Feb. 4, 1969 M. J. HENSLEY 3,425,631

ROTARY BURNERS

Filed July 7, 1967 Sheet 1 of 2

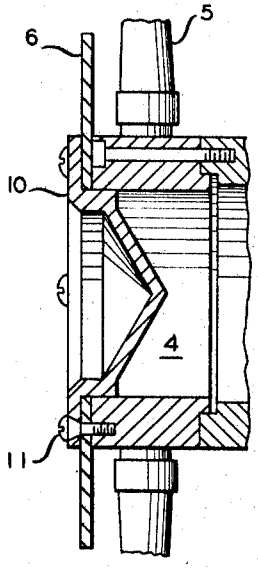


FIG. 2

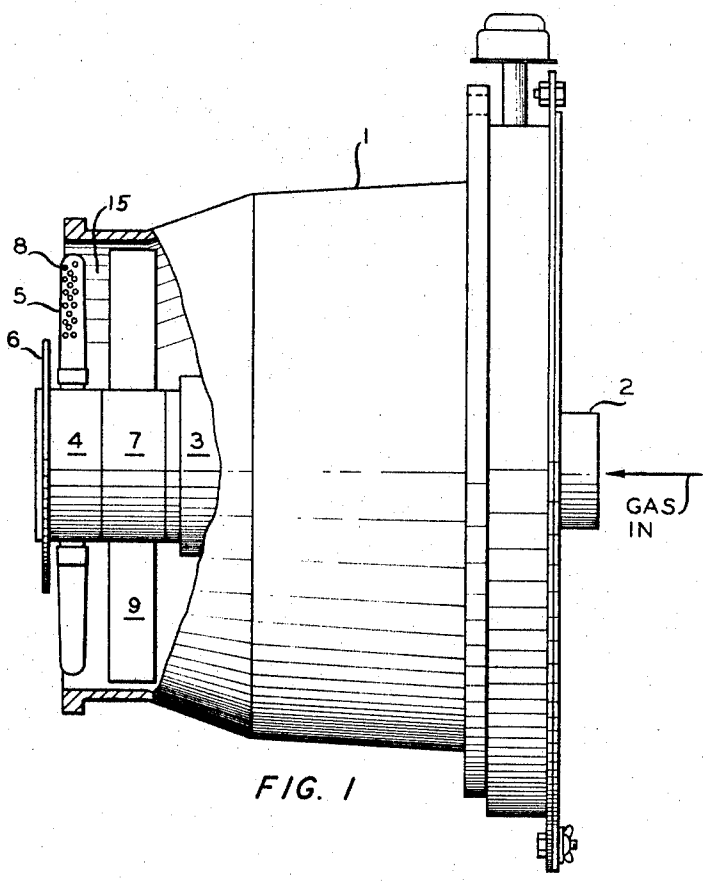


FIG. 1

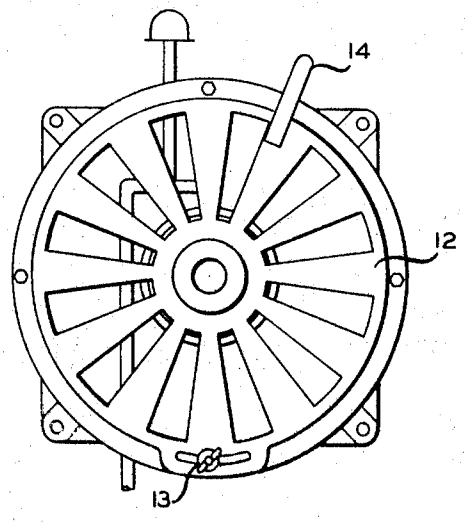


FIG. 3

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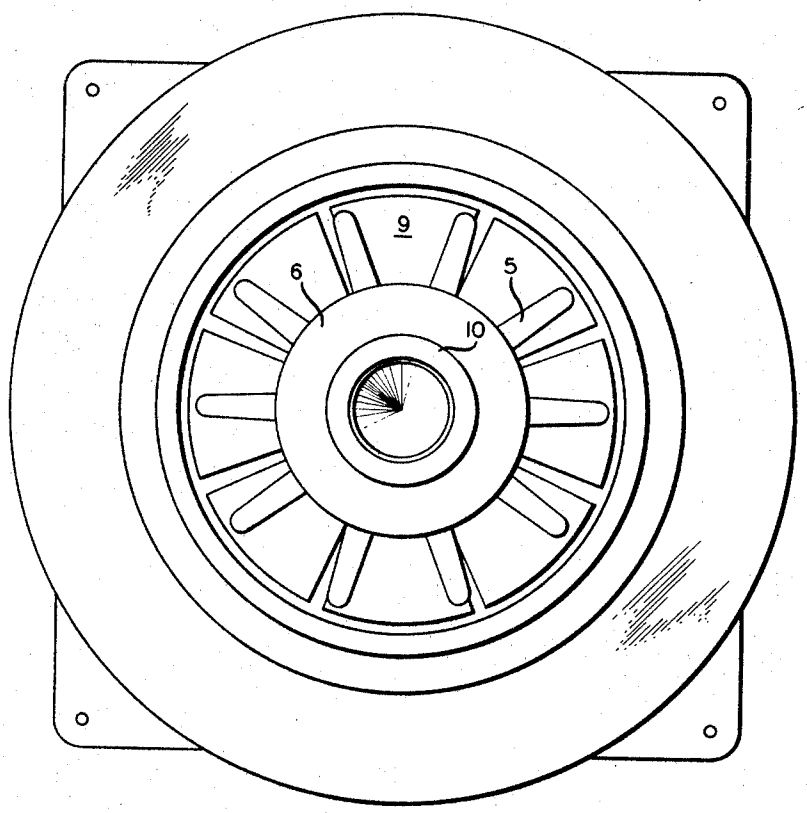


FIG. 4

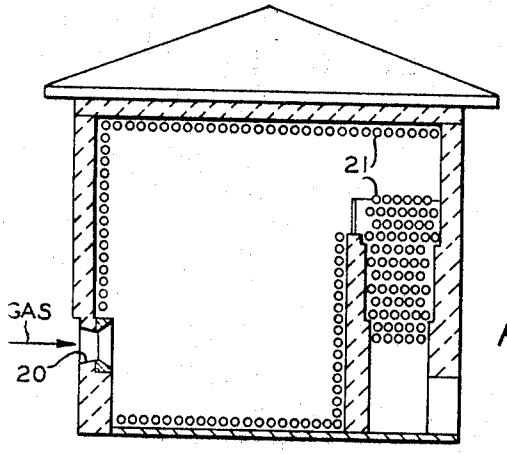


FIG. 5

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ROTARY BURNERS

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Continuation-in-part of application Ser. No. 446,283, Apr. 7, 1965. This application July 7, 1967, Ser. No. 660,144
U.S. Cl. 239—214.15 11 Claims
Int. Cl. B05b 3/02, 7/00; F23d 11/04

ABSTRACT OF THE DISCLOSURE

Combustion efficiency of rotary fuel burners is increased by mounting a deflection plate around the axis of the burner to divert axially flowing air annularly outwardly, resulting in improving mixing of fuel and air.

CROSS-REFERENCE TO RELATED APPLICATION

This application in a continuation-in-part of Ser. No. 446,283, filed Apr. 7, 1965 now abandoned.

BACKGROUND OF THE INVENTION

In one of its aspects, this invention relates to an obstruction and deflection plate for use on a rotary burner, said plate being so located as to deflect fuel and air to provide proper mixing of the air-fuel mixture to thereby effect substantially complete combustion of said fuel. In another aspect, this invention relates to the method of obtaining substantially complete combustion of fuel injected into a furnace by a rotary burner, by obstructing and diverting a portion of the fuel to concentrate a fuel-air mixture at various locations in the burner to insure complete combustion thereof.

