

3,145,670

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Aug. 25, 1964

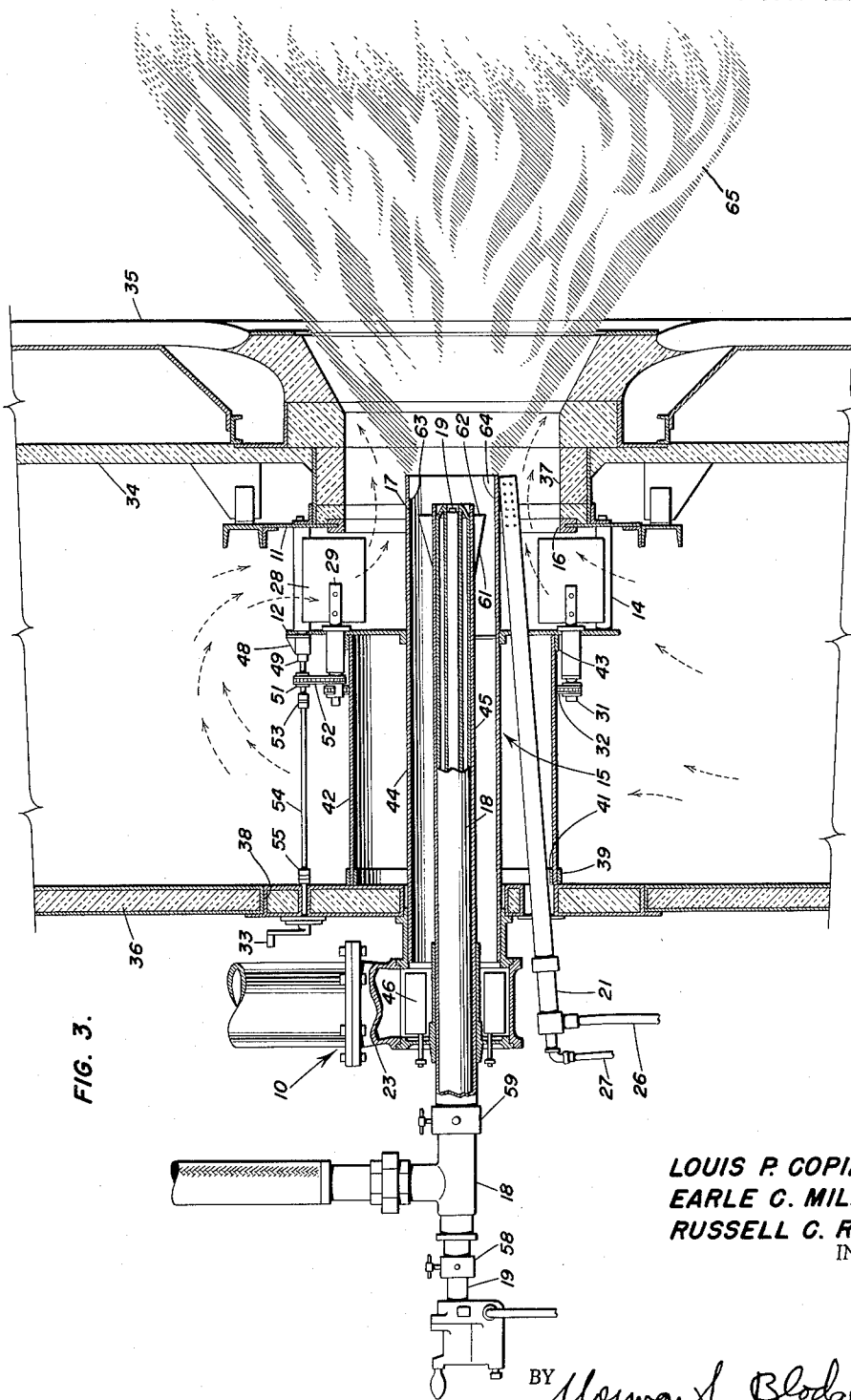
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BURNER

Filed March 16, 1961

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BURNER

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FIG. 6.

