Sept. 25, 1962 D. M. MARSHALL 3,055,416

FLAME DETECTOR ARRANGEMENTS

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FIG. 1

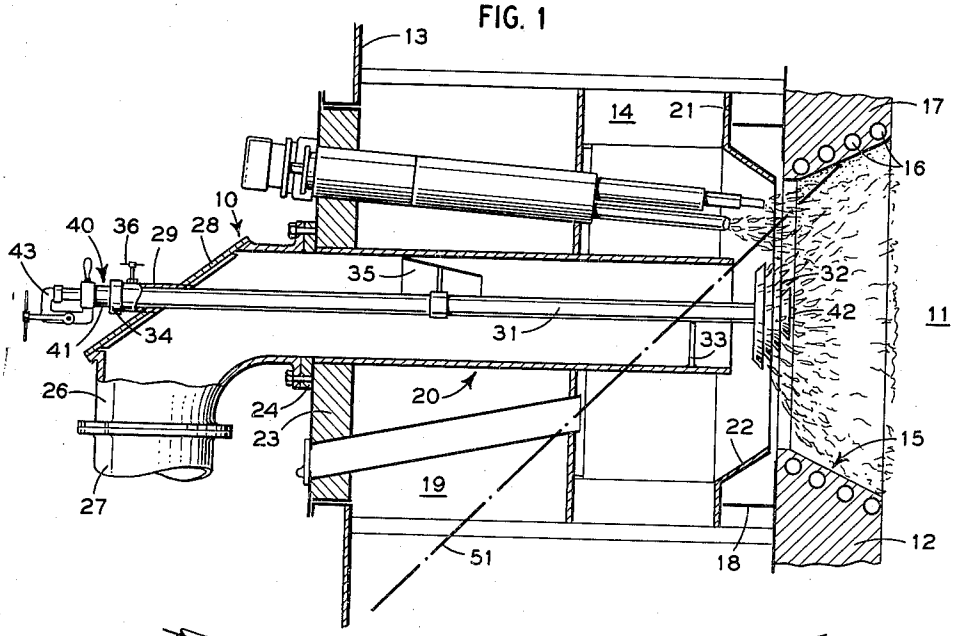



FIG. 2

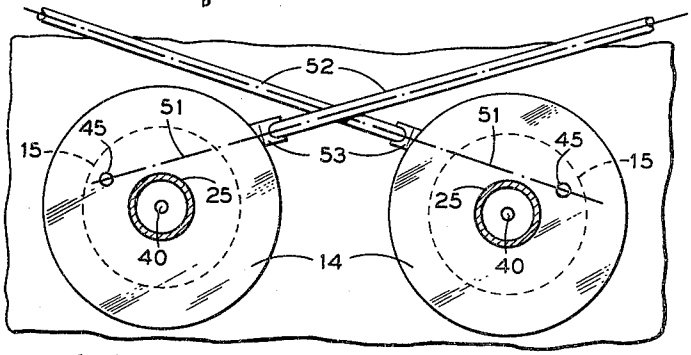
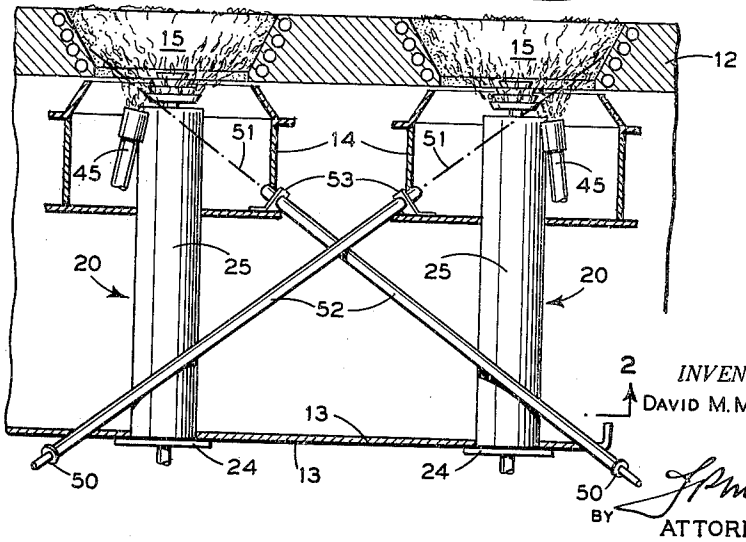



FIG. 3




2

2

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# FLAME DETECTOR ARRANGEMENTS

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10 Claims. (Cl. 158—28)

This invention relates to fuel burners and, more particularly, to a novel flame detector disposition for each individual burner of a multiple burner installation.

