

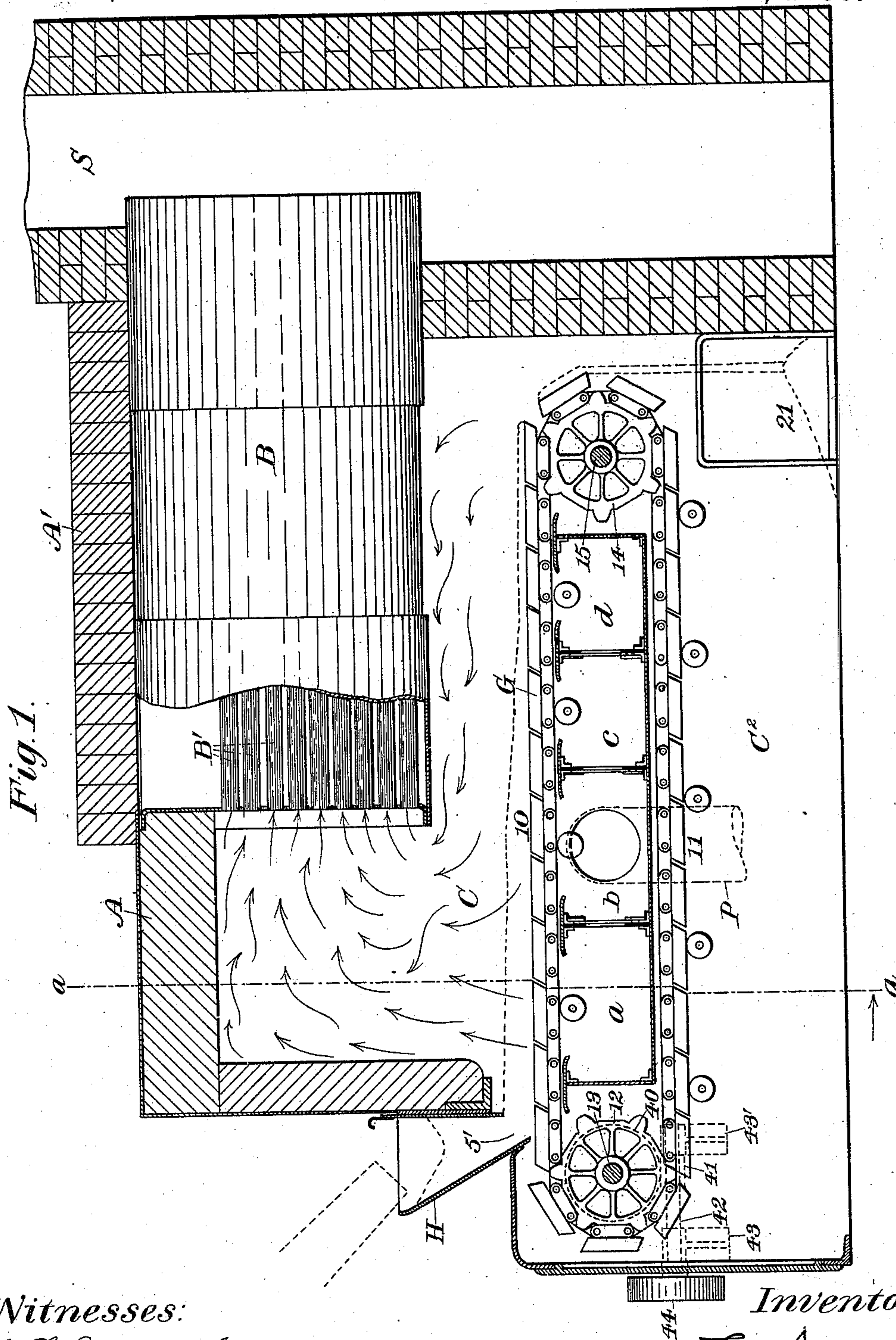
(No Model.)

2 Sheets—Sheet 1.

F. H. RICHARDS.  
TRAVELING GRATE FURNACE.

No. 535,404.

