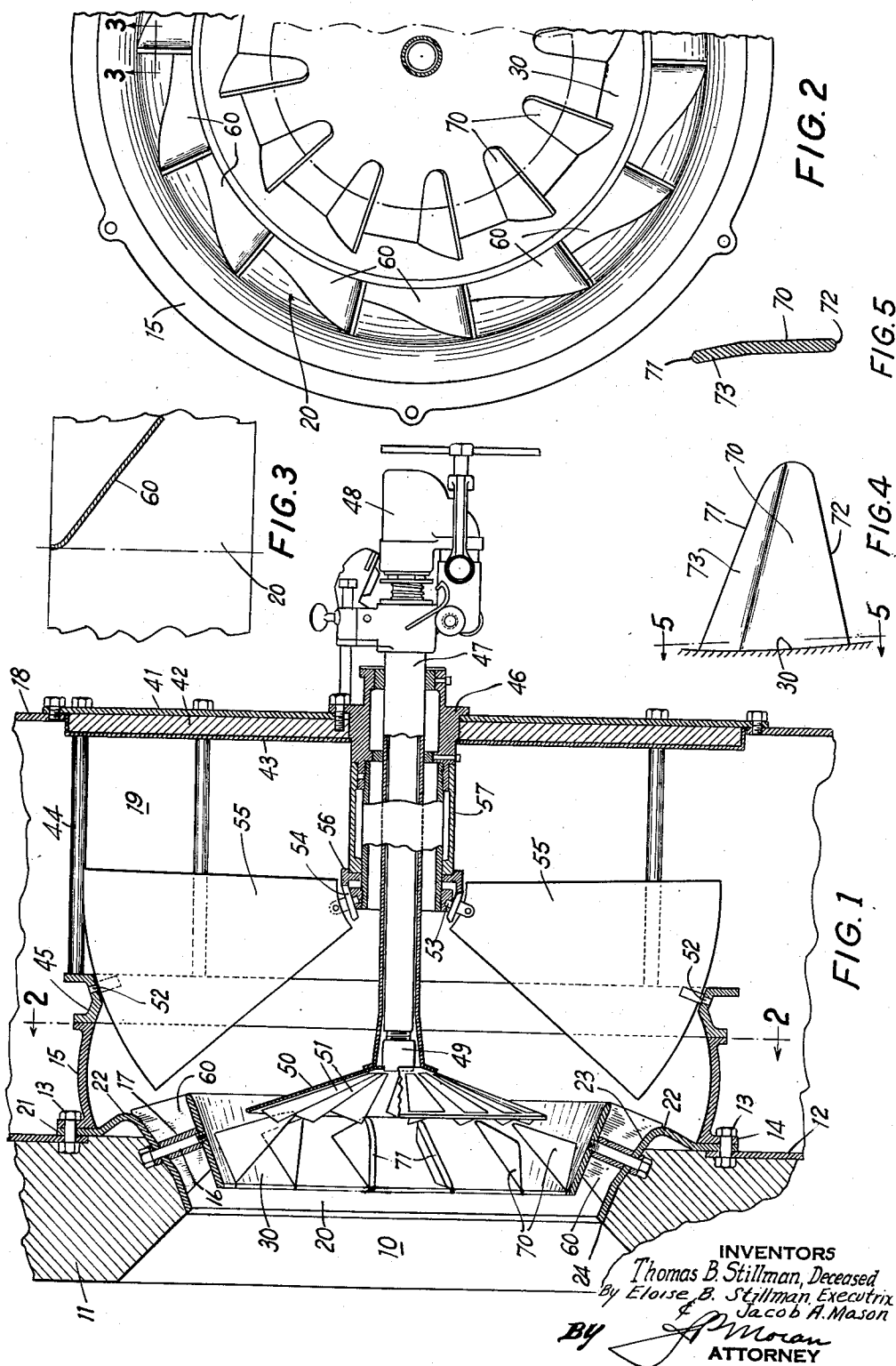


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BURNER THROAT WITH AIR INLET ANNULUS
DEFINED BY INTERNALLY BLADED CONE
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BURNER THROAT WITH AIR INLET AN-
NULUS DEFINED BY INTERNALLY
BLADED CONE

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The present invention relates in general to the construction and operation of fluid fuel burners, and more particularly, to improvements in the construction and the operation of high capacity liquid fuel burners utilizing a conical spray of atomized fuel discharging through a burner port into a swirling stream of air.

This invention is directed to a device, in a liquid fuel burner of the general type described, for directing the flow of combustion air through the burner port in a manner improving the mixing action of the entering fuel and air, and thus facilitating rapid and complete combustion of the liquid fuel. The present invention provides an arrangement for attaining sufficient swirl of the large quantity of combustion air required for high capacity burner operation, so that effective mixing of the entering air with the cone of fuel particles is quickly obtained, thereby promoting ignition and combustion of the fuel. A need for better control of the entering combustion air has developed with increases in burner capacity due to the use of higher fuel supply pressures and more efficient fuel atomizers.

