

Feb. 15, 1944.

L. V. ANDREWS

2,341,682

PULVERIZED FUEL BURNER

Filed Aug. 1, 1940

2 Sheets-Sheet 1

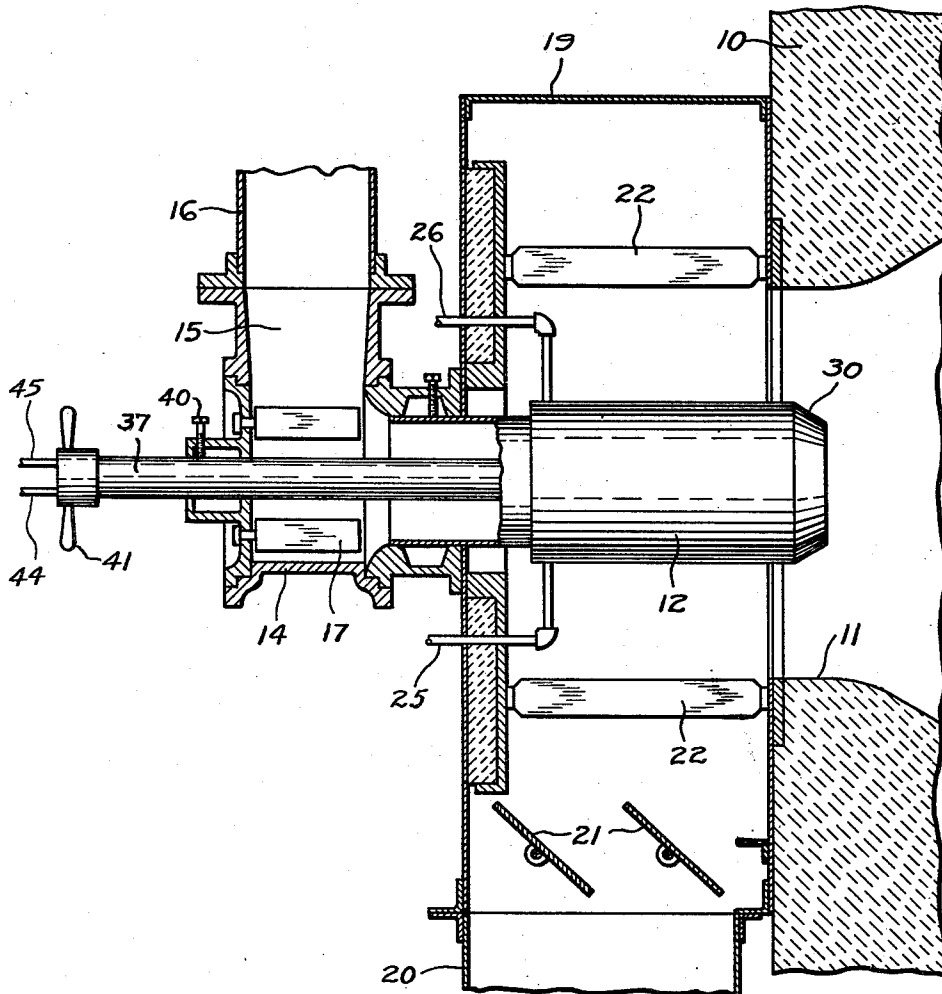


Fig. 1

Inventor

L. V. ANDREWS

By *Albert L. Blodgett*

Attorney

Feb. 15, 1944.

