June 14, 1938. M. A. POWERS ET AL 2,120,626

APPARATUS FOR BURNING LIQUID FUELS

Filed Sept. 28, 1934 3 Sheets-Sheet 1

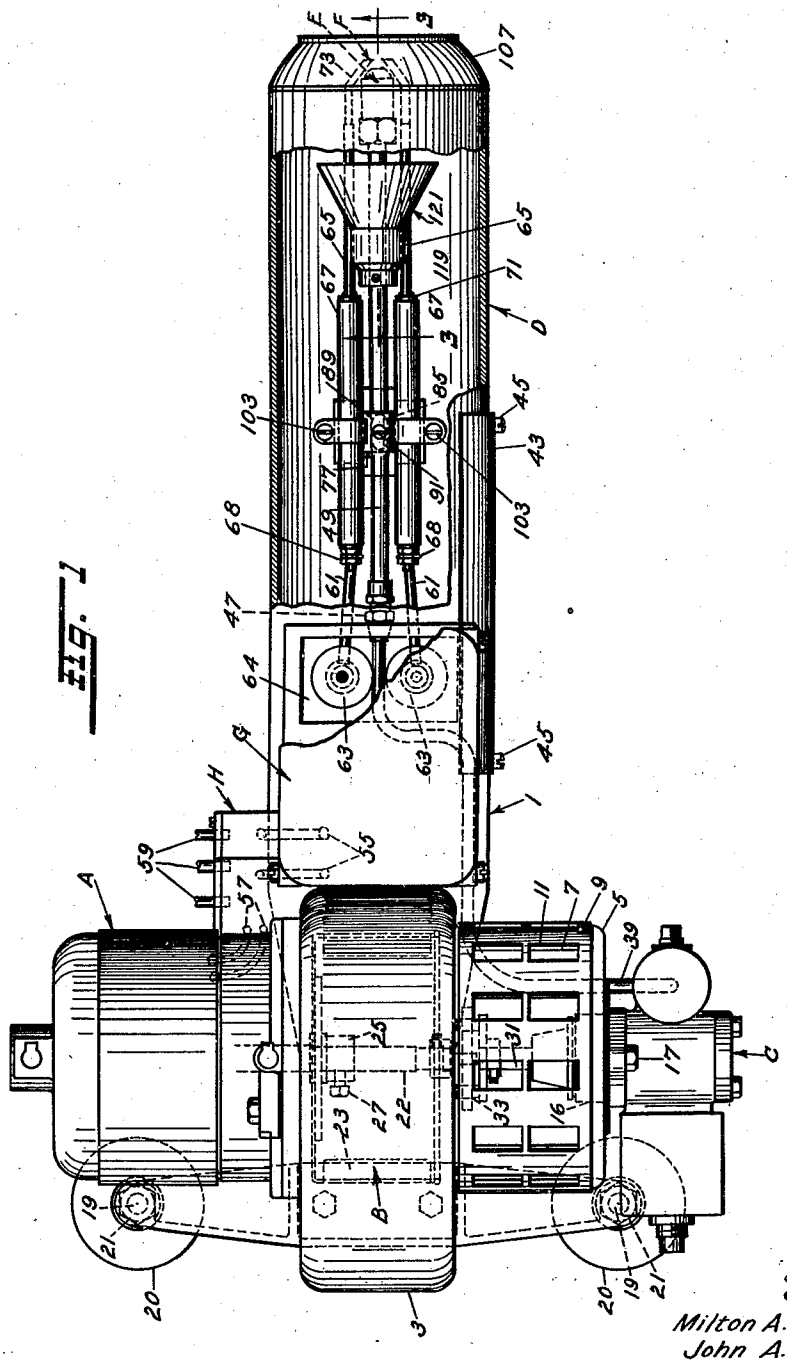


FIG. 1

Inventor
