Feb. 19, 1929. 1,702,936

A. B. FRENIER

LIQUID FUEL BURNING APPARATUS

Filed Nov. 1, 1926

Fig. 1

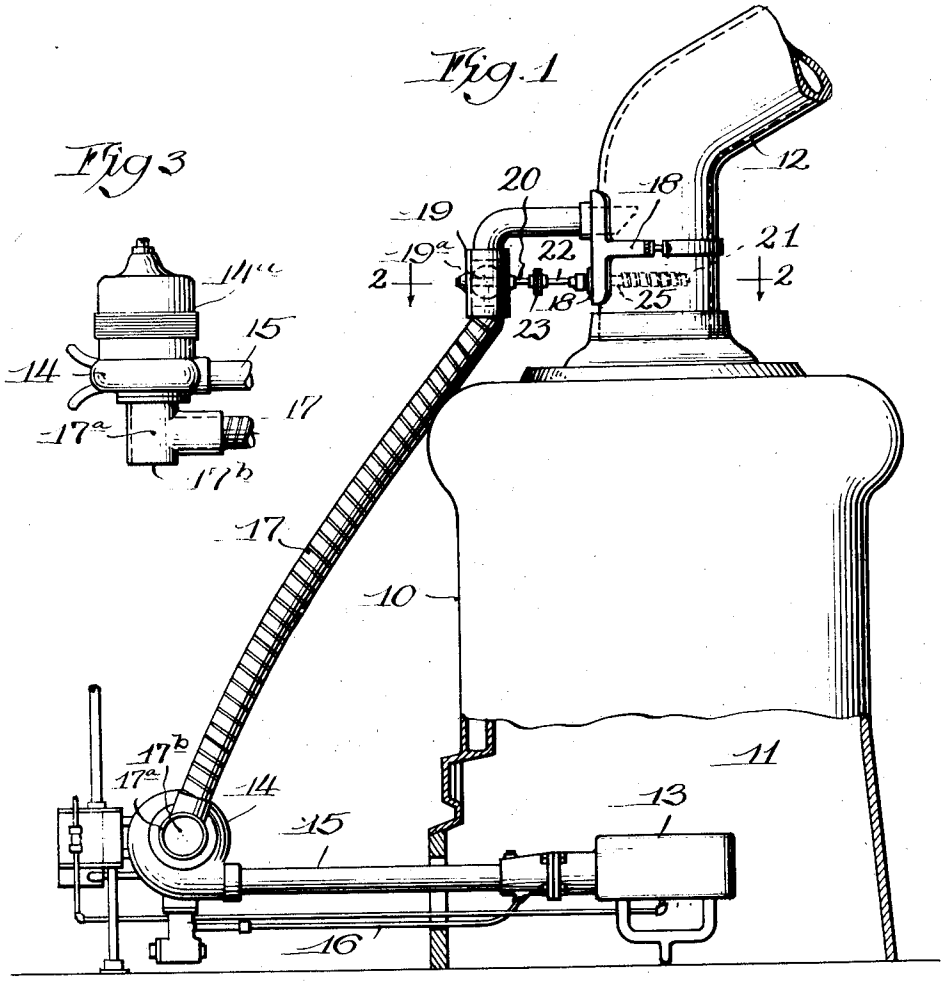


Fig. 3

Fig. 2

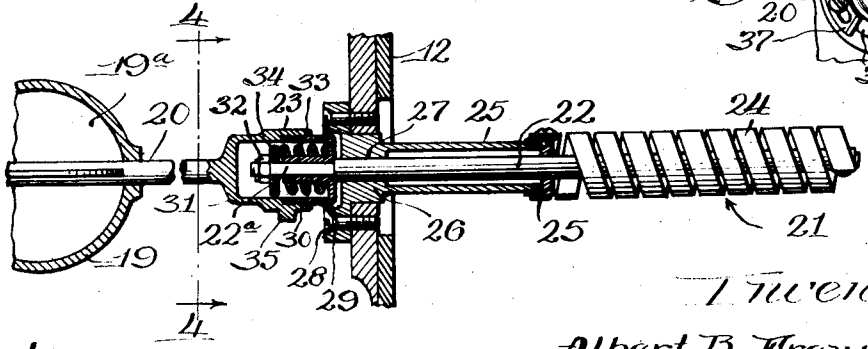
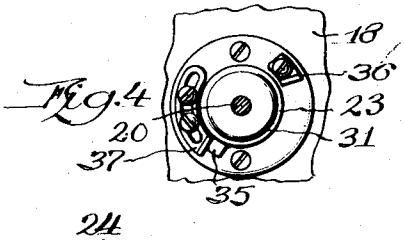