Rotary fuel burners are generally that type of burner which has radially disposed fuel spraying arms whereby, due to the rotation of the arms, the fuel is sprayed and mixed with air in proper proportion. These burners are generally well-known in the art, and are considered to have advantages over other types of burners, in that a better fuel-air intermixture can be obtained. However, there have been instances where improper combustion of the fuel has occurred using a rotary fuel burner. In at least one instance, it has been noticed that about one-third of the fuel to a boiler furnace in which a rotary fuel burner was installed was going out the stack of the furnace unburned. Obviously, in a large installation, such a large proportion of unburned fuel represents a substantial cost; and, therefore, occasioned the direction of considerable effort to the solution of this problem. It was found, however, that standard adjustments of the rotary fuel burner, and/or variation of the ratio of gas to air introduced to the furnace did not provide an adequate solution to the problem of unburned fuel.

I have now discovered a solution to the foregoing problem.

By various aspects of this invention, one or more of the following or other objects can be obtained.

It is an object of this invention to reduce fuel loss when using a rotary gas burner.

Another object of this invention is to provide better mixing and more turbulence in a rotary gas burner to promote even burning.

Another object of this invention is to provide substantially complete combustion of the fuel-air mixture produced in a rotary gas burner.

Yet another object of this invention is to stabilize rotary gas burner operation to reduce the waste of fuel.

Still another object of this invention is to provide an economical and expedient way to modify the operation of rotary gas burners to prevent fuel loss.

Other aspects, objects, and the several advantages of this invention are apparent from a study of this disclosure, the drawings, and the appended claims.

SUMMARY OF THE INVENTION

According to this invention, there is provided, on a rotary fuel burner, an obstruction and deflection plate located to obstruct and deflect fuel and air to provide proper mixing of the fuel mixture thereby effecting complete combustion of said fuel-air mixture.

There is also provided in accordance with this invention a method of obtaining more complete combustion of fuel injected into a burning zone or a furnace by rotary fan burner comprising obstructing and diverting said fuel and concentrating fuel and air to provide an optimum fuel-air mixture to insure complete combustion thereof.

There is further provided in accordance with the practice of this invention on a rotary gas burner, an obstruction and deflertion plate located on the flame side of said burner to obstruct and deflect fuel and air thereby providing proper mixing and effecting complete combustion of the fuel and air mixture.

DESCRIPTION OF THE DRAWINGS

The invention will be more fully described with reference to the drawings, in which:

FIGURE 1 is a drawing of a rotary gas burner with part of the housing cut away to show the deflection and obstruction plate of this invention.

FIGURE 2 is a detailed view of the deflection and obstruction plate of this invention attached to the rotary gas burner.

FIGURE 3 is a right-hand end view of FIGURE 1. FIGURE 4 is a left-hand end view of FIGURE 1. FIGURE 5 is a cross-sectional view of a furnace showing the location of a rotary gas burner.

Referring now to FIGURE 1, the rotary gas burner shown therein is enclosed by casing **1**. Gas is introduced to the rotary gas burner through inlet housing **2**. The gas passes through the interior of rotatable hollow shaft **3**, and passes through driver hub **4**, which is hollow, and is expelled through driver arms **5**. Deflection plate **6** is attached to driver hub **4**. Fan **7** is located between hollow shaft **3** and driver hub **4**. The interior of fan **7** is hollow to permit passage of the fuel to the driver hub and driver arms. In operation, gas under pressure is introduced at inlet housing **2** and passed through hollow shaft **3** to driver arms **5**, where it is expelled through openings **8** in the driver arms, thereby imparting rotational motion to the driver hub **4**, fan **7**, and hollow shaft **3**. Fan blades **9** serve to draw air into the rotary fuel burner as will be hereinafter described, and mix the air with fuel expelled by driver arms **5**. The air-fuel mixture thus formed is continuously combusted. Deflection plate **6** functions to concentrate fuel in the fuel-air mixing zone of the apparatus whereby the fuel losses are avoided. The advantages of deflection plate **6** will be pointed out below.

