

(No Model.)

F. H. RICHARDS.
FURNACE.

No. 517,627.

Patented Apr. 3, 1894.

Fig. 2.

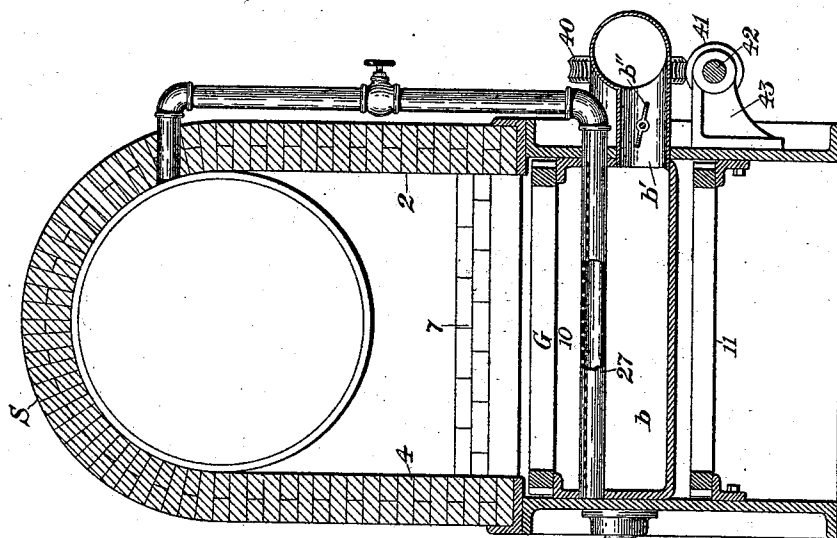
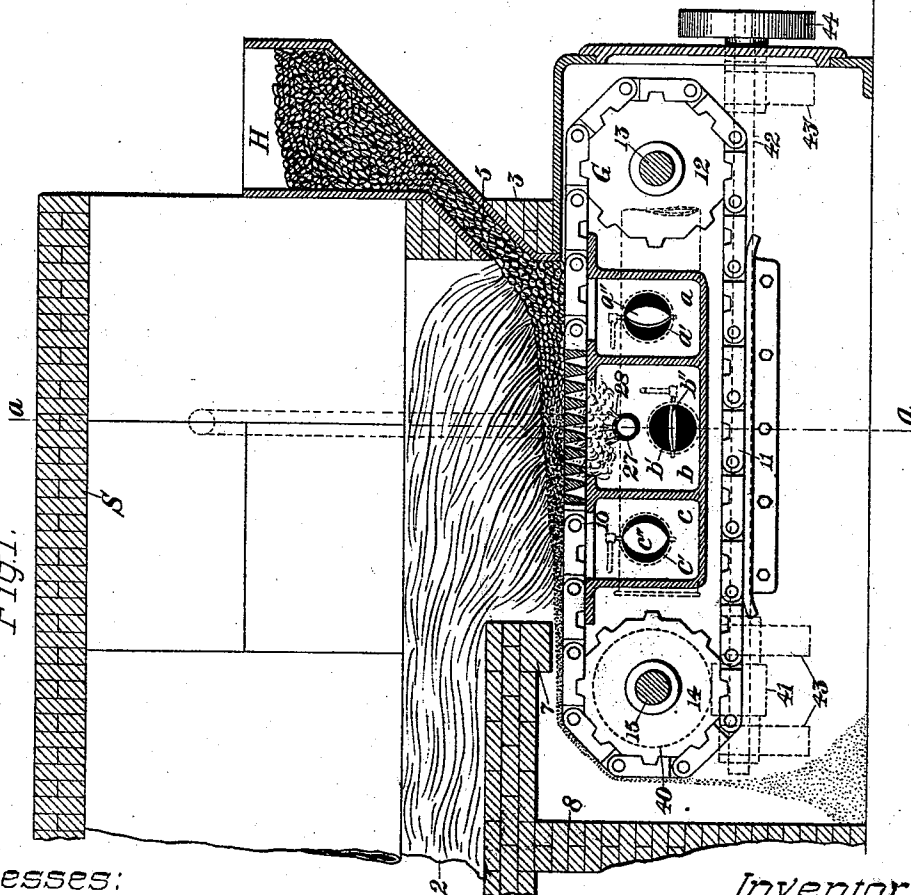


Fig. 1.



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FURNACE.

SPECIFICATION forming part of Letters Patent No. 517,627, dated April 3, 1894.

Application filed February 20, 1894. Serial No. 500,888. (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 Furnaces, of which the following is a specification.

This invention appertains to "furnaces" and relates to methods or processes for the economical burning of coal and other fuel, and to apparatus for carrying out the process, whereby the lower and cheaper grades of coal may be burned with economy and efficiency and whereby the formation of clinkers during the combustion of the coal is reduced.

