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D. C. ELLIOT ET AL

2,405,196

OIL BURNER

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3 Sheets-Sheet 1

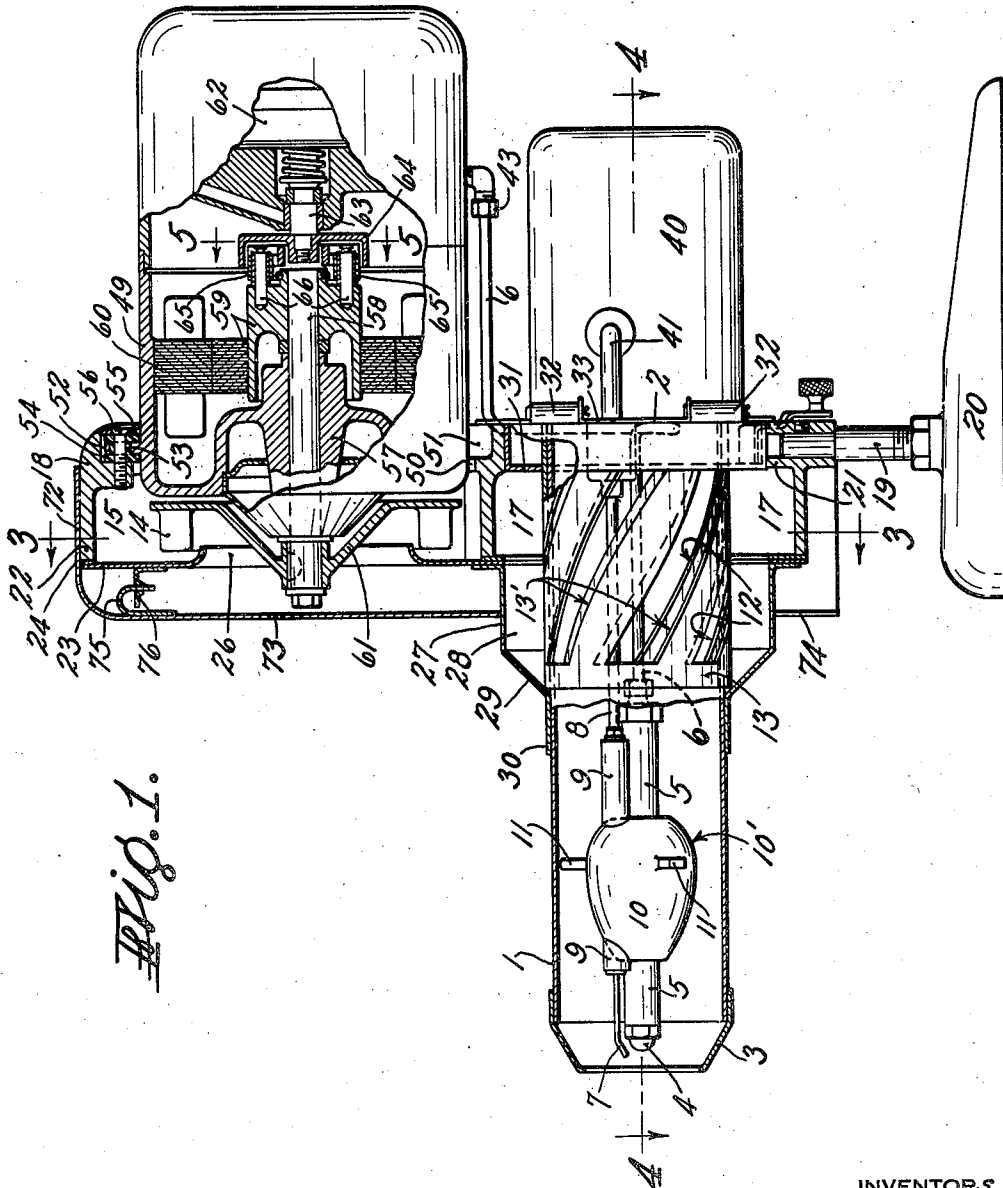


Fig. 1.

