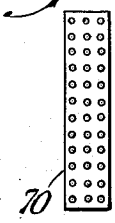
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BURNER INCLUDING AIR FEED MEANS

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Fig. 4



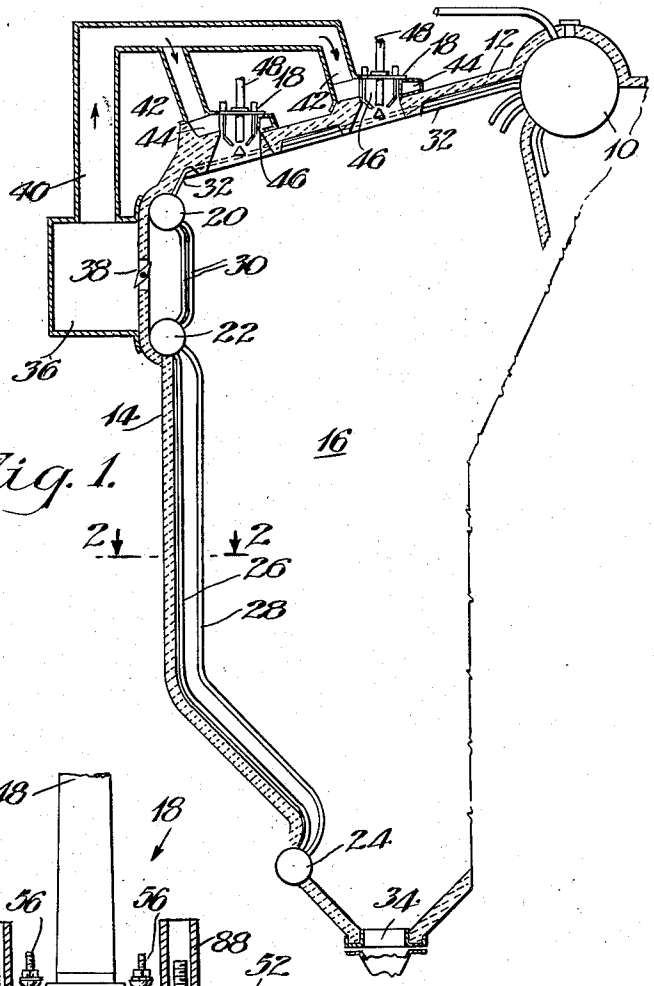


Fig. 1.

Fig. 2.

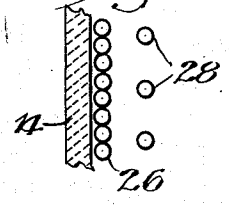
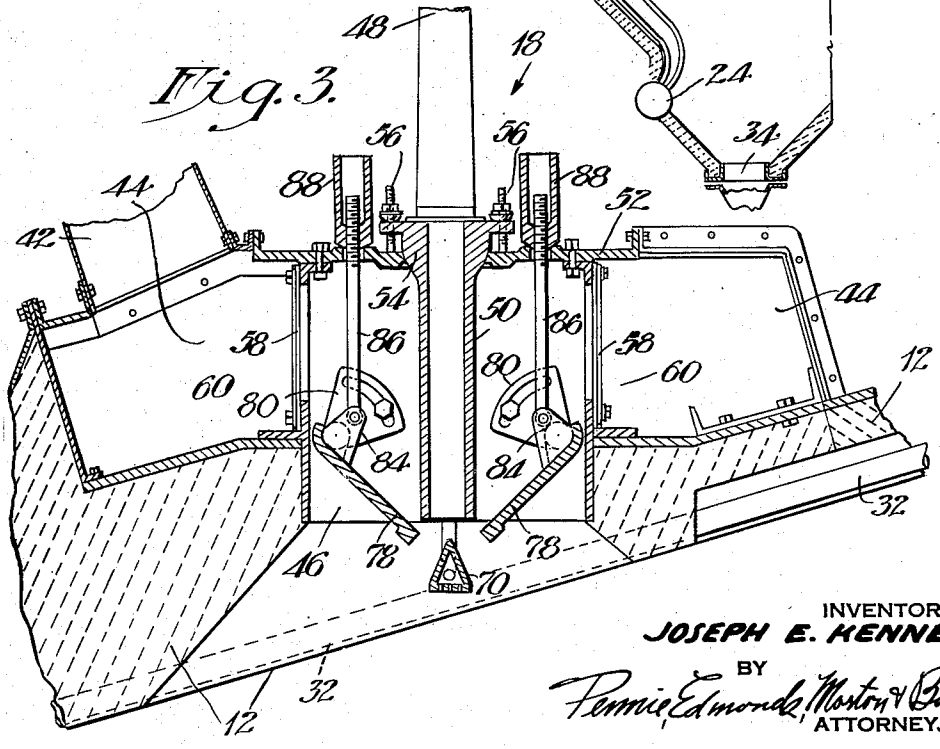


Fig. 3.