One method of attachment of deflection plate **6** to a rotary fan burner is that shown in FIGURE 2. In this method of attachment, deflection plate **6** is attached to driver hub **4** by bolts **11**, which pass through nose plate **10** and secure both nose plate **10** and deflection plate **6** to the driver hub.

FIGURE 3 is a right-hand view of the rotary fuel burner shown in FIGURE 1. The flow of air to the burner can be controlled by adjusting shutter **12**, which can be rotated by loosening wing nut **13**. Handle **14** is provided to aid in the rotation of the shutter.

FIGURE 4 is a left-hand end view of the rotary fuel burner shown in FIGURE 1. Nose plate **10** is shown located in front of deflection plate **6**, which is shown

located in front of driver arms **5**. Fan blades **9** are located in back of driver arms **5**.

FIGURE 5 depicts a typical furnace installation in which a rotary fuel burner as previously described can be used. The particular installation shown in the drawing depicts a tube still, in which a rotary fuel burner is inserted in aperture **20**. Fuel is ignited and materials passing through tubes **21** are heated.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Although the drawings shown some details of a rotary fuel burner which is presently preferred for use in combination with the deflection plates of this invention, other types of rotary fuel burners can also be used. As an example, the fuel burners shown in U.S. Patents 2,491,324, issued Dec. 13, 1949, to Carl J. Maki; 2,177,245, issued Oct, 24, 1939, to E. L. Dennis; 2,327,512, issued Aug. 24, 1943, to E. L. Dennis; and 2,494,893 issued Jan. 17, 1950, to C. O. Myers, can be used. A presently preferred rotary fuel burner for use in the combination of this invention is the "Fanmix" gas burner produced by Coppus Engineering Corp., Worcester, Mass.

The deflection plate of this invention shown in FIGURES 1, 2 and 4, is preferably in the form of a circular or annual plate as shown. However, the deflection plate **6** can have various geometrical configurations and still function in the prescribed manner. For example, the plate could be square, hexagonal, or octagonal, to name only a few of the possible symmetrical geometrical configurations. The plate can also have various unsymmetrical geometrical configurations.

The plate should be of sufficient size to cover the inner 25 to 50 percent of the driver arms, preferably covering about 30–35 percent. Therefore, in a burner having a 21½-inch throat 15 and a 7-inch hub, the driver arms will be about 7 inches long, and the plate should be of sufficient diameter to cover the inner 1¾ to 3½ inches of the driver arms. In this case, the diameter of the plate will be about 50 to about 65 percent of the throat diameter of the burner.

Although the location of deflection plate **6** is shown in FIGURE 1, 2, and 4, indicating that the plate is located on the flame side of driver arms **5**, this is only a presently preferred location. Other locations which are applicable, for example, are between driver hub **4** and fan **7**, or between fan **7** and hollow shaft **3**. Similarly, the deflection plate can be suspended by means of spoke arms from housing **1**.

The deflection plate preferably should be located on the flame side of the driver arms, and as close to those driver arms as possible, even touching the driver arms. Moving the deflection plate away from the driver arms will, of course, minimize the advantages of my invention, but I have found it possible to obtain substantial improvement in the combustion efficiency of the burner when the plate is up to 2 inches from the driver arms when using the burner of 21-inch throat diameter. Moving the plate even further away, for example as much as 6 inches, would be possible if the diameter of the plate were sufficiently large relative to the throat of the burner.

