July 4, 1950 W. W. HALLINAN 2,513,645

COMBUSTION HEAD FOR OIL BURNERS AND THE LIKE

Filed Jan. 21, 1948 3 Sheets-Sheet 1

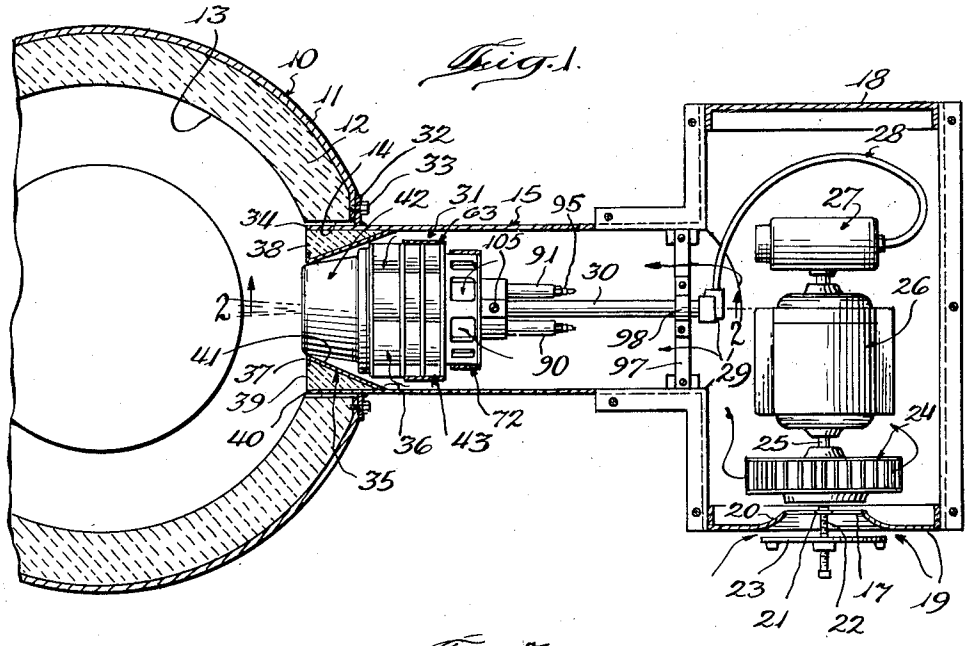


Fig. 1.

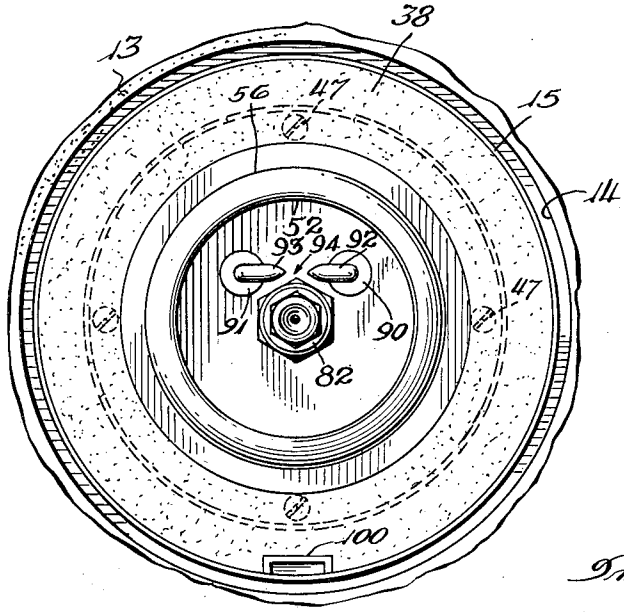


Fig. 3.

