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FORCED AIR DRAFT BURNER CONSTRUCTION

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2 Sheets-Sheet 1

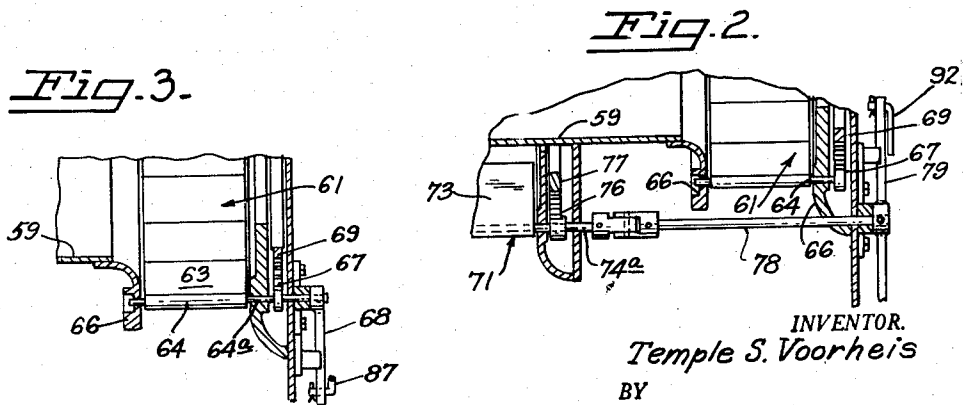
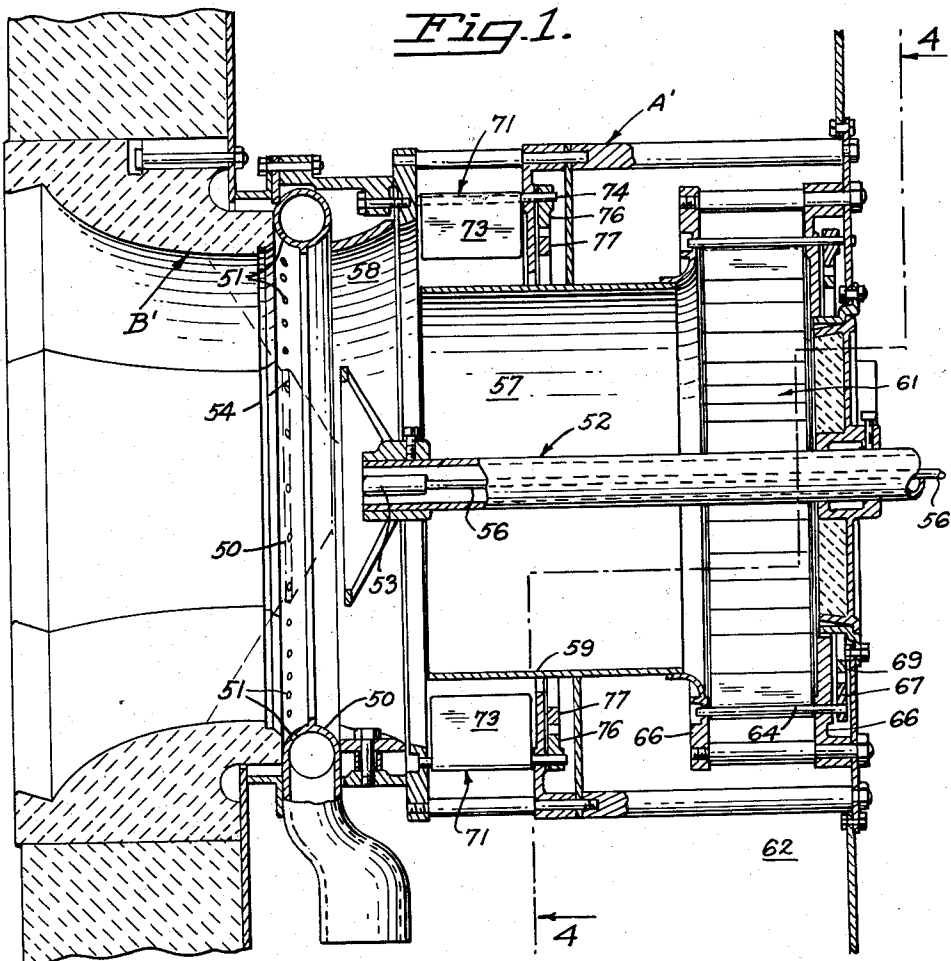
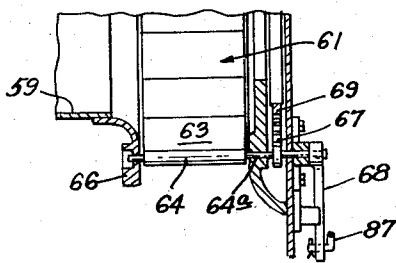


