July 15, 1952 S. O. RYE 2,603,533

LIQUID ATOMIZING APPARATUS

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Fig. 1

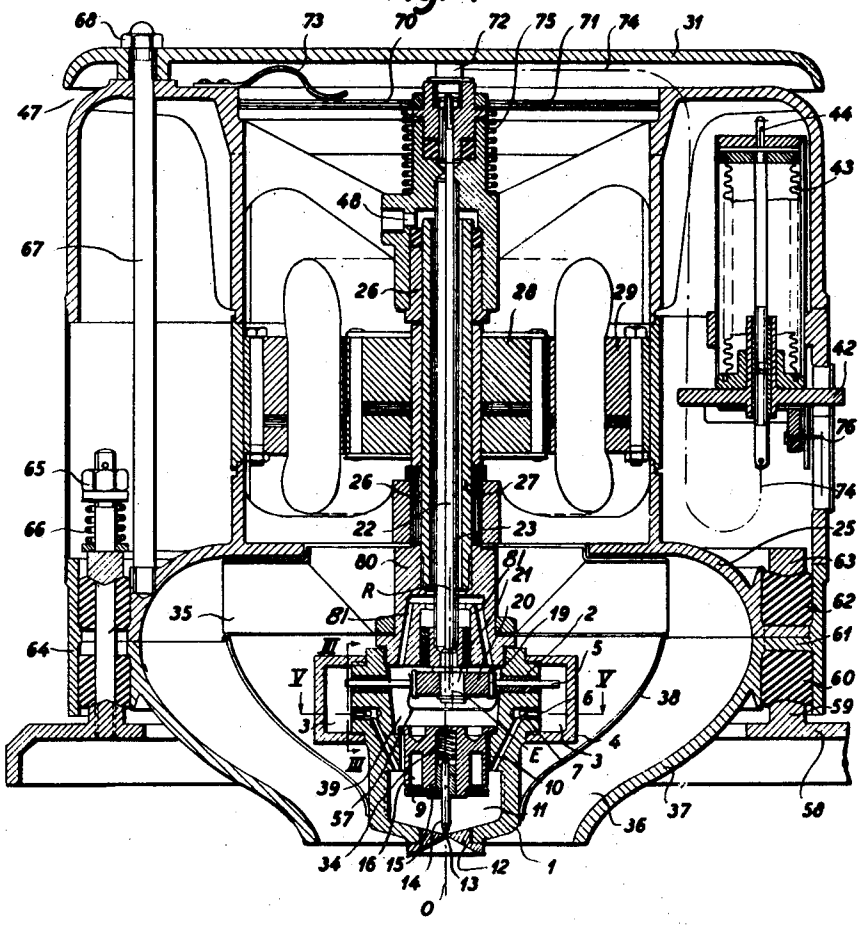


Fig. 2

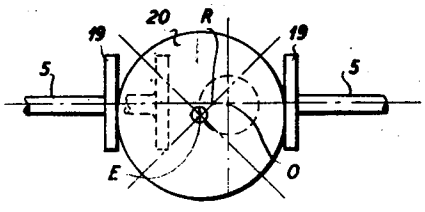
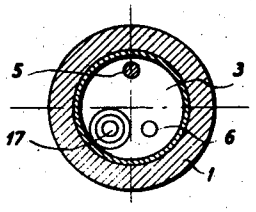


Fig. 3



INVENTOR.