Patented Mar. 12, 1895.



Witnesses:

J. L. Edwards Jr.  
Fred. J. Dole.

Inventor:

F. H. Richards

(No Model.)

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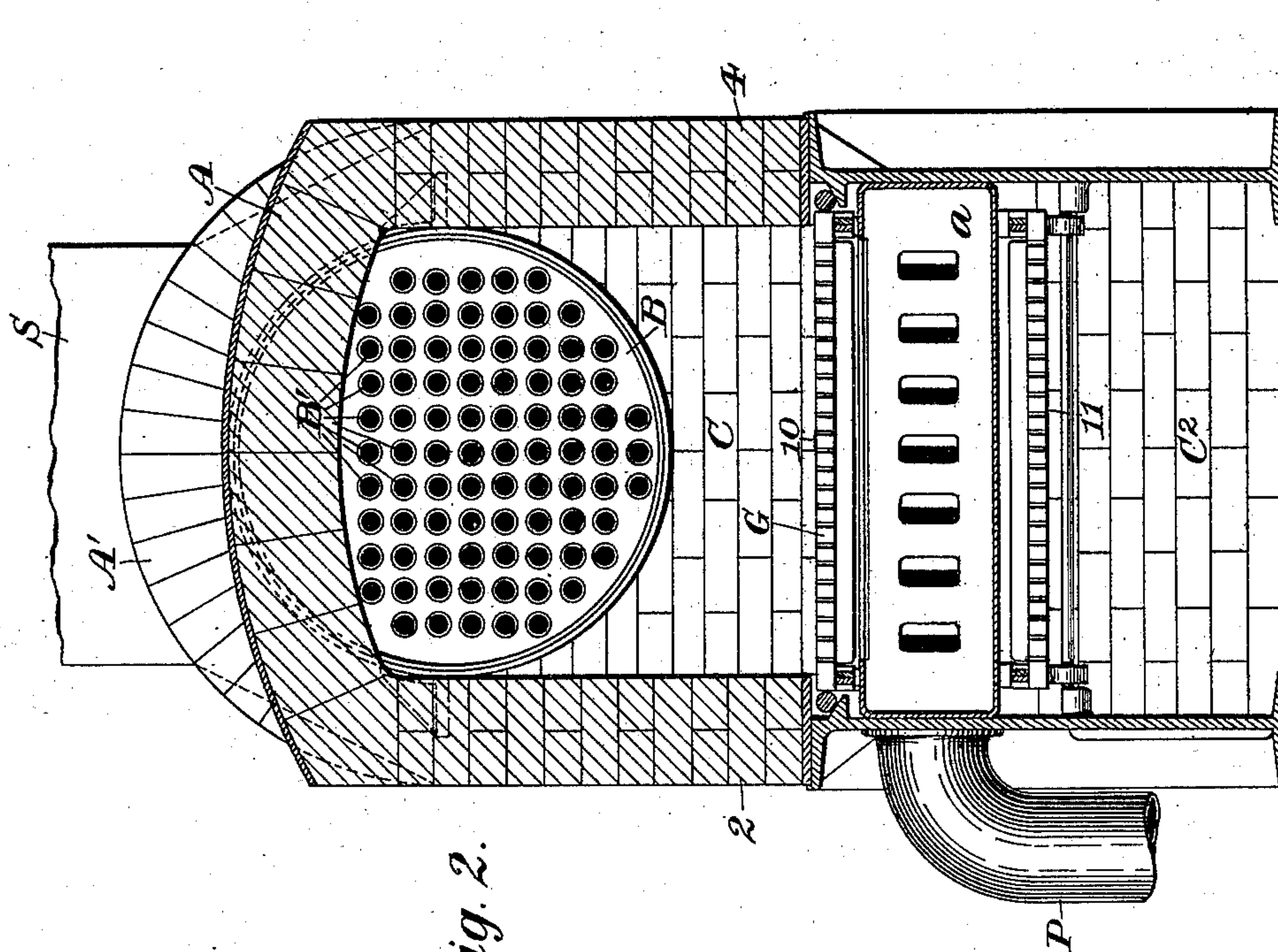


Fig. 2.

