Nov. 17, 1931. H. A. KUNITZ 1,832,131

OIL BURNER

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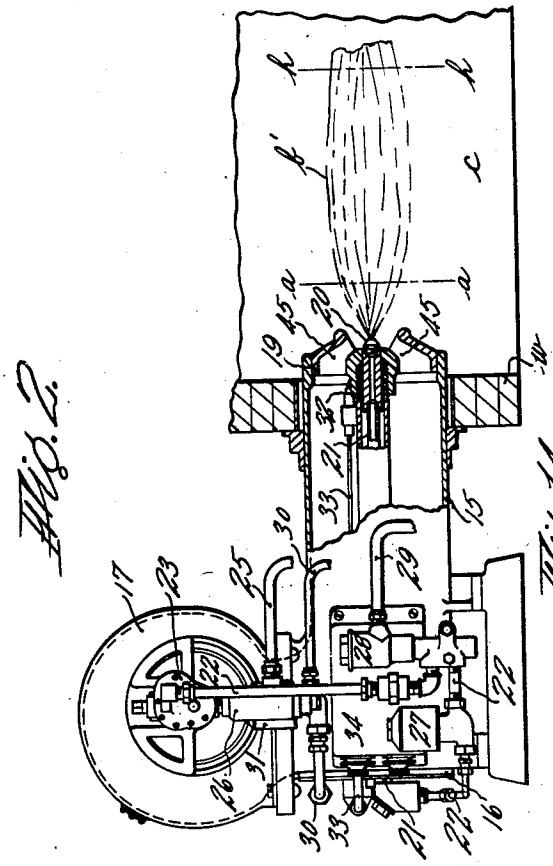


Fig. 2.

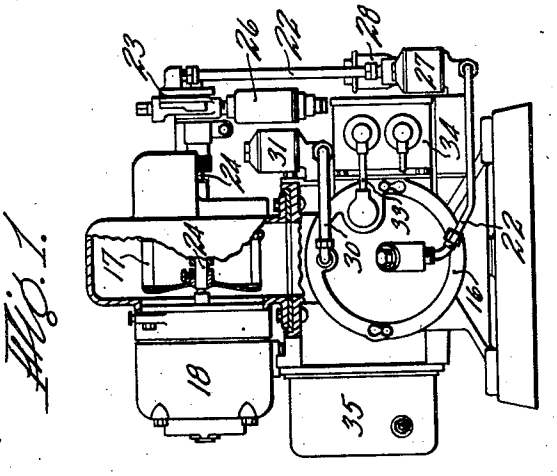


Fig. 1.

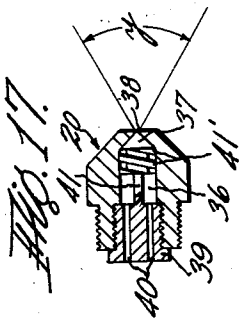


Fig. 17.

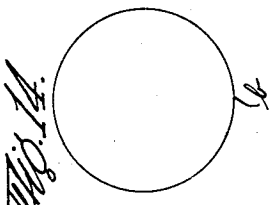


Fig. 14.

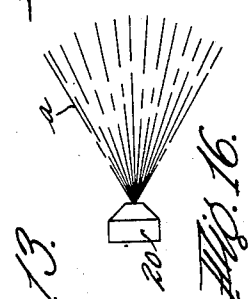


Fig. 13.



Fig. 16.

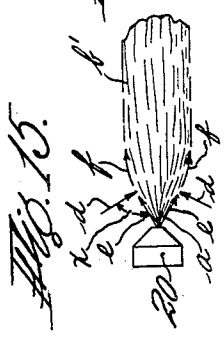


Fig. 15.

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Fig. 3.

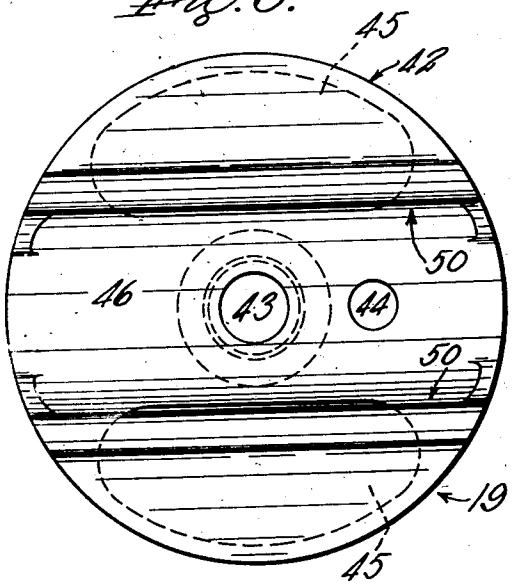


Fig. 4.

