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FUEL ATOMIZING BURNER FOR LIQUID FUELS

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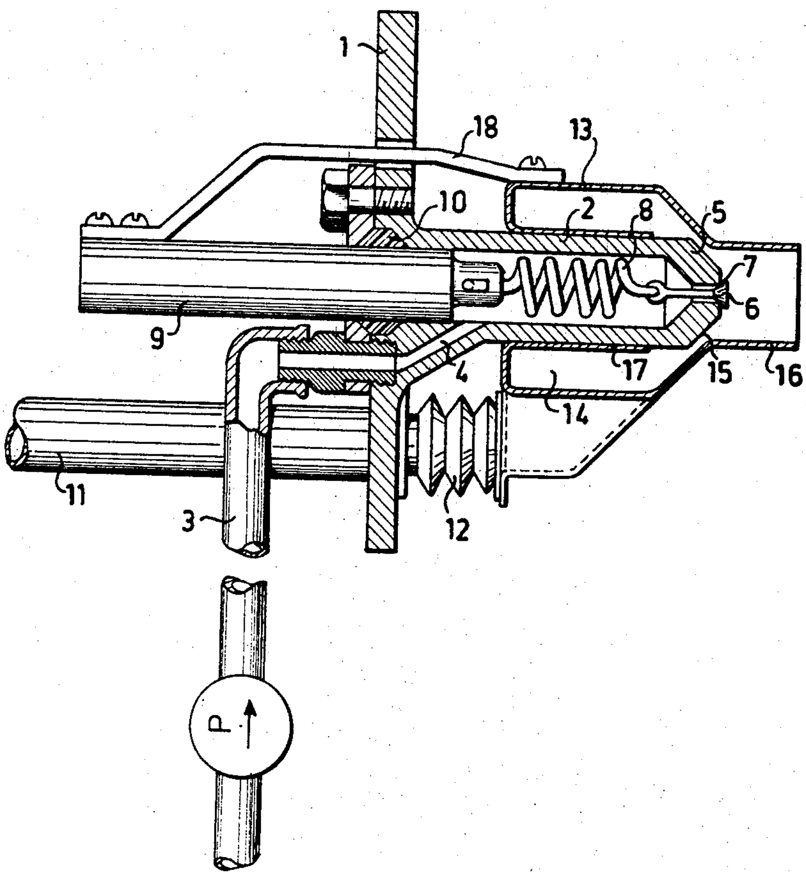

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FUEL ATOMIZING BURNER FOR LIQUID FUELS

Sture Anders Bäckman, Sturegatan 12, and Knut Ludvig Winquist, Hoglundagatan 22, both of Orebro, Sweden

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ABSTRACT OF THE DISCLOSURE

An atomizing burner for liquid fuels including a means for varying the amount of combustion air without substantially changing the air speed past the fuel inlet orifice. An air conduit is arranged to slide axially around the fuel tube whereby an air passageway between the conduit and the tube is varied in width.

Before liquid fuel can be burned the fuel must first be vaporized and the only practically possible method of providing for this vaporization is to first atomize the fuel. Consequently, the combustion efficiency is largely dependent on how well the fuel has been atomized. Present day atomizing burners are encumbered with a large number of drawbacks in this respect. Owing to the fact that the atomization is not fully complete a number of large drops of fuel remain in the fuel mixture, whereby they cannot be vaporized and form carbon or soot particles which are either deposited on the boiler or become entrained with the waste gases and contaminate the ambient air.

Another disadvantage is that it has not been possible to regulate the size of the flame according to the required effect but that it has been necessary to operate the burner intermittently at full power in an uneconomical manner. This is due to the fact that if the flow of fuel is reduced the atomizing force is also reduced resulting in poor atomization of the fuel. Connected with this problem is the problem of the supply of combustion air. When adjusting for smaller air-flows, for instance when operating at low power, it has been usual to reduce the flow by means of a throttle situated in the air conduit, whereby the velocity of the air flow is reduced at the nozzle opening, resulting in an impaired mixing effect. If, on the other hand, the flow of air is not reduced the efficiency of the plant is greatly lowered due to the excess of air.

The object of the present invention is to solve the aforementioned problems. For this purpose the arrangement according to the invention has been given the characteristics disclosed in the claims.

The invention will now be described in connection with the accompanying drawing which shows in longitudinal section a pressure oil burner having an arrangement according to the invention.

A supporting plate **1** supports a nozzle tube **2** to which fuel is supplied from a fuel line **3** through a channel **4**. The opening of the nozzle **5** is closed by a valve body **6** abutting a valve seating **7**, under the influence of a tension spring **8** secured between the valve body and a regulating or control rod **9**. The regulating rod is displaceably arranged in the plate **1** and runs in a seal **10**. The fuel is delivered, for instance, from a diaphragm pump P at a pulsating pressure having a frequency of between 50 and 100 Hz. (cycles per second) and a maximum pressure of between 1 and 1.5 mn./m.^{2} (meganewtons per square meter), owing to the pulsations of the fuel the valve body will execute small oscillations in the flow direction, towards and away from the valve seating.

