

Nov. 12, 1929.

F. E. KLING

1,735,687

REGENERATIVE FURNACE

Filed Feb. 28, 1922

4 Sheets-Sheet 1

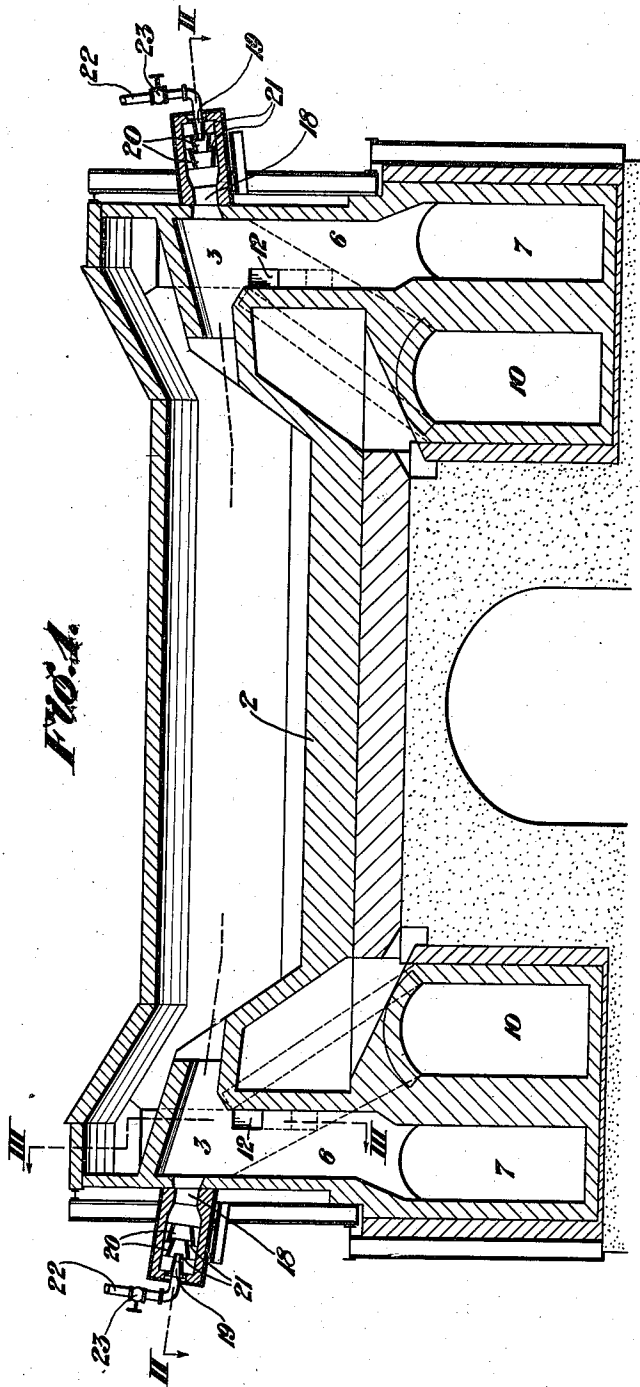


Fig. 1.