Milton A. Powers
John A. Wilson

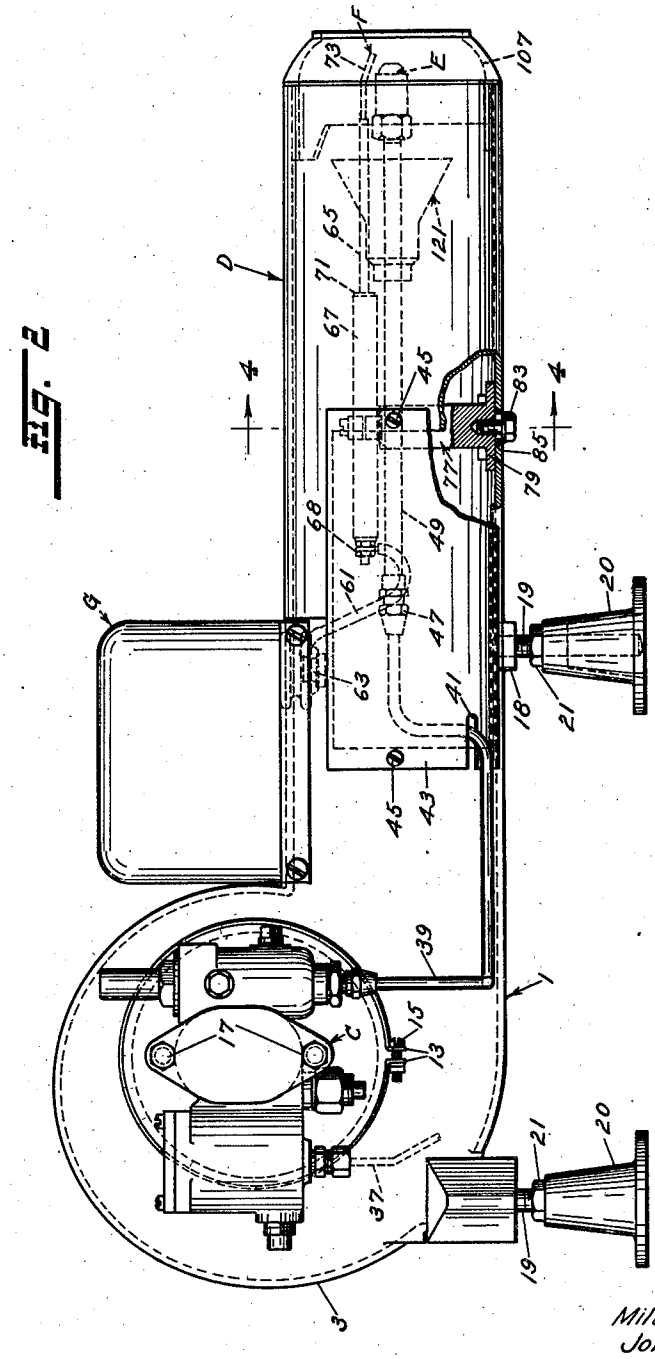
By Strauch & Hoffman
Attorneys

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APPARATUS FOR BURNING LIQUID FUELS

