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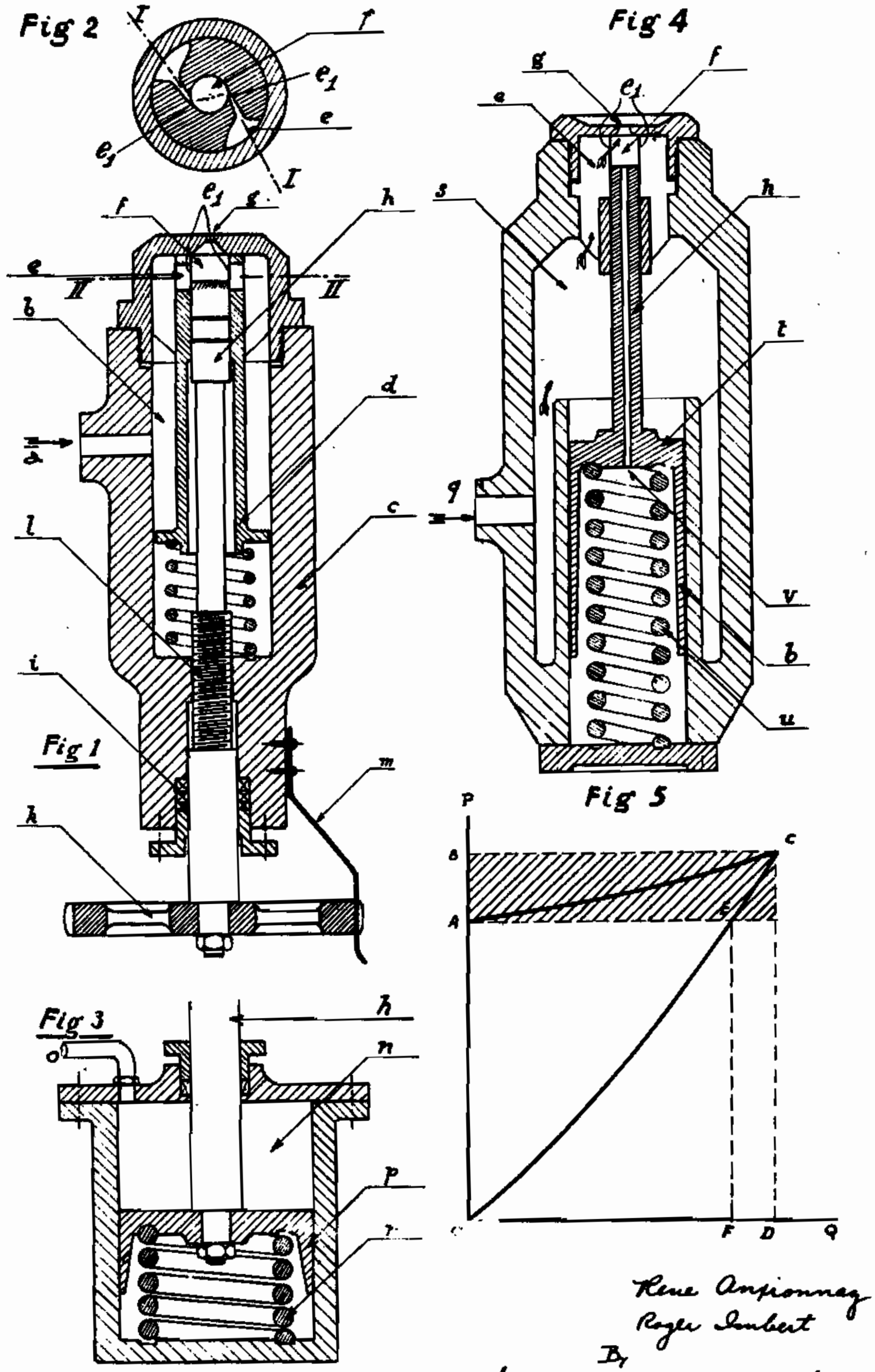

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ALIEN PROPERTY CUSTODIAN

MECHANICAL LIQUID FUEL ATOMIZING BURNER OF VARIABLE DISCHARGE

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This invention relates to mechanical liquid fuel atomizing burners, in contradistinction to steam spray atomising burners, of the kind which are used for instance for firing boiler furnaces or feeding gas turbines and in which the oil or other liquid fuel is fed under pressure to the burner.