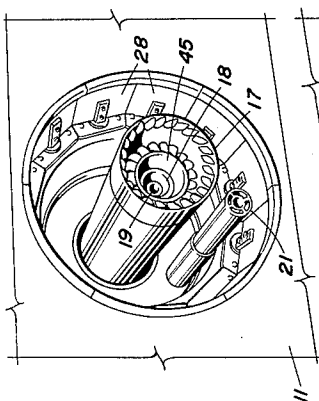


FIG. 7.

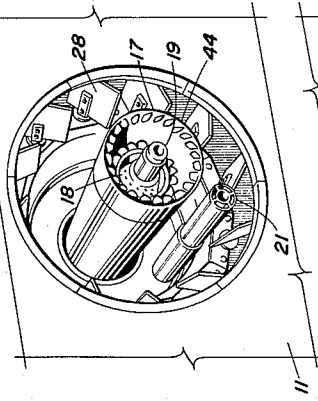


FIG. 8.

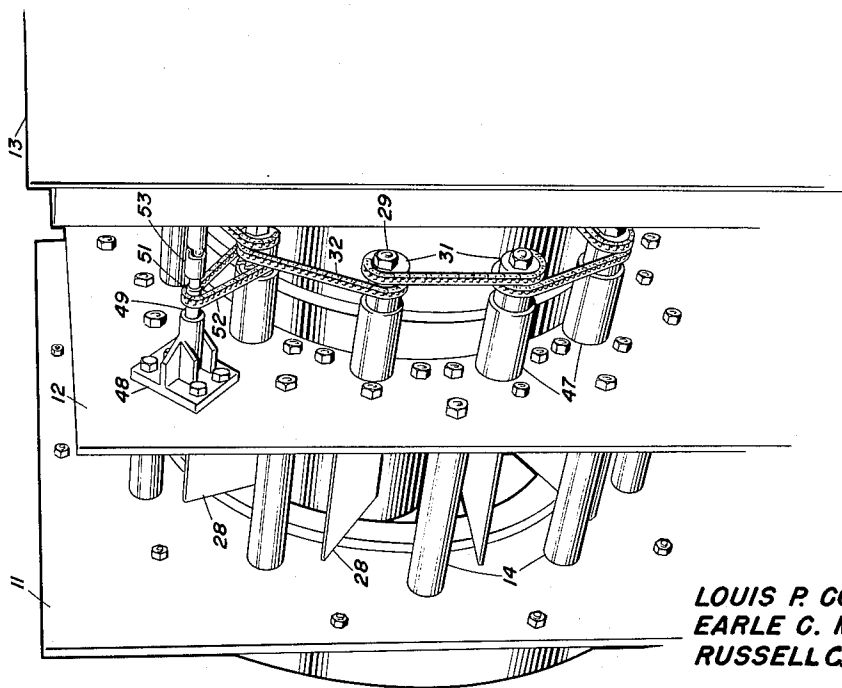
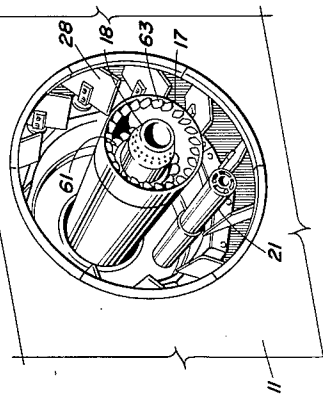


FIG. 4.