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FIG. 2



Inventor
Milton A. Powers
John A. Wilson

By Strauch & Hoffman
Attorneys

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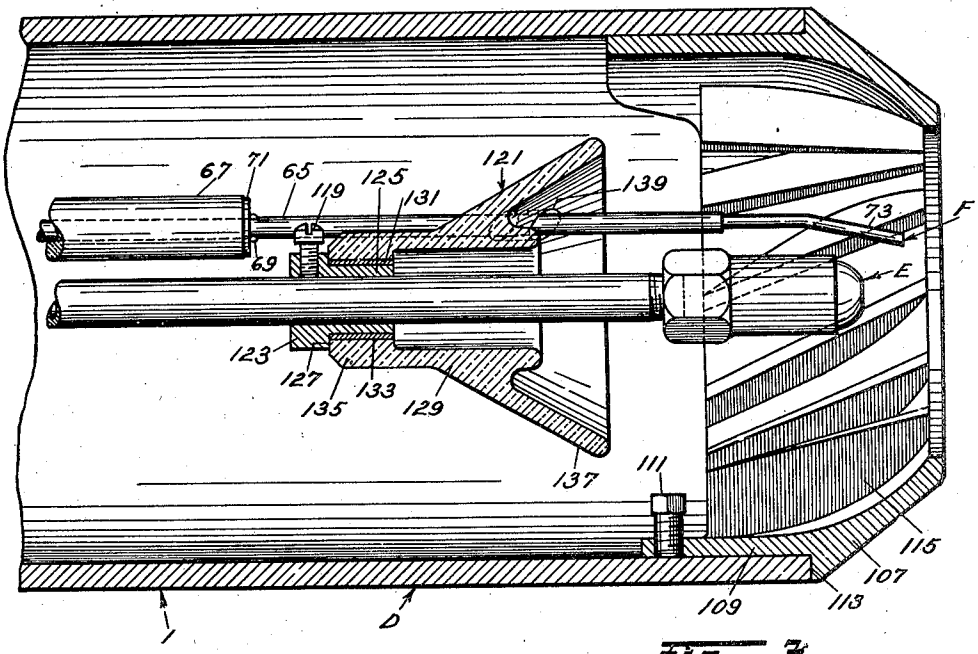


Fig. 3

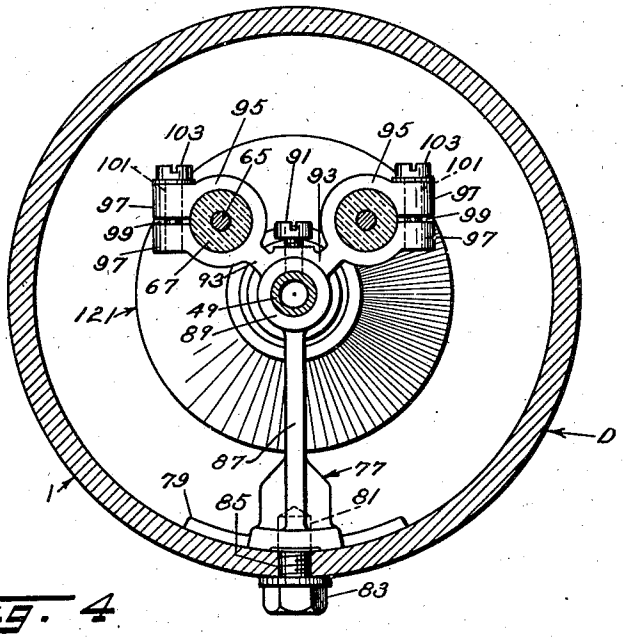


Fig. 4

Inventor
Milton A. Powers
John A. Wilson

By Strauch & Hoffman
Attorneys

Patented June 14, 1938 2,120,626

UNITED STATES PATENT OFFICE

2,120,626

APPARATUS FOR BURNING LIQUID FUELS

Milton A. Powers and John A. Wilson, Detroit, Mich., assignors, by mesne assignments, to The Timken-Detroit Axle Company, a corporation of Ohio

Application September 28, 1934, Serial No. 745,978

5 Claims. (Cl. 158—76)

This invention relates to pressure-type liquid fuel burners, and more specifically to what are commonly known as gun-type burners.

Devices of this nature are provided with means for supplying liquid fuel under pressure to a nozzle or spray jet where it is ejected in a fine spray, ordinarily of conical shape. There is also a provision for supplying a controlled quantity of air to mix with the spray and a means for igniting the combustible mixture thus formed. The velocity of the air blows the ignited mixture into a combustion chamber into which the nose of the burner projects. The combustion chamber is ordinarily the lower interior portion of a conventional furnace and when its walls are heated by the flame produced by the burner, heat is transferred to the heating medium whether it be water or air.