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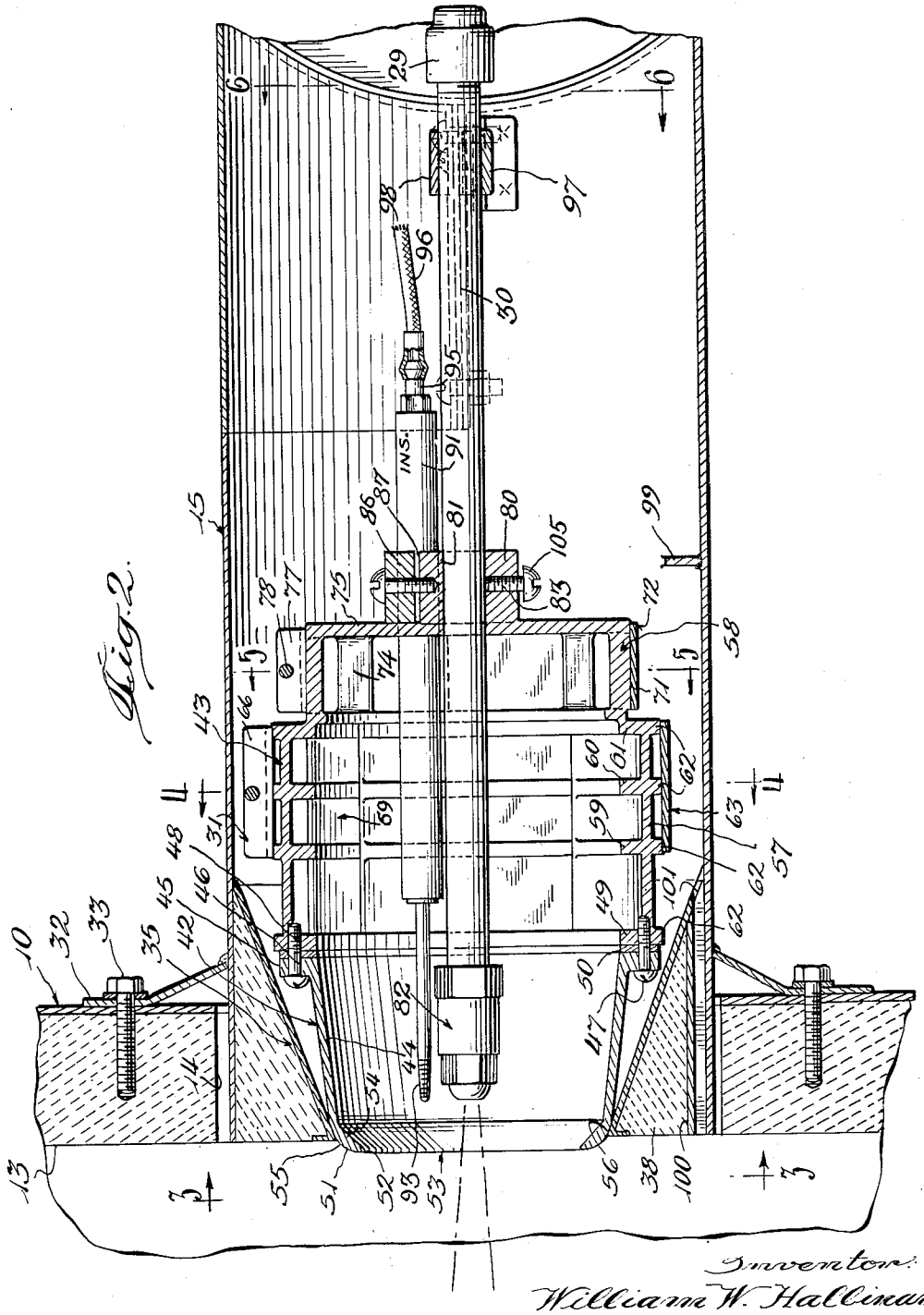


Fig. 2.