L. V. ANDREWS

2,341,682

PULVERIZED FUEL BURNER

Filed Aug. 1, 1940

2 Sheets-Sheet 2

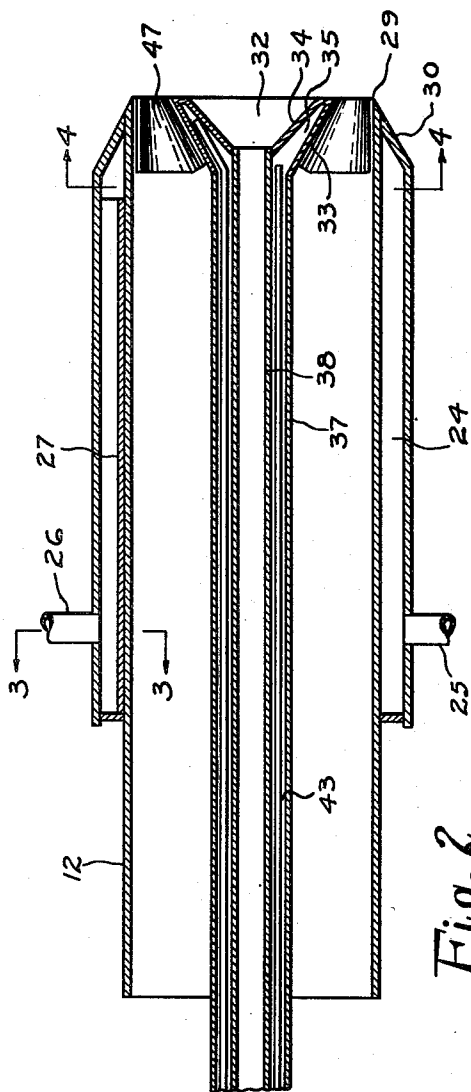


Fig. 2

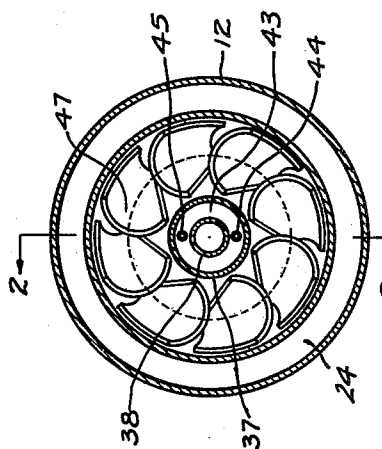


Fig. 4

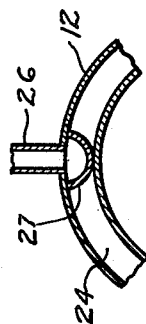
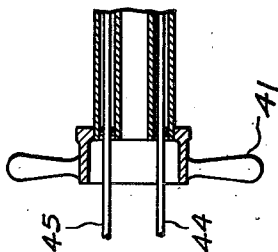


Fig. 3



Inventor

L. V. ANDREWS

By *Albert G. Blagden*
Attorney

UNITED STATES PATENT OFFICE

2,341,682

PULVERIZED FUEL BURNER

L V Andrews, Worcester, Mass., assignor to Riley Stoker Corporation, Worcester, Mass., a corporation of Massachusetts

Application August 1, 1940, Serial No. 349,216

4 Claims. (Cl. 110—104)

This invention relates to pulverized fuel burners, and more particularly to burners for use with fuels having comparatively low melting temperatures, such as pitch for example.

When fuels of this type are pulverized and then projected into a furnace for combustion in suspension, considerable difficulty is usually encountered by reason of deposits of unburned fuel which form on the burner nozzle and associated parts. Such deposits tend to block the fuel passages, and they eventually become ignited and destroy the metal parts of the burner. It has been recognized heretofore that the fuel tends to become sticky as its temperature rises, and that such stickiness is an important factor in the formation of the deposits. In order to solve the problem it has been proposed to discharge the fuel through a nozzle shaped to provide an annular chamber through which water can be circulated, thereby cooling the nozzle and preventing the fuel from adhering thereto. It is found however that mere water cooling of the nozzle is not sufficient, and the prior burners even with the water cooling have proven unsatisfactory in service.

It is accordingly one object of the invention to overcome these difficulties and to provide a pulverized fuel burner which will operate efficiently throughout a long life of service with fuels having comparatively low melting temperatures.

It is a further object of the invention to provide a pulverized fuel burner which is so constructed and arranged as to eliminate troublesome deposits of fuel on the fuel nozzle and associated parts, even with fuels such as pitch and the like.

It is a further object of the invention to provide a pulverized fuel burner which will bring about a rapid and thorough mixture of the fuel with the secondary air and thereby produce a comparatively short flame.

It is a further object of the invention to provide a pulverized fuel burner which can be operated efficiently and satisfactorily throughout a wide load range.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

Referring to the drawings illustrating one embodiment of the invention, and in which like reference numerals indicate like parts,

Fig. 1 is a vertical sectional view of a pulverized

fuel burner, with the fuel nozzle shown for the most part in full;

Fig. 2 is a longitudinal section through the fuel nozzle, taken on the line 2—2 of Fig. 4;

Fig. 3 is a section on the line 3—3 of Fig. 2; and

Fig. 4 is a section on the line 4—4 of Fig. 2.

