Oct. 24, 1939. G. A. BOYD 2,177,053

OIL BURNER

Filed Dec. 31, 1936

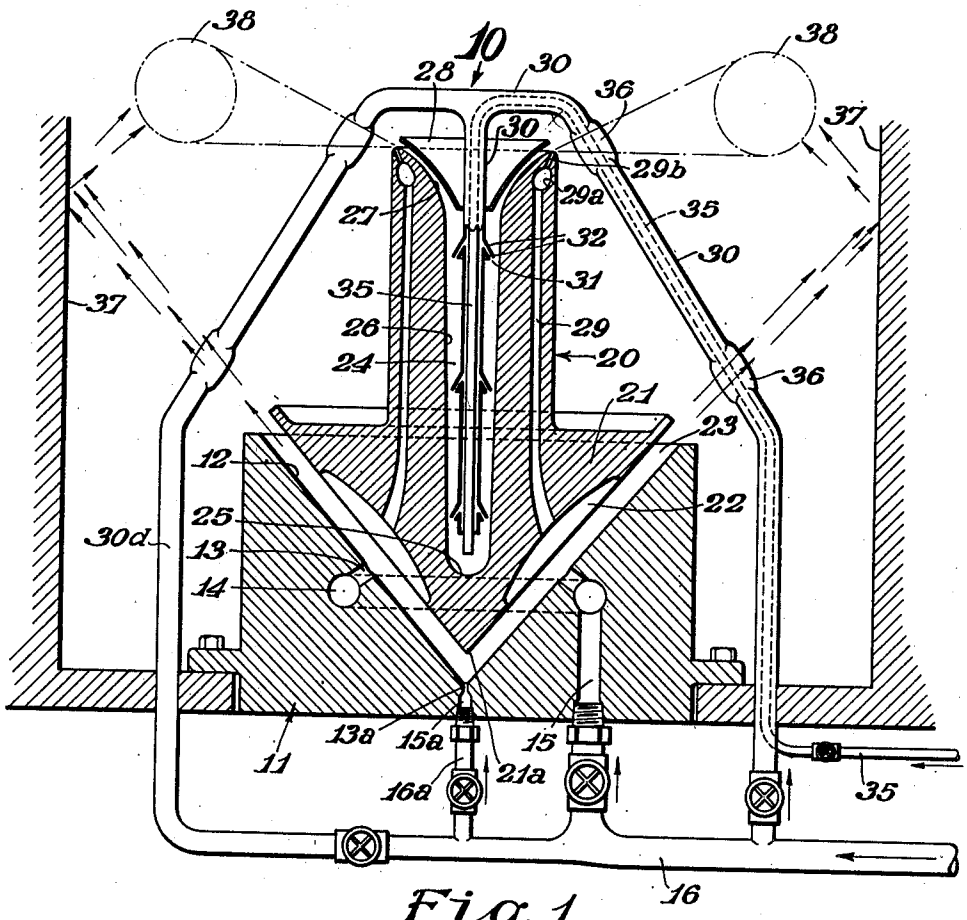


Fig. 1

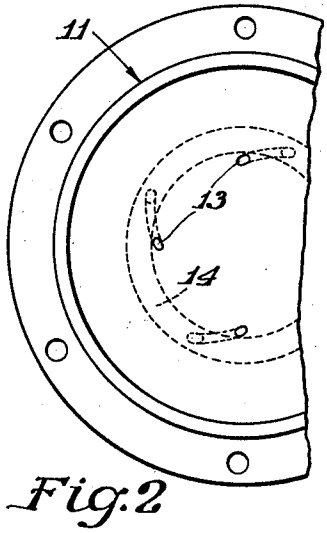


Fig. 2

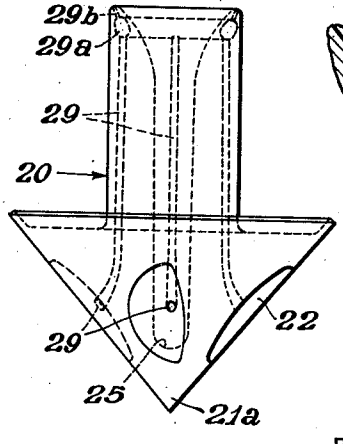


Fig. 3

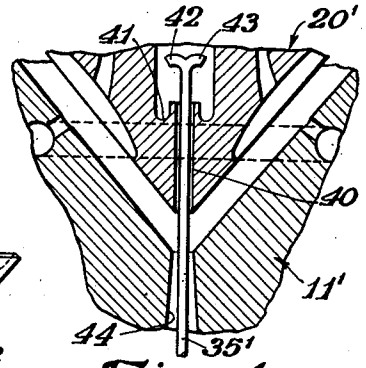


Fig. 4

INVENTOR
George A. Boyd
BY Lyle S. Motley
ATTORNEY

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OIL BURNER

George A. Boyd, Chicago, Ill., assignor to Standard Oil Company, Chicago, Ill., a corporation of Indiana

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11 Claims. (Cl. 158—77)

My invention relates to a new and improved fuel burner.

Difficulty has been experienced in prior forms of burners with incomplete atomization of the fuel and incomplete mixing of the atomized fuel with the air of combustion.

It is an object of the present invention to provide an improved burner which will effect a more complete atomization of the fuel and a more complete and satisfactory mixing of the atomized fuel with the air of combustion.

It is a further object of my invention to provide a centrifugal type of burner which will operate with highly refractory or viscous fuels and wherein the carbon deposits common to low speed burners will be eliminated.

It is a further object of my invention to provide a centrifugal type burner to operate with less refractory fuels of high fluidity, differing from the usual mechanical centrifugal burners by being rotated with air.

Other objects of this invention will become apparent from the following description thereof and the appended claims when read in conjunction with the accompanying drawing which forms a part of this specification, and in which:

Figure 1 is a vertical sectional view of the preferred embodiment of my burner.

Figure 2 is a plan view with the rotor removed and part of the base cut away showing the bowl and symmetrically disposed ports therein.

Figure 3 is an elevational view of my preferred form of the rotor.

Figure 4 shows a modification of the embodiment shown in Figures 1 to 3.

My new fuel burner comprises a rotor having a coaxially disposed cup therein for receiving fuel to be atomized by centrifugal force and is particularly characterized by the fact that the rotor is entirely supported on a film of air during normal operation thus eliminating metallic friction.