In accordance with the invention, burner port air flow directing means are provided which are an improvement over the internally bladed cone arrangement of Stillman U. S. Patent No. 2,260,062. Specifically an air flow directing means is provided whereby a greater quantity of combustion air may be delivered through the burner port and brought into effective mixing relationship with the atomized oil fuel.

The improvement to the burner of the Stillman patent resides in dividing the combustion air flow through the burner port into two annular concentric streams which may, for the purposes of this description, be termed "primary air" and "secondary air". This division of the combustion air supply is effected by providing two concentric radially spaced specially shaped cone members in the burner port, each provided with a series of specially shaped and arranged vanes imparting a whirling motion in the same angular direction to the combustion air passing through the port.

For a more thorough understanding of the principles of the invention, reference is made to the following description of a typical embodiment of the invention as illustrated in the accompanying drawing.

In the drawing:

Fig. 1 is a part sectional and part elevational view of a liquid fuel burner and an associated burner port air admission arrangement embodying the invention;

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Fig. 2 is an elevation view on the line 2-2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a sectional view on the line 3-3 of Fig. 2, looking in the direction of the arrows;

Fig. 4 is a section through the inner cone illustrating the form of the vanes therein; and

Fig. 5 is a section on the line 5-5 of Fig. 4.

The invention is illustrated as applied to a liquid fuel burner of the type shown in U. S. Patent No. 2,260,062. The burner is mounted in a circular burner port 10 formed in one of the vertical walls 11 of a liquid fuel burning furnace. The port 10 converges inwardly to an intermediate circular throat, and then diverges to the inner or furnace side of wall 11. A metallic port ring 20, substantially shaped as a truncated cone, defines the outer section of the burner port, and has a flange 21 secured to the metal casing 12 of the furnace wall 11 by bolts 13 which also secure the flange 14 of a spool member 15 to the cone 20 and casing 12. A second or inner port ring 30, likewise shaped as a truncated cone, is supported within and in spaced relation to cone 20 by studs 16 extending through tubular spacers 17. Ex-
teriorly spaced from casing 12 is an outer casing 18, the casings 12 and 18 forming a passageway 19 for the flow of pre-heated combustion air from a forced draft fan (not shown) to burner port 10.

A circular cover plate 41 closes an access opening in wall 18 arranged coaxially of and of larger diameter than the burner port 10. Plate 41 is provided with a heat protective covering of insulating material 42 held in place by a metallic sheet 43, and is rigidly connected by struts 44 to the outer circumference of an air register ring 45 carried by spool member 15, the parts 15 and 45 forming a continuation of outer cone 20. The passage 19, with rings 15 and 45, forms a means for directing combustion air through the burner port around the discharge end of the burner nozzle.

Cover plate 41 supports a central hub member 46 through which extends a burner barrel 47 having a fuel supply assembly 48 on its outer end and an atomizer head 49 on its inner or furnace end. The atomizing head 49 is preferably of a type producing a conical spray of atomized liquid fuel with the axis of the spray coaxial with the cones 20 and 30.

Concentrically attached to barrel 47 and exteriorly surrounding the atomizer head 49 is an impeller plate 50 shaped as a truncated cone with the base toward the furnace chamber. The conical surface of impeller plate 50 has a series

of equally spaced air openings and corresponding air deflector plates 51 associated therewith.

A circular series of segmental louver blades 55 are pivotally mounted within the annular space between ring 45 and barrel 47 by pins 52 and 53. The rotational axis of each louver blade is at an oblique angle to the axis of barrel 47, and the blades are adjustable about their axes by means of pinions 54 engaging a ring gear 56 on a rotatable sleeve 57. Sleeve 57 is rotated by suitable external mechanism (not shown), such as shown in said Patent No. 2,260,062, to position the louver blades 55 to control the flow of air from passage-way 19 into cones 20 and 30.

Inner cone 30 defines the primary air passage through the burner port. The secondary air passage is defined by outer cone 20 and inner cone 30. The cones 20 and 30 are provided with special vanes 60 and 70 respectively for imparting a whirling motion to the primary and secondary air streams, the whirling motion being about the axis of burner tube 47 and in the same angular direction as the whirl produced by the impeller deflectors 51.

Outer cone 20 has a reentrantly curved or bulging portion 22 immediately inwardly of and merging smoothly with flange 21. Portion 22 merges into a truncated cone shaped main portion 23 which terminates in a truncated cone shaped portion 24. Portion 24 makes a lesser angle to the burner tube axis than does portion 23, and is substantially parallel to the outer surface of inner cone 30.

