Feb. 9, 1943. R. W. BECKETT 2,310,274

APPARATUS FOR BURNING LIQUID FUEL

Filed Feb. 4, 1938 4 Sheets-Sheet 1

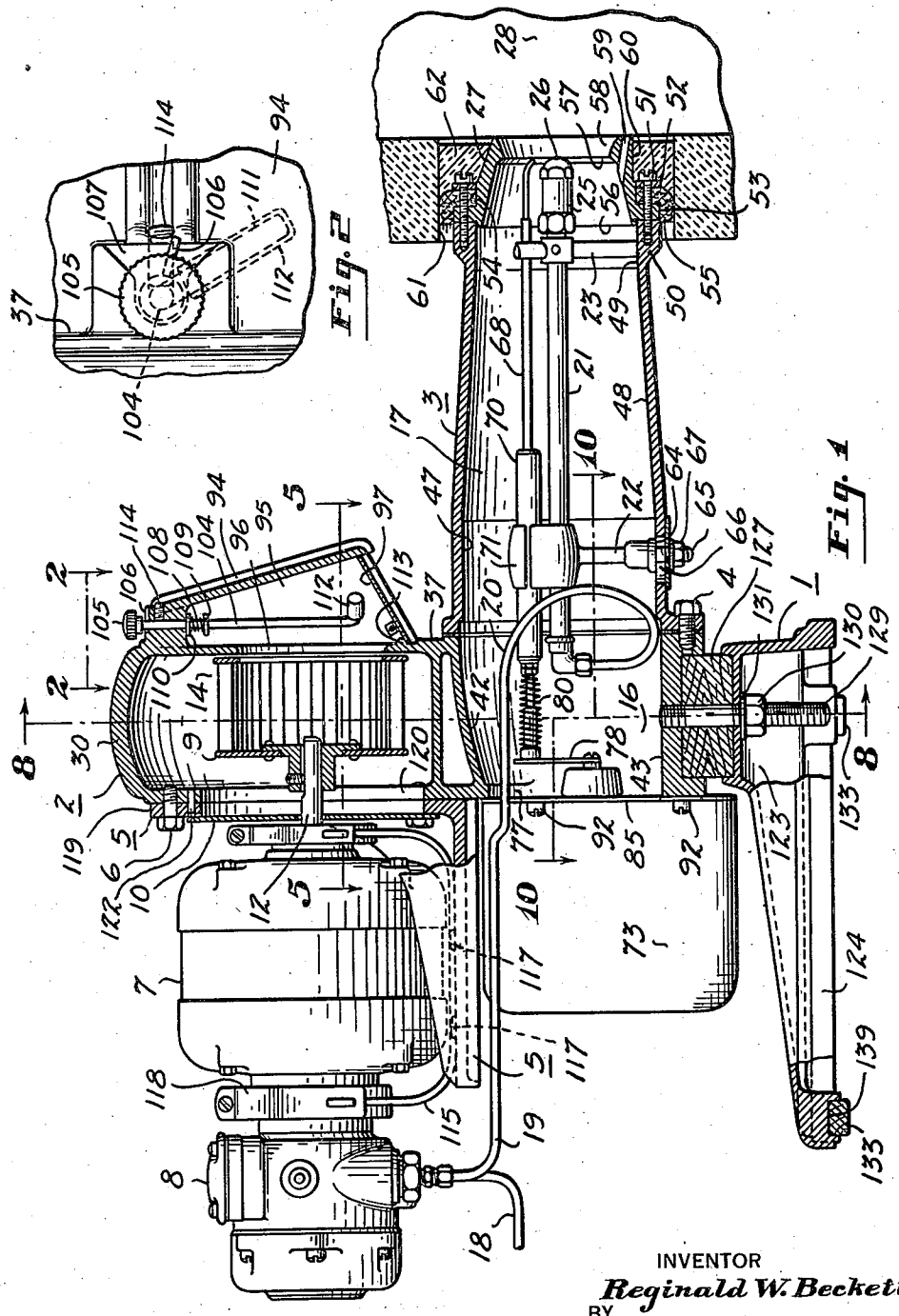


Fig. 1

Fig. 2

INVENTOR
Reginald W. Beckett
BY
Evans + McCoy
ATTORNEYS

Feb. 9, 1943. R. W. BECKETT 2,310,274

APPARATUS FOR BURNING LIQUID FUEL

Filed Feb. 4, 1938 4 Sheets-Sheet 2

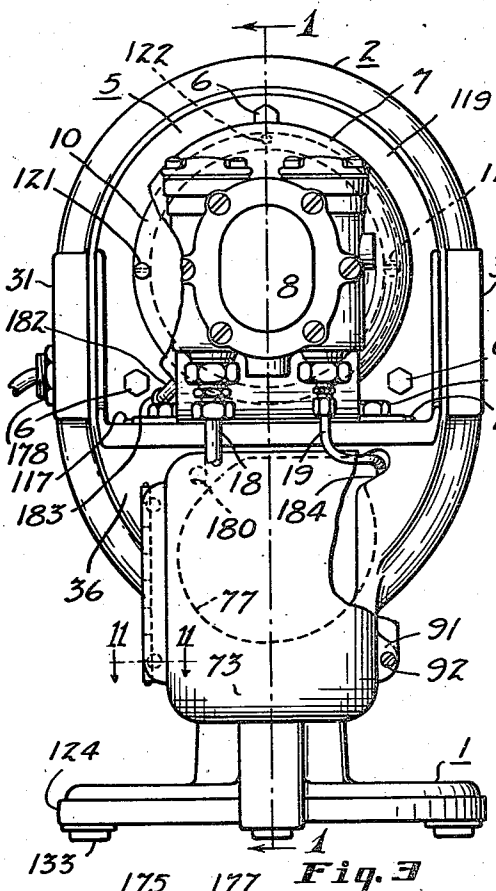


Fig. 3

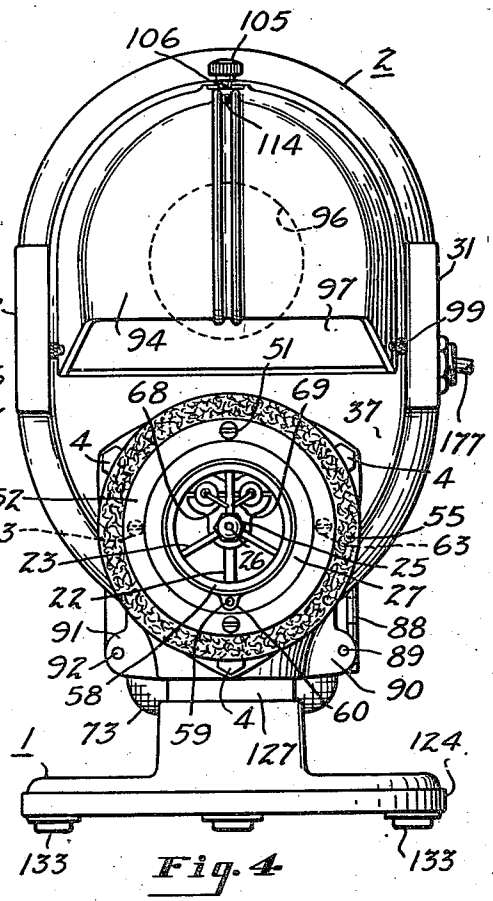


Fig. 4

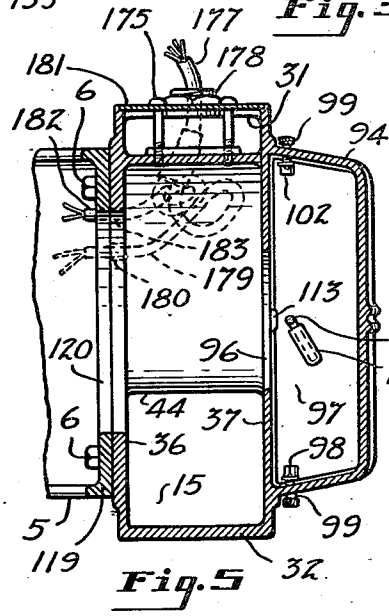


Fig. 5

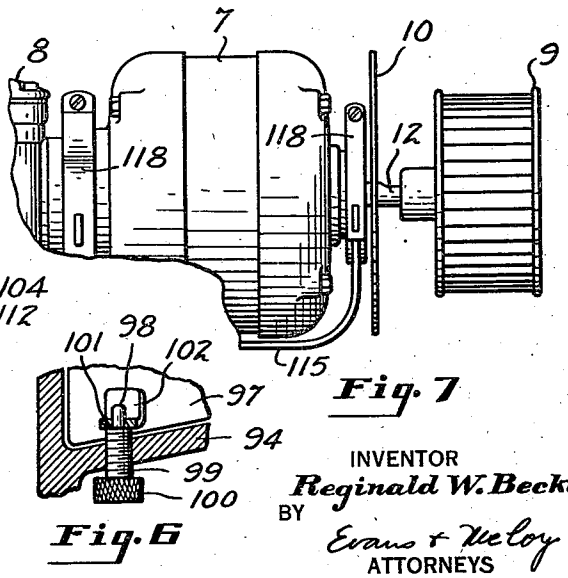


Fig. 7

Fig. 6

INVENTOR
Reginald W. Beckett
BY
Evans & Meloy
ATTORNEYS

Feb. 9, 1943. R. W. BECKETT 2,310,274

APPARATUS FOR BURNING LIQUID FUEL

Filed Feb. 4, 1938 4 Sheets-Sheet 3

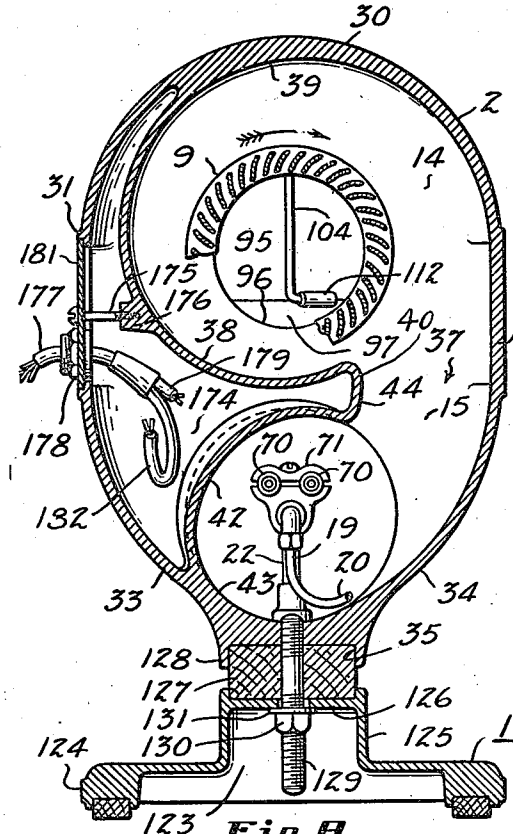


Fig. 8

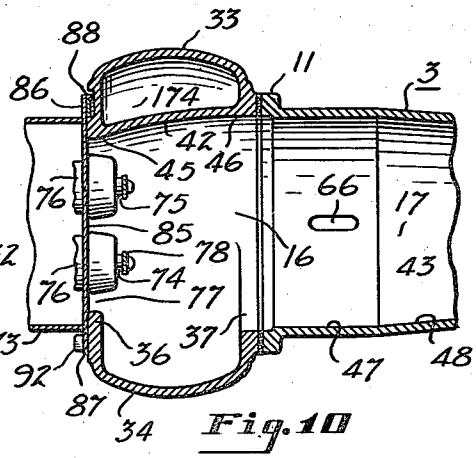


Fig. 10

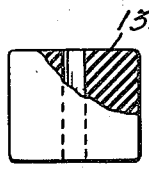


Fig. 9

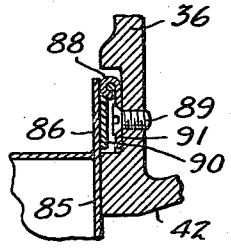


Fig. 11

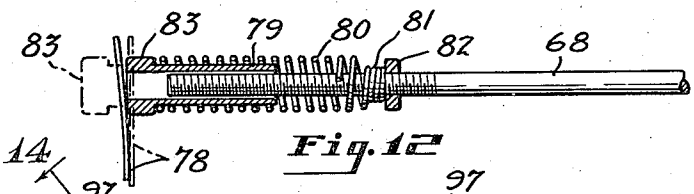


Fig. 12

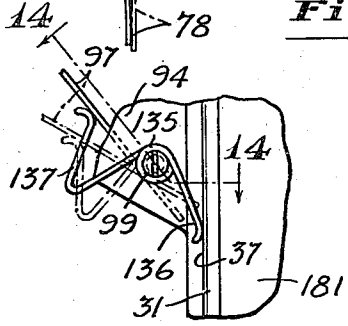


Fig. 13

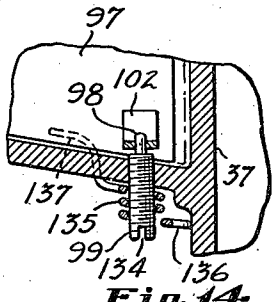


Fig. 14

INVENTOR
Reginald W. Beckett
BY
Evans & McCoy
