April 12, 1960 K. S. JAEGER 2,932,347

BURNER APPARATUS

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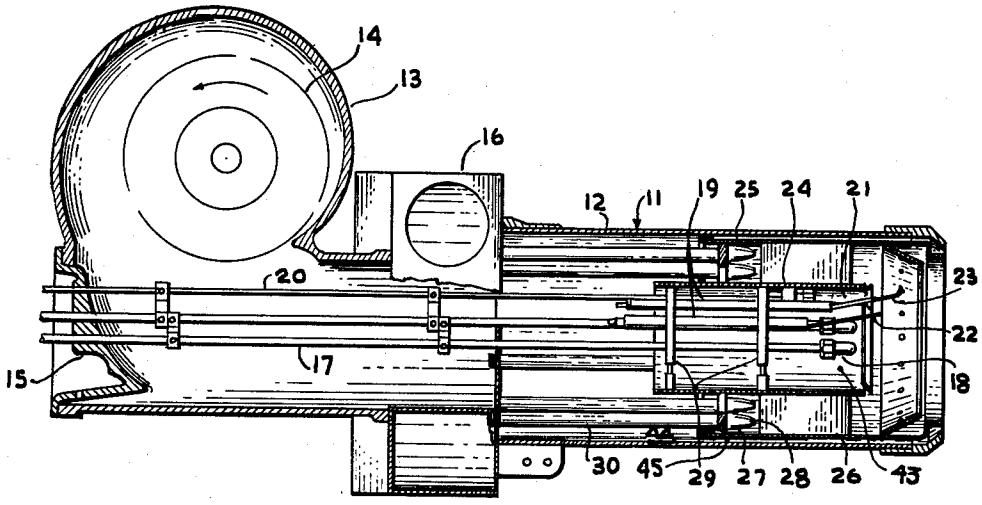


FIG. 1.

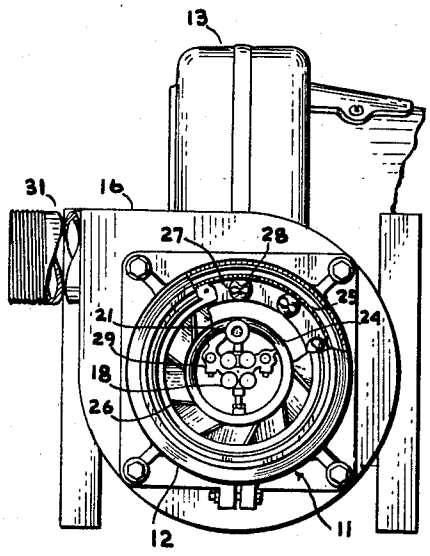


FIG. 2.

INVENTOR.

BY KURT S. JAEGER

Charles S. Haeg key

ATTORNEY

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BURNER APPARATUS

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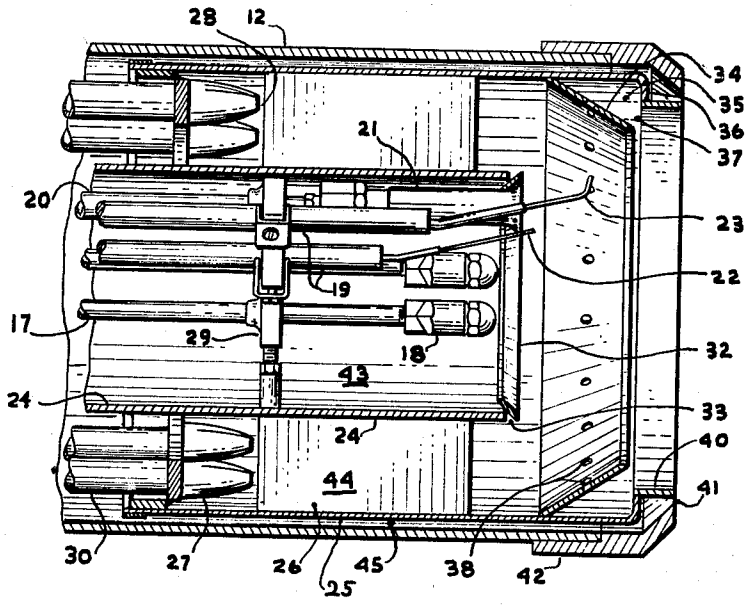


FIG. 3.

