Sept. 24, 1963 W. R. SCHWINDEMAN 3,104,696

FOAM HEATING OIL BURNER AND METHOD OF COMBUSTION

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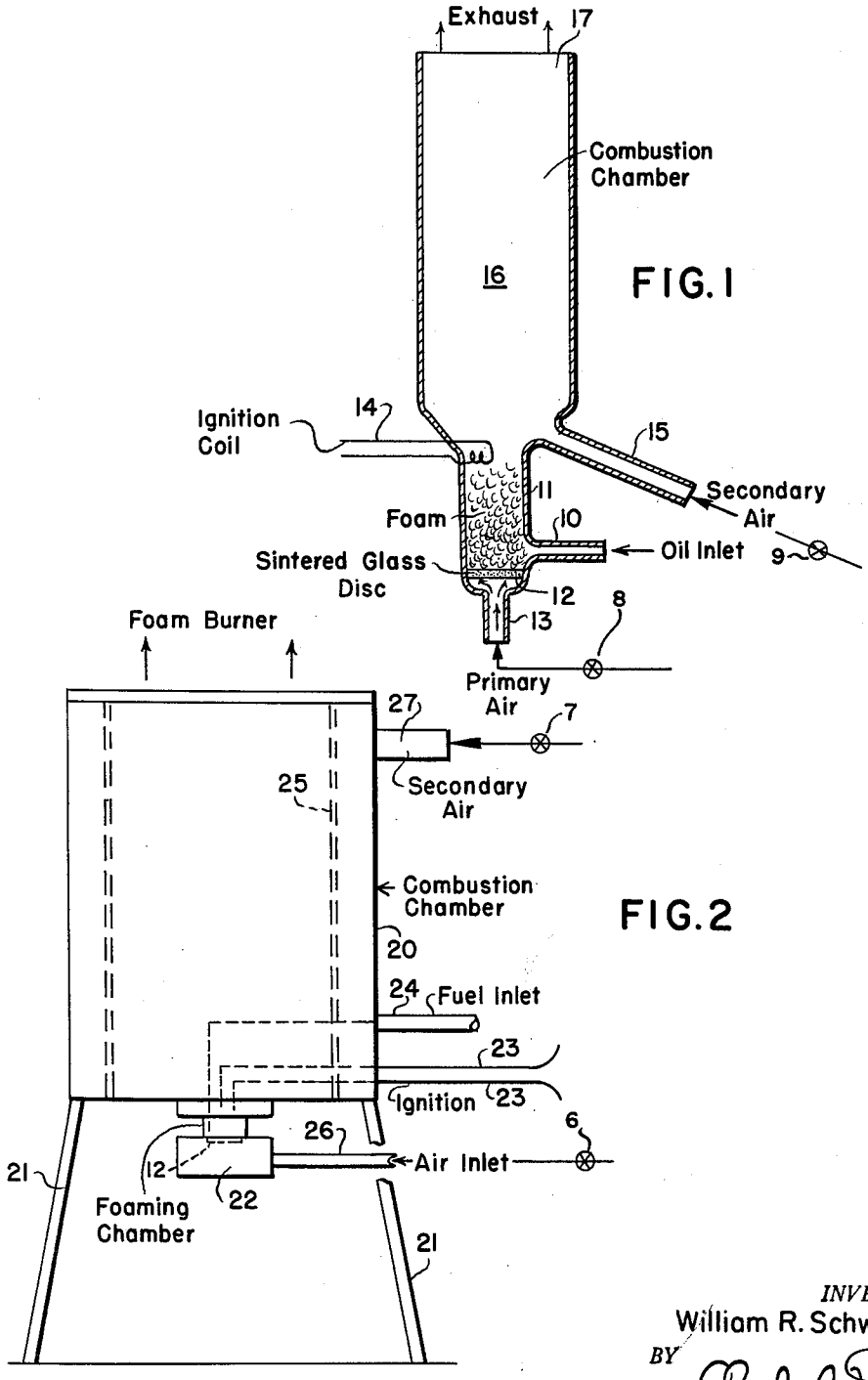


