Dec. 23, 1930. G. F. DOWNS ET AL 1,786,293

PORT CONSTRUCTION AND GAS BURNER FOR OPEN HEARTH FURNACES

Filed Nov. 4, 1920 3 Sheets-Sheet 1

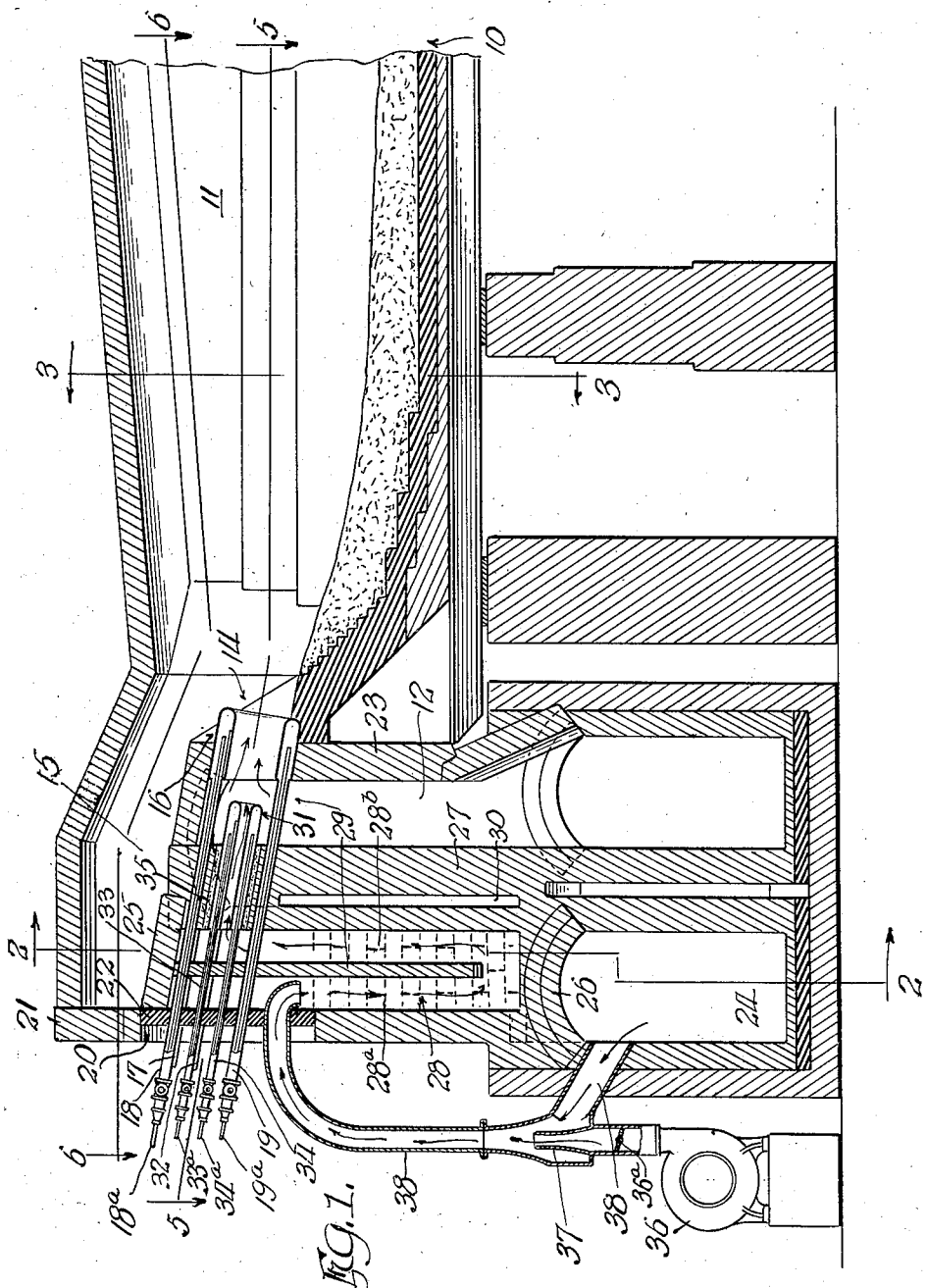

FIG. 1.

