Sept. 29, 1925. 1,555,631

C. A. BROWN

SYSTEM FOR INITIATING AND MAINTAINING COMBUSTION

Filed Nov. 5, 1919

Fig. 1

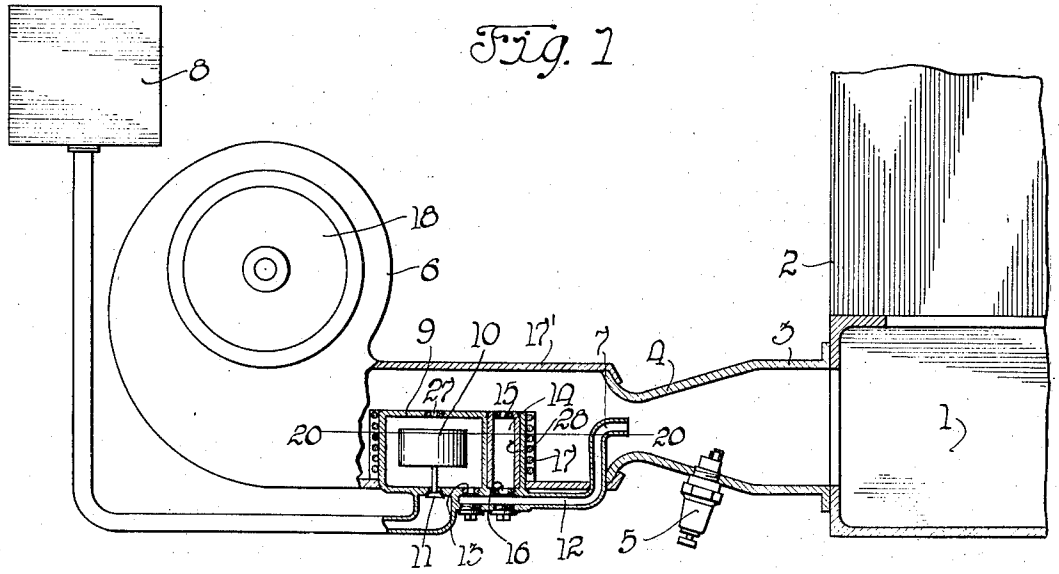
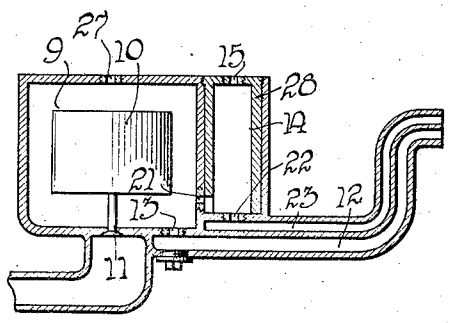


Fig. 3



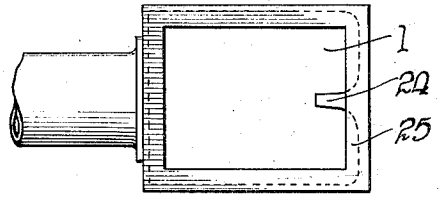


Fig. 2

Inventor
Charles A. Brown
By Brownell & Brownell
Attorneys

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UNITED STATES PATENT OFFICE.

CHARLES A. BROWN, OF HINSDALE, ILLINOIS, ASSIGNOR TO AMALGAMATED MACHINERY CORPORATION, OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

SYSTEM FOR INITIATING AND MAINTAINING COMBUSTION

Application filed November 5, 1919. Serial No. 335,957.

To all whom it may concern:

Be it known that I, CHARLES A. BROWN, a citizen of the United States, residing at Hinsdale, in the county of Du Page and State of Illinois, have invented a certain new and useful Improvement in Systems for Initiating and Maintaining Combustion, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to a method of and means for initiating and maintaining combustion of a mixture of atomized or pulverized fuel and air.

