United States Patent

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[31] P 15 51 993.4

[54] **FUEL BURNER WITH FUEL FEED CONTROL MEANS RESPONSIVE TO AIR AND FUEL FLOW**
1 Claim, 9 Drawing Figs.

[52] U.S. Cl. **431/90,** 431/12
[51] Int. Cl. **F23n 1/02**
[50] **Field of Search** 431/2, 90, 12, 181; 137/6, 9, 2

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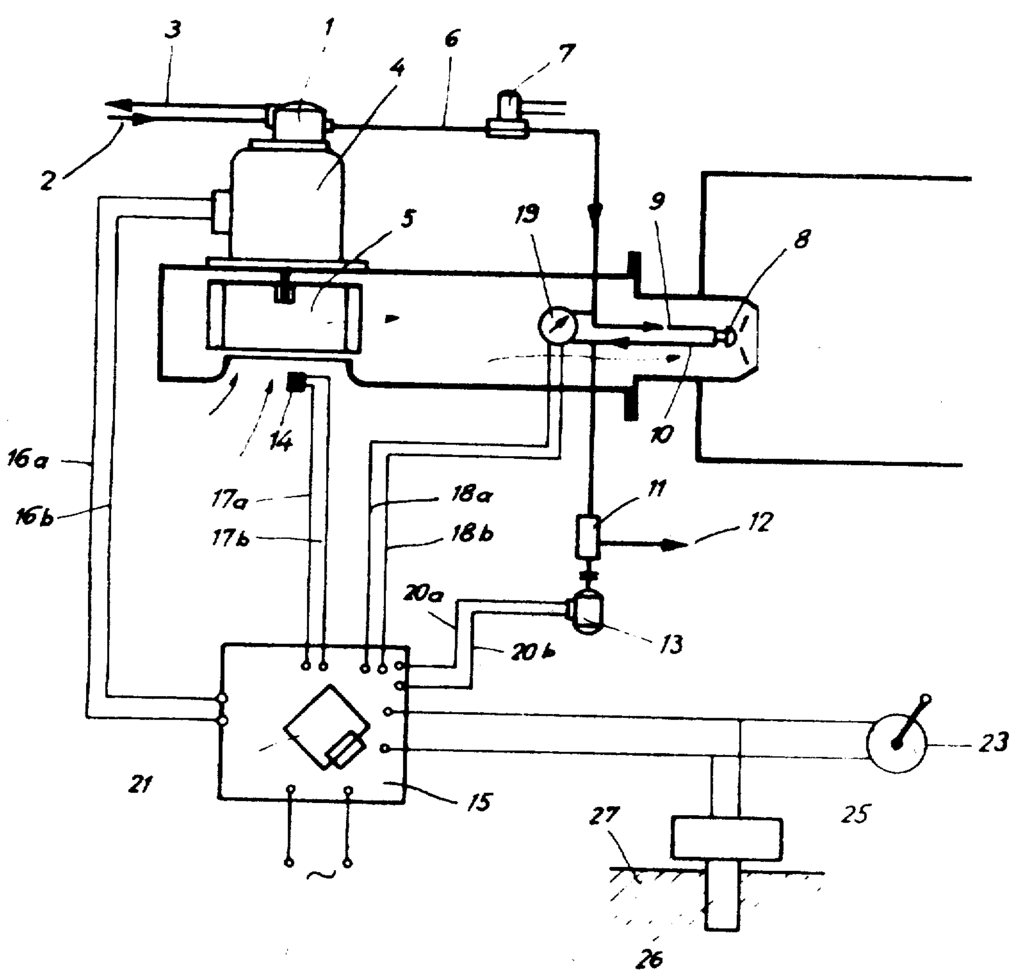
ABSTRACT: A fuel burner has a spray nozzle with fuel feed means and a blower for producing a flow of combustion air to the nozzle. The device includes a return line returning from the nozzle to the fuel source and a valve in this line which is controlled by comparing the actual value of the fuel flow or air flow with a predetermined desired value. The fuel flow is measured by a device which is connected both to the inlet and return lines of the fuel nozzle.



