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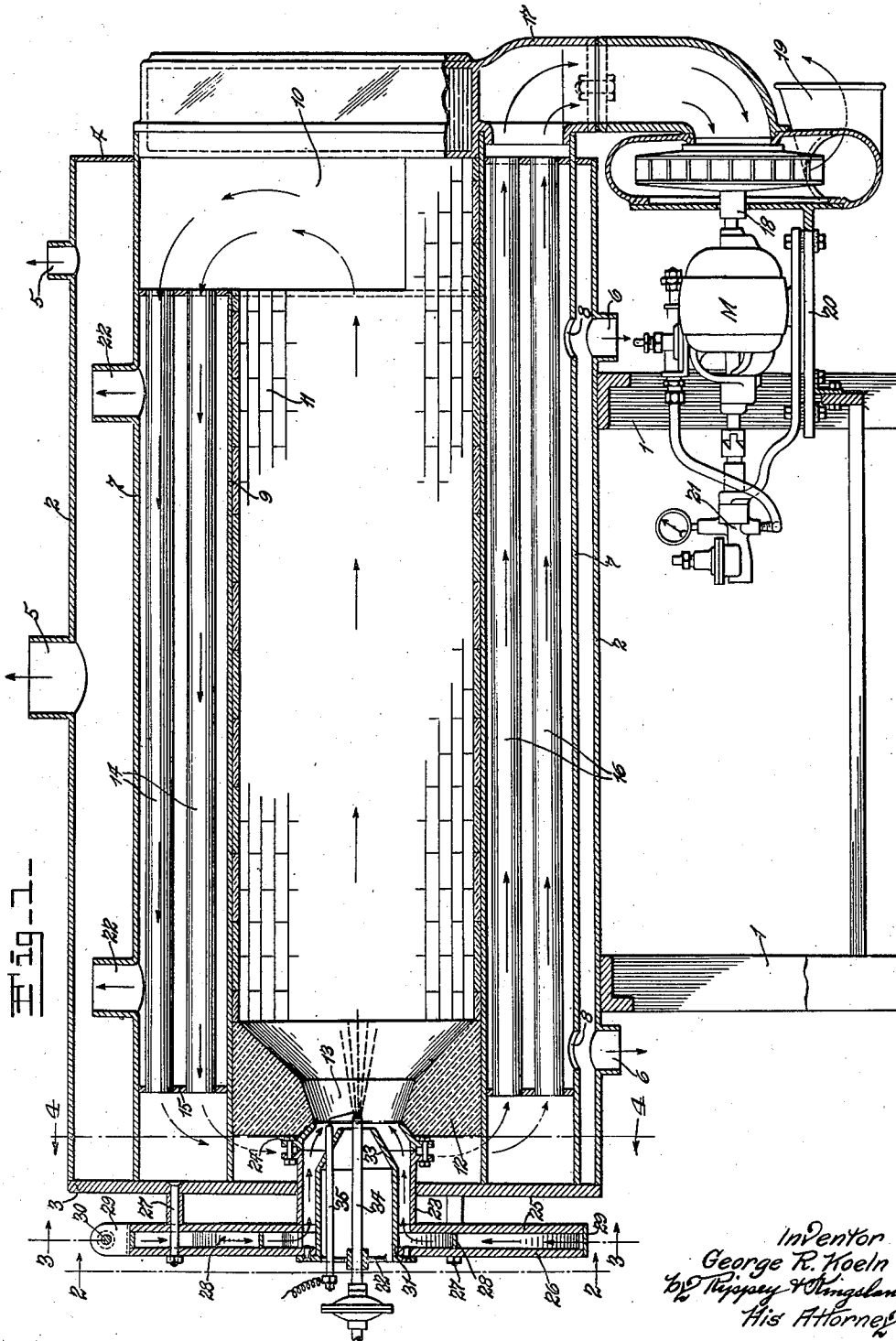
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2,053,003

COMBUSTION APPARATUS

Filed May 28, 1932

2 Sheets-Sheet 1



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Fig. 2.