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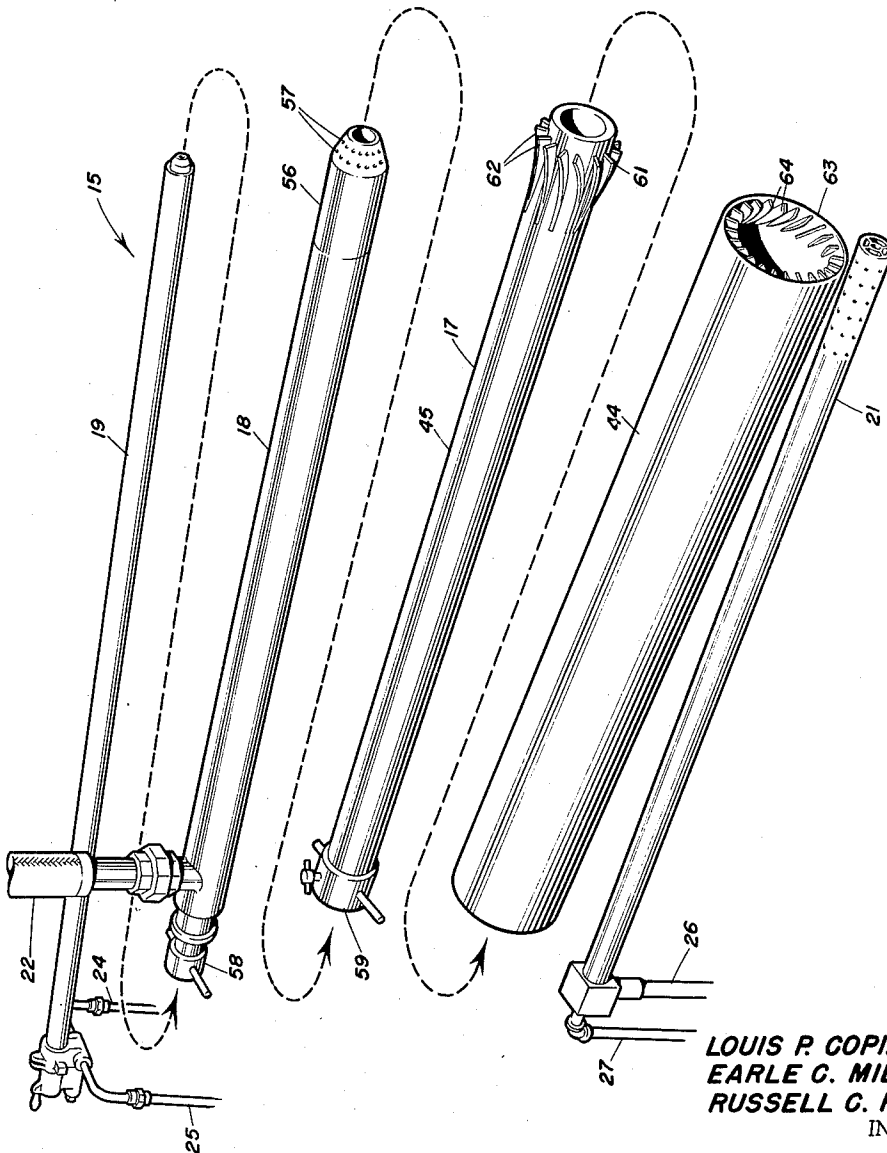
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BURNER

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FIG. 5.



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3,145,670 BURNER

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Filed Mar. 16, 1961, Ser. No. 96,132
3 Claims. (Cl. 110—28)

This invention relates to a burner and more particularly to apparatus arranged to burn various fuels in the combustion chamber of a steam generating unit.

Burners which have been designed and built in the past for use in steam generating units have suffered from a number of important disabilities. One problem is presented by the fact that one portion of the burner is exposed to the furnace heat, while the outward portion is exposed to the relatively cool air outside the furnace. This means that a considerable variation in thermal expansion takes place between the various parts of the burner and it means that the operating elements of the burner are very likely to bind. In burning pulverized coal there is considerable difficulty experienced with stratification of the coal, i.e., the coal tends to flow through the burner in one portion only. This results in poor mixing of air and fuel with the effect that the flame is very long and causes slagging on the opposite wall of the furnace, as well as other difficulties. In addition, it has been difficult in the past to arrange the vanes of the burner in such a way that they can be completely closed or can be set at various angles to produce a desired air flow into the fuel. These and other difficulties experienced with the prior art devices have been obviated in a novel manner by the present invention.