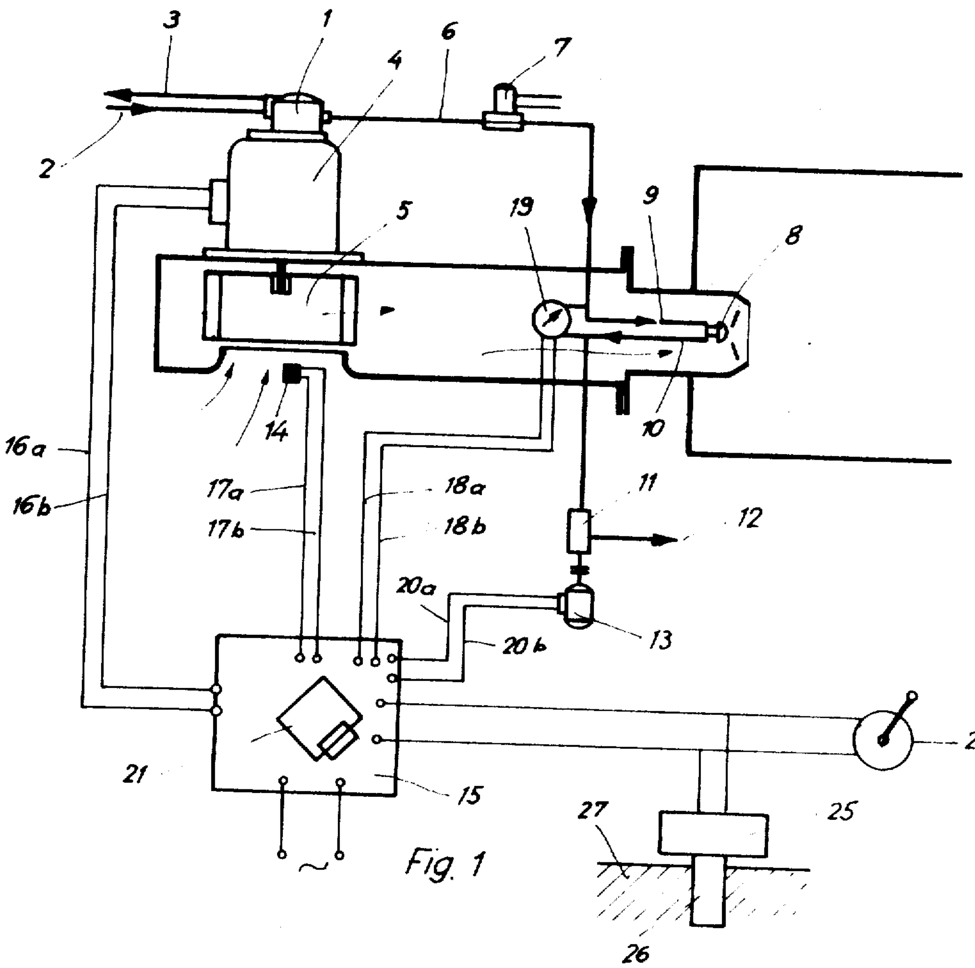


Fig. 1

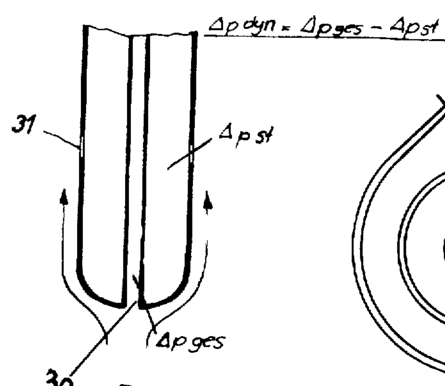


Fig. 2a

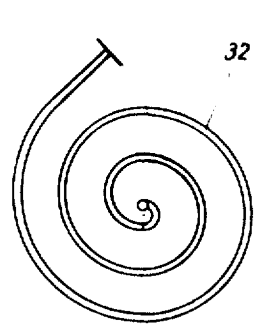


Fig. 2b

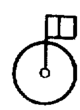


Fig. 2d

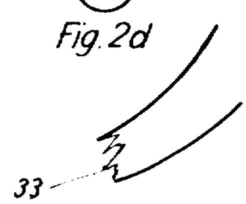


Fig. 2c

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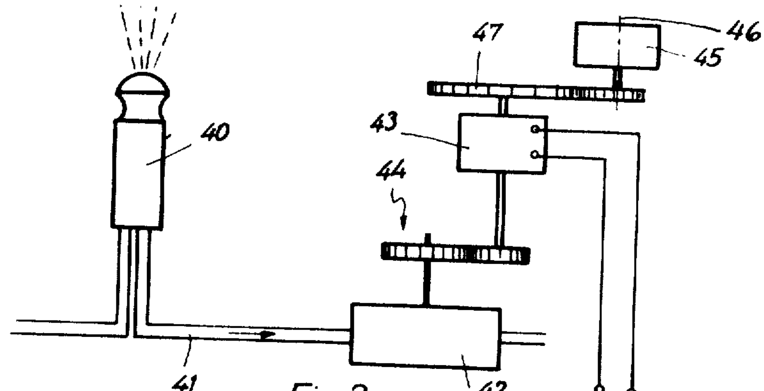

Fig. 3

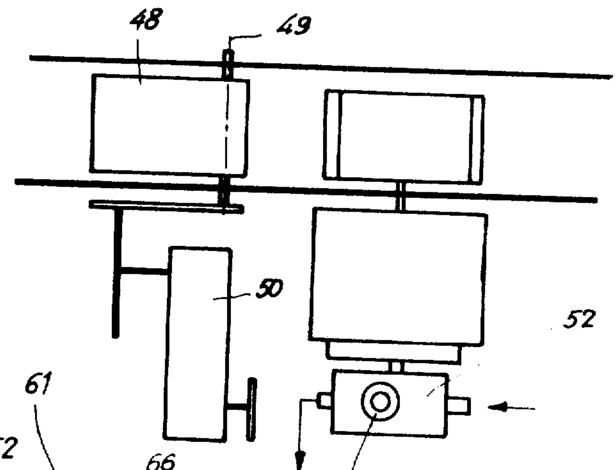

Fig. 4

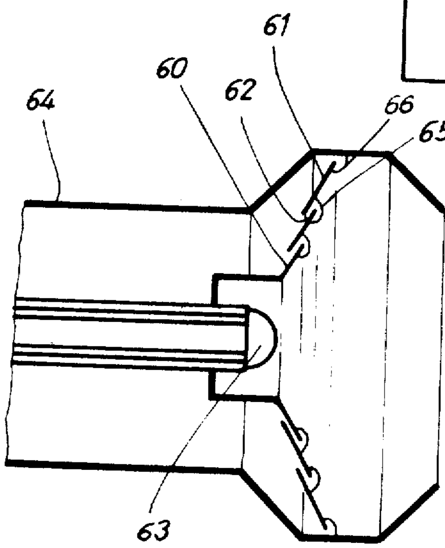

Fig. 5

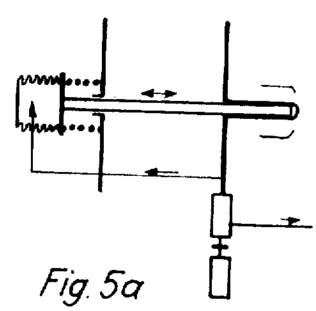
Fig. 5a

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FUEL BURNER WITH FUEL FEED CONTROL MEANS RESPONSIVE TO AIR AND FUEL FLOW

The invention is concerned with a method for continuously regulating the output of oil or gas burners and more particularly of such oil or gas burners which contain a blower for conveying the combustion air which is driven by an electric motor. The invention is also concerned with a device for performing the said method.

It is an object of this invention to provide a method of the kind here in question with which it is possible to continuously regulate the output of the burner in dependence on continuously determined valves of the data to be controlled and without great expenditure.