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Fred. J. Dole.

Inventor:

F. H. Richards



# UNITED STATES PATENT OFFICE.

FRANCIS H. RICHARDS, OF HARTFORD, CONNECTICUT, ASSIGNOR TO ECKLEY  
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## TRAVELING-GRATE FURNACE.

SPECIFICATION forming part of Letters Patent No. 535,404, dated March 12, 1895.

Application filed September 25, 1894. Serial No. 524,038. (No model.)

*To all whom it may concern:*

Be it known that I, FRANCIS H. RICHARDS, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Traveling-Grate Furnaces, of which the following is a specification.

This invention relates to the class of furnaces described in Letters Patent of the United States No. 499,716, granted to Eckley B. Coxe June 20, 1893, in which a fuel-traveling grate-mechanism is employed for carrying the fuel along in the furnace-chamber, and in which the fuel supported upon the grate is, during the traveling movement thereof, subjected to air-blasts of varying pressures at successive points in the length of the furnace-chamber.

My present invention is in the nature of an improvement upon the invention described and claimed in my prior application for Letters Patent in the United States, Serial No. 523,865, filed September 24, 1894, to which reference may be had; the object of this present invention being to provide an improved boiler-heating furnace of the class specified, in which the boiler to be heated is of such a nature and is so disposed relatively to the furnace-chamber, grate and air-blast apparatus with which said furnace is provided, as to constitute a deflecting-wall or lower roof for the rearward end of the furnace-chamber adapted for deflecting the rising gases of the later stages of the combustion-period each side the major axis of the boiler, mingling them in long streams each side the combustion-chamber, and carrying them in opposition to their natural course of travel or in a direction in opposition to the direction of travel of the fuel, toward the forward end of the furnace-chamber, and intermingling them with the gaseous products or combustible elements of the first stages of the combustion-period, or mingling them at a point above the ignition area of the fuel; also to provide means whereby the intermingled products of the first and last stages of the combustion-period will be deflected by incandescent walls at the forward end of the furnace-chamber and carried forward in separated streams (through flues)

through the water contained within the boiler, to thereby more effectively utilize the liberated energy for heating the water.

In the drawings accompanying and forming part of this specification, Figure 1 is a sectional side elevation of a boiler-heating furnace embodying my present improvements. Fig. 2 is a vertical cross-sectional view of the same taken in line *a-a*, Fig. 1, and looking toward the right-hand in said figure.

Similar characters designate like parts in both of the figures.

The furnace in connection with which my present improvements are shown is of the traveling-grate variety and somewhat similar to the furnace shown in the Patent No. 499,716 herein before referred to. In the present instance, however, the furnace is shown set for heating a boiler, B, beyond which boiler is the usual stack or flue, S, for discharging the gases after these have been used.

The furnace shown in the drawings has the usual grate-mechanism chamber C<sup>2</sup> in which is located a grate, designated in a general way by G, which is of the endless-grate variety, and which may be substantially the same as the grate shown in the patent hereinbefore referred to. Above the grate is a combustion-chamber, C, which is inclosed at its sides and ends by the usual side-walls 2 and 4, and end-walls 3 and 5, respectively, and is provided with a roof, A, at the forward end thereof.

At the forward end of the furnace this is provided with the usual fuel-supply hopper, H, from which fuel is admitted to the fuel-carrying run of the grate through the opening, 5', which is contiguous or in close proximity to the upper surface of said grate. In the form thereof herein shown, the endless grate which comprises the upper and lower runs 10 and 11, respectively, the upper run of which constitutes the furnace-floor proper, is carried at the opposite ends of said runs by chain-wheels, 12 and 14, carried upon shafts, 13 and 15, respectively, journaled in suitable bearings (not shown) secured to the side-walls of the grate-mechanism chamber; and as a convenient means for actuating said grate, the forward shaft 13 is shown (in dotted lines)



provided with a worm-wheel, 40, which meshes with a worm, 41, on a driving-shaft, 42, journaled in bearings, 43 and 43', which shaft is provided with a driving-pulley, 44, which may  
5 be driven from any suitable source of power (not shown). The hopper H will, in practice, be provided with a suitable cut-off gate for regulating the supply of fuel to the furnace-floor or grate.

