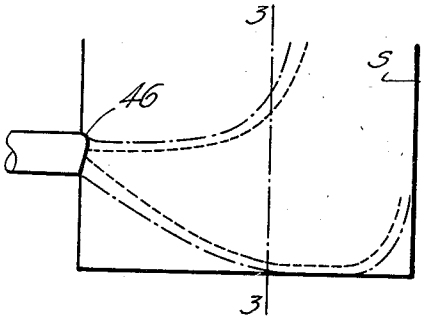

Fig 3b

(Burner C)

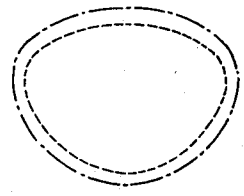

Fig 3c

INVENTOR
EMERT J LATTNER,
BY Flournoy Corey
ATTORNEY

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FLUID FUEL BURNER

Filed April 27, 1934 2 Sheets-Sheet 2

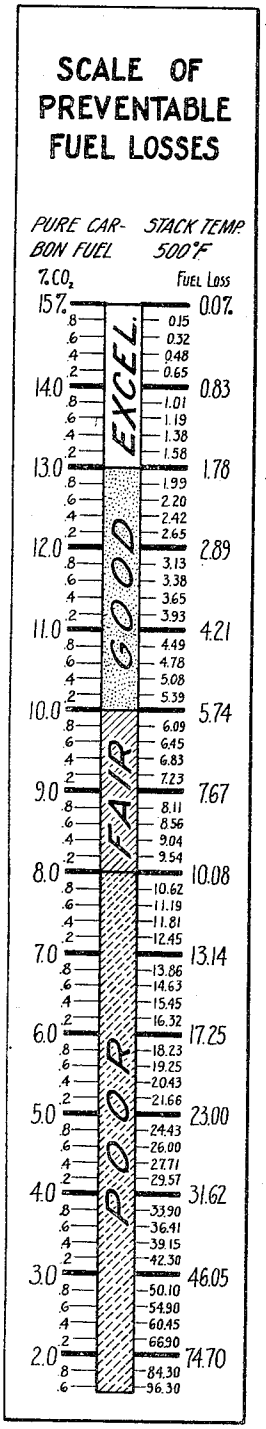
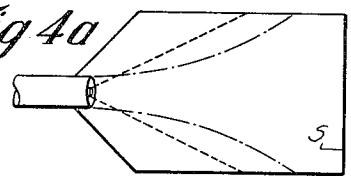


Fig 6

Fig 4a



(Burner A)

Fig 4b

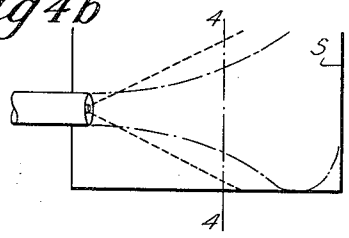


Fig 4c

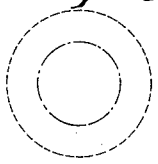
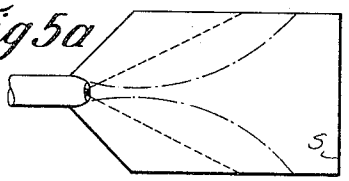


Fig 5a



(Burner B)

Fig 5b

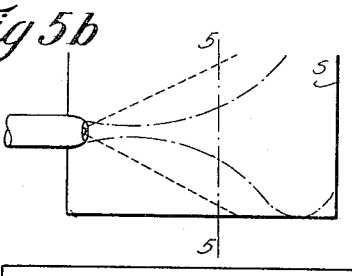
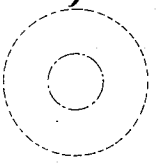


Fig 5c



REPRESENTATIVE TESTS OF THREE TYPES OF BURNER [ABC]

AIR TEMPERATURE 60° F ON ALL TESTS
OIL TEMPERATURE 60° F ON ALL TESTS
2 GALLONS OF OIL BURNED IN ALL TESTS
Nº 3 FURNACE OIL USED IN ALL TESTS
THE STACK TEMPERATURE 500°F IN ALL TESTS

TYPE MANIFOLD	AMT. AIR REQUIRED	FLAME TEMP.	PERCENT CO_2	PREVENTABLE LOSSES
BURNER A	2876.4	2299°	10.0	5.74
BURNER B	2754.0	2342°	13.0	1.78
BURNER C	2733.6	2470°	14.3	0.57

Fig 7

INVENTOR
EMERT J LATTNER,
BY Flournoy Corey.
ATTORNEY

Patented Nov. 9, 1937

2,098,455

UNITED STATES PATENT OFFICE

2,098,455

FLUID FUEL BURNER

Emert J. Lattner, Cedar Rapids, Iowa

Application April 27, 1934, Serial No. 722,715

3 Claims. (Cl. 158—76)

This invention relates to fluid fuel burners and particularly to that type of burner in which oil or the like is atomized and mixed with a blast of air delivered into the furnace by suitable air circulating means.

