

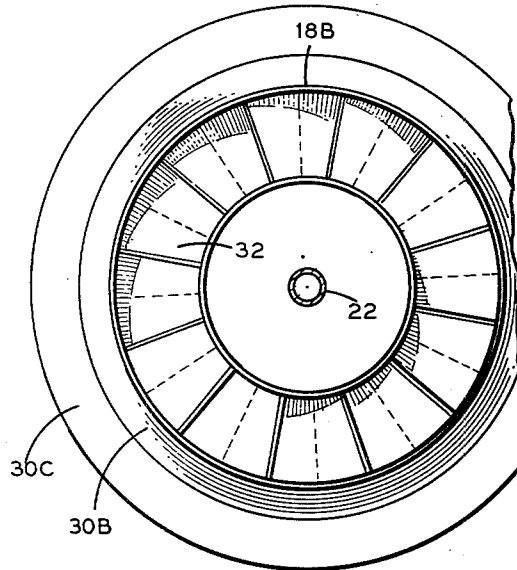
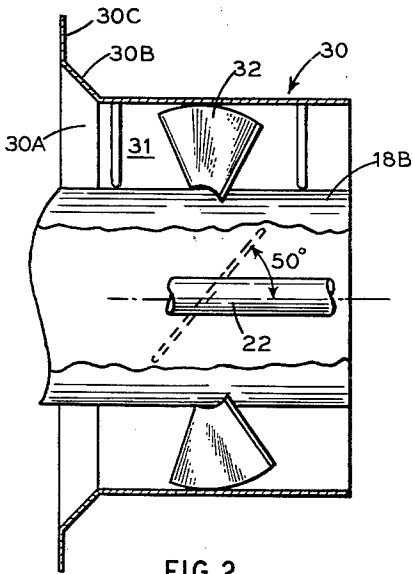
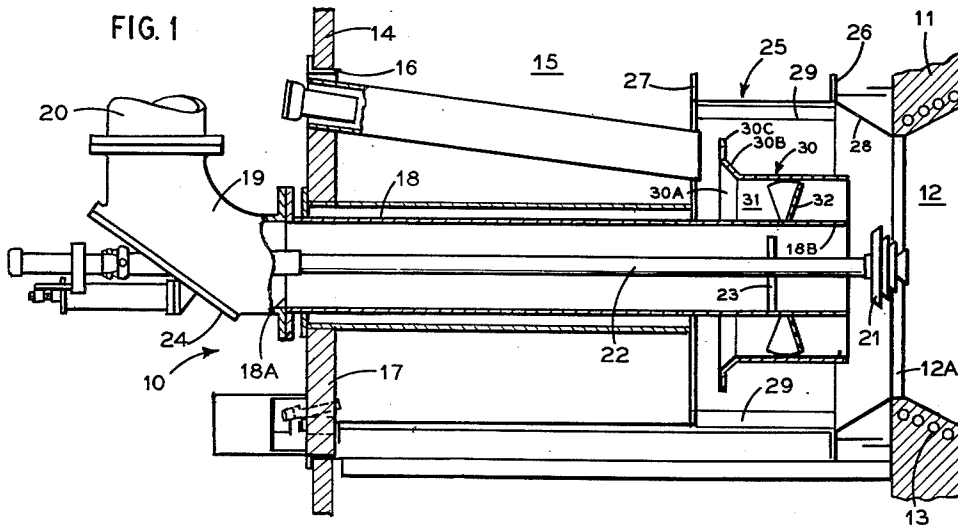
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METHOD AND APPARATUS FOR BURNING PULVERIZED COAL

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METHOD AND APPARATUS FOR BURNING PULVERIZED COAL

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This invention relates to a fuel burning method and apparatus therefor and more specifically to an improved method and burner means for firing pulverized coals which vary widely in volatile content.