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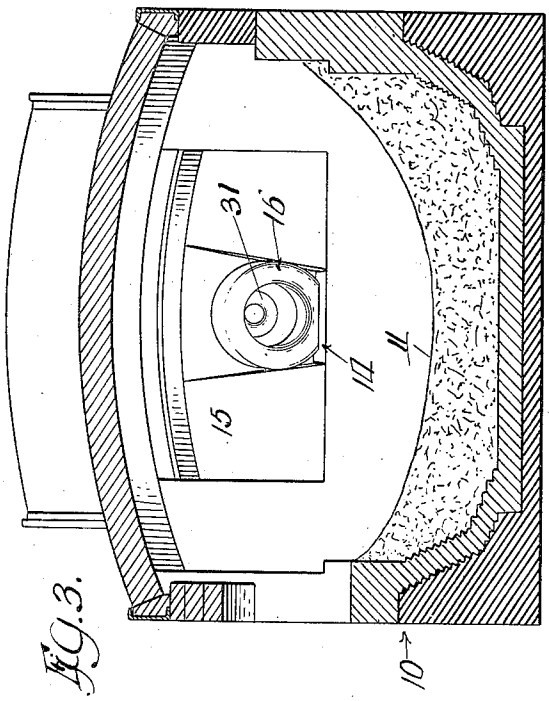

FIG. 3.

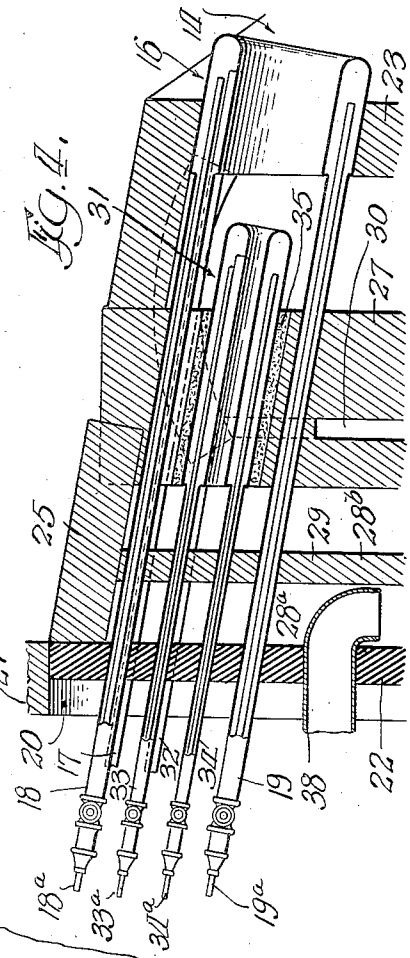

FIG. 4.

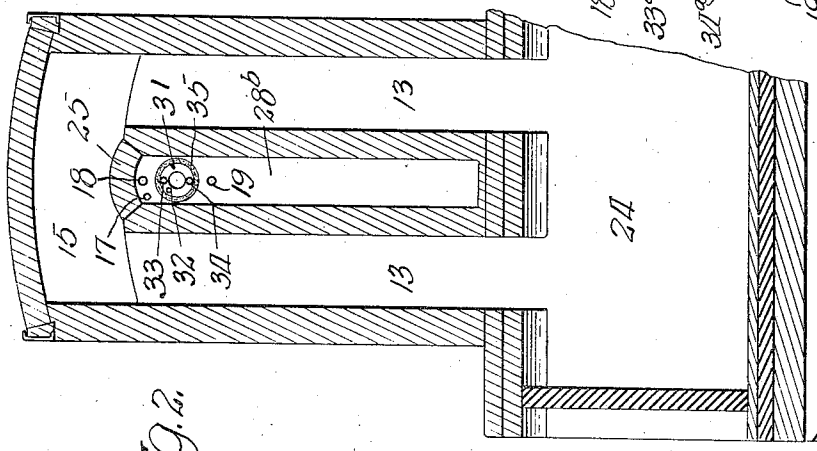

FIG. 2.