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COMBUSTION HEAD FOR OIL BURNERS AND THE LIKE

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Fig. 4

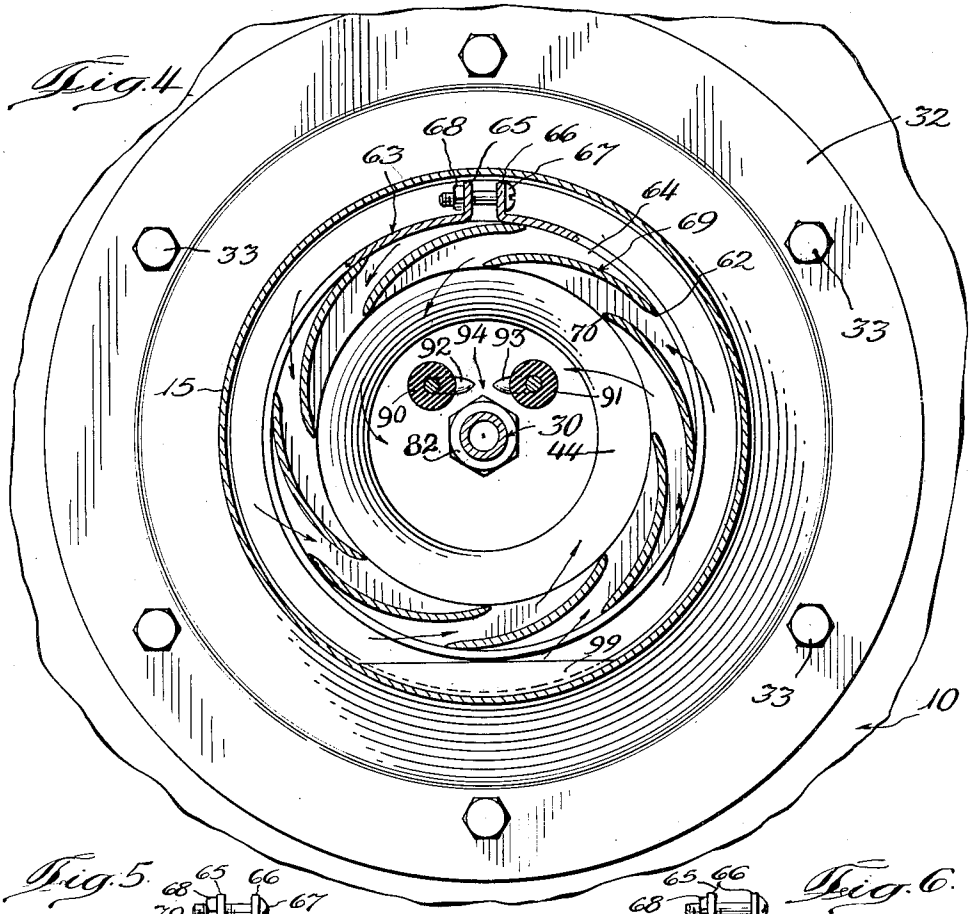


Fig. 5

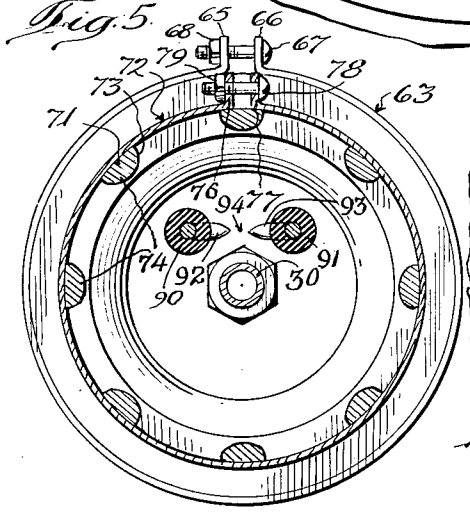
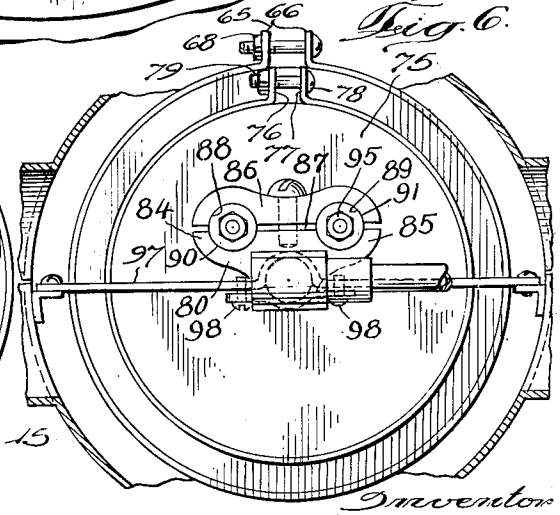


Fig. 6



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UNITED STATES PATENT OFFICE

2,513,645

COMBUSTION HEAD FOR OIL BURNERS AND THE LIKE

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Application January 21, 1948, Serial No. 3,423

5 Claims. (Cl. 158—76)

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The present invention relates to combustion heads for oil burners and the like, and is particularly concerned with an improved combustion head which is adapted to produce a hollow rotating cylinder of air which becomes a hollow cone of air as it is discharged from the air cone of the combustion head, but which may be so adjusted that the angle of the cone may be varied and the density of the air in the cone may also be varied.

One of the objects of the invention is the provision of an improved combustion head structure in which the air may be adjusted as to its angle and capacity, and in which the static head of air pressure maintained in the inlet tube may be controlled and the cone of air discharged may be varied as to its density from a full hollow cone to a full solid cone.

Another object of the invention is the provision of an improved combustion head provided with vaned air-inlet ports for producing a rotating cylinder of air, and with other inlet ports for admitting air into the rotating cylinder whereby the density of the air in the cylinder may be adjusted and the amount of air may be adjusted by controlling the size of said ports, so that the characteristics of the air discharge may be adjusted by providing a flame of any size or shape dictated by the construction of the furnace or construction of the fire box.

Another object of the invention is the provision of an improved oil burner combustion head unit, which is adapted to be removed as a unit from the air tube of the oil burner without the necessity for getting into or disassembling parts of the furnace.

Another object is the provision of an improved oil combustion head, which is adjustable in regard to the characteristics of the air discharge so that the atomizer may operate in a substantially cool condition at all times, thus eliminating a great deal of service of the burners of the prior art which is necessitated by carbon and oil varnish being driven back into the atomizer and solidified by the heat to which the atomizers are subjected in the combustion heads of the prior art.

Another object is the provision of an improved combustion head construction, including a combustion head unit which is self-centering and self-locating at its forward end and which is substantially heat insulated from the flame and fire and heat of the refractory, by the use of an insulated locating cone in the air tube.

Another object is the provision of a complete carbureting and igniting combustion head constructed as a unit, and having securing devices accessible from the rear end so that it may be easily removed from the burner as a unit for servicing, such as cleaning and adjusting the electrodes,

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and spark gap in relation to the atomizer and air cone, cleaning and adjusting the atomizer to be located in correct relation with respect to the air cone, and making the desired adjustments in the air-inlet ports by means of which the static air head is maintained and a conical air discharge is obtained which is suited in its characteristics to the size of the nozzle and the shape and characteristics of the fire box.

Another object is the provision of an improved means for controlling the air inlet ports of a combustion head, by means of which the volume of air and characteristics and shape of the conically discharged air may be controlled, if desired, after the combustion head has been installed and while it is operating so that these adjustments can be made while the flame is being observed through a suitable sight glass.

Still another object is the provision of an improved combustion head structure, which can be removed as a unit from the air tube by merely disconnecting the ignition leads and the fuel supply tube, and disconnecting a securing device which is located at the rear end of the unit in the air tube where it is conveniently accessible without disturbing any of the other parts of the furnace except to open the air tube.

Other objects of the invention will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the three sheets of drawings accompanying the specification,

Fig. 1 is a fragmentary sectional view taken on a horizontal plane passing through the furnace fire box, air tube and blower housing on a plane determined by the axis of the fuel supply tube;

Fig. 2 is a fragmentary sectional view on the larger scale, taken on the plane of the line 2—2 of Fig. 1 looking in the direction of the arrows and showing the construction of the combustion head;

Fig. 3 is a fragmentary transverse elevational view showing the discharge end of the combustion head as it appears from the inside of the fire box, on a plane determined by the lines 3—3 of Fig. 2 looking in the direction of the arrows;

Fig. 4 is a fragmentary sectional view taken on the plane of the line 4—4 of Fig. 2 showing the turbulator vanes which direct the flow of air into a hollow rotating cylinder of air;

Fig. 5 is a fragmentary sectional view taken on the plane of the line 5—5 of Fig. 2, looking in the direction of the arrows, and showing the air inlet ports which supply air to the inside of the rotating cylinder of air and

Fig. 6 is a fragmentary elevational view taken on the plane of the line 6—6 of Fig. 2, looking in

the direction of the arrows, and showing the rear end view of the combustion head unit.

