

March 12, 1935.

E. G. BAILEY ET AL

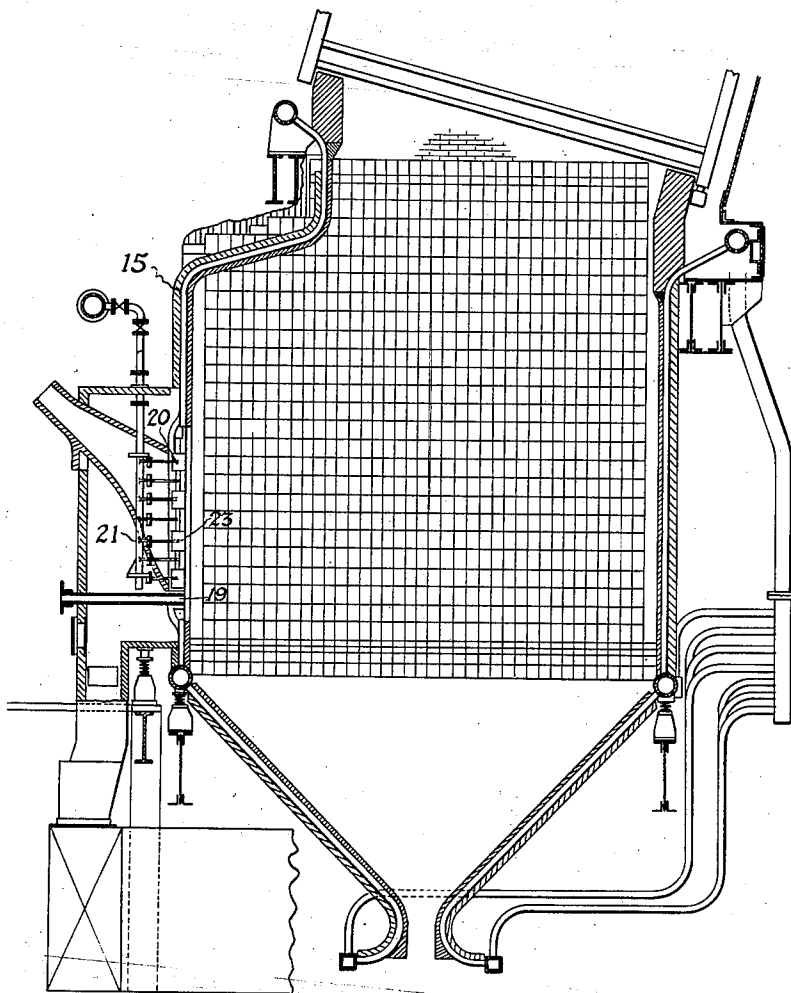
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BURNER