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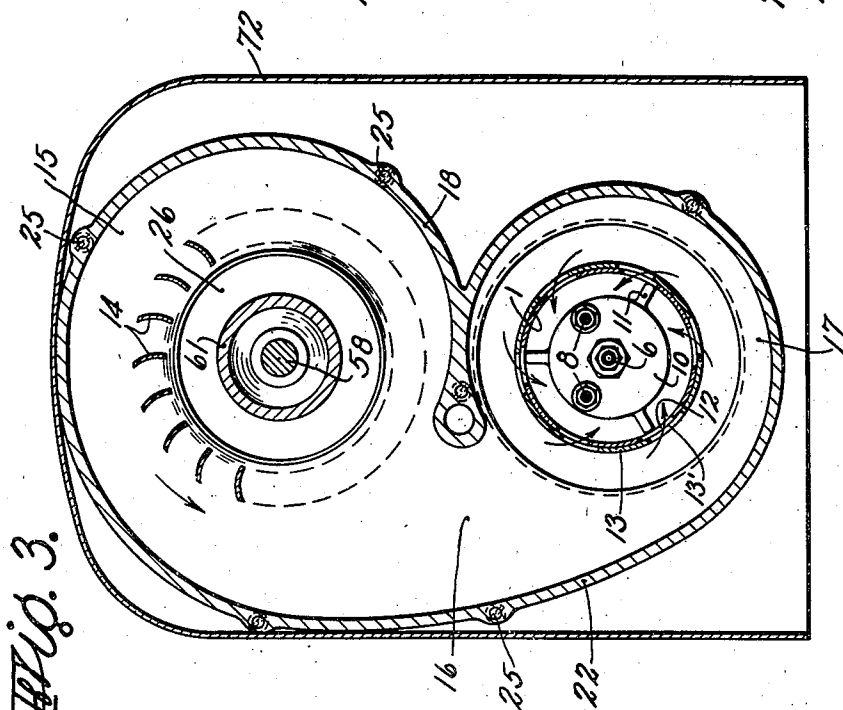
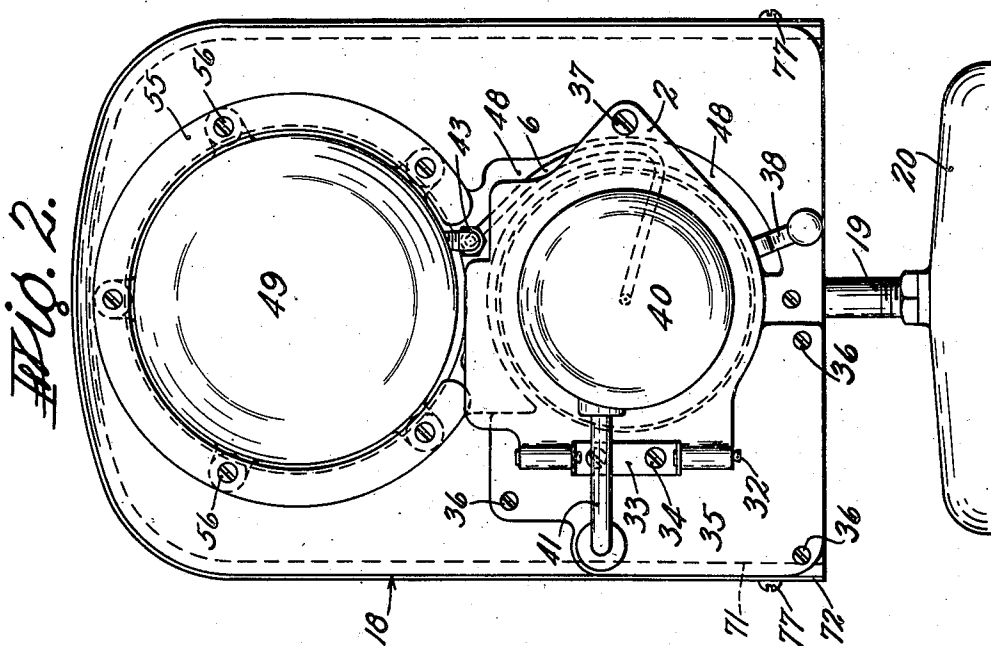