Referring to Figure 1, the present combustion head is shown in connection with a furnace 10 having an exterior metal shell 11 lined by a refractory insulating wall 12 and forming a fire pot 13. The fire pot 13 is provided with a cylindrical aperture 14 for receiving the air tube 15, which leads to a blower housing 16 having an inlet 17 at one of its ends.

The blower housing 16 may be substantially cylindrical and provided with a closure cover 18, 19 at each end, the cover 19 being provided with the centrally located air inlet 17 formed by an inwardly tapered part 20 of the cover 19. Air inlet 17 has a transverse frame member or bridge 21 with a threaded bore for receiving the threaded end of a screw bolt 22, which bolt carries a circular cover 23.

The cover 23 may be adjusted to positions close to or farther away from the air inlet opening 17 to meter the amount of air passing into the blower housing 16, so that sufficient air may be supplied for combustion, depending upon the size of the nozzle. The blower may consist of a centrifugal air impeller 24 carried by the shaft 25 of the motor 26, and the other end of the shaft 25 may drive a fuel pump unit 27, the fuel pump unit including the usual strainer, gear pump and pressure regulator valve.

Conduit 28 extends from the outlet of the fuel supply unit 27 to a detachable fitting 29 on the fuel supply tube or pipe 30 of the combustion head unit, which is indicated by the numeral 31.

The air tube 15 is provided, adjacent its forward end, with an outward annular attachment flange 32 adapted to be attached to the furnace shell 11 by a plurality of screw bolts 33 threaded into threaded bores in the shell 11. Attachment flange 32 is located rearwardly of the inner end 34 of the air tube 15 sufficiently so that the end of the air tube 34 is flush with the inner wall of the fire box 13 when the attaching flange 32 is secured to the furnace shell 11.

In order to protect the combustion head against flame and heat from the refractory and to support the combustion head at its forward end, the air tube 15 supports a frusto-conical steel collar 35 at its discharge end, the largest end 36 of the frusto-conical collar 35 engaging the inside of the air tube 15 and being welded to the air tube so that the small end of the frusto-conical collar 35 is flush with the end 34 of the air tube.

The small end of this frusto-conical collar 35 may be provided with an outwardly turned annular flange 37 serving as an anchoring formation for securing the cementitious filling of heat insulation 38, which is located outside of the frusto-conical collar 35 and inside the end of the air tube, and is finished with an outer surface 39 flush with the inside of the fire box 13 at its side corners 40.

The rigid insulation 38 is adapted to protect the combustion head unit 31 from the heat of the flame and the heat radiated from the refractory lining 12, and aids materially in keeping the atomizing nozzle cooler so that carbon and oil varnish from the fuel is not accumulated in the atomizer and hardened by heat, as it is in the prior art devices. This greatly reduces the service necessary on the oil burner.

The frusto-conical collar 35 has a frusto-conical inner surface 41 which tapers toward the discharge end, and is adapted to receive and support the tapered forward extension 42 on the turbulator 43 of the combustion head 31. The forward extension 42 of the turbulator 43 may comprise a steel or iron casting, which is provided with a frusto-conical wall 44, having at its rear end a radially extending attaching flange 45 provided with a plurality of apertures 46 for receiving screw bolts 47.

The screw bolts are threaded into threaded bores 48 in the end flange 49 of the turbulator, whereby the forward extension 42 supports the turbulator 43. An asbestos gasket 50, provided with apertures for the screw bolts 47, is preferably interposed between the flanges 45 and 49, thus aiding in insulating the turbulator housing from the cone 42 and also aiding in securing an air-tight fit. The only heat conduction between cone 42 and turbulator 43 is through bolts 47.

At its forward end the cone 42 has an inwardly curved partially spherical flange 51 terminating in an inwardly extending lip 52, which forms a circular discharge aperture 53. The inner surface 54 of the curved flange 51 may be substantially frusto-conical, and the outer surface 55 may be partially spherical and is preferably ground to shape.

The partially spherical surface 55 engages in the conical opening 56 at the restricted end of the collar 35, but is larger than the opening 56 so that spherical surface 55 may be seated in the cone 35. The surface 55, being a surface of revolution, may be seated in the end of the cone 35 at any of a multiplicity of different angles as it forms a substantially universal seat, which is substantially air tight and which automatically centers the end of the cone 42 in the air tube 15.

No other support is required for the discharge end of the combustion head unit 31, the cone 42 being held in the conical collar 35 by means of a securement at the other end of the combustion head unit 31.

The turbulator 43 may consist of an aluminum casting of substantially cylindrical shape overall, consisting of a larger body portion 57 and a smaller cylindrical extension 58. The body portion 57 includes a plurality of annular flanges like the end flange 49, which may be indicated at 59, 60 and 61. The external surfaces 62 of all of these flanges may be substantially cylindrical, and may be ground to fit the inner surface of a metal band 63 so that metal band 63 may be used to cover or uncover varying amounts of the inlet ports 64, depending upon the axial adjustment of the band 63.

