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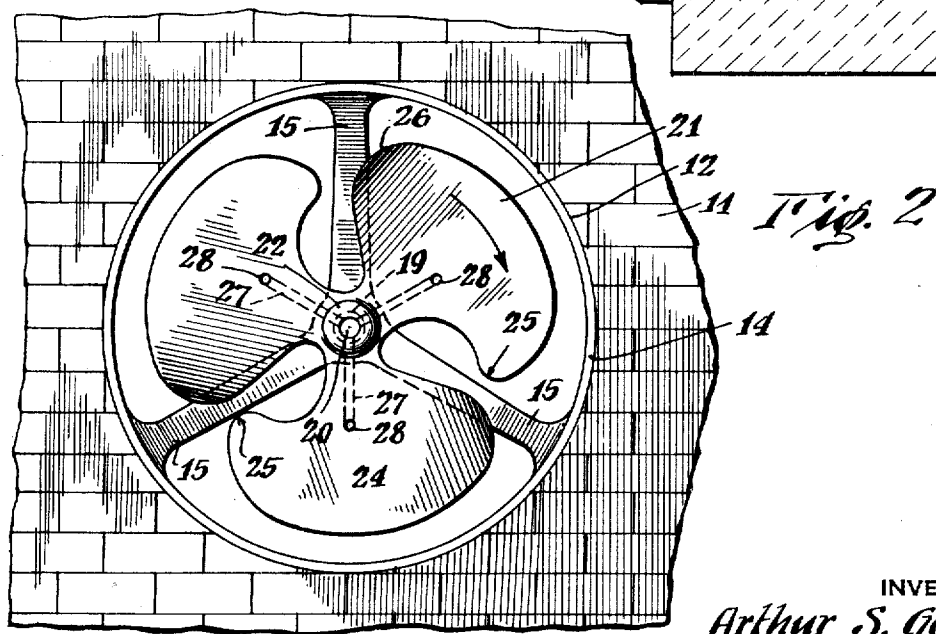
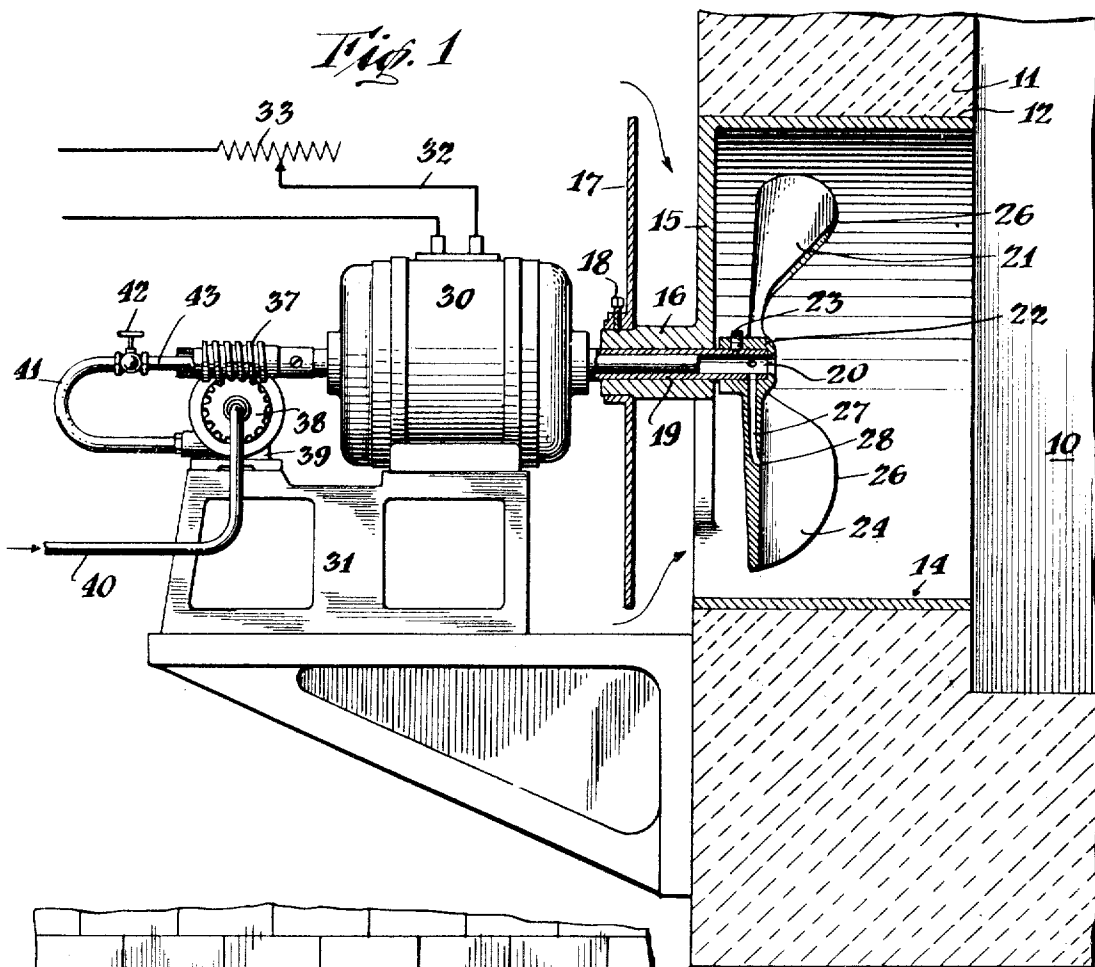
A. S. GERQUEST