It is a general object of the present invention to provide improvements, in such types of burners, which materially increase the effectiveness and economy of operation, and promote more uniform mixture of fuel and air.

A more specific object of my invention is to provide means for securing a practically perfect mixture of fuel and air to thus materially improve the efficiency of combustion.

Another important object of my invention is to provide means for securing control of the flame shape.

Another object of my invention is to provide a more efficient flame shape.

Another object of my invention is to provide means whereby the ignition is materially improved and whereby the ignition means is prevented from becoming carbonized.

Other and further features and objects of the invention will be more apparent to those skilled in the art upon a consideration of the accompanying drawings and following specification, wherein is disclosed a single exemplary embodiment of the invention, with the understanding, however, that such changes may be made therein as fall within the scope of the appended claims, without departing from the spirit of the invention.

In said drawings:

Figure 1 is an elevational view of a device embodying my invention. Portions of the structure have been broken away in order to show the interior of the blast tube and the devices located in the blast tube.

Figure 2 is a view in perspective of an air blast nozzle embodying my invention.

Figures 3A, 3B, and 3C are diagrams illustrating in plan, elevational and end views, respectively, how my device (air blast nozzle C) may be employed for improving the shape of the flame and distribution of atomized fuel in the air blast to increase the efficiency of combustion of a fluid fuel burner.

Figures 4A, 4B, and 4C are schematic diagrams illustrating in plan, elevational, and end views, respectively, the action which takes place with another type of blast tube nozzle (air blast nozzle A).

Figures 5A, 5B, and 5C are schematic diagrams illustrating in plan, elevational, and end views the action which takes place with another type of blast tube nozzle (air blast nozzle B).

Figure 6 is an illustration of a scale showing the preventable fuel losses for most fluid fuels with the exception of natural gas, and

Figure 7 is a table showing representative tests of three types of nozzles (air blast nozzles A, B, and C).

It is the usual practice in fluid fuel burners of the character herein considered to employ a blast tube and a fuel nozzle in the blast tube. The fuel is furnished to the fuel nozzle under pressure, and a blower delivers air through the blast tube to the end thereof at a fairly high velocity. In passing through the blast tube the air picks up atomized fuel discharged from the fuel nozzle and, by action of the blast of air, this atomized fuel is mixed to produce a combustible mixture.

In the combustion of fuel from "blast" type burners, and in fact from all burners, previously known to the art, there is a more or less unequal distribution of fuel in the air blast as it issues from the end of the blast tube. As a result the flame from these burners contains portions resulting from the combustion of a lean mixture, other portions resulting from the combustion of of an over-rich mixture, and limited portions resulting from combustion of a proper mixture. It is believed that the reason for this is that the fuel nozzle is usually located near the central axis of the cylindrical blast tube and in order for the oil to be forced outwardly into the blast of air the "cone of dispersion" of the vaporized fuel is wider than that of the air blast.

In Figures 4A, 4B, and 4C I have attempted to illustrate schematically, in plan, elevational, and end views the paths followed by the fuel and air as they issue from a burner utilizing a conventional fuel nozzle and a conventional cylindrical air blast nozzle. The heavy lines S may be considered as representing the fire box of the conventional heating system. The dotted lines indicate roughly the "cone of dispersion" of the atomized fuel and the dot-and-dash lines indicate roughly the path the air blast takes after issuing from the cylindrical air blast nozzle. The form of the air blast after it issues from the air blast nozzle remains substantially cylindrical and gradually enlarges. In order to force the fuel into all parts of the air stream it is necessary to force it from the fuel nozzle in a relatively wide cone.

A sectional view of the fire box and fuel and air blasts (Figure 4C) taken at the line 4—4 would probably show roughly that the outer area

of the blast is rich in fuel while the inner area is lean in fuel. If this is true then the outermost part of the blast will have incomplete combustion and carbon will be formed and fuel wasted in this part of the blast. The inner portion of the blast will be lean in fuel and consequently this portion of the blast will be utilized to a greater or less degree in heating excess air which passes up at the back and is lost. Adjustment of this type of burner to furnish more air to secure complete combustion around the outer edges of the blast results in excessive air in the central portion of the blast and a consequent loss in efficiency. Furthermore combustion is slowed down so that, in a fire box of limited dimensions, the flame is still burning as it strikes the floor, sides and far wall of the box. Incomplete combustion results and deposits of carbon are formed on the walls and bottom of the fire box.