The band 63 may consist of a strip of sheet steel bent to cylindrical shape, and having a substantially air-tight fit about the surfaces 62 on the turbulator 43. The band 63 may have a pair of radially extending securing flanges 65, 66 provided with apertures for receiving the screw bolt 67 having a nut 68. By means of the screw bolt 67 and nut 68 the metal band 63 may be fixedly secured at any axially adjusted position on the turbulator 43, being held in that position by friction.

The turbulator flanges 49, 59, 60 and 61 are joined by curved vanes 69 (Figure 4), which are an integral part of the turbulator 43 and extend from the outer surface 62 of the flanges 49, 59—61 to the inner surface 70 of these flanges. The vanes 69 may be referred to herein as tangential vanes or spiral vanes, by which terms I mean that they are curved and extend peripherally so that they direct the air coming from

the ports 64 in concentric rotary jets close to the outer wall of turbulator 43. Thus the air emerges from the vanes to form a hollow rotating cylinder of air in the turbulator 43 and cone 42. As this hollow cylinder of air progresses forwardly through the cone 42 and out of its discharge aperture 43 it is shaped into a rotating conical discharge of air and combustion gases.

The metal band 63 may be made wide enough to cover any desired amount of the turbulator ports 64, but as a certain amount of rotating air is required, in any event, it is only necessary to cover those ports which are intended to be controlled or regulated. Thus the band 63 is illustrated as extending from the flange 61 to flange 59, leaving the ports between flanges 49 and 59 always uncovered.

The ports between flanges 49 and 59 are made wider than those between the other flanges 59—61, because the size of ports between flanges 49 and 59 is sufficient to provide air for a predetermined size of nozzle. For example, the always open ports 64 between flanges 49 and 59 may be sufficient for a one-gallon nozzle, while the additional port area between flanges 59 and 60 may provide additional air for a two-gallon nozzle. Thus the rotating cylinder of air may be adjusted as to its volume for nozzles of different size by moving the metal band 63 axially.

The end flange 61 of the turbulator 43 supports the smaller cylindrical extension 58, which has an outer cylindrical wall surface 71 to be engaged by metal band 72. The cylindrical extension 58 has radially extending ports 73 between the axially extending struts 74, which struts carry the closed end wall 75. The metal band 72 in this case is wide enough to cover the ports 73, and it is again provided with radial securing flanges 76, 77 and a through bolt 78 with a nut 79 for clamping the band 72 in any desired axial position.

In this case it will be noted that the ports 73 are merely radial ports without vanes to direct the air in a rotating motion, and the air coming in at the ports 73 of the extension 58 is directed to the interior of the rotating cylinder of air that is produced by the main body 57 of turbulator 43.

By regulating the amount of air passing in at the ports 73 (Figure 5) to the interior of the rotating cylinder of air, the density of the air at the discharge end 53 may be varied from a hollow cone to a fully solid cone, and this includes intermediate densities in which the discharged cone of air has a rotating wall of different thicknesses.

Furthermore, I find that the angularity of the cone of air discharged from the opening 53 may be varied by regulating the amount of air passing in at the ports 73 to the central portion of the head. The angularity of the conical discharge from the opening 53 may be varied from approximately a cone angle of 100 degrees to 20 degrees, while at the same time the cone may be made a solid air cone or a hollow air cone by also regulating the air controlled by the band 63.

It will be noted that the extension 58 of the turbulator 43 is smaller than the main body 57, as shown in Figure 5, so that the flanges 76 and 77 on the smaller band 72 may be received within the larger band 63. This permits the larger band to be adjusted toward the right, overlapping the extension 58 and its band 72.

The rear wall 75 of the turbulator 43 is preferably provided with an integral central lug 80, having a centrally located bore 81, which is concentric with respect to the turbulator and adapted to receive the fuel tube 30. The fuel tube 30 carries an atomizing nozzle 82 in the cone 42, and the position of the nozzle in the combustion head may be adjusted by moving the combustion head longitudinally of the fuel supply tube 30.

The combustion head is clamped in proper adjusted position by a set screw 105 threaded into a threaded bore 83 communicating with the central bore 81, so that the set screw may engage the fuel supply tube 30. The lug 80 preferably has a substantial axial length, so as to give an elongated bearing surface for its bore 81 on the fuel supply tube 30 to hold the combustion head substantially concentric with the fuel tube over the full length of the combustion head.

Thus the atomizer nozzle 82 will be located centrally of the cone 42, and is held by having a bore 81 of substantial length and centrally located. The lug 80 is preferably widened at one side, as shown in Figure 6, forming clamping members 84, 85 and 86, separated by a saw-cut slot 87. This enlargement of the lug 80 has a pair of axially extending bores 88, 89, of sufficient size to receive the two porcelain sleeves or insulators 90, 91, which carry the high tension conductors that terminate in electrodes 92, 93.

These electrodes have inwardly turned end portions which are pointed and are accurately spaced to form the air gap 94, preferably located above the nozzle end and substantially flush with the end of the nozzle so that the ignition electrodes may be located out of the flame, but close enough to ignite the fuel discharged from the nozzle.

The connectors 95 carried by the rear end of the electrodes 92, 93 are connected by suitable detachable conductors 96 to the high voltage side of an ignition transformer, which is suitably controlled to provide ignition voltage whenever it is required.

