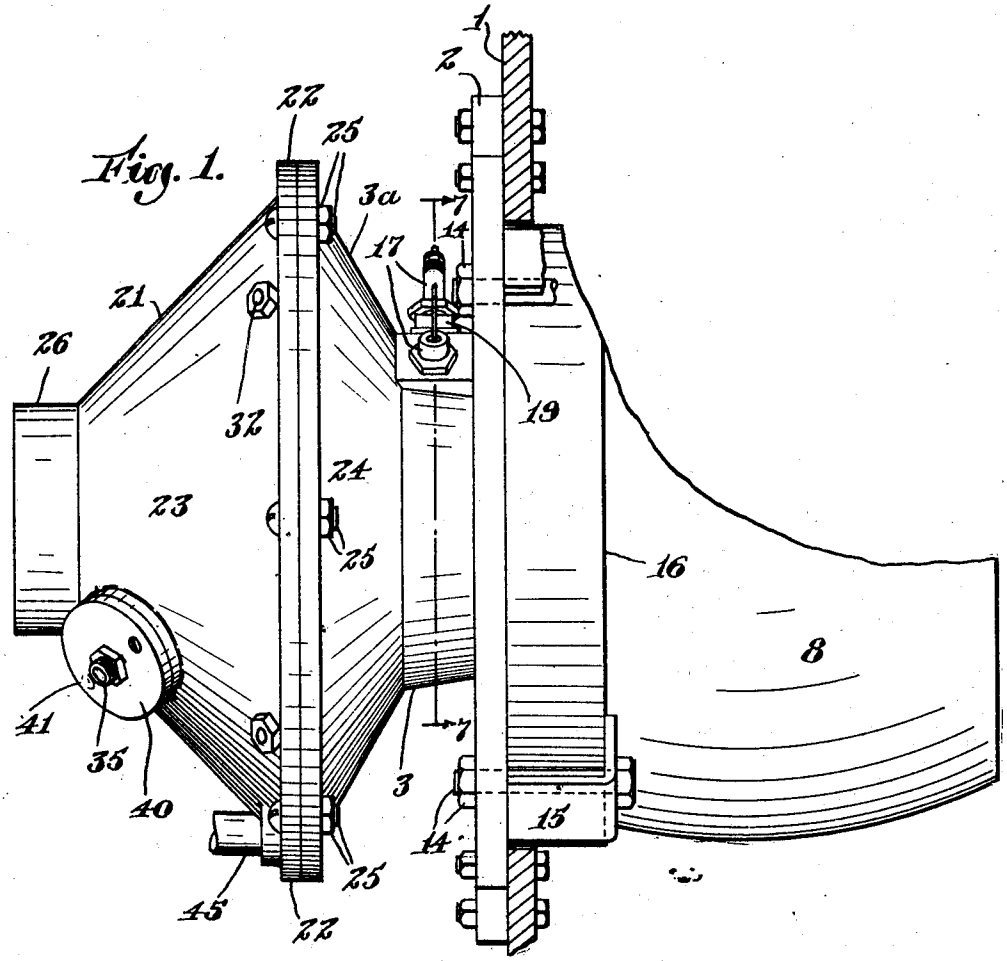
Jan. 8, 1929. 1,698,258

J. T. COOK

METHOD OF COMBUSTION

Filed July 16, 1926 2 Sheets-Sheet 1

Fig. 1.