FIG. 1

FIG. 2

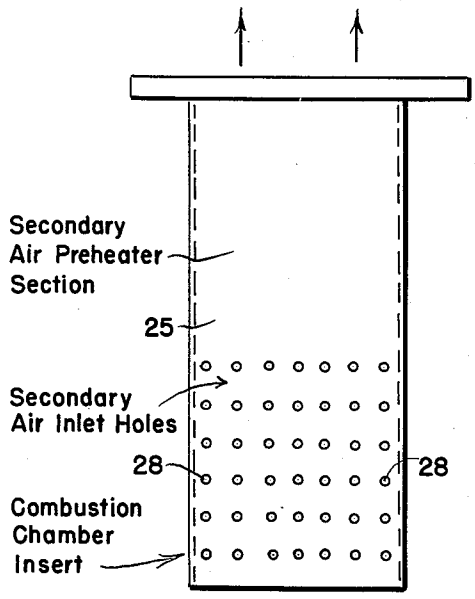
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FIG.3



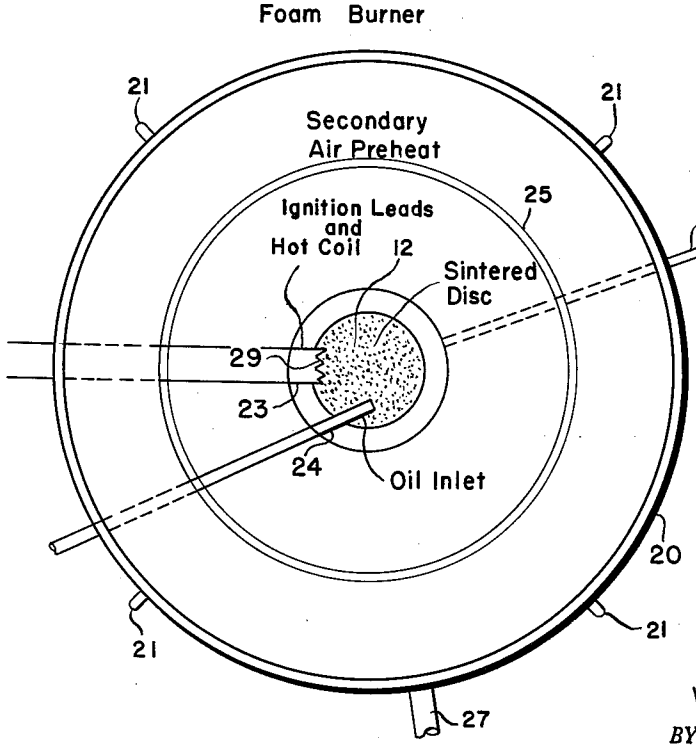


FIG.4

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FOAM HEATING OIL BURNER AND METHOD OF COMBUSTION

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3 Claims. (Cl. 158—4)

This invention relates to a method of burning fuel oil in home and industrial burners and to a novel burner construction. The invention particularly relates to an improved and simplified trouble free liquid fuel delivery system in an intermittently operating burner especially adapted for home heating installations, although not limited to that application.

Oil and gas heating systems have in recent years largely replaced coal systems as a means of heating homes and many industrial installations. The oil burner generally employed delivers a liquid fuel oil under substantial pressure to a nozzle by means of which the oil is atomized and sprayed into a combustion chamber. A spark is used to ignite the atomized oil and combustion commences and continues until the demand for heat is satisfied. The high-pressure pump required for delivery of the liquid oil to the nozzle is expensive and subject to wear and malfunctioning from time to time. The nozzle has a fine opening which becomes plugged or carbonized occasionally causing shut-down or inferior operation. An improved heating oil burner has been sought diligently for a long time, but an improvement over the gun type burner has not yet been found.