2,253,175

FUEL BURNER

Filed Oct. 19, 1940

2 Sheets-Sheet 1



INVENTOR
Arthur S. Gerquest
 BY *[Signature]*
 ATTORNEY

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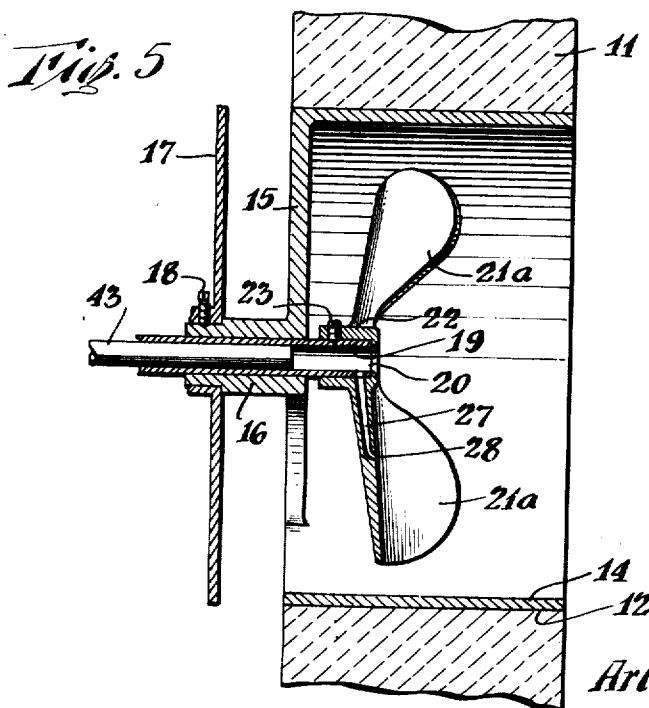
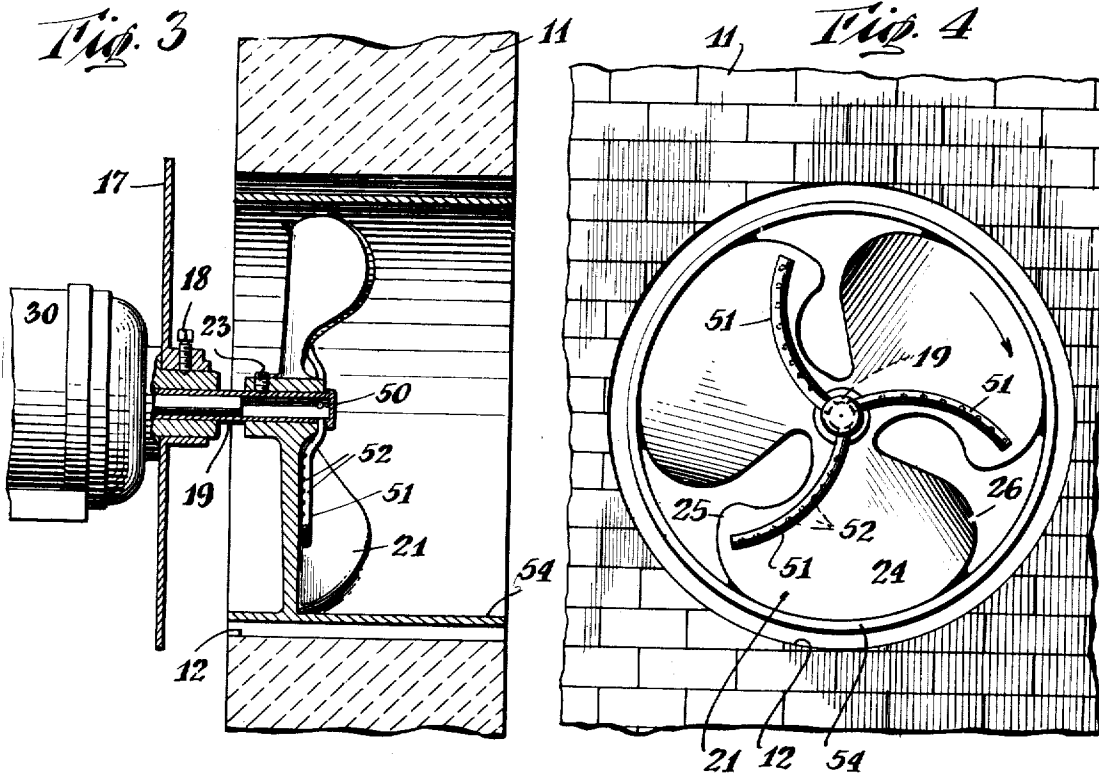
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FUEL BURNER