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Combustion air is introduced through an air conduit **11** connected, via a compensator in the form of a bellows **12**, to an air pipe **13** surrounding the nozzle tube, the air pipe **13** forming an atomizing chamber **14** for the air around said nozzle tube. The air tube **13** tapers at the nozzle **5** to a diameter which is less than the diameter of the nozzle tube, whereby the air tube with the nozzle forms an annular gap **15** for the combustion air. The air pipe then extends out into a burner tube **16**. The air pipe is displaceably mounted on the nozzle tube **2** by means of an axially directed portion **17**. By means of this displacement the width of the gap **15** can be varied and owing to the fact that the air pipe is connected with the regulating rod **9** by means of a rigid connecting link **18** the width of the gap can be changed according to the position of the regulating rod and thus the tension of the spring is also changed.

The arrangement functions in the following manner. Combustion oil is fed to the nozzle tube **2** via the conduit **3** and channel **4**. The valve body is forced outwards so that an annular gap corresponding to the tension of the spring is formed between the valve body **6** and the valve seating **7**, whereby a continuous flow of fuel corresponding to the width of the annular gap is released forward along the surface of the valve body. This flow comprises small particles of liquid fuel which appear as a result of the fuel being atomized by a maximum possible atomizing force, which is maintained by the valve body performing small oscillations in the direction of flow, towards and away from the valve seating. This has a twofold effect: (1) the flow of fuel is disintegrated and (2) the valve body is centered in the opening of the nozzle, owing to the fact that it is continuously urged by the valve seating towards the center whilst the vibrations continue in the fuel. This latter effect implies that the annular gap around the valve always has the same width, which means firstly that the reduction in pressure in the nozzle, proportional to the spring pressure, is always the highest possible, which favorably influences the atomizing effect, and secondly that the released flow of fuel is constantly proportional to the force by which the spring actuates the valve body (which means a definite flow of fuel for a specific position of the regulator rod line, connected to an automatic regulating device, e.g. a thermostat or pressurestat).

By changing the width of the air gap **15** simultaneously with the flow of fuel the air flow can be reduced to the required extent without reducing the velocity of the air, and thereby impairing the mixing effect, which would be the case if the air were to be regulated with a throttle in the conduit **11** or in similar manner.

The arrangement according to the invention thus allows the burner to be operated continuously with maximum atomization and with a constant regulating of the flow of fuel, and thereby the flame, within wide limits, the flow of air being regulated at the same time to a corresponding degree whilst the discharge velocity of both the fuel and air is constant the whole time at just that point where intermixing takes place, whereby an optimal mixing effect is obtained throughout the range of regulation. The result is better fuel economy and cleaner waste gases.

The invention is naturally not restricted to the described embodiment and thus, for instance, the vibrations of the valve body can be caused in another way than by pulsations in the fuel pressure.

We claim:

1. A discharge apparatus comprising a nozzle, a valve member disposed at the discharge end of said nozzle, a spring connected at one end to said valve member and adapted to urge same towards said discharge end, and means to supply fuel at a pulsating pressure to said nozzle, which pressure exceeds the force of said spring to permit oscillatory movement of said valve member and corresponding discharge of said fuel in an atomized state, further comprising a regulatory rod connected to the other end of said spring, said rod being movable with respect to said nozzle to regulate the flow of fuel from said nozzle, and an air pipe surrounding said nozzle and means to supply air to said pipe for mixture with fuel flowing from said nozzle, wherein said air pipe and the discharge end of said nozzle are tapered and together define a gap through which air flows, wherein said air pipe is movable with respect to said nozzle and further comprising means connecting said air pipe with said rod so that said air flow gap is varied in response to movement of said rod.

2. A fuel atomizing burner for liquid fuel, comprising: a fuel tube having a fuel outlet orifice extending therethrough, an inlet for liquid fuel leading into said tube, a valve member externally of said orifice and arranged to reciprocate along the axis of said orifice for opening and closing same, a spring means urging said valve member to a closed position relative to said orifice, said valve member being displaceable to an open position against the urging of said spring means and under the urging of liquid pressure in said tube, an air conduit for supplying air to the outlet side of said orifice, said conduit including a wall portion which surrounds a portion of said fuel tube adjacent to said orifice in spaced relationship therewith so as to define a passageway between said tube and wall portion, an air inlet leading into said conduit, first means to adjust the position of said tube relative to said conduit whereby the width of said passageway may be varied and second means to vary the extent to which said valve member opens relative to a particular amplitude of fuel pressure within said tube and wherein said first and second means are operatively interconnected whereby an adjustment of one effects a corresponding pre-established adjustment of the other.

