Sept. 3, 1957 F. L. RUNNINGER ET AL 2,804,916

OIL BURNER SECONDARY AIR CONTROL SYSTEM

Filed Sept. 8, 1953 2 Sheets-Sheet 1

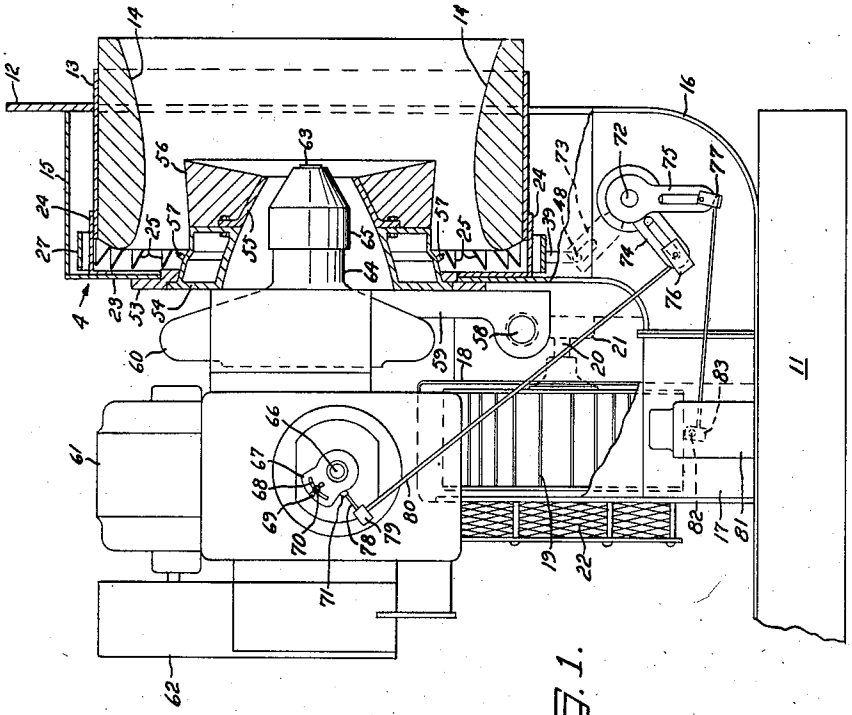


FIG. 1.

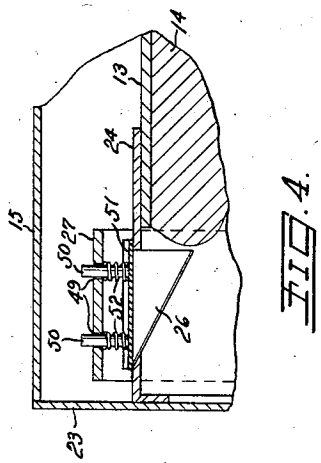


FIG. 4.

INVENTORS
Fredrick L. Runninger
Ernest C. Webb
Richard C. Wright

BY

AGENT

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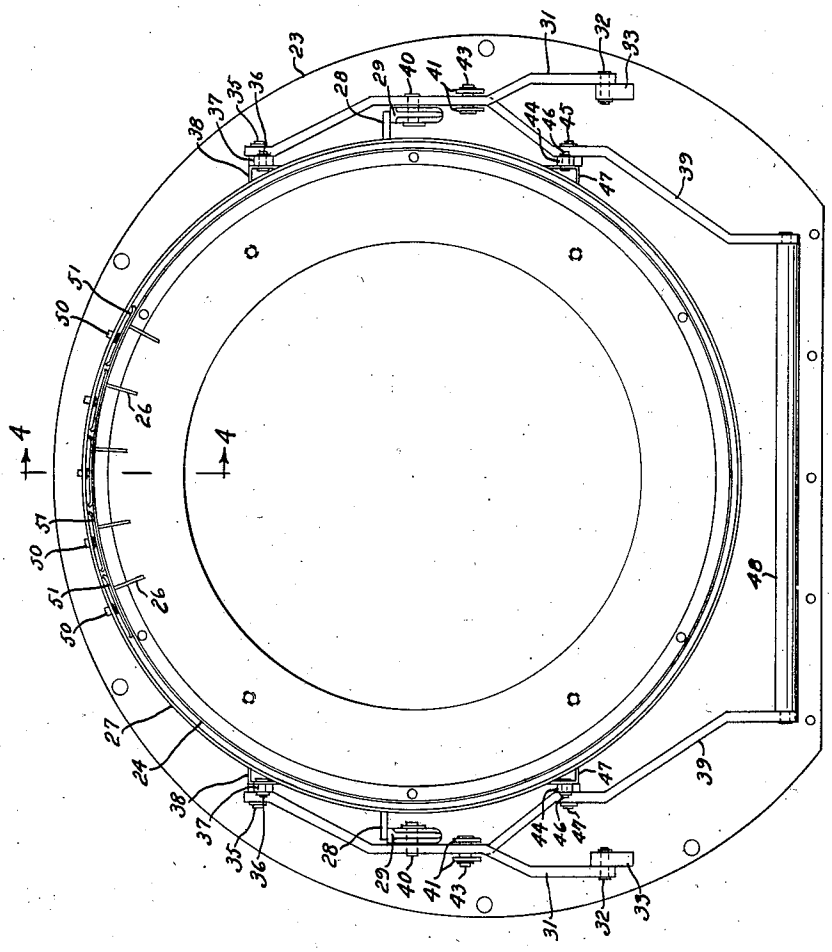