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2 Sheets-Sheet 2



INVENTOR
Arthur S. Gerquest
BY *W. H. H. H.*
ATTORNEY

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FUEL BURNER

Arthur Steven Gerquest, Ridgewood, N. J.

Application October 19, 1940, Serial No. 361,823

8 Claims.

(Cl. 158-77)

This invention relates to fuel burners and more particularly to a fuel burner of the variable capacity type.

This application is a continuation-in-part of my co-pending application, Ser. 246,049, filed Dec. 16, 1938.

An object of my invention is to provide a dependable, efficient, and commercially practical fuel burner of the type above indicated.

Another object is to provide a fuel burner which is suited for the efficient combustion of fuels over a wide range of capacities.

Another object is to provide a fuel burner of the type above indicated having stability of ignition at reduced capacity.

Another object is to provide a fuel burning system of the type above indicated in which the fuel and combustion air are automatically controlled in unison for maintaining optimum combustion conditions at different capacities.

Another object is to provide a liquid fuel burner for household heaters which may be operated efficiently at different capacities.

Various other objects and advantages will be apparent as the nature of the invention is more fully disclosed.

Although by novel features which are believed to be characteristic of this invention are pointed out more particularly in the claims appended hereto, the invention itself will be better understood by referring to the following description, taken in connection with the accompanying drawings, in which a specific embodiment thereof has been set forth for purposes of illustration.

In the drawings:

Fig. 1 is a side elevation, partly in section, of a fuel burner embodying the present invention;

Fig. 2 is a front elevation thereof;

Fig. 3 is a view similar to Fig. 1 illustrating a different embodiment of the invention;

Fig. 4 is a front elevation of the burner shown in Fig. 3; and

Fig. 5 is a longitudinal section through a burner illustrating a further embodiment of the invention.

In the following description and in the claims certain specific terms are used for convenience in referring to various details of the invention. These terms, however, are to be given as broad an interpretation as the state of the art will permit.

Referring to the drawings more in detail, the invention is shown as applied to a furnace chamber 10 having a front wall 11 provided with a burner opening 12 which, in the embodiment shown, is

lined by an annular throat member 14. The annular member 14 is provided with radial arms 15 carrying a hub 16 on which a baffle 17 is slidably mounted. The baffle 17 may be secured in adjusted position by suitable means, shown as a set screw 18.

