This invention relates to fuel burning equipment and more particularly to an improved air register for use in a fuel burner.

An object is to provide an air register of the above type having novel and improved operating characteristics.

Another object is to provide an air register suited to adjustably control the quantity, direction, velocity and turbulence of the air supplied to the burner tube.

Another object is to provide an air register of the above type which can be adjusted for optimum performance while the burner is operating.

Another object is to provide a multiple burner installation wherein the air to one or more of the burner tubes can be shut off as required without altering the angular adjustment of the air register vanes.

Various other objects and advantages will be apparent as the nature of the invention is more fully disclosed.

In accordance with the present invention, the outer air register is composed of an outer set of air vanes which may be fixed or adjustable as required and may be disposed radially or offset so as to supply air to a burner tube with or without rotation.

The inner set of air vanes is disposed to form an inner register to slide axially within the inner periphery of the outer register vanes so that, when in registration with the outer vanes, the air passes in sequence through the two sets of vanes in its path to the burner tube. The inner vanes are arranged to be shifted axially entirely out of the path of the air flow or to be shifted into registration with the outer set of vanes or may be shifted rearwardly into the burner tube so that the front mounting plate on which the vanes are supported serves to reduce or to entirely cut off the air supply to the burner tube. The inner vanes, like the outer vanes, may be disposed radially or may be adjusted angularly to provide for rotation of the air either in the same direction as that produced by the outer vanes or in the opposite direction. In this way, the degree of turbulence may be controlled as desired. The inner vanes may be fixed or adjustable and they may have their entering and leaving edges parallel to the axis of the burner tube or at an angle thereto for further controlling the rotation of the air supplied to the burner throat.

The nature of the invention will be better understood from the following description, taken in connection with the accompanying drawings in which certain specific embodiments have been set forth for purposes of illustration.

In the drawings:

FIG. 1 is an elevation of the burner assembly taken from the forward or firebox end, with parts broken away for clarity, wherein the outer vanes provide air rotation in a direction opposite to that produced by the inner vanes;

FIG. 2 is a transverse section taken on the line 2—2 of FIG. 1;

FIG. 3 is a sectional view taken on the line 3—3 of FIG. 2 looking toward the firebox end of the assembly;

FIG. 4 is a vertical section similar to FIG. 3 illustrating an embodiment of the invention wherein the outer vanes are positioned to produce counter-clockwise rotation of the air; the inner vanes are adjustable and disposed to produce counter-clockwise rotation and are shown as warped to provide improved air-flow characteristics;

FIG. 5 is a partial section similar to FIG. 3 wherein the outer vanes are adjustable;

FIG. 6 is a perspective of one of the vanes of FIG. 4;

FIGS. 7 and 8 are sections taken on the lines 7—7 and 8—8 respectively of FIG. 6 looking in the direction of the arrows.

Referring to the drawings more in detail, the invention is shown in FIGS. 1 to 3 as embodied in a fuel burner arranged to fire into a furnace having a furnace front plate 9 and a front wall 10 with a throat opening 11 which is flared toward the combustion chamber in the usual manner. A cylindrical burner tube 12 extends forwardly from the plate 9 and is affixed thereto by flanges 13. A gas ring 14 may be disposed around the burner tube 12 at the furnace end thereof for supplying gaseous fuel for combustion when desired.

At its forward end the burner tube 12 is flared outwardly at 15 and is formed with a flange 16 attached to a wall 17 which forms a division plate between the burner tube area and the air register area of the wind box or plenum chamber 18 and also forms a back plate for outer air register 19.

The air register 19 is formed by a plurality of vanes 20 which are spaced peripherally around the axis of the burner tube 12 and are shown in FIG. 3 as offset from the radial plane so as to direct the air from the wind box inwardly with clockwise rotation.

In FIGS. 1 to 3 the vanes 20 are shown as fixed rearwardly to the back plate 17 and forwardly to a front plate 21. The front plate 21 forms a partial front closure for the wind box which is closed laterally by a side wall 22 which extends between the air register front plate 21 and the furnace front plate 9 and is formed with a top opening 23 through which air is supplied by a fan 24 mounted on the side wall 22 and driven by a motor 25. The opening 23 is in substantial alignment with the back or division plate 17 and an adjustable baffle 27 is provided for adjusting the relative quantities of air supplied to the two sides of the division plate. The division plate 17 in FIG. 1 may be spaced peripherally from the side walls 22 to provide for the flow of air from the burner tube side of the division plate to the outer air register side around its entire periphery as shown more in detail in U.S. Patent to Dunn No. 3,219,093.