ATTORNEYS

Feb. 9, 1943. R. W. BECKETT 2,310,274

APPARATUS FOR BURNING LIQUID FUEL

Filed Feb. 4, 1938 4 Sheets-Sheet 4

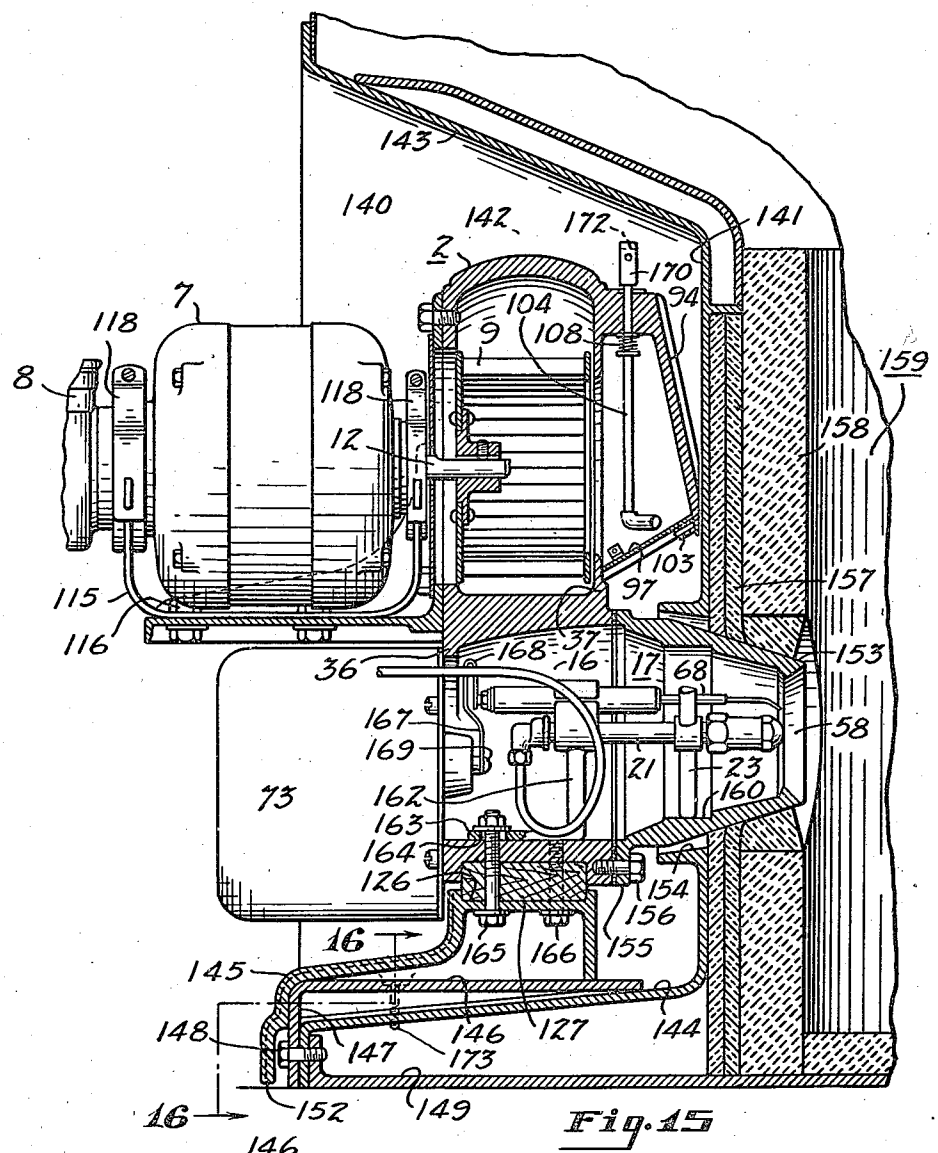


Fig. 15

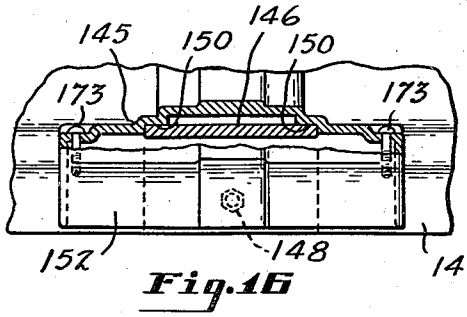


Fig. 16

INVENTOR
Reginald W. Beckett
BY
Evans & Meloy
ATTORNEYS

Patented Feb. 9, 1943 2,310,274

UNITED STATES PATENT OFFICE

2,310,274

APPARATUS FOR BURNING LIQUID FUEL

Reginald W. Beckett, Elyria, Ohio

Application February 4, 1938, Serial No. 188,731

19 Claims. (Cl. 158—76)

This invention relates to oil burners and more particularly to burners of the gun type in which a blast or current of combustion air is forced past and around a nozzle ejecting fuel under high pressure and into a furnace or other combustion chamber.

It is an object of the invention to provide an improved oil burner in which a spiral motion is imparted to the combustion air and the air is given an increased turbulence or agitation in the region of the fuel ejecting nozzle so that an improved mixing of the fuel and air is produced and an atomized mist of highly combustible fuel is projected from the mouth of the burner.