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FIG. 5.

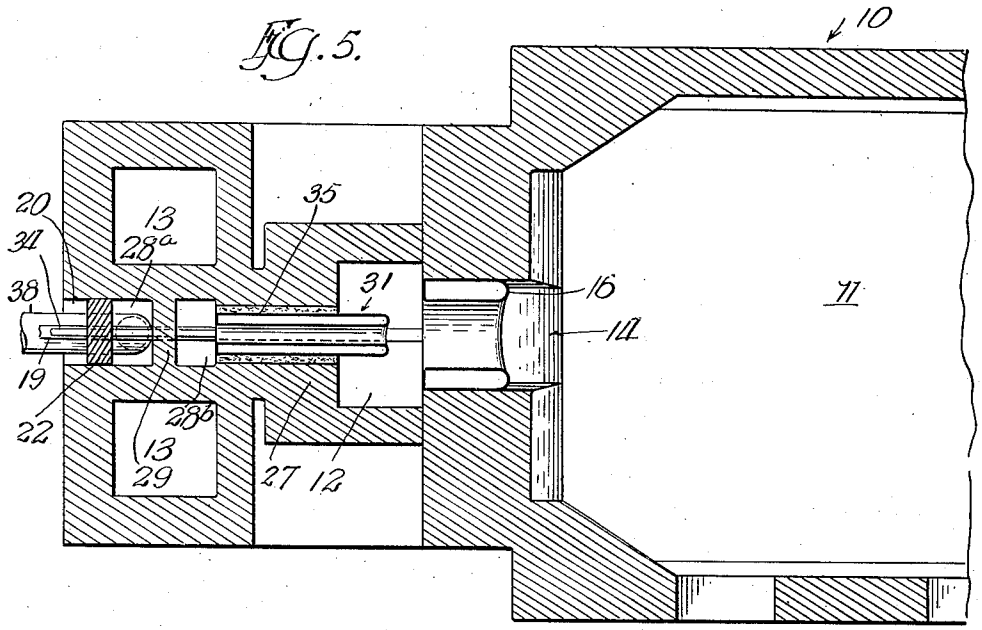
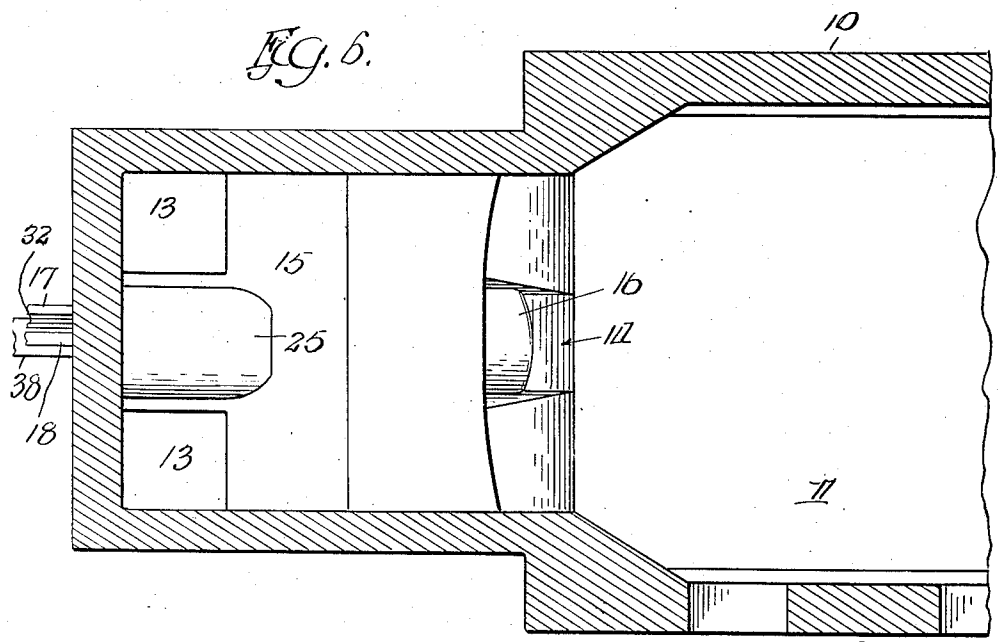


FIG. 6.