10 As a means for supplying air to the fuel at varying pressures at successive points along the fuel-carrying run of the grate, an air-supply apparatus is provided, which air-supply apparatus may be of the same general construction as that shown in Letters Patent No.  
15 499,716, hereinbefore referred to, it consisting of a series of successive air-supply chambers, *a*, *b*, *c* and *d*, respectively, located below the fuel-carrying run, 10, of the grate, and having the usual outlet openings contiguous to  
20 the fuel-carrying run of the grate. As a means for supplying air to the air supply chambers, I have shown a pipe, P, in communication with one of said chambers, as *b*, which pipe  
25 may receive its supply from any suitable blower or air-pump (not shown), the other air-supply chambers *a*, *c* and *d* receiving their supply of air from the chamber *b* through communicating valve-regulated openings in  
30 the side-walls of said chambers. The process of supplying air to the fuel at varying pressures, or at successively-reduced pressures at successive points in the length of the fuel-carrying run of the grate, is or may be substantially the same as the process described in  
35 Letters Patent of the United States No. 499,715, granted to Eckley B. Coxe June 20, 1893, to which reference may be had.

40 In operation, the fuel is fed to each section of the grate at or before the time this reaches the first air-supply chamber, *a*, and is then carried along, maintained substantially *in statu quo*, over that chamber and the succeeding chambers, *b*, *c* and *d*, during which period  
45 the combustible material of the fuel is consumed, the resulting cinder or ash being delivered over the rearward end of the grate into the ash-pit, 21, which ash-pit, in this instance, constitutes a part of the grate-mechanism chamber C<sup>2</sup>. In practice, the combustion goes on, at one stage or another, throughout the entire length of the furnace, or the entire length of the fuel-supporting run of the grate, the ignition taking place within a short  
55 distance of the point where the fuel falls upon the grate, or at that point near the forward end of the grate which is herein termed the "first combustion or ignition-area," said fuel being completely reduced to cinder over the  
60 last chamber, *d*, of the series, or at that point near the rearward end of the grate which is herein termed the "last combustion-area."

65 Heretofore it has been customary, in furnaces of this class, to carry the products of combustion from the first or ignition area, in the direction of travel of the upper run of the grate, toward and over the succeeding

combustion-chambers without material aeration or intermingling of the products of the first, last and intermediate areas, or the products of the various successive stages in the combustion period, other than that which might accrue from forced contact of the gaseous products moving in streams in one and the same direction, as will be understood by reference to the Patent No. 499,715 hereinbefore referred to; and in consequence, a considerable percentage of effective energy has been lost, owing to the incomplete oxidation of the combustible elements from want of proper aeration.

To facilitate the effective oxidation of the combustible elements and thereby secure the liberation of the maximum amount of energy to a given amount of burning fuel and in the shortest possible length of time, I have found that this can be done in traveling-grate furnaces by diverting the natural course of travel of the products of the later stages of the combustion period and causing them to travel reversely of the fuel-layer and intermingle with the products of the first stages of the combustion period; in other words, by creating two oppositely-moving currents comprising the combustible elements and intermingling said elements in the area above the fuel-carrying run of the traveling grate. As a convenient means for accomplishing this end, I have provided the furnace-chamber, at the upper forward end thereof, with a boiler, B, having a series of hot air tubes or flues, B', extending through the same from end to end, which tubes communicate at the forward end thereof with the furnace-chamber and at the rearward end thereof with the flue S. This boiler, which is covered by the roof A', is so set between the side-walls of the furnace-chamber that the lower depending portion thereof, or the lower half of said boiler, lies in a horizontal plane approximately midway between the grate G and the heat-radiating roof A of the furnace-chamber and constitutes an interiorly-convexed deflecting lower-roof for the rear portion of the furnace-chamber, or that portion of the furnace-chamber in the rear of and adjacent to the ignition and high-combustion areas of said chamber. This organization provides, so to speak, a reverberatory-chamber at the rearward end of the furnace above the grate, having passage-ways at the sides thereof which are relatively high as compared with the middle portion of said chamber. Thus it will be seen that the rising gases inherent to the last stages of the combustion period will be deflected by the convexed roof (*i. e.*, the lower portion of the boiler), sidewise, where they are intermingled in long streams each side the longitudinal center of said reverberatory-chamber and are carried forward to and are intermingled with the gaseous products of the first stages of the combustion period near the extreme forward end of the furnace-chamber, whence they rise upward and pass in