The fuel supply tube 30 is supported at its rear end (Figure 2) by transversely extending frame members 97 provided with clamping means 98, and secured to the inside of the air tube 15 so that the fuel supply tube may be fixedly and centrally secured by means of the frame member 97 at the rear end of the air tube 15. This rear end securement is only made after the cone 42 is pushed into a tight seat in the collar 35 of air tube 15, and thus the securement at the rear end is all that is necessary to center the combustion head automatically and hold it in adjusted position.

The combustion head comprising the turbulator, cone, nozzle, electrodes and the air adjustment bands may be removed with the fuel supply tube as a unit without disturbing the furnace, except to open the air tube 15. It is only necessary to disconnect the high tension leads 96 and the fuel supply connection at 29, whereupon the clamping means at 98 may be released and the combustion head removed.

Thus the electrodes may be checked as to air gap and as to proper location with respect to the nozzle and the cone. The central location of the nozzle in the cone and its axial position may be checked and rectified by bending the fuel supply tube slightly or by moving the turbulator axially on the fuel supply tube and securing it with the set screw 105.

The rotating air supply may be adjusted by

adjusting the band 63 axially; and the internal or central air supply may be adjusted by adjusting the axial position of the band 72; and the shape and size of the conical air discharge, as well as its density, may be controlled by adjusting these air control bands.

The air tube 15 preferably has a metal dam 99 welded across the lower inner surface just behind the turbulator, and has a channeled member 100 (Fig. 3) welded to the lower inside wall and passing through the rigid insulation 38 and through an aperture 101 (Fig. 2) in the rear end of cone 42.

The air tube 15 is also preferably pointed slightly downward toward its front end so that any leakage of oil from nozzle 82 will drain into the fire pot through the opening provided by the channel 100.

It has already been pointed out that the combustion head is automatically centered and seated by having its forward end shoved into tight contact with the inside of the conical collar carried by the air tube.

When the rear end of the combustion head is secured by securing the fuel supply tube to the rear end of the air tube, the combustion head installation is completed. Thus the combustion head is conveniently removable as a unit and may be adjusted and serviced, outside the burner.

In some embodiments of the invention the air bands 63 and 72 may be slidably mounted and carried by rods mounted in guides on the air tube, and provided with actuating means so that the bands can be slid axially from the outside of the burner. Thus an adjustment of the air can be made while the flame is being observed through the fire door.

The operation of the burner is as follows: As the fuel is supplied through the fuel supply tube 30 from the pump, under suitable pressure and volume for the nozzle 82, it is atomized by the nozzle and sprayed in a conical form out of the combustion head discharge aperture 53. The air supplied under suitable pressure by the blower passes down the air tube 15 and in at the ports 64 in the turbulator 43, where the vanes 69 cause the air to rotate inside the turbulator, forming a hollow rotating cylinder of air; and as it passes through aperture 53 it takes the form of a hollow cone, which will form a hollow saucer-shaped flame of approximately 100 degrees.

If additional air is supplied to the interior of this cylinder of air through the ports 73 in the turbulator extension 58, and by means of the adjustment of the band 72 the angularity of the conical air discharge may be varied from approximately 100 degrees cone to 20 degrees. This determines the shape of the flame or combustion area and enables the same combustion head to be used for furnace fire boxes of different size and shape; and if the band 72 is adjusted to fully uncover ports 73, the flame shape or angle will be approximately 20 degrees.

The same combustion head may also be used with nozzles of different capacity and spray angle; and the density of the air in the conical air discharge may be varied from a hollow cone to a fully solid cone by the adjustment of band 72. Thus the present combustion head may be adjusted to take care of many different furnace conditions, and more perfect combustion may be assured under all conditions.

By the combination adjustment of the band 63 over ports 64 and that of the band 72 over ports 73, and the air inlet plate 23 over opening 67, any combination of air rotation and density under any head pressure, within the capacity range of the blower, can be obtained. Therefore, not only can the flame be controlled to fit any shape combustion chamber and furnace, but also many types of atomizing nozzles having different spray angles and densities can also be used; and in each instance pulsations and furnace back pressure can be overcome, and the burner can be made to work equally as well in one furnace or boiler as in another, regardless of their design.

My improved apparatus utilizes an improved method of predetermining the shape and characteristics of the flame discharged from the combustion head by introducing air peripherally of the combustion head, and causing it to rotate to form a hollow cylinder of air, passing this air out of a restricted conical discharge opening, and at the same time supplying a predetermined amount of air to the inside of the hollow cylinder of air to determine and change, at will, the angularity of the conical discharge, as well as the density of the air in the conical discharge.