Fig. 3.



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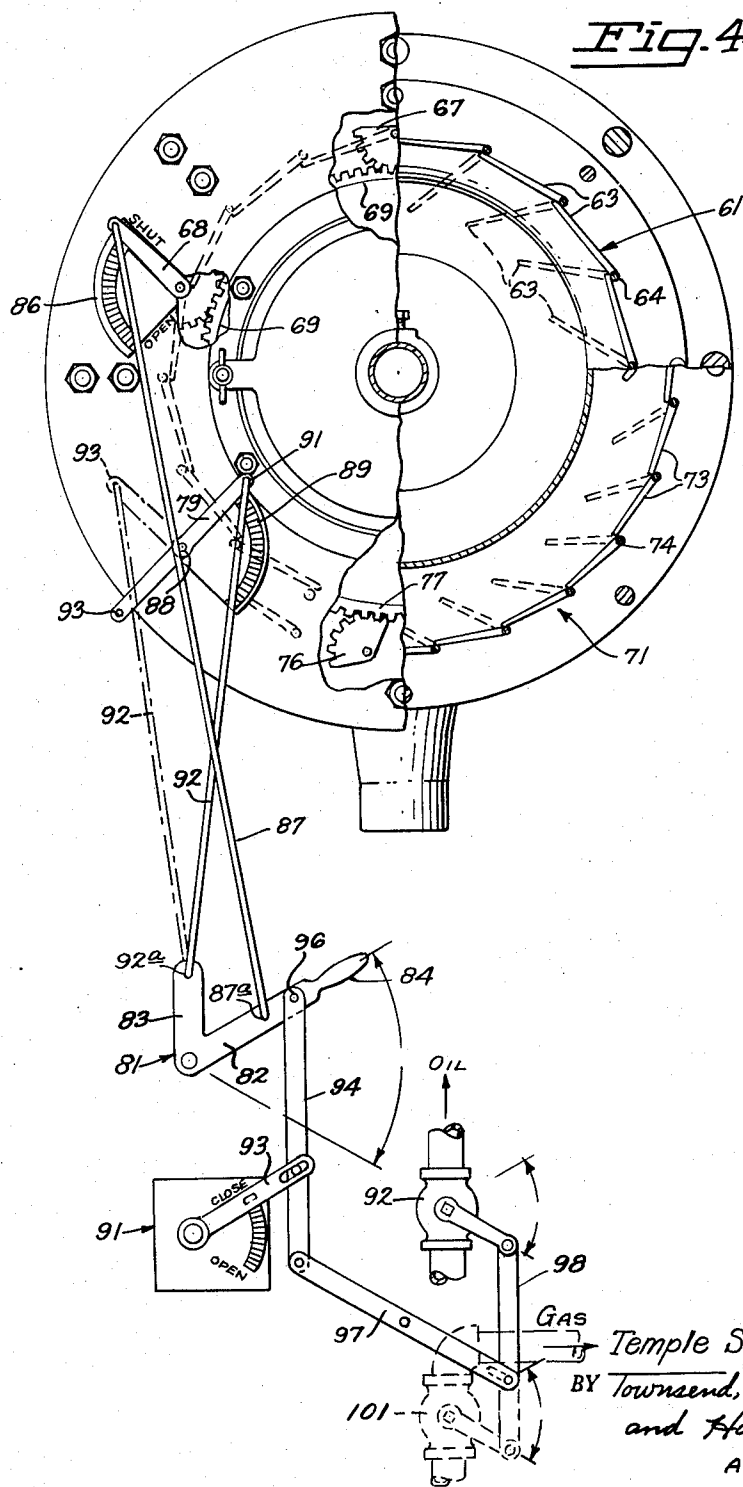
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FORCED AIR DRAFT BURNER CONSTRUCTION