Mechanical liquid fuel atomizing burners of the general kind referred to hitherto employed do not lend themselves to an important variation of discharge owing to the fact that the fuel atomization being obtained by forcing the fuel to pass under high pressure through narrow conduits or holes of determined constant section, variations of discharge can only be obtained by modifying said pressure, such modification of pressure being proportional to the square of the discharge (or to the discharge itself if the fuel outflow is purely viscous). But as the atomization is good only within rather narrow limits of pressure and as the discharge varies to a smaller extent than the pressure, a determined burner can be used only for a discharge comprised between very narrow limits, it being therefore indispensable to change the burner where the variation of normal working conditions is important; this constitutes a serious objectionable feature of the burners hitherto employed.

The present invention aims to obviate this objectionable feature and also some other objectionable features inherent to burners hitherto in use, as will be apparent hereinafter.

A burner made according to this invention will permit of a good atomization for all discharges from zero to the maximum dictated by steam boiler or other power plants under consideration, whereby any changing of burner will be avoided.

In a burner according to this invention, the holes or conduits of atomization are made to vary in function of discharge, and such variation is obtained by throttling these holes or conduits at will by means of a control slide valve gearing movable in front thereof.

In one form of burner according to this invention the atomization holes or conduits are provided each with a narrow elongated slot the longer dimension of which is adapted to be changed or modified at will by means of said control slide valve gearing, while the smaller dimension thereof remains invariable; in this way there is provided a variable free passage for the liquid fuel to be atomized and a good atomization thereof is insured whatever be the required discharge of the burner.

The invention also provides for improved design of atomization holes or conduits and several modes of controlling the discharge of burners, one such mode being of nature to render the control of discharge entirely automatic by utilising the pressure under which the liquid fuel is introduced into the burner.

The invention will now be described, by way of example, with reference to the accompanying drawing in which:

Fig. 1 is a longitudinal sectional view of one form of the burner according to the present invention (taken on the line I—I of Fig. 2);

Fig. 2 is a cross-sectional view thereof taken on the line II—II of Fig. 1;

Fig. 3 is an axial sectional view of a burner discharge controlling arrangement according to this invention;

Fig. 4 is a longitudinal sectional view of a modified form of the burner according to this invention (taken similarly to Fig. 1);

Fig. 5 is a graph showing variations of discharge in function of pressures.

In the burner illustrated in Fig. 1 and 2, the liquid fuel is fed at *a* and passes through an annular space *b* comprised between the burner body *c* and an internal tubular part *d* up to, and through holes or conduits *e* which open tangentially into a chamber *f* by means of narrow slots e_1 made along generating lines of the inner cylindrical surface of the tubular part *d*.

Atomization of the liquid fuel is produced by reason of the passage of the fuel through the holes *e* and slots e_1 under the action of very high pressure (of the order of 30 to 40 kilos per sq. cent. or atmospheres), whereby the liquid fuel is set into violent turbulence within the chamber *f* from which it escapes atomized through a jet-hole *g* into a fire or combustion chamber.

The slots e_1 which are of elongated form with their longer dimension along said generating lines and of very narrow width, may be throttled by means of a slide valve *h*, whereby the free passage for the liquid fuel may be rendered proportional to the required discharge of burner so as to obtain this discharge with a constant pressure upstream from the holes *e*, that is to say, in the annular space *b*. It will be understood that such pressure will be adjusted so as to insure the best atomization, so that the burner may operate at all discharges under the most favourable conditions.

The width of the holes *e* and that of the slots e_1 may be made variable throughout their height. In particular, it will be of advantage to give them a smaller width in the portion corresponding to smaller discharges and increase the width gradually towards the portion corresponding to the largest opening of the slide valve, so as to reduce the necessary stroke of the latter, while remaining under best possible conditions for operation at small discharges. Furthermore, when said width is variable the angle in a point, between the hole axis and wall of the chamber *f*, may be modified in this point in function of the width so that the angle of fuel inflow into the chamber *f* remain equal to that at which the best possible atomization be secured.

It will be understood that the particular design for the holes *e*, as illustrated in figures, is indicated only by way of example, and modifications may be brought thereto without departing from the scope of the invention.

The simplest way in which the slide valve *h* may be displaced by a hand control from the outside is illustrated in Fig. 1, wherein the valve rod extends from the burner body through a stuffing box *i* which has for its object to prevent the liquid fuel from leaking outwardly. The valve rod has a threaded portion *l* and carries a hand wheel *k* by means of which the rod may be displaced at will. The wheel *k* may be set into any desired position by means of a stop spring *m* one end of which is fastened to burner body and the other cooperates with notches arranged on the outer periphery of the wheel. The threaded portion *l* of the valve rod may also be provided externally of the burner body. The valve rod may also be longitudinally displaced without being rotated, in known manner by means of a confined nut entrainable by the hand wheel.