Most of the rotary burners commercially available are provided with a great number of their orifices on the outer half of the driver arms, and relatively few orifices on the half of the driver arm toward the axis. I have found it convenient to plug the orifices which will lie directly behind the deflection plate so that the only fuel orifices in the driver arms will lie outside the periphery of the plate. This, however, is merely a preferred embodiment, and the orifices inside the periphery of the deflection plate could be left open if desired.

Although the foregoing description has, in some instances, referred to gaseous fuel, it will be apparent that either a gaseous or a liquid fuel can be used in the rotary fuel burner. It is believed to be also apparent that other suitable sources of oxygen can be substituted for the air which is introduced to the burner.

As hereinbefore pointed out, the use of the deflection plates of this invention in combination with a rotary gas burner has as its advantage the saving in the amount of fuel used due to more complete combustion effected by its use. The following specific example will illustrate this advantage.

Specific example

Rotary fuel burners manufactured by Coppus Engineering Corp., Worcester, Mass. designated as DA–21 Fanmix burners, which were installed in nine Wickes Type A WT. boilers, were modified according to this invention. These burners have a 21½-inch throat diameter, and a 7-inch hub on which the driver arms are mounted. Burner changes consisted of installing a 12-inch O.D. X ⅛-inch thick stainless steel plate under the nose plate of a burner by bolting the plate through the existing nose plate holes. The plate was therefore about ½-inch in front of the driver arms. The six orifices per burner arm which lay behind the deflection plate were plugged, so that the only open orifices were outside the deflection plate periphery. The DA–21 burner before modification had ten burner arms with 31 orifices per arm: a total of 310 orifices per burner. The orifices size is 1/16-inch. With a total of 60 orifices plugged, the total number of burner orifices was changed from 310 to 250. Preceding the burner changes, the burner pressure was noted to be 18 pounds with full plant steam load. The fuel HV was 1152 B.t.u. with .68 specific gravity. After the burner changes, the burner pressure was increased to 20 pounds and the heat value of the fuel had changed from 1152 to 1125 B.t.u.

The following calculations and data illustrate the savings effected by the change:

Capacity of 1/16" orifice—c.f.h.:
.55 sp. gr. gas—1/16" orifice at 18#=119 CFH.
.55 sp. gr. gas—1/16" orifice at 20#=125 CHF.
Corection factor for .68 sp. gr.=901.
At 18#, 119 ×.901=107 c.f.h.
At 20#, 125×.901=113 c.f.h.

Conditions before burner changes:
Burner pressure 18#.
Number of 1/16" orifices/burner=310.
HHV fuel gas=1152 b.t.u.—.68 sp. gr.
9 Type A Wickes WT. boilers.
One DA–21 Fanmix/boiler.

C.f.h. fuel and b.t.u./hr. input at 18# burner press., 1152 b.t.u. gas.
310×107=33,170 c.f.h./b.l.r. at 18# burner press.
33,170×1152=36,719,190 b.t.u./hr.; input with 1152 b.t.u. gas.

Conditions after burner changes:
60 1/16" orifices plugged.
310—60=250 orifices remaining/burner.
Heating value of fuel changed from 1152 to 1125 b.t.u.
Fuel pressure raised from 18 to 20#.

C.f.h. fuel and b.t.u./hr. input at 20# burner press.; 250 orifices; 1125 b.t.u. gas:
250×113=28,250 c.f.h. at 20# burner press.
28,250×1125=31,781,150 b.t.u./hr./blr. input with 1125 b.t.u. gas.

Fuel savings per boiler, after burner changes:
36,719,190—31,781,250=4,937,940 b.t.u./hr./blr.

$\frac{4,937,940}{1125}$=4,338 cfh/blr. fuel reduction after burner change.

With 9 boilers, fuel savings=9×4,338=39,042 c.f.h.
Fuel savings per day=24×39,042—937,008 c.f.d.

