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LIQUID FUEL BURNER WITH COMBUSTION AID

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FIG. 1

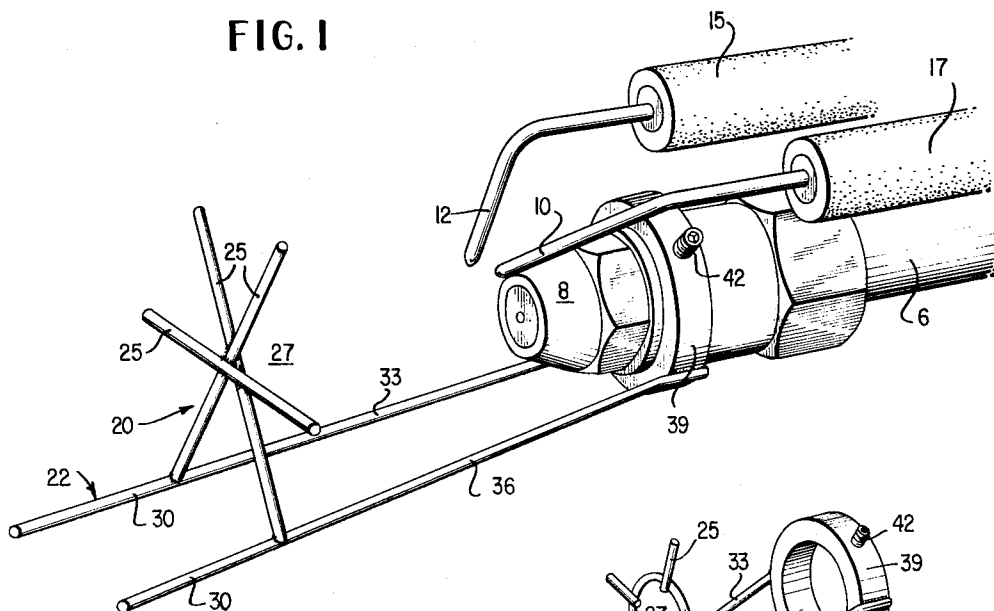


FIG. 3

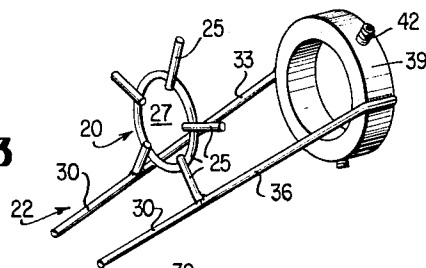
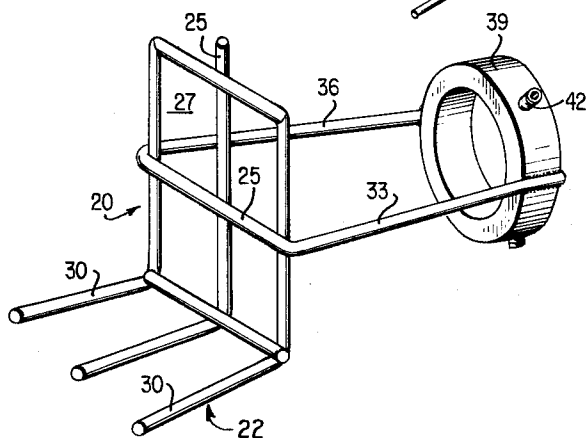


FIG. 2



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LIQUID FUEL BURNER WITH COMBUSTION AID
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This invention is a novel combustion aid for use with a liquid fuel burner. In liquid fuel burners, such as the ordinary gun-type domestic fuel oil burner, the invention serves to insure proper contact of fuel and combustion supporting gas and to steady or stabilize the combustion.

The gun-type liquid fuel burner has for many years been accepted as the standard domestic fuel oil burner. This type of burner generally comprises a fuel oil pump and line ending in an atomizing nozzle, and an air pump which supplies combustion supporting gas to the atomized fuel. Generally, a barrel-type conduit is supplied for the air and the fuel conduit is arranged concentrically within the air barrel, with the fuel nozzle recessed slightly within the exit end of the air barrel. In operation, it is conventional to so proportion the flow of liquid hydrocarbon fuel and combustion supporting gas that little, if any, surplus gas is supplied. In this way pumping costs and the size of equipment are reduced and the cooling effect of excess gas is minimized. This control over the proportions of fuel and gas makes good mixing of the fire components essential and almost universally the air barrel is provided with a nose cone or its equivalent flow director. The flow of air and fuel within the conduits provided is generally parallel, but downstream of the nozzle the flow of each fluid is generally altered to provide a mixing and combustion zone. Such mixing may be brought about by the use of an atomizing fuel nozzle which sprays the fuel into the mixing zone perhaps somewhat in the form of a cone. The constriction of the end of the air barrel by an end cone serves to deflect the air flow inwardly into admixture with the cone-shaped fuel spray. Ignition can be performed by electrodes which are within the mixture of air and atomized fuel. The gun directs the resulting flame into a combustion chamber or furnace where indirect heat exchange between the hot combustion products and the domestic heat exchange fluid is performed.

