Feb. 18, 1930. E. H. STEEDMAN 1,747,191

APPARATUS FOR BURNING FUEL

Filed Feb. 6, 1928

Fig. 1.

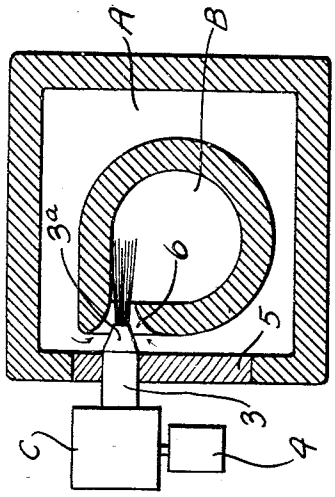


Fig. 2.

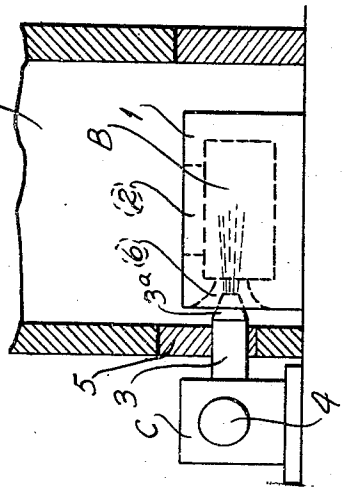
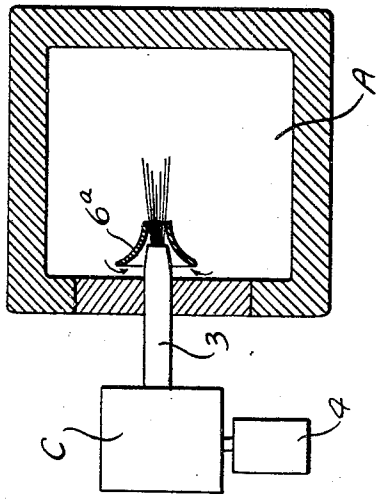


Fig. 3.



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Patented Feb. 18, 1930

1,747,191

UNITED STATES PATENT OFFICE

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APPARATUS FOR BURNING FUEL

Application filed February 6, 1928. Serial No. 252,300.

This invention relates to fuel burners of the kind in which the combustion air is supplied to the combustion chamber by a fan or other suitable means.

One object of my invention is to provide a practicable apparatus for burning a gaseous, liquid or pulverized fuel that is of durable construction, inexpensive to build and install, reliable in operation, and of such design that it will burn fuel with less noise than is produced by conventional burners.

Another object is to provide an apparatus for burning a gaseous, liquid, or pulverized solid fuel that insures an excess supply of combustion air when the fuel is first ignited, which excess air supply is thereafter automatically reduced, and during the continuance of the operation of burning the fuel, is maintained at the minimum quantity of air required for proper combustion.

To this end I have devised an apparatus for burning a gaseous, liquid, or pulverized solid fuel which is of such design that fuel will be introduced into a combustion chamber or other suitable space and combustion air will be supplied to said chamber or space under pressure, the velocity of the air that is being admitted to or introduced into the apparatus being utilized to cause additional combustion air or a gas or products of combustion to be drawn from said combustion chamber and incorporated with or injected into the burning fuel. By this procedure I obtain a sufficient excess supply of combustion air in the burning mixture, when the fuel is first ignited, to produce practically smokeless combustion and also eliminate the possibility of the flame becoming extinguished. The excess supply of combustion air is automatically reduced and finally replaced by hot products of combustion after the apparatus has been in operation for a short period, thereby producing a high temperature of combustion with minimum noise or violence of combustion, and also insuring the minimum quantity of air required for proper combustion, during the continuance of the operation of burning the fuel.

My invention is applicable to various types and kinds of fuel burning apparatus, in which combustion air, or combustion air together with fuel, is introduced into the combustion chamber under pressure, or with sufficient velocity to create a suction or partial vacuum that can be utilized to cause a volume of additional air, or gas or products of combustion to be incorporated with, mixed with or injected into the burning fuel. It is particularly applicable, however, to automatic oil burners of the kind that are now used extensively in domestic heating apparatus, and accordingly, I have herein illustrated it embodied in an oil burner of the kind that is equipped with a nozzle from which a stream of combustion air mixed with particles of oil is discharged under pressure into the combustion chamber or space in which the fuel is burned.

Figure 1 of the drawings is a diagrammatic horizontal sectional view, illustrating one form of my invention.

Figure 2 is a view partly in vertical section and partly in side elevation of the apparatus shown in Figure 1, and

Figure 3 is a diagrammatic horizontal sectional view, illustrating another form of my invention.

In the form of my invention illustrated in Figure 1 A designates the combustion chamber of a fuel burning apparatus, such as a domestic heating furnace, B designates a supplementary combustion chamber arranged preferably beneath or at the lower end of the combustion chamber A and provided at its upper end or in its top wall 1 with an opening 2 that discharges upwardly into the combustion chamber A, and C designates as an entirety any suitable type or kind of burner capable of being used for burning a gaseous, a liquid, or a pulverized solid fuel and provided with a nozzle 3 through which a stream of combustion air, or air, together with fuel, is introduced under pressure, or at considerable velocity into the supplementary combustion chamber B. As is usual, the burner C is equipped with a fan (not shown) that is driven by an electric motor 4 or other suitable source of power. The supplementary combustion chamber B can be formed of metal or refractory material;

