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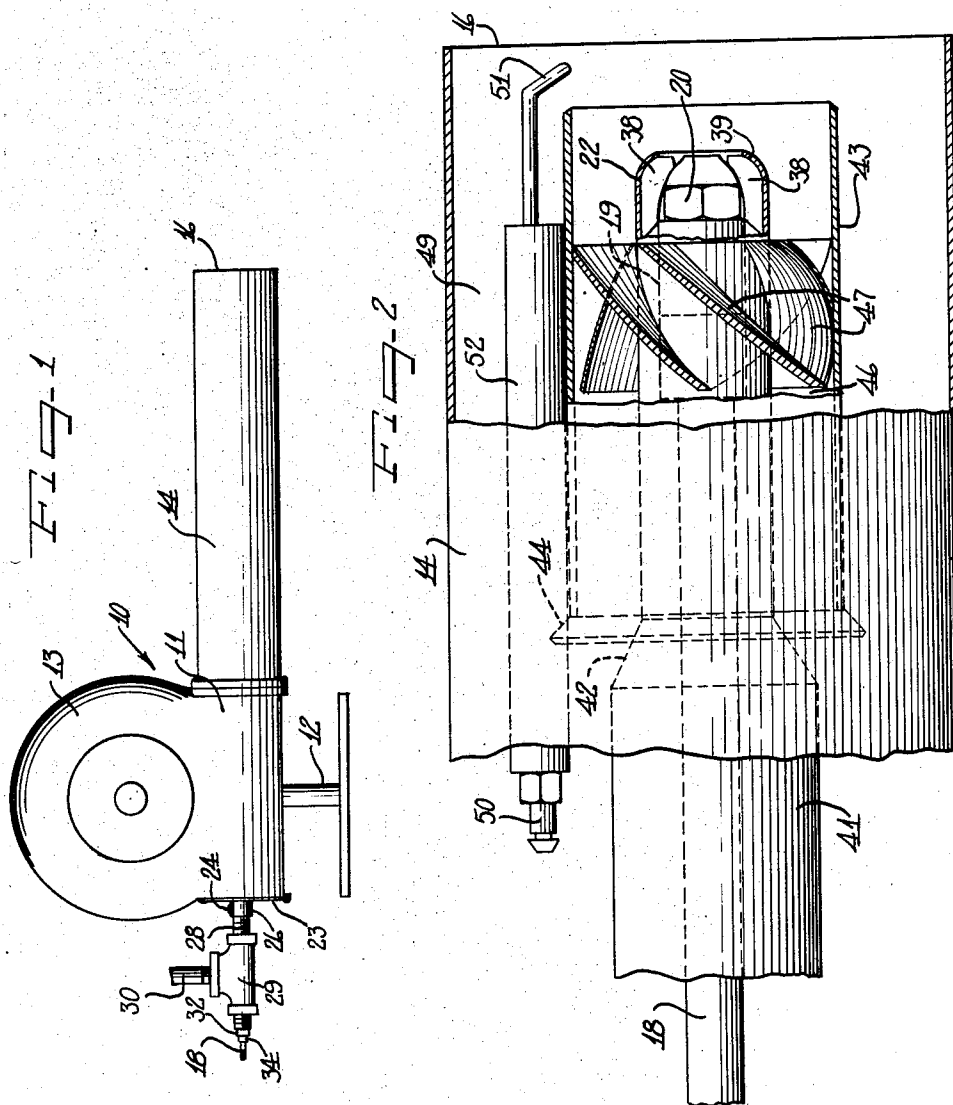
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2,803,296