Fig. 4



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UNITED STATES PATENT OFFICE.

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LIQUID-FUEL-BURNING APPARATUS.

Application filed November 1, 1926. Serial No. 145,394.

This invention relates to improvements in liquid fuel burning apparatus more especially adapted for use with steam or hot water boilers or hot air furnaces for heating homes or other buildings, and consists of the matters hereinafter described and more particularly pointed out in the appended claims.

In the burning of liquid fuel, especially non-volatile or heavy hydrocarbons, the fuel is either atomized wholly or in part or is vaporized, and is then mixed with air and with the air is forcibly discharged into an open combustion chamber, wherein it is ignited and burned. The combustion chamber of the preferred modern construction is so formed with reference to the incoming mixture of air and of atomized or partially atomized or vaporized liquid fuel, that the flame is caused to swirl about in the combustion chamber in a substantially horizontal plane and to roll or wind upon itself within the combustion chamber so that the flame is practically confined therein until combustion is practically complete. Such method and combustion chamber are described in Letters Patent No. 1,284,182 to Doble, November 5, 1918, and in a patent granted to the present inventor, No. 1,379,008, May 24, 1921.

In an application for patent hereinbefore filed by me on the 6th day of August, 1925, Serial No. 48,464, I described a method for burning liquid fuel in furnaces, whereby the inert products of combustion are introduced with the air included in the combustible mixture of oil and air supplied to the burner in order to slow down or retard combustion in the confines of the combustion chamber, thereby softening the flame and reducing the noise attendant upon the burning of the fuel in such a combustion chamber.

In carrying out said method combustion supporting air alone is initially introduced with the fuel into the combustion chamber, the mixture is ignited and is thereafter burned within the combustion chamber, when combustion is practically complete and a maximum temperature of combustion has been obtained, there is thereafter injected with the air and in a predetermined ratio the products of combustion taken from some point above the combustion chamber. The proportion of products of combustion is such as to delay combustion and reduce the noise thereof without expanding the flame materially beyond the vicinity of the combustion chamber. The combustible mixture including the products of combustion continues to burn in this manner until by reason of a thermostatic control associated with the burner the supply of liquid fuel is cut off whereupon the flame goes out and the burner is idle until a combustible mixture is again supplied to the combustion chamber and ignited, whereupon follows the same cycle as hereinabove described.

The object of the present invention is to provide a novel and efficient device by means of which the introduction and supply of the products of combustion to the burner, in the manner intended by the process hereinbefore referred to, is brought about and controlled.

The advantages of the invention will appear more clearly as I proceed with my specification.

In the drawings:—

Figure 1 represents a side elevation of a familiar domestic furnace, with a liquid fuel combustion chamber mounted within the fire-box and a liquid fuel atomizer automatically controlled for spraying liquid fuel with air into said combustion chamber, the same being provided with my novel means for introducing and controlling the supply of products of combustion and air to the burner.

Figure 2 is a detail transverse section on an enlarged scale in a plane indicated by line 2—2 of Figure 1.

Figure 3 is a detail top plan view including the blower and its connection to the conduit for introducing the products of combustion.

Figure 4 is a vertical section through Figure 2 in a plane indicated by the line 4—4 of Figure 2.