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by his Attorney,
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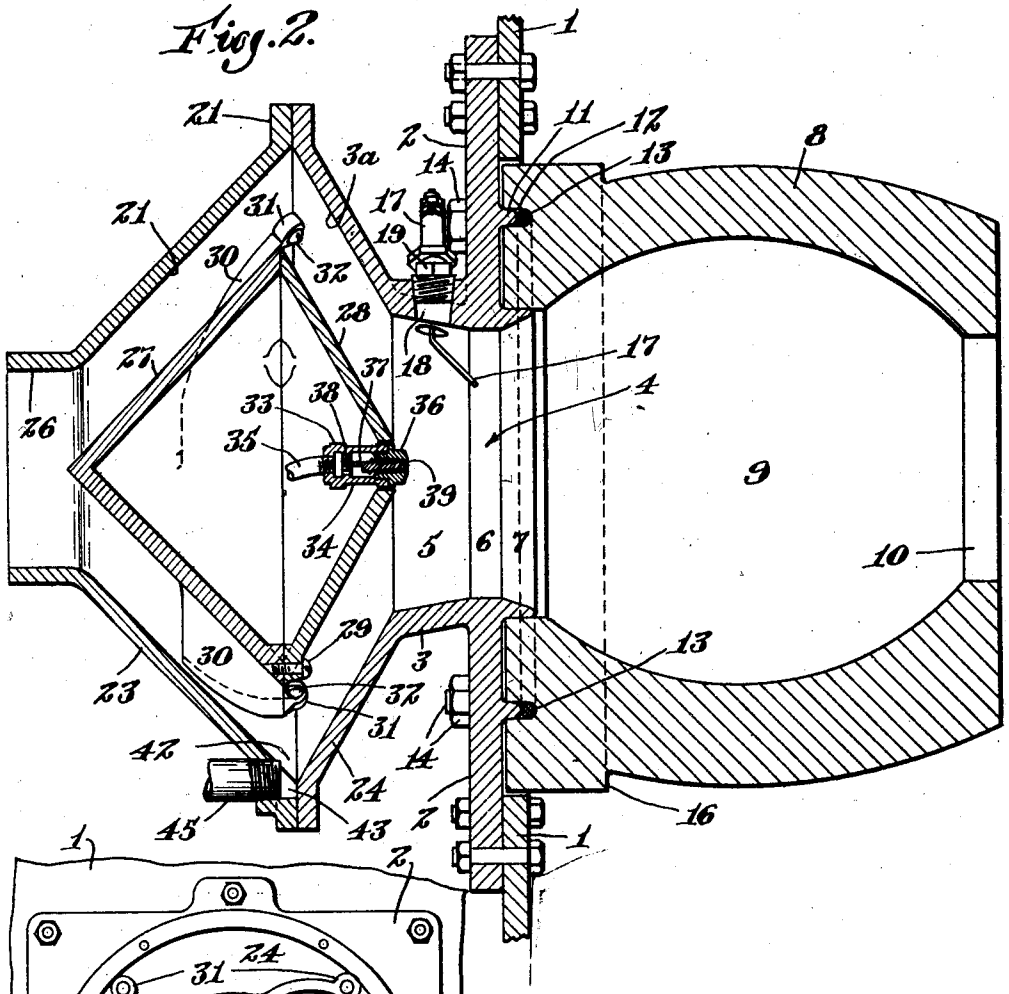
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METHOD OF COMBUSTION

Filed July 16, 1926 2 Sheets-Sheet 2

Fig. 2.



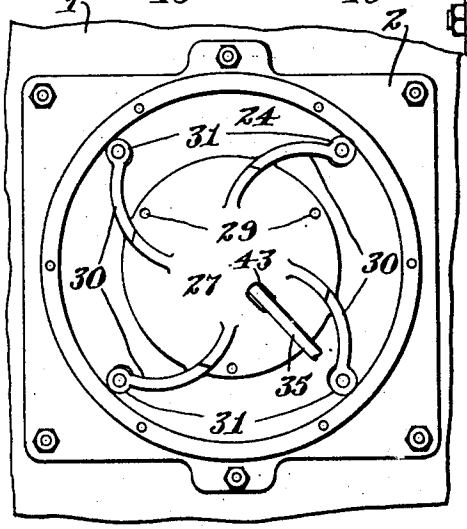


Fig. 3.

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Patented Jan. 8, 1929. 1,698,258

UNITED STATES PATENT OFFICE.

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METHOD OF COMBUSTION.

Application filed July 16, 1926. Serial No. 122,859.

My invention relates to oil burners, and has for its object the provision of apparatus whereby liquid distillate fuel oils may be more efficiently burned, through not only a perfected mixing of air and atomized oil for combustion, but also a perfected combustion of carbon particles before the desired flame or mass of heated gases emerge from the apparatus for heating purposes.