It is, therefore, an outstanding object of the invention to provide a burner for a steam generating unit in which the portions of the burner which are exposed to furnace heat are mechanically independent of the portions which are exposed to the cool air outside of the furnace.

Another object of this invention is the provision of a burner having vanes which may be completely closed in either direction of turning and may be set at any desired angle or hand to the axis of the burner while individual vanes may be preset at various angles relative to the other vanes.

A further object of the present invention is the provision of a burner having means for adjusting the vanes, which means is relatively free of difficulty due to fouling by dirt and the like.

It is another object of the instant invention to provide a burner for pulverized coal in which means is provided to assure that the coal is thoroughly mixed with the secondary air.

It is a further object of the invention to provide a burner which is so constructed as to be free of binding of any mechanical moving parts due to heating or cooling of burner support members.

A still further object of this invention is the provision of a burner providing a smooth, stable, non-pulsating flame throughout the entire burner load-range and in which turbulent mixing of the primary air-coal mixture with the secondary air takes place without any possibility of plugging of the coal nozzle.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

The character of the invention, however, may be best understood by reference to one of its structural forms, as illustrated by the accompanying drawings in which:

FIG. 1 is a perspective view of the burner as observed from the furnace side;

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FIG. 2 is a perspective view of the burner as observed from the outside of the furnace, looking toward the furnace;

FIG. 3 is a sectional view of the burner taken on the line III—III of FIG. 1;

FIG. 4 is a perspective view of the invention taken slightly sideways of the burner;

FIG. 5 is a perspective view of various elements of the burner separated, and

FIGS. 6, 7, and 8 show various conditions of the burner during use.

Referring first to FIGS. 1 and 2 in which are best shown the general features of the invention, the burner, indicated generally by the reference numeral 10, is shown as having a throat section 11, an intermediate section 12, and an outer section 13. All three sections are generally plate-like in form and are parallel to one another and at right angles to the axis of the burner. The throat section 11 and the intermediate section 12 are relatively close together and are joined rigidly by posts 14 which are arranged in a circle concentric with the axis of the burner, these posts constituting the only connection between the throat section and the intermediate section. Extending through all three sections concentrically of the burner axis is a fuel gun 15. The gun is supported by the outer section 13 and the intermediate section 12 but extends through a large circular aperture 16 in the throat section 11. The fuel gun 15 consists of a pulverized-coal gun 17, a gas gun 18, and an oil gun 19, these guns being arranged concentrically one within the other in the order named. Extending through the aperture 16 adjacent the fuel gun is a gas-electric igniter 21.

Connected to the outer end of the gas gun 18 is a conduit 22 for supplying the gun with gas. Attached to the pulverized coal gun 17 is a fitting 23 adapted to be connected to a pulverized coke conduit extending to the burner from a pulverized coal pulverizer. This fitting will admit to the gun a mixture of primary air and pulverized coal. Attached to the oil gun 19 are oil-supplying conduits 24 and 25. Connected to the outer end of the gas-electric igniter 21 is a gas conduit 26 and an electric cable 27. Located between the throat section 11 and the intermediate section 12 are a series of secondary air vanes 28, the vanes being arranged for rotation with shafts 29, which shafts are arranged in a circle within the circle of the posts 14. The shafts extend through the intermediate section 12 into the space between the intermediate section and the outer section 13. In this space each shaft is provided with a connection 31 attached to one end of a sprocket chain 32. A crank 33 extends outwardly of the outer section 13 and serves to actuate the sprocket chains 32 and the shafts 29.