Another object is to provide an oil burner having all moving or driven parts in a unit which is readily removed from, or replaced in, the burner.

Another object is to provide an air control for a burner of the type having an air inlet and an air discharge, such control being arranged to regulate the quantity of air moving through the burner both when the burner is active and when the burner is idle.

Another object is to provide a burner in which the several parts are readily accessible for adjustment or repair and in which individual parts may be replaced with a minimum of effort.

Another object is to provide a burner simple in design and construction and relatively inexpensive to manufacture, and one which may be quickly and easily installed with maximum precision and without the use of special appliances, tools or other equipment.

Suitable embodiments of the invention are illustrated in the accompanying drawings, in which:

Figure 1 is a side elevational view partly in section and with parts removed showing a burner in position for operation in a conventional furnace and taken substantially on the line 1—1 of Fig. 3;

Fig. 2 is a fragmentary enlarged detail plan view showing the control for the air inlet door. This view is taken substantially from the line indicated at 2—2 of Fig. 1;

Fig. 3 is a rear elevational view of the burner with parts broken away;

Fig. 4 is a front elevational view of the burner;

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

Fig. 6 is an enlarged fragmentary detail in section showing the mounting for the air inlet control door;

Fig. 7 is a view with parts broken away showing the moving parts of the burner which are removable therefrom as a unit;

Fig. 8 is a transverse vertical sectional view with parts removed taken substantially on the line 8—8 of Fig. 1;

Fig. 9 is a detail of a replacement or substitute supporting cushion block for changing the height of the burner;

Fig. 10 is a fragmentary detail view in section taken substantially on the line 10—10 of Fig. 1;

Fig. 11 is a fragmentary detail view in section taken substantially on the line 11—11 of Fig. 3, showing the hinge mounting for the transformer;

Fig. 12 is an enlarged fragmentary detail in section showing the construction of the electrode contact terminals;

Fig. 13 is a fragmentary elevational detail showing a modification in which a spring is employed to retain the air inlet control door in open position;

Fig. 14 is a fragmentary sectional view taken substantially on the line 14—14 of Fig. 13;

Fig. 15 is a side elevational view in section and with parts removed showing a modification of the burner installed in a furnace having a recess or pocket; and

Fig. 16 is a detail view partly in section and taken substantially on the line 16—16 of Fig. 15.

Referring to Figs. 1 through 12 of the drawings by numerals of reference, which indicate like parts throughout the several views, the burner comprises a pedestal or base, indicated generally by the numeral 1, which is surmounted by and supports a main body portion or housing, indicated generally by the numeral 2. A horizontally disposed air or blast tube 3 is secured to the lower portion of the housing 2 at one end thereof by cap screws or studs 4 which extend through a radially directed flange 11 formed at the inlet end of the air tube. On the upper portion of the housing 2 at the end thereof opposite the blast tube 3 a supporting member or bracket 5 is removably secured by cap screws or studs 6.

The bracket 5 carries a removable unit which comprises all the movable parts of the burner including motor 7, fuel pump and pressure regulator 8, blower 9 of the sirocco type, and cover plate 10. The blower 9 is actuated and supported by shaft 12 of the motor 7 which also actuates the fuel pump. The circular cover plate 10 has a running or clearance fit on the shaft 12 between the motor 7 and blower 9.

The blower 9 is received in a chamber 14 formed in the upper portion of the housing 2 and forces air downwardly through a throat 15 tangentially

into inlet end 16 of combustion air passageway 17 extending longitudinally through the bottom of the housing 2 and the air tube 3.

The fuel pump and pressure regulating device 8, which is preferably mounted on the motor and bell in the manner set forth in my co-pending application, Serial No. 190,309, filed February 12, 1938, draw liquid fuel through supply conduit 18 and force it under relatively high pressure through fuel pressure conduit 19 having a flexible loop 20 into fuel pipe 21 supported by bracket 22 and spider 23 in the air tube 3. A vaporizing or spray nozzle 25 is secured on the end of the fuel pipe 21 at the discharge end of the air tube 3 so that its outlet orifice 26 is disposed substantially in the plane of the smallest cross-sectional area portion of a burner head 27, to be later described. Air forced through the passageway 17 by the blower 9 and moving in a helical path commingles with the oil spray emerging from the nozzle orifice 26 to form a mist of finely dispersed oil particles which burn in combustion chamber 28 of a heating unit such as a domestic furnace.

The housing 2 is symmetric in external appearance and of generally ovate form as viewed from either end. It is carried in an upright position on the base 1, being of a materially greater height than width and of a materially greater width than length. The housing is of substantially uniform length from top to bottom and has a top wall 30 of generally rounded form merging into relatively straight vertical side walls 31 and 32. Inwardly curving or rounded bottom walls 33 and 34 extend downwardly as continuations of the side walls 31 and 32 and terminate in a downwardly directed socket 35, to be later described. Rear end wall 36 carries the bracket 5 which supports the removable motor unit, and front end wall 37 carries the air tube 3 as mentioned above.

The blower chamber 14 (Fig. 8) is of the form commonly employed with rotary blowers of the sirocco type having axially extending blades, and is partially defined by a curved internal wall or partition 38 which extends between the end walls 36 and 37 of the housing 2 from a point 39 where it is formed into the top wall 30 of the housing at substantially the center thereof downwardly to the left in a circular fashion and then to the right, as viewed in Fig. 8. The lower end of the wall 38 extends beyond the middle of the housing and to the cut off of the throat 15. The radial space between the peripheral margin of the rotary blower 9 and the walls of the chamber 14 progressively increases from the cut off of the throat 15 in a clockwise direction around the rotational axis of the blower substantially to the throat 15. This increase in the free radial cross-sectional area of the housing available for the flow of air is in the direction of rotation of the blower rotor 9, indicated by the arrow of Fig. 8.

In the bottom of the housing 2 is formed the inlet end 16 of the passage 17, as previously mentioned. Air moving through the throat 15 in a downward direction is directed tangentially into the passage portion 16 by the curved bottom wall 34 of the housing, the inside surface of which gradually approaches the passage 16 and is tangent thereto at substantially the bottom of the housing.

One side of the inlet end 16 of the passage, opposite the throat 15, is defined by an internal wall or partition 42 which starts substantially at the bottom center of the housing 2 where it is connected to the lower part of the bottom wall 33, as indicated at 43, and is then curved upwardly to the left and then to the right in a clockwise direction following the general curvature of the passage 17 as defined by the tube 3. The upper end of the partition 42 and the lower end of the partition 38 are joined by a short, vertically disposed partition 44 which partially defines the throat 15. The partition 42 is curved or sloped longitudinally of the inlet portion 16 of the air passage as shown in Figs. 1 and 10. This curvature is progressively increased from the lower portion 43 to the top portion where the partition 42 joins the vertical partition 44. The margin 45 of the partition 42, adjacent the end wall 36 of the housing 2, progressively approaches the axis of the air passage 17, while the margin 46 of the partition 42, adjacent the end wall 37 of the housing, remains substantially flush with the internal wall of the air tube 3. Air entering the inlet 16 of the air passage 17 tangentially through the throat 15 is directed in a helical path to flow through the tube 3. The opening in the front end wall 37 of the housing 2, which is covered by the air tube 3, is of substantially the same effective cross-sectional shape and area as the corresponding end of the air passage in the tube 3 so that the walls of the inlet portion 16 are substantially flush with the walls of the air tube 3. No portion of the inlet end 16 of the air passage 17, which is formed in the housing 2, is of greater effective cross-sectional area than the portion of the passage 17 which is formed in the tube 3. Preferably, there is a progressive decrease in the effective cross-sectional area inlet portion 16 from the plane of abutment between the flange 11 of the tube 3 and the wall 37 to the rear end wall 36 as appears in Figs. 1 and 10.

Tube 3 is substantially circular in cross-section throughout its length and has a portion 47 of cylindrical form and uniform diameter adjacent the housing 2 which merges into a tapering portion 48 which extends toward the discharge end of the tube where a second cylindrical portion 49 of uniform internal diameter and relatively short axial length is formed. The walls of the tube 3 are relatively thick and of heavy section at the discharge end thereof, preferably being in the form of an integral, thick-sectioned, annular collar 50 which reinforces the tube end and receives the screws which hold the head 27. A circular, radially directed flange 53 is integrally formed about the large diameter end of the head 27 and circumferentially abuts against the annular collar or thickened section 50 on the discharge end of the tube 3. A pair of screws 63 extend through suitable drill holes in the flange 53 and are threadedly secured in the collar 50 to clamp the head 27 in heat exchanging circumferential contact with the collar. The relatively extensive radial area of contact between the head 27 and tube 3 facilitates the conduction of heat from one of these metal parts to the other. Accordingly, heat is rapidly conducted away from the head 27 during operation of the burner so that it is maintained at a relatively lower temperature than would otherwise prevail, thus reducing the deterioration of the head and increasing its life.