A hollow shaft 19 is journaled for rotation in the hub 16. The open end 20 of the shaft 19 projects into the burner opening 12 and carries a fan of the propeller type having blades 21 and a hollow, open ended hub 22 which is secured to the shaft 19 by suitable means, such as a set screw 23. The blades 21 are preferably of the type adapted to produce a substantially uniform flow of air across the entire area of the burner opening, having a forward surface 24 suited to build up a positive air pressure, a leading edge 25 and a trailing edge 26. At least a substantial portion of the blades 21 extends forwardly of the plane of the end 20 of the shaft 19 and of the open hub 22, for the purpose to be described.

The blades 21 are shown as provided with ducts 27 communicating with the interior of the hollow shaft 19 and having discharge ports 28 located in the forward surface 24 of the blades well in advance of the trailing edge 26 thereof.

The shaft 19 is driven by suitable means shown as an electric motor 30 mounted upon a pedestal 31. The motor may be connected by a line 32 to a suitable current source and may be controlled in speed by suitable means, shown as a variable rheostat 33.

The shaft 19 is extended on the opposite side of the motor 30 and carries a worm 37 meshing with a worm gear 38 which drives a positive displacement pump 39 of suitable construction such as a piston pump or a diaphragm pump, adapted to supply fuel at a rate dependent upon the speed of operation thereof. The pump 39 receives fuel from a supply pipe 40 and discharges the fuel through a discharge pipe 41 controlled by a valve 42 to a supply pipe 43 which extends within the hollow shaft 19 to a point near the forward end thereof. Suitable sealing means, not shown, may be provided to prevent leakage of fuel between the pipe 43 and the shaft 19.

The fuel passes out of the end of the pipe 43 into the hollow drive shaft 19 and flows through the ducts 27 and the ports 28 to form a thin film on the forward surfaces 24 of the blades 21. The centrifugal force of the rotating fan causes the oil to flow outwardly through the ducts 27 for the above purpose. The rotation of the fan blades also causes a positive air pressure to be built up on the forward surfaces 24 and induces a current

of air to flow through the burner opening 12 which is substantially uniform across the entire area thereof. This air under pressure on the surface of the fan blades mixes with the film of fuel thereon to form a combustible mixture which burns on the surface 24 of the blades to produce a flame which extends from the surface of the blades substantially helically through the burner opening 12 and into the combustion chamber 10 of the furnace.

Fuel may also be supplied to the fan blades from the open end 20 of the drive shaft 19. The fuel which is thus discharged is thrown outwardly by centrifugal force from the end of the shaft and is picked up by the portion of the surface of the fan blades which is positioned forwardly of the plane of the end 20 of said drive shaft to assist in forming a film thereon.

It is to be understood that, if the shape of the blades is such that the desired supply of fuel may be obtained centrifugally from the end of the drive shaft, the ducts 27 may be omitted. In other instances it may be desirable to close the end of the drive shaft and rely upon the ducts 27 for supplying fuel to the surface of the blades or a plurality of such ducts may be associated with each blade and spaced thereover. Furthermore, the ducts 27 have been shown as cast into blades merely for convenience. The ducts may comprise separate supply pipes rotating with the blades and terminating in a position to supply oil onto the forward surface thereof, as shown in Fig. 3 (to be described).

The supply of air for combustion purposes may be regulated by means of the baffle 17 so as to obtain the proper combustion conditions. The baffle 17 may be adjusted axially of the hub 16 so as to vary the opening into the burner throat 12. The air supply may also be adjusted by varying the air pressure in a plenum chamber, not shown, supplying air to the burner throat or in the furnace itself.

After the above adjustment has been made for presetting the combustion conditions, the instantaneous supply of air is thereafter dependent upon the speed of the burner fan. The quantity of fuel supplied to the burner, being dependent upon the speed of the pump 30, is also proportional to the speed of rotation of the burner fan. Consequently, by adjusting the speed of the motor 25, both the air and fuel supply to the burner may be controlled in a proportional manner so as to vary the operating capacity of the burner while maintaining predetermined optimum combustion conditions at all loads.