Fuel savings with .15/m. cu. ft. gas:

$$\frac{937,008 \times .15}{1,000} = \$140.55 \text{ per day.}$$

$$30 \times °140.55 = \$4,216.50 \text{ per month.}$$

Reasonable variation and modification are permissible in the foregoing disclosure, the drawings and the claims without departing from the spirit of my invention.

I claim:

1. In a rotary fuel burner having a tubular casing from which fuel is injected into a combustion chamber through orifices in arms rotating about the longitudinal axis, and air is blown axially through said rotating arms into said combustion chamber, the improvement which comprises a fluid flow obstruction and deflection plate mounted on a hub having a diameter of about 7 inches, arms and having a radial extent sufficient to cover the inner 25 to 50 percent of the length of said arms, the diameter of said deflection plate being 50 to 65 percent of the inner diameter of said casing so as to cover the central portion of the outer face of the rotating burner arms to obtain improved fuel-air mixing and more efficient combustion.

2. The burner of claim **1** wherein said plate is mounted within 2 inches of said arms.

3. The burner of claim **1** wherein said plate is a round plate and is mounted about ½-inch from said arms.

4. The burner of claim **1** wherein said orifices lie entirely outside the periphery of said obstruction and deflection plate and wherein said deflection plate is a round flat plate mounted within 2 inches of said arms.

5. The burner of claim **1** wherein said fluid flow obstruction and deflection plate has a radial extent sufficient to cover the inner 30 to 35 percent of the length of said arms.

6. The burner of claim **3** wherein said inner diameter of said burner casing is about 21½ inches, said rotating arms are mounted on a hub having a diameter of about 7 inches, and said plate has a diameter of about 12 inches and said orifices lie entirely outside the periphery of said plate.

7. A rotary burner for gaseous or liquid fuel comprising in combination:

(a) an exterior casing to enclose the burner components,

(b) a coaxial shaft rotably mounted inside said exterior casing,

(c) a fuel inlet housing attached to said shaft,

(d) a fan attached to said shaft,

(e) a driver hub adjacent to and connected to said fan, and on the combustion side thereof,

(f) burner arms attached to said driver hub adapted to disperse said fuel through orifices on the combustion side of said arms and thereby rotate said arms, said shift, and said fan whereby said rotating fan draws air through an annular passageway defined by said exterior casing and said shaft substantially perpendicularly past said burner arms and into a combustion chamber,

(g) means for conveying fuel from said fuel inlet housing to said burner arms, and,

(h) a deflection plate mounted on said hub on the combustion side of said burner arms, said deflection plate having a radial extent sufficient to cover the inner 25 to 50 percent of the length of said arms and wherein the diameter of said plate is about 50 to 65 percent of the inner diameter of said casing.

8. The burner of claim **7** wherein said coaxial shaft is hollow and comprises said means for conveying fuel from said fuel inlet housing to said burner arms.

9. The burner of claim **7** wherein said orifices lie outside the periphery of said plate, and wherein said plate is a round flat plate mounted within two inches of said arms.

10. The burner of claim **9** wherein said deflection plate is mounted about ½-inch from said arms, and wherein said plate has a radial extent sufficient to cover the inner 30 to 35 percent of the length of said arms.

11. The burner of claim **10** wherein said inner diameter of said casing is 21½ inches, the diameter of said driver hub is 7 inches, the diameter of said plate is 12 inches, and said burner arms extend 7 inches from said driver hub.

References Cited

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2,396,306	3/1946	Von Haase	158—4
2,473,945	6/1949	Gibson	158—118 X

JAMES W. WESTHAVER, *Primary Examiner.*

U.S. Cl. X.R.

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PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,425,631 Dated February 4, 1969

Inventor(s) Max J. Hensley

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 16, Claim 1, delete "a hub having a diameter of about 7 inches," and substitute therefor -- the combustion side of and adjacent to said --.

Column 6, line 8, Claim 7, "shift" should be -- shaft --.

SIGNED AND
SEALED
NOV 18 1969

(SEAL)
Attest:

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Commissioner of Patents