The invention relates to means for modulating the flow of fluid through a conduit and particularly to means for controlling the supply of air or gas to an oil or like burner. It is known that in order to obtain complete combustion of the fuel in burners which are adapted for burning liquid fuel, gases and pulverised fuel, it is necessary to obtain intimate admixture of the fuel and air supplies, and to this end the air is admitted to the burner at positions in front of the actual combustion zone, through slots, or past vanes or shaped blades, so as to impart high velocity to the air and to create turbulence in the combustion zone. Such slots, vanes or blades are usually disposed so as to direct the air at an angle to the axis of the burner, being generally positioned radially around the axis of the burner to impart a rotary or swirling motion to the air in contact with the fuel stream.

Such means promote efficient combustion with a constant velocity of fuel and air in the correct proportions, but whereas the rate of flow of fuel can be controlled by simple means to alter the rate of firing of the burner, the rate of flow of air cannot be simply controlled without reducing the turbulence which is essential for good combustion. Normal means of controlling the rate of air flow by a damper or variation of fan output controls the quantity of air but leaves the area of the air slots unchanged with consequent change in velocity of the air.

It is among the objects of the invention to provide means whereby the quantity of air admitted to the combustion space in front of a burner can be varied without appreciably varying the velocity of the air, thereby maintaining violent turbulence at all rates of firing.

It is a further object of the invention to render possible a wider "turn-down ratio" that is to say, ratio of maximum to minimum rate of firing at which the burner is stable, and efficient, than has hitherto been possible in known oil-burning practice.

According to the invention, means for controlling the air in a burner for oil, gas or pulverised solid fuel, comprises a radially disposed series of vanes made of a flexible material and mounted around a burner tube so as to be adapted to be twisted, bent or otherwise moved in such manner as to guide the flow of fluid through the duct, the angle or surface of deflection of the vanes being variable by means operable from a position remote from the vanes, and advantageously through linkage operating along the axis of flow of the fluid controlled.

The vanes may be made of thin sheet metal of high temper, or of other resilient material having both the leading and trailing edges stiffened in any suitable manner. The vanes are equally spaced in radial relation in a cylindrical conduit and formed with a general taper from the outer periphery of the conduit inwardly.

According to the invention furthermore, in the application of the invention to oil burners with primary and secondary air flow, the means for controlling the flow of primary air may be linked to the means for controlling the secondary air in such manner as continuously to retain a predetermined relation between them, thus the flow of air to a primary fluid duct may be controlled by means of a sleeve which is also effective to alter the set or deflection of the vanes, the movement of the sleeve along the axis of the burner being advantageously controlled by hydraulic, pneumatic or other suitable means.

According to the invention furthermore, the control means for the vanes may comprise a sleeve surrounding the burner tube and being provided with a circumferential series of slots for the introduction of primary air, a slidable sleeve provided with a corresponding series of slots and so provided at one end to be connected to one or more hydraulically or pneumatically operated pistons, a spider secured at the other end of the slidable sleeve supporting the leading edges of a series of vanes, an outer sleeve on which is mounted a series of radial arms and an outer cylindrical housing, through which the secondary air flows, mounted on said radial arms and supporting the trailing edge or part thereof of the series of vanes.

Thus it will be understood that the quantity of air passing between the vanes and also the angle of its discharge are controlled by movement of the leading ends or parts of the vanes relatively to the trailing ends or parts.

The invention is diagrammatically illustrated by way of example in the accompanying drawings, in which:

Figure 1 is a longitudinal section showing the control means for an oil or like burner according to the invention;
Figure 2 is a corresponding end elevation;
Figure 3 is an enlarged elevation of one vane;
Figure 4 is a diagrammatic layout of the movement of one vane; and
Figure 5 is a part sectional view of a modified construction.

In carrying the invention into effect according to the construction illustrated in the drawings, the burner may comprise a sleeve 1 surrounding a burner tube 2 having a collar or annular flange 3, serving as an abutment for a purpose hereinafter described, and a gripping handle 4 for effecting insertion of the tube. The sleeve 1 is provided near the forward end with a circumferential series of slots 5 for the introduction of primary air and is formed at the outlet with an inwardly directed annular flange 6 so as to direct the primary air forwardly and inwardly onto the fuel issuing from the nozzle of the burner tube 2.