Such gun-type fuel-oil burners, which operate with air at or near atmospheric pressure, provide good efficiency to a domestic system in at least two respects; viz, in needing only the two pumps as moving parts and keeping most elements of the burner out of the way of the hot flames, and in producing a good deal of heat in the combustion chamber very quickly upon demand. The combustion efficiency of the gun-type burner, however is susceptible to improvement; for example, the position of the flame may pulsate and even though the nozzle may be finely adjusted to give the proper degree of atomization, momentary fluctuations in the oil supply may occur, either condition tending to create a less-than-ideally dispersed supply of fuel along the axis of the cone of spray. Whether caused by flame pulsation or faulty atomization, this oversupply of fuel is likely to pass through the combustion zone incompletely vaporized and therefore incompletely burned, cutting down on the combustion efficiency of the burner and leading to smoke problems.

Ordinarily the domestic fuel oil burner provides for ignition of the fuel-air mixture by means of an electrode arc which operates on a thermostatic principle. Thus the electrode circuit is provided with sensing means which, on perception of the heat from a burner flame, cuts off the electrode current. If a momentary over-supply of air to the burner occurs, perhaps due to the effect of strong air currents from outside the furnace, the resulting lower-

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ing of temperature may cause loss of the flame. The sensing means in this situation will reestablish the electrode current to reignite the fuel and gas mixture, but fuel values will be lost during the time that combustion is interrupted.

This invention aids combustion in a number of ways: it focuses the flame and assures better mixing of the fuel with combustion supporting gas. It overcomes the effects of momentary over- or under-supplies of fuel or combustion supporting gas by acting both as a fuel and a heat reservoir. The combustion aid of this invention provides a surface on which the flame can locate and spread out and on which fuel from momentary floods of unvaporized liquid particles or small clouds of vapor supersaturated with fuel may coalesce. The invention provides a further surface, downstream, to which the coalesced fuel may travel to be vaporized and mixed with further amounts of combustion supporting gas and burned. By thus spreading fuel out into a greater volume of the combustion zone this invention serves for better utilization of all available air, allowing the coalesced fuel to revaporize more homogeneously in the combustion-supporting gas and burn more completely.

The combustion aid of this invention is an armature having a fuel arresting portion and a drain portion which extends in a direction away from the zone of primary mixing of fuel and combustion supporting gas. The armature is placed just downstream from the zone at the end of the air barrel where the most vigorous mixing of the fuel and combustion supporting gas occurs. Preferably the arresting portion is coaxial with the nozzle of the fuel burner and covers only a minor portion of the cross-section of the combustion zone of the burner, that is, less than half, advantageously less than about one-third, of the flow space downstream of the fuel nozzle. The combustion aid is advantageously made of metal but may comprise other non-porous solid material, such as ceramics, which will withstand deformation at the temperatures of the combustion.

The arresting portion has a generally flat, discontinuous surface in which the open discontinuities usually comprise more than about one-half of the total surface defined by the member. Advantageously, the arresting portion is a fretwork of metal rods held rigidly together, for example, by welding. The drain portion is fastened to the lower edge of the arresting portion and also may comprise metal rods. This drain portion, as mentioned, extends out, usually in a plane generally perpendicular to the plane of the arresting portion, away from the nozzle of the burner. The drain portion is about parallel to the gas flow and is accessible to the combustion supporting gas. The drain member may be tilted slightly downward, that is, its trailing edge may be lower than its leading edge, in order to provide good distribution of fuel along the drain portion.

By thus imposing a solid member in the path of fuel from the burner nozzle, the combustion aid of this invention serves to enlarge and stabilize the flame area. It appears to intercept imperfectly atomized droplets of liquid fuel, probably causing them to coalesce on the surface of the arresting member. It is reasoned that the coalesced fuel, under the influence of gravity and continued gas flow from the nozzle and air barrel, drips downward to the drain portion and outward along the drain portion where the fuel may be vaporized uniformly into the still-hot gas stream for quick and complete combustion.

The device of this invention gives a better combustion effect than the so-called "flame-holders" known to the art. These prior devices serve as heat reservoirs during momentary interruptions of fuel flow; however, they also

serve to coalesce improperly atomized fuel and hold it within the primary gas stream. In operation, hydrocarbon fuel, coalesced on such devices and held in the main combustion stream frequently serves to reduce the carbon monoxide or carbon dioxide combustion gases, converting both gas and fuel to water and free carbon. This free carbon is usually wasted in the gas stream and, further, creates a smoke nuisance. The combustion aid of this invention reduces or avoids this effect by providing for conducting away the coalesced fuel from the main combustion zone. It can be seen that the combustion aid of this invention besides serving to assure combustion of over-supplies of fuel, also serves as a heat reservoir during momentary undersupplies of fuel.