COMBUSTION HEAD FOR BURNER APPARATUS

Filed June 5, 1952

3 Sheets-Sheet 1



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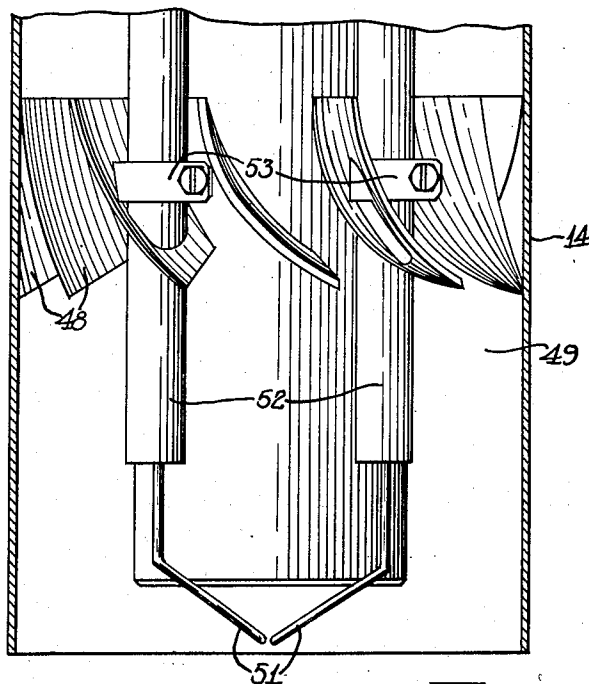
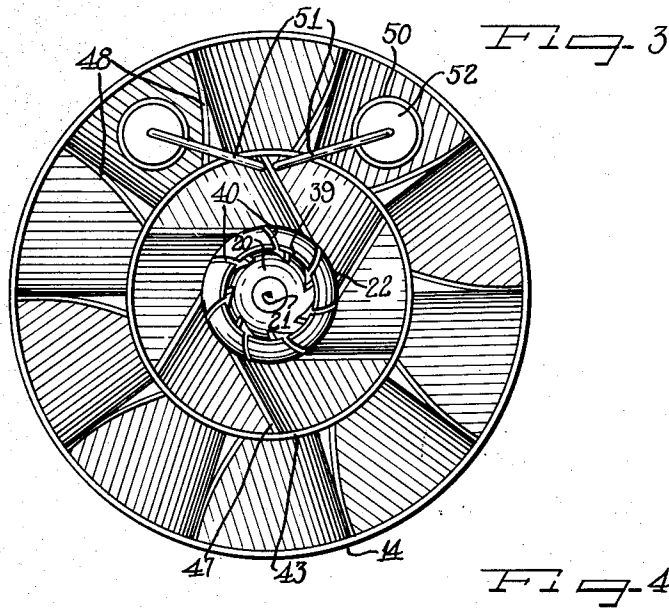
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COMBUSTION HEAD FOR BURNER APPARATUS