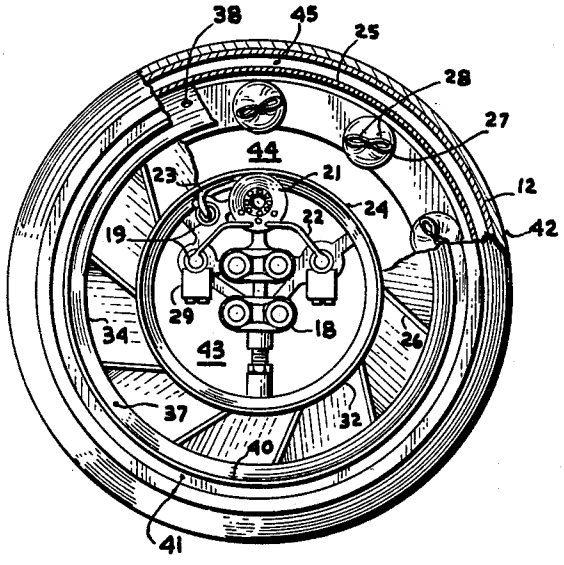


FIG. 4.

INVENTOR.

BY KURT S. JAEGER

Charles S. Haney

ATTORNEY

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BURNER APPARATUS

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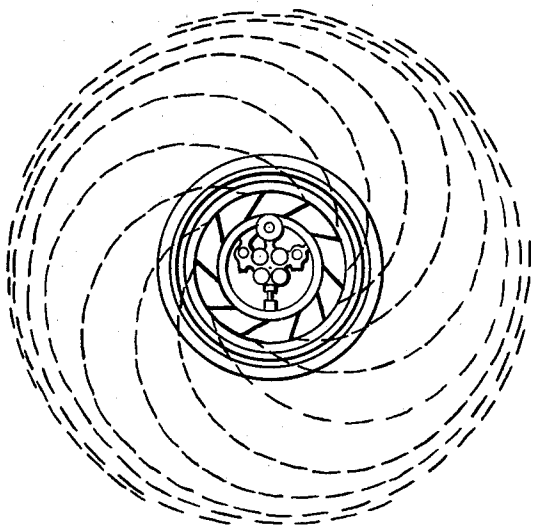


FIG. 6.

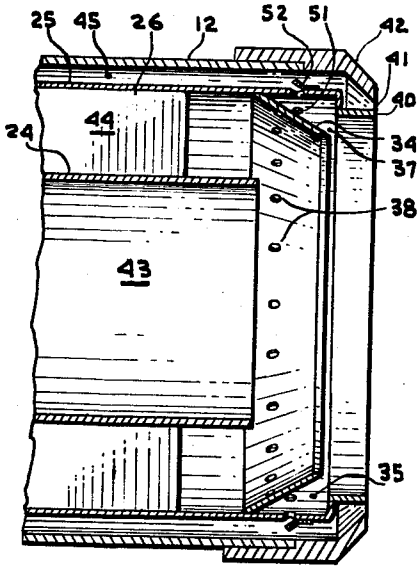


FIG. 7.

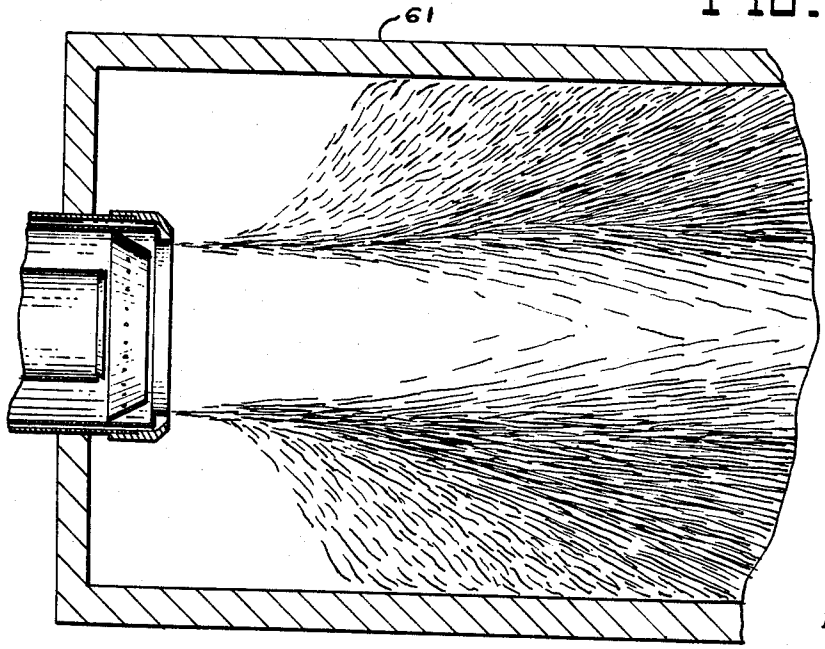


FIG. 5.