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Fig. 5.

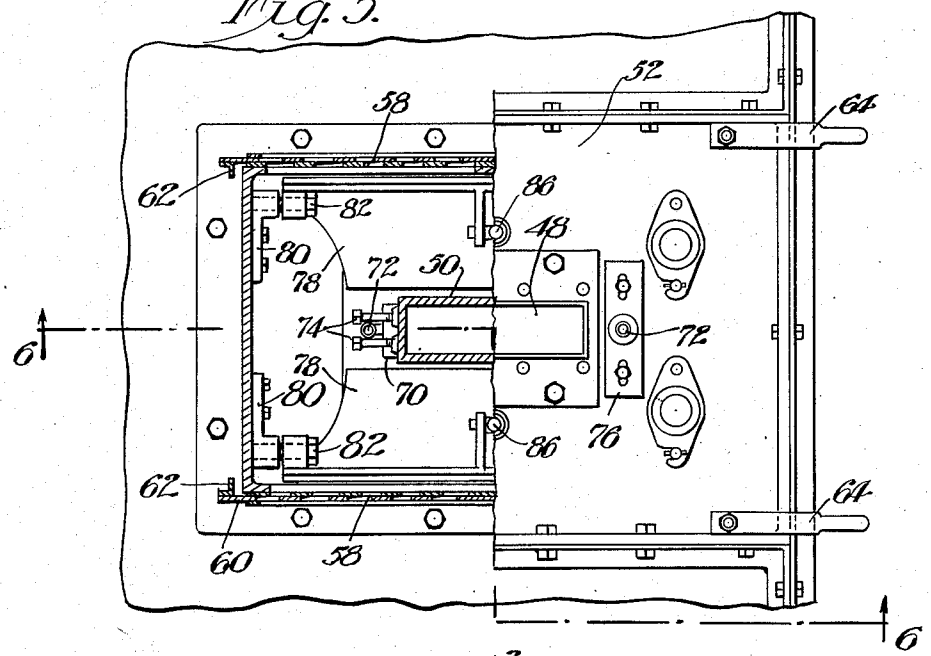
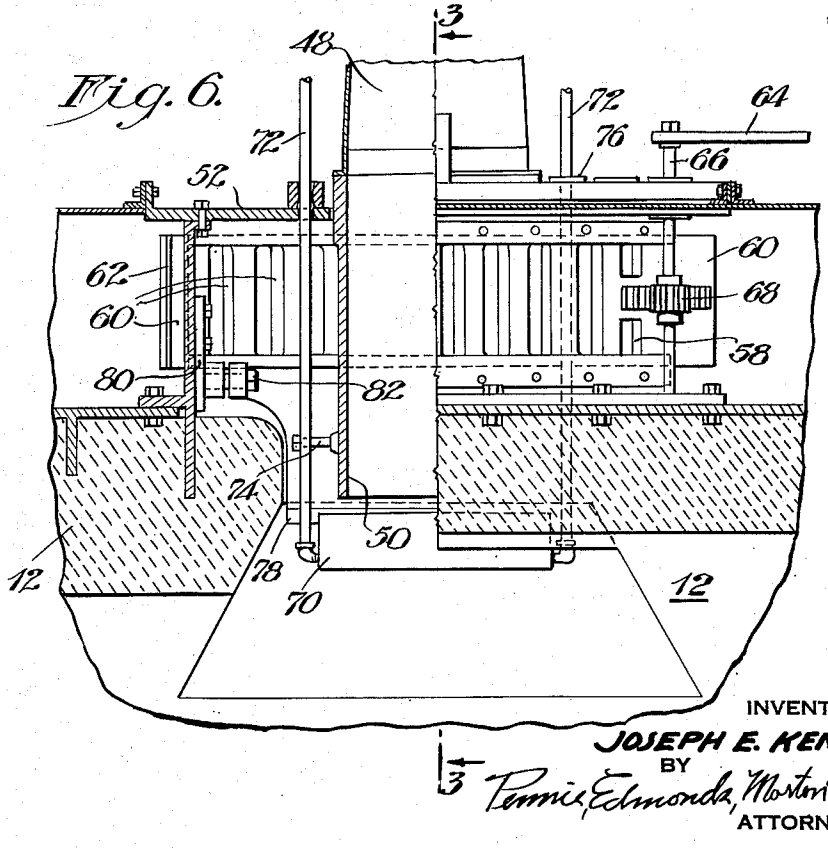


Fig. 6.