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UNITED STATES PATENT OFFICE

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PORT CONSTRUCTION AND GAS BURNER FOR OPEN HEARTH FURNACES

Application filed November 4, 1920. Serial No. 421,755.

This invention relates to improvements in port construction and gas burners for open hearth furnaces, and consists of the matters hereinafter described and more particularly pointed out in the appended claims.

In open hearth furnaces as heretofore and at present constructed, the oxygen for combustion of the fuel is provided by an overhead body of preheated air, or by a body of preheated air completely surrounding the body of fuel as it issues from the gas port:—the first method being illustrated in Patent No. 1,308,404, granted July 1, 1919, to the applicant Downs, and the second method being shown in Patents 1,343,314, and 1,343,315, granted applicants jointly in June 15, 1920. In both cases the air and fuel come together and unite under atmospheric pressure.

It is desirable in furnaces of the kind to bring about as early and as complete combustion of the fuel as possible in advance of its reaching the furnace hearth, so that the flame may be burning at its greatest efficiency, when it reaches the hearth. The object of the present invention is to provide a port construction and gas burner in which, in addition to the preheated air at atmospheric pressure which surrounds the body of fuel as it issues from the gas port, preheated air under pressure above atmosphere will be forced into the interior of the body of fuel gas in advance of its issue from the gas port. Thus combustion is supported on the inside of the body of fuel as well as on the outside, and a more thorough, complete and efficient combustion of the fuel is brought about.

In addition, the air supply inside the body of fuel being under pressure, it is possible to more exactly control and direct the flame, and as the gas and air issue from the gas port under pressure, the flame will travel towards the hearth at a high rate of speed, and will impinge upon the material on the furnace hearth with great force and intensity, thereby making the furnace work at greater speed than heretofore.

These and other advantages of our invention will be more particularly pointed out as we proceed with our specification.

In the drawings:

Figure 1 is a longitudinal vertical section of one end of an open-hearth furnace provided with my improved port construction.

Figure 2 is a view representing a vertical section through Figure 1 in the plane indicated by the line 2—2 thereof.

Figure 3 is a transverse section through the hearth in a plane indicated by the line 3—3 of Figure 1.

Figure 4 is a detail sectional view in the same plane as that of Figure 1, showing the port construction on an enlarged scale.

Figures 5 and 6 are horizontal sectional views taken respectively on the lines 5—5 and 6—6 of Figure 1.

Referring now to that embodiment of the invention illustrated in the drawings:—

10 indicates as a whole an open hearth furnace of well-known type and 11, the furnace chamber. 12 indicates the gas uptake. 13—13 indicate the air uptakes, which in this case are back of the gas uptake,—that is to say, are farther removed from the hearth of the furnace than the gas uptake 12 (which is next to the hearth) and are at the sides instead of the middle as heretofore. 14 indicates the gas port and 15, the air port.

16 indicates a gas flue. This may be of the ordinary kind made of refractory material, but is preferably, as illustrated in the drawings, a tubular water cooled gas flue of the type shown in the patents hereinabove referred to. The flue is water cooled as heretofore, cooling water being led thereto and discharged therefrom in a familiar manner by means of pipes 17, 18 and 19,—reciprocable agitator devices 18ª, 19ª, being employed for dislodging the sediment in a familiar manner. These pipes are extended rearwardly through an opening 20 in the rear wall 21 of the furnace, said pipes being directly supported in an easily removable wall section 22 which closes the opening 20.

The gas flue 16 is positioned in the gas port opening 14 in the wall 23 which separates the gas uptake from the furnace chamber.