it can be of various forms and dimensions and it can be arranged in various ways with relation to the main combustion chamber A, of the apparatus. In Figures 1 and 2 it is illustrated as being arranged in the ash pit of the furnace, and is provided with a substantially circular side wall and a top wall 1 having an opening 2, as previously described. The nozzle 3 of the burner C projects inwardly through an opening in a part 5 of the front wall of the furnace, and the terminal portion 3^a of said nozzle is tapered or made substantially cone-shaped, so that it will co-operate with a flared or tapered opening 6 in the side wall of the supplementary combustion chamber B to form an annular restricted passageway in which a suction or partial vacuum is created by the velocity of the stream of combustion air or air and fuel emerging from the nozzle 3 of the burner C, thereby causing additional air or gas or products of combustion to be sucked from the combustion chamber A into said restricted passageway and incorporated with, mixed with or injected into, the burning mixture in the supplementary combustion chamber B. The volume of the air, gas or products of combustion taken from the main combustion chamber and injected into the burning mixture can be accurately controlled or regulated in various ways, as, for example, by varying the size or shape of the inlet 6 in the side wall of the supplementary combustion chamber, or by changing the relationship or distance between the tapered portion 3^a of the nozzle 3 and the edge of the flared or tapered orifice 6 which surrounds the same.

While I have stated that the terminal portion of the nozzle of the burner co-operates with an opening in the side wall of the supplementary combustion chamber to form in effect an "injector", by means of which a volume of combustion air or gas or products of combustion is injected into the burning fuel, I wish it to be understood that the particular form or design of the "injector" that is used is immaterial, the essential thing being that the device which is used to supply or introduce a stream of combustion air, or air and fuel, into the fuel burning apparatus, be located in the main combustion chamber and of such a character that the force or velocity of the incoming stream is utilized to cause additional air, or a mixture of air and products of combustion in the combustion chamber, to be added to and effectively mixed with the burning fuel.

It is immaterial whether the stream of combustion air, or air and fuel, is introduced into the supplementary combustion chamber, or into the main combustion chamber of the apparatus. Accordingly, in Figure 3 of the drawing I have illustrated an apparatus embodying my invention, wherein the nozzle 3 of the burner C projects directly into the main combustion chamber A of the apparatus, and the terminal portion of said nozzle is associated with a flared or tapered annular member 6^a that co-operates with said terminal portion, to form in effect an "injector" which causes air, gas or products of combustion to be sucked from the combustion chamber A and injected into the fuel that is being burned in said combustion chamber.

The principle of operation of the two forms of my invention above described is the same. When the burner is first started or set in operation, the interior of the combustion chamber A is filled with relatively cold atmospheric air unmixed with products of combustion, and gradually, as the operation of burning the fuel proceeds, the interior of the combustion chamber A becomes filled with hot products of combustion containing some atmospheric air. Gradually, from the time the burner is started, the total amount of air for combustion is reduced by the addition of products of combustion, which are injected into the burning fuel, thereby causing the temperature of combustion to be increased and the rate of combustion slowed down, on account of the dilution of the burning mixture with products of combustion. After the burner has been in operation for a comparatively short time, the amount of air available for combustion becomes practically constant.

In my improved apparatus there is sufficient excess oxygen present when the fuel is ignited to eliminate the possibility of the flame becoming extinguished, but the excess supply of combustion air is gradually cut down and finally replaced by hot products of combustion which are injected into the burning fuel, thereby producing a high temperature of combustion that results in economy of fuel, and also reducing the violence of combustion, which, of course, reduces the noise produced by the burner. The apparatus is of durable construction, it has no complicated moving parts, and it is inexpensive to build and install.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An apparatus for burning a gaseous, liquid or pulverized solid fuel, comprising a main combustion chamber, a supplementary combustion chamber arranged at the lower end of said main combustion chamber and provided with a substantially circular side wall, an opening in the top of said supplementary combustion chamber through which the flame is discharged upwardly into the main combustion chamber, a nozzle whose terminal portion is tapered or substantially cone-shaped, and a flared or tapered opening in the side wall of said supplementary combustion chamber combined with the terminal portion of said nozzle so as to form an annular restricted passageway in which a suction

is created by the velocity of the stream emerging from the nozzle, thereby causing additional air, or gas, or products of combustion to be sucked from the main combustion chamber and incorporated with, mixed with or injected into the burning mixture in the supplementary combustion chamber.

2. An apparatus for burning a gaseous, liquid or pulverized solid fuel, comprising a main combustion chamber, a supplementary combustion chamber arranged at the lower end of said main combustion chamber and constructed so that the flame in the supplementary combustion chamber will be discharged upwardly into the main combustion chamber, a nozzle for introducing a stream of air into the supplementary combustion chamber provided with a tapered terminal portion, and an opening in one wall of the supplementary combustion chamber that co-acts with the terminal portion of said nozzle to form an injector which causes additional air, gases or products of combustion to be sucked from the main combustion chamber and incorporated with, mixed with, or injected into the burning fuel in the supplementary combustion chamber.

3. An apparatus for burning a gaseous, liquid or pulverized fuel, comprising a combustion chamber, a nozzle through which a gaseous stream is introduced into said combustion chamber under pressure, provided with a tapered portion that is positioned inside of said combustion chamber, and a tubular member in the combustion chamber completely surrounding the tapered terminal portion of said nozzle and spaced away therefrom so as to form an injector having an annular passage through which air, gases or products of combustion in the combustion chamber will be drawn and incorporated with, mixed with or injected into the burning fuel in the combustion chamber.

EDWIN H. STEEDMAN.