INVENTOR.
KURT S. JAEGER

BY Charles S. Haughey
ATTORNEY

United States Patent Office 2,932,347 Patented Apr. 12, 1960

2,932,347

BURNER APPARATUS

Kurt S. Jaeger, Tulsa, Okla., assignor, by mesne assignments, to Midland-Ross Corporation, Cleveland, Ohio, a corporation of Ohio

Application April 24, 1956, Serial No. 580,307

4 Claims. (Cl. 158—11)

This invention pertains to an improved fuel burner and more specifically to a burner capable of individually burning two fuels for use in boilers or the like.

Dual fuel burners are well known in the art, particularly those burners separately firing both oil and gas. There are several important aspects connected with the operation of this type of burner: both fuels must be burned efficiently; flame stability must be attained; the oil nozzles must be kept relatively cool to prevent coking or plugging thereof; the air-fuel mixture must be ignited smoothly, without concussion; the unit should require relatively little maintenance; and it should preferably be compact. Most dual fuel burners lack one or more of these factors and particularly do not produce a stable, efficient gas flame.

The present invention pertains to a burner that possesses all of the above advantages; it particularly develops an efficient, stable gas flame that maintains the oil nozzles cool, as will be subsequently explained.

For further consideration of what is novel and the invention, refer to the following specification, claims, and accompanying drawing.

In the drawing:

Figure 1 is a partially sectional, elevation view of a burner embodying the invention,

Figure 2 is a partially sectional, front view of the burner of Figure 1,

Figure 3 is a cross-sectional detailed view of a portion of Figure 1,

Figure 4 is a partially sectional, front view of the apparatus of Figure 3,

Figure 5 is a cross-sectional elevation view showing the shape of the burner flame when burning gas,

Figure 6 is a front view of the gas flame pattern, and

Figure 7 is a detailed view of an alternate form of a portion of the apparatus of Figure 3.

Referring to the drawing, and more particularly to Figures 1 and 2, burner 11 comprises an outer casing 12, a blower housing 13, a blower 14, a removable section 15 of housing 13, and a gas manifold 16. Section 15 permits oil lines 17, oil nozzles 18, pilot gas line 20, pilot burner 21, ignition electrodes 22, flame electrode 23, and inner casing 24, forming an inner passage 43, to be easily removed as a unit for replacement or repair. Ignition electrodes 22 and flame electrode 23 are encompassed in ceramic 19 which are, with oil lines 17 and pilot gas line 20, supported within casing 24 by harnesses 29. The inner casing 24 is axially aligned with outer casing 12, and an intermediate casing 25, which is axially aligned with the aforementioned casings, forms a passage 44 between the intermediate casing 25 and the inner casing 24, and also a passage 45 between the intermediate casing 25 and the outer casing 12. In passage 44 are vanes 26 and gas nozzles 27. These nozzles actually contain two ports 28, each of which is adapted to emit gas on either side of the corresponding vane 26 with which it is aligned. This affords a greater uniformity in gas distribution than would otherwise be attained if

a single larger port were located in the center of the passage between adjacent vanes. The ports 28 are preferably formed by aluminum tubes, affixed to gas lines 30, that are crimped to form the two ports. However, they may also be drilled in conventional spuds. The nozzles are supplied gas through gas lines 30 from manifold 16, to which gas is supplied by a pipe 31.

Referring more particularly to Figures 3 and 4, a truncated, conical wall 32 is positioned with respect to inner casing 24 so as to form an annular nozzle 33 therewith. This nozzle is arranged to direct a portion of the air in inner passage 43 toward ports 38. A longer, truncated conical wall 34 is attached to intermediate casing 25 to form chamber 35 defined by wall 34, intermediate casing 25, and an inwardly projecting wall 36, and has an outlet 37 adjacent the flame retention ring 40. Wall 34 contains ports or holes 38 which admit a small portion of the gases in passages 44 and 43 to this chamber 35. A flame retention ring 40 made of stainless steel or the like is attached to the inward edge of wall 36. This ring thus, in effect, forms a continuation of casing 25 and further forms a nozzle 41 with extension 42 which is attached to, or part of, outer casing 12.

In operation, air from blower 14 passes through passages 43, 44, and 45 formed, as previously mentioned, between the casings 12, 24, and 25. When only oil fuel is being burned, air passing through passage 43 serves as primary air, air through passage 44 as secondary air, and air through passage 45 as tertiary air. Also, when only gas fuel is being burned, air through passage 44 serves as primary air, air through passage 43 as secondary air, and air through passage 45 as tertiary air.