Referring particularly to Figure 1, a burner 10 is shown comprising a base member 11 having a conical bowl 12 in its upper face. A plurality of ports 13 are symmetrically disposed about the wall of the bowl 12 and a port 13a is located in the bottom thereof. An annular passage 14 for communication with the ports 13 is provided in the base member 11. Conduits 15, 16, connect the annular passage 14 with a suitable source of compressed air. Conduits 15a and 16a connect port 13a with conduit 16.

The adjective "conical" is here used in the broad sense of "gradually lessening in circumference". Likewise the word "bowl" is used in the broad sense of "a concave vessel of various forms . . .".

A rotor 20 is shown, the lower portion 21 of which is formed for reception within the bowl 12 for rotation therein. The lower portion 21 of the rotor is preferably provided with turbine-like reaction surfaces 22. The lower portion 21 of the rotor is shown as being in the shape of a cone fitting into a conical bowl 12 of the same shape but obviously other shapes may be employed so long as rotation is provided for. I may even employ a depression of one shape and the rotor bottom of another shape, i. e., curvatures of the two surfaces 12 and 22 may be any shape so long as they are substantially circular in horizontal cross-section.

The above referred to ports 13 are arranged to discharge air under pressure against the reaction surfaces of the rotor for driving the same and for assisting the air discharged from port 13a in entirely supporting the rotor. It is possible to thus eliminate metallic bearing friction during normal operation which, obviously, is an advantage over the usual mechanical centrifugal burner. Also because of the elimination of the metallic bearing friction the rotor may be rotated at high speeds not heretofore obtainable in an oil burner.

If so desired, anti-friction bearings may be provided for reducing friction upon starting and stopping. This arrangement may take the form of ball bearings (not shown) circularly disposed about the periphery of the bowl 12 preferably above the center of gravity of the rotor.

It is acknowledged that air floated and driven rotors are old broadly, as for example in centrifuges, and no claim is made thereto. It is the following described new combination embodying the above and the method of operation to which the present invention is directed.