In burning atomized or pulverized fuel such as is secured by injecting a spray of liquid fuel into a blast of air, it is desirable that the air and fuel be proportioned so that the flame propagation is rapid and the fire is clean. During the normal operation of the fire a relatively lean mixture of fuel and air is required. While such a condition is best after the fire is once started and the fire-box is hot, it is not the best condition for starting the fire. A lean mixture will not ignite as readily as a richer mixture, and consequently if the mixture which is normally supplied to the fire-box for burning is to be ignited, considerable difficulty will be encountered. While a rich mixture is preferable for starting, it is not adapted for normal burning because it will give a smoky fire and too long a flame. On starting the walls of the fire-box and adjacent parts are cold and consequently a richer mixture will be required to compensate for the tendency to deposit on the cold walls and to give the additional heat required for heating the walls. Another important feature is the fact that the atomized fuel is not vaporized as freely in the cold air or in the cold fire-box as it is in the heated furnace with heat radiating from the walls. This is particularly noticeable in a firebox of the Doble type which presents a relatively small volume for a given rate of combustion and wherein a vortex action is produced by the current of incoming fuel and air striking a wall of the firebox.

In situations where the fire is automatically cut off and turned on by rise and fall of the steam pressure, conditions similar to starting are encountered, but differ in degree between starting and running. This is because of the variations in heat radiation from the fire-box walls. During the interval between periods of firing the fire-box cools off and this requires the mixture to be increased in richness to correspond in a measure to the degree of cooling of the fire-box in order to secure the best results. This is a feature which has been overlooked in the prior art.

I am aware that heretofore it has been proposed to provide means for producing separately a lean mixture for normal running and a rich mixture which is ignited by the electric spark, and which rich mixture after it is ignited, is then employed to ignite the lean mixture, the heat and flame of the rich mixture being sufficient to cause ignition of the lean mixture.

It is the aim of the present invention to provide means for automatically furnishing a rich mixture on starting the fire and for thinning the mixture after the fire is started to the desired proportions for a lean mixture for normal running.

The invention provides further, means whereby it is possible to govern the richness of the mixture on starting in accordance with the period of delay between periods of firing. To secure the desired adjustments I provide adjustable orifices governing the rate of fuel flow and adjustable containers governing the amount of fuel which may accumulate during idle periods or periods of low rates of withdrawal.

In order to acquaint those skilled in the art with the method and means employed in practicing my invention, I will now describe in connection with the accompanying drawings which form a part of the present specification, one manner of embodying the invention.

Figure 1 is a partly sectional elevation, illustrating one embodiment of the invention;

Figure 2 is a plan view of the fire-box; and

Figure 3 is a sectional view, illustrating a modified form of construction of the fuel chambers employed.

I provide a fire-box 1, of the vortex type, which fire-box may be employed for heat-

ing a boiler 2, or for any other purpose. A combustible mixture is discharged into the fire-box, through the conduit 3, the mixture being formed at or adjacent the venturi 4, and ignited as by means of the spark plug 5, which spark plug is preferably operated automatically. A blower or fan 6 forces air through the venturi 4 and into the fire-box 1 and up through the tubes of the boiler 2 or other heated device as may be desired. A nozzle 7 provides liquid fuel to be atomized in the blast of air. While this nozzle is illustrated as of the plain cylindrical type, it is obvious that it may be of concentric type, air bled or any other preferred form for breaking up the fuel into a fine spray. The liquid fuel is supplied from a tank 8, which is maintained under sufficient head, either actual gravity head or pressure head, to feed the fuel to the float chamber 9. The float chamber 9 is provided with the usual float 10 and valve 11 for maintaining a substantially constant level of liquid fuel within the chamber 9. The nozzle 7 is connected by means of a passageway 12, and a graduated orifice 13 to the interior of the float chamber 9. The top of the float chamber 9 is open either to the atmosphere or to the interior of the conduit 3, as may be desired. An auxiliary well or chamber 14 also opens into the conduit 12 for feeding the nozzle 7, this auxiliary chamber 14 communicating with atmosphere or with the interior of the conduit 3 through the graduated orifice 15 and communicating with the passageway 12 through the graduated orifice 16. The size of the accumulating well may be varied by providing interchangeable sleeves 28 for governing the amount of fuel which is thus accumulated. The sleeve 28 is threaded at its upper end into the metal of the shell. The orifices 13, 15 and 16 are formed in small plugs which have interchangeable screw threaded mounting in the walls of their respective chambers. The sizes of these orifices may therefore be readily calibrated for different degrees of flow by the mere substitution of different plugs having different sized orifices.