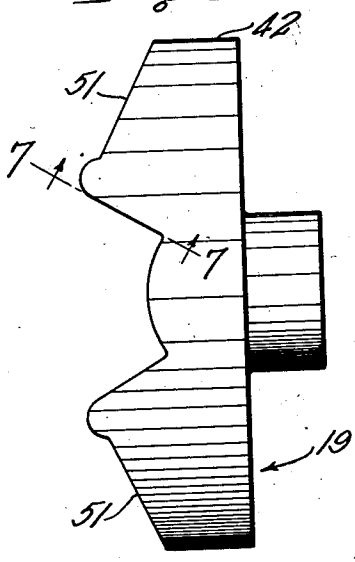


Fig. 5.

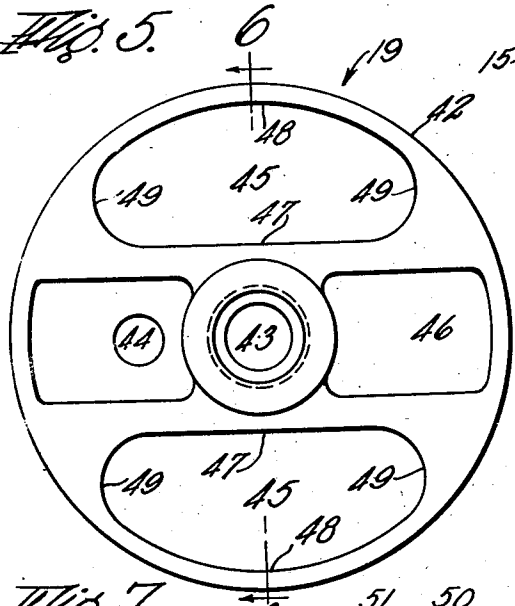


Fig. 6.

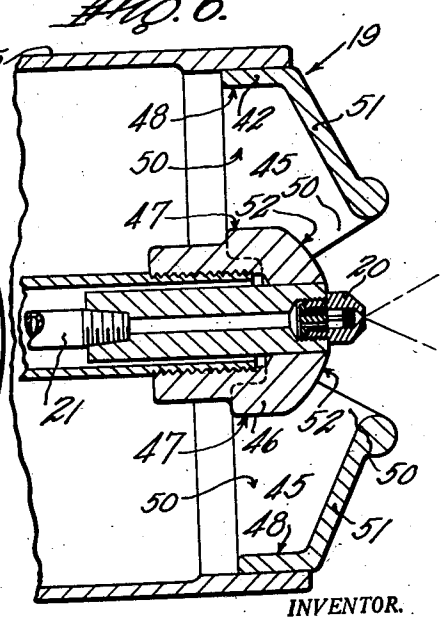
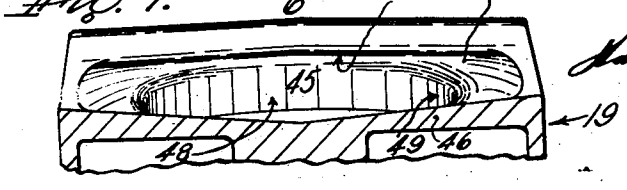


Fig. 7.



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Fig. 8.

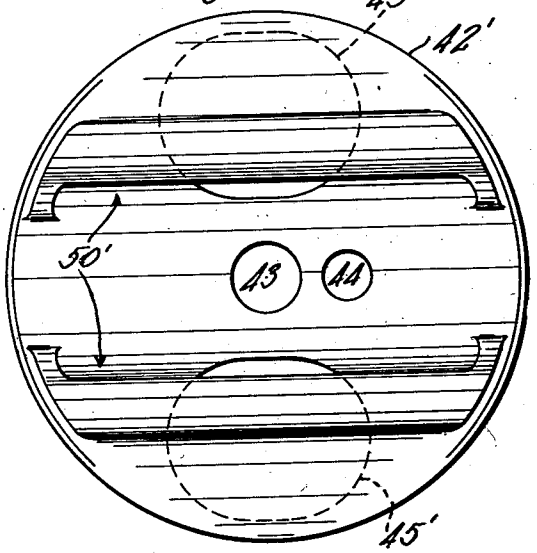


Fig. 9.

