Jan. 13, 1953 W. J. SMITH ET AL 2,625,213

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Filed March 14, 1947 3 Sheets-Sheet 1

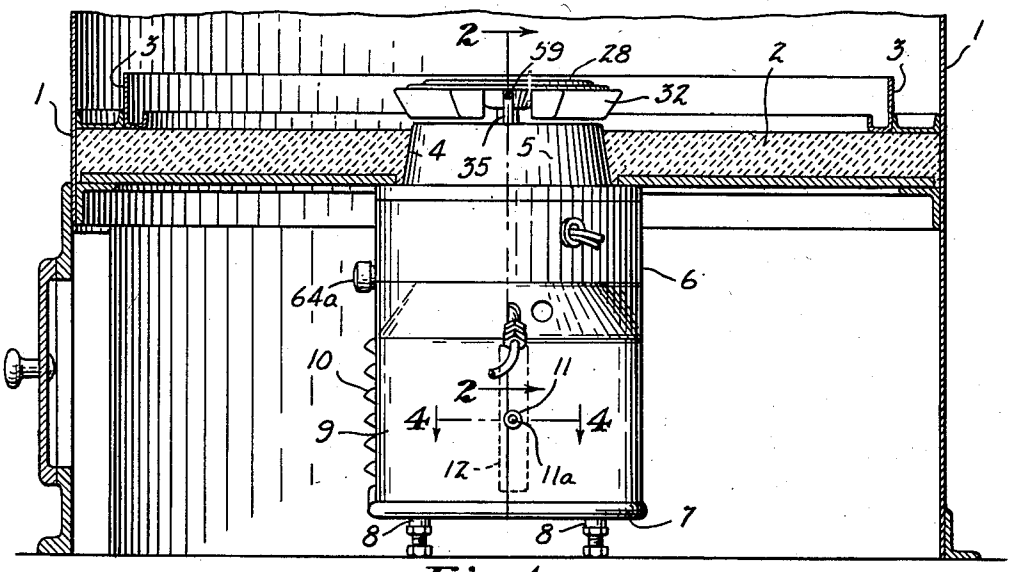


Fig. 1