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3 Sheets--Sheet 2



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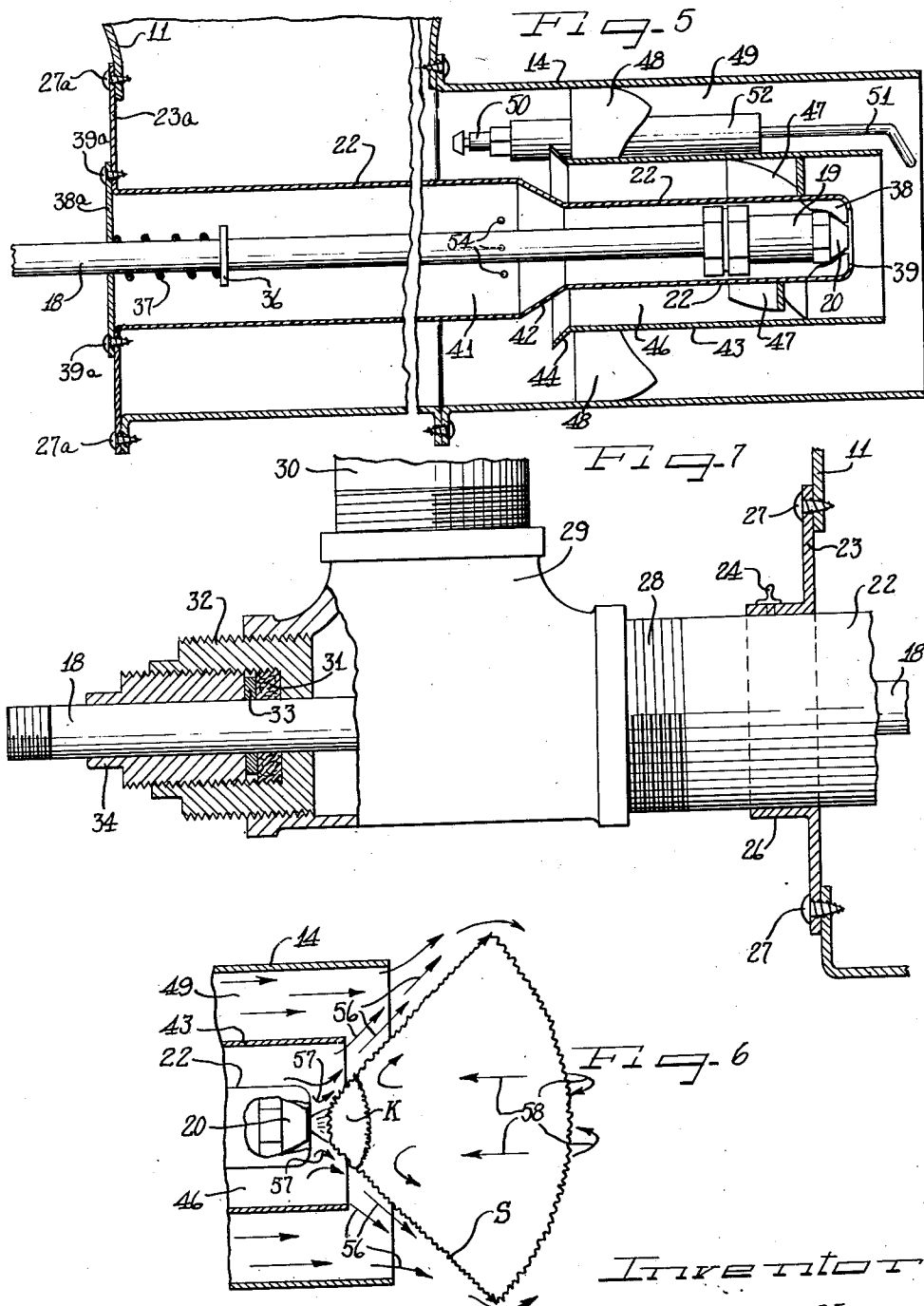
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COMBUSTION HEAD FOR BURNER APPARATUS

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3 Sheets-Sheet 3



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1

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COMBUSTION HEAD FOR BURNER APPARATUS

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1 Claim. (Cl. 158—76)

This invention relates generally to combustion apparatus and more particularly to an improved combustion head for an oil burner or for a combination gas-oil burning unit.

Combustion heads including spray nozzles with baffle means associated therewith have been heretofore provided, however, in the prior art devices the oil nozzle is usually exposed at the firing end to direct radiant heat from the oil flame in the combustion chamber. Moreover, under certain conditions of adjustment, the prior art devices permit combustion to occur at, or very near, the surface of the nozzle which phenomenon occurs in very undesirable burner operation.

The combustion heads of the prior art apparatus have also been deficient in that the devices are too sensitive to variable factors such as draft changes and slight changes in the combustion characteristics of the various fuel oils supplied.

In attempting to provide a solution for the problem of providing an efficient combustion head, the prior art devices have been modified to include air mixing arrangements which will effect control of the fuel-air mixture at the kindling zone, or area adjacent the spray nozzle including that section of the conically shaped oil spray where ignition takes place. In many instances, such control arrangements have been unsuccessful because too much air is mixed with the fuel in the kindling zone, thereby producing a lean mixture, or too violent a mixing of the fuel with the combustion-supporting air occurs so that an unstable flame condition is produced. The kindling zone is thus ill-defined and the oil flame is alternately blown away and reignited in a series of minor explosions, an operational phenomenon known as "pulsation."