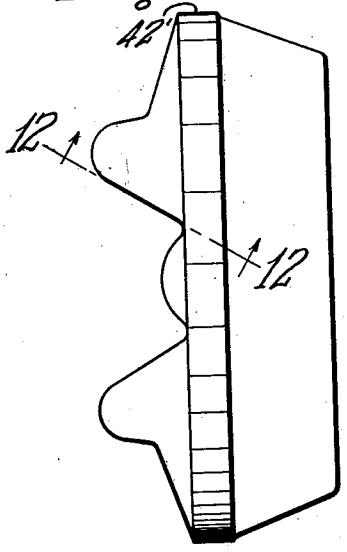


Fig. 10.

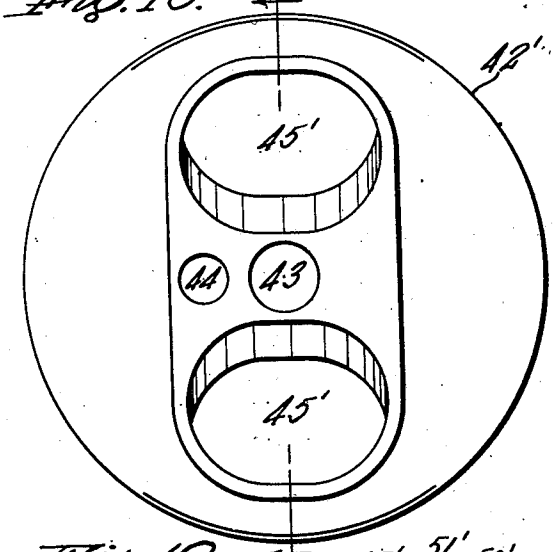


Fig. 11.

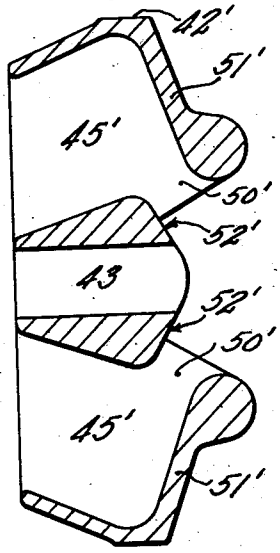
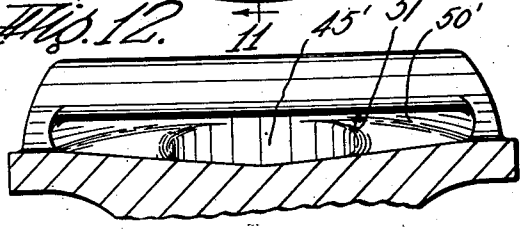


Fig. 12.



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Patented Nov. 17, 1931

1,832,131

UNITED STATES PATENT OFFICE

HANNIBAL A. KUNITZ, OF STRATFORD, CONNECTICUT

OIL BURNER

Application filed November 18, 1929. Serial No. 407,994.

This invention relates to improvements in oil or other liquid fuel burners.

The burner of this invention utilizes, for the atomization of the oil, a principle which has been found successful in industrial burners and which has been used in that field for many years. Atomization is accomplished by forcing the oil under relatively high pressure through a small, round orifice and by causing the oil stream to whirl rapidly just before it passes through the orifice. Such atomization is commonly known as "mechanical" or "pressure" atomization and atomizers of this type inherently produce a substantially hollow conical spray of finely divided oil particles. The known and proved advantages of this method of atomization have led me to utilize it in the burner of this invention.

With this method of atomization as a starting point, the general object of the invention is to modify the shape of the otherwise substantially hollow conical oil spray and flame, and change its characteristics in other ways, over what would be secured from prior art burners utilizing the same method of atomization, in order to render it better suitable for use in this and other fields of service, such for example as the domestic field.