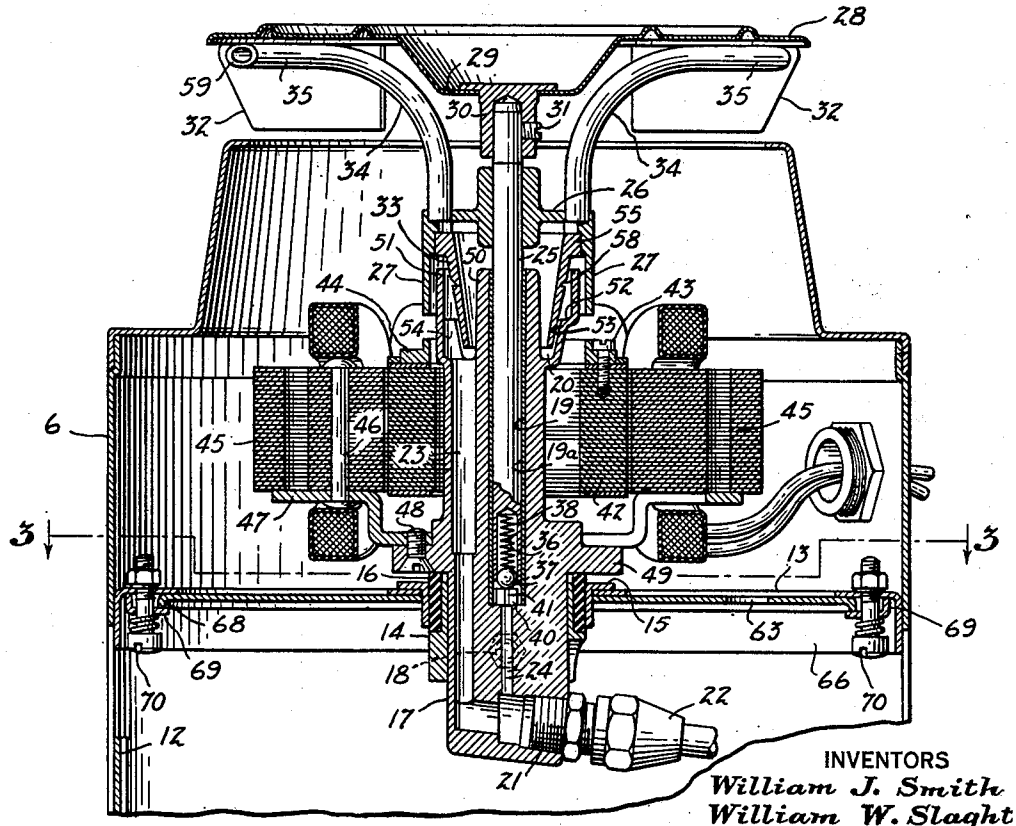


Fig. 2

INVENTORS
William J. Smith
William W. Slaght
BY
Evans & McCoy
ATTORNEYS

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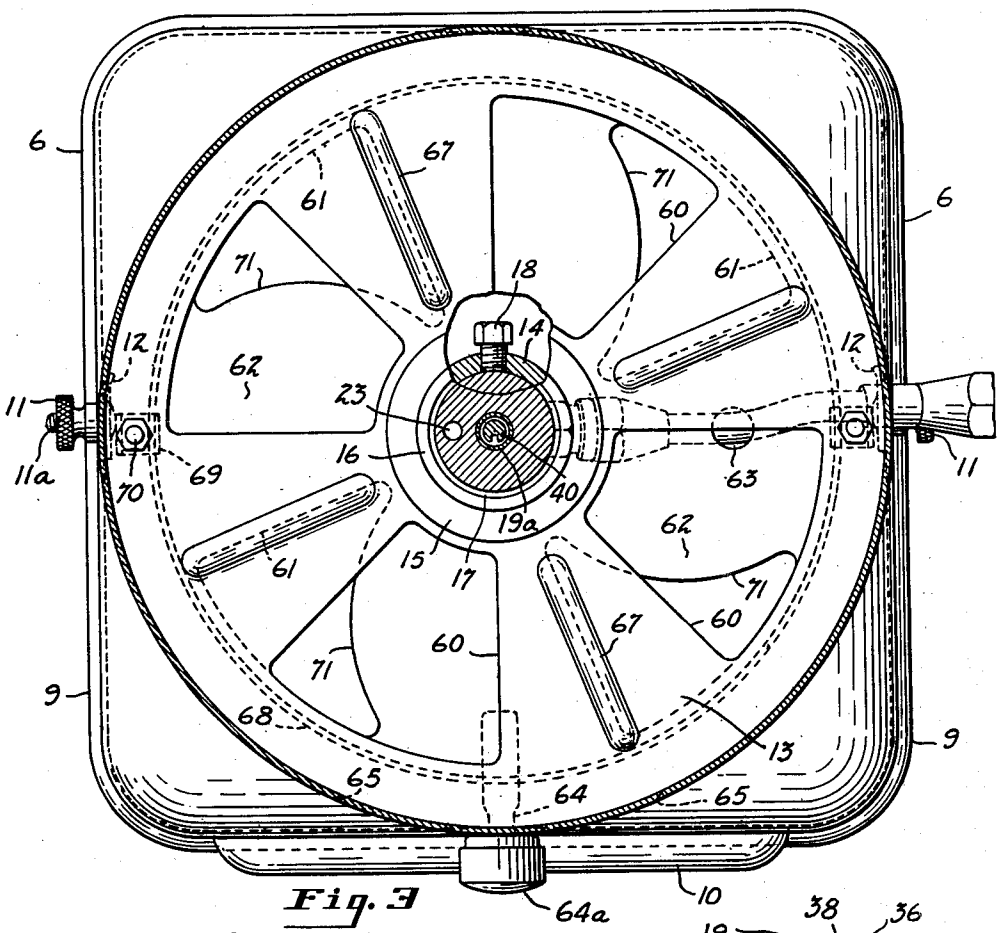