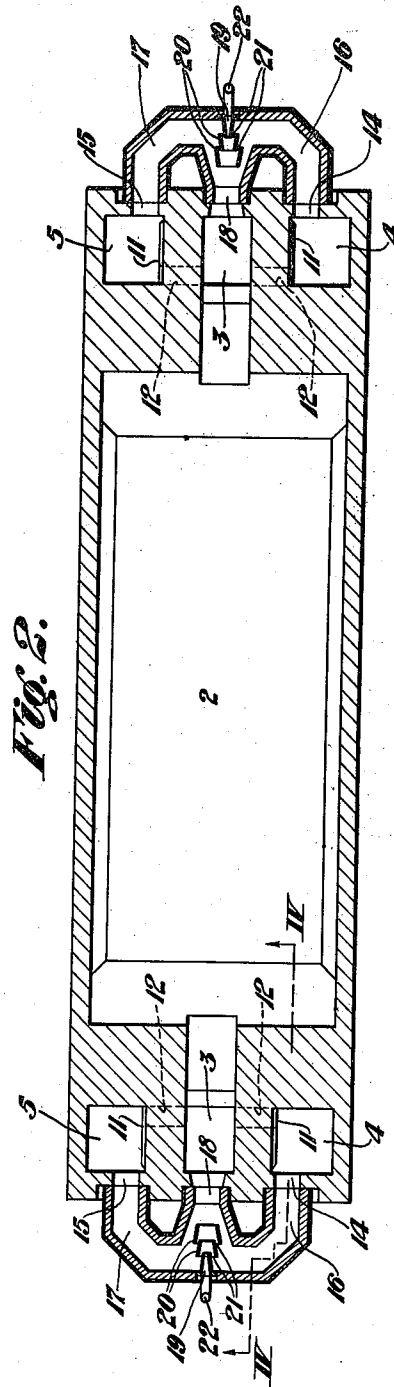


Fig. 2.

Witnesses:
Edwin Trueb

Inventor:
FRED E. KLING,
by
Anthony Usina
his Attorney.

Nov. 12, 1929.

F. E. KLING

1,735,687

REGENERATIVE FURNACE

Filed Feb. 28, 1922

4 Sheets-Sheet 2

Fig. 3.

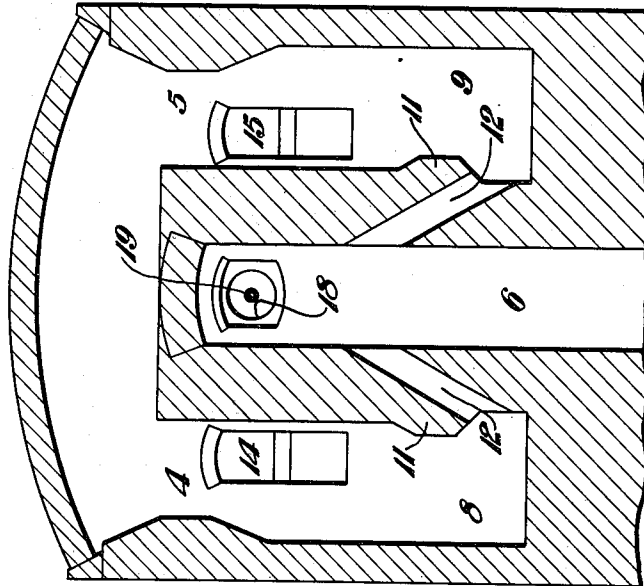
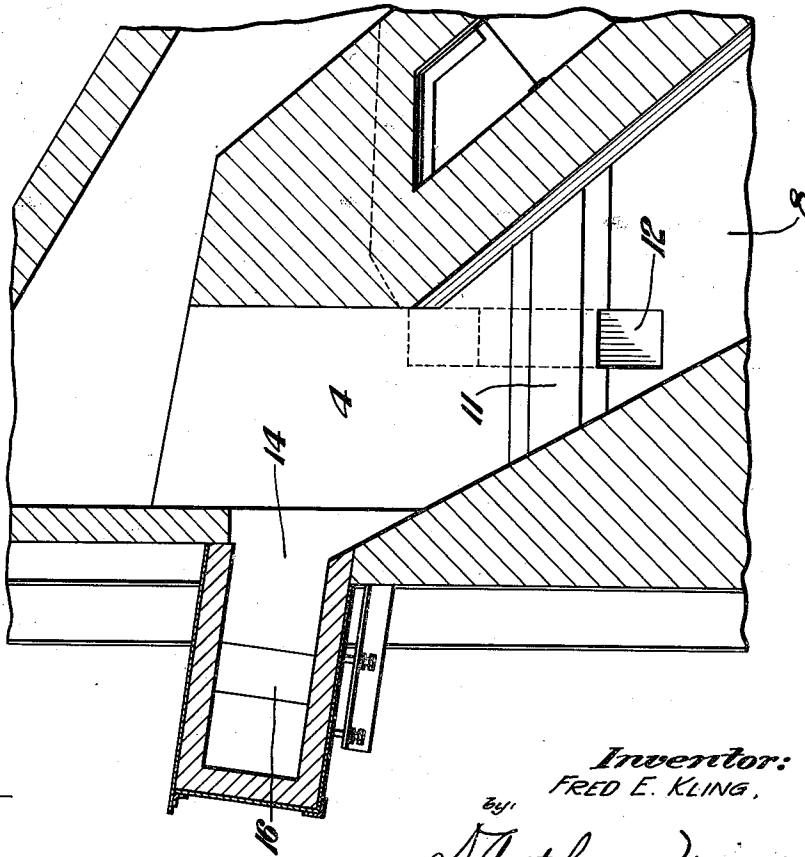