Referring next to FIG. 3 which shows a vertical sectional view of the burner, it can be seen that the burner 10 is used in connection with a steam generating unit 34 having a combustion chamber wall 35 and a wind box or air duct wall 36, these walls being parallel and spaced from one another. The throat section 11 is bolted to the furnace chamber wall 35 with its aperture 16 aligned with a similar aperture or throat 37 formed in the wall 35. With the throat section 11 firmly bolted to the wall 35 it can be seen that the posts 14 support the intermediate section 12 in the same way, i.e., rigidly attached to the combustion chamber wall 35. The outer section 13 fits snugly in a square aperture 38 formed in the duct wall 36 and is rigidly attached thereto. The inner surface of the outer section 13 is provided with a pair of rings 39 and 41 which are concentric with the burner axis and which define a narrow annular space. In this space is slidably mounted a drum-like housing 42 which extends concentrically of the burner axis to the outwardly-facing surface of the intermediate section 12.

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The furnace end of the housing 42 extends into a ring 43 welded to the outwardly facing surface of the intermediate section 12 and slides in that ring rather loosely. In this view it can also be seen that the fitting 23 is connected to an outer tubular portion 44 of the pulverized coal gun 17. Lying concentric to and within this portion is an inner tubular portion 45. The usual directing vanes 46 are associated with the connection of the fitting 23 to the portions 44 and 45 to permit the primary air and pulverized coal mixture to make the right-angle turn properly. This view shows clearly the manner in which the gas gun 18 lies within the inner tubular portion 45 of the pulverized coal gun while the oil gun 19 extends slidably through the gas gun 18. It can also be seen that the gas-electric igniter 21 is supported in both the outer section 13 and the intermediate section 12 with its furnace end located closely adjacent the furnace end of the fuel gun 15. This view shows particularly well the manner in which each secondary air vane 28 is bolted to the inwardly-directed end of its shaft 29 which, in turn, extends through the intermediate section 12 and is provided at its outer end with a connection 31. The connection is fastened to the outer end of the shaft 29 in such a way that it can be adjusted about that shaft independently of the other apparatus in the burner. In other words, the loosening of the set screws between a connection and its shaft will permit an individual vane 28 to be adjusted independently of the other vanes.

In FIG. 4 can be seen the manner in which the vane adjustment takes place. Each of the shafts 29 is mounted in a cast iron bearing 47 bolted to the intermediate section 12 and providing considerable axial support because of its elongation in the direction axially away from the furnace. It should also be noted that the connections 31 are constructed in such a way that a length of sprocket chain 32 extends at one end around the connection of each shaft and at the other end around the connection of an adjacent shaft. In addition, a further bearing block 48 is mounted on the outer surface of the intermediate section 12 and is provided with a stub shaft 49 on which is mounted a sprocket wheel 51 which drives a short sprocket chain 52 which drives one of the connections 31. The outer end of the shaft 49 is connected through a universal joint 53 to a drive shaft 54 which is connected through another universal joint 55 (see FIG. 3) to the hand crank 33.

FIG. 5 shows the components of the fuel gun 15. The oil gun 19 and its associated conduits 24 and 25 is of the conventional type. The gas gun 18 served by the conduit 22 is of the tubular type having a double-walled conical nose 56 with gas apertures 57. The gas gun 18 is formed of two concentric tubular walls (as can best be seen in FIG. 3), the outer wall fitting snugly within the inner tubular portion 45 of the pulverized coal gun 17. The oil gun 19 fits snugly within the inner tubular wall of the gas gun 18. The outer end of the gas gun 18 is provided with a lock collar 58 which clamps the oil gun 19 and holds it in a fixed position relative to the gas gun. In the same way the outer end of the inner tubular portion 45 of the pulverized coal gun 17 is provided with a lock collar 59 by which the axial position of the gas gun 18 can be fixed. This part of the drawings shows the manner in which the outer tubular portion 44 and the inner tubular portion 45 of the pulverized coal gun 17 are provided with spinners. The inner tubular portion 45 is provided with an inner spinner 61 having vanes 62 which are formed with a helix of long lead and which extend outwardly from the axis of the gun by varying distances, the distance increasing toward the furnace. The outer tubular portion 44 of the pulverized coal gun is provided with an outer spinner 63 having vanes 64 which extend inwardly and with the same hand and the same lead as the vanes 62 of the inner spinner 61. The vanes 64, however, extend toward the axis of the burner the same dis-

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tance at all points and they do not taper as the vanes 62 do.