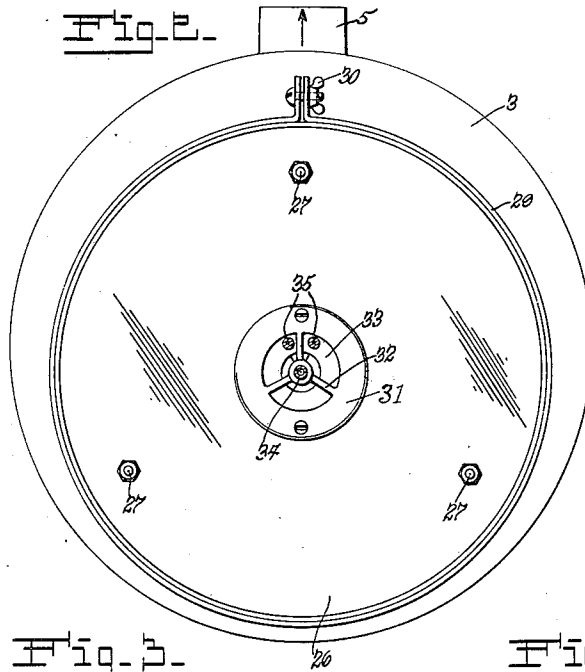


Fig. 3.

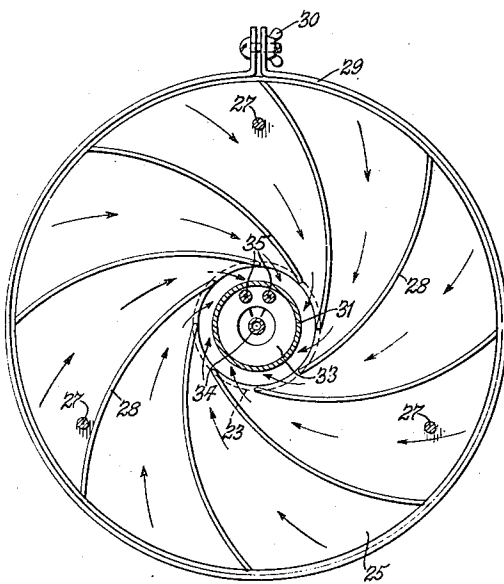
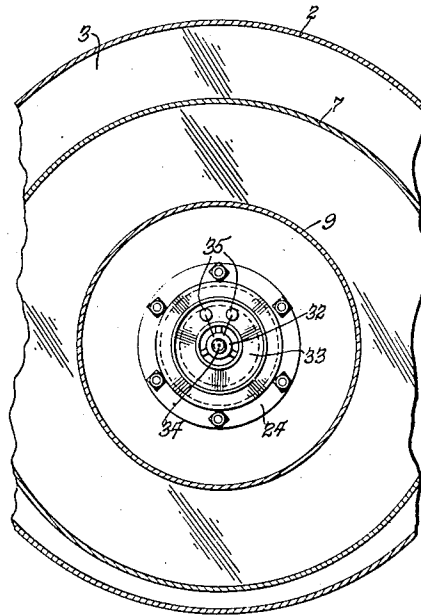


Fig. 4.



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UNITED STATES PATENT OFFICE

2,053,003

COMBUSTION APPARATUS

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Application May 28, 1932, Serial No. 614,976

5 Claims. (Cl. 158—1.5)

This invention relates to improvements in combustion apparatus; and consists in the novel construction hereinafter disclosed.

An object of the invention is to provide a combustion apparatus in which oil is mixed with a primary and secondary supply of air and drawn through the combustion chamber in a manner to increase the efficiency of the apparatus, so that a greatly increased quantity of fuel may be burned within a reduced space, thereby minimizing the overall dimensions of the apparatus.

Another object of the invention is to provide an apparatus of the class mentioned in which fuel in the form of oil is injected into a combustion chamber with a supply of primary and secondary air to initiate and complete combustion and then the products of combustion withdrawn from the combustion chamber through a tortuous passage, increasing the heat transfer surface commensurate with the amount of oil injected into the combustion chamber.

Another object of the invention is to provide an oil burner associated with a combustion chamber and means for causing travel of currents through said chamber, with provision for supplying secondary air for combustion in such a manner as to promote substantially complete combustion within the combustion chamber, together with means for withdrawing the products of combustion through conduits leading from the combustion chamber, said conduits being in heat exchange relation with the medium to be heated.

Additional advantages of the construction will be apparent from the following detail description thereof taken in connection with the accompanying drawings, in which—

Fig. 1 is a longitudinal section through the apparatus.

Fig. 2 is an end elevation taken substantially on the line 2—2 of Fig. 1.

Fig. 3 is a vertical section taken on the line 3—3 of Fig. 1.

Fig. 4 is a vertical section taken on the line 4—4 of Fig. 1.

In the embodiment of the invention as illustrated in the drawings, the apparatus is shown as including a support 1 upon which is mounted an outer shell 2 having a front plate 3 and a back plate 4. The outer shell 2 is equipped with the usual risers 5 and drain openings 6, it being understood that the return conduits may be connected into the outer shell at any suitable point, preferably on the side thereof. Within the shell 2 is an inner shell 7 arranged eccentrically with respect to the shell 2 to provide an enlarged steam space

at the top of the boiler and a preheating feed water jacket around the shell 7. Water from the space between the outer shell 2 and the inner shell is fed through openings 8 into the inner shell.