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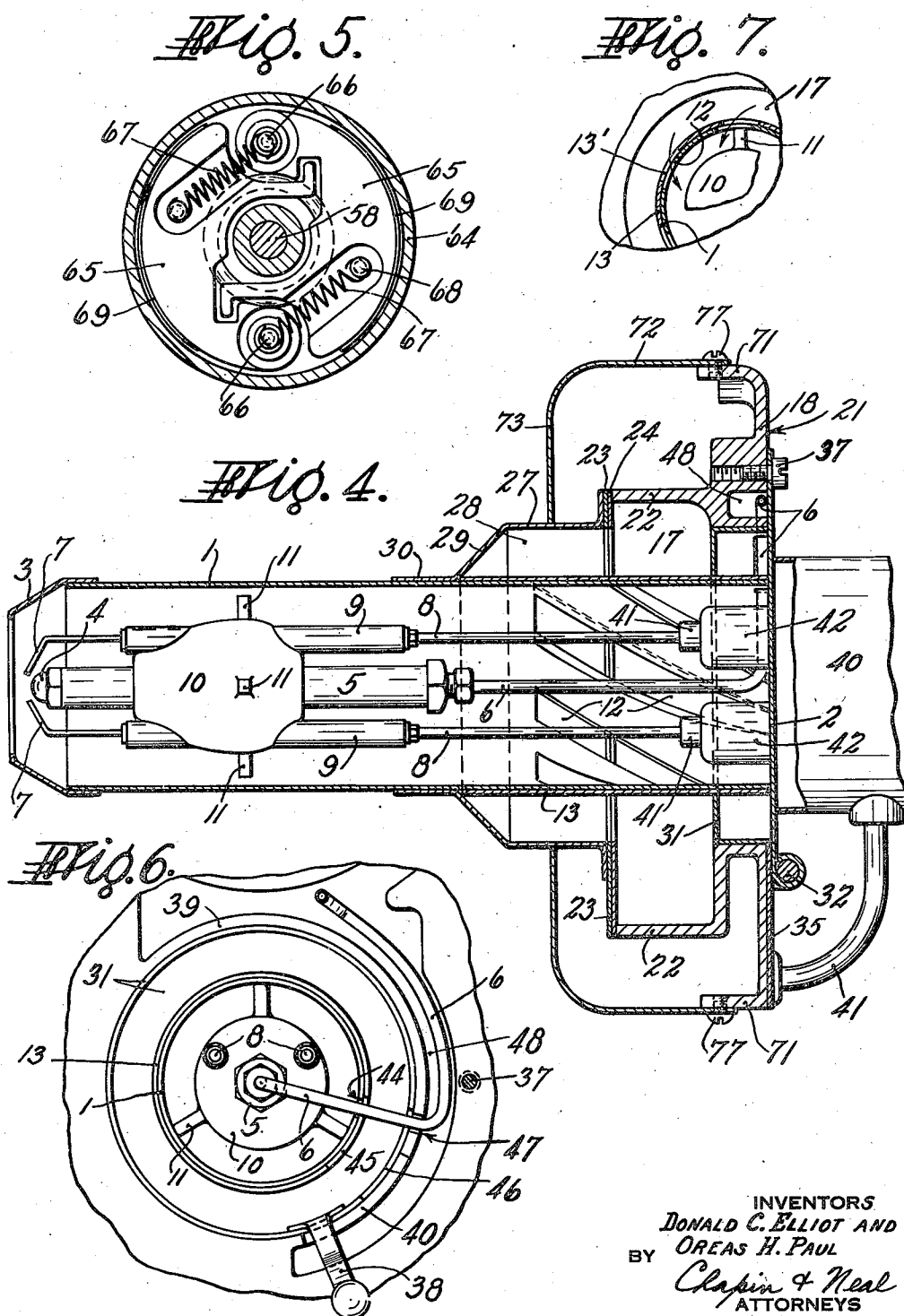
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3 Sheets-Sheet 3