Prior devices of this nature have been extremely complex in structure—numerous pipes and wires being exposed on the exterior. Thus anyone may tamper with them, and also as the burner is ordinarily placed on the floor these pipes and wires and other parts may be tripped over, and often pulled out of engagement. Further, these exposed pipes and wires materially detract from the appearance of the device, and although beauty is not a prime requisite of an oil burner, this factor is of importance as such burners are placed outside of the furnace and are exposed to view all of the time.

The efficiency of prior burners of this class has not been very great due to the fact that the combustible mixture is discharged through the nose of the burner in a straight line, impact with a wall of the combustion chamber opposite the burner nose being relied upon to distribute the combustible mixture throughout the combustion chamber. Due to this method of flame distribution, carbon is collected on what might be termed the "impact wall", which partially insulates the heat absorbing surface from the flame and produces a resultant decrease in efficiency. Also, thorough distribution of the flame throughout the combustion chamber is not obtained.

In gun-type burners heretofore proposed, it has not been possible to obtain even fair operation in certain installations by reason of the burner parts not being adjusted to properly take care of the operating factors of the installation involved.

It is accordingly a primary object of the present invention to devise a novel gun-type burner that presents a minimum of exposed pipes and wires, and is of relatively light weight.

It is another important object of this invention to devise a liquid fuel burner having all of the parts which affect combustion efficiency, mounted for adjustment so that all of the peculiarities of any installation may be compensated for and the efficiency of the burner raised to a maximum.

It is a further object of this invention to devise a gun-type burner which imparts a swirling motion to the combustible mixture and flame, whereby complete flame distribution is obtained.

A further object is to devise a gun-type burner having an oil spraying means and an air swirling means that may be adjusted with respect to each other so as to obtain ideal combustion conditions.

A further object is to provide a gun-type burner wherein the ignition means may be adjusted with respect to the oil-spraying means, in order to permit of several types of spray nozzles being used.

A further object is to provide a gun-type burner having an oil-spraying means and an ignition means which may be jointly adjusted with respect to an air-swirling means.

These and further objects will be evident upon a study of the following detailed description in connection with the annexed drawings, and from the appended claims.

In the drawings:

Figure 1 is a plan view of a burner embodying our invention, with parts thereof broken away to more clearly illustrate the construction.

Figure 2 is a side elevational view of the burner shown in Figure 1, with a part of the conduit broken away.

Figure 3 is a side sectional view taken substantially on the line 3—3 of Figure 1, and

Figure 4 is a vertical sectional view taken substantially on the line 4—4 of Figure 2.

With continued reference to the drawings wherein like reference characters have been employed to designate like parts throughout the several views, the burner consists essentially of a motor A, which operates an air-blower or fan B and an oil-pumping means C; a conduit D, which contains an oil-nozzle or spray-jet E; and a fuel ignition means F.

The burner housing 1 of which a conduit or nosing D, air conductor or conduit which will be hereinafter referred to as a conduit, is a part, has adjacent the rear of said nosing a circular portion 3 in which fan B revolves. On one side

of circular portion 3 is a flat surface to which is bolted motor A which may be of any suitable type. On the opposite side of the circular portion is a cylindrical extension 5, having a series of air intake apertures 7 formed therein. Placed around cylindrical portion 5 is a cylindrical stamping 9, termed an air shutter, having a series of apertures 11 which mate with apertures 7. The extremities of stamping 9 are provided with ears 13 which have aligned apertures therethrough for the insertion of a clamping screw and nut assembly 15. The air shutter 9 is adapted to be rocked a slight angular distance on cylindrical portion 5 of the housing to bring apertures 11 into such relation to apertures 7 that the correct quantity of air for proper combustion may flow inwardly therethrough. This adjustment is usually determined by the requirements of the particular installation. When the correct adjustment is obtained, clamping screw assembly 15 is tightened, thus maintaining the proper adjustment throughout operation.

The outer end portion of cylindrical portion 5 is provided with a central circular aperture for the insertion of a hub portion 16 of the oil pumping and supplying means device C, which is secured thereto by cap screws 17. Device C may be of any suitable form and supplies oil to the spray nozzle E under a predetermined pressure.