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BURNER, INCLUDING AIR FEED MEANS

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7 Claims. (Cl. 110—28)

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My invention relates to improvements in steam generator burner constructions adapted for the effective combustion of pulverized coal and more particularly for the burning of pulverized anthracite coal.

The problem of burning pulverized anthracite coal in steam generators has created considerable difficulties because of attempts to adapt present generator constructions for the use of pulverized anthracite coal. Furthermore, anthracite coal varies considerably in moisture content as well as in ash and other constituents. It is therefore difficult to provide a furnace burner construction which is readily adjustable for handling coals of various composition and moisture content.

The primary object of my invention is to provide improved burners for the effective handling of pulverized fuels.

Another object of my invention is to provide an improved burner construction which will provide for effective mixing of air and pulverized coal and which is readily adjustable for variations in the temperature of the preheated air and the composition and fineness of the pulverized coal.

A further object of my invention is to provide an improved method of firing steam generators with pulverized fuels.

According to my invention the improved burner structure includes an air supply box having one side opening into a combustion chamber, a burner tube having a cross-section which is long and narrow for delivering a stream of burning fuel, the burner tube extending through the air box and opening at said open side into the combustion chamber, air deflector means associated with the side of the air box opening into the combustion chamber and with the outlet end of the burner tube for directing air from the box into and toward the stream of burning fuel discharged from the burner tube, means for adjusting the deflector means with respect to the sides of the burner tube outlet, a fuel deflector at least as long as the burner tube outlet opening and mounted opposite the outlet end of the burner tube in the path of the fuel issuing therefrom, and means for supplying air to and through said fuel deflector for use in burning fuel from the burner tube, the fuel deflector being constructed and arranged for distributing air into the combustion products from the burner tube.

In the preferred method of my invention the pulverized coal is produced by a tube mill and delivered to the burners at the top of the combustion chamber of the generator in a stream

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of preheated air which is preferably produced by the generator. This mixture including primary air, is delivered through the burner orifices which are preferably flat or elongated and then passed over a V-shaped deflector so as to substantially divide the stream of fuel of each burner. In a preferred construction and method of operation highly preheated air, which may be called secondary air, is introduced at a deflected angle into the fuel mixture.

In some attempts to burn pulverized anthracite coal considerable losses have been encountered because of the incomplete burning of carbon particles, a large proportion of which is carried out with the ash while other quantities are discharged from the furnace with the smoke.

The features of construction and operation of my improved burner are illustrated hereinafter in connection with a steam generator unit.

My improved invention includes other features and advantages which will be apparent to those skilled in the art from the following more detailed description thereof taken in connection with the accompanying drawings which form a part of this application.

In the drawings:

Fig. 1 is a broken vertical sectional view of a steam generator unit, the view showing particularly the construction and arrangement of a portion of the combustion chamber.

Fig. 2 is a broken sectional view taken on the line 2—2 of Fig. 1, showing the arrangement of the tube wall of the combustion chamber.

Fig. 3 is a vertical sectional view of the improved burner construction of the present invention, the view being a broken view taken on the line 3—3 of Fig. 6.

Fig. 4 is a view showing the bottom of the deflector shown in Figs. 3 and 6.

Fig. 5 is a broken top view partly in horizontal section of the burner construction shown in Fig. 3.

Fig. 6 is a broken view of the burner construction shown in Figs. 3, 4 and 5 taken on the irregular line 6—6 of Fig. 5.

The steam generator of my invention is illustrated in connection with relatively large units of the type used in power plants in which large quantities of steam are produced as well as superheated steam. Referring to Fig. 1 of the drawings which show such a plant with parts largely broken away the installation comprises a steam and water drum 10 mounted in the upper part of the setting and from which a sloping roof 12 extends down to a side wall 14. The roof 12 and wall 14 are insulated and comprise parts of

a combustion chamber 16 provided with down draft combustion from burners 18 which are supplied with a mixture of preheated air and pulverized coal in the usual manner.