Fig. 3

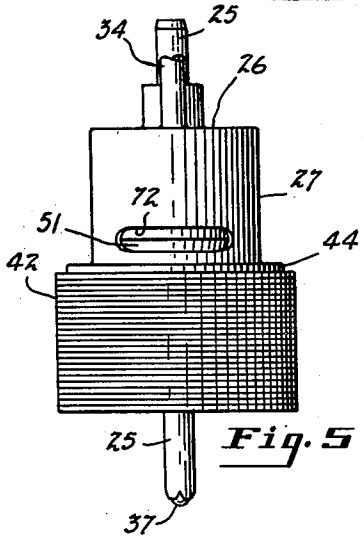


Fig. 5

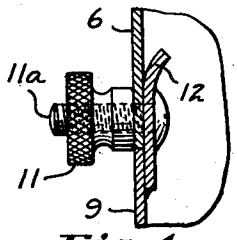


Fig. 4

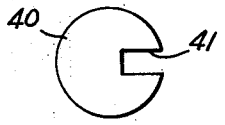


Fig. 7

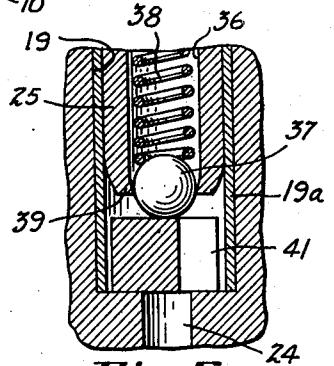


Fig. 6

INVENTORS
William J. Smith
William W. Slaght
BY
Evans & McCoy
ATTORNEYS

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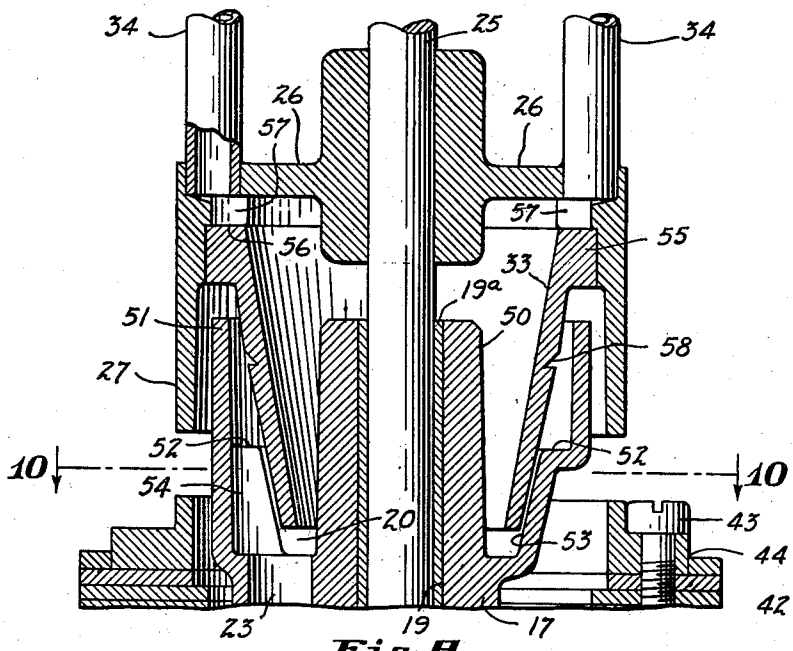