In illustrating the invention I have shown it applied to the type of liquid fuel burning apparatus shown in my patent aforesaid, No. 1,379,008. Referring now to that embodiment of my invention illustrated in the drawings, 10 indicates a furnace of any usual construction provided with a fire-box 11 and with a stack 12 through which the products of combustion are discharged. 13 indicates a combustion chamber, which in this case is a heavy metal box-like structure adapted to confine the flame. 14 indicates an electric motor-driven fan or blower, by means of which fresh air is normaly discharged through a pipe 15 into the combustion chamber, said air acting in the example illustrated

to atomize the liquid hydrocarbon fuel (supplied by pipe 16 from any convenient, suitably controlled source of supply) prior to or as it is introduced into the combustion chamber 13. The electric motor 14ª which operates the blower, is controlled by a thermostat or other auxiliary automatic control, adapted to close and open the switch in the circuit of the motor and to actuate the ignition device, as by opening and closing the valve supplying a pilot flame in the combustion chamber. Said parts of the apparatus are now familiar and may be as described in my patent referred to and require no further illustration or description.

17 indicates a pipe or conduit of comparatively small cross section, which is adapted to introduce the products of combustion along with the air into the fan casing, whence it is discharged with the fresh air through the pipe 15. The conduit 17, as illustrated, is connected in any suitable manner as by a fitting 18 to the stack 12. The other end of said conduit 17 is connected to the fan casing at the eye of the blower 14 by a T fitting 17ª. Thus any products of combustion which pass through the conduit 17 will enter the blower casing and therein will be mixed with the air drawn into said casing at the open end 17ᵇ of the T fitting and will be discharged to the burner.

As will be understood, at the time the burner is ignited, there will be no products of combustion passing through the stack 12 which will therefore be cold. In the pipe 17 adjacent the stack 12 is interposed a tubular casing 19 containing a butterfly valve 19ª adapted to close or to open the passageway through the conduit 17. Said valve 19ª is fixed on a transverse spindle 20 rotatably mounted in the wall of the casing 19.

In the stack 12 adjacent the point of entry of the conduit 17 is located a thermostatic element 21. Said thermostatic element is of a familiar kind, consisting of a ribbon or band comprising two strips of metal of different coefficients of expansion, arranged in a spiral coil about a rod or shaft 22. The spindle 20 and the rod or shaft 22 are in alignment and are attached together by a coupling 23. One end of the ribbon 24 of the thermostatic element 21 is fixed to the rod or shaft 22 and its other end is fixed to a tube 25 having a flanged head 26 with a bearing aperture 27 for the rod 22. The head is fixed in an opening in the fitting 18 as by means of bolts 28. By this construction the ribbon 24 is non-rotative as a whole but the rod 22 is capable of a rotating movement in the bearing provided in the head 26.

The coupling 23 consists of the following. The rod 22 has a reduced end 22ª on which is mounted a cup 29 having a centrally apertured sleeve 30 which bears directly on the reduced part 22ª and being backed up against the shoulder formed at the end of the larger part of the rod 22. The spindle 20 has a cup 31 fixed to its end adjacent the rod 22 and said cup 31 is threaded upon the cup 29. 32 indicates a nut on the reduced end 22ª of the rod 22, and 33 indicates a coiled spring interposed between a washer 34 which backs up against the nut 32 and the bottom of the cup 29. It is manifest that by this construction the coupling 23 provides a friction connection betwen the rod 22 and the spindle 20.

On the cup 31 is a radial stud 35 which is adapted to operate between stops 36, 37 attached to the head 26. One of these stops 36 corresponds to the position of the spindle 20 when the butterfly valve is closed and the other stop 37 corresponds to the open position of the butterfly valve and is made adjustable so as to determine the extent of the opening movement of the butterfly valve.

In the operation of the thermostatic member, the rod 22 will rotate the spindle 20 by reason of its frictional connection therewith until the stud 35 strikes one of the stops whereupon further movement of the rod 22 under the action of the thermostatic element will be ineffective to further rotate the spindle 20 in that direction.