The combustion chamber 9 is concentrically mounted within the shell 7 and abuts against the head plate 3 at its forward end, but the upper segment of the combustion chamber shell 9 terminates short of the back plate forming a vertically extending combustion chamber 10. The combustion chamber shell 9 is provided with a refractory lining 11 and, at its forward end, with a refractory heat block 12 having an opening 13 in the form of a truncated cone with flaring inner walls, as clearly illustrated in Fig. 1.

The products of combustion from the combustion chamber are withdrawn through a series of spaced fire tubes 14 occupying the upper segmental space between the shells 7 and 9 and extending from a header 15 to the inner wall of the chamber 10. The header 15 is spaced inwardly from the head plate 3 forming an annular chamber that communicates with a second series of fire tubes 16, so that the products of combustion exiting from the tubes 14 pass downwardly through the chamber at its forward end and return through the tubes 16, which open at their rear ends into a chamber formed by a fitting 17. A suction blower 18 is connected with the fitting 17 and discharges into a stack connection 19. The suction blower 18 is driven by a motor M conveniently mounted below the shell 2 on a support 20 carried by the lower frame of the apparatus. The motor M, in addition to operating the suction blower, also may be operatively connected with a fuel pump 21 for supplying fuel to the burner nozzle.

It will be understood that the returned water or condensate, as well as the raw water supply, is introduced into the space between the shells 2 and 7 and rises within the shell 7 to a point approximately at the top of the shell and over the tubes 14. Both the tubes 14 and 16 are, therefore, in heat exchange relationship with the water circulating in the boiler and, since the hottest part of the body of water will be at the top of the shell 7, the water vapor will discharge from the shell 7 through the pipes 22 into the vapor space at the top of the shell 2, from which it may be conducted for use through the risers 5.

The form of boiler described provides an efficient embodiment for the combustion apparatus because the fuel fed to the combustion chamber

is rapidly burned at a high temperature, substantially complete combustion taking place in the combustion chamber, the full heat transfer effect being conserved by passing the products of combustion endwise in both directions of the boiler by the suction device communicating with the return fire tubes.

Thus, a suction draft is created throughout the combustion chamber, causing a rapid velocity through the combustion chamber and through the fire tubes and, additionally, preventing the formation of pockets of the explosive mixture within the combustion chamber. In addition to providing for the efficient combustion of the fuel, the form of boiler disclosed also prevents the accumulation of a rich combustible mixture in the combustion chamber in the event of failure of ignition of the burner.

The form of boiler described is the most efficient construction for the embodiment of the novel burner apparatus, although other forms of boilers may be employed with suction draft connections by which a part at least of the efficiency of the invention may be attained.

The firing head in which the primary novelty of the invention resides includes a secondary air tube in the form of a cylindrical casting 23 that extends through an opening in the head plate 3. On the inner end of the casting 23 is a director ring 24 removably connected with the inner end of the tube so that it may be readily replaced. The director ring has inwardly inclined walls and fits into the outer end of the opening 13. A cylindrical chamber formed from spaced circular plates 25 and 26, supported on the head plate 3 by means of bolts 27, is in communication with the outer end of the tube 23.

A series of curved plates 28 are mounted in and extend across the space between the plates 25 and 26 and form a series of outwardly flaring curved chambers (Fig. 3). The outer ends of these chambers open to atmosphere through the space between a band 29 and the peripheral edges of the plates 25 and 26. The inner ends of the plates 28 are spaced apart, forming a series of restricted openings arranged annularly that communicate with the outer end of the tube 23. A band 29 is mounted around the peripheries of the plates 25 and 26 and has its ends connected by a thumb bolt 30. The band 29 is loose upon the plates 25 and 26, leaving a narrow space between said band and the peripheries of said plates for the passage of air into the chambers formed between said plates 25 and 26 by the plates 28. The thumb bolt 30 may be tightened or loosened in order to reduce or enlarge the space between the band 29 and the edges of the plates 25 and 26 and thereby regulate the amount of air that may pass therethrough. The size of the space between the band 29 and the peripheral edges of the plates 25 and 26 is small, such space shown in Figs. 2 and 3 being somewhat exaggerated.