Another pair of screws 51 extend through an annular holding ring 52, disposed about the head 27, through the flange 53 and are threadedly received in the annular thickened collar portion 50 at the discharge end of the tube 3. The ring 52 and flange 53 preferably have sub-

stantially the same outside diameter and the ring is axially movable over an external cylindrical portion 54 of the head 27 which extends forwardly from the base of the flange 53. Between the ring 52 and flange 53, and seating on the cylindrical portion 54 of the head, is an annular ring 55 of fireproof fibrous material such as asbestos. This ring is clamped between the holding ring 52 and flange 53 by the screws 51 which also hold the head 27 to the tube 3.

In the event that a new ring of asbestos 55 is to be fitted in place on the head 27, only the screws 51 need be removed, the screws 63 remaining in position to retain the head on the tube 3. The heat resisting asbestos ring, covered by the metal ring 52, protects the head from the heat in the combustion chamber and minimizes the corrosion of the screws 51 and 63 so that the screws may be more easily removed when desired.

Combustion air forced through the passage 17 in a spiral path is gradually accelerated in velocity by the general tapering form of the tube 3 which decreases in cross-sectional area towards the discharge end. The head 27 is formed to present a substantially continuous circular shoulder 56 to the advancing air and effects an agitation thereof which is beneficial in forming a suitable combustible mixture with the fuel oil. This shoulder 56 is adjacent the small diameter cylindrical portion 49 of the passageway 17 in which is located the spider 23. From the shoulder 56 the head 27 is tapered and the internal walls thereof converge to provide a progressively decreasing, substantially circular cross-sectional area in the direction of air flow. At substantially the region of smallest cross-sectional area the head 27 is formed with a shoulder 57 which further turbulates or agitates the moving air. From the shoulder 57 to the extreme end of the head 27 there is an outwardly tapering outlet or mouth 58.

A downwardly sloping passage or drill hole 59 extends through the bottom wall of the head 27 from the inside thereof between the annular shoulders 56 and 57, through a depending boss 60 integral with the head, to the foremost edge of the head. This hole serves as a drain for fuel oil that may drip from the nozzle 25 and directs the same into the combustion chamber 28. Preferably the end of the hole 59 inside the head is enlarged or dished to more effectively drain off the oil.

When installing the burner in a heating system, such as a domestic furnace, having the refractory lined combustion chamber or fire pot 28 the asbestos ring 55 is moistened to render it pliant and flexible so that the head 27 can be inserted into opening 61 in the fire pot 28 and the asbestos ring 55 accommodates itself to the walls of the opening 61 to effect a circumferential seal therewith. If desired, an additional quantity 62 of plastic asbestos cement or the like may be packed around the head 27 in advance of the asbestos ring 55 so as to provide a more permanent seal and to protect the head 27 from the heat of the fire pot.

The bracket 22 which holds the fuel pipe 21 has a curved or cylindrical bottom surface 64 which corresponds in curvature to the internal cylindrical surface of the portion 47 of the tube 3. This curved surface 64 assists in aligning the bracket in the air passageway 17 and affords a snug fit between the bracket and tube. The bracket is held in place by a depending threaded stud 65 which extends through an elongated slot 66 formed in the bottom of the cylindrical portion 47 of the air tube 3. Preferably, the stud 65 is made separately from the bracket 22 and threadedly secured therein. Accordingly, the bracket 22 may be adjusted longitudinally in the tube 3 so as to vary the position of the nozzle 25 with respect to the head 27. A nut 67 on the stud 65 locks the bracket in adjusted position and the novel shape of the tube 3 which provides a cylindrical portion for holding the bracket 22 retains the fuel pipe 21 centered in the air passageway 17 in all positions of adjustment. The cylindrical portion 49 at the discharge end of the air tube which has a uniform internal diameter permits the spider 23 to move longitudinally in the passageway 17 while the ends of the spider legs maintain sliding engagement with the walls of the tube. Thus both ends of the fuel oil pipe 21 are supported and retained centrally in the air passageway 17 regardless of the movement of the bracket 22 and spider 23 in adjusting the nozzle 25.

A pair of ignition electrodes 68 and 69 are disposed longitudinally through the passageway 17 slightly above and on opposite sides of the oil pipe 21. These electrodes are mounted in porcelain insulators 70 held in a clamp 71 on the top of the bracket 22. The forward ends of the electrodes 68 and 69 are directed toward one another in the region of the orifice 26 of the nozzle 25 so that a spark across the electrodes ignites the atomized fuel.

A transformer, carried in a box or second housing 73 disposed against the rear end wall 36 of the housing, furnishes high tension current to the electrodes 68 and 69. Conductors 74 and 75 enclosed by insulators 76 extend into the inlet end 16 of the air passageway 17 from the transformer box 73 through an opening 77 formed in the rear wall 36 of the housing which is normally covered by the transformer box 73. Each of the conductors is provided with a spring-like brush 78 formed of suitable sheet metal such as bronze or brass and which extends upwardly and at right angles across the axes of the electrodes 68 and 69.

Electrical contact is made between the brushes 78 and the electrodes by means of contact sleeves 79 (Fig. 12) slidably received on the threaded ends of the electrodes and urged toward the brushes 78 by helical compression springs 80. Each of the springs 80 has one end adjustably retained on the electrode by a reduced diameter portion 81 which grips the electrode, and a nut 82 which is threaded onto the electrode. The end of each of the springs 80, opposite the reduced diameter portion 81, bears against a shoulder formed by increased diameter head portion 83 of the sleeve 79. Thus the spring 80 is partially carried over the sleeve 79 to have sliding engagement therewith and prevent the individual turns of the spring from being caught on the threaded electrodes. The springs 80 are adjusted so that the heads 83 naturally take the position indicated by the broken lines in Fig. 12, and are moved to substantially the full line position when engaged by the brushes 78. In thus effecting electrical contact for the flow of current through the electrodes 68 and 69 the brushes 78 are likewise deflected from the broken line position to the full line position of Fig. 12 and placed under stress.

The transformer box 73 has a flat plate 85 which is arranged to cover the opening 77 in the

rear end wall 36 of the housing 2. Flange portions 86 and 87 of the plate 85 extend beyond the sides of the box 73 and are utilized in attaching the box to the housing. The flange 86 has a vertically disposed piano type hinge 88 secured thereto by suitable means such as spot welding. The upper portion of this hinge is seated in a recessed portion of the housing wall 36 (Fig. 11) and is secured thereto by flat head machine screw 89. The lower portion of the hinge is similarly secured to an ear 90 (Fig. 4) extending from the housing 2.

The flange 87 of the plate 85 is secured to the housing 2 and an ear 91 by fillister head screws 92 (Fig. 1). This novel mounting of the transformer facilitates opening of the inlet end of the combustion air passageway 17 so that adjustment or removal of the nozzle and electrodes may be made through the rear wall of the burner. The unique contact arrangement of the high tension electrical conductors for the electrodes 68 and 69 eliminates the use of loose high tension wires thus rendering the burner safer and less likely to get out of order. Each time the transformer box 73 is pivoted on the hinge 88 to uncover the opening 77 the secondary or high voltage connections to the electrodes 68 and 69 are automatically opened. When the transmission box 73 is pivoted to the closed position to cover the opening 77 the ignition connections to the tips of electrodes 68 and 69 are automatically closed. This feature is advantageous in that manual disconnection of the high tension electrodes from the transformer is unnecessary in removing the electrode assembly from the burner for service purposes. Similarly, manual connection of the high tension leads is obviated or eliminated when the burner is reassembled.

A wide range of longitudinal movement of the electrodes 68 and 69 in the passage 17 is permitted by the contact brushes 78 and the spring pressed contact sleeves 79 which are arranged to maintain a firm and positive electrical connection throughout such movement.

All the high tension conductors of the burner ignition system are contained or enclosed within metal parts so as to be concealed or shielded. Thus the possibility of damage or injury to the high tension leads and conductors is minimized as well as avoiding the possibility of a person receiving an electrical shock from accidental contact with a member of the high tension ignition circuit. Each leg of the high tension circuit is of substantially the same length and resistance, and substantially the same distance from the walls of the tube 3 which serves as a shield. In this manner, the possibility of radio interference and the like being caused by the burner ignition system is reduced to a minimum, the middle of the secondary winding of the transformer in the box 73 being grounded in the usual manner.

The end opening 77 into the longitudinally extending air or blast tube passageway 17 eliminates the necessity for a removable inspection plate or door in the side of the blast tube 3 for adjusting and otherwise servicing the burner. This feature is particularly advantageous in installations where it is difficult to get at the air tube because of close quarters. The adjustment of the nozzle 25 and electrodes 68 and 69 can be effected through the opening 77 without withdrawing the head 27 of the burner from the opening in the fire box. If desired, the assembly of electrodes, nozzle and fuel conduit can be adjusted while the burner is in operation by loosening nut 67 on stud 65 of bracket 22.

Air is drawn into the burner by the blower 9 through a downwardly directed inlet opening in a hood 94 formed on the front wall 37 of the housing 2. An air chamber 95 in the hood 94 communicates with the blower chamber 14 through a circular opening 96 formed in the front wall 37 and concentric with the shaft 12 of the blower and motor.