The embodiment illustrated comprises a furnace wall 10 having a circular opening 11 therein through which pulverized fuel is discharged from a fuel nozzle 12 mounted in alignment with the opening. The front or inlet end of the nozzle is supported in a hollow structure 14 commonly known as the burner "head." This head 14 is formed with an inlet passage 15 to which a mixture of pulverized fuel and primary air is supplied by a pipe 16 leading from a suitable source. The usual vanes 17 are provided within the head 14 to aid in distributing the fuel properly about the axis of the burner nozzle prior to its entrance therein.

The fuel nozzle 12 is surrounded by a casing 19 which forms a chamber for secondary air, this air flowing from the chamber through the opening 11 in surrounding relationship to the fuel stream. Air may be supplied to the chamber by natural draft or it may be supplied by forced draft from a suitable source through a duct 20, the rate of flow being controlled by dampers 21 at the chamber inlet. A series of vanes 22 is mounted within the chamber to impart a whirling motion to the air in known manner as it approaches the opening 11.

Referring now to Figs. 2 to 4, inclusive, it will be seen that the fuel nozzle 12 is formed with coaxial inner and outer cylindrical walls to provide an annular chamber or jacket 24 which extends to the rear or discharge end of the nozzle. Water is supplied to the lower portion of the jacket by an inlet pipe 25 and withdrawn from the upper portion of the jacket by an outlet pipe 26. These pipes 25 and 26 are located near the front end of the jacket, and in order to prevent short-circuiting of the water stream and to ensure that the water will circulate properly through the rear portion of the jacket, a baffle 27 is provided in the upper portion of the jacket and directly beneath the outlet pipe 26. This baffle is in the form of a U-shaped trough in cross section, and it extends rearwardly from the front wall of the jacket and terminates somewhat short of the rear wall thereof. It will be apparent that with this construction the water which enters through the pipe 25 will be compelled to flow to the rear end of the jacket 24 and thence forwardly above the baffle 27 to the outlet pipe 26.

For convenience in manufacture, the water jacketed nozzle 12 is formed from several separate metal pieces which are fastened together by welding in known manner.

Applicant has discovered that when fuels such as pulverized pitch are discharged from a burner nozzle, deposits of fuel will form on the rear end of the nozzle around the issuing stream, and that such deposits cannot be eliminated by simply providing a water jacketed nozzle. Applicant believes that such deposits are the result of eddy currents in the stream of fuel, combined of course with the sticky nature of the fuel, and he has discovered that he can eliminate the deposits by suitably shaping the nozzle adjacent its discharge end. For this purpose the nozzle is shaped to provide a comparatively sharp annular edge 29 at its discharge end. In the embodiment illustrated this is brought about by beveling the outer wall of the water jacket, at the rear end of the nozzle, in an inward and rearward direction, as indicated at 30 in Fig. 2. It will be noted that with this construction the inner and outer walls of the water jacket meet at an acute angle at the discharge end of the burner.

In order to bring about rapid combustion of the fuel and obtain a short flame, it is desirable to deflect the issuing fuel stream outwardly into the surrounding stream of secondary air. This has been recognized, and it has been proposed heretofore, when burning pulverized coal, to provide either a deflecting cone at the center of the issuing stream or a series of vanes adapted to whirl the issuing stream. However, it has been found impractical to use such devices with pulverized pitch, because of the deposits which would form upon them in operation.

These difficulties are avoided by the construction shown particularly in Figs. 2 and 4. Adjacent the outlet of the nozzle 12 there is provided a conical spreader 32 having an outer wall 33 which flares outwardly in the direction of fuel flow to deflect the issuing fuel into the surrounding secondary air. This spreader is hollow and has a cone-shaped inner wall 34 which is spaced from the outer wall 33 to provide an annular chamber 35 through which water may be circulated to cool the parts. The outer wall 33 is welded to the rear end of a tube 37, and the inner wall 34 is welded to the rear end of a smaller tube 38, these tubes being coaxial with the nozzle 12 and secured in the burner head 14 by means of a set-screw 40 (Fig. 1). A handle 41 is mounted on the front end of the tube 37 to aid in adjusting the spreader axially. The tubes 37 and 38 form an annular space 43 which communicates at the rear with the chamber 35 in the spreader 32, this space being suitably closed at its front end. A small inlet tube 44 extends rearwardly through the lower portion of the space 43 to the chamber 35, and a small outlet tube 45 extends rearwardly through the upper portion of the space 43, the rear end of the tube 45 being bent upwardly into the upper portion of the chamber 35. Cooling water is supplied under pressure to the tube 44 from any suitable source, and after flowing through the chamber 35 this water escapes through the tube 45. By this means the spreader 32 is adequately cooled so that it will withstand the conditions encountered in service and the fuel will not adhere thereto. It will be noted from Fig. 2 that the tube 38 is open at both ends, so that air will flow rearwardly therethrough under the influence of the furnace draft and of the in-

jector action of the issuing fuel stream. This air aids combustion, and prevents the formation of an excessive suction at the rear of the spreader, which would tend to cause deposits of sticky fuel.