Another object of this invention consists in providing a method of the kind here in question with which the quantity of the combustion air passing through the burner is measured and determined and with which the values determined are compared with the nominal values and, finally, the speed of the driving motor associated to the said blower is automatically so regulated or a throttling organ associated to the said blower is automatically so adjusted that the real value obtained by adjustment continuously corresponds to the said nominal value this latter being determined in dependence on the quantity of oil to be burned.

Yet another object of the invention consists in providing a method of the above said kind to be used in connection with oil burners with which the spray nozzle is constructed as a so-called return nozzle which is connected on the one hand with the oil feed pipe and on the other hand with the oil return pipe which is controlled by a return valve the obturating organ of which is driven by a positioning motor, in which method the quantity of the fuel passing through the burner is determined by measuring the pressure or the velocity of the fuel and in which, further, the positioning motor associated to the said return valve is continuously and automatically controlled in dependence on the measured values.

A further object of the present invention consists in providing a method of the above-mentioned general character with which the quantity or the pressure or the flow velocity of the combustion air passing through the burner and/or the quantity or the pressure of the fuel passing through the burner are measured and the operation of the driving motor associated to the blower and/or the operation of the positioning motor associated to the return valve are continuously and automatically controlled in dependence on the measured values.

Still another object of the invention consists in providing a device for performing the method of the general character described above with which the above-described advantages can be obtained by using simple means and with little expenditure.

A further object of the invention consists in providing a device of the beforementioned type which has an electrical control system which contains the said blower and the driving motor allotted to the said blower and a feeler element serving to determine and adjust the quantity of the combustion air passing through the blower.

Another object of the invention consists in providing a device of the general character described with which an electrical control system is provided which contains on the one hand the blower and a throttling organ allotted to the said blower and a positioning motor allotted to the said throttling organ and on the other hand a feeler element which serves for determining or measuring the amount or the pressure or the flow velocity of the combustion air passing through the said blower.

A further object of the invention consists in providing a device of the beforementioned type with which an electric control system is provided which contains the said return valve and the positioning motor allotted to the obturating organ of the said return valve and the measuring organ which serves for measuring and adjusting the quantity or the pressure of the fuel passing through the burner.

These and other objects, features, and advantages of the present invention will become further apparent from the following detailed description thereof.

Several embodiments of the invention are illustrated by way of example, in the drawings in which:

FIG. 1 is a schematical representation of an arrangement according to the invention,

FIG. 2a to 2d are different embodiments of feeler elements of the arrangement according to FIG. 1,

FIG. 3 is a schematical representation of a first variant of a regulating device according to the invention,

FIG. 4 is a schematical representation of a modified embodiment of the regulating device according to the invention, and

FIG. 5 and 5a are each an axially sectional side view of details of another embodiment of the invention.