The chambers 9 and 14 are preferably heated by an electric heater such as a resistance wire surrounding these chambers, which resistance wire is normally subjected to a small flow of current. The result of this is a gradual heating of the contents of the chambers 9 and 14 and a rising of the temperature of the liquid contained therein so long as the liquid in said chamber is stationary. As soon as the liquid begins to move through these chambers the heating effect will be relatively ineffective. Thus, while the blower 6 is idle the liquid in the chambers 9 and 14 becomes warm to such a degree that when the device is started, vaporization of the fuel will be much easier and starting will be more certain. If desired, the current may be switched off of the heater when the motor driving the fan is operating and switched onto the heater 17 when the motor 18 is idle. Any desired amount of heating may be secured by suitable control of the current flow. As the heater lies in the air conduit 17′ no loss of heat occurs.

The operation of the device is as follows:

Liquid fuel from the tank 8 flows into the float chamber 9 until the level of fuel rises substantially to the level indicated by the line 20 on Figure 1. Liquid fuel flows through the orifice 13 into the conduit 12, filling the same, and rising through the orifice 16 into the auxiliary chamber 14 and filling the same. The fuel discharged from the nozzle 7, in Figure 1, upon starting the burner comes from two sources, namely the float chamber 9 and the starting well 14. The rate of flow from the float chamber 9 is governed by the size of the changeable orifice 13 and by the degree of suction placed upon the nozzle 7. In the device which I have illustrated, the float chamber 9 communicates through a graduated orifice 27 with the interior of the air conduit 17′ so that merely the difference in pressures and not absolute pressure affects the flow from the nozzle 7. The float chamber may communicate with atmosphere but the effect in that case is smaller.

The starting well tends to discharge at once as soon as the device starts to operate, thereby adding an increased amount of fuel to that discharged from the float chamber through the suction controlled orifice 13. The discharge of the starting accumulator may be extended over a greater period by restricting the inflow of air through the graduated orifice 15. As soon as the accumulation is discharged from the well 14 air passes through the orifice 16 and mingles with the discharge from the orifice 13 thereby reducing the flow from the said orifice 13 and producing a leaner mixture in the fire-box.

While the device is particularly adapted for vehicle work and is controlled by turning the motor off and on so that the motor and fan run at a predetermined speed while in operation, it has the capability of use in a system where the rate of burning fuel is variable. Thus while the fan is running at a lower rate the well 14, if properly designed, may accumulate a quantity of fuel to be employed for enriching the mixture when the fan is speeded up or accelerated to force the fire. The orifice 16 is large enough to permit the fuel in the well 14 to discharge with comparative freedom.

In Figure 3 I have shown how the rate of accumulation of the starting supply may

be governed to correspond with the length of time between intervals of firing. In this case the starting well 14 has its own discharge conduit 23. By properly graduating the orifice 21 the filling of the well 14 can be governed to correspond to the rate of cooling of the fire-box 1 so that the proper amount of fuel will accumulate in the well 14 to provide a correspondingly proper mixture for starting the fire when the blower 6 is again operated.

The orifice 13 is pressure controlled and feeds in proportion to the suction or difference of pressure. The orifice 22 first discharges the accumulated starting and accelerating charge due to the suction or differences of pressure and then it passes a mixture of air and fuel which comprises a flow of fuel due to the gravity head on the orifice 21 and a flow of air due to the suction or the difference in pressures. Hence for varying degrees of suction or difference in pressures the orifice 13 feeds a flow of fuel tending to make the mixture richer for greater speeds of the blower, while the orifice 22 feeds a flow of fuel which is progressively leaner with greater speeds of the blower.