The volume of air discharged may also be regulated by means of my apparatus, which is also so insulated and cooled that it operates in a much cooler condition than the devices of the prior art, whereby the nozzle is not clogged with carbon or oil varnish, which is baked to a hard condition, due to the heat in the devices of the prior art. Thus less nozzle servicing is necessary when the present apparatus is employed.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

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

1. In a combustion head assembly for oil burners of the nozzle type, the combination of a substantially cylindrical metal air tube open at its rear end and provided at its forward end with a frusto-conical metal collar engaging the inside of the air tube at the larger end of said collar, and being flush with the end of said air tube at the smaller end of said collar, the space between said collar and said air tube being substantially filled with refractory, a supporting bracket carried by the open end of said air tube and having means for clamping a fuel pipe centrally located on said bracket in said tube, and a combustion head unit, said combustion head unit including a supporting fuel pipe, a nozzle carried by the end of said fuel pipe, a combustion head carried by the fuel pipe and comprising a metal member having a rear wall facing toward the open end of said fuel pipe, said rear wall having a hub enlargement surrounding an axial bore extending through the rear wall, for receiving said fuel pipe, said hub being provided with clamping means for clamping said combustion head in predetermined axial position on said fuel pipe, said rear wall also having a pair of eccentric through bores for receiving insulated ignition electrodes, and clamping means for clamping said electrodes, a pair of ignition electrodes provided at their rear ends with elongated refractory insulating tubes arranged in said latter bores, said electrodes having their ignition ends disposed laterally of but adjacent the discharge end of said nozzle, said

combustion head being of a size smaller than said air tube, and having a generally cylindrical body provided with a multiplicity of peripherally open air ports for receiving air from said tube, the said combustion head being provided on its forward end with a frusto-conical metal restricting member open at both ends and communicating at its rear with the said cylindrical body, said restricting member being provided at its discharge end with an inwardly extending peripheral flange which has a frusto-conical surface on its inner side for determining the frusto-conical shape of the combustion flame discharged from said combustion head, and provided on its outside with a partially spherical annular surface, said partially spherical annular surface being of a larger diameter than the smaller end of said first-mentioned metal collar, the engagement of spherical surface portions inside a conical discharge opening in the air tube effecting an air-tight seal around the inner end of the combustion head, while permitting a substantially universal adjustment or movement of the outer end of the fuel pipe without detracting from the tightness of said air seal, the first-mentioned metal collar guiding the combustion head into air sealing relation and into centered position as the combustion head is moved into said collar, where it can be secured solely by the clamping means engaging the rear end of the fuel pipe.

2. In a combustion head assembly for oil burners of the nozzle type, the combination of a substantially cylindrical metal air tube, open at its rear end and provided at its forward end with a frusto-conical metal collar engaging the inside of the air tube at the larger end of said collar, and being flush with the end of said air tube at the smaller end of said collar, the space between said collar and said air tube being substantially filled with refractory, a supporting bracket carried by the open end of said air tube, and having means for clamping a fuel pipe centrally located on said bracket in said tube, and a combustion head unit, said combustion head unit including a supporting fuel pipe, a nozzle carried by the end of said fuel pipe, a combustion head carried by the fuel pipe and comprising a metal member having a rear wall facing toward the open end of said fuel pipe, said rear wall having a hub enlargement surrounding an axial bore extending through the rear wall, for receiving said fuel pipe, said hub being provided with clamping means for clamping said combustion head in predetermined axial position on said fuel pipe, said rear wall also having a pair of eccentric through bores for receiving insulated ignition electrodes, and clamping means for clamping said electrodes, a pair of ignition electrodes provided at their rear ends with elongated refractory insulating tubes arranged in said latter bores, said electrodes having their ignition ends disposed laterally of but adjacent the discharge end of said nozzle, said combustion head being of a size smaller than said air tube, and having a generally cylindrical body provided with a multiplicity of peripherally open air ports for receiving air from said tube, the said combustion head being provided on its forward end with a frusto-conical metal restricting member open at both ends and communicating at its rear with the said cylindrical body, said restricting member being provided at its discharge end with an inwardly extending peripheral flange which has a frusto-conical surface on its inner side for determining the frusto-conical shape of the combustion flame discharged from said combustion head, and provided on its outside with a partially spherical annular surface, said partially spherical annular surface being of a larger diameter than the smaller end of said first-mentioned metal collar, the engagement of spherical surface portions inside a conical discharge opening in the air tube effecting an air-tight seal around the inner end of the combustion head, while permitting a substantially universal adjustment or movement of the outer end of the fuel pipe without detracting from the tightness of said air seal, the first-mentioned metal collar guiding the combustion head into air sealing relation and into centered position as the combustion head is moved into said collar, where it can be secured solely by the clamping means engaging the rear end of the fuel pipe, the said air tube being provided on its outside, adjacent its discharge end, but spaced sufficiently from the discharge end to bring the discharge end into a position flush with the inside of a furnace wall, with an annular attaching flange welded to said metal tube, and having apertures for reception of securing members by means of which it may be secured to the metal shell of a furnace, the said attaching flange being shaped for air-tight engagement with the side wall of the shell of the furnace.

3. In a combustion head assembly for oil burners of the nozzle type, the combination of a substantially cylindrical metal air tube open at its rear end and provided at its forward end with a frusto-conical metal collar engaging the inside of the air tube at the larger end of said collar, and being flush with the end of said air tube at the smaller end of said collar, the space between said collar and said air tube being substantially filled with refractory, a supporting bracket carried by the open end of said air tube and having means for clamping a fuel pipe centrally located on said bracket in said tube, and a combustion head unit, said combustion head unit including a supporting fuel pipe, a nozzle carried by the end of said fuel pipe, a combustion head carried by the fuel pipe and comprising a metal member having a rear wall facing toward the open end of said fuel pipe, said rear wall having a hub enlargement surrounding an axial bore extending through the rear wall, for receiving said fuel pipe, said hub being provided with clamping means for clamping said combustion head in predetermined axial position on said fuel pipe, said rear wall also having a pair of eccentric through bores for receiving insulated ignition electrodes, and clamping means for clamping said electrodes, a pair of ignition electrodes provided at their rear ends with elongated refractory insulating tubes arranged in said latter bores, said electrodes having their ignition ends disposed laterally of but adjacent the discharge end of said nozzle, said combustion head being of a size smaller than said air tube, and having a generally cylindrical body provided with a multiplicity of peripherally open air ports for receiving air from said tube, the said combustion head being provided on its forward end with a frusto-conical metal restricting member open at both ends and communicating at its rear with the said cylindrical body, said restricting member being provided at its discharge end with an inwardly extending peripheral flange which has a frusto-conical surface on its inner side for determining the frusto-conical shape of the combustion flame discharged from said combustion head, and provided on its outside with a partially spherical annular surface, said