With the embodiment shown in the drawings the oil-conveying pump is designated with 1, whereas 2 is the suction pipe leading to the pump, and 3 is the return pipe coming from the pump. The driving motor 4 of the pump serves also to drive the blower 5 which may be constructed as a radial blower or as a transverse flow blower and in this latter case especially as a so-called high-stability transverse flow blower. The pump, the motor and the blower are assembled together to form a compact unit. The pressure pipe 6 leads from the pump via the magnet valve 7 to the spray nozzle 8 which is constructed as a so-called return valve and which to this purpose is connected on the one hand with the feed pipe 9 and on the other hand with the return pipe 10 which leads via the return valve 11 to the oil container 12. To the obturating member of the return valve there is allotted a positioning motor 13 for opening and closing the return valve. There is also provided a feeler element 14 for feeling and determining the air velocity, the rheostat bridge 15 is connected via the lines 16*a*, 16*b* with the driving motor of the blower, via the lines 17*a*, 17*b* with the feeler element determining the air velocity, via the lines 18*a*, 18*b* with the organ for measuring the oil pressure and via the lines 20*a*, 20*b* with the positioning motor 13. The device according to the invention has, therefore, an electrical control system which contains the blower 5 and the driving motor 4 allotted to the blower and a feeler element 14 which serves for determining the quantity or the pressure or the flow velocity of the combustion air passing therethrough. Thereby the driving motor 4 and the feeler element 14 are interconnected via the rheostat bridge 21 in the control device 15 in such a manner that to the condition of equilibrium of the rheostat bridge there is allotted a certain predetermined condition or stage of operation of the driving motor and a certain predetermined and regulatable value of the quantity, the pressure, and the velocity of the combustion air flow passing therethrough. The connection between the rheostat bridge on the one side and the driving motor allotted to the blower or the feeler on the other side is performed thereby by an electronic device which may contain for example at least one thyristor (thyratron transistor). The above-said device has also an electric control system which contains the return valve 11 and the positioning motor 13 allotted or coordinated to the obturating member of the said return valve and the measuring organ 19 which serves for determining the amount or the pressure of the fuel passing therethrough. The positioning motor associated to the return valve and the measuring organ are interconnected via the bridge 21 in such a way that to the condition of equilibrium there is allotted a certain predetermined and regulatable condition or stage of operation of the positioning motor and a certain predetermined and regulatable value of the quantity and the pressure of the fuel flow passing therethrough. The connection between the rheostat bridge on the one side and the positioning motor and the measuring organ on the other side is effected by an electronic device which may contain, for example, at least one thyristor (thyraton transistor). Generally, the arrangement is such that the control system containing the return valve and the control system containing the blower are coordinated to one another via a common rheostat bridge in such a way that upon varying one of the values or data to be controlled and supervised the other characteristic and determinant values or data of the control system are automatically varied correspondingly in such a manner that there is obtained the equilibrium condition of the rheostat bridge. Instead of a control system containing the blower and the driving motor associated with the blower there can be provided also an electric control system which contains the blower and a throttling organ associated to the blower and a positioning motor associated to the throttling organ on the one side and a feeler element on the other side which serves for determining the amount or the pressure or the flow velocity of the combustion air passing therethrough. The throttling organ can be thereby constructed as a member composed of several semicups arranged so as to be drumlike rotatable within the inlet zone of the rotor, the breadth of which semicups differs along the periphery of these cups. In this manner it is obtained that the throttling organ causes reactions during the whole movement in such a manner that the increase of the resistance is constant for each change of the angle.

The arrangement may have also an adjusting organ 23 which may be operated, for example, by hand or may be also remote controlled and with the aid of which one of the determining values of the control system, for example, the amount or quantity of the fuel passing therethrough or the pressure of the combustion air to be passed therethrough may be adjusted whereby the other determining values of the control system are automatically adjusted in dependence on the determined value. Therefore, it is possible to proceed in the following manner: At first there is feeled and measured the quantity or the pressure or the flow velocity of the combustion air passing therethrough, and thereafter the motion or run or operation of the motor allotted to the blower is continuously and automatically controlled in dependence on the measured values. It is possible to proceed in the same manner if instead of a control system containing the driving motor for the blower there is provided a control system which contains a positioning motor for a throttling organ allotted to the said blower. With oil burners with which the spray nozzle is constructed as a so-called return valve connected on the one side with the oil feed pipe and on the other side with an oil return pipe controlled by a return valve the obturating member of which is driven by a positioning motor it is possible to proceed in such a way that at first there is measured the quantity or the pressure of the fuel passed therethrough, and then the positioning motor associated to the return valve is controlled continuously and automatically in dependence on the measured values. In general, with the embodiment shown in the drawings the arrangement is such that the quantity or the pressure or the flow velocity of the combustion air passing therethrough and/or the amount or the pressure of the fuel passing therethrough are measured and than the speed or operation of the driving motor allotted to the blower and/or of the positioning motor allotted To the return valve are continuously and automatically controlled in dependence on the measured values.