UNITED STATES PATENT OFFICE

2,405,196

OIL BURNER

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Application May 11, 1944, Serial No. 535,034

3 Claims. (Cl. 158—76)

1

This invention relates to improvements in oil burners of the so-called gun type adapted for residential heating purposes as distinguished from industrial furnaces.

More particularly, the invention is concerned with improvements having to do with the manner in which the air is supplied to and mixed with a spray of atomized oil issuing from a pressure-atomizing nozzle. In general, the air is supplied in a stream, which whirls around and around the conical oil spray, mixing therewith and burning with a relatively short flame. It is well known that if the air is supplied to the oil spray in a whirling manner, a more nearly perfect mixture of air and oil result with better and more efficient combustion.

This invention has for an object to provide improved means for supplying the air to the oil spray in a whirling stream without turbulence and effecting improved distribution of it around the oil spray so that the resulting mixture of oil and air is substantially uniform and the flame is of substantially uniform density throughout.

The invention has for another object to provide in a burner of the class described an air tube of substantial length which is of circular cross section and smooth from its inlet to its outlet end and to provide in the inlet end of the tube a circular series of slots and a plenum chamber surrounding the slotted end of the tube together with means for forcing air into the plenum chamber and through said slots in a whirling stream of substantially uniform thickness and advancing such stream without turbulence to the outlet end of the air tube to envelop a spray of oil issuing from a nozzle located in the tube at said outlet end.

The invention has for another object the provision in an arrangement such as has just been described, of slots which are helical with a steep pitch to assist in whirling the air and advancing it in the desired helical path.

The invention has for another object to combine with the slotted tube a valve sleeve movable on the tube to vary the effective area of the slots through which air may enter the tube.

A further object of the invention is to provide in the air tube a support for the oil nozzle and ignition electrodes which will not offer any substantial obstruction to or interfere with the desired whirling air stream in any such way as to create any substantial degree of turbulence.

These objects and others relating to constructional features of the burner will best be understood as the detailed description proceeds.

2

The invention will be disclosed with reference to the accompanying drawings, in which,

Fig. 1 is an elevational view, with parts in section and parts broken away, of an oil burner embodying the invention;

Fig. 2 is an end elevational view thereof;

Fig. 3 is a cross sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a sectional plan view taken on the line 4—4 of Fig. 1;

Fig. 5 is a fragmentary cross sectional view taken on the line 5—5 of Fig. 1;

Fig. 6 is a fragmentary end view showing the outer end of the air tube as it appears when its end closure is swung open; and

Fig. 7 is a fragmentary view of the air valve showing a different mounting of the same.

Referring to these drawings and first to Figs. 1 and 4 thereof; the burner includes an air tube 1, through which all of the air for combustion is supplied to the burner. This tube is of circular cross section and usually it is of uniform diameter, thus being cylindrical as shown. However, the true cylindrical form is not necessarily essential for all purposes. The important characteristic is that the internal peripheral surface of the tube is smooth from end to end so that air, which is whirled as it enters the tube at one end, may advance through the tube in a whirling layer or stream, hugging its smooth wall, and may issue from the tube in a whirling stream without turbulence. One end of tube 1 is closed, as by a plate 2. The other end is open but usually carries a more or less conical air nozzle 3 which condenses the air stream and directs it inwardly toward the oil spray.