On the underside of housing 1 are three bosses 18, spaced in triangular fashion with respect to the housing—one being placed centrally under conduit D and the other two being adjacent the rear portion of housing 1 and equally spaced outwardly with respect to the longitudinal axis of the burner. Bosses 18 are threadedly apertured for the insertion of studs 19. Three pads 20 are also provided with threaded apertures which are threaded onto studs 19. The burner is suitably positioned with respect to the surface on which it rests by screwing feet 20 upwardly or downwardly—as the case may be. Lock nuts 21, on studs 19, are then screwed down against the upper surfaces of feet 20, thus permanently retaining the correct adjusted position.

Shaft 22 of motor A projects into housing 3 and drives air-blower or fan B. The fan may assume any desired form but it is substantially cup-shaped and comprises a circular series of blades 23 bent inwardly from the outer periphery or wall portion of the cup, and a hub 25 provided centrally in the flat or bottom portion of the cup. A set screw 27 is threadedly inserted through the hub and against shaft 22 thereby providing a driving connection between the fan and the motor.

Oil pump C has a shaft 31 extending into cylindrical portion 5 of housing 1. Motor shaft 22 and oil pump shaft 31 terminate in close abutting relationship and are connected together by means of a flexible coupling 33. Coupling 33 takes care of and absorbs any misalignment between the two shafts, so that undue stresses are not transmitted to their respective mechanisms. It is accordingly seen that the motor constitutes a single driving means for operating the air and oil supplying means.

It is to be understood that no novelty is claimed for the motor A, or oil pump C per se, as any conventional motor or pump which has the desired characteristics and dimensions may be used. Suffice it to say that the oil pump C is provided with an inlet line 37 which connects with a suitable oil reservoir (not shown) and an oil outlet line 39. Suitable mechanism is provided within the oil pump for straining the oil and for automatically regulating the pressure in the oil supplied to oil outlet line 39.

It is to be noted that the pipe line constituting oil outlet 39 is the only exposed pipe line interconnecting burner parts, and that it is out of the way as it projects downwardly and then turns inwardly so that it lays along the burner housing. Pipe line 39 enters the burner housing 1 through a slot 41 provided therefor in inspection cover 43 which is secured to conduit D. Cover 43 is made of thin sheet metal and is shaped to fit the contour of conduit D and two screws 45 are provided to clamp the cover in place. On the interior of conduit D, pipe 39 is connected at 47 to pipe 49 which has screwed on its outer end an oil nozzle or spray jet E, and is suitably supported in conduit D by means yet to be described.

Immediately in front of circular portion 3 of housing 1, and removably secured to the top portion of conduit D is transformer G. The transformer is of conventional type, having a 110 volt primary and a 10,000 volt secondary. The primary leads 55 of the transformer extend within housing 1 to a connector box H. The motor is provided with leads 57 which likewise extend within the housing to connector box H. Connector box H is provided with three binding posts 59 for the attachment of the wires which connect with the burner control mechanism (not shown). A pair of high tension leads 61 connect the secondary binding posts 63 of the transformer G with the ends of electrodes F. Binding posts 63 extend through aperture 64 formed in the upper surface of conduit D.

Electrodes F consist of elongated bars 65 surrounded at their rearward ends by cylindrical insulators 67. The insulators are preferably composed of an electrically non-conductive material, such as "silimanite", and are positioned by means of pinched protrusions or nibs 69, protruding from bars 65 and against which are placed positioning washers 71. Protrusions 69 prevent insulators 67 or washers 71 from traveling outwardly on bars 65. Each insulator 67 is prevented from traveling inwardly on bar 65 at its other end by means of connecting nuts 68 threaded onto each bar.