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5 Sheets-Sheet 1

*Fig. 1*



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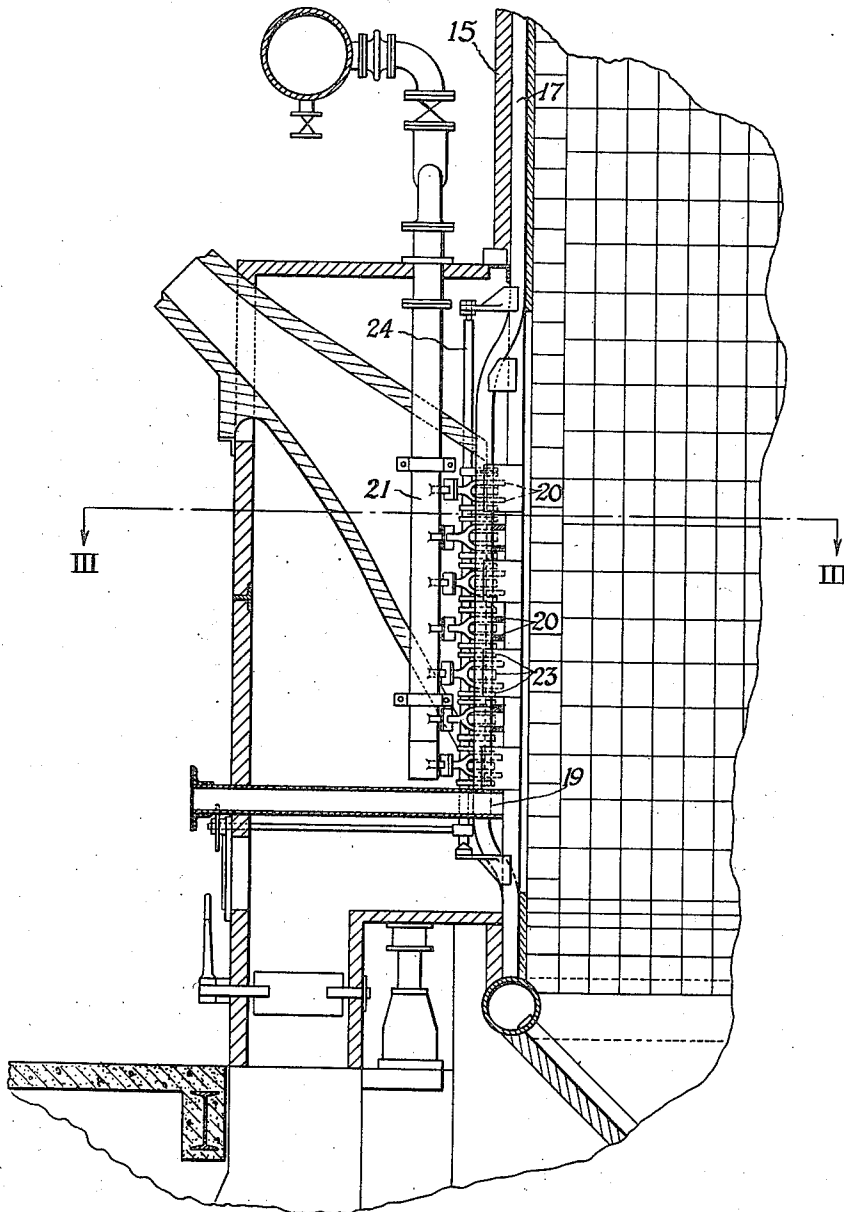
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Fig. 2



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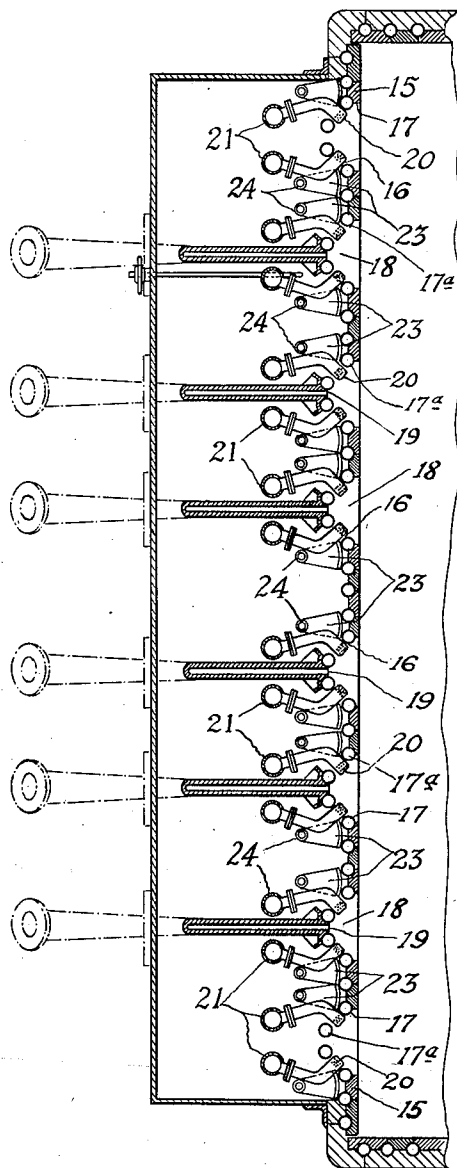
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5 Sheets-Sheet 3