The solid member can be supported by arms which extend from the fuel nozzle. For ease of replacement, the arms will generally be rigidly fastened to an adapter, e.g. a collar which fits around the standard fuel nozzle assembly and which may be supported thereby. These arms may be extensions of the drain portion. Such an arrangement provides for ease in installing and replacing the combustion aid.

The invention will be better understood by reference to the accompanying drawing which is to be considered illustrative only and not limiting. In the drawing

FIGURE 1 shows a liquid fuel burner, without the air barrel, to which the combustion aid of this invention is attached, and

FIGURES 2 and 3 show alternate embodiments of the combustion aid of this invention.

Conventionally, the liquid fuel burner will consist essentially of the fuel line 6, the nozzle 8 and the electrodes 10 and 12, which have the insulated leads 15 and 17, respectively. The combustion aid, as can be seen, is composed of two parts, the arresting portion 20, which is in a plane normal to the flow of fuel and combustion supporting gas and the drain portion 22 which is in a plane roughly parallel to this flow.

As shown, the arresting portion 20 comprises essentially a network of rods 25 which intersect each other to leave the voids 27. In FIGURE 1 this network takes the form of an asterisk while in FIGURE 2 it is a combination of intersecting parallelopipeds. In FIGURE 3 a small curved rod forms a circle to which short, outwardly extending rods are fixed. The drain portion 22 comprises the rods 30 which extend away from the nozzle a distance sufficient to provide for vaporization of coalesced fuel. Preferably, each vertical or semi-vertical member 25 of the arresting portion will lead downward to one or more of the rods 30. The combustion aid is generally supported on the nozzle assembly 8 by means of the arms 33 and 36 which extend between the arresting portion 20 and the collar 39 which may be affixed to the nozzle assembly 8 by means of the set screw 42.

As can readily be seen, the device of this invention can easily be installed on existing gun-type liquid fuel burners by putting the collar around the nozzle assembly and fastening it with the set screw. The length of the arms supporting the solid member is often sufficient to place the member just beyond the zone of greatest turbulence which occurs immediately downstream of the fuel nozzle. Generally, this length will place the solid member a distance in front of the fuel nozzle at least about twice the distance from the fuel nozzle to the exit edge of the end cone, preferably about 2 to 3 times the distance from the fuel nozzle to the exit edge. For example, the combustion aid of this invention is found effective when the arresting member is placed about 2" downstream from the fuel nozzle of a burner wherein the nozzle is set about 1" back of the exit edge of the end cone, and the drain member may extend outward a distance at least about equal to the length of the arms. Where the arresting member is about 2" from the nozzle, the drain member may be about 3" long.

As described above, the arresting portion usually extends outwardly from the axis of the nozzle a distance sufficient to intercept unmixed combustion supporting gas in a zone annular to the fuel-rich zone. In general, the lateral extent of the arresting portion will be almost equal to the opening in the end cone.

In operation, the collar is placed around the nozzle assembly, the arresting member is set a proper distance from the fuel nozzle and flow of air and fuel is begun. High voltage current is sent to the electrodes which arc in the mixture of fuel and air. Current is cut off after ignition is assured. Uncombusted fuel and air impinge on the arresting portion, causing coalescence of excess fuel which passes to the drain portion and is vaporized in further amounts of combustion supporting gas.

It can be readily seen that this invention aids combustion by assuring a steady flame and better mixing of the fuel with combustion supporting gas downstream of the zone of greatest mixing where the ordinary gun-type burner, despite the atomizing effect of the nozzle and the agitating effect of the nose cone, may still allow the flame to pulsate or provide too rich a fuel mixture. The invention serves to give stabilized and steady combustion by acting as a heat reservoir to give uniform combustion despite minor fluctuations in fuel or combustion gas flow or vaporization, and also serves to spread out the combustion zone. By such a combination of effects, the invention serves to give more efficient combustion, converting substantially all the carbonaceous fuel to carbon dioxide.

It is claimed:

1. In a gun-type liquid fuel burner having a nozzle and ignition means adjacent the nozzle, said nozzle being adapted to spray fuel into a mixing zone containing a combustion-supporting gas, the improvement which comprises a member in the path of the fuel flow downstream of said nozzle and said ignition means, said member having a generally flat, discontinuous surface facing said nozzle, the area of said surface covering a minor portion of the cross-sectional area of said mixing zone, draining means at the lower edge of said member, extending away from said member a distance at least about equal to the distance of said member from the nozzle, said draining means adapted to drain coalesced fuel away from said member to be revaporized, and support means for attachment of said member to said nozzle which includes collar means secured to said nozzle and arms supporting said member and secured to said collar means, said arms extending between the member and the collar.

2. A burner as defined in claim 1 wherein the arms are extensions of the said draining means.

3. The burner defined in claim 1 wherein said member is formed by a fretwork of metal rods coaxial with said nozzle which intersect each other to form said discontinuous surface, which comprises about one-half of the total surface of the member.

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