An air gate 97 is mounted off center on reduced diameter pin ends 98 (Fig. 6) of pivot screws 99 which are threadedly carried in aligned holes through the side walls of the hood 94. The screws 99 preferably have enlarged knurled heads 100 on the outside of the hood 94 so that they may be adjustably screwed toward or away from one another and shoulders 101 thereof may be made to frictionally engage apertured pivot brackets 102 which are secured to the air gate 97 to support the same and are received on the pin ends 98 of the pivot screws. Thus, by tightening the screws 99 against the brackets 102 the gate 97 may be retained in either opened or closed or in intermediate adjusted position, as desired, to regulate the flow of air through the burner. Upon loosening the screws 99, the gate 97 is freely pivoted on the pins 98 and falls by gravity to close the inlet opening into the hood except when held in open position by air pressure.

An adjusting rod 104 is vertically disposed in the air chamber 95 and rotatably journaled in a drilled hole in the top of the hood 94. An enlarged knurled head 105 is secured on the top of the rod 104 above the hood 94 so that the rod can be manually rotated. An indexing pin 106 extends through the rod 104 and extends radially therefrom. This pin rides in a recess 107 formed in the top of the hood 94 and having approximately a 90° opening therein so that the rotational movement of the rod 104 is limited to about 90°. The rod 104 is urged downwardly by a helical compression spring 108 which seats on a washer 109 secured on the rod 104 and a washer 110 bearing upwardly against the inside of the top wall of the hood 94. A foot 111 is formed at the bottom of the rod 104 by bending the latter substantially through 90°. This foot is disposed a short distance above the air gate 97 when the latter is closed and it is preferably provided with a rubber covering 112 to silence the contact between the foot and the gate when the movement of the latter is arrested by the foot. When the pivot screws 99 are loosened so that the air gate 97 is free to pivot on the pins 98, the gate is opened by the air pressure on the underside thereof when the blower 9 is rotating. The amount that the air gate will open under the influence of air pressure can be varied or adjusted by rotation of the rod 104 which moves the foot 111 to various positions. For example, when the rod is rotated to its extreme counterclockwise position as viewed in Fig. 2 and as limited by the pin 106 in the recess 107, the gate 97 will be able to open only a minimum amount whereas movement of the rod 104 to its extreme clockwise position as viewed in Fig. 2 will carry the foot 111 to a position substantially parallel with the axis of the pivot screws 99 and a maximum opening of the gate 97 is permitted. In this manner by means of the rod 104 the opening of the gate 97 which regulates the quantity of air forced through the passageway 17 by the blower 9 can be adjusted

while the burner is in operation to give the most efficient and desirable type of flame in the combustion chamber 28. The frictional effects of the pin 106 and spring 108 are adequate to temporarily hold the rod 104 while adjustment of the burner is being made. After the adjustment is complete the rod 104 is locked in position by set screw 114. As long as the blower 9 is in operation the gate 97 is held open against the foot 111 of the adjusting rod 104. Upon shutting off the burner so that the blower 9 stops, the air gate 97 drops by gravity to the closed position illustrated in Fig. 1. Downward pivotal movement of the gate 97 is limited by a suitable stop 113 (Fig. 5) or by engagement of the edges thereof which are parallel to the axis of the pivot screws 99 with the inside bottom edge of the wall of the hood 94 or the end wall 37 of the housing 2.

The movable parts of the burner, which are removable as a unit shown in Fig. 7, are carried by a substantially U-shaped cradle 115 secured to the floor of the supporting member or bracket 5 by studs 116 and centered thereon by raised tracks or bosses 117 (Fig. 3). The upstanding arms of the cradle 115 are provided with metal bands 118 which confine annular rubber rings or cushions (not shown) embracing the journal bosses on the bells of the motor 7. Accordingly, the motor, blower and pump are resiliently cushioned and the single rotating shaft is supported intermediate its ends at a plurality of points by rubber cushioned journals.

An upright portion 119 of the supporting member 5 is disposed against the upper portion of the rear wall 36 of the housing 2 and a circular opening 120 is formed through the portion 119 and the wall 36 to permit passage of the blower 9 when removing or replacing the movable parts or motor drive unit. This opening is closed by the cover plate 10 which is secured to the portion 119 of the bracket 5 by screws 121 (Fig. 3).

Mounting of the movable parts of the burner in the manner described facilitates the servicing of the burner since the complete assembly of moving parts can be quickly detached by removing the screws 121 and the bolts or studs 116, disconnecting the fuel conduits 18 and 19 and the electric leads to the motor. Replacement of a new or repaired unit can be quickly accomplished by a reversal of these operations and is facilitated by the arrangement which permits the relatively heavy unit of assembled moving parts to be supported by the bracket or member 5 leaving the operator's hands free to place and adjust the parts.

Another feature of the construction is that if desired the unit of moving or drive and driven parts may be taken from the burner by withdrawing the three studs or cap screws 6 which secure the supporting member 5 to the housing 2. This procedure may be preferred when the identical unit of movable parts is to be replaced in the burner after some minor adjustment, since a fewer number of bolts, studs or screws are removed than when the cradle 115 is removed from the bracket 5. The reassembling of the device when the entire bracket and drive unit have been removed is facilitated by the use of a locating or guide pin 122 secured in the housing and having sliding enaggement in a hole in the bracket 5 which partially supports and locates the bracket until the studs 6 are in place. The pin 122 is also used in originally assembling the burner at the place of manufacture. Its location at the top center of the upright portion 119 of the bracket 5 permits the latter to suspend itself from the pin 122 and pivot by gravity to align the holes for the studs 6.

The pedestal or base 1 has a relatively large footing portion 124 which affords a wide area support for the burner. Square or rectangular pads or cushions 133 are received in sockets 139 at marginal portions of the footing portion 124 of the base. Preferably, the pads 133 are three in number and formed of resilient cushioning or vibration-absorbing material such as wood, cork, or rubber, thus effecting a quieting three point mounting for the burner. In the event that the surface on which the burner is to be supported is irregular or of uneven height, the pads 133 can be made shorter or longer, as required, so as to carry the base 1 evenly and firmly. On account of the square or rectangular shape of the pads 133 the fitting of replacement pads in the sockets 139 is a relatively simple matter for a repair or service man. Upwardly directed wall portions 125 formed integrally at the central portion of the front end of the base are surmounted by a substantially horizontally disposed platform portion 126. This platform is thus disposed a material distance above the surface on which the footing portion 124 of the base rests. A vibration absorbing block 127 formed of suitable material such as wood or cork is carried on the platform portion 126 and is surmounted by the housing 2. Preferably the block 127 fits into the socket 35 formed in the bottom of the housing so that the top sides of the block are embraced by depending portions 128 of the socket. Similarly, the upwardly directed walls 125 of the base extend above the level of the platform 126 to embrace the bottom sides of the block 127.

In plan form the block 127 is non-circular in shape, preferably being square or rectangular. The depending portions 128 of the socket 35 are formed to a corresponding shape as are also the upwardly projecting portions of the walls 125 of the base so that when the block 127 is properly seated on the platform 126 and in the socket 35 the burner housing 2 is correctly aligned with respect to the base 1.

A stud 129 is secured in the central portion of the socket 35 and extends downwardly through an aperture in the center of the block 127 and has a loose fit in a central hole formed in the platform 126. The parts are drawn together by a nut 130 which forces a washer 131 of a material having the capacity to deaden vibrations, such as lead, upwardly against the bottom of the platform portion 126.

Adjustment of the burner to different heights is effected by altering the height of the supporting block 127, for example, in Fig. 9 is illustrated a block 132 which may be used when elevating the burner. This block if desired may be made of rubber as shown so as to impart increased vibration absorbing capacity to the base. The arrangement by which the space 123 is provided beneath the platform portion 126 of the base permits adjustment of the burner to various heights without changing the stud 129, this member merely moving up or down in the space 127 according to whether the burner is raised or lowered. Thus a concealed height adjustment is afforded which is of material advantage in installing the burner since no special equipment other than a supply of different sized blocks 127 for adjusting the base is required.

Another advantage of the construction de-

scribed is that a double cushioning effect for the moving parts is provided. The first cushioning is through the medium of the annular rubber rings which support the motor 7 in the cradle 115. Such vibrations as are not dampened at this point and are carried to the burner housing 2 are further diminished by the vibration absorbing block 127 which constitutes the sole support for the burner housing on the base 1. The stud 129 does not operate to support the housing 2 since it does not bear down on any part of the base and its sole contact therewith is through the vibration deadening washer 131.

Figs. 13 and 14 illustrate a modification in the operation of the air inlet gate 97 when it is desired to retain the latter open at all times so that a flow of air through the burner is permitted after the blower 9 stops. In this modification the enlarged knurled head 100 is eliminated from one of the pivot screws 99 and the latter provided with a screwdriver slot 134 for turning the same. The pivot screw is of increased length to receive on the portion thereof extending outside of the hood 94 a spring 135. One end 136 of the spring bears against the front wall 37 of the housing 2 to prevent rotational movement of the spring on the pivot screw 99 and the opposite end 137 of the spring is bent underneath the side wall of the hood 94 into engagement with the under side of the air gate 97 to urge the latter in a clockwise pivotal movement as viewed in Fig. 13 into engagement with the foot 111 of the adjusting rod 104. Accordingly, the spring 135 retains the gate 97 open as far as is permitted by the particular adjustment of the rod 104 preventing the gate from dropping by gravity to closed position when air is no longer forced through the burner by the blower 9.