Fig. 3



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Fig. 4

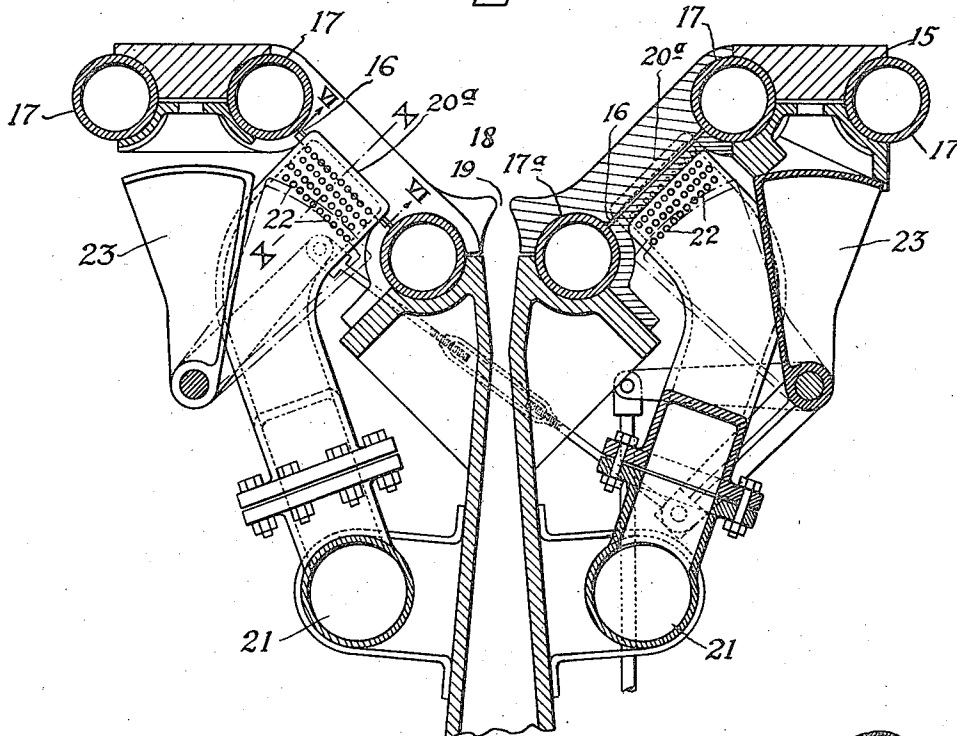


Fig. 5

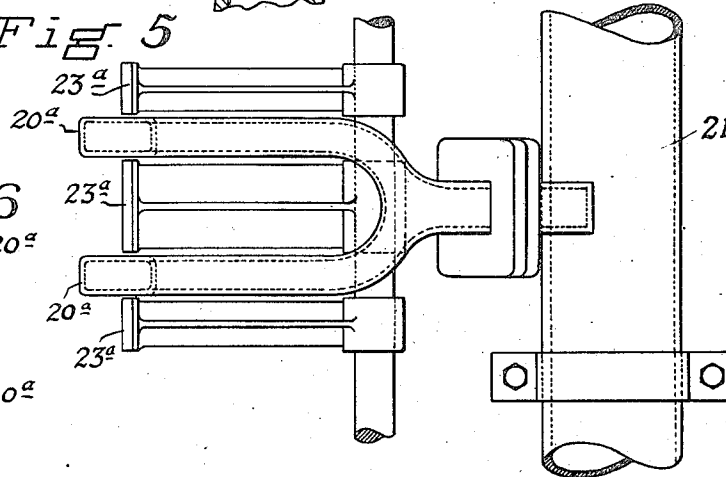


Fig. 6

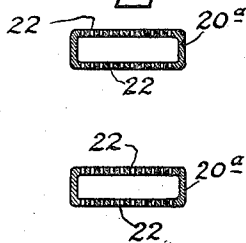
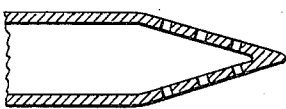