The combustion chamber structure includes an upper header 20 for the wall 14, an intermediate header 22 spaced substantially directly below the header 20 and a bottom header 24. The wall 14 in addition to including the outer insulated part includes a tube wall comprising closely mounted tubes 26 between the headers 22 and 24, as well as a shadow wall comprising tubes 28 spaced from the tubes 26 and also spaced from each other as shown in the detailed view of Fig. 2. The upper headers 20 and 22 are connected by relatively short steam generating tubes 30, alternate ones of which are bent out of line so as to provide spaces therebetween. The header 20 is connected with the steam and water drum 10 by means of roof tubes 32 which carry the steam and water from the tubes of the wall 14 into the steam and water drum. Water is supplied to the header 24 in the usual manner by a down-comer or supply line not shown.

The combustion gases generated in the upper part of the combustion chamber 16 pass downwardly substantially to the bottom of the chamber and are then directed to the right through suitable passages where the gases are utilized for superheating of steam and other purposes which are not illustrated and which form no part of the present invention. The ashes produced in the combustion chamber for the most part settle to the bottom and are withdrawn through an ash door 34.

Preheated air is provided for the upper part of the combustion chamber 16 through a duct 36 which for purposes of illustration is mounted opposite the tubes 30 for the convenience of supplying air to the upper part of the combustion chamber around these tubes. For this purpose the side of the air duct 36 is provided with a plurality of dampers 38 for the control of air introduced around the tubes 30. Other preheated air is connected through a duct 40 including branches 42 to the burners 18 mounted in the roof of the combustion chamber. This air first passes into an outer surrounding air supply chamber 44 then into an air box 46 which immediately surrounds the orifice tube of the burner. The mixture of pulverized coal and primary air for the burner 18 is supplied through ducts 48.

The burners shown more or less diagrammatically in Fig. 1 of the drawings are illustrated in substantial detail in Figs. 3 to 6 inclusive in which it will be noted that the ducts 48 connect directly with flat burner orifice tubes 50 which are shown in cross section. These orifice tubes 50 are mounted in a burner setting or frame work 52 by means of rounded upper side portions 54, which permit the angular adjustment of the orifice tube, the tube being bolted to the mounting by means of bolts 56 which may be utilized in a well known manner for adjusting the side angle of the orifice tube 50.

The orifice tube 50 in each burner extends through the surrounding air box 46 which is supplied with air from the outer air compartment 44 through a grating 58 on each side of the air box, each grating including a movable slotted slide 60 for controlling the air flow into the box 46. This slide on each side of the burner properly serves as a damper, and it will be noted that as shown in Fig. 5, each is provided with a stop 62. The slides are operated from the top of the burner mounting by handles 64 mounted on shafts 66 which extend along outside of the gratings and which carry a pinion 68 operating in a rack on the slide as shown in Fig. 6.

The burner construction includes a deflector 70 mounted directly below the burner orifice which comprises a hollow member of triangular cross section with a plurality of holes drilled in the side opposite the end of the burner orifice tube 50. This bottom side is shown in Fig. 4 of the drawings. Preheated air is supplied to the deflector through a pair of end pipes 72, which are preferably connected to a blower not shown so that the air will be supplied at relatively higher pressure than that in the ducts 36 and 40. However, if desired, the supply pipes 72 may be connected into the supply ducts 40 or 42. The supply pipes 72 serve to mount and position the deflector 70 with respect to the mouth of the tube 50, the pipes passing between positioning studs 74 as shown in Figs. 5 and 6, and being held in place by means of adjustable retaining brackets 76 bolted to the top of the mounting 52. The closer the deflector 70 is set to the mouth of the burner tube 50 the greater will be the angle of deflection of the materials discharged from the tube 50.

The air box 46 of each burner has walls which surround and which are spaced substantially from the burner tube 50, these walls opening directly into the combustion chamber 16. However, each side of the tube 50 is provided with an adjustable louver-like air deflector plate 78 the lower edge of each of which is normally mounted alongside the end of the tube 50. This plate 78 is provided with end lugs as shown in Figs. 5 and 6 which serve as pivot points and which are held to end brackets 80 by means of pivot bolts 82. The end brackets 80 are slotted so that the position of the pivot point of the plates 78 may be adjusted. In the position shown in Fig. 3 the brackets 80 are set so that the plate 78 will be almost as high as possible in the air box 46. This adjustment is correlated with the position of the deflector 70 so that air from the air box 46 is deflected by the plates 78 into the divided streams of fuel-air mixture issuing from the burner tube 50. If the adjustment is such that the deflector 70 is set considerably below the tube 50, the brackets 80 may be lowered so that wider streams of air would be directed into and thoroughly mix with the streams of fuel-air mixture alongside the deflector 70.