Flame detectors are used with furnace fuel burners as a safety device to prevent an explosive accumulation of a combustible mixture in the furnace, as may occur if a burner loses its ignition while still discharging fuel into the furnace. Should the fuel supply not be interrupted quickly upon flame failure, subsequent re-ignition of the burner may result in explosive combustion of the unburned combustible mixture discharged into the furnace.

The flame detector keeps a constant watch over the burner and, should the flame fail, the detector activates an alarm, or automatically shuts off the fuel flow, or preferably performs both functions.

The main fuel burners of furnaces are provided with igniter burners, generally burning oil or gas, which are lit before fuel is supplied to the main burner in order to assure ignition of the combustible mixture discharged from the main burner. Such igniters are normally maintained in operation for a sufficient time to assure stable ignition of the main burner.

Such flame detectors are preferably mounted so as to be responsive not only to the main burner flame but also to the igniter flame. Thus, the flame detector may be arranged to permit fuel flow to the main burner whenever there is a flame present, whether from the igniter or from the main burner, and to interrupt the fuel flow when there is no flame present at either the igniter or the main burner.

The larger sized furnaces are fired by two or more burners grouped together and each firing through its own individual burner port having a burner throat of refractory material, opening into the furnace. The throat may be water cooled. For example, the firing arrangement for a large capacity furnace may include 6, 8 or more burners grouped together.

In such multiple burner installations, it is difficult, if not impossible, for the flame detector of any individual burner to detect when the flame of its particular burner and/or lighter goes out, due to the presence of flame from the adjacent burners giving a false indication to such flame detector. If the burners are very closely spaced, this may not create a dangerous situation, as the individual burner may be re-ignited by the flames of adjacent burners.

However, if the burners are more widely spaced, and, in certain circumstances, even if they are closely spaced, a dangerous condition is created due to the continued discharge of a highly combustible mixture into the furnace without burning. As the unburned mixture accumulates in the furnace, it eventually will be ignited from the flames of the other burners with explosive effects.

In view of the foregoing conditions, many attempts have been made to provide flame detector arrangements which are responsive only to the presence or absence of a flame at the individual burner monitored thereby. Such arrangements, however, have not been practically successful when applied to multiple burner installations, particularly those involving a relatively large number of burners supplying a single furnace.

In accordance with the present invention, a flame detector arrangement for a multiple burner installation is provided in which the flame detector for each burner unit is so oriented that its line of sight extends across the corresponding igniter flame and terminates in the peripheral surface of the individual burner throat communicating with the furnace. It has been found that a flame detector having its line of sight oriented in this manner to terminate in the surface of the burner throat of its individual burner is responsive only to the presence or absence of a flame from the igniter monitored by the flame detector, and is not affected by the presence or absence of flames at adjacent burner units or in the furnace.



For an understanding of the invention principle, reference is made to the following description of a typical embodiment thereof as illustrated in the accompanying drawing.

FIG. 1 is an axial sectional view through a burner unit forming part of a multiple burner assembly and incorporating the flame detector arrangement of the invention;

FIG. 2 is essentially a sectional view on the line 2—2 of FIG. 3 with certain parts being omitted for clarity of illustration, and this figure illustrates a pair of adjacent burner units of the assembly to further delineate the orientation of the flame detectors; and

FIG. 3 is a horizontal sectional view corresponding to FIG. 2.