FIG. 2.

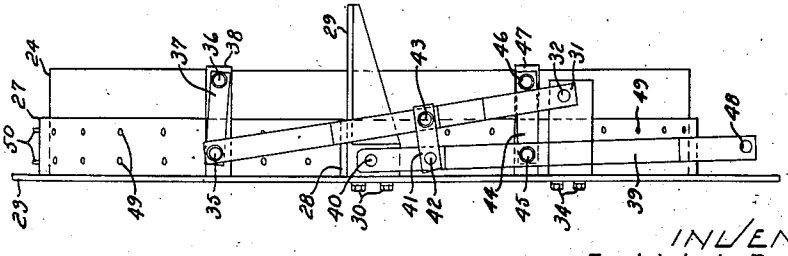


FIG. 3.

INVENTORS
Fredrick L. Runninger
Ernest C. Webb
Richard C. Wright

BY

AGENT

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OIL BURNER SECONDARY AIR CONTROL SYSTEM

Frederick L. Runninger, Parma, and Ernest C. Webb and Richard C. Wright, Bay Village, Ohio, assignors to Iron Fireman Manufacturing Company, Portland, Oreg.

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4 Claims. (Cl. 158—1.5)

This invention relates generally to industrial oil burners or the like but more particularly to industrial oil, gas, or combination oil and gas, burners to which the supply of secondary combustion air is by mechanical draft.

It has long been the practice in the large, or heavy oil, burner art to use forced draft means to supply primary combustion air under relatively high pressure to the combustion chamber in the form of a ring of high velocity air closely surrounding the rotary atomizing cup of the burner. It has also been common practice to introduce secondary air to the combustion chamber by barometrically induced draft through a dampered opening in the wall of the combustion chamber from which the air is guided to the underside of the oil flame by any one of several designs of refractory gratings.

The introduction of secondary air according to this prior art resulted in incomplete or delayed mixing of the secondary air with the oil rich primary air and oil flame and therefore required a large refractory lined combustion chamber in which the heated combustion materials could expand with uncontrolled mixing and a sufficient time and length of travel path in the refractory zone to give the required completeness of combustion of the combustion materials.

However in more modern practice there is rising a definite resistance to the cost in both materials and space of these older type large combustion chamber structures. Additionally, the users of these large burners are becoming more and more reluctant to provide the space for, and invest the required money in, the larger smoke stacks required for inducing the secondary combustion air into the furnace by natural draft.

Following this trend the obvious economy in first cost and the small space requirements of the so-called "package unit" made up of a compact Scotch Marine type boiler with a heavy oil burner designed particularly for use with such a boiler has made these units more and more popular.

The trend therefore is to require burner equipment of a compact type which will dress the flame to a minimum size combustion chamber and complete the combustion of the fuel-air mixture within the allowed space and within the time the combustible materials take to traverse the space.

These trends have developed a need for means for supplying secondary air to the furnace by mechanical draft and means for controlling with substantial exactness the secondary air as it enters the furnace. The mechanical draft means can be of either the induced or forced draft type but is usually of the forced draft type because the forced draft type equipment is smaller, lower in first cost, less costly to maintain, and requires less power to operate. These more economical features of forced draft equipment become clear when it is recalled that the combustion gases about double in absolute temperature and volume in passing through the furnace and therefore induced draft equipment must handle much

larger volumes of much hotter gases than does comparable forced draft equipment.