The fire-box 1 is preferably of the Doble construction having a dividing wall 24 for producing two eddies at the sides of the fire-box, and the surrounding flange 25 tending to hold the flames in the fire-box to the desired degree. It is to be understood, however, that any suitable form of fire-box may be employed.

The novel form of feeding the liquid fuel to the blast of air, depends upon the use of the accumulating well 14, which provides a rich mixture on starting, this mixture becoming thinner, due to the withdrawal of the accumulated charge, and due further to the admission of air through the openings 15 and down through the graduated orifice 16 or 22.

I do not intend to be limited to the precise details of construction shown and described, as it is apparent to those skilled in the art that modifications may be made in the embodiment of the invention without departing from the invention as defined in the following claims.

I claim:

1. In a liquid fuel burner, the combination of a fire box, a blower for blowing a blast of air into said fire box, an air conduit connecting said blower with said fire box, means for introducing fuel into the blast, said means comprising a constant level fuel supply chamber and a secondary chamber for accumulating a starting supply, and means connecting said conduit with the upper areas of both of said chambers whereby to control the air pressure therein.

2. In combination, a blower, a fire-box, a conduit between the blower and fire-box, a spraying device for spraying liquid fuel into the blast of air in the conduit between the blower and the fire-box, means for igniting the mixture in the fire-box, a constant level liquid supply chamber communicating with the spraying device, an auxiliary well open at its upper end and communicating by a graduated orifice with the spraying device, said auxiliary well being filled with liquid fuel from the constant level chamber during periods of idleness.

3. In combination, a blower, a fire-box, a conduit connecting the blower and the fire-box, a spraying device for spraying liquid fuel into the conduit between the blower and the fire-box, a tank for supplying liquid fuel to said spraying device, and heating means disposed in said conduit and adapted to supply heat to the liquid fuel during periods of idleness of the blower, whereby the liquid fuel will be warmed upon starting of the blower.

4. In combination, a blower, a fire-box, a nozzle, a main liquid fuel supply tank for the nozzle, a tank between the main tank and the nozzle for accumulating a relatively small quantity of liquid fuel and heating means for said relatively small tank, said small tank being adapted to accumulate heat during periods of idleness whereby a readily vaporizable mixture will be furnished to the fire-box upon starting of the blower.

5. In a fuel feeding device a float chamber for maintaining a predetermined level of liquid fuel, a nozzle communicating with the bottom of the chamber, an open accumulating well also communicating with said nozzle, and a sleeve for lining the well to govern the liquid content of the same.

6. In a fuel feeding device a float chamber, an orifice in the bottom of the chamber for discharging liquid fuel, an air conduit into which the liquid is discharged, a well having means for accumulating a supply of fuel during periods when the flow of air is below a predetermined minimum and for discharging the same into the conduit when the flow of air is above said minimum, and a sleeve for lining the said well to govern the liquid content of the same.

7. In combination a firebox of the Doble type, a blower for blowing a blast of air into the firebox and against a wall of said firebox to produce a vortex or whirl, means for injecting finely divided fuel into the blast said means comprising a source of constant supply and a stored supply which is accumulated during idle periods and is given up upon starting.

8. In combination a firebox of the Doble type, a blower for blowing a blast of air into the firebox and against a wall of said firebox to produce a vortex or whirl, means for injecting finely divided fuel into the blast

said means comprising two sources of liquid fuel one feeding liquid fuel in accordance with the blast and the other feeding a starting charge during starting for the purpose of providing a richer and more easily ignitable mixture and to warm up the firebox upon starting, said latter source drawing from a constant level chamber and feeding under the aspirating effect of the blast.

In witness whereof, I hereunto subscribe my name this 30th day of October, A. D. 1919.

CHARLES A. BROWN.