Fig. 4.



Witnesses:
Edwin Trub

Inventor:
FRED E. KLING,
by
Anthony Usina
his Attorney

Nov. 12, 1929.

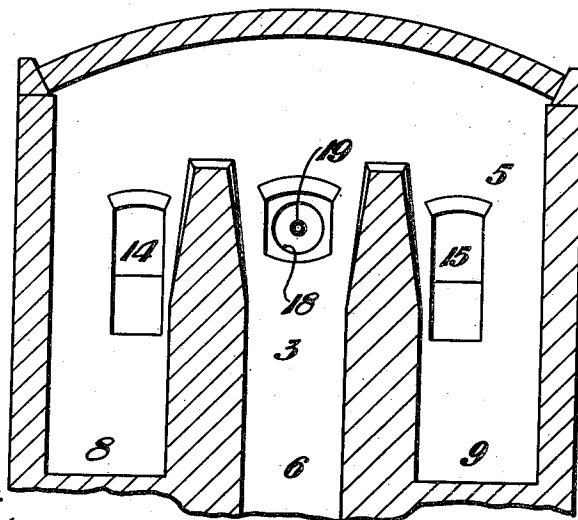
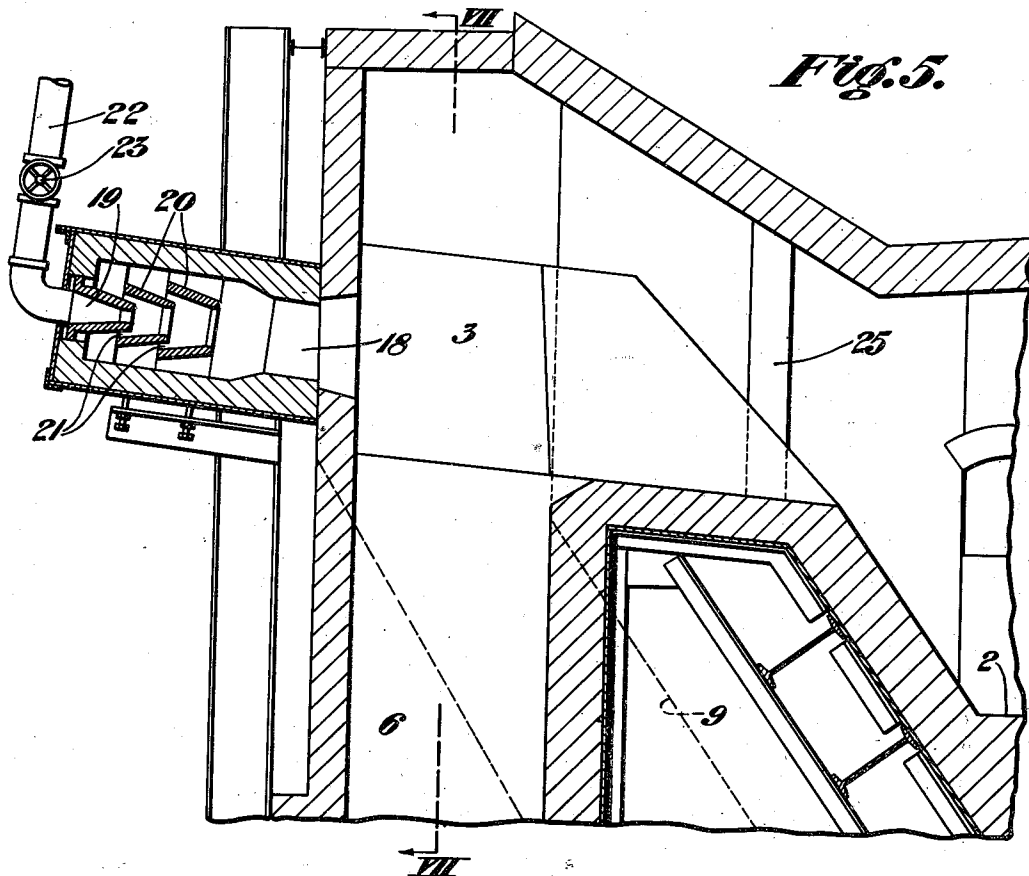
F. E. KLING