By means of my apparatus, combustion of exceptional merit results; the flame is carbonless, that is, there is an entire absence of so-called "sparklers", or particles of unconsumed carbon, so common to imperfect combustion; the flame produces a greatly increased amount of heat per pound of oil; quietness of operation is insured; economical results in cost of operation follow; the temperature of the gases is such that they will heat all kinds of heating apparatus efficiently; will heat kilns without discoloration of commodities, due to improper combustion of gases which are detrimental to the finished product; the flame, being carbonless, is hotter; the apparatus to be heated, say, a boiler, has carbonless heated surfaces, which more readily absorb the heat of the mass of heated carbonless gases and becomes more efficient apparatus; and less heat is lost, as is shown by the fact that a lower smoke-stack temperature is observed; any carbon that may be produced for a given period when the burner is ignited, or when the burner is shut down, is quickly and readily burned off, after the burner is under way.

Applicant's method makes use of two theories:

The first, that the dispersal of the atomized particles of oil, in their movements away from the nozzle of the burner, must remain substantially unaffected by the current of air in which they become suspended; in other words, the dispersing particles of oil, once the oil is atomized, must, during dispersion, remain atomized and suspended in the moving air without being brought into contact with each other, or crushed together, or become congested by the moving air, and thus form themselves into fewer or larger particles of atomized oil before proper ignition occurs, to adversely influence the primary flame.

That this result may follow, there are provided a large volume of air under low pressure and having a slow rotary movement, inward and forward in relation to the axis, and a body of finely atomized particles of oil having, in relation to said axis, a rotary outward and forward movement, under high pressure, the air and the oil meeting in a manner that permits the volume of air to envelope and pass through the atomized oil and take its general movement, without any congestion of the atomized dispersing particles, being brought about by the slow moving air. The consequence is the production of a perfectly uniform combustible mixture.

The second theory is: that any particle of oil unconsumed, say, by reason of the low temperature of the initial part of the flame in which it may be, for example, that adjacent to a comparatively cool surface of the burner, must, before emerging from the burner, pass through a temperature sufficiently high to cause said atomized particles of oil and the oxygen in the heated flame, to combine and discharge the proper heated gases.

That this result may be obtained, the heated gases, air, and any unconsumed oil particles, are caused to expand, contract and to pass spirally through an incandescent flame-chamber having a temperature that, without fail, will cause any carbon particles there may be in the gases, to unite with the oxygen and be burned, before that part of the flame in which the particle is, emerges from the flame-chamber of the burner, into proximity to the body which is to be heated by the flame or heated gases. Because of this, we have available in the flame or heated gases, the maximum amount of heat units obtainable.

In the drawings, illustrating the principle of my invention and the best form now known to me for attaining the results of applying these theories,

Fig. 1 is a side elevation of the burner attached to the ashpit plate of a heating apparatus.

Fig. 2 is a longitudinal vertical section of Fig. 1.

Fig. 3 is a front elevation, reduced in size, of Fig. 1 with front conical shell removed.

Fig. 1 shows my burner, one-half size.

My burner is here shown removably mounted upon, and in, an ashpit plate 1, Figs. 1 and 2, of a heating apparatus, by means of a cast iron plate 2, bolted thereto and forming a base of the pipe 3 of a cast iron funnel, that portion within the pipe forming a mixing chamber 4 for the air and oil to be consumed.

The entrance portion 5 of the pipe is slightly concave, while the middle portion 6 is cylindrical, and the outer portion 7 is oppositely concave.

An ovoidal block of fire brick 8, Figs. 1 and 2, has within it, a similarly shaped flame-chamber 9, with open ends, the diameter of the inner end opening corresponding with that of the outlet of the mixing chamber, while the opposite or free end opening 10 in the flame-chamber is slightly smaller in diameter.

On the inner face of the base plate, is a circular rib 11 integral therewith, while in the face of the outer end of the block 8 is a circular slot 12 corresponding to the rib, but slightly deeper than the depth of the rib and designed to engage said rib. When in operative engagement, a strip of asbestos packing 13 is compressed in the open space between the rib and the slot, by means of bolts 14 passing through straps 15 that engage a square shoulder 16 around the outside of the inner end portion of the block 8.