Fig. 10



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Fig 7

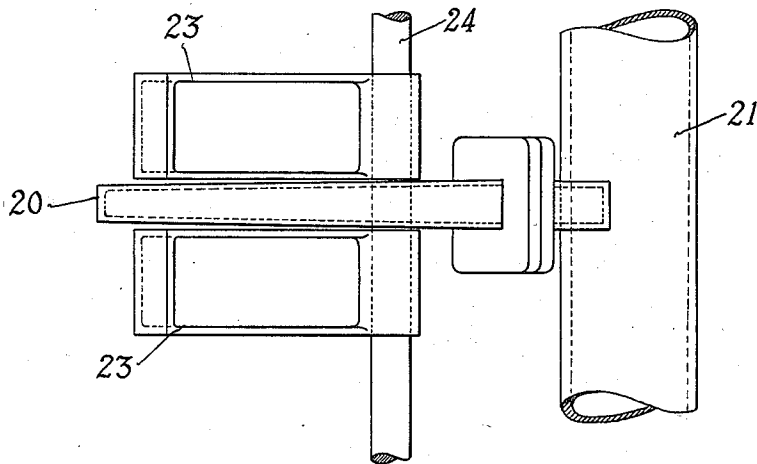


Fig 8

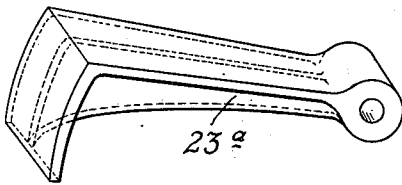
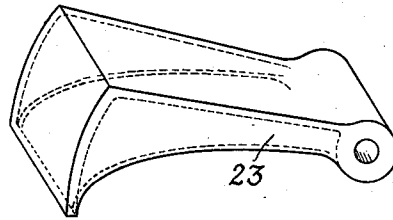


Fig 9



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## UNITED STATES PATENT OFFICE

1,994,447

BURNER

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Application April 7, 1931, Serial No. 528,324

18 Claims. (Cl. 110—22)

Our invention relates to burners, especially burners which are capable of operation with a plurality of fuels which may be burned jointly or separately. The invention is especially useful in connection with furnaces wherein pulverized coal and gas may be burned.

One object of the invention is the provision of a burner combination which will permit burning of two fuels, for instance, pulverized coal and gas, at the same time, and which will also permit the burning of these fuels separately, and require merely an operating adjustment for shifting from one fuel to the other. A further object of the invention is the provision of means for supplying the requisite quantity of air under all operating conditions. Still a further object is the provision of adequate cooling means for the burners and the walls immediately adjacent thereto. Other objects will be apparent upon consideration of the present specification.

The invention is shown by way of illustration in its application to a coal and gas burning furnace, in the accompanying drawings, wherein—

Figure 1 is a vertical section through a furnace constructed in accordance with the invention,

Fig. 2 is an enlarged view of a part of the construction illustrated in Figure 1, a modified form of burner being illustrated,

Fig. 3 is a horizontal section on the line III—III of Fig. 2,

Fig. 4 is a horizontal section through one of the burners and associated parts shown on an enlarged scale,

Fig. 5 is a fragmental view illustrating the gas burner and damper arrangement according to the construction shown in Fig. 2,

Fig. 6 is a vertical section on the line VI—VI through the gas burner illustrated in Fig. 4 showing the perforations through which the gas leaves the burner,

Fig. 7 is a fragmental view corresponding to Fig. 5 illustrating the gas burner and damper arrangement shown in Figure 1,

Figs. 8 and 9 illustrate on an enlarged scale the type of damper shown in Figs. 1 and 2, and

Fig. 10 is a section on the line X—X of Fig. 4.

A satisfactory form of burner for use with more than one type of fuel has long been desired in the combustion art. It is particularly important that such a burner be adapted for changing from one fuel to another without shutting down the furnace or making other than operating adjustments. The present invention provides such a burner, and is peculiarly adapted to meet the requirements of burning two fuels together or

changing from one fuel to another without shutting down the furnace and with a minimum of trouble and delay. For purposes of convenience the invention will be described as applied to a furnace in which pulverized coal and gas are burned, but it will be understood that other fuels in fluid or semi-fluid form might be employed.