According to the general principles of the present invention, a spray head nozzle having a port to discharge a generally conically shaped oil spray is surrounded by a guide tube which provides a calm atmosphere immediately adjacent the port or orifice of the spray head nozzle.

A cylindrical baffle is also provided as well as a barrel, the guide tube together with the cylindrical baffle and the barrel forming a plurality of annular air passageways concentrically arranged relative to the oil nozzle. Spinner vanes are provided in the annular air passageways so as to impart a rotating motion to combustion-supporting air furnished to the passageways. Thus, the combustion-supporting air is directed along the surface of the outwardly expanding conically shaped oil spray by means of the momentum from the rapidly rotating motion of the combustion-supporting air. In this manner the air in immediate contact with the oil spray, while not reduced in volume or velocity, does not interfere with the rapid kindling of the oil and neither chills the oil nor deforms the conical shape of the oil spray.

2

The principles of the present invention further contemplate the utilization of an oil nozzle which is removably assembled in the guide tube so as to facilitate ready servicing of the nozzle without disturbance of the other portions of the burner apparatus.

Another feature of the present invention resides in the utilization of a spray head nozzle which, together with its adapter assembly, may be fixed on the end of an oil line rotatably supported so that any long tongue of fire caused by a minor imperfection in the orifice of the spray head nozzle may be directed toward the bottom of the furnace upon rotating the oil line, thus covering the long tongue of fire with burning gases and air and minimizing the tendency thereof to smoke and interfere with efficient combustion.

It is an object of the present invention, therefore, to provide an improved combustion head which will overcome the deficiencies of the prior art devices.

Another object of the present invention is to provide an oil burner nozzle which may be readily removed from a burner assembly without disrupting the other components of the apparatus.

Another object of the present invention is to provide a combustion head which may be rotated from the front of the furnace for the purpose of controlling the flame characteristics of the burner.

Another object of the present invention is to provide a combustion head which will operate under all conditions of firing with minimum temperatures at the oil burning nozzle so as to reduce the accumulation of coke at the area of the spray head nozzle orifice.

A further object of the present invention is to provide a combustion head which will operate efficiently under varying draft conditions, particularly under conditions of reduced draft.

Another object of the present invention is to provide a combustion head for a burner apparatus which will reduce the amount of smoke in the combustion chamber.

Yet another object of the present invention is to provide a combustion head for a burner apparatus which will minimize pulsation.

A further object of the present invention is to provide a combustion head apparatus comprising a reduced number of highly simplified components which are readily accessible and which may be conveniently serviced by relatively unskilled personnel.

A still further object of the present invention is to provide a combustion head for a combination gas-oil burner unit wherein two fuels may be burned efficiently in a single burner with a minimal duplication of burner components.

Many other advantages, features and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of drawings, in which a preferred structural embodiment incorporating the principles of the present invention is shown by way of illustrative example only.

On the drawings:

Figure 1 is a fragmentary side elevational view of a burner apparatus incorporating the principles of the present invention.

Figure 2 is an enlarged fragmentary view with parts broken away and with parts shown in cross-section showing additional details of construction of the combustion head provided in the burner apparatus of Figure 1;

3

Figure 3 is an end elevational view of the combustion head shown in Figure 2;

Figure 4 is a cross-sectional view showing in plan elevation certain additional details of construction of the combustion head of Figures 2 and 3;

Figure 5 is a fragmentary cross-sectional view with parts shown in elevation showing the combustion head of the present invention assembled in an oil burner unit;

Figure 6 is a view somewhat similar to Figure 2 showing additional details of construction of the combustion head and illustrating the principles of operation; and

Figure 7 is an enlarged elevational view partly in section and showing how the burner unit of the present invention is adapted for combination gas-oil operation.