It may be noted here that the lower half portion of the block 8 is thicker than the top portion. This increases the strength of this saucer or pan-shaped portion of the chamber, and reduces the chances of a fracture, due to great heat, through which fracture unburnt oil, if any, in the saucer, would seep and collect in the furnace, and form gases that are subject to ignition when the burner starts.

In the top of the conical pipe portion 3, Figs. 1 and 2, of the funnel 3^a are mounted, in suitable openings, two electrical terminals 17 for ignition purposes. Between these openings is a threaded peekhole 18 and plug 19 to enable observation of conditions within the mixing chamber 4.

Adjacent to the outer edge of the cast iron funnel 3^a, is a second cast iron funnel 21 of somewhat similar form, the base 22 of the conical portion 23 having the same diameter as that of the other cone 24 and being secured together by bolts and nuts 25. It may here be noted that the angularity of the conical surfaces of funnel members 21 and 3^a bear to the longitudinal axis of the burner, is respectively 45 degrees and 60 degrees. The diameter of the outer air pipe portion 26 of the outer funnel 21 is somewhat less than that of the mixing chamber 4. An air pipe from a blower, not shown, is connected to the inlet pipe 26.

Located within the adjacent cast iron funnels, are two cast iron hollow cones 27, 28, Fig. 2, base to base, and secured together by bolts 29; their conical surfaces being parallel to those of the funnels and their apexes being in said longitudinal axis of the funnel.

Upon the outside conical surface of the inside outer cone 27, Fig. 3, are four right-handed curved blades 30 cast integral with the cone and contacting the inner surface of the outside cone 23. The end portion of each blade has a head 31 which contacts said surface and has therethrough a hole whereby a bolt and nut 32 secure said two abutting cone members 27 and 28 to the outer funnel 21.

In the pointed portion of the smaller cone 28, Fig. 2, pointing into the mixing chamber 4, is an orifice in which is mounted an oil nozzle 33 of particular construction. This nozzle consists of a cylindrical brass casting 34, into the rear end of which is screwed an oil supply pipe 35. Into the front end portion is screwed a cap 36 for the reception of a correspondingly tapered double-threaded screw spindle 37, the threads of which are right-handed and contact the sides of the opening, the rear of the spindle resting in a guide 38 formed in the cylinder. Longitudinally through the end of the cap, is a very small circular outlet 39 for the oil.

A catch basin 42, with a drip 45, Figs. 1 and 2, is formed by the junction of the bottom portions of the adjacent outside cones 23 and 24, for the reception of any unburnt oil, dripping, for any reason, from the nozzle 33, or flowing back from the mixing chamber 4, or from the flooded flame chamber 9.

The operation of my invention is as follows:

It is to be understood, that this burner is operated by the usual power methods, not shown, namely an air blower of sufficient capacity to supply the necessary air under proper pressure for the maximum capacity of the machine; also an oil pump capable of furnishing the desired amount of oil under proper pressure demanded for the proper atomization of the oil; and a drip pan to receive oil through a suitable pipe connected with the outlet of the oil catch basin and to stop the operation of the burner through an automatic control, not shown.

To start my burner in operation, the air blower and the oil pump are set in motion. With the particular burner illustrated and described herein, an initial pressure of, say, a third of a pound is imparted to the air, the amount of air delivered to the burner being, say, about 20 cubic feet per minute; while the oil pressure is at about 30 pounds, and the amount of oil delivered is about one and a quarter gallons per hour, or 1/20 of a gallon per minute.

The air from the blower flows through a pipe, not shown, into the pipe 26 of the outer funner 23, of the air tube, and is at once deflected outwardly by and between the conical funnels or air directors 23 and 27.

In its passage through, and between the funnels, it is also deflected by the blades 30, in a curved course to the right, at an angle of about 45 degrees with the longitudinal axis of the burner. The air thus has imparted to it, a slight forward and outward whirling motion.

It is to be noted that the cubical contents of this portion of the air passage, per inch of length, is somewhat greater than that of the main supply pipe 26, from the burner.