Within the tube 23 is a second tube 31 constituting the primary air supply. The tube 31 is open at its outer end and in the opening a spider 32 is fitted. The primary air supply enters between the arms of the spider 32 and is delivered through the inwardly tapered end 33 of the tube 31. The oil nozzle 34 extends axially through the tube 31 and terminates inwardly a slight distance from the inner edge of the tube 31.

In operation, the suction on the combustion chamber draws air into the primary air supply tube 31, which mixes with the oil ejected from the nozzle 34, forming a combustible mixture

that is ignited by the ignition devices 35. The secondary air supply is drawn down through the chambers formed by the plates 28 and is given an initial rotary movement. The rotary movement thus imparted to the incoming air currents causes a circular movement of the air currents as they pass through the space between the tube 23 and the tube 31 and, as the air is emitted from said space at the inner end of the tube 23, it continues to rapidly revolve and mix with the combustible mixture of atomized oil and primary air. The entire burning mixture of atomized oil and air is rapidly drawn through the combustion chamber with a circular movement, so that the burning volume of oil and air maintains a circular and longitudinal movement against the refractory walls of the combustion chamber. The rapid movement of the burning mixture imparts to the refractory walls a high temperature, promoting rapid combustion of substantially all of the oil before it reaches the chamber 10, so that only dry products of combustion enter the tubes 14, thus preventing the deposit of any substantial amount of carbon in the tubes and maintaining free passageways for the circulation of the products of combustion at a high temperature in their heat exchange relationship with the water in the boiler.

From the foregoing description, it will be understood that a combustion apparatus of high efficiency has been provided, and that the structure may be made extremely compact.

I am aware that the invention may be modified in numerous particulars without departing from the spirit and scope thereof. I do not limit myself, therefore, to the exact construction shown and described, but what I claim and desire to secure by Letters Patent is:—

1. In a combustion apparatus, the combination with a combustion chamber having an inlet opening, of a burner head comprising a primary air tube terminating adjacent said inlet opening and having unobstructed communication therewith, a fuel nozzle discharging into said inlet opening, a secondary air tube surrounding said first named tube and connected at one end with the inlet to the combustion chamber and forming a tubular chamber that discharges air only into said inlet opening, an air inlet chamber having a substantially enlarged chamber with respect to said secondary air tube and connected with the outer end of said secondary air tube and extending normal to the axis of said secondary air tube, and curved vanes in said air inlet chamber for imparting a spiral movement to the air currents in said air inlet chamber and in said secondary air tube.

2. In a combustion apparatus, the combination with a combustion chamber having an air inlet opening, of a burner head comprising a primary air tube discharging into the inlet opening of the combustion chamber, a fuel nozzle extending axially through said primary air tube, igniting means mounted adjacent said nozzle, a secondary air tube surrounding and spaced from said first named tube and connecting with the wall of said inlet opening of the combustion chamber, a casing connected with and opening into the outer end of said secondary air tube having a greater diameter than said secondary air tube and being open at its periphery, and walls in said casing forming inwardly converging chambers which discharge tangentially into said secondary air tube.

3. In a combustion apparatus, the combina-

tion with a combustion chamber provided with an inwardly flared inlet opening, of a burner head comprising a primary air tube disposed axially with respect to the inlet opening of said combustion chamber and having a discharge end adjacent thereto, means for delivering oil under pressure in the combustion chamber adjacent the discharge end of said primary air tube, a secondary air tube connected with the inlet opening of the combustion chamber in operative relationship to said primary air tube and burner head, means forming an air inlet chamber connected with said secondary air tube, and baffle walls arranged in said chamber forming means for imparting a spiral movement to air currents discharging into said secondary air tube.

4. In a combustion apparatus having a combustion chamber with an inlet opening, the combination of an oil nozzle, a tube having an inwardly converging wall for discharging air adjacent the nozzle, a second tube surrounding said first named tube and spaced therefrom to form an annular chamber, said second tube having an air inlet and an air outlet discharging into the

inlet opening of the combustion chamber, spaced plates connected to said second tube adjacent the air inlet thereof, a loose fitting closure about the periphery of said plates permitting the passage of air therebetween, said plates and said closure defining a second chamber opening into said outlet of said tube, transverse plates between said spaced plates converging inwardly to form compartments in said second chamber and said compartments having outlets discharging tangentially to the inlet of said second tube, whereby air drawn inwardly from said chamber and through said tube into said combustion chamber will be given a spiral motion.

5. In a device of the kind described, an air chamber including spaced walls having a peripheral opening therebetween, band means substantially and variably covering said opening, and means for contracting said band relatively tightly against said walls and for relieving it from said contraction to fit only loosely about said walls whereby to vary the size of the opening.

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