Fig. 8

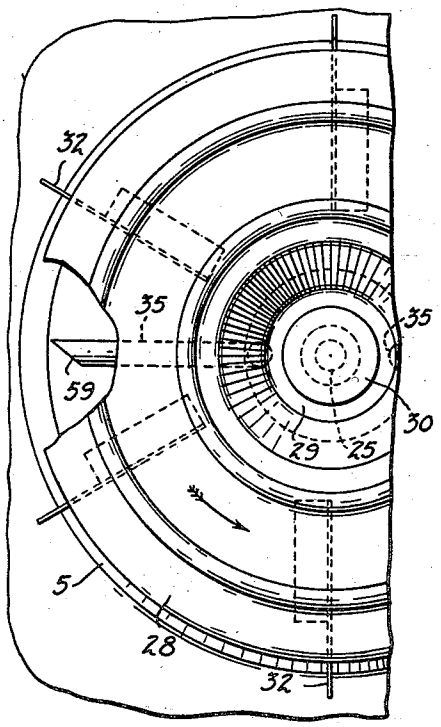


Fig. 9

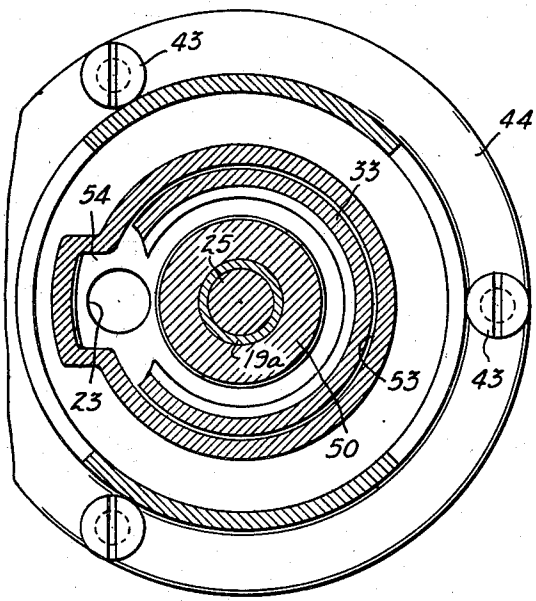


Fig. 10

INVENTORS
William J. Smith
William W. Slaght
BY
Evans & McCoy
ATTORNEYS

Patented Jan. 13, 1953 2,625,213

UNITED STATES PATENT OFFICE

2,625,213

BURNER

William J. Smith and William W. Slaght, Rocky River, Ohio, assignors to Cleveland Steel Products Corporation, Cleveland, Ohio, a corporation of Ohio

Application March 14, 1947, Serial No. 734,765

9 Claims. (Cl. 158—77)

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This invention relates to fuel feeders for liquid fuel burners and more particularly to burners of the wall flame type.

Important objects of the present invention are to provide a fuel feeder that is capable of delivering fuel without fluctuations throughout a wide range of rates of fuel delivery and which is adapted to deliver fuel uniformly in starting so that fuel is not wasted when the burner is frequently started and stopped by thermostatic control.

It is also an object of the invention to provide a feeder of simple and economical construction, that is easy to install and in which the parts are readily accessible and easily removable for replacement and repair.

A further object is to provide improved means for regulating the air supply, particularly when fuel is being delivered at a slow rate.

A further object is to provide means for delivering liquid fuel in exceedingly fine streams into the air streams directed toward the flame ring.

An additional object of the invention is to provide improved lubrication for the rotor shaft so that rotation thereof is not impeded by solidification of lubricant during long periods of idleness such as may occur in summer months.

It is also an object of the invention to provide a fuel feeder having all parts so mounted that they may be removed through the hearth opening.

With the above and other objects in view, the invention may be said to comprise the fuel feeder as illustrated in the accompanying drawings, hereinafter described and particularly set forth in the appended claims, together with such variations and modifications thereof as will be apparent to one skilled in the art to which the invention pertains.

Reference should be had to the accompanying drawings forming a part of this specification, in which:

Figure 1 is a vertical section through the base of the furnace, showing the fuel feeder of the present invention installed therein;

Fig. 2 is a vertical axial section through the fuel feeder taken on the line indicated at 2—2 in Fig. 1;

Fig. 3 is a horizontal section taken on the line indicated at 3—3 in Fig. 2;

Fig. 4 is a fragmentary section taken on the line indicated at 4—4 in Fig. 1;

Fig. 5 is a side elevation of the rotating unit with the fan removed;

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Fig. 6 is a fragmentary section through the shaft bearing similar to that shown in Fig. 2, but on an enlarged scale;

Fig. 7 is a plan view of the bearing disk upon which the distributor head is supported;

Fig. 8 is a fragmentary section through the fuel pump similar to the section shown in Fig. 2 but on a larger scale;

Fig. 9 is a fragmentary top plan view of the rotating unit, and

Fig. 10 is a fragmentary plan view of a portion of the fan with a portion broken away and showing the discharge end of one of the fuel delivering tubes in section.

In the accompanying drawings the fuel feeder of the present invention is shown installed in a furnace of conventional construction having an upright enclosing wall 1 and a horizontal hearth 2 spaced above the floor upon which the furnace is mounted. A flame ring 3 of conventional construction is shown mounted upon the top of the hearth 2, spaced inwardly a short distance from the wall 1 and surrounding a central opening 4 in the hearth. The opening 4 receives the upper outlet end 5 of a fuel feeder housing 6. The outlet 5 of the housing is of smaller diameter than the body of the housing and is preferably tapered toward its upper end. The housing 6 is provided with a base 7 that carries suitable adjustable legs 8 by means of which the housing may be supported in fixed position on the floor beneath the hearth of the furnace.

The lower portion of the housing 6 has a front half 9 that is removable to afford convenient access to the lower portion thereof. The detachable section 9 is provided with louvers 10 to permit free entry of air and is detachably held in place by thumb nuts 11 on threaded studs 11*a* carried by strips 12 welded to the side edges of the section 9 which are adapted to fit against the interior of the sides of the fixed portion of the housing which are slotted to receive the studs 11*a*. Above the detachable section 9 the housing 6 is provided with a horizontal partition 13 which carries a central supporting collar 14 that is composed of an outer flanged ring 15 supported upon the partition and a rubber cushioning sleeve 16 that is interposed between the body of the collar 14 and the ring 15 and bonded to both. The collar 14 serves as a support for the fuel feeding mechanism and the rubber cushioning sleeve 16 interposed between the body of the collar and the partition member serves to reduce the transmission of audible vibrations to the housing.