In the drawings there is shown a furnace wall 15 having air-ports 16 therein for the admission of combustion air to the furnace. The wall 15 preferably comprises water cooling tubes 17 which may be covered in any known or convenient manner to make a substantially airtight wall. As here shown, certain of the tubes 17a are displaced outwardly from the line of the furnace wall and form a recess 18 in the wall. This recess is of value in permitting a thorough mixture of fuel and air as the combusting fuel enters the furnace.

The air-ports 16 may open into the recess 18 which has just been described. Each air-port preferably lies between two of the water cooling tubes and is so associated with them that it is cooled by the tubes. Pulverized coal burners 19 are provided which extend through the wall in proximity to the air-ports. It will be seen that the coal burners 19 are ports or nozzles. It will also be realized that they project a stream of coal and carrying air into the furnace, and that where a stream of pulverized coal is mentioned as being projected by a coal burner, the stream is in fact a coal-air mixture. Obviously air alone might be projected through the coal nozzle 19 merely by shutting off the coal bin and continuing to operate the blower whereby the coal-air mixture is normally projected into the furnace. Thus, the nozzle 19 is in fact a coal or air nozzle. As here illustrated, these coal burners extend through the wall 15 at the recess 18 and may be located between two of the water cooling tubes in such location as to be cooled by these tubes.

Gas nozzles 20 which are fed from gas manifolds 21 extend into the air-ports 16 in the wall. The gas nozzles do not close the air-ports but leave an ample opening for air to pass through the wall when they are in place. In order that the air-port need not be made too large and that the gas nozzle need not obstruct it too greatly, the nozzle is preferably flattened. Perforations 22 are provided adjacent the ends of the gas nozzles nearest the interior of the furnace in order that the gas may escape in a number of small jets and thoroughly mix with the surrounding air in doing so. Thus, where gas is

burned a mixture of gas and air is discharged into the furnace through the air-ports.

Passage of air through the air-ports may be governed by dampers 23. In the embodiment illustrated in the drawings segmental dampers are movable over the air-ports 16 to restrict the passage of air through them. These dampers are pivoted to supports 24 and may be operated in any known or convenient manner. They are movable above and below the gas nozzles with which they do not interfere.

When gas alone is burned it may be desirable to supply to the furnace more air than can be passed through the air-ports. To this end means may be provided for supplying additional air to the furnace through the coal burner. We do not desire to restrict ourselves to any particular means for accomplishing this end, and therefore, merely mention by way of example the possibility of throwing a valve which will cut off the supply of pulverized coal to the coal burned and substitute therefor a supply of air.

The operation of a furnace constructed in accordance with the invention and provided with burners as above described will be obvious. When pulverized coal alone is burned the gas nozzles will remain in place but will not be used. Since they do not restrict the air-ports unnecessarily secondary air may be passed into the furnace through the air-ports, the rate of its passage into the furnace being controlled by the position of the segmental dampers. In the event of coal shortage or injury to the pulverized coal plant, it is only necessary to supply gas to the gas nozzles. Thus the gas flame may either assist a reduced pulverized coal flame or may replace it altogether. Air entering the furnace passes over the gas nozzles and is intimately mixed with the gas issuing therefrom by reason of the fact that the gas leaves the gas nozzles in a great number of small jets which are projected into the entering air stream at numerous points. The air passing over the gas nozzles tends to cool them in addition to the action of the water cooling tubes which act to cool the air-ports generally.

As illustrated in Fig. 4, the coal nozzle may be constructed to project the stream of pulverized coal across the air-ports 16, for instance, at right angles to the entering stream of secondary air. If gas is burned as well, the coal will be projected across the entering stream of secondary air and gas.

We prefer to stagger in a vertical direction the secondary air-ports on either side of the recess 18, and to turn the coal nozzle at each elevation toward the secondary air-port, as illustrated in Fig. 4.