When operating with gas fuel, air from blower 14 and gas from nozzles 27 in passage 44 are spun by vanes 26 and pass out the downstream end of this passage. Upon reaching the downstream end of inner casing 24, the air-gas mixture is met by a diverging stream of secondary air from nozzle 33 and passage 43. This diverging stream, coupled with the whirling effect of vanes 26, tends to force the mixture outwardly and maintain it in an annular path. The center of this annular path being air from passage 43, burning is prevented here until the air-gas mixture mixes with this air at a substantial distance downstream from the burner end. The oil nozzles 18 are thereby maintained well away from the flame and stay relatively cool. This is essential to prevent the oil nozzles from coking and thus becoming plugged, which will occur if they become too hot. Furthermore, the flame will not burn down in the head of the burner, a common fault that seriously shortens the life of such.

Toward the downstream end of intermediate casing 25, a small portion of the rich air-gas mixture in passage 44 and additional air from nozzle 33 enter ports 38 into chamber 35. Here they mix and flow at relatively low velocity past retaining ring 40 and at this point mix with more of the air emitted from nozzle 33. The new mixture then ignites readily from the pilot flame of gas pilot 21 and forms the base of the burner flame on retaining ring 40. The flame, when gas is burned, tenaciously clings to this ring and produces a very stable quiet operation. Without such an arrangement the base of the flame will constantly fluctuate which produces a loud, disagreeable noise. Such a burner may be audible for a distance of several city blocks or if placed in a boiler room, it will render adjacent rooms uninhabitable. It is not certain that the aforementioned co-action between the air emitted from nozzle 33 and the mixture in chamber 35 is exactly correct. However, if the casing 24 is extended so that nozzle 33 is directed substantially downstream of ports 38, the burner will not properly function when gas is burned.

The flame, upon emission from the burner, must not diverge too rapidly or blow-off will occur. Thus, the teritary air from nozzle **41** may be directed inwardly in a converging manner to counteract the spreading tendency of the spinning mixture from passage **44** for a short distance downstream of ring **40**. The air through the passages **44** and **45** must be apportioned so as to maintain the direction of the base portion of the flame between a converging angle of 10° and a diverging angle of 20° to the axis of the burner in order to prevent blow-off. The apportionment is also dependent on the angle of vanes **26**. A flame whose base portion travels in a direction outside these limits will not be maintained on the ring **40** with noisy, unsteady burning resulting.

The tertiary air from passage **45** also serves to support additional combustion primarily in the area adjacent retaining ring **40**. As the flame propagates further from ring **40**, the secondary air from passage **43** serves as additional combustion air to support additional burning, the air supplied through passage **44** being insufficient to sustain complete combustion.

The gas flame has a shape as shown in Figures 5 and 6 with a hollow center and the base at the retaining ring, as previously mentioned. It spreads in a conical manner, traveling in a spreading helical path shortly after leaving the burner, being prevented from immediately diverging due to the inward direction of air from nozzle **41**. The representation of Figure 5 is used to show the concentration of the burning gases and does not indicate the spinning effect. This rapidly spreading flame, which is caused by the whirling of the air-gas mixture created by vanes **26**, is especially advantageous for boiler applications where the burner is placed in a fire box represented by walls **61**. The spreading flame causes heating of a large portion of the fire box adjacent the burner that is untouched by other burners with their long, narrow flame emission. Thus the usual result for fire box applications is to overheat the far end of the box while leaving the closer end relatively cool. The subject burner heats the box more uniformly and thereby affords more effective use of it.

In an alternate method of construction as shown in Figure 7, a series of ports **51** are formed in intermediate casing **25** to afford an access from passage **45** to volume **35**. Scoops **52** may be included to direct air from passage **45** into volume **35**, the air mixing with the rich air-gas mixture therein emitted through ports **38** from passage **44**. The scoop may be formed by affixing a metal ring to the outer surface of intermediate casing **25** at the downstream edges of ports **51** or may be formed by extending outwardly the metal that is displaced from the ports, this metal still forming an integral part of the casing at the downstream edges of them. With this apparatus, the wall **32** may be eliminated since the additional air required to form a readily combustible mixture in volume **35** is now supplied from passage **45**.

When oil is used for firing, it is atomized by nozzles **18** and mixed with primary air in passage **43**. The air-oil mixture is ignited by gas pilot **21** which is used for the ignition of both gas and oil. The flame produced by this mixture is not maintained on the retaining ring as the gas flame is, but burns in a relatively steady flame about six inches away therefrom. There is no appreciable acoustic problem with the oil flame in spite of the fact it is not firmly retained by a ring or the like. This is due to the combustion characteristics of oil which produce an inherently relatively stable flame front as compared to that of gas.