The collar 14 receives the lower end of a supporting standard 17 which is slidable vertically in the collar 14 and which is supported in adjusted positions by means of a screw 18 carried by the collar 14. The standard 17 is provided with an axial bearing socket 19 which opens to the upper end thereof and which extends to near the lower end of the standard, and adjacent its upper end the standard is provided with an annular upwardly opening recess 20 forming a fuel well surrounding the upper portion of the socket 19. The lower end of the standard 17 which projects below the collar 14 is provided with a threaded socket 21 which receives a fitting 22 through which fuel may be delivered to the standard, the socket 21 forming the lower part of a longitudinal passage 23 which extends upwardly to the bottom of the fuel well 20. A branch passage 24 extends from the socket 21 to the lower end of the bearing socket 19 in which a shaft 25 which supports the fuel lifting and distributing means is journaled so as to maintain the liquid which serves as a lubricant at the same level in the socket 19 as in the well 20. The fuel supply is controlled by a suitable valve mechanism (not shown), as is common practice in the art, to maintain the proper fuel flow to the fuel well. The major portion of the length of the bearing socket 19 is below the fuel well 20 and oil delivered through the fitting 22 and maintained at the same level as in the fuel well effectively lubricates the shaft 25 at all times. The lubricant maintained to a high level in the bearing socket will prevent the solidification of the lubricant and the sticking of the shaft when the feeder remains idle for long periods of time as may occur during summer months.

A sleeve 19a of brass or other suitable bearing metal is mounted in the socket 19. The sleeve 19a is preferably permanently secured to the body of the standard which may be die cast around the sleeve.

The shaft 25 has a cap 26 attached to its upper end and the cap 26 has a cylindrical downwardly extending skirt 27 which surrounds the upper end of the standard 17 which is also cylindrical in form. The shaft 25 projects through the top of the cap 26 and supports a horizontally disposed disk 28 that has a central depressed portion 29 to which is attached a hub 30 provided with a socket that fits the upper end of the shaft 25 to which it is detachably secured by suitable means such as a set screw 31. The disk 28 is of a diameter slightly greater than the diameter of the opening 4 in the hearth and carries fan blades 32 that are attached to its under face outwardly of the central depression and so disposed that they draw air to support combustion upwardly through the housing 6 and discharge it radially toward the flame ring 3.

For delivering fuel into the air stream directed toward the flame ring, a hollow lift cone 33 is mounted within the cap 26 with its upper end fitting within the cylinder skirt 27 and its lower smaller end extending into the fuel well 20. One or more fuel delivery tubes 34 are permanently attached to the cap 26 by suitable means such as die casting, brazing, soldering or sweating, and open into the interior thereof above the upper end of the lift cone 33 to receive fuel elevated by the cone, and these tubes have substantially horizontal end portions 35 which are disposed substantially radially beneath the disk 28 and which terminate adjacent the periphery of the disk to discharge the fuel into the air stream.

The distributor head assembly consisting of the shaft 25, the cap 26, the lift cone 33, the disk 28, fan blades 32 and delivery tubes 34, is removable bodily from the supporting standard, and is assembled with the stationary elements by placing the lower end of the shaft 25 in the socket 19 and lowering the head to operative position. Since the distributor head assembly can be released and allowed to fall into place as soon as the shaft 25 is entered into the socket 19, it is desirable that a resilient support for the head be provided to prevent damage to the mechanism due to impact when the head is allowed to fall into place. To this end the lower end of the shaft 25 is provided with an axial socket 36 in which is mounted a bearing ball 37 that is backed by a coil spring 38 mounted in the socket, which presses the ball against a restriction 39 formed by upsetting the lower end of the shaft to reduce the diameter of the lower end of the socket sufficiently to prevent the ball 37 from falling out of the socket, the restriction 39 being such that a substantial portion of the ball which is pressed downwardly by the spring 38 normally projects past the lower end of the shaft. The bearing ball 37 rests upon a hardened bearing disk 40 mounted in the lower end of the socket 19, the bearing disk 40 being provided with a notch 41 which partially overlaps the axial oil passage 24 so as not to obstruct the flow of lubricant to the socket 19. The disk has flat top and bottom faces and is of a thickness such that it can be entered into the socket 19 only when the axis of the disk is alined with the axis of the socket. By so dimensioning the bearing disk it can be placed in the upper end of the socket 19 and allowed to fall by gravity to the lower end of the socket, and since the disk cannot turn about a transverse axis within the socket. it will always fall into proper position.