My rotor 21 is further provided with a cup 24 coaxially disposed therein for the reception of liquid fuel in a continuous stream to be subjected to centrifugal force and discharged therefrom in a highly atomized condition. I have shown this cup as having a rounded bowl-like bottom 25 joining with a vertical surrounding side wall 26, the side wall in turn diverging to form a mouth portion 27. Where fuels containing solid materials and fuels which carbonize readily are to be used, the cup wall 26 may be made to diverge slightly in the direction of the mouth to prevent the carbon and other solid matter from adhering to the wall. A funnel-like baffle 28 is mounted in

the mouth portion 27 in spaced relation thereto, the function of which will be hereinafter described.

A branch 30 of the air conduit 16 leading from a suitable source of compressed air extends into the cup 24 through the mouth of the funnel-like baffle 28. The fuel conduit 35, enclosed within the branch conduit 30, extends beyond the end of the branch conduit 30 and terminates near the bottom 25 of the cup. The portion of the air conduit on the inside of the cup 24 and surrounding the fuel conduit 35 is provided with a plurality of vertically spaced outwardly and downwardly directed ports 31. Each port is formed by a pair of spaced funnel-like members 32 defining a continuous annular opening which effects a funnel shaped discharge of the air therefrom. The funnel-like members 32 are connected together by suitable means such as ribs (not shown). The air is thus directed against the wall 26 of the cup at a plurality of levels to serve two purposes: (1) to give the first premixing of air with the fuel and (2) to prevent the oil from escaping from the surface of the bowl before the maximum centrifugal force is exerted upon it. The funnel-like baffle 28 above referred to has its outer periphery spaced from the mouth of the cup sufficiently to permit the discharge of fuel between it and the mouth 27 but sufficiently close to prevent the fuel from escaping from the cup without being subjected to the centrifugal effect of the mouth 27 of the cup. The baffle 28 is preferably supported on pipe 30, however, it may be supported on the mouth of the cup as by ribs or other spacing and supporting connections (not shown).

By introducing the fuel conduit 35 through the inside of the branch 30 of the compressed air conduit 16 it is thereby insulated from the heat incident to combustion. The outside conduit may be streamlined, as indicated at 36, to minimize interference with the fuel and air currents. I have provided a duplicate air conduit 30*d* in diametrically opposed relation to the above described air and fuel conduits for insuring a balanced condition of the rotor. This duplicate conduit 30*d* may carry a part of the air to the cup or merely act as a standby whose only function, even when not used for supplying air or fuel, is to maintain the rotor in a balanced condition.

A plurality of passages 29 are formed in the rotor for conducting a portion of the driving air to an annular surrounding passage 29*a* formed below the mouth portion 27 of the rotor. The annular passage 29*a* communicates with a continuous annular orifice or port 29*b* formed in the mouth portion 27 of the cup 24 for directing air into contact with the atomized fuel as it is discharged from the mouth by centrifugal action to effect further atomization of the fuel and a second mixing of fuel and air. The centrifugal force due to rotation of the cup tends to discharge the atomized fuel horizontally from the lip 27 of the cup. The annular port 29*b* is directed upwardly and outwardly to discharge a circular, continuous jet of air across the horizontal path of discharge of the fuel and hence to cause the fuel to be distributed above its otherwise normal position on a level with the upper edge of the mouth 27 of the cup. A suitable surrounding baffle wall 37 is provided for directing the driving air which is discharged from between the rotor 21 and the wall of bowl 12 into contact with the mixture of atomized fuel and air discharged from the mouth of the cup. The resultant position of the combustible mixture is indicated by the circle 38 in dotted lines. Obviously this position may be varied by varying the pressure within the supply conduits 15 and 15*a* and by changing the position of the baffle wall 37 and the direction of the jet from opening 29*b* in the mouth 27 of the burner, to thus cause burning either on the wall 37 or in space such as indicated at 38.

The premixing effected by the introduction of air to the cup 24 through the ports 31 and premixing effected by the discharge from jet 29*b* are particularly effective in installations wherein highly refractory fuels are to be used. For some fuels, however, the air discharged from the annular space 23 is sufficient for mixing with the highly atomized oil discharged from the mouth 27 of the cup, without the above described premixing. In all cases additional secondary air may be supplied in the usual manner to supplement that passing through the burner.

Figure 2 is a plan view of the bowl with the rotor removed showing the symmetrically disposed ports 13 therein for discharging the compressed air substantially tangentially against the lower portion of the rotor.