Many relatively large vapor generators are fired by a plurality of pulverized coal burners, oftentimes numbering 20 or more, of the type in which a primary air stream is used to transport pulverized fuel from its source to the burners, with secondary air for supporting combustion being introduced around the discharge end of the burner nozzles. As such generating units consume large quantities of coal it is oftentimes impractical, if not impossible, to maintain or control the quality of coal supplied to the burners. For this reason, the coals burned in the normal daily operation of a unit may vary widely in volatile content, ranging from a high of 40% to a low of 17% for bituminous coals on an "as fired" basis. As a result, the analysis of the coals consumed in any particular vapor generating unit can vary widely at any time, and in multiple fired units the analysis of coal delivered to the various burners will frequently vary from burner to burner. Heretofore under such operating conditions there are instances of unstable ignition occurring over a considerable portion of the load range and during load changes on a unit when relatively low volatile content bituminous coal of 17 to 20% is supplied thereto. In fact such unstable ignition has resulted in loss of ignition and in multiple burner units the loss of ignition will tend to move progressively from one burner to another. For this reason oil lighters are required to be kept in continuous service.

It is therefore an object of this invention to provide an improved method and a burner arrangement for practicing the same which is capable of maintaining stable ignition throughout the operating load range of a vapor generator, when firing coals ranging from low to high volatile content.

Another object is to provide a method and burner arrangement for efficiently and effectively burning pulverized coal having a low volatile content during sustained low load operation of a generating unit.

The improved method by which the foregoing objects are attained comprises essentially of dividing the secondary combustion air so that a portion thereof is positively directed toward the center of the burner; injecting a fuel mixture of pulverized coal and primary air into the divided air stream adjacent the zone of ignition, and retarding the forward motion of that divided portion of the secondary air stream which is positively directed toward the center of the burner by imparting a whirling motion thereto. The net result is a turbulent mixing of the fuel-primary air mixture with the divided secondary air, thereby permitting the fuel to be retained in the ignition zone long enough to provide ignition of the low volatile fuel. Thus stable ignition of low volatile coal is insured over a wide load range.

According to this invention the foregoing objects, features and advantages are mechanically attained by a burner arrangement comprising an air register means positioned adjacent a burner port located in the furnace wall of the vapor generator. An air register means is concentrically disposed about a burner nozzle which discharges a mixture of pulverized coal and primary air into

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a combustion chamber. Disposed in spaced relationship about the nozzle, within the air register means, is a sleeve for dividing the secondary air flowing through the air register into inner and outer bands of air. Vane means are positioned within the sleeve at an optimum angle relative to the longitudinal axis of the nozzle in order to effectively retard the forward movement of the inner air stream a predetermined amount and to impart to it a whirling motion to effect optimum commingling of the fuel-air mixture with the secondary air in the ignition zone for a period of time sufficient to permit and maintain stable ignition.

A feature of the invention resides in disposing a vaned sleeve member about the discharge end portion of a burner nozzle within the air register of a pulverized coal burner so that a divided portion of highly turbulent secondary air is positively directed toward the center portion of the burner to insure retention of the fuel-air mixture within the ignition zone long enough to stabilize ignition when a low volatile coal is fired at low loads.

Another feature of this invention resides in the provision of establishing in a circular burner, an optimum ratio of the secondary air sleeve diameter to the burner throat diameter.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which we have illustrated and described a preferred embodiment of the invention.

In the drawings:

FIG. 1 is a sectional side view of the pulverized coal burner in accordance with this invention.

FIG. 2 is an enlarged detail sectional side view of the vaned sleeve member dividing and retarding the forward flow of a divided portion of secondary air.

FIG. 3 is a fragmentary view of the furnace end of the vaned sleeve of FIG. 2.

Referring to FIG. 1, the burner 10 of the instant invention is illustrated in association with a furnace wall 11 of a vapor generating unit. A burner opening in the wall is defined by a frusto-conical burner port 12 having a throat 12A. As shown, the inner surface of the port diverges toward the furnace side of the wall 11, and is cooled by fluid cooling tubes 13 which line wall 11 of the furnace. Spaced from the furnace wall 11 is the burner windbox front or outer burner wall 14 which defines therebetween an air chamber or windbox 15 into which combustion air is supplied. Suitable dampers, not illustrated, may be provided to control the amount of air entering into the windbox 15.