Svend Ove Rye

BY

E. L. Wanderaa

Attorney

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Fig. 4

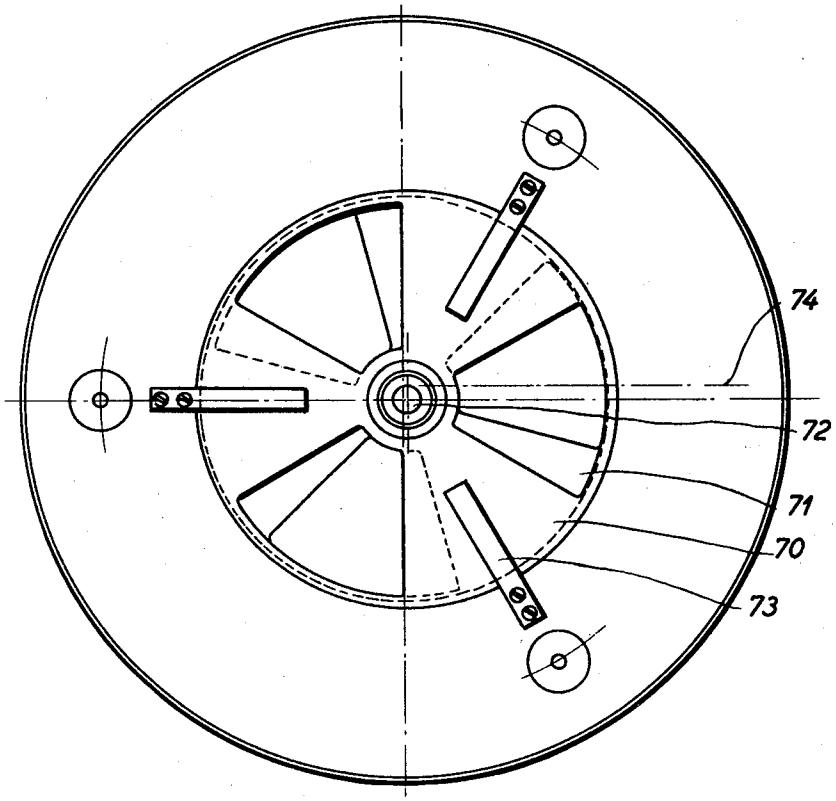
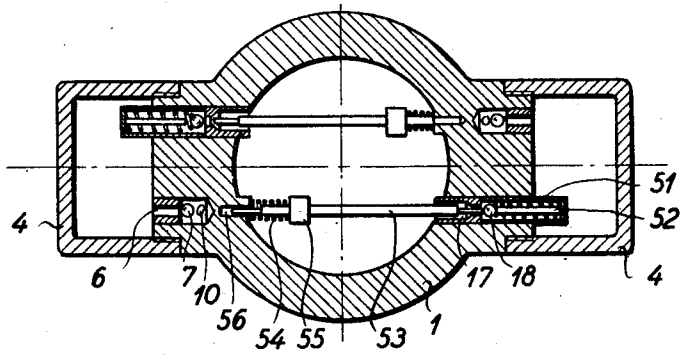


Fig. 5



INVENTOR.
Svend Ove Rye
BY
E. F. Wenderoth
Attorney

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Fig. 6

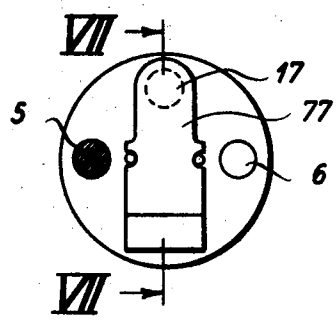


Fig. 7

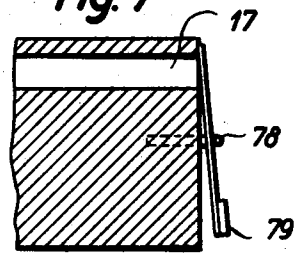
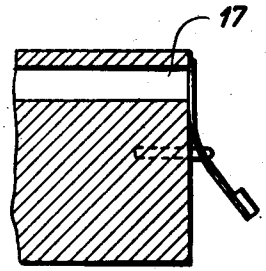


Fig. 8



INVENTOR.
Svend Ove Rye
BY
E. L. Underwood
attorney

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UNITED STATES PATENT OFFICE

2,603,533

LIQUID ATOMIZING APPARATUS

Svend Ove Rye, Charlottenlund, Denmark

Application March 8, 1949, Serial No. 80,292
In Denmark March 16, 1948

10 Claims. (Cl. 299—62)

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This invention relates to apparatus for atomizing liquids and has for its object to provide liquid atomizing apparatus which will produce a finer and more uniform atomization than obtained with atomizing apparatuses hitherto in use.

The invention is applicable to all fields in which a fine and uniform atomization of liquids is desirable such as for burning liquid fuels, vaporization of liquids, desiccation of liquid materials, and creating sprays and mists of liquid disinfectants.

The invention is particularly applicable to humidifying apparatus for air in air conditioning plants, to the atomizing of milk in dry-milk plants, and to the atomizing of oil in oil burners. To these ends the apparatus may preferably, but not necessarily, comprise a blower adapted to deliver a stream of air or other gas into which the spray of atomized liquid is directed and dispersed.