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2 Claims. (Cl. 158—11)

This invention relates generally to the art of forced draft gas and oil burners.

The embodiment of the invention illustrated in the drawings and to be described in more detail hereinafter relates to a convertible oil and gas burner which is designed to alternatively burn oil or gas. In this embodiment, the burner incorporates an annular gas ring and also an oil spray assembly operable to introduce an atomized conical oil spray into the combustion chamber throat when the burner unit is operated on oil instead of gas. The air supply system of the embodiment also comprises first and second concentric air passages operable to introduce into the combustion chamber two concentric air streams. However, adjustable register control means are provided to regulate the swirl characteristics of air flowing through both said air passages. More specifically, the inlet side of the first air passage is in communication with the outlet side of an adjustable louver type register which is operable to impart a clockwise swirling motion to air passing therethrough. The inlet side of the second passage is also in communication with the outlet side of a second air register which is adapted to impart a counterclockwise swirl to air flowing therethrough and through the second passage. Thus, the concentric air streams from the first and second passages may be introduced into the combustion chamber in counter-swirling directions, and the relative swirl of each stream may be variably regulated through operation of the two air registers respectively associated with said first and second passages.

A central control station is provided for simultaneously regulating and controlling both the fuel and air supply systems in proper relation to one another depending upon the type of fuel used and the firing rate at which the burner is operated.

A more specific object is that the central control station is so constructed as to permit operation of the two air registers in a substantially reverse manner when operating on oil than when operating on gas.

Other numerous objects and advantages of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings in which similar characters of reference represent corresponding parts in each of the several views.

In the drawings:

Fig. 1 is a fragmentary, longitudinal, sectional view of a convertible oil and gas burner embodying the invention and shown operably positioned relative to a combustion chamber throat.

Fig. 2 is a fragmentary sectional view of one air register control.

Fig. 3 is a fragmentary sectional view of the second air register control.

Fig. 4 is a sectional view taken substantially on section line 4—4 of Fig. 1, showing certain parts broken away, and showing substantially schematically a central fuel and air supply control mechanism.

Referring now more particularly to the drawings, the

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reference character A' indicates generally a convertible oil and gas burner unit and the reference character B' indicates the combustion chamber throat in association with the burner A'. The unit A' incorporates a gas ring 50 formed with jet openings 51 for introducing discrete streams of gas in a direction generally endwardly and radially across the throat opening B'. The burner unit further incorporates an oil spray assembly indicated generally at 52 and which may comprise a conventional spray nozzle tip 53 for introducing into the throat a conical oil spray, as indicated by phantom lines 54. The spray tip communicates via oil feed lines 56 to a conventional mechanical or steam atomizing unit (not shown) located exteriorly of the burner housing. The construction and operation of the oil spray assembly 52 may, as in the case of the gas ring assembly 54, be considered substantially conventional in construction and operation and, accordingly, the same does not per se constitute a part of the present invention. It will suffice to remark that the burner unit is adapted to operate alternatively on either gas supplied via ring 50 or on oil sprayed from assembly 52 in accordance with well understood practices in the art.