Located in the burner front 14 in axial alignment with the burner throat 12A is a circular access opening 16 for burner maintenance with a suitable closure 17 to seal the same. According to this invention the burner 10 includes a cylindrical nozzle 18 which extends through an opening in the closure 17 and across the windbox 15 to a point adjacent the burner throat 12A. Connected to the inlet end 18A of the burner nozzle 18 is an elbow 19 which in conjunction with a pipe 20 communicates with a source of the pulverized coal, e.g. a pulverizer, for supplying the burner 10, the pulverized coal being carried from the source in a stream of primary air. A coal impeller 21 is positioned slightly beyond the discharge end 18B of the nozzle and adjacent the burner throat. If desired, the impeller may be arranged for longitudinal adjustment by means of a rod 22 slidably supported within the nozzle by a suitable spider 23 and the end plate 24 of elbow 19.

Secondary air is supplied to the burner 10 through an

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air register means 25 which is disposed within the windbox 15 and adjacent the burner throat. As shown the air register means 25 is circumferentially spaced about the discharge end 18B of the burner nozzle 18.

The air register includes spaced front and rear end wall members 26 and 27, and an entrance cone 28 connected to the front wall 26 converging toward the burner throat 12. Circumferentially spaced and connected between end wall members 26, 27 about the periphery thereof are a plurality of air register doors 29 which are adapted to pivot between open and closed positions. With the air doors 29 in the open position, the air register is rendered in communication with the windbox 15. If desired, the air doors 29 are suitably geared, linked or otherwise connected together so as to be responsive to an operating means, not shown, which may be either manually or automatically controlled. Thus in the event that it becomes necessary to shut off the burner, all the air doors 29 may be simultaneously moved to the closed position by the actuation of the door operating means to cut off the air supply to the burner.

In addition to controlling the air supply to the air register, the air register doors 29 are also arranged to impart a whirling or spinning movement to the air flowing through the air register means 25. Because of the spin imparted to the secondary air, a relatively large portion will normally be concentrated in a narrow band hugging the inner periphery of the throat upon discharge therefrom. For this reason very little of the spinning air mass is directed toward the central portion of the burner throat 12. Therefore in the event the burner is being supplied with low volatile coal, an insufficient amount of secondary air is present at the center of the burner, thus resulting in unstable ignition and incomplete combustion.

In accordance with this invention ignition and combustion of the coals having low volatile content is improved by directing more of the secondary air toward the center portion of the burner, while simultaneously enhancing the spin thereof to increase turbulence at the point of fuel discharge.

According to this invention this is attained by an air sleeve 30 disposed within the air register 25 and concentrically spaced about the discharge end 18b of the nozzle 18. The inlet end 30A of the sleeve is spaced from the rear end wall 27 of the air register 25 and is defined by an outwardly flared end portion 30B terminating in a laterally extending flange 30C.

In order to increase the turbulence of the inner stream of the divided secondary air, vanes 32 are disposed in the annulus 31 formed between sleeve 30 and the burner nozzle. In the illustrated embodiment, vanes 32 are equidistantly spaced and secured in the annular chamber 31 formed between the sleeve and the burner nozzle. The vanes 32 are arranged to enhance the spin of the inner stream of air by spinning it in the same direction as the initial spin imparted to the air by the air register doors 29. Thus the vanes 32 enhance the turbulence of the inner stream while at the same time retarding its forward movement. This permits the fuel particles to be retained in the ignition zone for a time sufficient to insure ignition.

It has been observed that an optimum vane angle of substantially 50° relative to the longitudinal axis of the burner, turned in the direction of the rotating air stream, was best suited for effectively burning low (17 to 20%) volatile coals. It was also found that a burner so arranged would satisfactorily burn coals having a volatile content of more than 20%. Experiments have shown that the use of a vane angle greater than 50°, although beneficial in burning low (17 to 20%) volatile coal, would result in furnace pulsations when coals having over 20% volatile content are supplied to the burner. Vanes 32 angled at less than 50° relative to the longitudinal axis of the burner resulted in unstable ignition.