It is also possible to provide an electric signal apparatus or feeler element supervising, for example, the room temperature, the temperature of the water, of a surface, etc., by means of which signal apparatus or feeler element one of the determinant values of the control systems, for example, the quantity of the fuel or the pressure of the combustion air is automatically switched on as soon as the data to be controlled or supervised have reached a predetermined value whereby the other determinant or characteristic values of the control system are automatically adjusted in dependence on this predetermined value. Such a signal apparatus is shown at 25, its feeler element 26 supervises the chamber 26. To the adjusting organ there may be associated a control apparatus 15 which during starting of the burner displaces the adjusting organ from a position corresponding to to a small value gradually and automatically to the position which corresponds to the desired end value. The arrangement may be, for example, such that at first the return valve may be adjusted to an oil throughput of 5 kg. and the rotational speed of the blower may be correspondingly regulated so that only that amount of air is conveyed which corresponds to the above amount of oil. When using such a small amount of oil there is produced a small flame only. As soon as there is produced a flame, for example, as soon as the photosensitive cell ascertains that there exists a flame and as soon as the cell acts in response to the existence of the flame, the oil throughput is gradually increased until it reaches the predetermined amount. The throughput of air is correspondingly adjusted.

In FIG. 2*a*, 2*b*, 2*c*, 2*d* there are shown different possible embodiments of the feeler device or feeler element serving for measuring the velocity or the pressure of the combustion air. So, for example, the feeler element may be constructed as a so-called Prandtl-tube as shown in FIG. 2*a*, whereby at the tip of the tube the pressure Δp ges is measured at 30 and at the side bore 31 there is measured the static pressure Δp st, the difference between Δp ges and Δp st giving the air velocity at this point which corresponds to the value Δp dyn. However, the feeler device can be also executed as a spirallike wound tube 32 or as a U-shaped tube in the manner of the so-called Bourdon-tube which performs due to the dynamic pressure or the difference of pressures of the combustion airflow in dependence on the amount or the pressure of the combustion air passing therethrough a displacing movement which is imparted to a potentiometer which is contained in an electric line leading to the rheostat bridge. The magnitude of the thereby resulting resistance corresponds to the prevailing pressure. According to FIG. 2*b* the feeler device or feeler element can be constructed also as a so-called heat-sensitive conductor 33 serving to measure the flow velocity of the combustion air passing thereby and which on the one hand is situated within the flow path of the combustion air and is cooled by the air passing thereabout and on the other hand is contained in an electric line leading to the rheostat bridge whereby the electrical resistance of this temperature-sensing conductor decreases with increasing cooling effect. The temperature sensing or heat-sensitive conductor is the more cooled the greater the flow velocity is, and this is again expressed by means of a voltage value. Finally, the feeler device or feeler element can also be constructed according to FIG. 2*d* as a vanelike displacing body serving to measure the pressure of the combustion air passing therethrough which body transmits its displacing movement to a potentiometer contained in an electric line leading to the rheostat bridge.

By means of the arrangement according to the invention there can also be varied the rotational speed of the blower until the nominal value of the air throughput is reached whereby the air throughput may be controlled by measuring the air velocity at a definite point within the burner. However, there is also possible to determine the variation of the oil throughput through the return nozzle and the return valve until the nominal value is reached, whereby the control of the oil throughput is effectuated by measuring the difference of pressure at the return nozzle. Finally, there can also be obtained the variation of the air throughput by means of a throttle whereby in this case the rotational speed remains constant. Furthermore a variation of the air throughput can also be effectuated by varying the rotational speed and by adjusting the throttle. The burner head may be varied by varying the gaps and maintaining the mixing velocity. In general, in this manner it is possible to automatically adjust the oil and air throughput, for example, by adjusting the desired throughput at a rotary-type switch on the oil burner casing and by maintaining constant this throughput under the most different and most extreme counter pressures within the combustion chamber. The oil throughput may be maintained constant also when varying the burner head.

As driving motor for the blower there may be used a motor with infinitely regulatable speed.