Press-fittedly inserted into the outer end of each bar 65 is an electrode tip 73, which is bent at a point approximately half way of its length, so that it will be properly positioned with respect to oil nozzle E. Electrode tips 73 are made of a highly heat-resistant material which is relatively expensive with respect to the material of which bars 65 are made. Inasmuch as those portions of the electrodes which extend to the rear of the nozzle are not subjected to high temperatures, it is not necessary that this expensive material be used throughout the length of bars 65. Consequently, a less expensive material, which, however, is a good electrical conductor, is used for elongated bars 65.

Substantially midway of the length of conduit D is a positioning or supporting device 77, which is designed so that nozzle E and electrode tips 73, which are supported thereby, may be adjusted independently or collectively as desired. This device consists of standard 77 having a base 79 shaped to fit the interior of conduit D and provided with a threaded aperture 81 for the insertion of a clamping bolt 83. Bolt 83 extends through a slot 85 provided therefor in the bottom of the nosing and when tightened pulls base

79 into engagement with conduit D. Slot 85 permits limited longitudinal travel of the standard 77 with respect to conduit D when bolt 83 is loosened, thereby making it possible to move it into a plurality of adjusted positions. A central upstanding web 87 connects base 79 of standard 77 with a longitudinal cylindrical portion 89. Cylindrical portion 89 has a central aperture therethrough for the insertion of oil pipe 49. There is also a vertical threaded aperture through the cylindrical portion which connects with the central aperture for the insertion of a set screw 91 which is adapted to hold oil pipe 49 upon standard 77 in various adjusted positions.

Located outwardly and upwardly from cylindrical portion 89 of standard 77, and connected thereto by means of a pair of webs 93, are two identical cylindrical portions 95, having ears 97 on their outer sides. Ears 97 are provided with horizontal slits 99 and vertical apertures 101, the latter being threaded in the portions located on the underside of slits 99. Cylindrical portions 95 are provided with central apertures for the insertion of insulators 67. The insulators are adjustably clamped or positioned therein by means of clamping screws 103, threadedly inserted in apertures 101. When tightened, screws 103 cause the separated portions of ears 97 to be forced together.

From the above description it is evident that the nozzle E and electrode tips 73 may be adjusted with respect to each other, by manipulating them longitudinally of the conduit after loosening their clamping screws, and that the nozzle and electrode tips may be collectively adjusted with respect to the conduit by loosening screw 83 and moving the entire assembly longitudinally of conduit D.

Inserted into the outer end of conduit D is an air-swirling device 107. This device has an inner cylindrical portion 109 which is adapted to fit snugly into the inside end portion of conduit D and be held therein by means of set screw 111. A shoulder 113 is provided adjacent cylindrical portion 109 which limits the distance air-swirling device 107 may be inserted into conduit D. The outer portion of swirling device 107 is substantially conical in shape having a series of internal fins or blades 115 which are so formed, as indicated in Figure 3, as to impart a swirling motion to any air passing therethrough.

Although we preferably adjust the fuel spraying and ignition means relatively to the air-swirling device by moving the former, it is to be understood if desired set screw 111 may be loosened and member 107 adjusted longitudinally of conduit D without departing from the spirit of the present invention.

Positioned on oil tube 49, and held in place by a set screw 119 is an air deflecting device 121, consisting of a metal inner member 123 and an outer member 129 of insulating material, such as dielectric porcelain. Inner member 123 is substantially cylindrical in shape, having a central aperture therethrough for the insertion of oil tube 49, and an outer surface of two sizes. The larger and rearmost portion has a threaded aperture connecting the outer surface with the central aperture for the insertion of set screw 119. It is by means of this set screw that the air deflecting device may be held in various longitudinally adjusted positions with respect to oil tube 49 for securing the proper air-swirling action in the particular installation involved. The larger portion changes abruptly to smaller portion 125, thus forming shoulder 127.