Actual tests also have indicated that the most favorable

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results occurred when the diameter of the sleeve 30 was approximately 68% to 72% of that of the burner throat diameter 12A. In other words for a burner having throat diameter of 36 or 38 inches, a sleeve having a 26 inch internal diameter proved the most effective.

An important feature of this invention is that the vane sleeve construction results in a negligible pressure drop through the burner. For this reason the vane sleeve construction can be readily adapted to existing burners without disturbing the design characteristics thereof.

While in accordance with the provisions of the statutes there is illustrated and described herein the best form and mode of operation of the invention now known, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by the claims, and that certain features of the invention may sometimes be used to advantage without a corresponding use of other features.

What is claimed is:

1. An improved fuel burner means adapted for burning either high or low volatile pulverized coal with equal facility when burning said coal only comprising an air register for receiving secondary combustion air, said register having an axial outlet, means for imparting a whirling movement to the combustion air flowing through said register to said register outlet, a burner nozzle disposed within and extending axially of said register, said burner nozzle having a discharge end portion opening adjacent said register outlet for ejecting a fuel mixture of pulverized coal and primary air into the air discharging from said register, a cylindrical sleeve having an outwardly flaring inlet and circular outlet concentrically disposed in spaced relationship about the burner nozzle adjacent the discharge end portion thereof and within said register whereby said sleeve divides the combustion air within said register into an inner and an outer band of whirling air, said sleeve directing the inner band of air toward the discharge end of said nozzle, vanes disposed within said sleeve at an intermediate point between the flared inlet and circular outlet end thereof, said vanes being disposed so as to enhance the whirling motion of the inner band of air to retard the forward velocity of said inner air band relative to that of the outer air band and enhance turbulence at the discharge end of said nozzle so as to effect intimate mixing of the fuel with secondary air and retention of the fuel mixture in an ignition zone long enough to properly stabilize ignition over the load range of the burner means.

2. The invention as defined in claim 1 wherein said vanes are disposed at an angle of substantially 50° relative to the longitudinal axis of said nozzle.

3. The invention as defined in claim 1 wherein the diameter of the circular outlet of said sleeve is equal to approximately 68 percent of the diameter of said axial outlet of said register.

4. The invention as defined in claim 1 wherein the vanes in said sleeve enhance the whirling motion of said inner band of air in the same direction as the whirling of the combustion air flowing through said register.

5. An improved fuel burner means adapted for burning either high or low volatile pulverized coal with equal facility when burning said coal only comprising an air register for receiving secondary combustion air, said air register having a converging approach cone defining an axial outlet, means for imparting a whirling movement to the secondary air upon entering said register, a burner nozzle extending axially of said register, said burner nozzle having a discharge end for ejecting a fuel mixture of pulverized coal and primary air, a cylindrical sleeve having a flaring inlet and circular outlet concentrically disposed in spaced relationship about the burner nozzle adjacent the discharge end portion thereof and within said register whereby said sleeve divides the combustion air in said register into an inner and outer annular whirling band

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of air, said sleeve directing the inner band of air toward the fuel mixture ejecting from the discharge end of said nozzle, said nozzle and said sleeve having their respective discharge ends terminating in a common plane disposed normal to the longitudinal axis of said burner nozzle, the discharge end of said sleeve having a diameter which is at least 68 percent that of said axial outlet of said register, a plurality of vanes circumferentially disposed within said sleeve at an intermediate point between the flared inlet and circular outlet end thereof, said vanes being disposed so as to enhance the whirling motion of the inner band of air in the same direction as the combustion air in said register so as to effect a retarding of the forward velocity of said inner air band relative to that of the outer air band while at the same time enhancing turbulence at the discharge end of said nozzle to effect retention of the fuel mixture in an ignition zone long enough to properly stabilize ignition over the load range of the burner means,

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and said vanes being angled at substantially 50° relative to the longitudinal axis of said burner nozzle.

6. The invention as defined in claim 1, wherein said sleeve has a circular air discharge end and an outwardly flared air inlet end portion terminating in a laterally extending flange disposed in a plane perpendicular to the longitudinal axis of said nozzle, the discharge ends of said nozzle and sleeve terminating in a common plane disposed normal to the longitudinal axis of said nozzle.

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