1,735,687

REGENERATIVE FURNACE

Filed Feb. 28, 1922

4 Sheets-Sheet 3



Witnesses:
Edwin Trub

Inventor:
FRED E. KLING,
by
Anthony J. ...
his Attorney

Nov. 12, 1929.

F. E. KLING

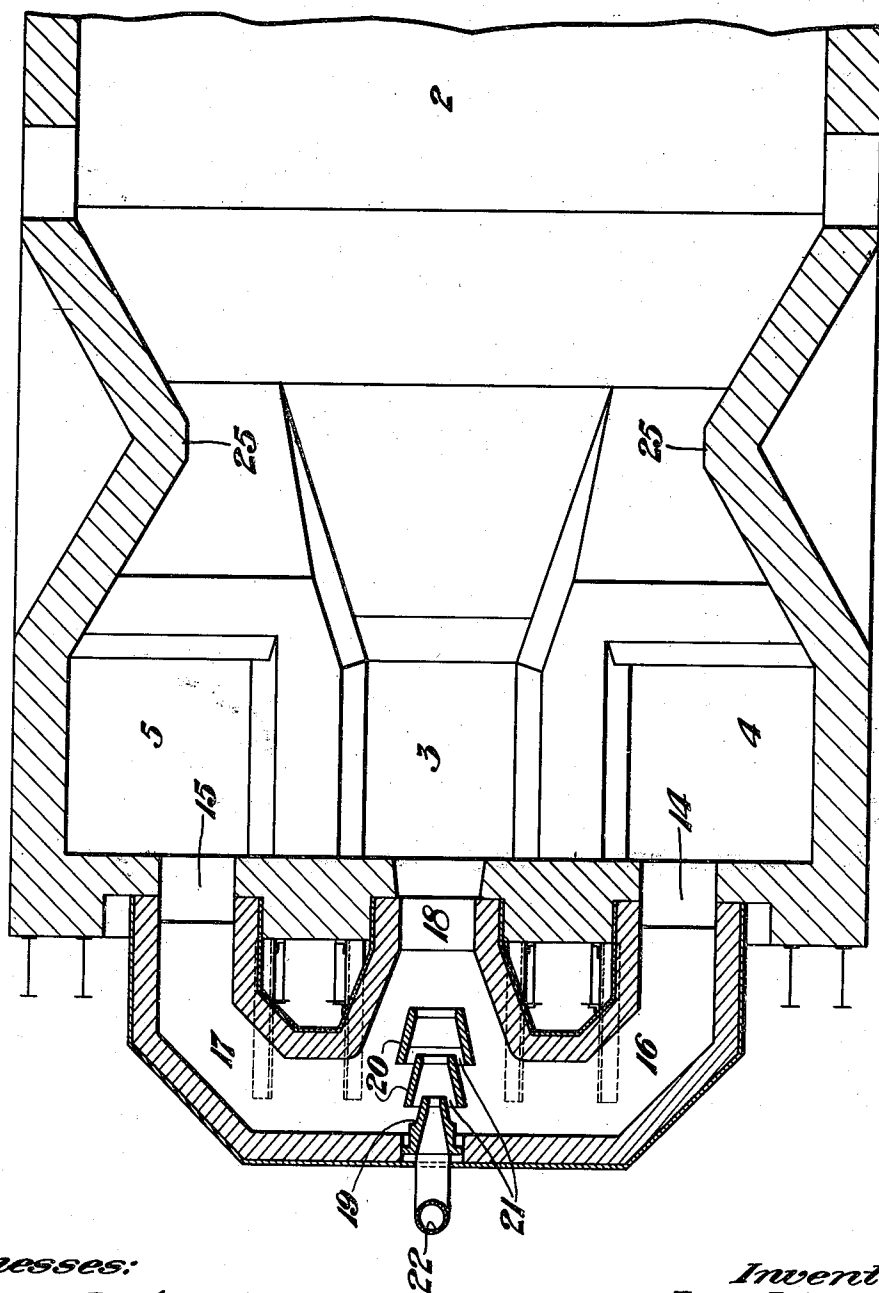
1,735,687

REGENERATIVE FURNACE

Filed Feb. 28, 1922

4 Sheets-Sheet 4

Fig. 6.



Witnesses:

Edwin Truel

Inventor:

FRED E. KLING,

by:

Anthony Vesna
his Attorney.

UNITED STATES PATENT OFFICE

FRED E. KLING, OF YOUNGSTOWN, OHIO

REGENERATIVE FURNACE

Application filed February 28, 1922. Serial No. 539,839.

This invention relates to regenerative furnaces, and while not limited thereto, relates more particularly to regenerative open hearth furnaces used in the manufacture of steel and similar reducing and refining operations.

One object of the invention is to provide a furnace of this class having novel port arrangements at each end of the furnace whereby the gas to be burned in the furnace is mixed with pre-heated air prior to passing it into the furnace.

Another object is to provide a blower located to the rear of the combined gas and air port for ejecting the mixture of gas and air from the port, and for inducing a flow of pre-heated air and gas into said port, thus providing in effect a Bunsen burner.

A further object is to provide means for regulating the ejecting fluid through the blower so as to regulate the effect of said blower and thereby regulate the flow of pre-heated air and gas into the combined air and gas port.

A still further object is to provide a furnace having the novel construction, design, and combination of parts described in the following specification and illustrated in the accompanying drawings.

In the drawings—

Figure 1 is a sectional side elevation of an open hearth furnace having my invention applied thereto.

Figure 2 is a sectional plan of the furnace of Figure 1, on the line II—II of Figure 1.

Figure 3 is a cross sectional elevation on the line III—III of Figure 1.

Figure 4 is a fragmentary sectional elevation on the line IV—IV of Figure 2.

Figure 5 is a sectional side elevation showing one end of a slightly modified form of furnace.

Figure 6 is a sectional plan of the modified form of furnace of Figure 5.

Figure 7 is a sectional elevation on the line VII—VII of Figure 5.

Referring more particularly to the drawings, the numeral 2 designates the hearth of a regenerative open hearth furnace which is of the usual design. The furnace is provided with a central combined air and gas port 3,

and two air ports 4 and 5 at each of the opposite ends of the furnace hearth. The ports are arranged in the same manner and have the same construction at each end of the hearth, so it is to be understood that the description of one will apply to both ends.