Such spray is emitted from a pressure-atomizing nozzle 4 located centrally of the tube, near its outlet end. This nozzle is carried by a longitudinally-disposed member 5, which forms a part of the oil supply conduit for the nozzle. To the rear end of member 5 is connected a pipe 6 which extends rearwardly of the tube and outwardly therefrom, in a manner later to be described, for connection to an oil pump. Ignition electrodes 7 are also mounted in tube 1 with their spark gap located in operative relation with nozzle 4. Each electrode has a conductor 8 which extends rearwardly of the tube and is supported by an insulating tube 9. These insulators 9 and the member 5 are properly located within the tube 1 by a support, which includes a central mass 10 and a plurality (preferably three) of pin-like members 11, for engaging the inner peripheral surface of the tube. This mass 10 is streamlined, having

the curved surface 10', to guide any air, which may advance in the central portion of the tube along the oil pipe 6, member 5 or electrode insulators 9, outwardly toward the peripheral part of the tube to merge with the whirling stream. This guide insures that all the air in the tube is forced into the whirling peripheral layer which hugs the wall of tube 1. The streamlined guide also directs the air smoothly as it leaves the pins and passes on toward the nozzle 4, preventing the eddies which might otherwise occur. The pins 11 present very little obstruction to the whirling air stream. Except for the pins 11, there are no obstructions of a kind to create turbulence in the air stream. Very little turbulence is created by the pins 11 and this is localized near the pins and does not persist long enough to have any effect on the air stream at the location where it acts on the oil spray.

The air is admitted to tube 1 through slots 12 which are formed in the peripheral wall of the tube near its closed end. Each slot extends generally lengthwise of the tube and preferably is of the helical form shown. The pitch of the helix may be right or left hand as desired. These slots are equally spaced angularly around the tube in a circular series. Rotatably mounted on the tube 1, near its outer end, is a sleeve valve 13. Preferably, this sleeve has slots 13', Fig. 3, which match the slots 12 and register therewith when the valve is in one position. The valve may be moved to various other positions to partially close slots 12 (see Fig. 3) and cut down the effective area of the openings through which air can enter tube 1.

Air is fed into the described slots in a manner best shown in Fig. 3. A fan 14 rotating in the direction of the arrow in a scroll chamber 15 forces air through the conduit 16 into a plenum chamber 17. This chamber completely surrounds the outer end of tube 1 and its only outlet is by way of slots 12 and 13' into tube 1. The only inlet to chamber 17 is by way of conduit 16, which is disposed tangentially of the chamber, whereby the air entering the latter is caused to whirl around the tube and to enter through the slots as indicated by the arrows and continue to whirl in tube 1, advancing in a helical stream, hugging the peripheral wall of tube 1, to meet the oil spray. The helical form of the slots is preferred as this will assist in the whirling action and in causing the air to travel forwardly in a helical path, as is desired. The valve may also be arranged as shown in part in Fig. 7. With this arrangement the air enters the slots more smoothly and produces a somewhat better whirling stream of air within the tube 1.

Referring now more particularly to the details of the exemplary apparatus, the scroll chamber 15, conduit 16 and part of the plenum chamber 17 are formed in a casting 18, which is supported vertically by an adjustable leg 19 from a base 20 as will be clear from Figs. 1 and 2. This casting has a flat end wall 21 from which projects the marginal flange 22 (Fig. 3) which defines the chambers 15 and 17 and their connecting conduit 16. A thin plate 23 is secured to flange 22 with a gasket 24 interposed between them, as by a series of screws 25. This plate closes the scroll chamber recess in casting 18, except for an inlet 26, Fig. 1, opening axially of fan 14. It also closes the recess in the casting which forms conduit 16 and part of the recess which forms the plenum chamber 17. Fixed with this plate to the casting 18 is the end flange of a tube 27 which encompasses part of tube 1 in spaced relation therewith, form-

ing an annular chamber which is part of the plenum chamber 17, above described. This tube 27 is connected by a frusto-conical part 29 to a cylindrical sleeve 30 which closely fits tube 1 and closes one end wall of the plenum chamber. The sleeve 30 is fastened as by welding, to tube 1 and serves to support the latter from the panel-like frame casting 18.