In the drawings accompanying and forming a part of this specification, Figure 1 is a sectional side elevation of a furnace embodying apparatus adapted for carrying out my present invention. Fig. 2 is a vertical cross-sectional view taken on the line *a-a*, Fig. 1, showing the parts at the left hand of said line, as seen from a point at the right-hand thereof.

Similar characters designate like parts in all the figures.

For the purpose of illustrating the application and utility of my present invention, I have herein shown apparatus for carrying out the present process as applied to a furnace similar to the one described in Letters Patent of the United States, No. 499,716, granted to E. B. Coxe June 20, 1893, to which reference may be had. It will be understood, however, that the objects of my invention may be attained with any form of furnace in which the fuel has a traveling movement in the furnace-chamber, when said furnace is provided with apparatus capable of carrying out my improved process; therefore it is not desired to confine this invention to any particular form of furnace, nor to a particular kind of grate-mechanism therefor.

The furnace herein described is shown having a fuel-traveling grate and means for actuating the same, and has the usual inclosing walls at the sides and ends thereof, and is also shown provided with the ordinary roof, S.

The side-walls are designated by 2 and 4, respectively, the front end-wall, 3, rear wall, 8, and bridge-wall 7. At the forward end of

the furnace this is provided with the usual fuel-hopper H from which fuel is admitted to the furnace-chamber through the inclined chute or opening 5 in a well-known manner. In the form herein shown, the grate is in the nature of an endless chain-grate, designated in a general way by G, and comprising the upper and lower runs 10 and 11, respectively, said upper run constituting the furnace-floor under which is located the air-blast apparatus, which, in the preferred form thereof herein shown, comprises the successive air-blast chambers *a*, *b* and *c*, arranged according to the invention described in the aforesaid Letters Patent No. 499,716. Said air-blast apparatus is supported by some suitable connection with the side-walls 2 and 4 of the furnace.

The air-blast chambers *a*, *b*, and *c*, are shown provided with air-supply pipes, *a'*, *b'* and *c'*, respectively, in which may be placed regulator-valves, *a''*, *b''* and *c''*, respectively, for independently regulating the air-blast in the successive air-blast chambers *a*, *b* and *c*. Said air-supply pipes may be furnished with air from a blower (not shown) substantially as described in the prior Letters Patent hereinbefore referred to.

For actuating the fuel-traveling grate this is herein shown carried by chain-wheels, 12 and 14, which are supported on shafts, 13 and 15, respectively; and for revolving one of the shafts and thereby actuating the grate, said shaft 15 is shown provided with a worm-wheel, 40, which meshes with a worm, 41, on the driving-shaft 42, that is supported in bearings 43 and 43', and is provided with a driving pulley, 44, that is driven by power from any suitable source, not shown.

The features just described, relative to the elements of the furnace proper, are fully described in the patent hereinbefore referred to, and constitute, in their particular construction and organization, no material part of the present invention; the preceding description only defining one form of furnace to which my invention is applicable.

It is well known that, in practice, some kinds of coal, and especially some mixtures of different kinds of coal are much inclined to clinker during combustion, and that this

tendency to clinker is, in some cases, greatly counteracted by subjecting the burning fuel to combined air-and-steam blasts; it is also found that the ignition of the fuel is greatly accelerated by a dry-air blast, and that during the latter stages of combustion, the application of a dry-air blast to the fuel causes a more complete combustion of the fuel; and it is one of the principal objects of my present invention to furnish a process whereby the fuel is subjected to a dry-air blast during its ignition period and during the latter stages of combustion, and whereby it may also be subjected to a combined air-and-steam blast during the middle portion of its combustion, or intermediate to the ignition period and latter stages of combustion, to thereby obviate the formation of clinkers, in a great measure, and secure the best practical results in the burning and combustion of said fuel. As a means for accomplishing this end, I have shown a steam-blast apparatus located in one of the air-blast chambers below the grate between the ignition region of the furnace, and the region where the combustion of the fuel is completed. When only three blast-chambers are used as shown in the drawings, the first air-chamber *a* will supply the moderate-pressure air-blast suitable for igniting the fuel; the second air-chamber *b* will supply the high-pressure blast suitable for forcing the rapid combustion of the fuel, and the third air-chamber *c* will supply the low-pressure air-blast for gently blowing the nearly consumed fuel during the last stages of the combustion period.

The steam-blast apparatus may properly consist of a pipe, 27, extending into the air-chamber transversely of the furnace and having a series of perforations in the upper side thereof through which jets of steam issue upwardly toward the grate, as indicated at 28 in Fig. 1 of the drawings.