The combined air and gas port 3 is supplied with gas by an uptake flue 6 extending upwardly from a slag pocket 7 which is connected with the usual regenerative chamber (not shown) adapted to pre-heat the gas in the usual manner. It will be understood, however, that gas may be supplied to the port 3 direct, without pre-heating, if desired.

The air ports 3 and 4 receive their supply of air through upwardly extending flues 8 and 9, respectively, leading from a suitable slag pocket 10 which is connected with the usual regenerative chamber (not shown) adapted to pre-heat the air in the usual manner.

In the furnace of Figures 1 to 4, the air flues 8 and 9 are provided intermediate their ends with a projection or restrictor 11 forming a restricted passage for the flow of air and consequently higher pressure below said restrictor. Upwardly inclined auxiliary airways 12 are formed in the walls between the air flues 8 and 9 and gas flue 6, said airways extending from a point just below the restrictor 11 in the high pressure area to a point in the gas uptake flue 6 just below the bottom of the air and gas port 3. These airways provide for the flow of pre-heated air from the air uptakes into the gas uptake, so that a mixture of air and gas is delivered into the combined air and gas port.

The air flues 8 and 9, at a point to the rear of the air ports 4 and 5, are provided with outlet openings 14 and 15, respectively, in their rear walls which communicate with suitable air ducts 16 and 17, both of which meet and enter a single opening 18 in the rear wall of the combined air and gas port 3, thereby forming passageways for additional pre-heated air to pass from the air flues 8 and 9 into the combined air and gas port 3 and mix with the gas.

By adding or mixing air with the gases in the port 3, partial combustion of the gases

takes place in the port 3, so that the hydrocarbons contained in the gases are broken up, and the partially combusted mixture then burns with a higher luminosity when it passes into the furnace than it would if such partial combustion did not take place.

A blower 19 is mounted in the air ducts 16 and 17 directly in the rear of the inlet opening 18, so that it ejects the fluids passing therethrough through the opening 18 into the combined air and gas port 3. The blower 19 is of the usual sectional nozzle type, composed of a plurality of cone-shaped sections 20 telescoping within each other in spaced relation so as to form inlet or suction openings 21 between each section, and provided with a feed pipe 22 having a valve 23 therein adapted to supply fluid under pressure to the blower.

In operation, fluid under pressure will be passed through the blower 19 from the pipe 22, and due to the construction of the blower will create a suction in the blower which will draw pre-heated air from the ports 4 and 5 and flues 8 and 9, through the openings 14 and 15 and through the ducts 16 and 17 into the blower 19, and the blower will eject such air into the combined air and gas port 3. The force of the fluid supplied to the blower and the air drawn into the blower when ejected into the port 3 will operate as any well known form of ejector to force the gas and air out of the port 3 and over the hearth 2, where it forms a blowtorch or blast flame similar to the well known Bunsen burner. By ejecting the mixture of air and gas from the port 3 a partial vacuum or suction is created in the port area which tends to draw up the gas through the flue 6 into the port. The ejected effect of the blower may be increased until a suction is created in the gas flue 6, instead of the gases flowing under some pressure as is the usual practice.

It will readily be understood, therefore, that by varying the supply of fluid under pressure to the blower 19 by operating the valve 23, a greater or less amount of suction will be created, and consequently a greater or less amount of air and gas will be drawn through the flues 6, 8, and 9, into the respective ports, 3, 4, and 5, and since the amount of air drawn through the ducts 16 and 17 depends entirely upon the suction created by the blower 19, the air supplied by these ducts to the port 3 will vary directly with the varying of the fluid under pressure applied to the blower 19.

In many cases the gas passing through the flue 6 to the port 3 is at a higher pressure than the air passing through the flues 8 and 9, and therefore the air will not flow through the airways 12 unless the gas is brought to a lower pressure. However, with the blower 19 ejecting the gas and air from the port 3 a sufficient vacuum will be formed to cause a suction in

the flue 6, and, therefore, allow the air to flow through the airways 12. This flow of air through the airways 12 is also aided by the projections or restricters 11 in the flues 8 and 9, which serve to raise the pressure of the air in the area adjacent the airways 12 and thus permit it to flow into the gas flue 6.