The operation of the apparatus will now be readily understood in view of the above description. Preheated air arrives at the burner in the wind box between the combustion chamber wall 34 and the air duct wall 36. The air which arrives in that manner extends entirely around the burner. Assuming that all three fuels, i.e., oil, gas, and pulverized coal, are to be burned, the oil arrives through the conduits 24 and 25 to the gun 19; the gas arrives through the conduit 22 to the gas gun 18; and the primary air and pulverized coal arrives from the pulverizer through the fitting 23 to supply the pulverized-coal gun 17. The air flows through the annular space between the throat section 11 and the intermediate section 12 and flows over the secondary air vanes 28. The setting of these vanes will determine the manner and amount of air which flows in this manner. The air then flows axially toward the furnace between the fuel gun 15 and the aperture 16 in the throat section and the throat 37 formed in the wall 35. The fuel flows from the fuel gun in an axial direction and the secondary air and fuel combine to form the flame 65. The mixture of pulverized coal and primary air flows axially between the outer tubular portion 44 and the inner tubular portion 45 and eventually strikes the inner spinner 61. The vanes 62 cause the coal and air mixture to rotate slightly and this rotation causes the heavy particles to be thrown outwardly by centrifugal force against the inner surface of the outer tubular portion 44 of the gun. As is evident in FIG. 3, the portions of the gun are adjusted so that the inner spinner 61 is spaced upstream slightly from the outer spinner 63; the design of the vanes 62 and the spacing between the two spinners is such that, by the time the fuel reaches the outer spinner 63, the heavy particles are moving close to the inner surface of the outer tubular portion 44. Fuel, air, and the heavier particles of fuel strike the vanes 64 of the outer spinner 63 and are given an additional spinning action. This means that the fuel and particularly the heavier particles are projected outwardly from the front of the gun with a considerable spin about the axis of the gun, and it is in this condition that they meet the air arriving from the wind box. This spinning action of the heavy particles produces a beneficial turbulent mixing of the fuel and air and particularly good mixing of the air with the heavy particles. These heavy particles would normally be delayed in combustion and would cause such problems as slagging on the opposite wall of the furnace experienced with prior art burners. The provision for the adjustment of the individual vanes 28 may be useful if it is desired to produce an even flow of air through the annular flow passage in the burner despite variations in air pressure and flow around the burner. The provision for adjustment between the connections 31 and their shafts 29 permits angular adjustment of a single vane to be accomplished without disturbing the other vanes. On occasion it is desirable to bias the burner, that is to say, produce a greater flow of air at one part of the annular passage than at another, to cause the flame to be directed in one direction or another; it is, of course, possible to adjust the vanes to different angles to produce this effect. Once the vanes have been set at particular angles to one another, or at equal angles to one another, it is possible for the vanes to be moved to various positions in the range from closed position (where it is tangential to an imaginary cylinder in the burner) to an entirely open position (in which all of the vanes extend radially of the burner axis) by turning the crank 33. This turning action operates through the universal joint 55, the drive shaft 54, and the universal joint 53 to rotate the shaft 49 and its sprocket wheel 51 whereby the chains 52 drive the shafts 29. This movement of the chains 32, of course, causes equal rotations of all of the vanes 28 to open or close them and to

set them at various degrees of openings to control the flow of air through the burner.