It has been found that in a burner of the above type the capacity may be varied over a wide range without producing instability of ignition. The burner, for example, may be operated at full capacity or may be operated at a reduced capacity, even as low as half of the full capacity while maintaining efficient combustion conditions and without any tendency for the flame to become unstable. The burner is accordingly adapted for variable loads and, as applied to household use, may be used to provide continuous or substantially continuous combustion and thereby eliminate the undesirable effects produced by intermittent combustion.

The burner is not restricted to use in a furnace but may be adapted to various other uses. If not confined by a burner throat or the like, the flame, of course, tends to spread out in the form of a cone or disc. This, however,

does not interfere with the stability of combustion.

In the embodiment of the invention shown in Figs. 3 and 4, the fan construction is generally similar to that described above and corresponding parts have been identified by similar reference numbers. In this embodiment the end 20 of the shaft 19 is closed by a cap 50 and a plurality of ducts 51 extend from the end of the shaft 19 above the forward surface of the blades 21 adjacent the leading edge 26 thereof. These ducts 51 are provided with openings 52 which are shown as spaced therealong so as to supply fuel over a substantial portion of the blade area. The ducts 51 supply fuel to the forward surface of the fan blades for burning thereon. It is to be understood, however, that the ducts may be formed in the blades themselves as in Fig. 1 or that the outside ducts 51 of Fig. 3 may be used in the embodiment of Fig. 1 if desired. The ducts 51 should be positioned so as not to interfere with the fan action and may be made thin in section.

A rim 54 is shown in Figs. 3 and 4 as forming a part of the fan casting and extending around the periphery of the rotor beyond the ends of the fan blades 21. The rim 54 extends forwardly a substantial distance beyond the forward plane of the fan blades. In the event that fuel is thrown from the blades 21, this fuel impinges against the inner surface of the rim 54 and burns thereon. The operation is similar to that described above except that the rim 54 causes the flame to retain a substantially helical form. This embodiment may be used in combination with a furnace as shown or may be used independently for other heating purposes inasmuch as the shape of the burner throat is not relied upon to control the flow of air for combustion.

In the embodiment shown in Fig. 5 the beneficial effects of the forms of both Figs. 1 and 3 are obtained. In this embodiment the construction is similar to that of Fig. 1 with the exception that the blades 21a are inclined forwardly beyond the plane of the end 20 of the hollow drive shaft 19. This forward inclination of the blades produces in the air flow a radial component toward the axis and thereby assists in maintaining a concentrated flame. The forward inclination of the blades also provides a greater surface forwardly of the plane of the end of the hollow drive shaft and makes a larger blade area available for receiving fuel which is discharged centrifugally from said shaft. This construction also reduces the tendency for the fuel to be thrown from the surface of the blades onto the burner throat.

If desired, the blades 21 may be faced with a refractory absorbent material, such as asbestos, with suitable provision for discharging fuel from the ducts 27 or from the end of the drive shaft onto the asbestos facing. The fuel then forms a film over the asbestos facing and burns thereon. The refractory protects the metal of the blades themselves and it may be renewed when necessary.

In all of the above embodiments the baffle 17, in addition to providing means for adjusting the air flow, also shields the motor 25 from the radiant heat of the burner. It has been found that the passage of air over the rapidly rotating blades and over the radial arms 15 serves to cool the same and prevents the heat of the furnace from injuring the blades or the metal arms even when operating continuously.

While the above burner is particularly designed for use with liquid fuel, such as oil, it is to be understood that in certain cases it may be used for burning other types of fuel. For burning gaseous fuel, however, it is usually preferable to close the end of the drive shaft and thereby cause the gas to be supplied directly to the surface of the blades through the ducts 27. Preferably, a plurality of such ducts are disposed over the surface of each blade.

Although certain specific embodiments of the invention have been shown for purposes of illustration, it is to be understood that the invention is not to be limited thereto, but that various changes and modifications may be made as will be readily apparent to a person skilled in the art. The invention is only to be restricted in accordance with the scope of the following claims.

What is claimed is:

1. A fuel burner comprising a fan of the propeller type having blades adapted to induce an axial flow of air and to discharge said air forwardly, means driving said fan, fuel supply means including ducts rotating with said fan and terminating in the forward surface of said blades in a position to supply fuel directly onto said surface and to cause the same to form a film thereon in contact with the air induced by rotation of said blades, whereby a combustible mixture forms on the surface of said blades for burning thereon, said fan being positioned and arranged to discharge the burning combustible mixture axially.