An oil barrel 30 of the usual type having an atomizer tip 31 extends axially through the burner tube 12. A diffuser pipe 32 carrying a diffuser 33 is disposed over the fuel barrel 30 for suitable axial adjustment. The oil barrel 30 may, of course, be replaced by a barrel suited to carry pulverized fuel or gas.

An inner air register 39 is composed of peripherally spaced vanes 40, mounted on a mounting plate 41 having a hub 42 which slides on the diffuser pipe 32.

The vanes 40 may be disposed radially or offset from the radial plane so as to supply air with rotation or with a clockwise or a counter-clockwise rotation, as desired. The outer peripheries of the inner vanes 40 are disposed to pass within the inner peripheries of the outer vanes 20 and within the forward end of the burner tube 12.

The register front plate 21 is formed with a central opening 43 and carries a cylindrical wall 44 which extends forwardly therefrom around the opening 43 to form an air register chamber 45 which is closed by a front closure plate 46. Pull-rods 47, attached to the mounting plate 41, extend through the front closure plate 46 to permit axial or angular adjustment of the inner register.

When the inner register is shifted axially into the chamber 45 and entirely out of the path of the air passing through the outer register, the air passes between the outer
3,367,385 3 vanes 20 into the burner tube 12 and is unaffected by the inner air register vanes.

When shifted axially into registration with the outer register vanes, the air supply passes first between the outer vanes 20 and then between the inner vanes 40 as it is supplied to the burner tube 12. In such case, if the vanes of both registers are radially disposed, the air will be supplied to the burner tube without rotation. If both sets of vanes are disposed to cause rotation of the air in the same direction, the rate of rotation in the burner tube will be correspondingly increased. On the other hand, if the two sets of vanes are disposed to cause rotation in opposite directions while traveling through the duct or while wholly cancelled out and turbulence will be increased. Hence, by suitable selection or adjustment of the vanes, the degree of rotation and turbulence may be made to correspond to the requirements of the particular burner with which the register is being used. It has been found in actual practice that this combination of vanes or blades produces unusual combustion results, permits optimum control of the flame shape and operation with a clean fire without smoke when burning fuel with a very low percentage of air over and above that theoretically required for complete combustion.

When the inner register is further displaced rearwardly toward the burner tube, the annular area available for air-flow between the periphery of the mounting plate 41 and the forward end of the burner tube 12 progressively decreases. In its fully rearward position, the mounting plate 41 shuts off completely the air-flow into the burner tube 12. Hence by suitable adjustment, the air velocity through the inner vanes may be varied without altering the rotational effect or the air flow may be shut off completely. This latter feature permits a selected burned of a bank to be shut down when the bank is supplied by a common windbox instead of by an individual fan for each burner.

In the embodiment of FIG. 4, the arrangement of the parts is similar to that of FIGS. 1 to 3 except that the outer set of vanes 20 each of which is offset to the left of a radius so as to impart counterclockwise rotation to the air passing therebetween.

Each vane 40 of the inner set is provided with a flange 45 which is fixed to a shaft 49 extending through the mounting plate 41 and rotatable therein for angular adjustment of the vanes. The vanes may be adjusted in unison, if desired, by suitable mechanism such as a ring gear and connecting links as shown in U.S. Patent to Vroom No. 2,325,645. In addition, the pull-rods 47 which extend through the outer closure plate 46 may be shifted angularly in arcuate slots 50 in the closure plate so as to adjust the angular position of the mounting plate and hence the entire set of inner vanes with respect to the outer vanes.

The embodiment illustrated in FIG. 5 is similar to that of FIGS. 1 to 3 except that the outer vanes 20 are mounted to extend radially of the register and are pivoted for adjustment for clockwise or counterclockwise rotation. Each vane 20 may be mounted on a rod 51 which is pivoted in the front plate 21 for adjustment. Suitable means, such as that shown in the Vroom Patent No. 2,325,645 above mentioned may be provided to effect adjustment in unison, if desired.