The sleeve valve 13, Fig. 4, extends from the closure plate 2 to the part 29 and may be frictionally held in place between these parts. This sleeve valve 13 has an annular ring 31 of angle section suitably fastened thereto, as by welding. One face of this ring serves as a closure for plenum chamber 17 while the other seats in a circular opening in the wall of casting 18. The closure plate 2 (Fig. 2) is large enough to close the last-named opening. This plate may abut the adjacent ends of tube 1, sleeve valve 13 and ring 31, as shown in Fig. 4. The end plate 2 is hinged as at 32 to a support 33, Fig. 2, fixed as by screws 34 to a plate 35, which in turn is fastened by screws 36 to the casting 18. When closed, plate 2 is held in place by a screw 37, threaded into casting 18.

For operating the sleeve valve 13, a handle 38 is provided. The inner end of this handle is fixed, as by welding, to the ring 31 of the valve (Fig. 6). The flange 39 is recessed at 40 to enable handle 38 to move through the range necessary to move valve 13 from fully closed to fully open position. The closure plate 2 abuts this flange 39. By loosening screw 37, the handle 38 may be turned to rotate valve 13. The valve is held against movement, when screw 37 is fully tightened, because it is then clamped between the parts 2 and 39.

The closure plate 2 may, if desired, carry the ignition transformer 40, the supply cable 41 of which is shown as entering a recess in casting 18 beneath plate 35. The high tension terminals of the transformer are shown at 41 and their insulators at 42. When the cover plate 2 is swung open to expose the outer end of the air tube, the terminals 41 of the transformer move away from the ends of the conductors 8 and thus break the high tension circuit.

When closure 2 is open, the assembly of nozzle 4, member 5, electrodes 7, conductors 8, insulators 9, streamlined guide 10 and support pins 11, may be removed as a unit from tube 1 by pulling outwardly on oil pipe 6 after the latter has first been disconnected at the union 43 (Fig. 1). The oil pipe, at the outer end of tube 1, extends radially outward through a notch 44 in tube 1 (Fig. 6) slots 45 and 46 in sleeve valve 13 and ring 31, respectively, and a notch 47 in flange 38. The slots 45 and 46 enable the valve 13 to turn through the desired range. The oil pipe 6, on leaving notch 47 enters a recess 48, Fig. 4, in wall 20, which lies beneath closure plate 2, and extends upwardly to the union 43.

An electric motor 49 is mounted on the frame 18 to drive the fan 14 and an oil pump. The motor casing is cylindrical and one end thereof lies in a circular opening 50 in the frame 18 but is spaced therefrom. A gutter 51 surrounds part of this opening 50. The motor has a series of ears 52 which lie in this gutter. Each ear has a rubber bushing 53 therein and on either side of the ear are rubber washers 54. A steel plate 55 of arcuate form closes the gutter 51 and is perforated to receive screws 56, one for each ear. Each screw passes through plate 55, and threads into the base wall of the gutter. The plate 55

5

closely fits the outer and circular wall of gutter 51 but it does not engage the motor casing although it comes very close to it. The motor is thus resiliently supported from frame 18.