Should it be found that with the dampers wide open insufficient air is entering the furnace to permit complete combustion of the gas, additional combustion air may be supplied through the coal burner as previously described.

From the above description it will be seen that pulverized coal and gas may be burned at the same time, air being supplied for both fuels through the air-ports. It will be further apparent that by the simple process of shutting off the gas, pulverized coal alone may be burned, the stream of coal and carrying air entering the furnace through the coal burner and the secondary air entering through the air-ports past the inactive gas nozzles. Further, by supplying the gas nozzles with gas and shutting down the coal burner, the furnace may be operated on gas alone; and if the supply of air through the air-ports should be insufficient to support com-

plete combustion of the gas additional air may easily be supplied through the coal burner.

Clearly, the invention need not be limited in its application to the precise form above described by way of example and illustrated in the accompanying drawings. Variations which do not depart from the proper scope of our invention will readily occur to those skilled in the art.

We claim:

1. In a furnace, a wall comprising water cooled tubes, certain of said tubes being displaced outwardly from the line of the furnace wall to form a recess in said wall, said wall having an air-port opening into the recess therein between two of said tubes and cooled thereby, and a pulverized fuel nozzle extending through said wall at the recess cooled by said tubes, in combination with a gas nozzle extending into the air-port in said wall, and a damper movable alongside said gas nozzle and over that portion of the air-port in said wall not utilized by said gas nozzle to restrict the passage of air through the air-port.

2. In a furnace, a wall comprising water cooled tubes, certain of said tubes being displaced outwardly from the line of the furnace wall to form a recess in said wall, said wall having an air-port opening into the recess therein between two of said tubes and cooled thereby, and a nozzle for delivering pulverized fuel and/or air extending through said wall at the recess cooled by said tubes, in combination with a gas nozzle extending into the air-port in said wall, a damper movable alongside said gas nozzle and over that portion of the air-port in said wall not utilized by said gas nozzle to restrict the passage of air through the air-port, said pulverized fuel or air nozzle supplying additional air to said furnace when gas alone is burned, substantially as described.

3. In a furnace, a wall comprising water cooled tubes, certain of said tubes being displaced outwardly from the line of the furnace wall to form a recess in said wall, said wall having an air-port opening into the recess therein between two of said tubes and cooled thereby, and a pulverized fuel nozzle extending through said wall between two of said tubes at the recess and cooled by said tubes, in combination with a flattened perforated gas nozzle extending into the air-port in said wall, and a segmental damper extending above and below said gas nozzle movable alongside said nozzle and over that portion of the air-port in said wall not utilized by said gas nozzle to restrict the passage of air through the air-port.

4. In a furnace, a wall comprising water cooled tubes, certain of said tubes being displaced outwardly from the line of the furnace wall to form a recess in said wall, said wall having an air-port opening into the recess therein between two of said tubes and cooled thereby, and a nozzle for delivering pulverized fuel and/or air extending through said wall between two of said tubes at the recess and cooled by said tubes, in combination with a flattened perforated gas nozzle extending into the air-port in said wall, and a segmental damper extending above and below said gas nozzle movable alongside said nozzle and over that portion of the air-port in said wall not utilized by said gas nozzle to restrict the passage of air through the air-port, said pulverized fuel or air nozzle supplying additional air to said furnace when gas alone is burned substantially as described.

5. In combination, a furnace wall having a

fuel burner port formed therein, a pulverized fuel burner nozzle arranged to discharge a stream of pulverized fuel through said burner port, a plurality of spaced gaseous fuel burner nozzles at one side of said pulverized fuel burner nozzle and arranged to discharge high velocity gaseous fuel jets through said burner port toward said pulverized fuel stream and impinging thereon adjacent said wall, spaced cooling fluid tubes extending across said burner port between said pulverized and gaseous fuel burner nozzles, means for passing air for combustion through said burner port intermediate said gaseous fuel burner nozzles, and means for controlling the effective area of the air discharge space intermediate each pair of gaseous fuel burner nozzles.