Each of the pivoted plates 78 is provided with a lug 84 which in turn is attached to a threaded rod 86 extending through the top of the burner mounting 52. Each rod is threaded to a readily operable nut member 88, the operation of which positions the plates 78. The plates 78 on each side of the burner tube 50 are individually adjusted so that the amount of air supplied to each side of the burner 50 may be varied independently. The flame from the burner therefore may be directed to one side of its normally straight path if desired. These plates 78 are individually adjustable for the further reason that the burner tube 50 may be set at a different angle than that shown in Fig. 3, or some of several burner tubes set at different angles from others.

The combustion chamber shown in Fig. 1 of the drawings will normally be of considerable width so that the roof 12 will carry a considerable number of the burners 18. In the roof structure the burner mountings terminate in a body of refractory material and the burner openings are

surrounded by the roof tubes 32 which are turned out of line at the position of the burners.

In carrying out the operation of the furnace and improvements in the burning of pulverized anthracite coal, the coal and primary air mixture is supplied from the usual type of equipment to the burner supply tubes 48 and projected through the burner tubes 50 against the deflectors 70. At the same time secondary air is supplied from the air box 46 over the plates 78 directly into the broad streams of fuel-air mixture alongside the deflector 70. The injector of the secondary air in this manner creates an intense turbulence and facilitates the ignition of all of the fuel particles in the region adjacent to the burner. At the same time preheated air is introduced through the deflectors 70 and distributed through the small drill holes in the bottom thereof into the heart of the burning mass of fuel from the burner. I have previously employed deflectors of this general type without providing the perforated bottom and without introducing preheated air therethrough but found that such constructions did not enhance the burning of anthracite coal. However, when the deflector was constructed in the manner shown in Figs. 3 and 4, and preheated air distributed therethrough, I found that the burning anthracite coal was greatly facilitated and that the operation resulted in a more effective operation with considerably less carbon in the ash and flue gases.

I also found that the burning of anthracite coal as well as other coals could be greatly facilitated and improved by means of a furnace wall construction for introducing tertiary air into the upper part of the combustion chamber. My improved operation therefore advantageously includes the introduction of tertiary air from the duct 36 around the tubes 30 into the burning fuel in the upper part of the combustion chamber. This introduction of air as well as that from the distributor 70 adds in maintaining a very high combustion temperature in the upper part of the combustion chamber, thereby keeping the refractory portions of the roof in a very highly heated condition which facilitates the ignition of the pulverized fuel. While I have shown the arrangement of the furnace wall for the introduction of tertiary air from the duct 36 only on one side of the chamber 16, it is to be understood that a similar construction may be provided at the ends of the combustion chamber so that at least three sides of the chamber include means for introducing tertiary air at a point or level near but substantially below the burners.

In mounting the burners in the roof 12 they may be ranged in parallel rows or they may be staggered so as to provide a somewhat different distribution across the upper portion of the combustion chamber. Furthermore, since each of the burners are individually adjustable with respect to direction, and with respect to the spacing of the distributor 70 and plates 78, the tubes 50 of some of the burners may be directed at an angle toward a particular side of the furnace in order to increase the temperature at that particular point. Two rows of burners at different elevation are provided as indicated in Fig. 1 of the drawings. The upper row may be operated with the deflectors 70 at a lower point than is the case in the lower row of burners so that the main flame or combustion in the upper part of the combustion chamber 16 will be substantially at one level. In other words the flames from the upper burners may be projected farther into the combustion chamber than the flames from the lower burners.

Various other modifications are possible with the particular burner construction used in cooperation with the particular furnace wall constructed for the admission of tertiary air. In some cases it may be desirable to have most of the combustion take place at a level above the point of introduction for tertiary air or directly opposite such introduction. These arrangements are possible in view of the flexibility of the particular burner described above.

From the foregoing description it will be apparent that while the apparatus as described is particularly adapted for the burning of pulverized anthracite and other coals which are difficult to burn, the apparatus may be used with considerable advantage in the burning of other fuels which may be gas, liquid or solid. The apparatus may be modified in some respects without departing from the scope of the invention and still achieve the important results described above. Such changes are contemplated as coming within the scope of the appended claims.