Low pressure or gravity flow heating or burning systems have been used to some extent in the past generally in conjunction with a wick. The liquid fuel is fed by gravity to the wick and the fuel vaporizes at least in part within the wick. The vapors are burned and the burning vapors cause additional vaporization. Light and easily vaporized fuel is used in many gravity flow systems, particularly when a wick is not used. The capacity of burners of this type are limited to the rate of vaporization of the fuel. Excessive fuel flow causes the burner to carbonize and smoke. Another major problem with this type of unit is carbonization at the point where the fuel is introduced into the vaporizing chamber at low flame. These gravity flow burners are generally inadequate for home and industrial heating systems of substantial capacity.

It is an object of this invention to provide a simplified burner and method of combustion for use in burning heating oil.

It is a further object of this invention to provide a simplified, trouble-free burner for use in burning oil in heating systems.

It is a further object of this invention to provide a method of burning a liquid hydrocarbon oil intermittently with minimum initial investment in equipment and with minimum operational trouble.

It is a further object of this invention to provide a trouble-free burner for fuel oil which operates intermittently with minimum investment.

These and other objects of the invention will be more apparent in the following detailed discussion of the invention which is to be read in conjunction with the attached figures.

FIGURE 1 is a vertical view in section of a burner designed for operation in accordance with this invention.

FIGURE 2 is a view in vertical section of an alternate embodiment of this invention.

FIGURE 3 is a vertical view of a preheater unit for use in the burner of this invention.

FIGURE 4 is a plan view of the burner of this invention.

The invention will now be disclosed in detail, first in respect to FIGURE 1.

FIGURE 1 shows the general arrangement of a small burner arranged in accordance with this invention. I have found that when oil is supplied freely to a pool and a gas such as air is discharged into the pool from a number of locations to bubble through the pool, an oil foam is formed above the oil if the gas supply is sufficient and this oil foam will tend to rise above the oil. The foam can be ignited readily by a spark plug or hot wire or other ignition means. The primary air provided to produce the foam must be within critical limits required to raise the foam and yet not high enough to extinguish the flame by cooling action. Under controlled conditions of primary air flow, the combustion temperature rises to provide flash combustion which can then be aided by the introduction of secondary air to provide maximum efficiency combustion.

Referring to FIGURE 1, the fuel oil is introduced from a reservoir through the inlet **10** to reach a level in the foaming chamber **11**. This can be accomplished by gravity feed using conduits of sufficient diameter to avoid any possibility of plugged or partially plugged lines. A sintered disk **12** of glass, ceramic or metal is provided in the foaming chamber **11** below the oil inlet to serve as a floor. Primary air is passed through the conduit **13** at a flow rate controlled by valve **8** to pass upwardly through the voids in the sintered disk and enter the oil pool located thereabove. The primary air is dispersed by the sintered disk to enter the oil as a multitude of small bubbles. A foam is formed which rapidly rises in the foaming chamber to reach the ignition coil **14** and combustion of the oil occurs, provided an excessive amount of primary air is not used.

After combustion has been initiated, the flame flashes down to the fritted base. The primary air can be increased at this point to provide an improved flame. In order to improve combustion efficiency, a flow of secondary air is introduced through the conduit **15** at a flow rate controlled by valve **9** and the major portion of the combustion occurs in the combustion chamber **16**. The exhaust gases are discharged from the top of the combustion chamber through outlet **17**.

In order to illustrate the invention, a glass unit similar to the design shown on FIGURE 1 was constructed and put into operation using a sintered glass disk in the foaming chamber. The primary air was started at about 5–10 cubic feet per hour at a pressure of about 0.5 p.s.i. (gauge). The ignition coil was energized and fuel oil introduced at a rate of about 480 cubic centimeters per hour (⅛ gallon per hour). Ignition occurred within about one minute from a cold start. It was found necessary to limit the primary air during start up since excessive air flow produced a cooling effect and produced too coarse a foam structure for easy ignition.

Upon ignition, the foam was found to burn more rapidly than it formed, and the unit commenced to operate as a flash-vaporizing burner. At this time secondary air was introduced at a rate of about 250–300 cubic feet per hour from a centrifugal blower (with no static pressure required). This secondary air flow was found to provide efficient burning in the combustion chamber. The primary air rate was increased at that time to 20–30 cubic feet per hour to form a torch-like flame at the surface of the sintered disk.