When in the operation of the apparatus the fan motor is started, fresh air is drawn in through the open end 17ᵇ of the T fitting and discharged with the fuel oil atomized thereby through the pipe 15 into the combustion chamber 13 where the combustible mixture is instantly ignited by a pilot light or other lighting device in a familiar manner. Combustion takes place with a white, hot flame which is substantially confined within the limits of the combustion chamber 13 as heretofore. The hot products of combustion passing up the stack and the radiant heat therefrom affect the thermostatic ribbon 24 and cause it to slowly uncoil. The uncoiling of the ribbon communicates a rotative movement to the rod 22 and through the coupling 23 to the spindle 20 so as to open the butterfly valve 19ª.

In this movement of the butterfly valve under the action of the thermostatic ribbon there will be admitted first a small then a gradually increasing proportion of the products of combustion with the fresh air into the pipe 15 to be discharged thereby into the combustion chamber to dilute the combustible mixture until a predetermined opening for the butterfly valve, determined by the position of the adjustable stop 37, has been reached, whereupon further movement of the butterfly valve is arrested notwithstanding the further uncoiling movement of the thermostatic ribbon.

The noiseless combustion, as described in my hereinbefore referred to previously filed application, then continues until under the operation of the thermostatic control, the ro-

tation of the blower is stopped and the supply of fuel to the combustion chamber ceases. The temperature in the stack falls and in the first 50 degrees fall of the temperature the thermostatic ribbon is effected to close the butterfly valve. This cycle is reproduced when the burner is again started.

In the construction embodying the present invention, the operation of the butterfly valve is very sensitive to the actual fall of temperature in the stack. The themostatic member is in the main effected only by the heat of the products of combustion.

As the change of temperature of the products of combustion in the stack is more rapid both in its rise and in its fall than at points in the furnace at or near the burner, the control of the products of combustion between temperature limits is made more definite and certain and the operation of the control valve will respond more promptly to temperature variations.

I claim as my invention:

1. In a liquid hydrocarbon fuel burning apparatus, in combination with a furnace and its stack, means for supplying a flame combustible to said furnace, a conduit for intermittently introducing the products of combustion from said stack with said flame combustible, a valve casing in said conduit, a normally closed valve in said casing, a spindle to which said valve is fixed, a thermostatic device in said stack, a rod operated by said thermostatic device, a friction coupling connecting said rod and said valve spindle and means for adjusting the opening movement of said valve.

2. In a liquid hydrocarbon fuel burning apparatus, in combination with a furnace and its stack, means for supplying a flame combustible to said furnace, a conduit for intermittently introducing the products of combustion from said stack with said flame combustible, a valve casing in said conduit, a normally closed valve in said casing, a spindle to which said valve is fixed, a thermostatic device operable upon a rise or fall of a predetermined number of degrees of temperature at any temperature in said stack, a rod operated by said thermostatic device, a friction coupling connecting said rod and said valve spindle and means for adjusting the opening movement of said valve.

3. In a liquid hydrocarbon fuel burning apparatus, in combination with a furnace and its stack, a combustion chamber and means for supplying a flame combustible to said combustion chamber, a conduit for intermittently introducing the products of combustion from said stack with said flame combustible, a valve casing in said conduit, a normally closed valve in said casing, a spindle to which said valve is fixed, a thermostatic device in said stack, a rod operated by said thermostatic device, a friction coupling connecting said rod and said valve spindle and means for adjusting the opening movement of said valve.

4. In a liquid hydrocarbon fuel burning apparatus, in combination with a furnace and its stack, a combustion chamber and means for supplying a flame combustible to said combustion chamber, a conduit for intermittently introducing the products of combustion from said stack with said flame combustible, a valve casing in said conduit, a normally closed valve in said casing, a spindle to which said valve is fixed, a thermostatic device operable upon a rise or fall of a predetermined number of degrees of temperature at any temperature in said stack, a rod operated by said thermostatic device, a friction coupling connecting said rod and said valve spindle and means for adjusting the opening movement of said valve.

In testimony that I claim the foregoing as my invention, I affix my signature this 28th day of October, 1926.

ALBERT B. FRENIER.