Particular objects are to flatten down the spray which would normally be of substantially hollow conical form, making it more nearly oval in cross section than round, as formerly; to spread the flame laterally; to shorten the flame longitudinally; to secure a short, bushy flame; to effect improved, rapid and intimate mixture of the air and oil; to utilize an amount of air for combustion which is only slightly in excess of theoretical requirements; and to obtain practically silent combustion.

In carrying out these objects, secure the result by utilizing the air which is supplied to the oil spray. This air, at relatively low pressure, is not supplied evenly all around the oil spray as formerly, but is directed to the spray in two opposed broad streams which converge in a direction forwardly of the oil nozzle, and start to impinge on the oil spray from opposite sides and at a point near the nozzle, with the result that the spray, and the flame resulting from the ignited mixture of air and oil, is flattened down and broadened out into more or less oval cross section. A novel an important characteristic of my invention is that the shape of the oil spray formation is changed after it leaves the nozzle and its shape and that of the flame is substantially controlled and modified by the air streams, as distinguished from prior art flat flame burners, wherein the shape of the oil spray and flame is controlled by the shape of the oil and/or air openings and as distinguished from burners wherein the air and oil are mixed inside the nozzle and the mixture emitted through a rectangular slot.

Another feature of my invention relates to the control of the velocity of the aforesaid streams with relation to the rate of flame propagation, whereby a change of pace is effected in the air streams, characterized by a velocity initially greater than said rate in order to keep the starting point of the flame away from the nozzle and prevent the troubles which would otherwise result and by a velocity which soon becomes less in order to prevent the flame from "drifting" away from the nozzle.

Other features of the invention will appear as the description proceeds and will be pointed out in the appended claims.

The invention will be described with reference to the accompanying drawings, in which:—

Figs. 1 and 2 are side and end elevational views, partly in section, of an oil burner embodying the oil and air-nozzle features of my invention;

Figs. 3, 4 and 5 are front, side and rear elevational views, respectively, of one form of air head, embodying my invention;

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 5;

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 4;

Figs. 8, 9 and 10 are front, side and rear elevational views, respectively, of a second form of air head embodying my invention;

Fig. 11 is a sectional view taken on the line 11—11 of Fig. 10;

Fig. 12 is a sectional view taken on the line 12—12 of Fig. 9;

Figs. 13 and 14 are diagrammatical views illustrative of the form of the oil spray produced by the oil nozzle;

Figs. 15 and 16 are diagrammatical views illustrative of the manner in which the oil spray formation is changed, after it leaves the nozzle, by the use of air streams from either form of air head; and

Fig. 17 is a sectional view of the oil nozzle.

In Figs. 1 and 2, I have shown, by way of illustrative example, a complete burner in which my invention is embodied. As there shown, the burner includes a horizontally-disposed, cylindrical tube 15, suitably supported as indicated, and having its rear end closed by a head 16. The forward end of the tube 15 passes through the wall *w* of the boiler or the like and opens into the combustion chamber *c* thereof. A fan 17, mounted on tube 15 and driven by an electric motor 18, supplies air at low pressure to tube 15 and thus to chamber *c*,—all of the air supply to the latter preferably coming by way of tube 15 from fan 17. The outlet end of tube 15 is partially closed by an air head 19 of special construction, later to be described in detail. Mounted centrally in this air head is a pressure of mechanical atomizing nozzle 20, to which oil is supplied by a pipe 21. Pipe 21 extends rearwardly to and through head 16 and connects with a pipe 22, leading to the outlet of a suitable pump 23, connected to the shaft 24 of fan 17 to be driven therefrom. Oil is drawn in by pump 23 from a pipe 25 through a suitable strainer 26 and is forced under relatively high pressure through pipes 22 and 21 to nozzle 20.

Other usual accessories indicated in the drawing are an electromagnetically-operated valve 27 to control the supply of oil to nozzle 20; a by-pass valve 28, which functions to maintain the pressure of the oil supplied to nozzle 20 within limits at a substantially constant figure by opening, whenever the desired predetermined pressure is exceeded, to by-pass part of the pumped oil to a return pipe 29; a gas supply pipe 30, including an electromagnetically operated controlling valve 31, for maintaining a gas pilot for ignition purposes; a spark plug 32 for igniting the gas pilot; a wire 33 leading to the plug from a suitable source of high tension electricity, such as a coil housed in box 34; and electrical control mechanism housed in box 35.