It is a principal object of this invention to provide an industrial fluid fuel burner having means for controlling the supply of secondary air to the combustion chamber in a desired fuel to air ratio throughout the range of fuel supply rate for which the burner is adapted.

It is a second object to provide such a burner with means for controlling the secondary air supplied to a symmetrical pattern adapted to flow in the same direction, surround, and mix with the primary air-fuel mixture injected into the combustion chamber.

It is a third object to provide such a burner having multiple secondary air openings to the combustion space symmetrically spaced from, and about, the axis of the burner together with means for simultaneously and similarly adjusting the resistance to air flow of each of the openings.

It is a fourth object to provide such a burner having an approximately cylindrical path coaxial with the fuel injection means for the secondary air approaching the combustion chamber and means for giving the air a desired spiral whirl in its approximately cylindrical path.

It is a fifth object to provide such a burner in which each of the secondary air openings is provided with a similar, resiliently mounted shutter.

It is a sixth object to provide such a burner with means coaxial with the burner and movable for similarly and simultaneously positioning said shutters.

It is a seventh object to provide such a burner with a linkage means adapted on movement of a handle in one direction to move said coaxial means to similarly and simultaneously move said shutters to progressively increase the resistance to air flow of each of the secondary air openings to the burner and on movement of the handle in the other direction to progressively decrease the resistance to air flow of each of the secondary air openings.

How these and other objects are attained are explained in the following description referring to the attached drawings in which:

Fig. 1 is a fragmentary side view in partial section of one form of the burner of this invention.

Fig. 2 is a rear elevation of the secondary air control means of the burner.

Fig. 3 is a side elevation of the mechanism of Fig. 2.

Fig. 4 is an enlarged fragmentary view in partial section as seen along the lines 4—4 of Fig. 2 and in the general location indicated by the arrow 4 in Fig. 1.

Similar numerals of reference refer to like parts in the several figures of the drawing.

Referring now to the drawings, for an understanding of the positions and use of the novel parts of our complete burner the prior art parts of the burner are shown positioned in outline but not in detail in Fig. 1. At **11** is indicated a fragment of a base on which the entire boiler and burner of a so called "package unit" is mounted. **12** indicates the front plate of the boiler, and **13** is a cylindrical metal collar secured to plate **12** and forming the firing opening to the combustion chamber of the boiler. **14** is the refractory lining for collar or cylindrical conduit **13**. Secondary air plenum chamber housing **15** is connected by air duct elbows **16** and **17** to the housing **18** of secondary air forced draft fan **19** carried on shaft **20** of its driving motor **21**. Screen **22** covers the inlet of fan **19**.

Referring to Figs. 2, 3, and 4 for more complete disclosure, the front plate **23** of plenum chamber **15** has secured thereto secondary air port ring **24** which in assembly telescopes with collar **13** to separate plenum chamber **15** from the combustion chamber.

Multiple triangular inlet ports **25** in ring **24** are equally

spaced throughout the entire circumferenec of ring 24 as indicated in Fig. 1 but are formed in detail as shown in Fig. 4 by slicing through ring 24 on two sides of each port 25 then bending inwardly the triangularly shaped blank 26 along its uncut edge.

Shutter band 27 spaced from and completely surrounding ring 24 has lugs 28 secured to it on opposite sides and is supported through lugs 28 on brackets 29 secured to plate 23 by cap screws 30. Lugs 28 carrying band 27 are slidable axially of the burner on brackets 29.

Levers 31, spaced at each side of band 27 are pivoted at points 32 on brackets 33 secured to plate 23 by cap screws 34. The other ends of levers 31 are linked through pivot pins 35, 36 and links 37 to brackets 38 secured to band 27.

Levers 39 spaced at each side of band 27 are pivoted at points 40 on brackets 29. Links 41 connect levers 31 and 39 through pivot pins 42 and 43. Links 44 through pivot pins 45 and 46 connect levers 39 to brackets 47 secured to band 27. Handle bar 48 connecting the lower ends of lever 39 is thus shown to be adapted when moved forwardly or backwardly to move shutter band 27 in the same direction of motion axially and substantially concentrically of air port ring 24.