The pilot burner **21** is ignited by conventional electric ignition electrodes **22** which are spaced slightly apart in front of pilot burner **21** and form an arc therebetween when current is applied. Flame electrode **23** is connected with a commercially available electronic unit for shutting off the supply of fuel should the pilot flame become extinguished.

The apparatus described herein is the best mode known to the inventor of carrying out the invention, the scope of which is limited only by the appended claims.

I claim:

1. A fuel burner comprising: an outer cylindrical casing; an inner cylindrical casing coaxial with said outer casing and forming a first passage; an intermediate cylindrical casing coaxial with said inner casing and forming a second passage between said intermediate casing and said inner casing, and a third passage between said intermediate casing and said outer casing; a plurality of gas nozzles equally spaced in said second passage; means for supplying gas to said nozzles; supply means for furnishing air to said first, second, and third passages; a flame retention ring located adjacent the downstream end of said outer casing for retaining thereon the base of the flame resulting from an ignited mixture of the gas and air; wall means forming an annular chamber with the inner surface of the downstream end of said intermediate casing and a plurality of ports in said wall means to admit gas and air from said second passage to said chamber, said chamber having an outlet adjacent said flame retention ring; and means for directing additional air toward said chamber for supply thereto.

2. A fuel burner for boilers and the like comprising an outer casing; an inner casing coaxial with said outer casing, located within said outer casing, and forming a first passage, the downstream end of said inner casing terminating substantially upstream of the downstream end of said outer casing; a first truncated, tapered wall coaxial with said inner casing, said wall being spaced from the downstream end of said inner casing to form a first nozzle therewith; an intermediate casing located between said inner and said outer casings and coaxial therewith, the downstream end of said intermediate casing terminating downstream of the downstream end of said inner casing, said intermediate casing forming second and third passages between said intermediate casing and said inner casing and between said intermediate casing and said outer casing respectively, said second passage having a cross-sectional area substantially larger than the cross-sectional area of said third passage; a flame retention frame coaxial with said intermediate casing, being smaller than said intermediate casing, and including means and forming a second nozzle with said outer casing for directing air from said third passage in a convergent, downstream direction; a plurality of fuel nozzles spaced around said second passage; means for supplying fuel to said fuel nozzles; means for supplying air to the upstream ends of said first, second, and third passages; a second truncated wall attached to the inner surface of said intermediate casing and tapering in a downstream direction to form a chamber with said intermediate casing and said flame retention frame, the downstream end of said second wall terminating upstream of said flame retention frame, said second wall containing a plurality of ports through which a portion of the fuel and air in said second passage can flow into said chamber, said first nozzle being upstream of said ports and being directed toward said ports to direct air from said first passage toward said ports; and ignition means located in said first passage for igniting an air-fuel mixture, whereby the portion of the air and fuel entering said chamber will slow down and be ignited adjacent said flame retention frame and the air flowing through said first passage will push out the central portion of the flame front and maintain it substantially downstream of the end of said outer casing and said flame retention frame.

3. A burner according to claim 2 and a plurality of vanes in said second passage downstream of said fuel nozzles for whirling the air-fuel mixture passing thereby.

4. A fuel burner for boilers and the like comprising an outer casing; an inner casing coaxial with said outer casing, located within said outer casing, and forming a first passage; a first truncated, tapered wall coaxial with

said inner casing, said wall being spaced from the downstream end of said inner casing to form a first nozzle therewith; an intermediate casing located between said inner and said outer casings and coaxial therewith, said intermediate casing forming second and third passages between said intermediate casing and said inner casing and between said intermediate casing and said outer casing respectively, said second passage having a cross-sectional area substantially larger than the cross-sectional area of said third passage; a flame retention frame near the end of said intermediate casing, and forming a second nozzle with said outer casing; a plurality of gas nozzles spaced around said second passage; means for supplying gas to said gas nozzles; means for supplying air to the upstream ends of said first, second, and third passages; a second truncated wall attached to the inner surface of said intermediate casing and tapering in a downstream direction to form a chamber near said flame retention frame, said second wall containing a plurality of ports through which a portion of the fuel and air in said second passage can flow into said chamber, said first nozzle being upstream of said ports and being directed toward said ports to direct air from said first passage toward said ports; at least one oil nozzle located centrally of said first passage and wholly upstream of the downstream end thereof; and ignition means for igniting an air-fuel mixture, whereby the air flowing through said first passage will push out the central portion of the flame front established by the ignited fuel and maintain it substantially downstream of the end of said oil nozzle.

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