The burner, thus described, will serve as one example of many widely varying types of burners with which my invention may be used. The details, thus far described, are not important to the present invention and may be varied widely in form and arrangement. The effort has been to convey a general picture of a complete burner, as a setting or background for the real invention, which relates to the manner whereby the air, supplied to the oil spray issuing from nozzle 20, effects changes in the formation of the spray and the resulting flame.

The nozzle 20 utilizes old principles but it will be briefly described to insure that its operation is understood. Referring to Fig. 17, the nozzle 20 has an axial passage 36 which terminates with a conical end 37, converging toward and terminating with a small circular outlet orifice 38. The rear end of passage 36 is closed by a plug 39, except for two holes 40 which allow oil to pass from pipe 21 to passage 36. Interposed in passage 36, and formed integrally with plug 39, is a cylindrical member 41 carrying a double screw thread 41′. Oil, entering passage 36, can reach outlet 38 only by travelling in a spiral path through the spaces between adjacent screw threads 41′, whereby the oil is given a whirling motion. The oil, under high pressure, say for example from 50 to 100 pounds per square inch, is forced through the small outlet orifice 38 and is thoroughly broken up, issuing in a form like mist or fog. The normal shape of the oil spray issuing from a mechanical atomizing nozzle is substantially that of a hollow cone, as indicated in Fig. 13, and the cross section at any point is circular as indicated in Fig. 14.

The real problem of this invention is to change this normal shape of the oil spray and the resulting flame by means of the air which is supplied to the oil and mixed therewith. This work can be accomplished by the air head 19, or a modified form thereof later to be described, or by any other style of head which will function in a generally similar way. The heads, shown herein, I believe to be the best designs for their intended purposes but I recognize that the designs may be varied widely and still embody the essentials of my invention. Therefore, I do not intend to be limited to the details, hereinafter described, except as they may be essential for the accomplishment of the work desired.

The head, shown in Figs. 3 to 7, is a substantially cylindrical member 42 having a central through passage 43 to receive the oil pipe 21 and part of nozzle 20 and having two diametrically opposed air passages 45. The head also has a passage 44 to receive the delivery end of the pipe 25, which end serves as a gas pilot. The passages 45 are separated by a central bridge 46, extending diametrically across the member 42. The inlet ends of the passages 45 are roughly oval-shaped as shown in Fig. 5, although each has an inner wall 47, which is straight. The outer wall 48 is curved concentrically with member 42 and curved end walls 49, of shorter radius, connect the inner and outer walls 47 and 48.

The outlet end 50 of each passage 45 is roughly rectangular in shape (Fig. 7) and is considerably longer than it is wide. From the inlet to the outlet, each passage 45 changes progressively in shape. The outer wall 51 of the outlet end of each passage 45 is steeply inclined and forms a deflector to change the direction of the air stream. The two walls 51 converge in a direction forwardly of the oil nozzle and, if extended, would meet in a transverse line located well ahead of the nozzle. The face of bridge 46, which is opposed to wall 51, is convexly curved and the upper and lower parts of this curved surface, which parts form the inner walls 52 of the air outlets, approximate the steeply-pitched inclination of the outer walls.

The second form of head, shown in Figs. 8 to 12, is designed for smaller capacity than the head just described. It functions, however, in the same general way and illustrates the fact that the design of the head may vary widely in detail and still effect the result. This head 42′ has the two diametrically opposed air passages 45′ and the central oil passage but lacks a clearly defined bridge, such as 46. The inlet ends of the air passages are roughly elliptical but the ellipses are very fat and closely approach circular form. The outlets 50′ are substantially rectangular but not as closely so as with the other form,—the outlet being widest at its center and tapering in opposite directions toward narrower ends. The steeply pitched outer and inner walls 51′ and 52′ are found as before, the former serving to deflect the air streams and change the directions thereof.

Each type of head has this in common. It performs the work of changing the direction of the air streams and distributing the air laterally so that two wide, substantially flat, sheet-like streams of air issue in converging relation with a tendency to meet in a line in front of the oil nozzle 20. It is not necessarily essential that any substantial change in velocity of the air be effected by the air head. The two streams are so directed as to start to impinge on the substantially conical spray of oil emitted from nozzle 20 at an angle which, for best results, should be ninety degrees or thereabouts, as shown at x in Fig. 15. The angle x of impingement may, however, be any acute angle although the steeper the angle, and the nearer its approach to ninety degrees, the better the results obtained. It should be pointed out that while the direction of the outlets of the air nozzles is fixed, the angle of impingement of the air streams on the normally cone-shaped oil spray is variable by changing the angle of the oil spray (shown at y in Fig. 17) which may readily be done by changing the oil nozzle. Nozzles are available for producing oil sprays, having angles ranging from 70 to 120 degrees.