Referring to the drawing, the flame detector arrangement is illustrated as incorporated in a furnace firing arrangement involving a plurality of burner units grouped to fire a single furnace. While the firing arrangement may include a group of fifteen or more burner units, only two adjacent units are illustrated as being adequate to exemplify the principles of the invention without unduly complicating the disclosure.

By way of example only, the burner units 10 are illustrated as of the multiple fuel type arranged for firing the furnace 11 with either pulverized fuel or oil. Thus each unit 10 comprises a pulverized fuel burner 20 and a liquid fuel atomizer or burner 40 coaxially arranged, with the unit being coaxial with a burner port 15 in the wall 12 of furnace 11. Burner port 15 is illustrated as having a water-cooled throat, exemplified by tubes 16, covered by refractory 17, and forming part of the fluid circulating tubes associated with furnace 11. However, the principles of the invention are applicable equally where the burner throat is not water cooled and merely refractory lined.

A partition or wall 13 is spaced from the outer surface of furnace wall 12 to form the outer wall of a windbox 19 supplied with air under superatmospheric pressure by a forced draft fan or the like. The air supply to each burner unit is controlled by means of a circular air register 14, of known construction, mounted concentrically of burner port 15, a casing 18 being disposed between the inner wall 21 of register 14 and furnace wall 12. Air from windbox 19 is controllably supplied to the fuel burners by means of adjustable louvers or doors in the register periphery, the air being directed through port 15 by an inwardly converging throat cone 22. An insulated circular register cover 23 is removably mounted in an opening in windbox wall 13 in alignment with register 14 and port 15.

Pulverized fuel burner 20 comprises a relatively large diameter pipe or nozzle 25 having a flange 24 on its outer end. Nozzle 25 extends axially through door 23 and register 14, and slightly into throat cone 22. An elbow 26 is bolted to flange 24 and has a fuel supply pipe 27 connected to its other end for delivery of an air-borne stream of pulverized fuel to burner 20.

The outer side of elbow 26 has a removable cover 28 with a wear plate on its inner surface. Cover 28 has a

boss 29 extending outwardly therefrom coaxial with nozzle 25, and boss 29 slidably receives an impeller regulating pipe 31 carrying an impeller plate 32 on its inner end. Pipe 31 is concentrically supported in nozzle 25 by pins or studs 33 extending radially from the inner surface of the nozzle. The impeller pipe and impeller 32 are adjustable axially of nozzle 25 by a handle 34 and locked in adjusted position by a T bolt 36 in boss 29. A conical pulverized fuel distributor 35 is mounted on pipe 31 intermediate its ends, and converges inwardly toward impeller 32.

The liquid fuel burner 40 comprises a mechanical atomizer including a distance piece 41 extending through pipe 31, an atomizer tip 42, and a handle assembly 43 connected to a source of liquid fuel such as fuel oil. Tip 42 is located just beyond the inner end of impeller plate 32 to deliver a whirling spray cone of liquid fuel and air through port 15 into furnace 11.

The burners 20 and 40 are lit by means of an oil atomizer igniter 45 extending through door 23 and into register 14. Igniter 45 includes a supporting housing 44 from which project an atomizer 46 and an electrode arrangement 47 arranged to provide a spark to ignite the combustible mixture discharged from atomizer 46. The igniter extends toward the discharge ends of burners 20 and 40 so that the flame from the igniter will light the fuel and air mixture discharged from either burner. The presence of a flame from igniter 45 assures ignition or re-ignition of the combustible mixture discharged from burners 20 or 40.

If the flame from igniter 45 should fail, a hazard is created should the flame from the then operating burner 20 or 40 fail. The continued discharge of the combustible mixture into the furnace results in an explosion hazard when the burner is re-ignited either by igniter 45 or by the flames from adjacent burner units. It is therefore important to maintain a constant observation of at least igniter 45 to check the presence or absence of a flame thereat. Flame detectors are used for this purpose but, as hitherto installed, have been unable to distinguish between the flames of adjacent burners.