The invention is exemplified by the following description of an oil atomizing and burning apparatus with reference to the accompanying drawings in which

Fig. 1 is a sectional elevation of an oil burner incorporating the improved atomizing means,

Fig. 2 is a diagram drawn to a larger scale and showing the operation of control means,

Fig. 3 is a section partly diagrammatical, along the line III—III of Fig. 1,

Fig. 4 is a plan view of Fig. 1 with some parts omitted,

Fig. 5 is a section on the line V—V of Fig. 1 showing modified valve means,

Fig. 6 is a view similar to Fig. 3, but showing modified valve means, and

Figs. 7 and 8 are sections along the line VII—VII of Fig. 6 with the parts in two different positions.

Referring to the drawings in which like reference numerals designate corresponding parts throughout the figures, 58 denotes a base plate adapted to be secured by suitable means (not shown) to a domestic central heating boiler or other corresponding furnace. The top face of the base plate is provided with an annular rib 59 upon which is seated a ring 60 of flexible material such as rubber, asbestos or the like. A pair of annular flanges 61 are clamped between the ring 60 and a corresponding ring 62 by means of a clamping ring 63 and a suitable number of bolts 64 one of which is shown in Fig. 1. The bolts 64 are anchored in the base plate 58 and provided with nuts 65 pressing upon the ring 63

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by the intermediary of springs 66. In this manner the flanges 61 and thus the entire apparatus is clamped resiliently to the base plate 58.

Mounted in suitable bearings 26, preferably made from a self-lubricating metal or alloy, is a vertical hollow shaft 27 carrying between the bearings the rotor 28 of an electric motor the stator of which is denoted by 29 and mounted in the casing.

On the lower end of the hollow shaft 27 is secured a hub 80 of a centrifugal blower impeller wheel 35 and a liquid atomizing head designated generally by 1.

The atomizing head 1 comprises in its lower end a liquid chamber 11 having a plug 12 with an atomizing jet orifice 13 situated in the axis of rotation O of the hollow shaft 27 and atomizing head 1. Coaxially with the axis O is situated a needle valve 14 which is preferably guided in a self-lubricating plug in a plug 15 forming the upper wall of the liquid chamber 11, and actuated by a compression spring 34 to close the needle valve against the action of the liquid pressure in the chamber 11. The plug 15 has an annular groove closed at the top and shielded below by an annular disc 9, so as to provide an air trap which acts as a dash-pot for equalizing pressure variations in the chamber 11 during operation.

Liquid is introduced into the chamber 11 under pressure by way of channels 10 and liquid pumps of the reciprocating piston type. Each pump unit comprises a cover 4 screwed onto a suitable stud on the atomizing head and confining a pumping space 3 remote from the axis of rotation. Each pumping space has in the wall nearest to the axis of rotation a delivery or pressure orifice 6 with an automatic ball valve 7 and inlet or suction orifice 17 with a suitable inlet valve of the automatic type. One type of inlet valve is shown in Fig. 5 in the form of an ordinary ball valve 18 with a closing spring 51 and another type of inlet valve is shown in Figs. 6–8.

The inner wall of each pumping space likewise comprises a bore for a pump piston 5, which bore is preferably but not necessarily contained in a plug 2 of self-lubricating metal or alloy. The inner end of each piston 5 is widened to form a foot 19 resting against the periphery of a circular disc 20 made preferably from self lubricating metal or alloy. The disc 20 is mounted freely rotatable on a pin 21 which is eccentrically mounted on the lower end of a control shaft 22 extending upward through a stationary tube 23 within the hollow shaft 27. The

feet of opposed pistons 5 are kept in contact with the periphery of the disc 20 by means of a C-shaped leaf spring 57.

During operation the pin 21 is kept substantially stationary, except for movements for regulating purposes, and upon rotating with the atomizing head the pistons 5 will be forced to perform a reciprocating movement with a stroke the length of which depends upon the position of the pin 21.

This appears more readily from the diagram in Fig. 2. This diagram shows the disc 20 and the inner ends of the pistons 5, E designating the axis of the disc 20, O the axis of rotation, and R the axis of the control shaft 22. In actual practice the disc 20 is substantially stationary whereas the atomizing head and the pistons revolve around the axis O, but in order to facilitate the explanation it is supposed in the following that the atomizing head is stationary and the disc 20 rotates around the axis O in the inverse direction. The center of the disc thereby describes a circle the radius of which is defined by the distance O—E and a reciprocating movement with a stroke amounting to twice this distance is imparted to the pistons 5.