The air supply system incorporated in the burner unit comprises two concentric air passages 57 and 58, respectively, both disposed in coaxial alignment with the chamber throat opening B'. Air passage 57 is defined by an air tube 59 of smaller diameter than the throat opening and has its inlet side in communication with the outlet side of a substantially conventional adjustable louver type air register 61—the inlet side of the air register being in flow communication with the windbox 62. Air register 61 comprises a plurality of air vanes 63 each pivotally supported on an axle 64 journaled between mounting plates 66. Mounted on each axle 64 is a gear segment 67 in mesh engagement with a ring gear 69 by virtue of which simultaneous opening and closing of the air vanes 63 is accomplished. One of the vane mounting axles indicated at 64^a in Fig. 2 is extended rearwardly through the rear wall of the burner housing and to which is keyed a control lever 68.

The second air passage 58, also in communication with the windbox 62, is defined by the outer circumference of air tube 59, annular adjustable louver type air register 71, and an annular partition 72 of larger diameter than the aforementioned air tube 59. The air register 71 is mounted on and circumferentially surrounds air tube 59. Register 71 comprises a plurality of air vanes 73 pivotally supported on axles 74 to each of which is keyed a gear segment 76 in mesh engagement with a ring gear 77. One of the axles 74^a (see Fig. 3) is utilized as a control shaft for operating the ring gear. As shown in Fig. 2, said axle 74^a is provided with an extension 78 which also projects through the rear wall of the burner and to which is affixed a control lever 79.

It is noted that the air vanes 63 of register 61 when in fully closed position (as shown in full lines in Fig. 4) overlap one another in a direction opposite to the overlapped position of vanes 73 of register 71 when in fully closed position. Accordingly it is seen that registers 61 and 71 will function to impart a counter-rotating swirling motion to the two streams of air which pass respectively through said two registers and through air passages 57 and 58, respectively.

It is important to introduce the two concentric air streams into the throat opening in such manner that the discrete streams of gas from the gas ring are permitted to penetrate into the air mass a sufficient distance to insure proper and thorough admixing of air and gas within the combustion chamber throat and to prevent the unignited gas from being swept down the walls of the

throat into the furnace. In accomplishment of this end, it is desirable to introduce the outer concentric stream of air into the chamber in a substantially straight line and non-swirling path of movement—particularly during the cycles of ignition and initial combustion when the throat and furnace temperatures are low. As will be seen, when the convertible burner unit is operated on gas, the two air registers 61 and 71 can be controlled so as to introduce the inner stream of air from the air tube with a high degree of swirl and to introduce the outer stream of air through passage 58 with practically substantially no swirl during the cycles of ignition and initial combustion.

When burning oil, it is important to control the air supply in quite a different manner. It is noted that whereas the gas streams are emitted from the gas ring radially inwardly toward the center of the combustion chamber throat, the oil spraying from nozzle 53 is directed generally radially outwardly toward the walls of the combustion chamber throat. It has been found that to insure diffusion of the oil particles into proper combustible mixture with the air mass within the chamber throat (particularly large diameter throats), it is important to impart a very high degree of swirl to the outer concentric air stream flowing through passage 58. At the same time, it is also desirable to maintain a relatively high degree of swirl in the inner air stream flowing through air tube 59. As above explained, the direction of swirl imparted to air flowing through register 71 and passage 58 is counter-rotational to the direction of swirl imparted to air flowing through register 61 and air tube 59. As a consequence, a maximum scrubbing action between the concentric air streams is obtained, particularly during the cycle of ignition and initial combustion when both of the air registers 61 and 71 are started in substantially fully closed position with the air vanes of each register overlapping one another as shown in full lines in Fig. 4.

Fig. 4 also discloses, more or less schematically, a single or unitary manual control assembly for simultaneously controlling the air and fuel supply systems of the convertible burner when operated on either oil or gas. Preliminarily, it is noted that certain parts or linkages in the system are shown both in full lines and in phantom lines. These parts as shown in full lines illustrate their arrangement within the system when the burner unit is operated on gas, whereas the same parts as shown in phantom lines illustrate their arrangement in the control system when the burner unit is operated on oil.