The steam-blast apparatus is herein shown as entering the high-pressure chamber *b* of the air-blast apparatus; the jets of steam issuing from said steam-blast apparatus commingle with and impregnate the air in the high-pressure chamber, thus forming a combined air-and-steam blast of relatively high-pressure to the action of which the fuel is subjected during the middle portion of the combustion period.

According to my present process, the fuel is subjected to a low-pressure dry-air blast at the ignition-period, thus insuring a better ignition of the fuel than if the steam-blast were supplied to the fuel during the ignition-period; and the full effect of the steam-blast is secured for preventing the formation of clinkers, since this formation only occurs after the fuel has become fully ignited and has reached a state of rapid combustion. In some cases it may be desirable to use the steam-blast in connection with two or more air-blasts of varying pressures, especially if more than three air-chambers are used under the

grate. The steam blast may also be applied at a point or points intermediate to two air-blasts.

The fuel is supplied to the grate from the hopper *H* through the chute or opening 5 and is carried forward upon the grate in a layer. The fuel being ignited when it first enters the furnace-chamber, the ignition of the advancing layer is continued by an air-blast of moderate pressure from the first air-blast chamber *a*. The ignited fuel is carried forward by the movement of the grate over the second air-blast chamber where it is blown with a relatively high pressure blast of air, or of combined steam-and-air if the steam blast apparatus is located at this point as shown in the drawings. The fuel is next carried over the succeeding air-blast apparatus, comprising the chamber *c* where it is subjected to a dry-air blast of much lower pressure and where the combustion of the fuel is completed, the resultant ash and cinder being discharged over the rearward end of the grate.

A portion of the process herein described, *i. e.*—that of subjecting the fuel while spread in a layer to successive air-blasts of varying pressures is substantially the same process as described and claimed in Letters Patent of the United States No. 499,715, granted to E. B. Coxe June 20, 1893. The successive steps of the process consist of igniting the fuel spread in a layer; subjecting the same to a dry-air blast of moderate pressure during the ignition period; moving the ignited fuel forward and subjecting the same to an air-blast of increased pressure and at the same time, or substantially so, subjecting the fuel to a steam-blast, and subsequently carrying the fuel forward and subjecting the same to a dry-air blast for completing the combustion thereof.

Having thus described my invention, I claim—

1. The herein-described process of burning fuel, which consists in igniting the mass spread in a layer, subjecting said ignited layer to successive air-blasts of varying pressures during the successive stages of the combustion period, and also subjecting said mass to a steam-blast between the first and last stages of the combustion thereof, substantially as described.

2. The herein-described process of burning fuel, which consists in igniting the mass spread in a layer, subjecting the same to a dry-air blast during the ignition period, a dry-air blast during the last stages of the combustion period, and a combined steam-and-air blast near the middle portion of the combustion period, substantially as described.

3. The herein-described process of burning coal and other fuel, which consists in igniting the mass spread in a layer, feeding said mass forward subjected to a dry-air blast of relatively low pressure during the early part and the latter part of the combustion period and subjecting said layer to a combined air-and-

steam blast of relatively high pressure during the middle portion of the combustion period, substantially as described. 30

4. The herein-described process of burning
5 fuel, which consists in supplying a grate with fuel spread in a layer thereon; igniting the same and first subjecting it to a dry-air ignition-blast from below the grate, then moving it forward and subjecting it to a combined
10 air-and-steam blast, thence moving it forward and subjecting it to a dry-air blast, substantially as described and for the purpose set forth.

5. The herein described process of burning
15 fuel, which consists in spreading the same in a layer, igniting the layer, moving the layer forward during combustion and subjecting the same during the successive periods of combustion to successive dry-air and steam-
20 blasts, substantially as described.

6. The herein-described process of burning coal and other fuel, which consists in subjecting a moving mass or layer first to heat and to a dry-air blast of relatively low pressure for igniting the same, next subjecting the
25 ignited layer to a combined steam-and-air blast of relatively high pressure, and subsequently subjecting the burning fuel to a dry-air blast of relatively low pressure, substan-

tially as described and for the purpose set forth. 30

7. In a furnace, the combination with a traveling grate and with successive air-supply chambers underneath the grate at successive points in the length thereof, of means for supplying air to the chambers at different pressures, and means for supplying steam to the grate through one of said chambers, whereby the fuel may be ignited by a dry-air blast, continued burning by a combined air-and-steam blast, and the burning completed by a dry-air blast, substantially as described. 40

8. In a furnace, the combination with a traveling grate and with means for supplying the grate with fuel spread in a layer thereon, of a dry-air ignition-blast apparatus underneath the grate adjacent to the fuel-supply, a combined air-and-steam blast apparatus underneath the grate forward of the ignition air-blast, and an air-blast underneath the grate forward of the combined air-and-steam blast, substantially as described and for the purpose specified. 50

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