The left hand piston is shown in its outermost and innermost positions with full and dotted lines respectively. On turning the shaft 22 around its axis R the axis E of the disc 20 will be shifted relative to the axis of rotation O in such a manner as to vary the distance O—E and the stroke of the pistons. In the embodiment shown, the eccentricity of the disc 20 against the axis R is made equal to the eccentricity of the axis R against the axis of rotation O and the piston stroke may therefore be reduced to zero by turning the shaft 22 to bring the axis E to coincide with the axis O.

In operation the impeller wheel 35 forces a stream of air through an annular air duct 36 enclosed between a bottom portion 37 of the apparatus casing 25 and a streamlined shield 38 enclosing the major portion of the atomizing head and the entire pump mechanism. This stream of air catches the spray of atomized liquid emerging from the jet orifice 13 during operation so as to form in the present case an intimate mixture of air and very finely and uniformly atomized fuel oil excellently suited for complete and economic combustion.

In order to adapt the amount of air to the very finely adjustable supply of liquid fuel an air control valve is provided at the air intake of the blower. The air is drawn in by way of an annular slot between the upper end of the apparatus casing and a cover 31 secured by a suitable number of bolts 67. The air valve is in the form of superposed slotted discs 70 and 71 rotatable in relation to each other in order to open and close the slots more or less in well-known manner. The moving disc 71 is secured to a hub 72 on the upper end of the control shaft 22 in such a manner as to open and close the air slots corresponding to increase and reduction respectively of the fuel supplied to the jet orifice by the pump mechanism.

The slotted discs 70 and 71 are kept in sliding contact at a suitable pressure by means of leaf springs 73 secured to the casing and pressing with their free ends upon the uppermost of the stationary discs 70.

The control may be by way of any desired manually or automatically adjustable device, a Bowden cable 74 being shown as an example in Figs. 1 and 4. The moving part of the Bowden cable is wound around the hub 72 and counteracted by a combined compression and torsion helical spring 75 whereas the stationary part of the cable is secured to stationary parts of the casing in any convenient manner. The other end of the Bowden cable is connected to a pressure-responsive device of the bellows-type 43 having a feeler tube 44 leading to some desired feeling point, so as to govern the output of the burner in accordance with the temperature prevailing at the feeling point. For adjustment an adjustment screw 42 is inserted between the pressure-responsive device and the Bowden cable with an indicating needle 76 showing the setting against a suitable scale.

The above described regulating system may of course be modified according to requirements, and the control thereof may be dependent upon other factors than a temperature, e. g. a pressure, a relative humidity etc. depending upon the use to which the atomizing apparatus is put.

In operation the hollow shaft 27 and the atomizing head with pump units are kept rotating with a suitable velocity, e. g. 3000 revolutions per minute, and liquid is fed by way of a bore 48 to the upper end of the hollow shaft 27 whence it passes through the space between the hollow shaft and the stationary tube 23 down into the hub 80 and through channels 81 in the latter into a suction space 39 in the atomizing head.

In the suction space 39 the liquid is centrifuged outwards and freed from air bubbles and thereafter penetrates through the suction channels and valves into the pumping spaces 3 displacing any air entrapped therein inwardly through the suction or pressure valve. In order to promote this procedure the suction valves may be arranged to be kept positively opened until the atomizing head has attained its minimum operative speed of say two thirds of normal operative speed.

Fig. 5 discloses a suction valve arrangement constructed for this purpose. Each of the suction ball valves 18 is kept away from the valve seat by means of a push rod 53 and a compression spring 54. The push rod is guided in the suction channel 17 and a suitable bore 56 in the atomizing head. This position is shown in the lower half of Fig. 5 and corresponds to rotational speeds less than minimum operative speed. At higher speeds the centrifugal force acting upon a weighted portion 55 of the push rod 53 restores the same to inactive position as shown in the upper half of Fig. 5 thereby allowing the suction ball valve to operate normally. The valve spring 51 together with a retaining pin 52 are located in a slotted tube through which the liquid penetrates into the pumping space on the suction stroke of the piston.

A corresponding effect is obtainable by the valve shown in Figs. 6–8. The valve member is in the form of a leaf spring 77 one end of which projects over the orifice of the suction channel 17. At lower speeds the leaf spring 77 is substantially straight and does not close the suction channel as shown in Fig. 7. At higher speeds the centrifugal force upon the weighted end 79 of the leaf spring bends the spring as shown in Fig. 8, so as to press it against the mouth of the suction channel. In this condition the spring operates as a normal automatic leaf spring valve.