2. A fuel burner comprising a fan of the propeller type having blades adapted to induce an axial flow of air and to discharge said air forwardly, means driving said fan, fuel supply means including ducts rotating with said fan and terminating in a position to supply fuel directly onto the forward surface of said blades and to cause the fuel to form a film thereon in contact with the air induced by rotation of said blades, whereby a combustible mixture forms on the surface of said blades for burning thereon, said fan being positioned and arranged to discharge the burning combustible mixture axially.

3. A fuel burner comprising a fan of the propeller type having blades adapted to induce an axial flow of air and to discharge said air forwardly, means driving said fan, said drive means including a hollow drive shaft, means to rotate said shaft, means supplying fuel to said drive shaft, said fan blades having ducts communicating with said drive shaft and terminating in the forward surface of said blades in a position to supply fuel directly onto said surface to cause same to form a film thereon in contact with air induced by rotation of said blades, whereby a combustible mixture forms on the surface of said blades for burning thereon, the fan being positioned and arranged to discharge the burning combustible mixture axially.

4. A fuel burner comprising a fan of the propeller type having a hollow, open ended hub and having blades extending forwardly of the plane of the open end of said hub, said blade being adapted to induce an axial flow of air and to discharge said air forwardly, means driving said fan including a hollow drive shaft carrying said hub, means supplying fuel to said drive shaft, and means rotating said drive shaft to cause fuel to be thrown outwardly from the open end thereof onto said forwardly extending fan blades and to form a film thereon in contact with air induced

by rotation of said blades whereby a combustible mixture forms on the surface of said blades for burning thereon, the fan being positioned and arranged to discharge the burning combustible mixture axially.

5. A fuel burner comprising a fan of the propeller type having blades adapted to induce an axial flow of air and to discharge said air forwardly, means driving said fan, said drive means including a hollow drive shaft, means to rotate said shaft, means supplying fuel to said drive shaft, means to supply fuel from said drive shaft onto the forward surface of said blades in a position well in advance of the trailing edge thereof to form a film thereon in contact with the air induced by rotation of said blades, whereby a combustible mixture is formed on the surface of said blades for burning thereon, the fan being positioned and arranged to discharge the burning combustible mixture axially.

6. A fuel burner, comprising a fan of the propeller type having blades adapted to induce an axial flow of air and to discharge said air forwardly, means supplying liquid fuel to the forward surface of the rotating fan blades to cause the same to be mixed thereon with the air induced by rotation of said blades to form a combustible mixture, said fan being positioned and arranged to discharge the burning combustible mixture axially, means driving said fan and means actuated by said drive means to control said fuel supply means so as to supply fuel at a rate which varies in accordance with the speed of rotation of said fan, whereby the ratio of fuel and air is maintained substantially constant as the capacity of said burner is changed by varying the speed of said drive means.

7. A fuel burner, comprising a fan of the propeller type having blades adapted to induce an axial flow of air and to discharge said air forwardly, means supplying liquid fuel to the forward surface of the rotating fan blades to cause the same to be mixed thereon with the air induced by rotation of said blades to form a combustible mixture, said fan being positioned and arranged to discharge the burning combustible mixture axially, means driving said fan, a fuel supply pump of the positive displacement type having a capacity dependent upon speed of operation and means actuated by said drive means to drive said pump so as to supply fuel at a rate which varies in accordance with the speed of rotation of said fan, whereby the ratio of fuel and air is maintained substantially constant as the capacity of said burner is changed by varying the speed of said drive means.

8. A fuel burner comprising a fan of the propeller type having blades adapted to induce an axial flow of air and to discharge said air forwardly, means driving said fan, fuel supply means rotating with said fan to supply fuel onto the forward surface of said blades to cause the same to form a film thereon in contact with the air induced by rotation of said blades, whereby a combustible mixture forms on the surface of said blades for burning thereon, said fan being positioned and arranged to discharge the burning combustible mixture axially, and an axial rim disposed around the periphery of said blades to receive fuel which may be thrown outwardly therefrom and to cause the flame to retain a substantially helical form.

ARTHUR S. GERQUEST.