6. In combination, a furnace wall having a fuel burner port formed therein, pulverized fuel nozzle means arranged to discharge pulverized fuel through said port in a stream elongated transversely of the direction of fuel discharge, gaseous fuel nozzle means positioned at opposite sides of said pulverized fuel nozzle means and having openings in opposite sides of the end portions thereof for the discharge of gaseous fuel jets, and means for passing air for combustion in relatively high velocity jets past said end portions and impinging on said gaseous fuel jets and subsequently on said pulverized fuel stream.

7. In combination, a furnace wall having a fuel burner port formed therein, pulverized fuel nozzle means arranged to discharge pulverized fuel through said port in a stream elongated transversely of the direction of fuel discharge, a plurality of staggered air inlet ports at opposite sides of said pulverized fuel nozzle means, gaseous fuel nozzles positioned in said air inlet ports at opposite sides of said pulverized fuel nozzle means and having openings on opposite sides of the end portions thereof for the discharge of gaseous fuel jets, and means for passing air for combustion through said air inlet ports in relatively high velocity jets past said end portions and impinging on said gaseous fuel jets and subsequently on said pulverized fuel stream.

8. In combination, a furnace wall, pulverized fuel nozzle means arranged to discharge pulverized fuel through said furnace wall in a plurality of streams alternately oppositely directed, a plurality of ports opening to the furnace at opposite sides of said pulverized fuel nozzle means, and means for passing air for combustion and gaseous fuel through said ports in high velocity jets impinging on and commingling with corresponding oppositely directed fuel streams.

9. In combination, a furnace wall having a series of spaced cooling fluid tubes, pulverized fuel nozzle means arranged to discharge pulverized fuel between adjacent tubes in a plurality of streams alternately oppositely directed, a plurality of ports at opposite sides of said pulverized fuel nozzle means and opening to the furnace between adjacent tubes, means for passing air for combustion and gaseous fuel through said ports in high velocity jets impinging on and commingling with corresponding oppositely directed fuel streams.

10. In combination, a furnace wall having a fuel burner port formed therein, pulverized fuel nozzle means arranged to discharge pulverized fuel through said port in a stream elongated transversely of the direction of fuel discharge, an air inlet port at one side of said pulverized

fuel nozzle means, gaseous fuel nozzle means positioned in said air inlet port and arranged to discharge a gaseous fuel jet, means for passing air for combustion through said air inlet port, and means for deflecting said pulverized fuel stream across said air inlet port.

11. In combination, a furnace wall having a fuel burner port formed therein, pulverized fuel nozzle means arranged to discharge pulverized fuel through said port in a stream elongated transversely of the direction of fuel discharge, a plurality of staggered air inlet ports at opposite sides of said pulverized fuel nozzle means, gaseous fuel nozzle means positioned in said air inlet ports at opposite sides of said pulverized fuel nozzle means and arranged to discharge gaseous fuel jets, means for passing air for combustion through said air inlet ports in contact with said gaseous fuel nozzle means, and means for deflecting different portions of said pulverized fuel stream respectively across air inlet ports at opposite sides of said pulverized fuel nozzle means.

12. In combination, a furnace wall having a series of spaced cooling fluid tubes, a fuel burner port in said wall, pulverized fuel nozzle means arranged to discharge pulverized fuel through said port and between adjacent tubes in a stream elongated transversely of the direction of fuel discharge, gaseous fuel nozzles at opposite sides of said pulverized fuel nozzle means and arranged to discharge gaseous fuel jets, and means for deflecting different portions of said pulverized fuel stream respectively across gaseous fuel nozzles at opposite sides of said pulverized fuel nozzle means.