The motor has a single long bearing 57 for its shaft 58. The rotor is indicated at 59 and the stator at 60. The fan 14 is fixed to the one end of shaft 58 which projects from the motor casing and it has its hub connected to the fan by a conical part 61, which enables the motor bearing to lie partly within it. A substantial part of the motor casing lies inside the frame, thereby materially lessening the part which projects outwardly from the frame. The motor casing houses in its outer end a fuel-supply unit which includes the pump, pressure-regulating and cut-off valves and filter and may, for example, be constructed as shown in the application of Virgil E. Duemler, filed April 1, 1944, under Serial No. 529,048, which application is owned by the assignee of the present application. For the present purposes, it will suffice to state that 62 indicates the pump, the outlet of which is suitably connected to the pipe 6, and 63 its drive shaft.

The oil pump is driven from the motor through a speed-responsive coupling, comprising a drum 64 fixed to pump shaft 63, and a pair of weight segments 65, pivotally mounted on pins 66 fixed to the rotor. The coupling is shown in more detail in Fig. 5. A spring 67 connects a pin 68 on each segment to the outer end of pivot pin 66. Each segment has a suitable facing 69 to engage the inner periphery of the rim of drum 64. It will be clear that as the motor reaches a certain speed, the centrifugal force acting on the segments will overcome the force of springs 67 and swing the segments outwardly, pressing their facings 69 against the drum and causing the latter and the pump shaft to rotate. The motor and fan are thus enabled to start up without the load of the oil pump and to acquire speed more rapidly than they would otherwise be able to do. Thus, the fan can have time to clear the dead air out of tube 1 and establish the desired whirling stream of air adjacent the nozzle before any oil issues from the nozzle. On deenergization of the motor, the coupling will soon operate to disconnect the pump, which will then stop almost instantly, while the fan 14 will continue in motion due to its momentum and that of the heavy rotor 59. Thus, the emission of oil from the nozzle 4 will be stopped before the air supply in order to avoid poor combustion during the stopping interval of operation of the burner.

The frame 18 has a marginal flange 71 of inverted U-shape to receive the correspondingly-shaped flange 72 on a cover 73. This cover has a slot 74 of inverted U-form to fit over the tubular wall 27. The cover is connected near its upper end by a hook 75 on its inner wall engaging in an eye 76 on plate 23. The cover is further held in place by two screws 77, one adjacent each lower corner, which screws thread into the flange 71.

In operation, on energization of motor 49, the fan 14 is brought nearly up to full speed before the speed-responsive coupling picks up the oil pump. The result is an establishment of substantially full air flow in sufficient volume and at sufficient velocity to create the desired whirling air stream at and near the oil nozzle 4 before oil issues therefrom in an atomized spray. This is an important improvement for the reasons fully pointed out in the copending application of Warren H. DeLancey, filed May 1, 1944, under Serial No. 535,036, which application is owned by the

6

assignee of the present invention and in which application said improvement is claimed.

According to the present invention, the air is admitted from the fan by passage 16 into plenum chamber 17 in a stream which enters the plenum chamber and is subdivided into a plurality of streams, one for each slot of the circular series. These air streams enter the slots, one through each, and a much better distribution of the air circularly is obtained than would be possible without it. Aside from uniform distribution of the air, the slots of the preferred helical form assist in advancing the air in a spiral path through the tube. That is, air which enters any slot, as indicated in Fig. 1 by the arrow in the case of one slot, is free to move forwardly (to the left as viewed in Fig. 1) and the stream thus has a tendency to move in a helical path as is desired. The several streams passing through slots in tube 1 merge inside the tube in a single layer or stream of air which hugs the interior wall of the tube and advances in a helical path to the nozzle of the burner. The stream is substantially uniform in thickness due to the uniform feeding in of air through the slots at evenly distributed points around tube 1. If any of the air flow lies inside the stream nearer the axis of tube 1, the streamlined guide 10 will direct it outwardly and into the stream and without creating turbulence. As the air passes the supporting pins 11 it has to be divided to some extent but the obstructions offered by these pins are so small as to be negligible. The air unites after passing the pins 11 and the uniform annular stream is guided to the oil spray by the cone 3 and by the forward streamlined part of guide 10. The air issues from tube 1, whirls around and around the oil spray, enveloping it, penetrating it and mixing with it. The mixture formed is exceptionally uniform as evidenced from observation of the resulting flame which shows uniform density throughout. A solid mass of flame of uniform color throughout is obtained, indicative of a most effective and uniform mixing of the oil and air. These results are secured, it is believed, because the air when formed into a whirling stream at the inlet end of the air tube is uniformly distributed around the circular wall of the tube so that the air stream is of uniform thickness. Then the stream, so formed, is maintained in its formation while advancing along the tube to meet the oil spray, by making the tube smooth from end to end to avoid turbulence such as would destroy the uniform distribution of air in the stream. And the streamlined guide offers help if and when needed by insuring that all air which passes it lies in the stream. The desired results are secured by a substantially uniform distribution of air in the whirling envelope which surrounds the spray and this, of course, results in a flame showing uniform density at all parts of it.