partially spherical annular surface being of a larger diameter than the smaller end of said first-mentioned metal collar, the engagement of spherical surface portions inside a conical discharge opening in the air tube effecting an air-tight seal around the inner end of the combustion head, while permitting a substantially universal adjustment or movement of the outer end of the fuel pipe without detracting from the tightness of said air seal, the first-mentioned metal collar guiding the combustion head into air sealing relation and into centered position as the combustion head is moved into said collar, where it can be secured solely by the clamping means engaging the rear end of the fuel pipe, the said frusto-conical collar and refractory being provided, adjacent the lower inside of the air tube, with a through conduit for draining liquid fuel from the air tube into the fire pot used with said combustion head, in the event of leakage of liquid fuel from said nozzle.

4. In a combustion head assembly for oil burners of the nozzle type, the combination of a cylindrical metal air tube which is open at its rear end and provided at its discharge end with an axial circular opening of smaller size than the said tube, with a combustion head having a forward extension, said forward extension having a round discharge opening bordered by an inwardly extending annular flange which is provided with an inner frusto-conical surface, defining the conical shape of the discharge from said combustion head, the said combustion head including a substantially cylindrical metal body closed at its rear end and communicating with said extension at its front end, said body having a fuel pipe located centrally of said air tube and extending through said rear end and provided with a nozzle located inwardly and centrally with respect to said frusto-conical surface, the said cylindrical body being formed with a forward portion of larger diameter and a rearward portion of smaller diameter, the said smaller cylindrical portion comprising a plurality of externally cylindrical, axially extending struts secured to said rear wall and to an annular end wall of said larger cylindrical portion, said struts being spaced peripherally from each other to provide radially extending air ports, and a cylindrical band adjustably mounted for axial adjustment on said smaller cylindrical portion, to adjust the size of said latter air ports, the said larger cylindrical portion comprising a plurality of radially extending annular flanges spaced axially from each other for guiding the air from said tube into said combustion head in a direction transverse to the axis of said tube, the said annular flanges being joined by a multiplicity of spirally extending vanes, each spirally extending vane extending from the outside of said annular flanges spirally in the same peripheral direction and inwardly to a point adjacent the inside of said annular flanges, and each succeeding spiral vane having its outer portion overlapping the inner end of the next adjacent spiral vane so that the spiral vanes and annular flanges define peripheral ports of rectangular shape whose inlet openings and outlet openings are so directed that the air entering is directed in such manner as to form a whirling air cylinder inside the combustion head, the said annular flanges being adjustably covered

by a cylindrical metal band which is adjustable in an axial direction to regulate the amount of air supplied to the combustion head from the air tube in a whirling sense, the radial ports in the smaller cylindrical portion of said body supplying air for the inside of said whirling cylinder of air, and the adjustment of all of said ports serving to determine the size and shape of the flame discharged from said combustion head, to adapt the combustion head to fire boxes of different sizes and shapes without the necessity for the flame discharged to hit the back wall of the combustion chamber.

5. In a combustion head assembly for oil burners of the nozzle type, the combination of a cylindrical metal air tube which is open at its rear end and provided at its discharge end with an axial circular opening of smaller size than the said tube, with a combustion head having a forward extension, said forward extension having a round discharge opening bordered by an inwardly extending annular flange which is provided with an inner frusto-conical surface, defining the conical shape of the discharge from said combustion head, the said combustion head including a substantially cylindrical metal body closed at its rear end and communicating with said extension at its front end, said body having a fuel pipe located centrally of said air tube and extending through said rear end and provided with a nozzle located inwardly and centrally with respect to said frusto-conical surface, the said combustion head comprising a plurality of radially extending annular flanges spaced axially from each other for guiding the air from said tube into said combustion head in a direction transverse to the axis of said tube, the said annular flanges being joined by a multiplicity of spirally extending vanes, each spirally extending vane extending from the outside of said annular flanges spirally in the same peripheral direction and inwardly to a point adjacent the inside of said annular flanges, and each succeeding spiral vane having its outer portion overlapping the inner end of the next adjacent spiral vane so that the spiral vanes and annular flanges define peripheral ports of rectangular shape whose inlet openings and outlet openings are so directed that the air entering is directed in such manner as to form a whirling air cylinder inside the combustion head, the said annular flanges and spiral vanes causing the air which passes into the combustion head at its periphery to form a whirling cylinder of air, the size and shape of which may be adjusted by covering predetermined of said ports to form a spreading flame which may be adjusted for furnaces of different characteristics, without the necessity for the flame to engage the back wall of a combustion chamber.

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