In the space between the air uptakes 13—13 and above the slag pocket 24, there is provided a space defined by the back wall 21 of

the furnace, a top partition wall 25, the arch 26 above the slag pocket, and the wall 27 which separates said space from the gas uptake. In said space there is a passageway 28, which has a downward branch 28[a], and an upward branch 28[b], the two being divided by a partition wall 29 depending from the wall 25, and extending downwardly to a short distance above the arch 26. A cooling space 30 is left in the wall 27 either for air or for a water bulkhead not shown.

In the wall 27, in line with the gas port opening, is located an air flue 31. Said flue is preferably a water cooled tubular structure similar to the gas flue, and has connected to it water circulating pipes 32, 33, and 34 which extend rearwardly through the wall section 22 as in the case of the cooling water pipes for the gas flue. Said pipes likewise have agitator devices 33[a], 34[a]. The air flue itself is sealed in the opening in the wall 27 in which it is located, by means of soft refractory material 35, which may be readily removed when it is desired to remove or adjust the air flue. The air flue 31, as shown, is of a length to project beyond the wall 27 into the space above the gas uptake. It may terminate at this wall or it may project beyond this point into the gas flue. In any case the air passing through it will mix and intermingle with the gas in advance of the discharge of the gas from the gas flue.

The passageway 28 has its upwardly directed branch 28[b] connected to the air flue 31, as will be apparent from the drawings. Means is provided for taking the preheated air from the slag pocket 24 and forcing it under pressure through the passageway 28 to the air flue as follows:—This, in the embodiment of the invention illustrated, consists of a blower 36, a jet 37, and a conduit leading from the top of the slag pocket 24 to the top of the downwardly directed branch 28[a] of the high pressure air passageway 28. 36[a] is a shut-off valve.

The operation of the improved construction will be apparent from the foregoing description. Air enters the regenerators from the air valves and passes through the regenerators wherein it is preheated in the usual manner. From the latter the preheated air passes into the slag pocket 24. Here it is divided, part passing through the uptakes 13—13 in the familiar way to the air port 15, where it supplies the air to the outside of the body of gas issuing from the gas flue. The other part of the preheated air is forced through the air passageway 28[a] under pressure to and through the water cooled air flue 31 into the interior of the body of gas that is passing to and through the gas flue. As the air passes the air injector nozzle 37, it becomes compressed and attains a pressure above that of the gas in the gas flue or uptake. The preheated high pressure air introduced into the interior of the gas flue brings the fuel into very rapid and complete combustion.

The air flue 31 is easily movable by reason of its setting in the soft refractory material 35, and is thus capable of ready adjustment to suit conditions. As shown, the air flue 31 is positioned with its end terminating above the gas uptake, and it does not extend across the air uptake. This position, however, may be varied as desired, and the air flue may have its end terminate before reaching the gas uptake, or said end may extend into the inside of the gas flue. The air flue may be lined with refractory material, or may be used without such a lining as desired.

By having the gas and air in the gas flue under pressure, the flame will issue from the gas flue at a high rate of speed, and will impinge upon the material on the furnace hearth with great force and intensity, thereby making the furnace work much faster than by methods hitherto used. In addition, the flame will be under better control than in the earlier types of furnace, as it will be confined until it issues from the gas flue which terminates at or near the edge of the furnace hearth.

As illustrated in full lines of the drawings, the part of the compressed air passage 28 between the air uptakes is shown as an unimpeded passageway. This passageway may, however, be baffled or filled with checker work, as indicated in dotted lines, the compressed air passing through this portion of the flue being thus heated as it comes in contact with the walls of the passage. The walls of the passageway 28 will receive heat from the air from the regenerators when on the incoming end, and receive heat from the outgoing waste gases when on the outgoing end, thereby constantly absorbing heat.

By supplying preheated air from the regenerators both on the inside as well as the outside of the body of fuel, it is possible to greatly reduce the amount of air to be heated since the air is supplied or used more efficiently. At the same time a more efficient operation of the furnace is brought about.