It is seen that as handle bar 48 is pulled to the right as viewed in Figs. 1 and 3, levers 39, pivoted at 40 on brackets 29 secured to plate 23, move in the same direction as bar 48 and through links 41 move with then the upper ends of levers 31 pivoted at 32 on brackets 33 secured to plate 23. Links 44 are pivoted at 45 on levers 39 and at 46 on brackets 47 secured to band 27. Links 37 are pivoted at 35 to levers 31 and at 36 to brackets 38 secured to band 27. Therefore as bar 48 moves outwardly levers 39 pivoted at 40 and levers 31 pivoted at 32 move outwardly and through links 37 and 44 move outwardly with them band 27 supported by its lugs 28 on brackets 29.

Spaced axially of the burner in band 27 radially adjacent each of the air ports 25 in ring 24 are a pair of guide holes 49 each pair of holes being adapted to receive and guide a pair of pins 50 secured at one end to an air port shutter 51. Compression springs 52 secured one on each of pins between the outer faces of shutters 51 and the inner faces of bands 27 resiliently urge shutters 51 to seat closely on ring 24 but without binding on ring 24 as a movement of handle 48 axially positions band 27 and thereby moves all of shutters 51 to similarly and simultaneously adjust the amount of closure of all of air ports 25. It is therefore seen that at any rate at which fuel is being fed to the cumbustion chamber there will be a position of handle 48 at which the desired total amount of secondary air will be fed to the cumbustion chamber and, equally or more important, the distribution of secondary air will be maintained symmetrically about the axis of the burner.

Also it should be noted that by bending and thus positioning vanes 26 the desired amount of air whirl for the particular installation can be established and then will remain as set.

As a typical environment for our secondary air control we show in Fig. 1 in skeleton outline and section a combination heavy oil or gas burner of a type with which we have found our air control to be successfully and valuably used. Secured to plate 23 by cap screws (not shown) is a burner mounting plate 53 into which is mounted a fuel gas manifold 54 which also forms part of the cone structure through which the oil burner nozzle is positioned for use. The cone structure is completed by part 55 bolted to manifold 54 as shown. Refractory 56 not only protects parts 54 and 55 from the intense heat of the flame but also aids in forming a desirable venturi-shaped annular throat through which the whirling and uniformly distributed secondary air is controlled as it is injected into the combustion chamber.

Indicated at two positions only but actually closely spaced completely around the fuel gas manifold 54 are gas burner raised ports 57 through which when gas is used for fuel the gas is injected from the gas manifold into the air stream at the entrance to the venturi throat. Gas fuel is supplied to the burner through the pipe connection 58 and hollow gas duct 59 to the interior of manifold 54.

Mounted on burner mounting plate 53 by a special hinge post (not shown) having the desired oil passages therein is the primary air fan housing 60 of the oil burner. This fan housing is part of the main frame of the oil burner and all other parts of the oil burner are carried thereon to swing into and out of burning position therewith on the hinge post above mentioned.

The motor 61 through a V-belt drive protected by belt guard 62 drives the hollow, oil conducting, nozzle shaft of the burner which terminates in the rotary cup atomizing nozzle indicated at 63. Primary air from the primary air fan carried on the nozzle shaft within the housing 60 passes to the combustion chamber within the fan housing extension 64 and the air cone 65 surrounding the nozzle shaft.

The oil feed rate adjustment of the burner is not a part of this invention but the mechanism for synchronizing the air control of our invention with the oil feed rate adjustment is indicated in Fig. 1, where the shaft adapted to be rotationally positioned to control the oil feed rate is shown at 66 with lever 67 secured thereto to rotate therewith. Rotatably carried on shaft 66 is a collar 71 having an arm carrying a stud 70 extending loosely through arcuate slot 68 in lever 67. Collar 71 is then angularly positionable with respect to lever 67 to size the burner to the furnace with which it is used and this position is maintained by wing screw 69 threaded into stud 70 to clamp lever 67 to collar 71.

Shaft 72 journalled in the sides of air duct elbow 16 carried secured thereon a pair of levers 73 whose forked ends are adapted to engage secondary air adjustment handle bar 48 to vary the flow of secondary air to the burner as shaft 72 is turned. Adjustably positioned on shaft 72 are radially slotted levers 74 and 75. Radially positionable along the slots in lever 74 and 75 are pivot carriers 76 and 77 respectively. Shafts 66 and 72 are connected to have simultaneous motion in a desired relation by their connection through lever 67, collar 71, rod 78, knuckle joint 79, rod 80, pivot carrier 76 and lever 74. Similarly reversible control motor 81 has its shaft 82 operatively connected to shaft 72 through lever 83, rod 84, pivot carrier 72 and lever 75. It is seen therefore that the supply of fuel and secondary air is synchronously controlled in a preset relation in accordance with the operation of motor 81 which in turn is controlled by a means (not shown) which is responsive to the heat supply requirement of the furnace. Also similarly but not shown the gas fuel supply to the burner is controlled by a gas supply line valve similarly linked to shaft 72.