As shown on the drawings:

In Figure 1 is shown a burner apparatus 10 of the gun-type which includes a frame 11 mounted on a base 12 adapted to be placed in firm assembly with a support structure and, in turn, carrying a blower housing 13 enclosing the impeller of an electrically driven blower provided in accordance with conventional practice. It will be understood that the burner apparatus 10 further includes a motor driven oil pump and such other accessories as are usually incorporated in a gun-type burner apparatus.

Extending from one side of the frame 10 is a barrel 14, or air supply duct, terminating in a firing end indicated at 16.

On the other side of the frame 11 is mounted an inspection plate 23 which may be removed to give access to the burner apparatus components extending through the frame 11 and the barrel 14 towards the combustion chamber of the furnace with which the burner apparatus 10 is associated.

An oil supply line is indicated at 18 and extends through the frame 11 and into the barrel 14. The firing end of the oil supply line 18 is connected to a nozzle adapter 19 which, in turn, carries a spray head nozzle 20. It will be understood that the oil supply line 18 can be connected at its front extremity to a pressurized oil supply means so as to furnish pressurized oil to the spray head 20. The spray head 20 is provided with a port or orifice 21 to discharge a generally conically shaped oil spray indicated in Figure 6 by the reference character S.

Referring particularly to Figure 7, it will be noted that a guide tube 22 is placed in firm assembly with the inspection plate 23 by means of a lock screw 24 cooperating with a hub portion 26 receiving the guide tube 22. The flanged inspection plate 23 is attached in firm assembly to the frame 11 of the burner apparatus 10 by means of a plurality of fasteners 27.

The end of the guide tube 22 may be externally threaded as at 28 and thread into a T member 29 adapted to be connected to a conduit 30 associated with a supply of gas fuel.

The oil supply line 18 extends through the T member 29 and a packing gland is provided between the oil supply line 18 and the T member 29 to provide a gas-tight seal. The packing gland includes a ring of packing material 31 enclosed by a pipe plug 32 and is cooperatively engaged by a packing washer 33 engaged by a packing nut 34.

In Figure 5 the guide tube 22 is modified for installation in an oil burner unit and terminates in a radially outwardly extending inspection plate 23a connected in firm assembly to the frame 11 by a plurality of fasteners 27a. The oil supply line 18 is provided with a ring stop 36 bottoming a coil spring 37 arranged to have its opposite end engage a flange 38a connected to the guide tube 22 by means of a plurality of fasteners 39a engaging the inspection plate 23a. Thus, the coil spring 37 is compressed between the flange 38a and the stop ring 36 and the oil supply line 18 will be relatively slidable with respect to the flange 38a as it is likewise slidably related to the packing gland assembly of Figure 7.

4

At the firing end of the guide tube 22, a plurality of circumferentially spaced radially inwardly extending guide fingers 38 may be provided and are conformably shaped to radially position the spray head nozzle 20 in central alignment relative to the guide tube 22.

The guide tube 22 may also be provided with a plurality of radially inwardly extending vanes 39 between which are formed a series of elongated orifices 40 arranged to direct the gaseous fluid flowing through the guide tube 22 in a rotating manner relative to the spray head nozzle 20.

In other words, the end portion of the tube is curved or tapered radially inwardly and slots are formed therein to provide the orifices 40 with the vanes 39 being formed by the segments of the end portion of the tube 22 between the vanes. As shown in Figure 3 the fingers 38 are slanted to form vanes such that air passing therebeyond is rotated about the nozzle axis, and the slots 40 are also slanted in generally parallel relation to the slant of the fingers 38 so as to promote and not interfere with such rotation while permitting axial flow. At the same time, the segments of the tube between the slots 40, i. e. the vanes 39, protect the nozzle from heat radiated directly from the flame, to a substantial extent.