While in describing our invention we have referred to certain details of mechanical construction and arrangement, it is to be understood that the invention is in no way limited thereto except as pointed out in the appended claims.

We claim as our invention:—

1. In a furnace of the kind described, in combination with the furnace walls defining gas and air uptakes, gas and air ports, and air and gas regenerators, means for conducting a part of the air from the air regenerator to the interior of the body of gas in advance of the issue of the gas from the gas port, and means for compressing said air prior to its

introduction into the interior of said gas body.

2. In a furnace of the kind described in combination with the walls defining the gas and air uptakes, gas and air ports, and the gas and air regenerators, means providing an air passageway back of the gas uptake, an air flue connecting said passageway with the interior of the body of gas passing from the gas uptake through the gas port, and means for conducting a part of the air from the air regenerator to said passageway and for raising the pressure of said air above that of the body of gas.

3. In a furnace of the kind described in combination with the furnace walls defining the gas and air uptakes and gas and air ports, a tubular metallic water cooled gas flue in the gas port, and a tubular metallic water cooled air flue connecting the air uptake with the said gas flue.

4. In a furnace of the kind described in combination with the furnace walls defining the gas and air uptakes and gas and air ports, a tubular metallic water cooled gas flue positioned in the gas port, and a tubular metallic water cooled air flue adapted to discharge air into the interior of the body of gas discharged from the gas flue in advance of the point of such discharge.

5. In a furnace of the kind described in combination with the furnace walls defining the gas and air uptakes, gas and air ports, and gas and air regenerators, means for conducting a part of the air from the air regenerator to and into the interior of the fuel gas in advance of its discharge from the gas port, said means including walls adapted to be heated in the operation of the furnace both by the incoming preheated air and by the outgoing waste gases.

6. In a furnace of the kind described in combination with the furnace walls defining the gas and air uptakes, gas and air ports, and gas and air regenerators, means for conducting a part of the air from the air regenerator to and into the interior of the fuel gas in advance of its discharge from the gas port, said means including walls adapted to be heated in the operation of the furnace both by the incoming preheated air and by the outgoing waste gases, and means for raising the pressure of the air after it has passed through the regenerator chamber and before it passes into the gas port to a pressure above that of the fuel gas.

7. In a furnace of the kind described, in combination with the furnace walls defining the gas and air uptakes, gas and air ports, and gas and air regenerators, a tubular metallic water cooled gas flue in the gas port, the air uptake being back of the gas uptake and having two branches located at either side of the gas uptake, an air passageway located intermediate the two air uptake branches and defined in part by a wall separating it from the gas uptake, a conduit adapted to conduct the air from the air regenerator into said air passageway, mechanical means including a shut-off valve for inducing pressure in the air in said conduit, and a tubular water cooled air flue connecting said air passageway with the interior of the gas body discharged from said gas flue at a point in advance of the point of discharge.

8. In a furnace of the character described, the combination of a hearth, a horizontally extending gas port at the end thereof, a vertical duct connected with the rear end of said port, an air duct on each side of said port discharging into the upper portion of the furnace, a fuel supply discharging into said port, and an aspirator connected to draw air from said air ducts and discharge the same in said port adjacent the outlet of said fuel supply.

9. In an open hearth furnace or the like having main air and gas passages and ports, an auxiliary air passage leading from the main air passage to the gas passage, and a source of compressed air connected to a discharge nozzle directed into said auxiliary air passage.

10. In an open hearth furnace or the like having main air and gas passages and ports, an auxiliary air passage leading from the main air passage to the gas passage, and a source of compressed air connected to a discharge nozzle directed into said auxiliary air passage, said auxiliary air passage entering the gas passage adjacent its entrance into the gas port and being directed toward said port, said nozzle serving as an ejector and drawing the air through the auxiliary passage and into said gas passage.

11. In an open hearth furnace or the like having air slag pockets, uptakes and ports, and gas uptakes and ports, an auxiliary air passage leading from the air slag pocket to the gas uptake, and a source of compressed air connected to a discharge nozzle directed into said auxiliary air passage.