Outer cone 20 is preferably cast from a suitable temperature resistant alloy, and has a circular series of symmetrically spaced deflector vanes 60 welded or the like to its inner periphery and contacting with the outer periphery of inner cone 30. In the illustrated embodiment, fourteen (14) vanes 60 are provided, although a greater number may be used, but, in any event, the number of vanes 60 should always be greater than the number of vanes 70 on the inner cone. The major portion of each vane 60 lies in a single plane extending generally at an angle of 35° to the entrance and exit planes of cone 20, the vanes extending from reentrant surface 22 to points short of the inner or furnace end of cone 20.

Each vane 70 has a short entrance section 71 parallel to the burner tube axis and smoothly merging with the angularly directed main vane section 72. Thus, the secondary air has its flow direction changed smoothly from parallel to the burner tube axis to an inwardly converging, helical direction to provide a whirling action.

The inner or discharge end of the cone 30 is formed with a non-circular flattened periphery, preferably a flat-sided regular polygon. A twelve-sided polygon is preferred in the illustrated embodiment, and ring 30 is preferably cast of a suitable temperature resisting alloy. Cone 30 has the circular series of symmetrically spaced deflector vanes 70 welded to its inner periphery and corresponding to the number of sides of the polygon. Each vane 70 is arranged at a general angle of preferably 35° to the plane of the discharge edge of the cone. The inner edge 71 of each vane extends from a point on the inner edge of the cone midway of the corresponding flat at an outward inclination corresponding to the peripheral surface of a cone having a 45° base angle, is rounded off at its top, and merges with the outer vane edge 72 which is straight and substantially normal to the corresponding por-

tion of the cone at a point midway of its length. As indicated in Figs. 4 and 5, the inner edge portion 73 of each vane 70 is bent to provide a slight fillip.

It should be noted that a circle tangent to the radially inner ends of vanes 70 has a diameter less than that of impeller plate 50 which may, in the illustrated example, have a 15½ inch diameter, thus approaching the diameter of the furnace end of cone 30. Vanes 70 thus act as a limit for the permissible movement of atomizer head 49 and impeller 50 toward the furnace, the atomizer and impeller thereby being positioned at all times toward the wind box or outside of the vanes 70.

In the operation of the described burner, the air passing through impeller 50 has a swirl imparted thereto for effective mixing with the whirling conical spray of liquid fuel directed from atomizer 49. The outer portion of the air stream through impeller 50 passes through the primary air passages formed by cone 30 and vanes 70, being mixed therein with the primary air entering cone 20 beyond the periphery of impeller 50. A whirling motion is imparted to the air passing through cone 30, for effective mixing of the air with the fuel stream. At the same time, the secondary air passing through the secondary air passages, formed by cones 20 and 30 and vanes 60, has a large degree of swirl imparted thereto. The secondary air entering these passages has its pressure somewhat reduced and its velocity increased as it passes from the relatively large cross sectional entrance areas of the secondary air passages into the gradually constricted secondary air passage portions formed by convergence of outer cone portion 23 toward cone 30. The high velocity whirling motion of the secondary air leaving the furnace end of cone 20 results in a further effective mixture of the secondary air with the mixed primary air and liquid fuel cone.

The mixing of the air with the fuel thus takes place in three steps. First, the air passing through impeller 50 is effectively mixed with the fuel cone. Next, the primary air delivered from inner cone 30 is mixed with the air-fuel mixture. Finally, a large supply of whirling secondary air is admixed with the fuel-air mixture entering the furnace; thus, a large quantity of combustion air is given a degree of swirl sufficient to assure effective mixing with the fuel for quick combustion. The division of the air into primary and secondary air streams assures better control of the air and better mixing, as needed for higher oil pressures with more efficient atomizers.

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

We claim:

1. In combination with a furnace wall having a fuel burner port therein and a liquid fuel burner nozzle constructed to discharge a stream of liquid fuel through said burner port; means for directing a portion of the combustion air immediately around the discharge end of said burner nozzle and through the burner port; means disposed in the burner port and dividing the remainder of the combustion air into a primary air stream having a substantially circular cross section at its exit from the port, and an annular secondary air stream, said means comprising a

first truncated cone shaped port ring member disposed within the burner port and a second truncated cone shaped ring member mounted concentrically around the first ring member and defining the peripheral surface of the burner port; said first ring member forming a primary air passage embracing the fuel stream and being smaller in diameter than said second ring member to form therewith a secondary air passage embracing the primary air passage; a first series of deflector vanes on the inner surface of said first ring member; a second series of deflector vanes extending between and jointly engaging the facing surfaces of each of said members; and each of said deflector vanes being arranged to extend at an oblique angle to the planes of the discharge ends of said members; and means limiting inward movement of the burner nozzle to a position in which its discharge end is located completely outwardly of said vanes and truncated cone shaped members.