In Figs. 15 and 16 is illustrated a modified construction of the burner which is designed for use in connection with a furnace or heater having a recess or pocket 140 to accommodate the burner. Furnaces of this character are usually constructed of steel or iron and the pocket may be formed of a single casting having integral rear, side, top and bottom walls 141, 142, 143, and 144, respectively. The burner is provided with a base 145 similar to the base 1 previously described and which rests on the bottom wall 144, the latter inclining upwardly toward the rear wall 141 of the pocket 140. A horizontally disposed track 146 is positioned over the bottom wall 144 of the pocket and supports and guides the burner when the latter is slid into or out of the pocket. A depending leg portion 147 of the track 146 extends downwardly across the front marginal edge of the bottom wall 144 and is secured by a stud 143 which extends through a flange on the bottom wall and into an upwradly directed flange formed on the margin of base 149 of the furnace. The base 145 is formed with longitudinally extending bearing portions 150 which have sliding engagement with the top and sides of the track 146 at marginal edge portions so that the burner is wholly supported by the track and guided for straight line movement. Upon withdrawing the burner from the pocket 140 a depending apron 152 formed along the rear edge of the base serves as a support for the burner when the center of gravity thereof moves beyond the end of the track 146.

In order that the burner may be substantially wholly received within the pocket 140, the length of the combustion air passage 17 is materially shortened so that the mouth 58 of the head is relatively close to the inlet end 16 of the passage. Desirably, the burner may be provided with an integral head and air or blast tube 153 which projects through an opening 154 in the rear wall 141 of the pocket. The head 153 is provided with a flange 155 corresponding to the flange 11 previously described and which is disposed against the front end wall 37 of the burner housing 2, being secured thereto by studs 156. The head 153 is frustoconical in shape converging toward the mouth 58 thereof and effecting a seal with insulating material 157 disposed in a plurality of layers between the rear wall 141 of the pocket 140 and refractory lining 158 of the furnace combustion chamber 159.

The fuel pipe 21 is supported in the head 153 by the spider 23 having sliding engagement with cylindrical portion 160 of the passage formed internally therein and which corresponds to the cylindrical portion 49 previously described. A bracket 162 positioned within the inlet end 16 of the air passageway 17 carries the fuel pipe 21 and electrodes 68 and 69 in a manner similar to the bracket 22 previously described. A horizontally disposed foot portion 163 of the bracket 162 rests on the floor of the inlet portion 16 of the air passage in the lower part of the housing 2 and has an elongated slot 164 received on the upwardly extending end of a securing bolt 165. This bolt extends upwardly through the platform portion 126 of the base 145 supporting block 127, and is threadedly secured in the bottom of the housing 2. The upwardly extending end of the bolt 165 is in the nature of a stud which receives a tightening nut to lock the bracket 162 in adjusted position. Additional holding bolts 166 extend upwardly between the platform portion 126 of the base and housing 2 through the block 127 being threadedly secured in the housing to reinforce the connection between the base and housing. The lead washers 131 are employed as previously described to deaden the transmission of vibrations from the housing to the base.

The electrical connections between the conductors 74 and 75, leading from the transformer, and electrodes 68 and 69, are effected by spring brushes 167 formed of suitable material such as bronze or brass and having a reverse bend 168 to impart increased resiliency thereto. These brushes are secured by screws 169 to the conductors 74 and 75 and extend upwardly across the axes of the electrodes 68 and 69.

The adjusting rod 104 for the air gate 97 has secured on its upper end above the hood 94 a cylindrical head 170 which has a transverse screwdriver slot 172 formed across its upper end so that adjustment of the air gate may be effected without reaching one's hand into the head 170 which is relatively close to the hot walls 141 and 143 of the furnace pocket. The spring 108 is made of sufficient strength so that the friction of the indexing pin 106 and washers 109 and 110 is sufficient to prevent inadvertent movement of the adjusting rod 104. A rubber covered pin 103 secured in the front wall of the hood 94 at the bottom inside edge thereof, limits downward pivotal movement of the air gate 97.

Desirably the burner as illustrated in Figs. 15 and 16 is secured in place within the pocket 140 by screws 173 which extend through the base 145 and are threaded into the bottom wall 144 of the pocket. These screws prevent sliding movement of the base on the track 146 and resist lateral tipping and vibration of the burner. Other parts of the burner which correspond to parts pre-

viously described have been indicated by the same numerals of reference.

The unique design of the burner housing 2 provides a wiring box 174 between the outside walls of the housing and the internal partitions 38 and 42. A removable plate or plates 181 held in place by a screw or screws 175 secured in a boss 176 formed on the partition wall 38 close the opening in the side wall 31 leading into the terminal or wiring box 174. Thus but a single electrical conduit 177 leads to the burner and enters the wiring box 174 through a fitting 178 in the removable side wall plate 31. The power leads 179 to the transformer extend through a cored hole 180 (Figs. 3 and 5) in the rear wall 36 of the housing and the power leads 182 to the motor 7 pass through a cored hole 183 extending through both the rear wall 36 of the housing and the upright portion 119 of the bracket 5. Accordingly, the wiring leads for the burner are substantially concealed and protected from injury. During the opening or closing of the aperture 77 of the housing 2 by the pivoting movement of the transformer casing 73, the primary leads 179 to the transformer move through the hole 180, there being sufficient slack provided in the leads 179 within the wiring box 174 to permit this movement. As shown in Fig. 3, the hole 180 is covered by the transformer box 73 when the burner is in operation.

The fuel pressure conduit 19 extends through a slot 184 formed in the rear wall 36 of the housing and which is formed radially from the opening 77. Accordingly, when the transformer box 73 is pivoted to open position, the conduit 19 may be readily removed longitudinally through the passage 17 and out the opening 77 merely by sliding it out of the slot 184. Preferably a rubber grommet (not shown) fits around the conduit 19 in the slot 184 to prevent the flow of air therethrough and wear of the conduit on the walls of the slot.

Oil burners constructed in accordance with the design of the present invention exhibit improved operating characteristics. Particularly advantageous are the features relating to the flow of air which travels in a helical path through the combustion air or blast tube and is given increased turbulence and agitation in the region of the nozzle 25. The inlet end of the air passageway through the combustion air tube which is formed in the housing of the burner is of no greater cross-sectional area than the inlet end of the air tube so that air forced tangentially into the inlet end of the passageway 17 from the blower chamber 14 and throat 15 is substantially immediately given a spiral or helical path by the sloping or inclined wall 42.

During operation of the burner, combustion air, directed tangentially into the inlet end 16 of the air passageway 17 by the curved wall 34 of the throat 15, moves in a curved path which develops into a spiral path as the air travels forwardly through the tube 3. On account of the taper of the passageway 17 in the portion 48 of the air tube the spirally moving column of air is gradually accelerated so that its velocity is greater as it enters the head 27 than when leaving the cylindrical portion 47 of the tube.

The increased taper of the conical internal walls of the head 27 between the shoulders 56 and 57 with respect to the taper of the portion 48 of the air tube, further accelerates the combustion air in the region of the nozzle 25 so that the maximum velocity of the column of spirally moving air is substantially in the plane of the orifice 26 of the nozzle. Liquid fuel oil forced by the pump through the conduit 19 and pipe 21 is projected under high pressure from the orifice 26 of the nozzle 25 in the form of finely divided particles or droplets into the rapidly rotating stream or vortex of air surrounding and moving past the nozzle.

The spirally moving air column in the air tube 3 has a greater velocity at the radially outward portions thereof than at the center, and as the air enters the head 27 the radially outermost or peripheral portions of the air stream are deflected by the circumferential shoulder 56 in the passageway 17 and directed to flow transversely across the helical air column in advance of the nozzle 25 to entrain particles of the sprayed fuel oil. At substantially the region of smallest cross-sectional area and adjacent the extreme outlet end of the passage 17 the circumferential or annular shoulder 57 deflects the outermost part of the spirally advancing air column to flow transversely across such column and entrain particles of fuel oil projected from the nozzle 25. In this manner each of the shoulders 56 and 57 serves to create crosswise currents in the spiral column of accelerated combustion air which are beneficial in creating an increased turbulence or agitation of the air immediately in advance of the nozzle orifice 26. This increased turbulence promotes the atomization of the fuel oil into the form of a mist which increases the operating efficiency of the burner and results in a more uniform and regular combustion flame. Outwardly of the burner mouth 58 the spirally moving air stream expands radially in the combustion chamber 28. The central part of the air stream is highly agitated or in a state of great turbulence effected by the cross currents influenced by the shoulders 56 and 57 and the outer portion of the air stream continues to move spirally. Fuel oil sprayed from the orifice 26 forms a rich mixture in the highly agitated central portion of the combustion air. Combustion is initiated in this rich mixture and is completed in the outer shell of relatively leaner mixture which is rotating in a spiral fashion. A spark plays across the tip ends of the electrodes 68 and 69 in the region of the nozzle orifice 26 substantially continuously and insures ignition of the combustible mixture in the highly agitated central portion of the air stream. If desired, the spark may be discontinued after ignition has been obtained and the burner is in operation.