While in the foregoing certain specific embodiments and employments of the invention have been described it should be understood that the invention is not limited thereto unless as far as appears from the appended claims. Two pump units have been described, but one or more could be employed and diaphragm pumps may be used instead of piston pumps. The eccentrically

mounted adjustable driving disc for the pump members may be replaced by other driving means such as a crank or cam mechanism. Means may be provided for controlling the spring pressure upon the jet orifice valve means in order to adjust the atomizing condition to the properties of the liquid. The blower may be in the form of a screw fan instead of a centrifugal blower, and the blower vanes may be integral with the atomizing head. The entire apparatus with or without blower may be mounted in any desired position with vertical, oblique or horizontal axis.

I claim:

1. A liquid atomizing apparatus having a rotatable atomizing head and means for continuous high-speed rotation thereof, a closed liquid chamber in said head adjacent the discharge end thereof and provided with a single restricted jet orifice located at the point of intersection between one wall of said chamber and the axis of revolution, pumping means associated and rotating with the atomizing head for feeding liquid under pressure into said chamber and comprising at least one pumping space remote from the axis of revolution, inlet and outlet valve means for said pumping space being provided in the wall thereof nearest to the axis of revolution, centrifugal means being provided for keeping at least one valve means of said pumping space open at less than minimum operative rotational speed.

2. A liquid atomizing apparatus as claimed in claim 1 in which said centrifugal means comprises a spring-loaded push-rod acting upon the valve member of the pumping space inlet valve to keep the same open at less than minimum operative speed and weighted to be retracted into inoperative position by centrifugal force at higher than minimum operative speed.

3. A liquid atomizing apparatus as claimed in claim 1 in which said centrifugal means comprises a leaf-spring loosely mounted within the pumping space with one end extending over the inlet orifice and the other end weighted in such a manner as to press the first-mentioned end against the inlet orifice under the influence of centrifugal forces at higher than minimum operative rotational speed.

4. A liquid atomizing apparatus having a rotatable atomizing head and means for continuous high-speed rotation thereof, a closed liquid chamber in said head adjacent the discharge end thereof and provided with a single restricted jet orifice located at the point of intersection between one wall of said chamber and the axis of revolution, a reciprocating pump member associated and rotating with the atomizing head for feeding liquid under pressure into said chamber, a substantially stationary eccentric means being provided in the vicinity of the axis of revolution and cooperating with said pumping member for reciprocating same.

5. A liquid atomizing apparatus as claimed in claim 4 further characterized in that said eccentric means is adjustable as to eccentricity against the axis of revolution.

6. A liquid atomizing apparatus as claimed in claim 4 in which said eccentric means comprises a circular disc journalled on a pin carried eccentrically on a control shaft mounted substantially parallel with and off-set in relation to the axis of revolution.

7. A liquid atomizing apparatus as claimed in claim 6 further characterized in that the eccentricity of the said disc relative to the axis of the control shaft is substantially equal to the eccentricity of the axis of the control shaft relative to the axis of rotation.

8. A liquid atomizing apparatus having a hollow shaft journalled in bearings and supporting the rotor of an electric motor, an atomizing head being secured on one end of said shaft and provided with a liquid chamber with a single restricted discharge jet orifice located at the point of intersection between one wall of said chamber and the axis of said shaft, a liquid pump of the reciprocating pumping member type associated and rotating with said head for feeding liquid under pressure into said chamber, a stationary tube extending through said hollow shaft spaced from the wall thereof and supporting substantially stationary eccentric means cooperating with said pumping member for reciprocating same, and a control shaft for adjusting the eccentricity of said eccentric means extending through said stationary tube.

9. A liquid atomizing apparatus as claimed in claim 8 further characterized by an inlet chamber provided in the atomizing head substantially coaxially with the axis of revolution, and by passages in the atomizing head establishing connection from one end of the space enclosed between the hollow shaft and the stationary tube to said inlet chamber, means being provided for conducting liquid into the other end of said space.

10. A liquid atomizing apparatus as claimed in claim 8 further characterized by a blower associated and rotating with said atomizing head, and a control valve for regulating the blower output associated with and operated by said control shaft for adjusting the eccentricity of the pump member operating eccentric means.

SVEND OVE RYE.

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