In Fig. 3 is illustrated a modified form of the invention, wherein the slide valve *h* is controlled with the aid of a servo-motor or self-starting motor. To this end the valve rod carries a piston *p* which on one side is acted upon by a fluid under pressure introduced through o into the space *n* and on the other side by a spring *r* or another resilient agent (such for example a fluid under pressure). By causing the pressure of the fluid introduced into *n* to vary, a displacement of the piston *p* and with it of the valve *h* is effected, the latter thus being brought into, and maintained in, the position corresponding to the required discharge of the fuel. This arrangement therefore permits to control from distance the discharge of one or several fuel burners and eventually also their automatic regulation by any suitable means adapted to regulate the pressure of the fluid in the space *n* in function of the discharge to obtain.

According to this invention, another arrangement for controlling the position of the discharge regulating member by means of the fuel pressure itself is illustrated in Fig. 4. The fuel is brought to the burner by a conduit *q* and spreads throughout the internal space *s* wherein prevails substantially the same pressure as in the conduit *q* and wherefrom the fuel under the action of said pressure passes through the atomization holes *e* to be finally ejected through the jet-opening *g* into the combustion chamber. The passage of the fuel through the holes *e* is regulated by positions of the slide valve *h*. The latter carries a piston *t* one side of which is subjected to the pressure prevailing in the internal space *s* occupied by the fuel. A counter-spring *u* holds the piston in equilibrium. Any fuel leakages liable to occur between the piston *t* and the cylinder in which the piston moves are returned through a conduit *v* into the atomization chamber *f* wherein they mix with the atomized fuel ejected into the fire chamber. The conduit *v* is made to sufficient cross-section in order that the pressure underneath the piston remains substantially equal to that prevailing in the chamber *f*. This arrangement has a great advantage of preventing any fuel from leaving outside the burner and of dispensing with any stuffing boxes.

With this arrangement it is evident that when the pressure of the fuel introduced into the burner through the conduit *q* is increased, the increased pressure spreads over the space *s* up to the piston *t* and moves the latter downwards, thereby compressing the spring *u* and opening the holes *e* to a greater extent, hence increasing the fuel discharge. Inversely, when the fuel pressure is decreased the slide valve under the action of the spring *u* moves upwardly whereby the fuel discharge is decreased.

The required dimensions of the piston and resilience of the spring can readily be determined so that the two extreme positions of the slide valve would correspond to two pressures chosen beforehand and differing little enough in order that the atomization would remain good throughout the intermediate zone. If, for example, a good atomization requires pressures comprised between 35 and 40 kg/cm² a burner may readily be made in which the slide valve would be entirely closed at a fuel pressure of 35 kg/cm² and entirely open at a fuel pressure of 40 kg/cm². In this way, a satisfactory atomization will be obtained for all fuel discharges comprised between zero and the maximum contemplated.

In Fig. 5 is shown a graph wherein, by way of example, a curve AC represents discharge variations in function of respective pressures in a mechanical burner according to this invention, and a curve OC represents such variations in an ordinary mechanical burner of heretofore used kind. OA and OB represent the minimum and maximum pressures, respectively, between which the fuel atomization remains good, the corresponding zone being hatched. The essential difference between the two burners is quite apparent; it resides in the fact that in the ordinary burner the section of the atomization holes or conduits is constant and the zero discharge corresponds to zero pressure, whereupon only a small part EC thereof is comprised in the zone of good atomization, with the result that such a burner may be used only for discharges comprised between F and D. On the contrary, with the burner according to this invention, the zero discharge may be obtained at a pressure equal or superior to the minimum necessary for a good atomization, the operation thereof remaining satisfactory for all discharges comprised between o and the maximum contemplated.

It is to be understood that, without departing from the scope of this invention, the piston *t* may be replaced by a diaphragm or a deformable membrane, and the spring *u* may be suppressed if the elasticity of the deformable member permits of doing so.

Apart from the advantages resulting from the simplicity of construction and suppression of stuffing boxes for the slide valve rod, the possibility of control of the burner according to this invention by means of the fuel pressure per se permits of many advantageous applications of this burner to regulation apparatus employing such burners (for example, in connection with steam power plants, industrial furnaces, gas turbines, etc.)

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