In operation, air is supplied by fan 17 to tube 15 at relatively low pressure,—preferably at a pressure of a fraction of an ounce,—in order to avoid noise. Oil is supplied by pump 23 under heavy pressure and issues from nozzle 20 in a spray which is initially of substantially hollow conical form and circular cross section as shown at a and b in Figs. 13 and 14, respectively. The oil spray, and the resulting flame, would continue in such form if air were supplied evenly at all points around the circle b of Fig. 14, as is usually done, and except for the impinging air streams issuing from the air head. The oil which is under high pressure in nozzle 20, loses most of its pressure when it issues from the nozzle orifice 38. The pressure is transformed into velocity. The result is a fine fog-like spray of oil in substantially the formation of a hollow cone. This formation is changed, after the spray leaves the nozzle, by the oppositely impinging air streams broadly indicated by the arrows d in Fig. 15. The effect, roughly speaking, is to squeeze the conical spray between the air streams and flatten it down into more or less elliptical cross-section form, as diagrammatically shown at b' in Figs. 15 and 16. The action may be likened to that which occurs when a barrel hoop is squeezed together from two diametrically opposite points. The air, coming from one direction, such as that indicated by the arrow d in Fig. 15, meets oil coming from another direction, such as that indicated by the arrow e, and the resultant of the two forces is indicated by arrow f. The direction of the oil particles is changed by the impingement of the air streams thereon but in different ways and to different degrees at different points around the circle b of the oil spray. At the top and bottom of the circle, the greatest change in direction of the oil is effected while near the two extreme side positions the least change is effected.

Not all the air will follow the even course described. Some of the air, as will later appear, penetrates the oil spray and becomes saturated therewith, resulting in an intimate gaseous mixture of air and oil, which is ignited in any suitable way at a point slightly in advance of the nozzle 20, as will be readily understood by those skilled in the art. For any such gaseous mixture there is a certain speed of flame propagation. It is important that the velocity of the air streams issuing from the air head be initially somewhat greater than such speed of flame propagation for, by so doing, the flame is blown away from the nozzle, thus avoiding troubles from carbon deposits and burning of the nozzle. The nozzle is kept cool and free from soot. The velocity of the air streams diminishes and, though initially greater than the speed of flame propagation (say at the location a—a in Fig. 2), it soon becomes equal to such speed and eventually, (say at

the location *h*—*h*), less than such speed. As soon as the velocity of the air streams becomes equal to that of flame propagation, the flame is no longer blown forwardly and any further travel of the flame thereafter is due solely to flame propagation,—such further travel being not very great because, due to the intimate and thorough mixing of oil and air, the mixture is soon consumed. As the velocity of the air becomes less than that of flame propagation, the tendency then is to draw back the flame and prevent it from drifting away from the nozzle. This change of pace of the air streams with respect to the rate of flame propagation, is therefore important as controlling the length of flame as well as keeping the flame away from the nozzle and yet restraining the flame from drifting away from the nozzle far enough to result in extinguishment.

The effect, just described, is I believe, controlled in a measure by the angle of impingement of the air streams,—especially the suddenness of the change of pace. The effect of the impingement of the air streams on the oil spray is presumably a sharp reduction in velocity of the air streams and presumably also, the steeper the angle of impingement, the greater the reduction in air velocity. By using a less steep angle of impingement, the tendency is to lengthen the flame and this may be desirable in some installations in order to fill the fire-box. In other installations, a shorter flame will be required. I provide nozzles of different angles to help in meeting these different conditions.

By a proper choice of nozzle and air head, I am enabled to control the length and width of flame and secure a substantially uniform distribution of it over the area of the fire-box,—flattening the flame down, spreading it laterally and contracting it in length over what would be obtained by the use of a mechanical atomizing nozzle and an air supply uniformly distributed around the circle of the oil spray.