The method of burning the liquid fuel carried out by the burner of the present invention is particularly successful in overcoming difficulties previously encountered in burners which were operated intermittently, such as domestic oil burners. One such difficulty is the tendency for smoky combustion during the heating up of the fire box. Another such difficulty is the pulsating or throbbing encountered when a burner is set in operation after a period of inactivity. The cause or causes of such pulsations are not thoroughly understood but it has been found that the burner described above, operating in accordance with the method outlined, substantially overcomes the objectionable pulsating effects so that entirely satisfactory intermittent operation can be had. It is believed that the increased agitation or turbulence and the cross currents immediately in advance of the nozzle orifice, in combination with the spirally advancing air column which is accelerated in its path toward the burner head and during its pas-

sage therethrough, are instrumental in effecting the improved operation.

In servicing or repairing the burner the movable parts which are movable as a unit, illustrated in Fig. 7, can be quickly replaced so that there is no substantial interference with the continuous operation of the burner.

The arrangement for controlling the admission of air to the burner is advantageous in that the amount of air flowing when the blower is in operation can be regulated while the burner is operating, so that maximum operating efficiency of the burner can be quickly established. Additionally, the air inlet gate can be readily converted, from the type which remains open a predetermined amount at all times whether the burner is idle or in operation, to the type which is open only when the blower is operating and automatically closes by gravity when the blower is idle.

Other modes of utilizing the principles of the invention may be resorted to, change being made, as desired, in the particular construction and arrangement of parts shown and described, it being understood that numerous modifications and alterations are contemplated and that the embodiments disclosed are given for purposes of explanation and illustration only.

Inventions disclosed but not claimed herein form the subject matter of my copending applications Serial Nos. 317,243, 317,244, 317,245 and 317,246, all filed February 5, 1940, Serial No. 325,370 filed March 22, 1940, and Serial No. 325,761 filed March 25, 1940.

What I claim is:

1. In an oil burner, a housing defining a blower chamber having generally curved walls, a rotary blower in said chamber and means for actuating the same to rotate a mass of air in the chamber, an air tube associated with the housing and cooperatively defining therewith a substantially straight combustion air passage having an inlet end substantially in the plane of rotation of said air mass and an outlet spaced from the inlet in a direction parallel to the rotational axis of the blower, said inlet end having a cross sectional area materially less than the co-planar cross sectional area of the blower chamber, said housing including walls defining a passage to receive air tangentially from the rotating mass thereof in said chamber and to conduct the same tangentially into the inlet end of said combustion air passage to rotate in the latter in the same direction and in the same plane as in the blower chamber about an axis substantially parallel to the blower rotational axis whereby the conducted air is accelerated in the inlet end of the combustion air passage by the decrease in area while rotating in the same plane and in the same direction as the air in the blower housing, and means for supplying fuel oil in finely divided form to combustion air discharged from said outlet.

2. In an oil burner, a housing having spaced front and rear walls of generally ovate shape with top, bottom and side walls extending between the edges of the front and rear walls, the top and bottom walls being curved, curved partitions extending between the front and rear walls and dividing the interior of the housing into blower and air chambers and providing a passage between the chambers along one of the side walls, the blower chamber being larger than the air chamber whereby air forced from the blower chamber into the air chamber is accelerated in the latter, power driven means in the blower chamber for forcing air into the air chamber, an air delivery tube having one end secured to the front wall of the housing and communicating with the air chamber through an opening in said wall, and means adjacent the delivery end of the tube for discharging atomized oil into air forced through the air tube from the housing.

3. In an oil burner, a housing having oppositely disposed front and rear end walls of generally ovate form, with top, bottom and side wall extending between the end walls, the top and bottom walls being curved, partition means extending between the end walls and curved tangentially into the top and bottom walls to provide blower and air chambers with substantially continuous curved walls and a passage connecting the chambers and extending along one of the side walls, said air chamber being smaller than the blower chamber to effect acceleration of the air in the air chamber, power driven means in the blower chamber for forcing air through the passage and into the air chamber to rotate in the latter, an air delivery tube secured at one end to the front end wall of the housing and having an elongated passage communicating with the air chamber through an opening in the front wall, said tube passage extending as a continuation of the air chamber and having walls substantially flush with the air chamber walls, and means adjacent the delivery end of the tube for discharging atomized oil into air forced through the air tube from the housing.

4. In an oil burner, means defining an air passage of elongated character and circular cross section having spaced cylindrical wall portions of different diameters that substantially parallel the longitudinal axis of the passage and a tapered wall portion extending between the cylindrical portions, a fuel conduit extending longitudinally through the passage, a supporting bracket for the conduit, said bracket having bearing engagement with the larger cylindrical wall portion of the passage and being slidable therealong, centering means for supporting the conduit, said centering means being spaced from the bracket and having sliding engagement with the smaller cylindrical wall portion, one end of the conduit and a source of fuel supply connected to the other end of the conduit, and means for securing the bracket to said larger cylindrical wall portion of the air passage in different positions of longitudinal adjustment in the passage, said bracket and centering means being adapted for movement as a unit with the conduit whereby the bracket and centering means retain the conduit in fixed relation to the passage axis in different positions of longitudinal adjustment.

5. In an oil burner, housing and tube means defining a substantially straight passage for combustion air generally circular in cross section and having an air receiving end and an air discharging end and a blower chamber communicating with the receiving end of the air passage and arranged to direct air tangentially into said air receiving end of the passage, a blower mounted in the blower chamber for rotation about an axis substantially parallel to said straight air passage, the housing and tube means including a wall at the receiving end of the passage inclined to the axis of the straight air passage, facing toward the discharge end of the passage and disposed in the path of the air directed tangentially into the passage to direct and guide such air toward the discharge end, and means for supplying fuel oil to

the air at the discharge end of the straight air passage.

6. In a pressure atomizing oil burner having a blower housing formed with an air intake and an air outlet, a blower within said housing to draw combustion supporting air into the housing and to force the same under pressure through said air outlet, an air tube generally circular in cross section and having an air inlet end secured to said housing coaxially with said outlet and having a discharge end, a fuel nozzle located axially within said tube at the discharge end thereof, and fuel pump means having connection with the nozzle for delivering oil under high pressure to said nozzle, said air tube progressively decreasing in diameter from said inlet end to said discharge end to progressively increase the velocity of combustion air forced therethrough, said housing including air deflecting wall means adjacent said outlet, said wall means being inclined toward and extending longitudinally with respect to the axis of the air tube for directing air from the blower to flow spirally through the tube with greater velocity adjacent the wall of the tube than at the center thereof, whereby atomized oil is projected from the nozzle into the center of a mass of spirally rotating combustion supporting air.

7. In an oil burner, tube means providing walls defining an elongated passage of generally circular cross section for combustion supporting air having a relatively long portion tapering from a relatively large diameter inlet end to a relatively small diameter discharge end for progressively accelerating the velocity of a column of combustion supporting air moving therethrough, means for introducing combustion supporting air tangentially into said inlet end and causing such air to flow in a substantially helical path through the passage with a greater velocity along the walls thereof than in the central portion thereof, said passage including a relatively short portion at the discharge end of the long portion and extending as a continuation of the latter, said short portion of the passage having an increased taper to effect a further acceleration of the air flowing therethrough and having walls substantially unobstructed circumferentially to minimize the resistance to air flowing adjacent such walls, a circumferentially extending relatively shallow shoulder at one end of the short portion of the passage and extending radially inward to intercept the high velocity air moving spirally along the walls of the tube means for deflecting the intercepted air to flow transversely across the air column while the flow of air in the central portion of the column is substantially unobstructed, a fuel oil nozzle supported axially in the short portion of the passage, and means for supplying oil under pressure to said nozzle.

8. In an oil burner, an air tube having a longitudinally extending passage of generally circular cross section tapered from a relatively large diameter inlet end thereof to a relatively small diameter discharge end thereof for progressively accelerating the velocity of combustion air moving through the tube, means for introducing combustion supporting air into said inlet end of the tube and causing such air to flow spirally through the tube to the discharge end thereof with a greater velocity along the walls of the air tube than at the central portion thereof, a burner head secured to the discharge end of the tube and having a circular passage extending as an axial continuation of the tube passage, said head passage being tapered to effect a further acceleration of the combustion air flowing therethrough and having walls substantially unobstructed circumferentially to minimize the resistance to air flow adjacent such walls, a circumferentially extending relatively shallow shoulder substantially at the discharge end of the tube passage and extending radially inward to intercept the high velocity air moving spirally along the air tube walls for deflecting the intercepted air to flow transversely across the passage in the head while the flow of air through the central portion of the tube passage is substantially unobstructed, a fuel oil nozzle supported axially in the head passage, and means for supplying oil under pressure to said nozzle.

9. In an oil burner, tube means providing walls defining an elongated passage of generally circular cross section for combustion supporting air, means for introducing air into one end of the passage and causing such air to flow in a substantially helical path through the tube means with a greater velocity along the walls thereof than in the central portion thereof, said tube means including a relatively short tapered portion at the other end thereof to effect acceleration of the air column flowing therethrough and having walls substantially unobstructed circumferentially to minimize the resistance to air flowing adjacent such walls, said short tapered portion being provided with circumferentially extending relatively shallow shoulders at the ends thereof and extending radially inward to intercept the high velocity air moving spirally along the walls of the tube means for deflecting the intercepted air at both ends of the tapered portion to flow transversely across the moving air column while the flow of air in the central portion of the column is substantially unobstructed, a fuel oil nozzle supported axially in the air passage, and means for supplying oil under pressure to said nozzle.