We claim:

1. In an oil burner, an air tube having an internal peripheral surface which is smooth from one end to the other, a closure for one end of the tube, the other end of the tube being open and constituting the outlet for air for combustion, a pressure-atomizing nozzle mounted in the outlet end of the tube and adapted to emit a conical spray of atomized oil, said tube having in its periphery near its closed end and remote from said outlet a plurality of slots through which all the air for combustion is admitted to said tube, said slots extending generally lengthwise of the tube and being angularly spaced about the periphery of the tube in a circular series; a housing having

7

near its lower end a chamber enveloping the slotted end of said tube, a scroll chamber near its upper end and a conduit between said chambers; and a fan in said scroll chamber, said conduit directing the air from the fan tangentially into said lower chamber whereby the air whirls therein around the slotted portion of said tube enters the tube through said slots and is uniformly distributed around the tube and formed into a whirling stream which is advanced through said tube substantially without turbulence to mix with the oil spray from said nozzle.

2. In an oil burner, an air tube having an internal peripheral surface which is smooth from one end to the other, a closure for one end of the tube, the other end of the tube being open and constituting the outlet for air for combustion, a pressure-atomizing nozzle mounted in the outlet end of the tube and adapted to emit a conical spray of atomized oil, said tube having in its periphery near its closed end and remote from said outlet a plurality of slots through which all the air for combustion is admitted to said tube, said slots being helical and angularly spaced about the periphery of the tube in a circular series; a housing having near its lower end a chamber enveloping the slotted end of said tube, a scroll chamber near its upper end and a conduit between said chambers; and a fan in said scroll chamber, said conduit directing the air from the fan tangentially into said lower chamber whereby the air whirls therein around the slotted portion of said tube enters the tube through said slots and is uniformly distributed around the tube and formed into a whirling stream which is advanced through said

8

tube substantially without turbulence to mix with the oil spray from said nozzle.

3. In an oil burner, an air tube having an internal peripheral surface which is smooth from one end to the other, a closure for one end of the tube, the other end of the tube being open and constituting the outlet for air for combustion, a pressure-atomizing nozzle mounted in the outlet end of the tube and adapted to emit a conical spray of atomized oil, said tube having in its periphery near its closed end and remote from said outlet a plurality of slots through which all the air for combustion is admitted to said tube, said slots being helical and angularly spaced about the periphery of the tube in a circular series; a housing having near its lower end a chamber enveloping the slotted end of said tube, a scroll chamber near its upper end and a conduit between said chambers; and a fan in said scroll chamber, said conduit directing the air from the fan tangentially into said lower chamber whereby the air whirls therein around the slotted portion of said tube enters the tube through said slots and is uniformly distributed around the tube and formed into a whirling stream which is advanced through said tube substantially without turbulence to mix with the oil spray from said nozzle, a sleeve rotatably mounted on the tube and having helical slots to match the slots in the tube and to register with the tube slots when the sleeve is in one position, said sleeve being movable on the tube to vary the effective area of the openings through which air enters said tube.

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