By controlling the flow of fluid under pressure to the blower 19, the flow through the combined air and gas port 3 and air ports 4 and 5 is readily controlled, and the blast of the burning gases is also controlled, thereby providing an efficient and simple control for the furnace.

The fluid supplied to blower 19 under pressure may be either gaseous, liquid, a combination of gaseous and liquid, or a combination of gaseous fluids and solid matter, such as compressed air, oxygen, steam, gaseous fuels, liquid fuels, a combination of a solid fuel carried by a suitable fluid, or any combination of the above, and it will be understood that the term "fluid" used throughout the specification and claims as designating the matter under pressure supplied to the blower 19, shall include any of the above ingredients or combinations.

In the modified furnace shown in Figures 5 to 7, the construction is substantially the same as that of Figures 1 to 4, the only difference being that the airways 12 extending from the flues 8 and 9 into the flue 6 are omitted, and the arched top wall of the combined air and gas port is removed. Heretofore it has been impossible to have a gas port with an open top, as applicant has here shown, since the object of the port was to direct the gas and, therefore, the flame into the furnace and over the hearth, while with applicant's novel blower control the air and gas entering the port is ejected or blown into the furnace and over the hearth without the use of the port top.

In the modified construction, the elimination of the airways 12 compels all the air entering the port 3 to enter through the blower and to mix with the gas only in the port 3.

This modified form of furnace in addition to eliminating the airways 12 and top wall of the port 3 has its side walls contracted or projected inwardly adjacent the mouth or hearth ends of the air ports 4 and 5 as at 25, thus providing a Venturi tube effect to aid in drawing the air and gases into the furnace.

While I have shown and described specific embodiments of my invention, they are only illustrative, and I do not wish to be limited thereto since various modifications may be made without departing from the scope of my invention as defined in the appended claims.

I claim—

1. A regenerative open hearth furnace having a combined air and gas port at each end thereof and air ports at each side of said com-

bined air and gas ports, gas uptake flues for said combined air and gas ports, air uptake flues for said air ports, said air uptakes being contracted intermediate their ends to form a high pressure area below said contracted portion, and auxiliary airways leading from said high pressure areas in said air uptakes below said contracted portions to said gas uptake flues to provide a combined air and gas supply to said combined air and gas ports.

2. A regenerative open hearth furnace having a combined air and gas port at each end thereof and air ports at each side of said combined air and gas ports, gas uptake flues for said combined air and gas ports, air uptake flues for said air ports, said air uptakes being contracted intermediate their ends to form a high pressure area below said contracted portion, auxiliary airways leading from said high pressure areas in said air uptakes below said contracted portions to said gas uptake flues to provide a combined air and gas supply to said combined air and gas port, and air ducts leading from said air uptake flues to said combined air and gas ports to supply additional air to said combined air and gas ports.

3. A regenerative open hearth furnace having a combined air and gas port at each end thereof and air ports at each side of said combined air and gas ports, gas uptake flues for said combined air and gas ports, air uptake flues for said air ports, said air uptakes being contracted intermediate their ends to form a high pressure area below said contracted portion, auxiliary airways leading from said high pressure areas in said air uptakes below said contracted portions to said gas uptake flues to provide a combined air and gas supply to said combined air and gas port, air ducts leading from said air uptake flues to said combined air and gas ports to supply additional air to said combined air and gas ports, and a blower in said air ducts immediately to the rear of said combined air and gas ports and adapted to eject the mixture of air and gas from said ports.

4. In a heating furnace, the combination of entering and auxiliary discharge ports and means for using a gaseous jet of higher velocity to control the direction of the flame and the paths of the entering gases.

In testimony whereof I have hereunto set my hand.

FRED E. KLING.