Outer member 129, or the air deflector proper, consists essentially of a hub portion 135 and a conical portion 137. Hub portion 135 is adapted to fit around portion 125 of inner member 123 and abut shoulder 127. Outer member 129 is rigidly secured to inner member 123 by means of porcelain cement 131, or any other suitable securing means, which is inserted between portion 125 of inner member 123 and inner diameter 133 of hub portion 135 of outer member 129. Conical portion 137 is provided with two longitudinally directed holes 139 through which electrodes F loosely project. As outer member 129 is made of an insulative material it is incapable of short-circuiting the electrodes, which lie almost in contact with the walls of holes 139.

Air deflector device 121 is so positioned on oil tube 49 that all air supplied from fan B and which passes through the central portion of conduit D will be deflected outwardly and forced through the blades 115 of air-swirling device 107.

It should be particularly observed that the inner surface of member 107, intermediate blades 115, is inwardly curved. This is important as it causes the helical air currents set up by blades 115 to be directed inwardly and be intimately mixed with the fuel spray issuing from nozzle E. If it were not for this feature, the helical air currents would rapidly increase in diameter upon leaving the conduit and would probably not mix as intimately with the fuel.

Different sizes and designs of nozzles E may be used depending upon the installation in which the burner is to be used. There is no novelty claimed for the nozzle per se, as any atomizing nozzle having the desired characteristics and dimensions may be used. The electrode tips 73 are so adjusted that their terminals will be outside of the main spray of liquid fuel ejected from nozzle E. This adjustment will be determined by whether a wide spray or a narrow spray nozzle is used. Were the electrode tips 73 directly in the main fuel spray they would quickly collect carbon and ignition would be impaired.

Regardless of how well the nozzle may be made, there is always a fine spray of fuel outside of, and surrounding the main conical spray, in which the spark is located. It is this fine spray which is first ignited. Baffle 121 protects the spark from the direct blast of air and establishes at least a semi-quiescent zone in the region of the spark. Electrode tips 73 and nozzle E are adjusted collectively so that the oil spray and the spark are in the correct position with relation to the air forced through the swirling blades 115, so that quiet and efficient combustion takes place. It is observed that by adjusting nozzle E toward and away from the conduit end, the oil spray may be introduced in different portions of the air-swirl, to suit conditions.

The operation of the burner is exceedingly simple. A suitable source of current is supplied whereby operation of the motor A is started which in turn turns the fan B and the oil pump C. Oil is pumped to the nozzle E and air is blown through the conduit D and forced by means of air deflector 121 through blades 115. Current is also supplied to the transformer G and causes a spark to jump between electrode tips 73. Ignition of the truant oil from the main oil spray occurs and the flame spreads to the main spray, and the flame is carried outwardly from the burner nose, because of the velocity of

the air supplied by the fan B. When the burner has come up to operating temperatures the ignition device is automatically shut off by opening the primary circuit of the transformer, and this may be effected by any suitable mechanism contained in the burner control.

Inasmuch as only the air-swirling device 107 and the very tip of conduit D projects into the combustion chamber the remainder of the mechanism is quite far removed from heat. Also, any heat imparted thereto will be prevented from being conducted through the metal of conduit D back to the motor and other parts due to the cooling effect of the air blowing through the nosing in the opposite direction; in fact, during operation a human hand may be laid upon conduit D without discomfort.

From the foregoing description, it is evident that an extremely simple and compact liquid fuel burning device is obtained. Due to the various adjustments provided, adaptability of the device to various types and sizes of installations is obtained. Due to the use of an air deflector and fins for imparting a swirling motion, the atomized fuel and the air are intimately mixed, thereby avoiding rich or lean spots and a swirling fire is obtained, which has proven to be the most efficient variety.