separate streams through the flues of the boiler B, and thence are delivered, after use, into the flue S at the rear end of said boiler.

This organization of the several features of the furnace herein described insures a very thorough and effective mingling of the several air-supplies and the effective oxidation of the several portions of the furnace gases, and also permits the effective utilization of the relatively high temperature of the later stages of the combustion period, not only for heating the boiler which it first affects, but also for heating and igniting the fresh fuel as it is delivered to the grate, by passing over the same and intermingling the products of the later stages of combustion with the gaseous products at the ignition area of the furnace, after which the combined energy liberated by the intermingling of the gaseous products of the first and last stages of the combustion is utilized within the flues of the boiler for heating the water surrounding said flues.

Having thus described my invention, I claim—

1. In a furnace of the class specified, the combination with the fuel-traveling grate; and with the air-blast apparatus located underneath the fuel-carrying run of said grate, and comprising means for supplying air to the fuel at varying pressures at successive points in the length of said grate, to thereby positively carry the products of combustion of the later stages of the combustion-period toward the rear end of the grate; of a combustion-chamber located above said grate and having a relatively-high roof at the forward end thereof extending over and above the ignition-area of the grate; and having a relatively-low depending convexed roof at the rearward end thereof extending over and above the rear end or low-combustion area of the grate, and adapted to deflect the products of combustion of the later stages of the combustion-period and to carry them toward the forward end of the grate and thereby intermingle said products with the products of the first stages of the combustion-period, substantially as described and for the purpose set forth.

2. In a furnace of the class specified, in combination, a fuel-traveling grate, means for

actuating said grate to impart a traveling movement to the fuel supported thereon, an air-blast apparatus comprising a series of air-blast chambers located below the fuel-carrying run of said grate and adapted for supplying air to the fuel at varying pressures at successive points in the length of said grate, a combustion-chamber located above said fuel-carrying run and having a relatively high roof at the forward or ignition end thereof, a boiler located at the upper rearward end of said combustion-chamber and so disposed relatively to the grate and furnace-chamber as to form a relatively low depending convex roof for said chamber at the rearward end of said chamber approximately midway between the relatively high roof of said chamber and the fuel-carrying grate and which extends longitudinally over a considerable portion of the rearward end of said grate, substantially as described and for the purpose set forth.

3. In a furnace of the class specified, in combination, a fuel-traveling grate, means for actuating said grate to impart a traveling movement to the fuel supported thereon, a series of air-blast chambers located under the fuel-carrying run of said grate and adapted for supplying air to the fuel at varying pressures at successive points in the length of said grate, a relatively high combustion-chamber located above the ignition-area of the grate, a relatively low combustion-chamber or reverberatory chamber located above the series of air-blast chambers at the rear end of the grate having its outlet into the relatively high combustion-chamber, and a boiler located above the relatively low combustion-chamber and of such disposition relatively thereto as to form a current-deflecting roof for said low combustion-chamber and having a series of hot-air outlet flues in communication at one end with the relatively high combustion-chamber near the upper end thereof, said boiler extending over the grate-area of the later stages of the combustion period, substantially as described and for the purpose set forth.

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