12. The method of furnace operation which consists in delivering a supply of air to the gas passages by moving said air with a relatively small stream of compressed air.

13. The method of furnace operation which consists in delivering a supply of heated air to the gas uptake adjacent the gas port by moving said air into the uptake and port by means of a small stream of relatively cool compressed air.

14. In an open hearth furnace or the like having main air and gas passages and ports, an auxiliary air passage leading from the main air passage to the gas passage, and air moving means associated with said auxiliary air passage and adapted to draw air from the main air passage and deliver it to the gas passage.

15. In an open hearth furnace or the like

having main air and gas passages and ports, an auxiliary air passage leading from the main air passage to the gas passage, and air moving means associated with said auxiliary air passage and adapted to draw air from the main air passage and deliver it to the gas passage substantially in alignment with the gas port.

16. In an open hearth furnace or the like having air and gas slag pockets, uptakes and ports, an auxiliary air passage leading from the air slag pocket to the gas uptake, and adapted to deliver air to the gas uptake.

17. In an open hearth furnace or the like having air and gas slag pockets, uptakes and ports, an auxiliary air passage leading from the air slag pocket to the gas uptake and entering said uptake approximately at its point of junction with the gas port and adapted to deliver air to the gas uptake.

18. In an open hearth furnace or the like having air and gas slag pockets, uptakes and ports, an auxiliary air passage leading from the air slag pocket to the gas uptake and entering said uptake approximately at its point of junction with the gas port and in substantial alignment with said gas port and adapted to deliver air to the gas uptake.

19. In an open hearth furnace or the like having air and gas slag pockets, uptakes and ports, an auxiliary air passage leading from the air slag pocket to the gas uptake and adapted to deliver air to the gas uptake, and a fan in said auxiliary passage adapted to draw air from the slag pocket and drive it into the gas uptake.

20. The method of open hearth furnace operation which consists in drawing a supply of heated air from the air passages and delivering it under forced pressure to the gas uptake adjacent the gas port.

21. The method of open hearth furnace operation which consists in drawing heated air from the air slag pocket and carrying it by an auxiliary passage and delivering it to the gas uptake.

22. The method of open hearth furnace operation which consists in drawing heated air from the air slag pocket and carrying it by an auxiliary passage and delivering it under forced draft to the gas uptake adjacent the gas port.

23. In an open hearth furnace or the like having air and gas slag pockets, uptakes and ports, an auxiliary air passage leading to the gas uptake and entering said uptake approximately at its point of junction with the gas port and in substantial alignment with said gas port and adapted to deliver air to the gas uptake.

24. In a reverberatory furnace, a furnace head having air and gas ports, one of said ports surrounding the other, and means to longitudinally move one of the ports with respect to the other.

25. In an open-hearth regenerative furnace, a hearth, a fuel gas port opening thereto, an air-injecting port opening into said gas port adjacent to its end for projecting a stream of air into the fuel gas entering the hearth, an auxiliary air port opening into said furnace, a regenerator for heating air, a conduit connecting said regenerator with said auxiliary air port, and a conduit connecting said first-named conduit with said air-injecting port and including a fan for increasing the pressure on the heated air.

26. In the operation of a regenerative furnace the method herein described of effecting the mixing of the gaseous components of a combustible mixture which consists in causing the components to flow each from its proper regenerator in separate streams, maintaining a line of communication from one to the other of said streams, and inducing flow from one stream into the other by projecting in such line of communication a jet of extraneous fluid.

27. In a regenerating furnace the combination of a furnace chamber, gas and air regenerators at either end of the furnace chamber, passageways opening between furnace chamber and regenerators, an interconnecting duct opening between an air passageway and a gas passageway and means for projecting longitudinally within said duct a jet of fluid of variable intensity.

In testimony that we claim the foregoing as our invention, we affix our signatures this 27th day of October, A. D., 1920.

GEORGE F. DOWNS.
HERBERT F. MILLER, JR.