In order to aid in mixing the fuel with the secondary air and to facilitate the maintenance of ignition, particularly at low rates of fuel burning, metal vanes 47 are welded to the outer surface of the spreader wall 33 and extend outwardly close to the inner surface of the fuel nozzle 12. As indicated in Fig. 4, these vanes are skewed relative to the axis of the burner, so that they serve to whirl the issuing fuel. Each vane 47 is preferably formed from a thin plate bent to a U-shaped cross section and tapering rearwardly, the concave surfaces of the vanes being turned toward the on-coming fuel so that the vanes provide troughs along which the fuel flows and from which it is discharged in concentrated jets rich in fuel and consequently easily ignited. Preferably each vane is shaped substantially as one-half of a hollow conical frustum divided by an axial plane.

The operation of the invention will now be apparent from the above disclosure. The pulverized fuel, for example, pitch, is carried on a stream of primary air through the burner head 14 and rearwardly through the nozzle 12. At the rear end of the nozzle the fuel encounters the spreader cone 32 and the vanes 47, which spread the fuel outwardly and whirl the same, thus bringing about a rapid mixture of the fuel with the secondary air which flows rearwardly from the casing 19 and through the opening 11. Because of the comparatively sharp edge 29 at the rear end of the nozzle, deposits of fuel on the nozzle are avoided, apparently by reason of the elimination of certain eddy currents. The spreader 32 is cooled by the circulation of water through the chamber 35, and the vanes 47 are cooled by the transfer of heat through the welded connection to the outer wall 33 of the spreader. It will be noted that while the rear portions of the vanes 47 are subjected to the greatest heat, they are narrower than the front portions and hence more effectively cooled, since the heat has less distance to travel to the water cooled wall 33. This cooling avoids adherence of fuel and prolongs the life of the parts. The peculiar shape of the vanes 47 promotes ignition and contributes to efficient operation at all rates of fuel burning.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A pulverized fuel burner comprising a nozzle for the discharge of a stream of fuel and primary air, means to supply secondary air in surrounding relation to the issuing fuel stream, walls forming a chamber at the center of the nozzle adjacent the discharge end thereof, the outer wall of the chamber flaring outwardly in the direction of fuel flow and spaced radially inwardly of the nozzle, means to circulate water through the chamber, and vanes secured to the said outer wall and extending outwardly into the path of the fuel, the vanes being skewed relative to the axis of the burner and of decreasing width in the direction of fuel flow.

2. A pulverized fuel burner comprising a nozzle for the discharge of a stream of fuel and primary air, means to supply secondary air in surrounding relation to the issuing fuel stream, and a series of deflecting vanes mounted in the path of

the fuel adjacent the rear or discharge end of the nozzle, each vane being substantially U-shaped in cross section to provide a trough having a concave surface, the vanes being skewed relative to the burner axis in such a direction that the said concave surfaces face forwardly toward the rearwardly traveling fuel and the fuel will impinge upon the said concave surfaces and be discharged from the troughs in a series of comparatively small streams which are directed tangentially to produce a whirling motion.

3. A pulverized fuel burner comprising a nozzle for the discharge of a stream of fuel and primary air, means to supply secondary air in surrounding relation to the issuing fuel stream, means forming a chamber at the center of the nozzle adjacent the discharge end thereof and having an outer wall spaced radially inwardly of the nozzle, means to circulate water through the chamber,

and vanes secured to the said outer wall and extending outwardly into the path of the fuel, the vanes being skewed relative to the axis of the burner.

5 4. A pulverized fuel burner comprising a nozzle for the discharge of a stream of fuel and primary air, means to supply secondary air in surrounding relation to the issuing fuel stream, walls forming a chamber at the center of the nozzle adjacent the discharge end thereof, the outer wall of the chamber flaring outwardly in the direction of fuel flow and spaced radially inwardly of the nozzle, means to circulate water through the chamber, and vanes secured to the said outer wall and extending outwardly into the path of the fuel, the vanes being skewed relative to the axis of the burner.

L V ANDREWS.