The control system comprises a pivotally supported bell crank 81 defining perpendicularly disposed crank arms 82 and 83. Master control lever 84 is formed as an extension of crank arm 82. Previously designated operating lever 68 associated with register 61 is adapted to swing relative to quadrant 86 from "shut" toward "open" position as indicated. The outer end of lever 68 is connected to bell crank arm 82 by a connecting rod 87. Control lever 79 (also previously designated) for operating air register 71 is centrally pivoted at 88 relative to a quadrant 89 and is also movable from "shut" to "open" position as indicated.

When the burner is to be operated on oil, inner end 91 of lever 79 is connected to bell crank arm 83 by connecting rod 92 as shown in full lines. Hence it is seen that when master lever 84 is moved from its shut toward open position as indicated by the directional arrows, both the air register control levers 68 and 79 are correspondingly moved from their respective shut to open positions. Master control lever 84 is also linked to the inlet air damper (shown schematically at 91) and the oil feed valve regulator (indicated schematically at 92). More specifically, the damper control lever 93 is pivotally connected to link arm 94 which latter element is pivoted as at 96 to master control 84. Link arm 94 is connected to oil feed valve regulator 92 by additional

link elements 97 and 98. As shown in Fig. 4, when the master control arm is moved from shut toward open position, the components linking control 84 to the damper and oil feed regulator move correspondingly as indicated by the directional arrows. As a consequence, the damper is moved from closed toward open position thereby admitting a greater volume of air into the windbox, while the oil valve is also progressively opened to supply a greater volume of oil through supply tip nozzle 53.

From the above described control system provided when the unit is operated on oil, it is apparent that when the burner is started during the ignition cycle, both of the air registers 61 and 71 are initially operated at substantially fully closed position whereby the overlapped air vanes of each impart a maximum swirl in counter-rotating directions to the two concentric air streams flowing through passages 57 and 58. As explained earlier, it is important that the outer concentric air stream be introduced into the burner throat at maximum swirl, particularly during ignition and initial combustion when operating on oil to insure rapid and efficient diffusion of the oil particles in proper admixture with the air relatively high up in the combustion chamber throat where the flame front should be anchored. It is also apparent that as the master control lever is moved progressively further toward open position, the vanes 63 of register 61 will be caused to open at a relatively more rapid rate than the opening of vanes 73 of register 71. This is because the pivotal connections 87^a and 92^a for the air register control rod are angularly displaced relative to one another adjacent the outer ends of bell crank arms 82 and 83 respectively. Thus, the total vector movement of rod 87 tending to open register 62 through any predetermined arcuate movement of master control 84 will be substantially greater than the total vector movement of control rod 92 tending to open register 71. As the firing rate increases, air flowing through register 71 and passage 58 will for a substantial interval continue to be introduced at maximum swirl, whereas during the same interval the vanes of register 61 will have opened considerably farther, and air flowing therethrough will enter the chamber throat with increasingly lesser swirl than air entering from passage 58. However, after the master control lever has been moved through approximately one-half of its arc from shut toward open position, continued movement of said lever toward open position will impart maximum vector movement tending to open the vanes of register 71 and will correspondingly impart a lesser vector opening movement to control rod 87 associated with register 61. Consequently, it is seen that when the master control lever has been moved to its substantially fully open position, both of the air registers will have also been operated to their maximum open positions; and so also will the air damper control and oil feed valve regulator have been moved to their respective maximum open positions.

When the burner is operated on gas, the same master control system described above with reference to oil burning operations is utilized except that the control rod 92 is pivotally attached to end 93 of lever 79 of register 71. Additionally, link arm 98 is disconnected from the oil feed valve regulator 92 and is connected instead to the gas feed valve regulator indicated schematically at 101. By this arrangement it is seen that when operating on gas, the component elements of the master control system will operate substantially the same as described relative to oil burning operations except that the register 71 will be started at substantially fully open rather than fully closed position, and as the master control lever 84 is moved progressively from shut toward open position, the vanes of said register 71 will be caused to progressively close. This mode of air register control is consistent with obtaining the desired type of air flow characteristics within the combustion chamber as ex-