Although we have illustrated, and prefer to support the air-swirling device on the conduit, it is to be understood that if desired it may be supported on oil pipe 49, and the appended claims are intended to embrace our invention when it is embodied in this form. Moreover the electrode assembly may be supported on pipe 49 instead of standard 77, without in any way impairing the operation of the apparatus.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. In a liquid fuel burning apparatus, a conduit; means for causing a stream of air to traverse said conduit; air swirling means adjacent the discharge end of said conduit for imparting a swirling motion to said stream of air as it leaves said conduit; said air swirling means comprising a plurality of blades extending from the inner wall of said conduit inwardly toward, but terminating considerably short of the center of said conduit, to provide a comparatively large substantially unobstructed central opening adjacent the discharge end of said conduit; and an air deflecting member centrally located with respect to the longitudinal axis of said conduit and disposed adjacent said air swirling means for deflecting substantially the entire stream of air through said air swirling blades and means, located adjacent the discharge end of said conduit, for projecting a substantially cone-shaped stream of atomized liquid fuel into the air stream issuing from said air swirling blades.

2. In a liquid fuel burning apparatus, a conduit through which an air stream is adapted to be blown, a fuel atomizing nozzle disposed in said conduit and operable to discharge a fuel spray of generally cone shaped configuration surrounded by a mist of finely atomized fuel; spark forming means disposed adjacent said nozzle and operable to establish a spark in the mist of fuel surrounding said spray for igniting the same; a plurality of air swirling blades disposed in said conduit adjacent said nozzle and extending toward the center of said conduit, but terminating short thereof, and air deflecting means disposed in said conduit in the path of said air stream for shielding said spark forming means from the direct action of said air stream, to thereby maintain a semi-quiescent zone adjacent said spark, said air deflecting means also deflecting the central part of said air stream from the central axis of said conduit and into said air swirling blades.

3. The liquid fuel burning apparatus described in claim 2, wherein said air deflecting means is mounted for adjustment toward and away from said spark forming means for adjustably varying the degree of quiescence adjacent said spark and for adjustably varying the quantity of air that is deflected away from the axis into said air swirling blades.

4. In a liquid fuel burning apparatus, a substantially cylindrical conduit adapted to convey combustion air to a combustion chamber, a fuel pipe centrally disposed in said conduit and having a nozzle at the end thereof for mechanically atomizing liquid fuel, said conduit being provided adjacent its discharge end with a plurality of inwardly extending air swirling blades, the free ends of said blades terminating considerably short of the axis of said conduit to provide a comparatively large central opening, means for blowing combustion air through said conduit toward the discharge end thereof, and a deflecting device disposed within said conduit for causing substantially all of the air blown therethrough to enter and be acted upon by said air swirling blades, said air deflecting device comprising a member disposed in said conduit and mounted upon said fuel pipe and presenting a substantially conical face to the stream of air flowing through said conduit, said member having a maximum outside diameter substantially equal to that of the central opening provided by said air swirling blades.

5. In a liquid fuel burning apparatus, a substantially cylindrical conduit adapted to convey combustion air to a combustion chamber, said conduit being provided adjacent its discharge end with a plurality of inwardly extending air swirling blades, the free ends of said blades terminating considerably short of the axis of said conduit to provide a comparatively large central opening, means for blowing combustion air through said conduit toward the discharge end thereof, a fuel pipe disposed in said conduit and located substantially centrally with respect to the axis of said conduit and terminating adjacent said air swirling blades in a fuel atomizing nozzle, an air deflecting device disposed within said conduit for causing substantially all of the air blown therethrough to enter and be acted upon by said air swirling blades, said deflecting device comprising a member mounted on said fuel supply pipe for sliding movement toward and away from said nozzle, said air deflecting device having a pair of openings extending therethrough in a direction substantially parallel to said fuel supply pipe and presenting a substantially conical face to the stream of air blown through the conduit, said air deflecting device having a maximum out-

side diameter substantially equal to that of the central opening provided by said air swirling blades, a pair of electrodes disposed in said conduit and extending through said openings in said air deflecting device and terminating adjacent said nozzle in a pair of spark forming terminals, and means for supporting said electrodes independently of said air deflecting member, whereby the latter may be moved toward and away from said nozzle without disturbing the position of said electrodes.

MILTON A. POWERS.
JOHN A. WILSON.