The inner set of vanes 40 in FIGS. 4 and 6 to 8 are shown as generally arcuate in section with the radius of curvature of the rearward end 40 of the vane less than that at the forward end so that the rearward inner corner 40 is shaped to deflect the air stream toward the axis of the burner so that the air passes thereover for thereby causing the air stream to impinge on the fuel spray with increased turbulence. The inner edge 40 of the vane 40 is shown as inclined rearwardly away from the burner tube axis in a manner such that the rearward end of the vane is narrower than the forward end thereby providing increasing air-flow area between the vanes in the direction of air-flow through the burner tube.

What is claimed is:

1. In combination with a fuel burner having a burner tube disposed to supply air for combustion to a burner throat, a plenum chamber carrying air for combustion, an outer air register in said plenum chamber having a back plate and a plurality of air vanes spaced around the periphery of said burner tube with their inner peripheries lying in a circle having a diameter at least as large as that of said burner tube, said vanes being disposed axially forward of the entrance end of said tube, and an inner air register having a set of peripheral spaced air vanes having their outer edges lying in a circle no larger than the inside diameter of said tube, a transverse mounting plate carrying said last vanes and disposed axially forward thereof and means mounting said mounting plate for axial movement with respect to said outer air register and said tube between a rearward position, with said last vanes disposed within said tube and axially rearward of the zone of said outer air register, and an advanced position, axially forward of the zone of said outer air register and out of the path of the air flow therethrough into said tube.

2. Apparatus as set forth in claim 1 in which the vanes of said outer and inner air registers are disposed to cause rotation of the air passing therethrough in opposite directions.

3. Apparatus as set forth in claim 1 in which the vanes of said outer and inner air registers are disposed to cause rotation of the air passing therethrough in the same direction.

4. Apparatus as set forth in claim 1 in which the vanes of the outer air register are disposed to cause no rotation of the air passing therethrough.

5. Apparatus as set forth in claim 1 in which the vanes of said outer air register are mounted for angular adjustment for varying the direction and extent of rotation produced thereby.

6. Apparatus as set forth in claim 1 in which the vanes of said inner air register are mounted for angular adjustment for varying the extent of rotation produced thereby.

7. Apparatus as set forth in claim 1 in which the vanes of the outer air register are substantially straight and the vanes of the inner air register are curved.

8. Apparatus as set forth in claim 1 in which said mounting plate, when shifted to its fully rearward position, is adapted to substantially close the entrance to said burner tube so as to prevent passage of air therethrough.

9. Apparatus as set forth in claim 1 in which a fixed front plate closes said plenum chamber at its forward end, said front plate having a recess shaped and positioned to receive said inner air register when advanced to its fully forward position out of the path of the air stream from said outer air register.

10. Apparatus as set forth in claim 1 in which a fuel barrel surrounded by a diffuser pipe carrying a diffuser is disposed axially of said burner tube and said mounting plate is disposed to slide axially on said diffuser pipe between forward and rearward positions.

11. Apparatus as set forth in claim 1 in which said inner air register is mounted for both rotational and axial adjustment with respect to said outer air register.

12. Apparatus as set forth in claim 1 in which the vanes of said inner air register are arcuate in section with the radius of curvature at the inner end less than that at the outer end.

13. Apparatus as set forth in claim 1 in which the inner vanes are formed with their inner sides inclined to the burner axis and with their rearward ends narrower than their forward ends.

14. Apparatus as set forth in claim 1 in which said outer air register and said burner tube occupy, respec-
5 tively, forward and rearward axial zones of said plenum chamber, said outer air register back plate being extended to divide a substantial portion of said plenum chamber into said zones.

15. Apparatus as set forth in claim 14 having a fan mounted on said plenum chamber and an adjustable guide vane mounted in the discharge of said fan for directing the flow of air therefrom into said plenum chamber.

16. Apparatus as set forth in claim 15 in which the flow of air from the discharge of said fan is divided by said outer air register back plate.

17. Apparatus as set forth in claim 1 in which a fuel chamber is disposed peripherally around said burner tube at its rearward end for admitting fuel into said tube adjacent said burner throat for mixture with air for combustion.

References Cited

UNITED STATES PATENTS

2,325,443 7/1943 Vroom ------------- 158—1.5
2,439,554 4/1948 Anderson ----------- 158—1.5
3,219,493 11/1965 Dunn ------------- 158—1.5

JAMES W. WESTHAVER, Primary Examiner.

E. G. FAVORS, Assistant Examiner.