The distributor head is preferably driven by an electric motor which is built up around the standard 17 and which includes a rotor 42 of cylindrical form which is attached by means of bolts 43 to a flange 44 at the lower end of the skirt 27. The rotor 42 is surrounded by an annular stator 45 that is attached by means of rivets 46 to a spider 47 that is attached by bolts 48 to a flange 49 on the standard 17 adjacent the lower end thereof above the collar 14. Suitable clearance is provided between the rotor 42 and the fixed standard 17, and between the rotor 42 and the fixed stator 45, to allow for circulation of air through the motor during operation.

The skirt 27 preferably projects below the fuel well 20 and the bearing standard 17 which projects through the rotor and stator is of a length such that the bearing socket for the distributor shaft can be made of a depth sufficient to enable the shaft to be effectively lubricated by the liquid fuel supplied through the passage 24.

The fuel well 20 is of annular form and its inner wall is formed by a cylindrical portion 50 of the standard 17 which surrounds the upper end of the socket 19. Intermediate the top and bottom thereof, the well is provided adjacent its outer wall 51 with a horizontal ledge or shoulder 52 and the lower portion of the well below the shoulder 52 is provided with a tapering outer wall 53 shaped to conform to the lower end of the lift cone 33. The wall 53 provides a narrow space around the exterior of the lower portion of the lifter cone 33 except for a recess 54 directly above the passage 23 which serves to break the con-

tinuity of the annular space between the tip of the lifter cone and the wall 53. The small clearance between the wall 53 and the cone 33 together with the recess 54 so affects the fuel flow that fluctuations in the level of the liquid in starting and during rotation are substantially eliminated and fuel is lifted by the cone from the well at a substantially uniform rate without surging.

The lift cone 33 is provided with a thickened upper end 55 that fits within the skirt 27 beneath a shoulder 56 in the upper portion of the cap 26, the internal diameter of the cap above the shoulder 56 being substantially the same as the internal diameter of the upper end of the lift cone 33 so that the interior of the cone conforms at its top edge to the interior of the cap above the shoulder 56.

To obtain efficient delivery of fuel, it is desirable that the delivery tubes 34 open into the interior of the cap at points radially outwardly of the interior of the lift cone 33 and in order to so place the delivery tubes and to avoid restriction of the outlets into the tubes, recesses 57 are formed on the interior of the cap above the shoulder 56 to permit free access of liquid into the tubes 34. The diameter of the upper end of the well 20 is sufficient to admit the upper end portion of the lift cone 33 with a small clearance, and since the skirt 27 is spaced slightly from the exterior of the standard 17, the oil within the well is subjected to atmospheric pressure. There is some tendency for liquid to creep up the exterior of the lift cone, and in order to prevent leakage of liquid through the opening between the skirt and the standard a groove 58 is formed in the exterior of the cone 33 which limits the flow of liquid along the external surface of the lift cone, causing the liquid that reaches the groove to be thrown outwardly against the wall 51 below the top thereof, thereby preventing escape of fuel over the top edge of the wall 51.

The discharge ends 59 of the delivery tubes 34 are preferably beveled as shown in Figs. 2 and 9, the beveled faces being disposed vertically and facing in the direction of rotation so that the sharp end of the bevel forms the trailing edge of the delivery end of the tube. By so forming the delivery ends of the tubes a tapering channel is provided at the delivery end of each against which the liquid fuel is held while its radial flow is accelerated due to centrifugal force so that it is delivered into the air stream in a fine stream from each tube.

During the operation of the burner air is drawn by the fan blades 32 upwardly through the housing 6 and discharged radially toward the flame ring 3. It is important for efficient operation, particularly when the feeder is operated to provide a slow rate of fuel delivery, that the volume of air discharged with the fuel be very accurately regulated. To this end a damper is provided in the partition 13 which is adjustable to regulate the flow of air. The partition 13 is provided with openings 60 of substantial size which may be sector-shaped as shown in Fig. 3 and these openings cooperate with registering openings 61 in a disk 62 that is mounted to turn on the collar 14 immediately beneath the partition 13. The disk 62 turns from a position in which the openings 61 are disposed between the openings 60 of the partition, to a position where the openings 61 are fully registered with the openings 60. In order to prevent extinction of the flame due to lack of oxygen a small opening 63 is provided in the disk 62 which registers with one of the openings 60 in the partition 13 when the disk is adjusted to closed position. In order to conveniently adjust the disk 62, a handle 64 is attached to the disk and projects radially through a slot 65 in the housing 6. The handle 64 has a knob 64a at its outer end that is threaded on the handle so that it can be screwed into engagement with the housing wall to hold the disk in adjusted positions.