It has been found that a simple diaphragm pump or other simple pump is adequate to provide the low pressure primary air. A simple blower is adequate to provide the secondary air at substantially no pressure and the oil can be introduced by gravity flow, an oil pump being unnecessary.

Referring now to FIGURE 2, a modified embodiment of the invention is shown vertically mounted. The combustion chamber **20** is shown mounted on legs **21** with the foaming chamber **22** located therebelow. The ignition leads **23** are projected into the combustion chamber **20** and the fuel line **24** projects into the foaming chamber from the combustion chamber **20**. The preheater unit **25** projects downwardly into the combustion chamber **20**; this unit is shown in more detail on FIGURE 3. The primary air is introduced through the conduit **26** at a flow rate controlled by valve **6** and the secondary air is introduced through the conduit **27** at a flow rate controlled by valve **7**. The combustion gas is discharged through the top of the burner to exit through the exhaust stack (not shown).

FIGURE 3 shows the combustion chamber insert. The secondary air is passed around the exterior of this unit to travel downwardly to the secondary air inlet holes **28**. Combustion occurs within the insert **25** and the combustion gases are discharged from the top into a fire box of a heating unit. The remainder of the heating unit is conventional and not shown.

FIGURE 4 shows a plan view of the burner. The sintered disk **12** is shown in the center. This disk may be of glass, metal or ceramic. The disk apertures are controlled to prevent or limit the downward penetration of fuel. The size of the apertures or voids cannot be made too small, however, since this will unnecessarily increase the required primary air pressure and hence complicate the primary pump design. The primary air can be commenced before oil is introduced onto the disk and the upward flow of air through the disk will prevent downward flow of oil when the oil flow is commenced. The oil inlet **24** projects downwardly into the foaming chamber and the ignition leads **23** connect with the hot coil **29** at the upper end of the foaming chamber.

The fuel used in these burners is generally a distillate hydrocarbon oil such as kerosine or a gas oil boiling in the range 350–800° F. The lighter fuel, boiling below 350° F., is more volatile and hence generally not used to avoid the danger of explosion. The heavier fuels, boiling above about 800° F., are avoided because of ignition problems and handling difficulties. The broad range of fuels usable in this burner, viz. 350–800° F., provide a distinct advantage since the usual gravity flow burner cannot use such a broad range of fuel without smoking and carbonizing excessively.

The invention has been adequately illustrated in the examples hereinabove. These descriptions are intended

only to aid in an understanding of the invention and are not intended as limitations. The only limitations intended are found in the attached claims.

I claim:

1. A liquid fuel burner which comprises in combination, a foam chamber, a porous member positioned across the lower cross section of said foam chamber, the upper end of said foam chamber in open communication with a combustion chamber, means beneath the porous member for introducing a separately controlled amount of primary air, electrical ignition means located in the upper end of said foam chamber, means for introducing a liquid fuel to said foam chamber intermediate said porous member and said ignition means, means for introducing separately controlled secondary air to said combustion chamber adjacent the lower portion thereof and exhaust means adjacent the upper end of said combustion chamber.

2. A method for igniting and burning a liquid hydrocarbon fuel boiling in the range of from about 350° F. to about 800° F. in a liquid hydrocarbon fuel combustion zone which comprises, intermixing a liquid hydrocarbon fuel with primary air in a first zone under conditions to produce a foam mixture of the fuel and air, discharging said foam into said combustion zone, igniting the foam to initiate combustion of the hydrocarbon fuel entering said first zone, increasing the flow rate of primary air combined with the liquid hydrocarbon fuel to maintain combustion of the entering liquid hydrocarbon fuel and introducing a secondary air stream into said combustion zone at a rate to maximize combustion efficiency of the ignited hydrocarbon fuel.

3. The method of claim 2 wherein the primary air stream is a minor portion of the total combustion air introduced to the combustion zone.

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