Surrounding the sleeve 1 is a slidable sleeve 7, which is adapted to slide over the sleeve 1 along the axis of the burner tube 2, and is provided with a circumferential series of slots 8 at a lengthwise position in the sleeve corresponding to the position of the slots 5 in the sleeve 1. Mounted on the forward end of the slidable sleeve 7 is a spider 9 which is formed with a series of radial arms 10 of channel or U-section into which the leading edge of each of a series of vanes 11 is secured as by pins or the like.

The rear end of the slidable sleeve 7 is provided with a plate 12 to which are connected the rear ends of the piston rods 13 having at the forward ends pistons 14 operating within hydraulically or pneumatically operated cylinders 15.

The cylinders 15 are mounted on an end plate 16 which is secured in spaced relation to a backplate 17, which in turn is secured to an outer sleeve 18 surrounding the rear end of the slidable sleeve 7, which is formed to a reduced cross-section to present an annular shoulder 17A against which the forward end of the sleeve 18 bears in the fully open position of the vanes 11. Three or more radial arms 19 are secured to the outer sleeve 18 and serve to support an outer cylindrical housing 20 to present an annulus between the housing and the sleeve 7 for the flow of secondary air to the burner.
The trailing edges of the vanes 11 are secured to reinforcing pins 21 which are mounted as by universal joints 22 on the forward end of the housing 20. The housing 20, though normally stationary, is mounted with sliding fit within a cup-shaped casing 23, which is secured as by welding or the like to the front face 24 of the furnace, and is provided with laterally disposed air inlets 25 through which the secondary air enters to pass into the housing 20.

The backplate 17 is held in contact with the base of the cup-shaped casing 23 by suitable locking means 26, to enable withdrawal of the complete burner into the casing 23, when not in use. In effecting this movement the housing 20 covers up the air inlets 25, and cuts off the air supply which ensures that the burner is rendered inoperative. The withdrawal of the burner may be effected by hand, hydraulically or pneumatically.

Mounted on the rear end of the sleeve 1 is a fuel control valve 27, through which oil from the main supply pipe 28 flows to the burner tube 2, through the oil pipe 29. The control valve 27 is provided with a control lever 30 which is effective to lock the burner tube 2 in position against lengthwise movement by engagement with the collar or flange 3, when the oil is flowing, and to only relieve the burner tube 2 for withdrawal when necessary, when the supply of oil is cut off.

In the operation of the burner, air is passed under pressure through the inlets 25 into the housing 20 and out past the vanes 11. Simultaneously, air from the housing 20 passes through the corresponding inlet slots 5, 8 into the annulus between the sleeve 1 and the burner tube 2 and out around the nozzle of the burner tube 2.

Control of the secondary air is effected by movement to bend the vanes 11 from the fully open position, where they lie substantially parallel to the longitudinal axis of the burner, to the fully closed position where they are substantially at right angles to this axis.

For this purpose the leading edge of the vanes 11 which is secured along its whole length to a radial arm 10 of the spider 9 is moved in the direction of the arrow A (Figure 4) towards the trailing edge, with the result that the general curve of the vane (as viewed along the upper edge) is altered from that indicated by B in Figure 4 to that indicated by C shown in the same figure, and the secondary air thus directed on to the issuing jet of oil and air at an angle α (corresponding to the curve C) instead of at an angle β corresponding to the curve B, thus widening the area of discharge of the secondary air and the quantity of air admitted to the mixture of oil and primary air.

Control of the primary air is effected by the longitudinal movement of the slots 8 over the slots 5 to vary the size of the opening through which the air passes.

To adjust the primary and secondary air flows the slidable sleeve 7 is moved forwards and backwards along the axis of the burner over the sleeve 1. This movement is effected by the pistons 14 operated through pipe lines 31 from a suitable source of power supply.

It will be understood that the linking together of the control means for both the primary and secondary air flows ensures a continuous predetermined ratio between them, which is essential for effective operation.