It will be noted that the spray head nozzle 20 carried on the end of the adapter 19 connected to the oil supply line 18 is axially loaded by the coil spring 37 against the guide fingers 38, however, relative rotation of the spray head nozzle 20 may be effected by selectively rotating the oil supply line 18. In other words, by disconnecting or loosening the oil supply line 18 at the union normally used for connecting it to an oil source, the spray head nozzle 20 may be relatively angularly positioned from the front of the furnace so that any long tongue of fire caused by a minor imperfection in the orifice of the spray head nozzle 20 may be directed toward the bottom of the furnace where it will be covered by burning gases and air, thus reducing the tendency to smoke. This advantageous feature makes it possible to successfully utilize nozzles which would otherwise be discarded.

Referring particularly to Figure 2, it will be noted that the guide tube 22 is provided with a reduced diameter portion at the firing end thereof and further includes an enlarged diameter portion 41 joined to the reduced diameter portion by a tapered portion 42. Surrounding the reduced diameter portion of the guide tube 22 is a cylindrical baffle 43 which is provided with an annular tapered flange 44 arranged in alignment with the tapered portion 42 of the guide tube 22 to provide an air inlet throat for an annular air passageway 46 formed between the guide tube 22 and the baffle 43 in concentric relationship to the spray head nozzle 20.

A plurality of circumferentially spaced air spinner vanes 47 are located in the air passageway 46 between the baffle 43 and the guide tube 22 and impart a rotational movement to the air or gas passing through the passageway 46 so as to impart a rotational motion to said gaseous fluid in the same rotational direction as the orifices 40.

Referring now to Figures 2, 3 and 4, it will be noted that a plurality of circumferentially spaced air spinner vanes 48 are provided in an annular air passageway 49 formed between the baffle 43 and the barrel 14 and impart a rotational motion to any gaseous fluid passing through the passageway 49 of the same rotational direction as the gaseous fluid passing through the passageway 46 and through the guide tube 22.

Suitable ignition means of conventional design may be employed in connection with the structural members of the present invention and in the preferred embodiment herein described a pair of electrical igniters 50 connected to a suitable source of current include converging electrodes 51 aligned in registry with the firing end of the baffle 43. Suitable insulation sleeves 52 enclose the electrodes 51, the sleeves 52 passing through appropriate apertures formed in a pair of the spinner vanes 48. The

5

igniters 50 are located in the passageway 49 and may be retained in firm assembly with the baffle 43 by means of a pair of bracket clamps 53.

Referring now to Figure 6 in conjunction with the other figures of the drawings, the operation of the combustion head thus far described may be reviewed.

As is well known, radiant heat from the oil flame and from the combustion chamber of most burner apparatus tends to increase the temperature of the spray head nozzle, however, it will be noted that the structure of the present invention shields the complete nozzle adapter 19 and all of the spray head nozzle 20 except for a small portion immediately around the orifice 21 by virtue of the arrangement of the spray head nozzle 20 within the guide tube 22, the end of the guide tube 22 being partially closed by the radially inwardly extending vanes 39.

Moreover, if a supply of combustion-supporting air is furnished to the interior of the guide tube 22 through ventilating apertures 54 located in the side walls of the guide tube 22, such air will be given a rapidly spinning motion by the orifices 40 and cools the surface of the spray head nozzle 20.

It will be understood that a supply of combustion-supporting air will be furnished by the blower into the barrel 14 and will pass through the throat provided between the tapered portion 42 and the annular tapered flange 44 into the passageway 46 whereupon the combustion-supporting air will be given a rapidly spinning motion by the vanes 47. Thus, the amount of air surrounding the orifice 21 is actually increased and the rapidly spinning air fills the space immediately surrounding the orifice shield provided by the guide tube 22 and operates to cool the spray head nozzle 20.

By controlling the direction of air flow through the burner head and in particular in that zone immediately adjacent the oil orifice 21, satisfactory combustion occurs under a wide range of draft conditions.

It will be noted that a very definitely defined kindling zone indicated by the character K is provided immediately adjacent the oil orifice 21. The rotating motion of the combustion air supply through the passages 46 and 49 causes the combustion-supporting air to be thrown outwardly in an expanding conical stream as is indicated by the arrows 56. Since the air flow path from the end of the burner head apparatus is unimpeded, directional changes are avoided maximizing the adjustability of the burner with respect to the supply of combustion-supporting air and the supply of oil fuel. Moreover, since the combustion-supporting air flows parallel to the oil spray S, there is no sudden chilling of oil vapors in the combustion area.