What I claim as new is:

1. A burner for steam generators and the like having a combustion chamber comprising a burner structure including an air box having one side opening into the combustion chamber, a burner tube having opposite flat sides and a cross-section which is long and narrow, the burner tube extending through the air box and opening at said open side and spaced from the side walls of the box, means for conducting fuel and air to the burner tube, an air supply chamber substantially surrounding the air box, means including air passageways for admitting air from the supply chamber through the sides of the air box, means for varying the area of said passageways, adjustable means operatively associated with the end of the air box projecting into the combustion chamber and with the outlet end of the burner tube, said adjustable means including a louver-like plate adjacent each flat side and near the outlet end of the burner tube for directing air from the box into the stream of fuel and air discharged from the burner tube, a deflector the length of the burner tube opening and mounted opposite the outlet end of the burner tube, and means for supplying air to and through said deflector, the deflector being constructed and arranged for distributing air into the combustion products resulting from the burning of the fuel discharged from the burner tube.

2. A burner for steam generators and the like having a combustion chamber comprising a burner structure including an air box having one side opening into the combustion chamber, a burner tube having a cross-section which is long and narrow, the burner tube extending through the air box and opening at said open side and spaced from the side walls of the box, means for conducting fuel and air to the burner tube, an air supply chamber substantially surrounding the air box, means including air passageways for admitting air from the supply chamber through the sides of the air box, means for varying the area of said passageways, adjustable means operatively associated with the end of the air box projecting into the combustion chamber and with the outlet end of the burner tube for directing air from the box into the stream of fuel and air discharged from the burner tube, a deflector at least as long as the burner tube opening and mounted opposite the outlet end of the burner tube, and

means for supplying air to and through said deflector, the deflector being constructed and arranged for distributing air into the combustion products resulting from the burning of the fuel discharged from the burner tube.

3. A burner for steam generators and the like having a combustion chamber, comprising a burner structure including an air box having one side opening into the combustion chamber, a burner tube having a cross-section which is long and narrow providing opposite broad sides, the burner tube extending through the air box in spaced relation to the side walls thereof and opening at the open side of the box into the combustion chamber, means for conducting fuel and air to the burner tube, means including air passageways for admitting air through the sides of the air box opposite the broad sides of the burner tube, means for varying the area of said passageways, adjustable means operatively associated with the end of the air box projecting into the combustion chamber and with the outlet end of the burner tube for directing air from the box into the stream of fuel and air discharged from the burner tube, a deflector opposite the outlet end of the burner tube and extending lengthwise of the tube opening, and means for supplying air to and through said deflector, the deflector having an edge facing the open end of the burner tube and arranged for distributing air from a side opposite said edge into the combustion products resulting from the burning of the fuel discharged from the burner tube.

4. A burner for pulverized fuel comprising a burner tube having an oblong-shaped outlet opening, means for conducting fuel and air to the burner tube, an air supply box around said tube arranged to deliver air at the outlet of the tube, a long hollow deflector of triangular cross-section mounted opposite and spaced away from the outlet end of the burner tube with an edge facing toward the tube opening so as to divide the stream of fuel and air discharged therefrom, the deflector extending the full length of the tube outlet opening, means for supplying air to the deflector, and a multiplicity of passageways in the deflector for distributing the air into the burning products resulting from the combustion of the fuel and air discharged from the burner tube.

5. A burner as defined by claim 4 in which the deflector includes a substantially flat side opposite the edge facing the burner tube outlet opening, said flat side having said multiplicity of air passageways therein.

6. A burner as defined by claim 4 characterized by including an air deflector plate mounted in the air supply box on each long side of the burner tube opening, and means for adjusting the angle of said plates to direct streams of air toward the opposite sides of the deflector.

7. A burner for burning pulverized anthracite coal, comprising a burner tube having an oblong-shaped outlet opening and through which a mixture of pulverized anthracite coal and air is delivered, means for conducting fuel and air to the burner tube, a long hollow deflector mounted opposite and spaced away from the outlet end of the burner tube, said deflector having an edge formed by converging side walls facing toward the tube opening and arranged to divide the stream of products issuing therefrom into two substantially flat streams, said deflector extending the length of the tube outlet opening and having a wall opposite said edge, a multiplicity of air distributing passageways through the wall opposite said edge, means for supplying preheated air to said deflector for distribution through said passageways into the burning products resulting from the combustion of the fuel and air discharged from the outlet of the burner tube.

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