From FIG. 3 and 4 it can be taken that with the new burner to the blower for conveying the combustion air there is associated an organ for regulating the quantity of the air which is so coupled with the regulating organ for the quantity of the conveyed fuel that an adjustment of the one organ brings about automatically a corresponding adjustment of the other organ. With the arrangement according to FIG. 3 the oil burner is provided with a so-called return nozzle **40** from which a return pipe **41** leads back to the oil reservoir which return pipe is controlled by a return valve **42** the obturating member of which may be adjusted by means of a positioning motor **43**. Thereby, the positioning motor which is connected with the return valve and the obturating member thereof by means of a gearing **44** serves at the same time for operating the organ for regulating the amount of the combustion air. With this arrangement there is provided for conveying the combustion air a transverse-flow blower to the rotor of which there is allotted a wedgelike shaped vortex forming tongue **45** which has two effective faces enclosing between them an acute angle of, for example, 20° to 60° and the surface of which turned to the suction side encloses with the periphery of the rotor a gap widening in the direction of rotation. It can be taken from the drawings that the wedgelike shaped vortex forming tongue can be rotated by means of the positioning motor **43** about an axis **46** parallel to the rotation axis of the rotor whereby this positioning motor is connected with the vortex forming tongue via a gearing **47**. With the embodiment according to FIG. **4** for conveying the combustion air there is provided also a transverse flow blower to the rotor of which there is allotted a wedgelike shaped vortex-forming tongue **48** which has two effective faces enclosing therebetween an acute angle of, for example, 20° to 60°, the effective face of which facing the suction side encloses with the periphery of the rotor a gap widening in direction of rotation. This wedgelike shaped vortex forming tongue is also rotatable about an axis **49** parallel to the rotational axis of the rotor, and for rotating the vortex forming tongue there is provided an organ **50** which may be constructed as hand-operated organ or as a positioning motor and which serves at the same time also for actuating the regulating organ **51** for regulating the pressure of the pump **52** with which it is coupled via agearing. This embodiment is provided especially for small regulating intervals and for a limited number of regulating operations.

With the embodiment according to FIG. **5** and **5***a* the baffle plate **60** consists of several ring-shaped discs **65** with differing inner diameters which are arranged concentrically and/or coaxially whereby between two successive ring discs there is provided a ring gap **62** respectively. These ring discs are thereby so assembled in radial direction that beginning with the ring disc having the smallest diameter there follow in direction towards the exterior ring discs with radially increasing diameters. As seen in the flow direction of the oil these ring discs are so assembled that the ring disc with the greatest diameter is situated on the side facing the spray nozzle and that to this ring disc there follow in axial direction ring discs with gradually decreasing diameters so that the ring disc with the smallest diameter is situated at the side facing the combustion chamber. The ring discs constituting the baffle plate are connected with one another and with a fixed portion of the arrangement yieldingly and elastically and they are provided with a device by means of which a pull in axial direction can be exerted thereon. To this purpose the end areas of the ring discs facing the longitudinal middle axis of the burner tube **64** are interconnected by means of leaf springs **65** which tend to remove the discs from one another, whereas the outer periphery of the outermost ring disc is connected with the burner tube by means of leaf springs **66** which tend to remove the arrangement from the burner tube whereby the device for exerting the axial pull engages on the innermost ring disc. When the flame is continuously varied within a wide range, with burner heads destinated for the upper area of the range there are obtained in the lower area of the interval too small mixing velocities, therefore the combustion is unfavorable. By narrowing the gaps in the above-said manner the mixing velocity can correspondingly be increased.

Although my invention has been illustrated and described with reference to the preferred embodiments thereof, I wish to have it understood that it is in no way limited to the details of such embodiments, but is capable of numerous modifications within the scope of the appended claims.

I claim:

1. In a fuel burner having a spray nozzle, fuel-feeding means for producing a flow of fuel to said nozzle and a blower for producing a second flow of combustion air to the nozzle, the spray nozzle being a return nozzle, said fuel feed means comprising an oil feed pipe and an oil return pipe both connected to the spray nozzle, a return valve in the oil return pipe having an obturating organ, a positioning motor connected to said obturating organ, means for measuring the flow of fuel and the flow of combustion air, means for measuring a variable of one of said flows, means for comparing the value obtained by such measuring means with a predetermined nominal value, and means to adjust, in response to differences in said obtained value and said nominal value, a characteristic of the flow whose value is compared with the predetermined nominal value in such a way that the real value corresponds continually to the nominal value, said means for measuring the flow of fuel comprising a measuring means connected to the oil feed pipe and to the oil return pipe upstream of the obturating organ.