After the air leaves this outwardly enlarged portion of the funnel 21, it strikes the inside of the cone 24, and is deflected inwardly between the two cones 24 and 28, thereby, at an angle of about 60 degrees with the longitudinal axis; and in its movement between the two conical faces, the air whirls both forwardly and inwardly between said conical surfaces, and into the mixing chamber 4, where it assumes a forward spiral movement.

But at the same time, the pump is delivering oil through the oil pipe 35 and nozzle 33 under said pressure of about thirty pounds, and at said rate of 1/20 of a gallon per minute, this oil emerges from the oil nozzle in a mechanically atomized state in the form of a hollow cone, rotating to the right, and advancing into the mixing chamber.

In short, here in the mixing chamber, the air in its forward and spiral movement, and the oil in its rotary conical movement, meet and intermingle, but yet acquire the same general forward spiral movements, while the volume of the air is so great and its velocity so small, that its commingling with the dispersed particles of atomized oil, does not interfere with the dispersal of the fine particles of oil in the air, but conduces to the complete and perfect mixture of the air and oil particles, at the time and place of ignition.

It is again to be observed that, while the capacity of the air channels between the two pairs of cones 23 and 27 and 24 and 28 is greater than that of the main supply pipe 26, the capacity of the mixing chamber 4, is about twice that of the main air supply pipe; and that all of the operation, so far described, shows how the apparatus furnishes the necessary amount of air, gives it the desired directions and speeds without diminishing the volume of air necessary to insure the proper amount of oxygen for perfect combustion without, at the same time, destroying the atomization of the oil.

At this point, ignition is brought about by the completion, by suitable means, of an electric circuit through the terminals 17. Combustion begins; the flame comes back to about one-quarter of an inch of the cap 39 of the nozzle, and extends forward into and through the flame chamber 9, and emerges from the outlet 10. At first, the flame is short and red in appearance, due to the low temperature of the apparatus, especially that of the flame chamber; but, in a very short time, the character of the flame changes to a clear incandescence which, if followed by the eye for a period of one or two minutes, becomes transparent and bluish in tint, and absolutely clear of anything that would destroy perfect combustion conditions.

It will be noted that, immediately after ignition, the burning forwardly spirally moving gases are contracted and confined in the mixing chamber 4, and then released into the flame chamber 9, expanding as they proceed forwardly up to the centre of the chamber, and contracting from the center of the chamber, to the outlet 10.

Now what is commonly known as an "air jacket", is found to surround the flame of an oil burner; it is most objectionable as it cools the flame, and hence reduces its efficiency. Air jackets must, therefore, be removed; and the form of my flame chamber is such, that it will accomplish this result, by causing the spirally advancing hot gases to expand and then contract, and be subjected to the intense heat given off by the flame chamber; the air jacket disappears, and any and all unburnt particles entrained in the current of gases, are entirely eliminated, thus obtaining the discharge from the flame chamber 9, of gases of very high temperatures, clean and without carbon.

It is of course to be understood that, while I have stated the approximate amounts of air and oil, and their respective velocities, used in illustrating the operation of my invention, these approximations may be varied to suit various conditions that may arise, so long as the principle or method of my invention is employed to obtain carbonless combustion.

Realizing that the spirit of my invention may be embodied in many different forms without departure therefrom, and desiring to protect my invention in the broadest manner legally possible,

What I claim is:

The method of obtaining complete combustion of oil and air, before the resulting hot gases are employed for heating purposes, consisting in providing a continuously forwardly rotating cone of rapidly dispersing particles of oil under high pressure; and an oppositely disposed forwardly rotating cone of air moving slowly under low pressure; said cones of oil particles and air meeting at an angle, the air passing through said cone of oil particles, and into the interior, without interfering with the atomization and dispersal of said oil particles; in laterally confining said body of slowly and spirally moving air, and particles of oil dispersed therein, in igniting the same; in causing the said ignited spirally moving mixture to expand and to contract laterally to complete combustion; and then, in releasing the laterally confined hot gases, for heating purposes.

In testimony whereof I hereunto affix my signature.

JOHN T. COOK.