While the above explanation is my theory of the action which takes place my explanation and theory may be erroneous and may be disproved. However, it has been established by hundreds of tests that a burner of this type will have preventable losses of approximately 5.74% under even the best of conditions, and it would seem that my explanation of the reasons for inefficient combustion is logical.

In another type of air nozzle structure, which I have attempted to illustrate in Figures 5A, 5B, and 5C, the outer end of the air nozzle has been curved inwardly about its entire periphery. It would appear, at first, that this construction really aggravates poor combustion conditions inasmuch as the air blast is condensed and the lean area is smaller, but by increasing the quantity of air furnished through the burner per unit of time the large rich area may be made to burn with more nearly the correct proportion of air, than is the case with burner A. The center portion of the blast is still lean and has an excess air supply. But since the larger area is more nearly substantially correctly proportioned in air and fuel this type of burner has a slightly better overall efficiency, and its preventable losses, under the best conditions are approximately 1.78%. Carbon is still deposited upon the floors and walls of the fire box and the burner still heats excess quantities of air, which pass on up the stack and are wasted.

It is to be noted that, with both burner A and burner B, the shape of the combined air and atomized fuel blast is circular. I have discovered that improved results over any of the conventional burners may be secured by changing the shape of the flame to something other than a circular blast or by providing one or more deflectors for directing portions of the air blast as desired.

In accordance with the present invention, the blast tube is so constructed as to eliminate the difficulties hereinbefore enumerated.

Referring now more particularly to Figure 1 I have illustrated a simple form of oil burner adapted to be used in conjunction with a conventional furnace, the front wall of which is shown at 10. The end of a blast tube or air blast nozzle 12, constructed according to my invention, projects through a suitable opening in the wall in accordance with the usual practice. This outer end of the blast tube is preferably a separate piece which is adapted to be secured to the main part of the blast tube by means of a flange 11 and bolts 15.

The fluid fuel burner here shown is of a construction more particularly described in my copending application Serial Numbers 642,440 filed November 12, 1932, 642,441 filed November 12, 1932, and 643,560 filed November 21, 1932. Of course my nozzle may be employed with many other types of burners, either for fluid fuel or pulverized solid fuel, in fact, in any type of burner in which an air blast is employed.

The burner here shown is comprised of a box-like housing 13 in which a blower is mounted. A motor (not shown) is mounted on the housing on the side opposite to the side here shown and this motor is adapted to drive both the blower and the rotating parts of a pump 14. Fuel flow control devices, including the strainer 16 and the pressure control valve 17, are employed to furnish fluid fuel under pressure to the fuel nozzle 18, as by means of the conduit 19.

An ignition coil is housed within the housing 21 and conductors 22 pass from the ignition coil forwardly to a pair of ignition points 23, the tips of which are located just above the fuel nozzle 18. The box-like housing 13 is supported on a standard 24 which in turn is supported by feet 26.

In a preferred form of my invention the outer end of the air blast nozzle or tube 12 is deformed from its usual cylindrical form by providing an inwardly-extending flange or lip 46 on the end of the tube at one portion of the periphery thereof. I preferably locate this lip 46 at the upper side of the blast tube nozzle 12 in order to direct the upper portion of the air blast down upon itself.

In order to secure a smooth downward deflection of the air blast from side to side of its upper portion I preferably start to turn the outer edge of the tube inwardly part way up the sides thereof and make the inward turning more pronounced on approaching the top. In fact I can secure the proper results by providing a tube having a uniform inwardly curved lip about its outer edge and then making an angular slice through the tube which does not remove any of the material at the top and which removes the entire lip at the bottom. Even cutting the end of the blast tube 12 at an angle will secure some deformation of the air blast and hence improved efficiency of combustion of the burner.

Of course other suitable deflectors may be employed which will secure dispersion of the air blast in other than a circular or conical form. For instance, I might employ small horizontally-extending vanes for the purpose and while they might not be as satisfactory they would at least partially attain the purpose.

With a device constructed according to my invention a combined air and atomized fuel blast form is secured which is approximately illustrated in Figures 3A, 3B, and 3C. Both the air blast and the atomized fuel cones of dispersion spread more quickly in more or less curved lines so that the blast spreads out to a greater extent through the horizontal than in the vertical plane. The combined blast is, in this embodiment of my invention, directed in a curved path downwardly and, therefore, much more completely fills the fire box. Combustion is more rapid and more complete because the proper mixture of fuel and air is secured, and by the time the blast has reached the far wall of the fire box, combustion has been completed and the heated gases pass upwardly toward and through the stack. The zone or area of proper mixture is substantially as great as the blast itself. Since combustion is rapid and over a much larger area very little

carbon is deposited on the floor and walls of the fire box.