10. In an oil burner of the pressure atomizing type, an elongated air tube of generally circular cross section providing a passage for combustion air and having a relatively long tapered portion and an integral relatively short cylindrical portion at one end, a burner head secured on said cylindrical end of the air tube and having a tapered passage extending as a continuation of and axially aligned with the air tube passage and a discharge opening, a fuel conduit extending longitudinally through the tube passage, a fuel nozzle on one end of the conduit and disposed in the head passage, means for supplying fuel oil under pressure to said conduit, a spider on the conduit and slidingly engaging the cylindrical portion of the blast tube whereby the conduit and nozzle can be shifted longitudinally in the tube passage and in the head passage while retained axially therein by the interengagement of the spider and the tube, and means for introducing combustion air into the air tube and causing the air to flow spirally therethrough, said long tapered portion effecting an initial acceleration in the velocity of the air, and said tapered head passage effecting a second acceleration in the velocity of the air subsequent to the movement of the air past said spider and while the air surrounds the nozzle immediately prior to release through the head discharge opening.

11. In an oil burner of the pressure atomizing type having a blower housing and an elongated air tube extending from the housing to provide a passage for combustion supporting air, a chamber in the housing continuous with the passage

and axially aligned therewith, fuel pump means supported exteriorly of the passage and the chamber, a fuel nozzle and a fuel supply conduit therefor extending longitudinally through the passage and the chamber, support means for the nozzle and conduit, said housing having an opening from said chamber aligned with the passage and of sufficient size to permit axial withdrawal therethrough of the nozzle, conduit and support means as a unit, removable closure means for said opening, said support means being independent of the closure means whereby the latter can be removed for optional inspection or axial withdrawal of said unit, the housing being provided with a slot extending from said opening to a point beyond the closure means, and said conduit normally extending through said slot and connecting to the fuel pump means exteriorly of the chamber and the passage, whereby upon disconnecting the conduit from the fuel pump and withdrawing said unit axially the conduit is moved clear of the slot and is withdrawn substantially without bending thereof.

12. In an oil burner of the pressure atomizing type having a blower housing and an elongated air tube extending from the housing to provide a passage for combustion supporting air, a chamber in the housing continuous with the passage and axially aligned therewith, fuel pump means supported exteriorly of the passage and the chamber, a fuel nozzle and a fuel supply conduit therefor extending longitudinally through the passage and the chamber, spaced members supporting the nozzle and the conduit and guiding the same for axial movement in the passage and the chamber, said housing having an opening from said chamber aligned with the passage and of sufficient size to permit axial withdrawal therethrough of the said nozzle, conduit and support means as a unit, removable closure means for said opening so disposed and arranged as to provide with the housing a normally closed end wall for the chamber, said support means being independent of the closure means whereby the latter can be removed for optional inspection or axial withdrawal of said unit, said end wall being provided with a slot continuous with said opening, and said conduit normally extending through said slot and connecting to the fuel pump means exteriorly of the chamber and the passage, whereby upon disconnecting the conduit from the fuel pump and withdrawing said unit axially the conduit is moved clear of the slot and is withdrawn substantially without bending thereof.

13. In an oil burner, an air tube having a passage therethrough for combustion air and a discharge end, means for forcing air through the tube toward the discharge end thereof, a nozzle at the discharge end of the tube for projecting fuel into combustion air, means for supplying fuel under pressure to the nozzle, and a passage of small cross sectional area relative to the air passage formed in the bottom wall of the air tube adjacent the discharge end thereof, said small passage extending longitudinally of the air tube and having one end opening into the air passage beneath the fuel nozzle and the other end opening adjacent the discharge end of the tube whereby liquid fuel dripping from the nozzle is conducted by the small passage out of the air passage and to the discharge end of the tube.

14. In an oil burner of the gun type, air tube means having walls defining a passage for combustion air, tube means having an inlet end for receiving air and a discharge end adapted for connection to the fire box of heating apparatus, means for supplying air to the passage at the inlet end of the tube means, a fuel nozzle supported in the passage adjacent the discharge end, and a liquid passage separate from the air passage and having an opening at the discharge end of the tube means, said liquid passage being formed in the lower part of the tube means and extending from a point substantially beneath the nozzle to a point in the discharge end of the tube means, said passage being inclined downwardly toward said discharge end whereby liquid fuel dropping from the nozzle is received in the liquid passage and conducted thereby into said fire box.

15. In an oil burner, a housing of generally ovate form having spaced front and rear oval walls and curved walls extending between the edges of the oval walls, partition means dividing the interior of the housing into blower and air chambers each having generally continuous curved walls and providing a passage between the chambers for tangential delivery of air to the air chamber from the blower chamber, the walls of said chambers including said curved walls of the housing, power driven means in the blower chamber for forcing air into the air chamber through the passage, an air tube of substantially circular cross section having one end secured to the front wall of the housing and communicating with the air chamber through an opening in such wall and having a discharge outlet at the other end, the major portion of the periphery of said opening being substantially flush with the air chamber walls and the inside surface of the air tube to effect a non-turbulent flow of air into the tube from the air chamber, and means for supplying atomized fuel oil to air released through the discharge outlet of the air tube.

16. In an oil burner of the pressure atomizing type having a blower housing formed with an air intake and an air discharge opening, a blower within said housing to draw combustion supporting air into the housing and to force the same under pressure through said opening, an elongated air tube of generally circular cross section and having an air inlet end secured to the housing over the opening and coaxially thereto and having an outlet at the other end, a fuel nozzle and means supporting the same coaxially in the air tube adjacent the outlet, and fuel pump means having connection with the nozzle for delivering oil thereto under relatively high pressure, said air tube progressively decreasing in diameter from said inlet end to said outlet end to progressively increase the velocity of combustion air forced therethrough, said housing including curved air deflecting wall means substantially flush with said opening and the air tube walls, said wall means being disposed to receive air generally tangentially from the blower and being inclined toward and extending longitudinally with respect to the air tube axis for directing received air to flow spirally through the tube with greater velocity adjacent the wall of the tube than at the center thereof.

17. In an oil burner, a housing having oppositely disposed front and rear walls with an opening in the front wall, an air tube secured at one end to the front wall of the housing over said opening and having a longitudinally extending passage of substantially circular cross section aligned with said opening and communicating with the interior of the housing through

said opening, partition means in the housing and dividing said interior into an air chamber in line with the opening and the tube passage and a blower chamber offset laterally from said opening, said partition means also providing an air passage along one side of the housing connecting the blower chamber with the air chamber for movement of air from the blower chamber along said housing side and tangentially into the air chamber, a portion of the partition means defining the air chamber being substantially flush with said opening, a blower in the blower chamber and means for actuating the blower to force air from the blower chamber through the air passage in the housing and tangentially into the air chamber along one side of the latter whereby air rotates in the air chamber and flows spirally and non-turbulently through said opening into the air passage in the tube, and means adjacent the other end of the air tube for supplying atomized fuel oil to the spiral stream of air so produced.

18. In an oil burner, a housing having oppositely disposed front and rear walls with an opening in the front wall, an air tube secured at one end to the front wall of the housing over said opening and having a longitudinally extending passage of substantially circular cross section aligned with said opening and communicating with the interior of the housing through said opening, partition means in the housing and dividing said interior into an air chamber in line with the opening and the tube passage and a blower chamber offset laterally from said opening, said partition means also providing an air passage along one side of the housing connecting the blower chamber with the air chamber for movement of air from the blower chamber along said housing side and tangentially into the air chamber, a portion of the partition means defining the air chamber being substantially flush with said opening and disposed at an acute angle relative to the longitudinal axis of the tube passage, a blower in the blower chamber and means for actuating the blower to force air from the blower chamber through the air passage in the housing and tangentially into the air chamber along one side of the latter whereby air rotates in the chamber and said angularly disposed portion of the partition means directs the rotating air to flow spirally and non-turbulently through said opening into said air passage in the tube, and means adjacent the other end of the air tube for supplying atomized fuel oil to the spiral stream of air so produced.

19. In an oil burner construction, housing and tube means having walls defining a substantially straight elongated passage for combustion supporting air, said passage being of generally circular cross section and having an inlet at one end, an outlet at the other end and a relatively large diameter portion between the inlet and the outlet, said walls being so formed as to provide a progressive increase in cross sectional area of the passage between the inlet and said large diameter portion and a progressive decrease in cross sectional area of said passage between the large diameter portion and the outlet, a nozzle supported adjacent the outlet, means for supplying fuel oil under pressure to the nozzle, and a blower for supplying combustion supporting air to the passage, said housing and tube means being so constructed and arranged as to introduce the supplied air tangentially into the passage at said inlet, whereby the introduced air flows at relatively high velocity along the walls of the passage from said inlet to said outlet and the air is first progressively decelerated as the air moves into the large diameter portion of the passage and is then progressively accelerated as the air moves from the larger diameter portion to the outlet.

REGINALD W. BECKETT.