The construction described has the advantage that variations in the amount of air admitted may be effected over a fairly wide range without any great influence on the location of the point where the flame starts. This facilitates a proper application of the ignition means. It also enables a burner, of any given size, to operate satisfactorily over a wide range of oil consumption.

Another and an important feature of the invention relates to what I call "an air retort effect", which results from the enveloping action of part of the air streams with respect to the oil spray. I conceive that part of each air stream, after it meets the oil spray, will follow a more or less definite course, such for example as has been indicated generally by the arrows *f*, and that such part substantially envelops and completely surrounds the oil spray. Other parts of each air stream will not follow such an even course but will penetrate the oil spray and be met by similar parts of the opposite air stream with the result that there are, within the region of the oil spray, impinging air currents which produce a state of turmoil. The result, I believe, is that there is a moving envelope of air encompassing a region in which oil and air are in a state of turbulence and in which a thorough mixing of these two ingredients takes place. The outer and enveloping part of the air streams confines and retains the other part of the air and the oil, and is finally used up in combustion. The practical effect, I believe, is substantially that of a retort burner. All of the advantages of a retort burner appear to be secured without the disadvantage, usually incident thereto, of noisy operation. The absence of noise is very likely due to the resiliency of the air which in effect forms the walls of a retort. Much larger amounts of oil may be burned with very little noise, using the "air retort" than can be done with any ordinary retort with which I am familiar.

I believe myself to be the first to provide an oil burner in which the initially conical shape of the oil spray formation is changed, after it leaves the nozzle, by means of two streams of air, which impinge on opposite sides of the conical spray and effect a squeezing down and a lateral spreading out of the mixture,—producing a short bushy flame; and I desire to claim my invention in the broadest legal manner.

What I claim is:

1. In an oil burner, means for producing a substantially hollow conical spray of oil, means for supplying air under controlled pressure and velocity to the oil spray, and means for dividing the air thus supplied into two streams one on each of two opposite sides of the oil spray and for directing said streams in forwardly converging relation so as to impinge on the spray after it leaves the first named means, whereby the oil spray is squeezed between said air streams and the resulting mixture and flame is relatively flat and laterally spread.

2. In an oil burner, means for producing a substantially hollow conical spray of oil, and two air nozzles disposed on opposite sides of the axis of said spray to direct the air in two forwardly converging streams which impinge on the oil spray at a location near but spaced forwardly from the apex of the conical oil spray, whereby the oil spray is squeezed between the air streams and the resulting mixture is flattened down and spread in directions at right angles to that in which it is flattened down.

3. In an oil burner, means for producing a substantially hollow conical spray of oil particles, and two air nozzles disposed on op-

posite sides of the axis of said spray and constructed to direct upon the substantially conical spray in forwardly converging relation with respect to the direction of travel of the oil, two broad sheet-like streams of air, which impinge on said spray and change the direction of the oil particles thereof but to different degrees around the circle of the oil spray.

4. In an oil burner, means for producing a substantially hollow conical spray of oil, and force feed means for supplying air to the oil and directing it in two streams which impinge upon the substantially conical spray at diametrically opposite locations and adjacent but spaced from the apex of the spray, whereby the oil spray formation is changed in shape after it leaves said means and a mixture of air and oil is produced which is roughly elliptical in cross sectional shape.

5. In an oil burner, means for producing a substantially hollow conical spray of oil, force feed means for supplying air, and two air nozzles disposed on opposite sides of the axis of said spray to direct the air in two forwardly converging streams which impinge on the oil spray at a location near but spaced forwardly from the apex of the substantially conical oil spray, whereby the oil spray is squeezed between the air streams and the resulting mixture is flattened down and spread in directions at right angles to that in which it is flattened down.

6. In an oil burner, means for producing a substantially hollow conical spray of oil particles, force feed means for supplying air, and two air nozzles disposed on opposite sides of the axis of said spray and constructed to direct upon the substantially conical spray in forwardly converging relation with respect to the direction of travel of the oil, two broad sheet-like streams of air, which impinge on said spray and change the direction of the oil particles thereof but to different degrees around the circle of the oil spray.

7. In an oil burner, a mechanical atomizing oil nozzle for producing a substantially hollow conical spray of finely divided oil particles, two air nozzles disposed on opposite sides of the axis of said spray, and means for forcing air at very low pressure through said nozzles, said nozzles being constructed to deliver broad and substantially flat streams of air in forwardly converging relation and being so located with reference to the oil nozzle that the streams impinge on the oil spray after it leaves the nozzle.