In accordance with the present invention, the presence or absence of a flame at the igniter 45 of any individual burner unit is detected without interference from the flame from any other burner unit by mounting a photo cell type flame detector 50, i.e. a "Firetron" detector or the like, in such a manner that its line of sight extends across at least the flame from the igniter monitored thereby and terminates in throat 15. The "Firetron" detector, referred to above, includes a photo conductive cell highly responsive to infra red and also circuits which distinguish between a flame and other sources of radiation, such as reflected light or glowing refractory. By mounting or orienting the flame detector 50 so that its line of sight 51 terminates in throat 15, the flame detector responds only to the presence or absence of an igniter flame it its particular unit 10, and is not affected by the glowing refractory of the given throat or by the presence or absence of a flame at any other burner unit 10.

Each detector 50 is mounted at the outer end of an elongated small diameter pipe 52 supported in wall 13 and register 14. A bracket 53 supports the inner end of pipe 52 on the frame of the register. Pipe 52 is disposed angularly to the axis of burner unit 10 and so oriented that the extension of its axis crosses the extension of the axis of igniter 45 and intersects the pilot flame from the igniter 45.

Should the pilot or igniter flame fail, the flame detector, through suitable known automatic controls, interrupts the supply of fuel to the igniter burner. The flame detector responds only to a flame at its individual burner unit 10, and will not permit continued fuel flow thereto if there is no igniter flame even though there is a flame in the furnace or at other burner units of the firing arrangement.

FIGS. 2 and 3 show one practical way of mounting the flame detectors for adjacent burner units 10 so as not to interfere with each other. The flame detectors herein referred to as "Firetron" are manufactured by Combustion Control Corp. of Boston, Mass, and publicized in its bulletin CP 511.

Tests have indicated that the termination of the line of sight of the detector in throat 15 provides full discrimination between burners, which is not possible where the detectors are so mounted as to sight on a spot other than the burner throat.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the invention principle, it will be understood that the invention may be embodied otherwise without departing from such principle.

This application constitutes a continuation of now abandoned application Serial No. 536,563 filed September 26, 1955.

What is claimed is:

1. In combination, a furnace having a wall formed with a burner port extending therethrough between the inner and outer faces thereof and bounded by a port surface, a fuel burning means constructed and positioned with respect to said wall so as to provide a flame in said port during normal operations thereof, and a flame detector capable of distinguishing a flame from other sources of radiation, said detector being associated with said fuel burning means to detect the presence or absence of a flame thereat, said detector being positioned and oriented so that the line of sight of said detector intersects the flame of said fuel burning means and terminating in said port outwardly of the inner face of the furnace wall.

2. In combination with a furnace having a wall formed with a burner port bounded by a surface extending through the wall between the inner and outer faces thereof and a fuel burning igniter constructed and positioned to provide an igniting flame in said port, a photo cell type flame detector aimed at said flame and capable of distinguishing a flame from other sources of radiation, said detector being aimed so that its line of sight intersects the flame of said fuel burning igniter and terminates in said port surface outwardly of the inner face of the furnace wall.

3. In combination, a furnace having a wall formed with a burner port bounded by a surface extending between the inner and outer faces of said wall, a main fuel burner constructed and positioned to fire through said port, a fuel burning igniter positioned to provide a flame in said port so as to ignite the flame of said main burner, a flame detector for sensing the presence or absence of the igniter flame and capable of distinguishing said igniter flame from other sources of radiation, said detector being aimed so that its line of sight intersects the flame of said fuel burning igniter and terminates in said surface of said port outwardly of the inner face of the furnace wall.

4. In combination, a furnace having a wall formed with a burner port bounded by a surface extending through said wall between the inner and outer faces thereof, a main fuel burner constructed and positioned to fire through said port, a fuel burning igniter positioned to provide a flame in said port in igniting relationship to said main fuel burner, a flame detector capable of distinguishing a flame from other sources of radiation, said detector having a line of sight aimed to intersect with the flame of said fuel burning igniter only, and said line of sight terminating in said port surface outwardly of the inner face of the furnace wall.