Furthermore, means may be provided to pre-set the ratio between the primary and secondary air flows. This pre-setting may be effected by turning a handle 32 which is secured to the rear projecting end of the sleeve 1 in such manner as to effect a rotational movement of the sleeve 1 relatively to the sleeve 7, and thus to vary the size of the opening, through which the air passes, radially.

It will be understood that the control means in the fully closed position allows sufficient air to pass through to keep the burner burning, thus in the possibility of the coking-up of the nozzle of the burner tube, should it be left for relatively long periods projecting into the hot furnace.

In a modified construction, as illustrated in Figure 5, a fixed series of radially disposed vanes 11a may be provided, immediately adjacent the inner sleeve 5 and the series of radially disposed adjustable vanes 11 around the fixed vanes 11a.

In this embodiment, the ratio of the total area of both the adjustable and the fixed series of vanes to the area of the fixed series of vanes will be approximately the down ratio of the burner.

This construction ensures that vigorous turbulence is maintained adjacent the burner tube under low load operating conditions.

As illustrated, the fixed series of radially disposed vanes 11a are mounted in any convenient manner, and the sleeve 1, and a series of radial arms 33 are mounted on the forward end of the slidable sleeve 7, to support a ring 34 which overlaps the rear ends of the fixed vanes 11a. The spider 9 with arms 10 and the vanes 11 are mounted on the ring 34 in the manner hereinbefore described.

The slots 5, 8 former respectively in the sleeves 1, 7 are provided in such manner that when the vanes 11 are in the fully closed position a space is left to allow sufficient primary air to pass through the slots into the inner sleeve 5 for the necessary predetermined relation between the primary air and the secondary air passing through the fixed vanes.

I claim:

1. Means for supplying fuel and modulating the flow of air to a burner comprising a housing forming an air passage, a tube located centrally of said housing through which fuel is fed to a combustion chamber, a plurality of flexible, air-directing vanes spaced around the forward end of the housing, mounted thereon and extending radially inwardly towards the tube to impart a rotary motion to the air passing through the end of the housing past said tube, means for variably flexing said vanes by movement of one edge of each vane axially of the tube whereby the amount of air fed and its rotary motion are varied and a series of fixed vanes mounted adjacent to the tube and towards the inner end of the flexible vanes, whereby a turbulent flow of air may be maintained near the outlet of the tube while the main body of air is variable.

2. Means for modulating the flow of fluid through a conduit, including a cylindrical housing at least part of which is mounted for axial movement within the said conduit, a series of juxtaposed and flexible vanes radially mounted transversely of said conduit, a movable support for the leading edges of said vanes, said movable support being in the form of an axially slidable sleeve extending into said housing, a fixed support in the form of a stiffener for the trailing edges of said vanes, said stiffeners being mounted on said housing, radial arms for supporting said housing, an outer sleeve on which said arms are mounted, said outer sleeve extending coaxially with and closely adjacent to part of said movable support, the portion of said movable support contained within said outer sleeve being of reduced cross-section, the portion of larger cross-section of said movable support abutting the said outer sleeve to limit movement of the movable support, and means for moving the said movable support axially to flex said vanes to open and close said vanes.

3. Means for modulating the flow of a stream of fluid, comprising a conduit through which the stream of fluid passes, a series of juxtaposed and flexible vanes radially mounted transversely of said conduit, said vane being adapted to be brought into overlapping relation to close said conduit, an axially slidable sleeve extending into said conduit and forming a movable support for the leading edges of said vanes, a fixed support in the form of a stiffener for the trailing edges of said vanes, said stiffeners being mounted on said conduit, and means for
moving said axially slidable sleeve to flex said vanes to open and close said vanes.

4. Means for modulating the flow of fluid through a conduit as set forth in claim 2 having a stationary hollow sleeve mounted within the slidable sleeve forming the movable support for the leading edges of the vanes, said stationary sleeve forming a primary passage for the fluid and corresponding openings in said stationary and slidable sleeves for the passage of fluid to said hollow stationary sleeve, said openings being variable upon movement of the slidable sleeve whereby movement of the slidable sleeve varies the passage of fluid by the vanes and through the hollow stationary sleeve in a fixed ratio.

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