8. In an oil burner, a mechanical atomizing oil nozzle for producing a substantially hollow conical spray of finely divided oil particles, two air nozzles disposed on opposite sides of the axis of said spray, and means for forcing all the air for combustion at very low pressure through said nozzles, said nozzles being constructed to deliver broad and substantially flat streams of air in forwardly converging relation and being so located with reference to the oil nozzle that the streams impinge on the oil spray after it leaves the nozzle.

9. In an oil burner, a mechanical atomizing nozzle, means for forcing oil at high pressure through said nozzle, whereby a substantially hollow conical spray of finely divided oil particles issues in mist-like form from said nozzle, two air nozzles disposed on opposite sides of the axis of said spray, and means for forcing air at very low pressure through said nozzles, said nozzles being constructed to deliver broad and substantially flat streams of air in forwardly converging relation and being so located with reference to the oil nozzle that the streams impinge on the oil spray after it leaves the nozzle.

10. In an oil burner, a mechanical atomizing-nozzle, means for forcing oil at high pressure through said nozzle, whereby a substantially hollow conical spray of finely divided oil particles issues in mist-like form from said nozzle, two air nozzles disposed on opposite sides of the axis of said spray, and means for forcing all the air for combustion at very low pressure through said nozzles, said nozzles being contructed to deliver broad and substantially flat streams of air in forwardly converging relation and being so located with reference to the oil nozzle that the streams impinge on the oil spray after it leaves the nozzle.

11. In an oil burner, a low pressure air blower, a cylindrical air tube receiving at one end the discharge from the blower, an air head closing the other end of said tube except for two diametrically opposite air passages which at their intake ends are roughly oval-shaped and at their outlet ends are roughly of rectangular shape, said passages changing the direction of the air and distributing it laterally so that two broad sheet-like streams of air issue in converging relation, a mechanical atomizing nozzle mounted centrally in said air head and back of the line along which said air streams tend to meet, and means for forcing oil at high pressure through said mechanical atomizing nozzle, whereby a substantially hollow conical spray of finely divided oil particles issues in mist-like form therefrom, the direction of the particles of oil in said spray being changed by the impinging action of the opposed air streams after the oil particles have left the nozzle and the mixture produced being broad and roughly flat in form.

12. In an oil burner, means for producing a substantially hollow conical spray of finely divided oil particles, two air nozzles disposed on opposite sides of the axis of said spray, means to force air through said nozzles, the latter constructed to direct the air in two forwardly converging streams which

impinge on the oil spray near but after it leaves the nozzle, means for igniting the mixture of oil and air, said air forcing means delivering the air to the oil at a velocity initially greater than that of flame propagation to keep the flame away from the oil nozzle, the velocity of the air after impingement with the oil becoming rapidly less than that of flame propagation with the result that the flame is of short length and bushy character.

13. In an oil burner, means for producing a substantially hollow conical spray of oil, and means for supplying air to the oil and directing it in two streams which impinge on the spray at substantially diametrically opposite locations adjacent but spaced from the apex of the spray, part of said streams serving to press down upon and envelop the spray and form a moving confining wall therefor, other parts of said streams penetrating the spray and creating turbulence within the moving wall to secure thorough mixture of the ingredients.

14. An oil burner, comprising, a low pressure air blower, an air conduit receiving at one end the discharge from the blower and closed at the other end except for two opposed air nozzles, the intake ends of which are roughly oval-shaped and the outlet ends of which are roughly of rectangular shape and in substantially parallel relation, said nozzles changing the direction of the air and distributing it laterally so that two broad sheet-like streams of air issue in forwardly converging relation, oil atomizing means located between said nozzles, and means for forcing oil at high pressure to said atomizing means.

15. In an oil burner, a low pressure air blower, an air conduit receiving at one end the discharge from the blower, and closed at the other end except for two diametrically opposed air passages the outlet portions of which are in forwardly converging relation, means located between said air outlets for producing a hollow conical spray of finely divided oil particles, said spray being subjected to the impinging action of the opposed air streams issuing in converging relation from said outlets and being flattened down and broadened out and contracted in length thereby.

In testimony whereof I have affixed my signature.

HANNIBAL A. KUNITZ.