The partition 13 has a downwardly extending peripheral flange 66 that is attached to the housing wall and may be provided with radial stiffening ribs 67 between the openings 60.

The disk 62 is provided at its periphery with a short downturned flange 68 which rests upon spaced clips 69 which support the disk against the under side of the partition 13. The clips 69 are L-shaped sheet metal members held in place by bolts 70 with one flange vertical and engaging the under side of the partition 13 and the other flange horizontal and engaging the flange 68 of the disk.

When fuel is being delivered at a slow rate it is desirable that an accurately regulated amount of air be delivered to the fuel and to obtain such accurate regulation of the air supply the leading ends of the openings 61 of the disk are tapered as indicated at 71 so that a substantial amount of movement of the disk is required to effect a small change in the area of the air passages through the partition, and accurate regulation of air flow can be obtained by angular adjustments of the disk 62.

The flow of air through the housing is so directed as to effectively cool the electric driving motor, the air flowing upwardly through the housing 6 above the partition 13, flowing through the annular spaces between the rotor 42 and the standard 17 and between the rotor 42 and the stator 45. In order to permit the flow of air between the rotor 42 and the standard 17, the skirt 27 is provided with slots 72 permitting flow of air between the rotor and standard in the direction in which air is drawn by the fan.

The fuel feeder of the present invention is so constructed that all working parts may be readily removed from the housing and reassembled in the housing without disturbing the housing itself which may be permanently fixed with respect to the hearth of the furnace. As has been explained, the distributor unit can be lifted out of the bearing standard whenever desired. The standard 17 and stator 45 can also be lifted bodily through the hearth opening when the screw 18 is loosened and the fitting 22 detached, since the external diameter of the rotor 42 is less than the diameter of the upper end of the housing outlet 5. In assembling, the lower end of the standard 17 may be inserted into the collar 14 and secured by the screw 18, after which the distributor head may be lowered into place and the fuel supply line connected to the fitting 22. After assembly, the standard 17 together with the fuel feeding mechanism carried thereby can be readily adjusted to position the fan and fuel delivery outlets at the proper height with respect to the flame rings.

It is to be understood that variations and modifications of the specific devices herein shown and described for purposes of illustration, may be made without departing from the spirit of the invention.

What we claim is:

1. A fuel feeder for liquid fuel burners comprising a stationary standard having an annular recess in its upper end forming a fuel well and

an elongated axial bearing socket within the well, said socket having an open upper end and a bottom above the lower end of the standard, the major portion of the length of said socket being below said well and the top of said socket being no higher than the top of said well, means for supplying liquid to said well and to said socket including a passage in said standard communicating with both the well and said socket to normally maintain liquid at the same level in the well and socket, a shaft mounted in said socket and having a continuous bearing surface therein that extends downwardly from adjacent the upper end of said socket, means carried by the shaft for lifting liquid from said well and discharging the same radially, and means for driving said shaft, said bearing surface extending uninterruptedly from above to a point below the lower end of said feeding means, whereby liquid maintained in said well at a level up to the lower end of said feeding means will at least partially submerge said bearing surface.

2. A fuel feeder for liquid fuel burners comprising a supporting member formed to provide a fuel reservoir and having an elongated axial open top vertical bearing socket, a shaft journaled in said socket and supported on the bottom thereof, said shaft being removable vertically from said socket and having an axial socket at its lower end, means for driving said shaft, means carried solely by said shaft and removable therewith from said supporting member for elevating liquid from said reservoir and discharging the same, and means for yieldably supporting said shaft comprising a bearing ball mounted in said shaft socket and a spring in said shaft socket exerting a downward pressure on the ball.