Having thus recited some of the objects of our invention, explained the need for and use of our invention, described a preferred form of our invention, and illustrated its adaptation to a typical environment for which no mechanism of the previous art has been so well adapted, we claim:

1. In combinaton, a combustion chamber, a fluid fuel burner adapted to inject a fluid fuel into said combustion chamber in a conical stream, means for supplying combustion air to said combustion chamber at a rate varying to maintain a preset relation of fuel and air supplied to said combustion chamber, said means comprising an annular plenum chamber for combustion air to be supplied to said combustion chamber, a cylindrical partition coaxial with said burner separating said plenum chamber from said combustion chamber, said partition being formed with a plurality of air port openings therethrough, said openings being equally spaced around said partition in an annular band normal to the axis of said burner, a cylindrical shutter band surrounding said partition and

radially spaced therefrom, a plurality of shutters for said openings spaced around said partition between said partition and said band, means for moving said band coaxially of said partition, means cooperatively formed on said shutters and said shutter band radially slidable individually to support said shutters on said shutter band as said shutter band is moved, a plurality of resilient means interposed respectively between each of said shutters and said shutter band to press each of said shutters onto said partition adjacent one of said openings and means adapted to move said band axially of said burner to vary the amount of closure of said openings by said shutters as the amount of fuel supplied to said combustion chamber is varied.

2. In combination a supply means for fluid under pressure, a cylindrical conduit for said fluid, and means for supplying said fluid to the interior of said conduit, said means including means for maintaining a desired distribution of said fluid as said fluid is supplied to the interior of said cylindrical conduit as the total fluid supplied is varied in response to the change of a condition, said last mentioned means comprising an annular band on said cylindrical conduit formed with a plurality of circumferentially spaced holes therethrough, the individual sizes of said holes and the angular spacing of said holes about the axis of said band being selected to give said desired fluid distribution at one rate of total fluid flow, means for maintaining said fluid at a required pressure at the outside ends of said holes, a plurality of shutters formed slidably to fit the outer surface of said band at said holes, each of said shutters being positioned over a respective one of said holes, a ring operator for all of said shutters, said ring being concentrically positioned and radially spaced outwardly of said band, individual means radially slidably supporting each of said shutters on said ring, individual resilient means interposed between each of said shutters and said ring to bias said shutters individually towards the surface of said band, means for moving said ring coaxially with respect to said band in response to said change of said condition whereby at every position of said ring each of said shutters will simultaneously be positioned approximately to maintain the fluid flow through its associated hole at a pre-set ratio to the total flow through all of said holes.

3. In a fluid fuel burner having a plenum chamber for secondary air under pressure and a combustion chamber a cylindrical section forming part of a partition therebetween, said cylindrical section being perforated by a plurality of secondary air inlet openings into said combustion chamber from said plenum chamber, the combination therewith of secondary air control means comprising a plurality of shutters each respectively formed slidably to seat on said cylindrical section over a respective one of said openings, a shutter ring radially spaced about said cylindrical section coaxially therewith, individual means slidably supporting each of said shutters for radial movement between said ring and said cylindrical section, individual means interposed between said ring and each of said shutters individually biasing each of said shutters toward said cylindrical section and means for moving said ring axially of said cylindrical section proportionately to vary the closure of said openings by said shutters.

4. Means forming an outer space and an inner space separated by means comprising a cylindrical band perforated by a plurality of openings into said inner space from said outer space, a plurality of shutters slidably seated on said band at each of said respective openings, a shutter ring radially spaced about said shutters coaxially with said band, a plurality of individual supporting means slidably supporting said respective shutters on said ring for radial movement between said ring and said band, a plurality of individual resilient means respectively biasing each of said shutters toward said band, together with means supporting said ring for coaxial movement with respect to said band simultaneously and similarly to change the linear coverage of each of said openings by a respective one of said shutters.

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