3. The burner of claim 2, wherein said fuel tube and air conduit are coaxially arranged, said conduit and tube including mutually cooperating wall portions which define said passageway, said conduit and tube being axially displaceable relative to each other and said cooperating wall portions being so arranged that a variation in the axial position of said tube relative to said conduit effects a variation in the distance between said cooperating wall portions.

4. The burner of claim 3, wherein said conduit comprises an annular chamber defined by outer and inner radial walls coaxial with said tube, said inner wall contactingly surrounding the outer surface of said fuel tube, an air inlet leading into said chamber, said outer wall being extended by a wall portion which is inclined towards the axis of said tube, said orifice extending through an end wall of said tube coaxially therewith, said tube having an end wall portion extending from adjacent said orifice in a direction substantially parallel to the inclined wall portion of said conduit, one end of said chamber opening toward the inclined wall portion of said conduit, and said conduit inner wall being axially slidable along the outer surface of said tube.

5. The burner of claim 4, wherein the inclined wall portion of said conduit terminates in a cylindrical wall of smaller internal diameter than the outer diameter of said fuel tube.

6. The burner of claim 2, said second means being actuable to vary the force with which said spring means urges said valve member towards a closed position relative to said orifice.

7. The burner of claim 6, including a means for supplying liquid fuel under a pulsating pressure into said fuel tube.

8. The burner of claim 7, said valve member including a stem portion extending through said orifice and into said tube, a coil spring connected at one end to said stem and at its other end to a control member, said spring and control member extending coaxially with said tube, said control member being axially displaceable to vary the the tension in said spring.

9. The burner of claim 7, wherein said orifice is formed in a rigid, stationary end wall of said fuel tube.

10. The burner of claim 3, including a means for supplying liquid fuel under a pulsating pressure into said fuel tube, said valve member including a stem portion extending through said orifice and into said tube, a coil spring connected at one end to said stem and at its other end to a control member, said spring and control member extending coaxially with said tube, said control member being axially displaceable to vary the tension in said spring.

11. A fuel atomizing burner for liquid fuel, comprising: a fuel tube having a fuel outlet orifice extending therethrough, an inlet for liquid fuel leading into said tube, a valve member externally of said orifice and arranged to reciprocate along the axis of said orifice for opening and closing same, a spring means urging said valve member to a closed position relative to said orifice, said valve member being displaceable to an open position against the urging of said spring means and under the urging of liquid pressure in said tube, an air conduit for supplying air to the outlet side of said orifice, said conduit including a wall portion which surrounds a portion of said fuel tube adjacent to said orifice in spaced relationship therewith so as to define a passageway between said tube and wall portion, an air inlet leading into said conduit, first means to adjust the position of said tube relative to said conduit whereby the width of said passageway may be varied and second means to vary the extent to which said valve member opens relative to a particular amplitude of fuel pressure within said tube, and wherein said fuel tube and air conduit are coaxially arranged, said conduit and tube including mutually cooperating wall portions which define said passageway, said conduit and tube being axially displaceable relative to each other and said cooperating wall portions being so arranged that a variation in the axial position of said tube relative to said conduit effects a variation in the distance between said cooperating wall portions, and including a means for supplying liquid fuel under a pulsating pressure into said fuel tube, said valve member including a stem portion extending through said orifice and into said tube, a coil spring connected at one end to said stem and at its other end to a control member, said spring and control member extending coaxially with said tube, said control member being axially displaceable to vary the tension in said spring, and, including a rigid connecting link extending from said control member to said air conduit whereby said member and conduit are integrally axially displaceable.

12. An atomizing fuel burner for liquid fuels, including a fuel tube having a liquid fuel orifice for admitting atomized liquid fuel into a combustion chamber and an air conduit for supplying a stream of air travelling at a velocity into said chamber and past said orifice, and including a regulating means for varying the flow quantity of said air while maintaining a substantially constant air stream velocity past said orifice, said orifice being formed in a wall of said fuel tube, said air conduit including a wall which is spaced from the first mentioned wall and thereby forms a gap therebetween through which the air must flow to pass from said conduit into said conduit, said conduit and fuel tube being adjustably mounted relative to each other whereby the width of said gap may be varied, and, including a second regulating means to vary the amount of fuel flow through said orifice in response to a variation in said air gap width.

13. The burner of claim 12, said conduit defining an annular air chamber upstream of said gap of substantially larger cross-sectional area than that of said gap.

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FREDERICK L. MATTESON, Jr., *Primary Examiner.*

E. G. FAVORS, *Assistant Examiner.*