5. In combination, a furnace wall having a plurality of spaced burner ports extending therethrough, each of said ports being defined by a surface extending between the inner and outer face of said wall, a plurality of main fuel burners, one of said main fuel burners being constructed and positioned to fire through one of said ports, a fuel burning igniter positioned adjacent each of said main burners, each of said igniters being positioned to

provide a flame in its respective port to ignite the adjacent burner, said ports being spaced one from the other in a proximity with respect to one another wherein the flame of an igniter flame within one of said ports is likely to be visible on a line of sight extending through an adjacent burner port, a plurality of flame detecting means, each of said flame detecting means being arranged to monitor only the flame of its respective fuel burning igniters, each of said flame detector means being positioned so as to have its respective line of sight intersecting the flame of its respective fuel burning igniter only to sense the presence or absence of said igniter flame, and the line of sight of each detector terminating in the surface of its respective port at a point intermediate the inner and outer faces of said wall so as to render it impossible for the detector monitoring the flame of its respective igniter to sight through its respective burner port and see the flame of an adjacent igniter.

6. In a multiple burner fired furnace having a wall formed with a plurality of burner ports extending therethrough, each of said ports being defined by a surface extending between the inner and outer face of said wall and a plurality of main fuel burners, each of said main fuel burners being constructed and positioned to fire through its respective port, and a fuel burning igniter positioned adjacent each of said main burners, and each of said igniters providing a flame in its respective port to ignite the flame of an adjacent burner, said ports being spaced in a proximity with respect to one another that the flame of one burner of one port is likely to be visible from an adjacent port on a line of sight extending through said latter port, the improvement comprising a plurality of photo cell type flame detector means, each of said flame detecting means being arranged to monitor only the flame present in its respective burner port, each of said flame detectors means being positioned so as to have its respective line of sight intersecting the flame in its respective port to sense presence or absence of the flame therein, and the line of sight of the respective detectors terminating in the surface of its respective port at a point intermediate the inner and outer faces of said wall so as to render it impossible for the detector monitoring the flame in its respective port to sight therethrough and see the flame of an adjacent port.

7. The invention as defined in claim 6 and including an igniter operatively associated in each of said ports and arranged to provide a flame in igniting position with respect to said main oil burner flame in each of said ports.

8. The invention as defined in claim 1 wherein said fuel burning means comprises an igniter adapted to provide a flame in said port.

9. In a furnace having a wall formed with a plurality of spaced burner ports extending therethrough, each of said ports being defined by a surface extending between the inner and outer faces of said wall, and a plurality of fuel burning means, one of said fuel burner means being associated with one of said ports, each of said burner means being positioned with respect to its respective burner port so as to provide a flame in its respective port, and said ports being spaced one from the other in proximity wherein the flame of a burner means firing in one port is likely to be visible on a line of sight extending through an adjacent burner port, in combination therewith the improvement of a plurality of flame detectors, each capable of distinguishing a flame from other sources of radiation, one of said flame detectors being associated with one of said fuel burner means, and each of said detectors being positioned and oriented so as to have its respective line of sight intersecting in the surface of its respective port at a point intermediate the inner and outer faces of said wall so as to render it impossible for the detector associated with one of said burner means to sight through its respective burner port and see the flame of an adjacent burner means.



10. In a furnace having a wall formed with a plurality of spaced burner ports extending therethrough, each of said ports being defined by a surface extending between the inner and outer faces of said wall, and a plurality of fuel burning igniters one of said fuel burning igniters being associated with one of said ports, each of said igniters being positioned with respect to its respective burner port so as to provide a flame in its respective port, and said ports being spaced one from the other in a proximity with respect to one another wherein the flame of an igniter firing in its respective port is likely to be visible on a line of sight extending through an adjacent burner port, in combination therewith the improvement of a plurality of flame detectors capable of distinguishing a flame from other sources of radiation, one of said flame detectors being associated with one of said igniters, and each of said detectors being positioned and oriented so as to have its respective line of sight intersecting the flame of its respective fuel burning igniter and terminating in the surface of its respective port at a point intermediate the inner and outer faces of said wall so as to render it impossible for the detector asociated with one of said igniters to sight through its respective burner port and see the flame of an igniter firing in an adjacent port.

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