2. In combination with a furnace wall having a fuel burner port therein and a liquid fuel burner nozzle constructed to discharge a stream of liquid fuel through said burner port; means for directing a portion of the combustion air immediately around the discharge end of said burner nozzle and through the burner port; means disposed in the burner port and dividing the remainder of the combustion air into a primary air stream having a substantially circular cross section at its exit from the port, and an annular secondary air stream, said means comprising a first truncated cone shaped port ring member disposed within the burner port and a second truncated cone shaped ring member mounted concentrically around the first ring member and defining the peripheral surface of the burner port; said first ring member forming a primary air passage embracing the fuel stream and being smaller in diameter than said second ring member to form therewith a secondary air passage embracing the primary air passage; a first series of deflector vanes on the inner surface of said first ring member; a second series of deflector vanes extending between and jointly engaging the facing surfaces of each of said members; each of said deflector vanes being arranged to extend at the same oblique angle to the planes of the discharge ends of said members, and the number of vanes in said second series being substantially greater than the number of vanes in said first series; and means limiting inward movement of the burner nozzle to a position in which its discharge end is located completely outwardly of said vanes and truncated cone shaped members.

3. In combination with a furnace wall having a fuel burner port therein and a liquid fuel burner nozzle constructed to discharge a stream of liquid fuel through said burner port; means for directing combustion air around the discharge end of said burner nozzle and through the burner port; means disposed in the burner port and dividing the remainder of the combustion air into a primary air stream having a substantially circular cross section at its exit from the port, and an annular secondary air stream, said means comprising a first truncated cone shaped port ring member disposed within the burner port and a second truncated cone shaped ring member mounted concentrically around the first ring member and defining the peripheral surface of the burner port; said first ring member forming a primary air passage embracing the fuel stream

and being smaller in diameter than said second ring member to form therewith a secondary air passage embracing the primary air passage; a first series of deflector vanes on the inner surface of said first ring member; a second series of deflector vanes extending between and jointly engaging the facing surfaces of each of said members; the inner portions of each of said deflector vanes being arranged to extend at an oblique angle of substantially 35° to the planes of the discharge ends of said members; and means limiting inward movement of the burner nozzle to a position in which its discharge end is located completely outwardly of said vanes and truncated cone shaped members.

4. In combination with a furnace wall having a fuel burner port therein, an oil burner nozzle constructed to discharge a stream of atomized oil through said burner port, and a truncated cone shaped impeller plate mounted on said nozzle; means for directing a portion of the combustion air immediately around the discharge end of said burner nozzle and through the burner port; means disposed in the burner port and dividing the combustion air into a primary air stream having a substantially circular cross section at its exit from the port, and an annular secondary air stream, said means comprising a first truncated cone shaped port ring member disposed within the burner port and a second truncated cone shaped ring member mounted concentrically around the first ring member and defining the peripheral surface of the burner port; said first ring member forming a primary air passage embracing the oil stream and being smaller in diameter than said second ring member to form therewith a secondary air passage embracing the primary air passage; a first series of deflector vanes on the inner surface of said first ring member; and a second series of deflector vanes extending between and jointly engaging the facing surfaces of each of said members; each of said deflector vanes being arranged to extend at an oblique angle to the planes of the discharge ends of said members; the radially inner ends of the vanes of said first series extending radially inwardly of the impeller plate periphery whereby said first series of vanes limits movement of the nozzle and impeller plate inwardly of the burner port.

5. In combination with a furnace wall having a fuel burner port therein and a liquid fuel burner nozzle constructed to discharge a stream of liquid fuel through said burner port; means for directing combustion air around the discharge end of said burner nozzle and through the burner port; means disposed in the burner port and dividing the combustion air into a primary air stream having a substantially circular cross section at its exit from the port, and an annular secondary air stream, said means comprising a first truncated cone shaped port ring member disposed within the burner port and a second truncated cone shaped ring member mounted concentrically around the first ring member and defining the peripheral surface of the burner port; said first ring member forming a primary air passage embracing the fuel stream and being smaller in diameter than said second ring member to form therewith a secondary air passage embracing the primary air passage; a first series of deflector vanes on the inner surface of said first ring member; each of said deflector vanes being arranged to extend at an oblique angle to the planes of the discharge ends of said members; a second series

of deflector vanes extending between and jointly engaging the facing surfaces of each of said members, each of said second series of vanes having an air entrance section lying in a plane through the burner axis and an exit section lying in a plane radial to the burner but at an oblique angle to the plane of the entrance section.

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