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plained previously. More specifically, when burning on gas, it is desirable to introduce the outer concentric stream of air into the chamber throat in a substantial straight line, non-swirling path of movement to permit the gas stream to penetrate the air mass a substantial distance without prematurely being swept down the walls of the chamber throat into the furnace. Thus, by starting air register 71 in fully open position, comparatively little swirl is imparted to the outer concentric stream flowing from passage 58 into the chamber. However, as the master control 84 is opened further and as the firing rate increases through introduction of a proportionately greater volume of fuel and air, the air register 71 will be caused to progressively close and air flowing from passage 58 will have imparted to it a correspondingly greater amount of swirl. At the same time register 61 will have been caused to open at a substantially more rapid rate than the gradual closing of register 71 because of the difference in vector movement imparted to the control shafts 87 and 92 as hereinabove explained. It has been found that the ability of discrete streams of gas from the gas ring to penetrate the outer concentric streams of air increases as the firing rate increases and as the temperature within the combustion chamber rises. This appears to account for the reason why it is not disadvantageous to increase the swirling characteristics of the outer stream flowing through register 71 as the firing rate of the burner is increased. It is also noted that the two air streams flowing through registers 61 and 71 will always swirl in counter-rotating directions whereby a desired scrubbing action between the two streams will be created. As already explained, the relative scrubbing action constantly occurring between the two streams has a pronounced advantageous effect in enhancing the break-up and diffusion of fuel particles throughout the air stream mass relatively high up in the combustion chamber throat.

Although the present invention has been described in some detail by way of illustration and example for purposes of clarity of understanding, it is understood that certain changes and modifications may be made within the spirit of the invention as limited only by the scope of the claims appended hereto.

I claim:

1. In a convertible oil and gas burner construction of the type incorporating a gas ring disposed coaxially adjacent a combustion chamber throat opening operable to introduce discrete gas streams into said throat generally radially inwardly toward the center thereof, and an oil nozzle disposed coaxially with said throat opening alternatively operable to inject a conical spray of oil generally outwardly toward the walls of the burner throat,

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the improvement comprising: means including a circular, adjustable, air-vane type register mounted coaxially and rearwardly of said gas ring operable to direct a first air stream into said throat opening of smaller cross-sectional area than the cross-sectional area of said throat opening; means including an annular, adjustable, air-vane type register mounted coaxially and rearwardly of said gas ring operable to direct an annular second air stream into said throat opening concentrically sheathing said first air stream; the set of air vanes of said circular air register and the set of air vanes of said annular air register when in closed position overlapping one another; the set of vanes of said circular register overlying one another in a direction opposite to the direction of overlapping of the set of vanes of the annular register whereby the respective air streams discharged from said two registers are caused to swirl in counter-rotating directions; first operating means for simultaneously opening and closing the vanes of said circular air register; second operating means for simultaneously opening and closing the vanes of said annular air register; a master control means movable from first to second positions; first and second linkage means for respectively connecting said first and second operating means to said master control means; said linkage means being so connectable to said master control means in a first arrangement of operation for burning oil whereat movement of said master control from its first to second arrangement will cause the vanes of both said registers to open simultaneously; said linkage means being so connectable to said master control means in a second arrangement of operation for burning gas whereat movement of said master control from its first to second arrangement will cause the vanes of said circular register to open while simultaneously closing the vanes of the annular register.

2. The combination of claim 1 and wherein said first and second operating means each comprises a pivotally supported lever control arm; and wherein said first and second linkages each includes a link arm connected at one end to said master control means; and means whereby one end of one of the linkage means is alternatively connectable to opposite sides of the pivotal axis of one of the control lever arms.

References Cited in the file of this patent

UNITED STATES PATENTS

1,754,433	Peabody	Apr. 15, 1930
2,271,587	Haynes	Feb. 3, 1942
2,439,554	Anderson	Apr. 13, 1948

FOREIGN PATENTS

599,163	Great Britain	Mar. 5, 1948
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