Figure 3 is an elevational view of the rotor showing the arrangement of turbine-like reaction surfaces 22 on the lower portion thereof.

Figure 4 is a modification of the arrangement shown in Figure 1 and differs therefrom in the method of introducing the fuel into the cup. In this modification the fuel is introduced through the bottom of the rotor 20^1 by passing the conduit 35^1 through coaxial opening 40 therein. This opening is slightly larger than the conduit 35^1, there being no appreciable bearing contact between the rotor 20^1 and the conduit. The air which passes up through the opening 40 about the pipe 35^1 is effective to reduce bearing friction to a minimum and to produce a first premixing of air and fuel. An annular well 41 is formed in the bottom of the cup surrounding the conduit, for preventing the fuel from spilling into the opening 40 around the conduit 35^1. The upper end of the conduit 35^1 is formed into two outwardly diverging branches 42 and 43 to assist in preventing fuel from leaking through opening 40. Fuel pipe 35^1 is passed up through a conduit 44 in the center of the stator 11^1, this conduit being larger than pipe 35^1 and adapted to communicate with the atmosphere or a source of air under pressure in a like manner to that shown in Figure 1 as for example by a suitable pipe and valve connection. Any tendency at high speeds of the escaping air to create a vacuum under the rotor with the consequent touching of the stator by the rotor can thus be overcome by controlling the admission of air through conduit 44. In other respects the arrangement in Figure 4 is identical with that described in Figure 1.

Liquid fuels which can be used include petroleum oils, other combustible liquids and colloidal fuels such as dispersions of solid fuels in liquid fuels.

I have referred throughout the description to the use of air as the driving medium but it is apparent that other gases, e. g., flue gas, mixtures of air with other gases, and even liquids can be used.

The drawing is not made to scale as the actual features of engineering design necessarily incorporated in my burner are within the skill of the expert in the art.

Operation

It is believed that a better understanding of my burner may be gained from an exemplary operation taken in connection with Figure 1. Air under pressure is discharged from the port 13*a* and the symmetrically disposed ports 13. The air from ports 13 impinges against the turbine-like reaction surfaces 22 driving and supporting the rotor 20 while the air from port 13*a* has a supporting effect only.

Speeds as high as 165,000 R. P. M. have been obtained under experimental conditions for this type of apparatus; however, such extreme speeds are not necessary under actual operating conditions. Speeds of 50,000 to 100,000 R. P. M. are all that are needed to effect the complete atomization of the more refractory fuels. For the less refractory fuels speeds as low as 10,000 to 50,000 R. P. M. may be used.

While the cup 24 (see Figure 1) is rotating, fuel is continuously introduced into its lower portion through the inner conduit 35. Air under pressure is passed through the outer coaxial conduit 30 into the cup 24 through the funnel shaped ports 31 for effecting a first premixing and forcing of a film of fuel out against the wall 26 of the cup 24. From the bottom of the rotating cup the fuel flows in a very thin film along the vertical wall by virtue of the centrifugal force to which it is subjected. As this film moves outwardly over the curved surface formed by the mouth 27 of the cup, it covers a larger area and hence is subjected to additional thinning. This additional thinning aids in breaking the intra-film bonds. As the atomized fuel is discharged from the mouth 27 of the cup it is subjected to an additional atomization and a second mixing of air therewith by the cross current of air discharged from the annular passage 29*b* in the mouth 27 of the rotor. The air from the vortical film below the rotor is also directed into contact with the above stream of air and atomized fuel by suitable baffles 37. Additional air may also be supplied in the usual manner.

A suitable device such for example as an electrical igniting circuit may be employed for initiating combustion in a conventional manner (not shown).

While I have described my invention in connection with certain specific embodiments thereof, it is to be understood that these are by way of illustration rather than by way of limitation and I do not mean to be limited thereby except as indicated by the scope of the appended claims which should be construed as broadly as the prior art will permit.

I claim:

1. A fuel burning device comprising a stator formed with a conical bowl in the upper portion thereof, a rotor operable in said bowl, means for discharging air between said stator and rotor for supporting and driving said rotor, a coaxially disposed cup in said rotor, and means for continuously supplying fuel to the inside of said cup, said fuel being subjected to centrifugal force and continuously discharged from the mouth of said cup in a highly atomized condition.