The provision for sliding motion of the various elements of the fuel burner 15 relative to one another allows various portions of the burner that are not being used in a particular instance to be withdrawn so that they are not harmed by exposure to the radiant heat of the furnace. In FIG. 6, for instance, is shown the condition of the elements during coal firing only. The gas gun 18 and the oil gun 19 are drawn well inside of the inner tubular portion 45 of the pulverized coal gun 17. In FIG. 7 the situation is shown where oil firing only is used. The gas gun 18 is withdrawn well within the inner tubular portion 45 of the pulverized coal gun 17 while the oil gun 19 extends forwardly to a point extending toward the furnace about the same distance as the outer tubular portion 44 of the pulverized coal gun. In this condition, it is possible, also, to fire pulverized coal. In FIG. 8 is shown the condition wherein gas firing alone is used, and it can be seen that the gas gun 18 extends forwardly toward the furnace while the oil gun 19 is withdrawn deep within the gas gun and cannot be seen. The pulverized coal burner, however, as in all situations, extends forwardly in its normal position and, of course, coal firing could take place with the gun as shown. In FIG. 6 the vanes 28 are shown in closed position; in FIGS. 7 and 8 the vanes 28 are shown partly open. As is obvious from an examination, the spin of the air produced by the vanes 28 in FIG. 8 is the same hand as the spin produced by the inner spinner 61 and the outer spinner 63. This situation could, of course, be reversed, with the vanes going in the opposite direction to produce even greater turbulence between the pulverized coal and the secondary air.

It is obvious that minor changes may be made in the form and construction of the invention without departing from the material spirit thereof. It is not, however, desired to confine the invention to the exact form herein shown and described, but it is desired to include all such as properly come within the scope claimed.

The invention having been thus described, what is claimed as new and desired to secure by Letters Patent is:

1. A burner for steam generating unit having a combustion chamber wall and an air duct wall spaced outwardly therefrom, comprising a throat section adapted to be mounted on the chamber wall, an outer section adapted to be mounted on the duct wall, an intermediate section located between the throat section and the outer section, a fuel gun supported by the outer and intermediate sections and extending through an opening in the throat section, secondary air vanes extending between the intermediate and throat sections, a series of shafts each of which carries one vane and constitutes the sole support for its vane, a series of bearings mounted on the intermediate section, each of the bearings carrying the outer end of one of the said shafts, each of the shafts protruding from both sides of the intermediate section, one of the said vanes mounted on the portion of each shaft which extends toward the throat section, a chain drive mounted on the portion of each shaft extending away

from the furnace, the chain drive extending around each of the shafts, means for driving the chain drive for the rotation of the shafts and the vanes simultaneously, and means for adjusting each vane shaft relative to the chain drive without disturbing the other vane shafts and vanes.

2. A burner for a steam generating unit having a combustion chamber wall and an air duct wall spaced outwardly therefrom, comprising a throat section adapted to be mounted on the chamber wall, an outer section adapted to be mounted on the duct wall, an intermediate section located midway between the throat section and the outer section, a fuel gun supported by the outer and intermediate sections and extending through an opening in the throat section, secondary air vanes extending between the intermediate and throat sections, a series of shafts each of which carries one vane and constitutes the sole support for its vane, a series of bearings mounted on the intermediate section, each of the bearings carrying the outer end of one of the said shafts, the shafts protruding from both sides of the intermediate section, one of the said vanes mounted on the portion of each shaft which extends toward the throat section, a chain drive mounted on the portion of each shaft extending away from the furnace, the chain drive extending around the shafts, means for driving the chain drive for the rotation of the shafts and vanes simultaneously, means for adjusting each vane shaft relative to the chain drive without disturbing the other vane shaft and vanes, the gun consisting of an outer tubular portion adapted to receive a mixture of pulverized coal and air and an inner tubular portion of generally cylindrical formed supported coaxially of the outer portion, an inner spinner mounted on the inner portion and having outwardly-extending vanes, an outer spinner mounted on the outer portion and having inwardly-extending vanes, the outer spinner vanes and the inner spinner vanes being directed toward each other and being spirally-formed of the same hand, the radial extent of the inner spinner vanes increasing gradually in the direction of the furnace.

3. A burner as set forth in claim 2 wherein a series of posts join the intermediate and the throat sections and constitute the only connection therebetween, a drum-like housing extending between the outer and intermediate sections and connected at its ends to the sections by means capable of permitting angular movement therebetween.

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