13. In combination, a furnace wall having a series of spaced vertically extending cooling fluid tubes, pulverized fuel nozzle means arranged to discharge pulverized fuel between adjacent tubes in a stream elongated transversely of the direction of fuel discharge, a plurality of air inlet ports at opposite sides of said pulverized fuel nozzle means and between adjacent tubes, gaseous fuel nozzle means positioned in said air inlet ports at opposite sides of said pulverized fuel nozzle means and arranged to discharge gaseous fuel jets, means for passing air for combustion through said air inlet ports adjacent said gaseous fuel nozzle means, and means for deflecting different portions of said pulverized fuel stream respectively across air inlet ports at opposite sides of said pulverized fuel nozzle means.

14. In combination, a furnace wall having a series of spaced vertically extending cooling fluid tubes, a fuel burner port in said wall, pulverized fuel nozzle means arranged to discharge pulverized fuel through said port and between adjacent tubes in a stream elongated transversely of the direction of fuel discharge, a plurality of staggered air inlet ports at opposite sides of said pulverized fuel nozzle means and between adjacent tubes, gaseous fuel nozzle means positioned in said air inlet ports at opposite sides of said pulverized fuel nozzle means and arranged to discharge gaseous fuel jets, means for passing air for combustion through said air inlet ports and impinging on said gaseous fuel jets, and means for deflecting different portions of said pulverized fuel stream respectively across air inlet ports at opposite sides of said pulverized fuel nozzle means.

15. In combination, a furnace wall having a series of spaced vertically extending cooling fluid

tubes, a fuel burner port in said wall, nozzle means arranged to discharge a fluid through said port and between adjacent tubes in a stream elongated transversely of the direction of discharge, a plurality of staggered air inlet ports at opposite sides of said nozzle means and between adjacent tubes, gaseous fuel nozzle means positioned in said air inlet ports at opposite sides of said first named nozzle means and arranged to discharge gaseous fuel jets through said burner port, means for passing air for combustion through said air inlet ports impinging on said gaseous fuel jets, and means for deflecting different portions of said fluid stream respectively across air inlet ports at opposite sides of said first named nozzle means.

16. The method of burning fuel in suspension in a furnace which comprises discharging pulverized fuel into the furnace in a stream elongated transversely of the direction of fuel discharge, discharging gaseous fuel into the furnace in a plurality of streams at opposite sides of said pulverized fuel stream, discharging air for combustion into the furnace in a plurality of streams at opposite sides of said pulverized fuel stream and commingling with said gaseous fuel streams, and causing different portions of said pulverized fuel stream to be deflected in diverging directions towards and commingling with corresponding streams of air and gaseous fuel.

17. The method of burning fuel in suspension in a furnace which comprises discharging pulverized fuel into the furnace in a stream elongated transversely of the direction of fuel discharge, discharging gaseous fuel into the furnace in a plurality of staggered streams at opposite sides of and directed toward said pulverized fuel stream, discharging air for combustion into the furnace in a plurality of staggered streams at opposite sides of and directed towards said pulverized fuel stream and commingling with corresponding gaseous fuel streams, and causing different portions of said pulverized fuel stream to be deflected in diverging directions, each deflected portion being directed towards and commingling with a corresponding oppositely directed stream of air and gaseous fuel.

gated transversely of the direction of fuel discharge, discharging gaseous fuel into the furnace in a plurality of streams at opposite sides of and directed toward said pulverized fuel stream, discharging air for combustion into the furnace in a plurality of streams at opposite sides of and directed towards said pulverized fuel stream and intermediate the points of discharge of and commingling with said gaseous fuel streams, and causing different portions of said pulverized fuel stream to be deflected in diverging directions towards and commingling with corresponding streams of air and gaseous fuel.

18. The method of burning fuel in suspension in a furnace which comprises discharging pulverized fuel into the furnace in a stream elongated transversely of the direction of fuel discharge, discharging gaseous fuel into the furnace in a plurality of staggered streams at opposite sides of and directed toward said pulverized fuel stream, discharging air for combustion into the furnace in a plurality of staggered streams at opposite sides of and directed towards said pulverized fuel stream and commingling with corresponding gaseous fuel streams, and causing different portions of said pulverized fuel stream to be deflected in diverging directions, each deflected portion being directed towards and commingling with a corresponding oppositely directed stream of air and gaseous fuel.

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