A large number of tests have been run on the various known burner types, as has been previously stated, as a means of comparing these devices with the results secured with a device constructed according to my invention.

In order to explain these tests reference may be made to Figures 6 and 7. Figure 6 is a representation of a scale showing how the fuel loss varies with various per cents of CO_2 in the flue gas, as determined by the Orsat or similar tests.

In Figure 7 is shown a table illustrating the result of representative tests on burner A, burner B and burner C (Figures 4, 5, and 2, respectively). These tests were run under standard conditions of air temperature, oil temperature, and stack temperature and with the same quantity of the same grade of fuel oil. With burner A the amount of air required was 2876.4 cubic feet, the flame temperature 2299° Fahrenheit, the per cent of CO_2 in the stack was 10% and thus the preventable loss was 5.74%.

With burner B, which utilized the tapered air nozzle, the air required was less than with burner A, the flame temperature was higher, the per cent of CO_2 was higher and the preventable loss was 1.78%.

With burner C, which was the same burner used in the previous tests, but with an air blast nozzle constructed according to my invention, the amount of air required was only 2733.6 cubic feet, the flame temperature was much higher, averaging 2470° Fahrenheit, the per cent of CO_2 was 14.3, which is 1.3% higher than with any burner of the general type herein considered, and the preventable losses were only .57%.

While the decrease in preventable losses amounts to 1.21%, the value of this increase of efficiency is much greater than would appear on the surface. With devices known to the art, installation and running conditions of the devices would necessarily have to be practically perfect in order to secure the highest efficiency. It is to be noted that for 1% difference in CO_2 at the bottom two-thirds of the scale shown in Figure 6, the fuel losses vary from 2% to 26%, but that as 15% CO_2 is approached the fuel losses vary only by fractions of a per cent for each one per cent of difference in CO_2. With a burner of the conventional type installation of the burner and operating conditions must be practically perfect in order to reduce the preventable fuel losses to a minimum. With a device constructed according to my invention CO_2 contents of 13 to 14% are readily secured and a burner, even though improperly installed and operating under adverse conditions, will secure losses of only 1.78% and less, thus bringing the burner constructed according to my invention readily into the "excellent" division of the scale.

Another marked improvement is secured with a burner constructed according to my invention. This improvement relates to the ignition conditions and structure. The air blast is speeded up by reason of the deflector **46**, as it passes by the ignition points **23**, and consequently the ignition flame is blown out further away from the points. The points may be set further back in the tube than is the usual practice without decreasing the effectiveness of the ignition means and thus they are further removed from the flame. Because the points are further removed from the flame, they are not as readily covered with soot and are not readily affected by the heat of the flame. Furthermore the increased air velocity assists in keeping the points cool and clean.

It is apparent that modifications may be made by those skilled in the art. Such modifications may be made without departing from the spirit and scope of my invention as set forth in the appended claims.

I claim as my invention:

1. A fluid fuel burner having a substantially cylindrical air nozzle, a fuel nozzle located within the air nozzle near the discharge end thereof adapted to project fuel flowing therefrom into the air blast to form a combined air and fuel blast, and a crescent-shaped, inwardly-curved lip on the upper portion of the discharge end of the cylindrical air nozzle integral therewith for flattening out the upper portion of the combined air and fuel blast to produce a deformed conical blast bulged out at the sides and flattened at the top.

2. A fluid fuel burner having a substantially cylindrical air nozzle, a fuel nozzle located within the air nozzle near the discharge end thereof adapted to project fuel flowing therefrom into the air blast to form a combined air and fuel blast, and a crescent-shaped, inwardly-curved lip on the upper portion of the discharge end of the cylindrical air nozzle integral therewith and merged into the cylindrical air nozzle at the bottom portion for flattening out the upper portion of the combined air and fuel blast to produce a deformed conical blast bulged out at the sides and flattened at the top.

3. In an oil burner, means for producing a substantially conical spray of finely divided oil particles, means including an air nozzle surrounding the spray producing means for directing a blast of air around the conical spray, and means at the upper portion of the air nozzle to deflect the upper portion of the air blast at an angle downwardly into the conical spray to produce a combined mixture of air and finely divided fuel the cross section of which outlines a blast which is flattened at the top and bulging at the sides, to permit complete mixing of fuel and air and form the combined blast to more completely fill the fire pot with which the oil burner is used.

EMERT J. LATTNER.