The partially closed end of the guide tube 22 actually provides a calm atmosphere immediately adjacent the oil orifice 21. Small eddy currents of air indicated by the arrows 57 are present and this air is drawn into the high velocity oil spray S by the suction effect thereof. In other words, the air is not forced into the oil spray S but is induced by the movement of the oil spray S. Thus, a gentle mixing of a small quantity of air immediately adjacent the oil orifice 21 precludes violent contact between the oil spray S and the combustion-supporting air. Since the supply of combustion-supporting air moving through the passageway 46 is directed along the surface of the outwardly expanding cone-shaped oil spray S by means of the momentum from the rapid rotating motion given by the air spinner vanes 47, rapid kindling of the oil spray S is facilitated since an adequate volume of combustion-supporting air is available. Actually, an inner film of the conically-shaped air stream is in contact with an outer film of conically-shaped oil spray S and at this point of contact combustion occurs. Within the burning film, the oil fuel is momentarily suspended as it travels from the apex of the conically-shaped oil spray S at the orifice 21 into the combustion chamber since a

6

hot flame tends to recirculate towards the apex of the oil spray as is indicated by the arrows 58.

The supply of combustion-supporting air from the passageway 49 also expands along the outer conical surface of the oil spray S without interfering with or deforming the delicately defined oil spray cone. Consequently, the more volatile and finely divided fuel particles traveling parallel to the combustion-supporting air kindle rapidly from the heat of the oil flame. The combustion of these particles in close proximity to the heavier and slower burning fuel particles improve the ignition and combustion of the heavier "ends" so as to promote an efficient burner operation.

The supply of a surrounding layer of combustion-supporting air which gradually blends with the fire stream promotes a smooth and even ignition of fuel and achieves a gradual but complete combustion which is free of the adverse effects of pulsation.

In the event that the burner head unit is used in conjunction with a combination gas-oil burner as shown in Figures 1 and 7, a supply of gas fuel is carried by the conduit 30 through the T member 29 and into the guide tube 22 whereupon the gas fuel will be delivered around the spray head nozzle 20, a spinning motion being imparted to the gas fuel by the action of the vanes 39 so that the gas fuel will develop a conical surface approximating that of the oil spray S. The flow of combustion-supporting air through the passages 46 and 49 during gas fuel operation of the burner unit will be similar to that described in connection with oil operation.

It may be noted that the orifices 40 extend into the wall of the guide tube 22 so that any oil droplets escaping from the oil orifice 21 at the beginning or end of an oil firing period will drain out of the guide tube 22.

Since the spray head nozzle 20 is generally the burner component which is most likely to require servicing, it should be noted that the present invention affords a very convenient servicing feature whereby the spray head nozzle 20 may be removed from the front of the furnace. The oil supply line 18, adapter 19 and spray head nozzle 20 are easily removed upon disconnecting the flange 38a (Figure 5) or the packing gland between the T member 29 and the oil supply line 18 (Figure 7) whereupon inspection and service may be effected without disrupting the combustion air spinner assembly and the igniter assembly.

Although various minor structural modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

In a burner, a supply line, a nozzle disposed on the end of said supply line and having an end portion convergently tapered to an orificed end face, a tube in surrounding relation to said nozzle to provide a path for flow of a gaseous fluid therebeyond, and a plurality of vanes extending radially between said nozzle and the inner surface of said tube, said vanes being slanted for inducing rotation of the gaseous fluid stream about the nozzle axis, said tube having an end portion convergently tapered inwardly in parallel relation to said tapered end portion of said nozzle, said end portion of said tube having a plurality of circumferentially spaced radially extending slots slanting in a direction parallel to said vanes for axial flow of the rotating gaseous fluid stream.

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