2. A fuel burning device comprising a stator formed with a conical bowl in the upper face thereof, a rotor operable in said conical bowl, means for discharging air between said stator and rotor for entirely supporting and driving said rotor, said means comprising a vertically disposed port for directing air vertically against the lowermost portion of said rotor and a plurality of ports circularly disposed about said conical bowl for directing air against the under side of said rotor for driving the same, said rotor being further provided with a coaxially disposed cup therein, and means for continuously supplying fuel to the inside of said cup, said fuel being subjected to centrifugal force and continuously discharged from the mouth of said cup in a highly atomized condition.

3. The structure as defined in claim 1 wherein said rotor is formed with a circular opening coaxial with the axis of rotation of said rotor and opening into the bottom of said cup, and including a fuel pipe of slightly smaller diameter than said opening positioned therein for introducing fuel into said cup from below said rotor.

4. The structure as defined in claim 1 wherein said rotor is formed with an opening coaxial with the axis of rotation of said rotor and opening into the bottom of said cup, and a fuel pipe positioned in said opening for introducing fuel into said cup from below said rotor, an inner flange at the base of said cup forming an annular well in the bottom of said cup surrounding said opening and means on said fuel pipe for directing fuel against the wall of said cup above said annular well.

5. The structure as defined in claim 1 wherein the means for introducing fuel into said cup comprises a fuel conduit passed upwardly adjacent the outside of said rotor over the rim of and down into said cup, a second conduit of slightly greater diameter than said fuel conduit disposed thereabout and adapted to convey air for insulating said fuel conduit and supplying air for a first premixing of air and fuel, and a third conduit, also adapted to convey air symmetrically disposed with respect to said second conduit for effecting a balancing of said rotor.

6. In a burner device for burning liquid fuel, centrifugal means for effecting a high degree of atomization of said fuel, comprising a rotor having a coaxially disposed cup therein and being provided with reaction surfaces thereunder, means for continuously delivering said fuel to the inside of said cup, means symmetrically disposed about the under side of said rotor for directing air under pressure against said reaction surfaces to form a vortical film of air therebeneath for entirely supporting said rotor and driving the same at high speed, said fuel being formed into a fine film against the wall of said cup by a centrifugal action and continuously discharged from the mouth of said cup in a highly atomized condition, and means for directing said driving air into contact with said atomized fuel for mixing therewith for supporting combustion.

7. An oil burner comprising a rotor, having a cup formed coaxially therein, means for continuously introducing a liquid fuel into said cup, means for supporting said rotor on a film of air comprising a base member having a conical bowl formed therein, said bowl being defined by a surrounding wall which continuously diverges upwardly, the lower portion of said rotor being complementarily formed for reception within said bowl, means disposed about the conical bowl for directing air under pressure substantially tangentially against said lower portion of said rotor, said air directing means, said diverging wall and said lower portion of said rotor being effective to cause said air to form a vortical film beneath said rotor for entirely supporting and rotating the same at an extremely high speed, whereby said fuel is subjected to centrifugal force and continuously

discharged from said cup in a highly atomized condition.

8. A fuel burner comprising a rotor provided with a coaxial fuel cup therein and with reaction surfaces on the under side thereof, means for directing a fluid against said reaction surfaces for impelling and supporting said rotor, means for introducing a fuel into said fuel cup so that it may come under the influence of the rotor and be discharged therefrom by centrifugal force, and means for mixing air with said fuel for supporting combustion.

9. The fuel burner of claim 8 which includes means for bringing the fluid which has been used for supporting and impelling the rotor into contact with fuel discharged from said rotor.

10. In apparatus of the class described a rotor having in the top a coaxial cup with tapered sides terminating in a mouth portion and having at the bottom thereof a plurality of reaction surfaces, means for directing air against said reaction surfaces for supporting and rotating said rotor, means for introducing a liquid fuel into said cup so that the rotation of the rotor may force said liquid fuel by centrifugal action along the sides of said cup and from the mouth thereof, and means for directing at least a part of the air which has been used for supporting and rotating said rotor into the path of the liquid fuel which is thrown from the mouth of the cup, so that the air which has been used to impel the rotor may subsequently be used for burning the fuel.

11. The apparatus of claim 10 which includes means for introducing air as well as liquid fuel into said cup.

GEORGE A. BOYD.