3. A fuel feeder for liquid fuel burners comprising a supporting member formed to provide a fuel reservoir and having an elongated axial open top vertical bearing socket, a shaft journaled in said socket and supported on the bottom thereof, said shaft being removable vertically from said socket and having an axial socket at its lower end, means for driving said shaft, means carried solely by said shaft and removable therewith from said supporting member for elevating liquid from said reservoir and discharging the same, a bearing block seated upon the bottom of said socket and free from attachment to the standard, a ball mounted for vertical movement in the shaft socket, and a spring in the shaft socket exerting a downward pressure upon said ball and an upward pressure on the shaft to hold the ball against said block and to yieldably support the shaft with its lower end spaced from said block.

4. A fuel feeder for liquid fuel burners comprising a bearing standard having an open top fuel well and an elongated axial bearing socket opening to its upper end, a shaft journaled in said socket and having an axial socket at its lower end, means for driving said shaft, means carried by said shaft for elevating liquid from said well and discharging the same, a free bearing block of slightly less diameter than said shaft and lying upon the bottom of said bearing socket, said block having flat top and bottom faces either of which is adapted to seat upon the bottom of the socket in the standard and of an axial thickness such that it cannot enter the socket of the standard except with its axis alined with the axis of the socket, and means for yieldably supporting said shaft comprising a bearing ball mounted in said shaft socket and a spring exerting a downward pressure on said ball.

5. A fuel feeder for liquid fuel burners comprising a standard having an open top fuel well and an elongated axial bearing socket opening to its upper end, the major portion of the said socket being below said well, a shaft journaled in said socket, means for supplying liquid to said well and to said shaft receiving socket including a passage in said standard leading to said well and a branch passage to the bottom of said shaft receiving socket, means carried by said shaft for elevating liquid from said well and discharging the same, a bearing block resting upon the bottom of said socket and having a slot registering with said branch passage, and means for yieldably supporting said shaft including a spring pressed bearing ball mounted in the lower end of said shaft and resting upon said block.

6. A fuel feeder for liquid fuel burners comprising a head rotatable about an upright axis, said head having a concentric hollow downwardly tapering fuel lifter having a tubular tip that is circular in horizontal cross section and a plurality of distributor tubes through which the fuel is discharged, a stationary member having a fuel well into which said lifter extends, said well having a restricted tapering lower portion which conforms to the shape of the lifter and receives the tip of the lifter and a shoulder at the top of the restricted portion, said restricted portion having a peripheral recess opening to said shoulder, means for supplying fuel to said well, and means for driving said head.

7. A fuel feeder for liquid fuel burners comprising a head rotatable about an upright axis, said head having a concentric hollow downwardly tapering fuel lifter and a plurality of distributor tubes through which the fuel is discharged, said lifter having an external circumferential groove intermediate its ends to impede the flow of liquid, a stationary member having a fuel well into which said fuel lifter dips, said well having a restricted lower portion to receive the tip of said lifter and an upright wall surrounding the lifter to above said groove, means for supplying liquid fuel to said well, and means for driving said head.

8. A fuel feeder for liquid fuel burners comprising a housing having an outlet at its top adapted to deliver air through a hearth opening, said housing having an air inlet and a partition above said inlet provided with a set of spaced openings for passage of air, fuel feeding means including a distributor head rotatably mounted in the housing above said partition, a fan carried by said head for drawing air upwardly through said housing and means for delivering liquid fuel to said head, an adjustable closure member having a set of spaced openings certain of which register with certain of the partition openings in one position of the closure member and are completely out of registry therewith in another position of the closure member, one of the openings of one set being relatively small and positioned to register with one of the openings of the other set when the partition and closure members are positioned with all of the other openings therein completely out of registry.

9. A fuel feeder for liquid fuel burners comprising a housing having an outlet at its top adapted to deliver air through a hearth opening, said housing having an air inlet and a partition above said inlet, said partition having a set of spaced openings for passage of air, a fuel well in said housing, a distributor head rotatably

mounted in the housing above said partition and having a fuel lifter extending into said well, a fan carried by said head for drawing air upwardly through said housing, and an adjustable closure member in the form of an adjustable plate carried by said partition member, said plate having a set of openings certain of which are positioned to move simultaneously into and out of registry with certain of the partition openings, all but one of the openings of one of said sets being adapted to be simultaneously moved into and out of registry with openings of the other set and being elongated and tapered toward the end thereof last closed by movement of said plate, whereby substantial movements of the plate are required for slight variations in air flow in low volume positions of the plate, said one opening being relatively small and positioned to be uncovered by one of the openings in the other set when all of the other openings of the plate and partition are out of registry.

WILLIAM J. SMITH.
WILLIAM W. SLAGHT.

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