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H. A. POPPENHUSEN.
FURNACE.

APPLICATION FILED APR. 26, 1904.

3 SHEETS—SHEET 2.

Fig. 2

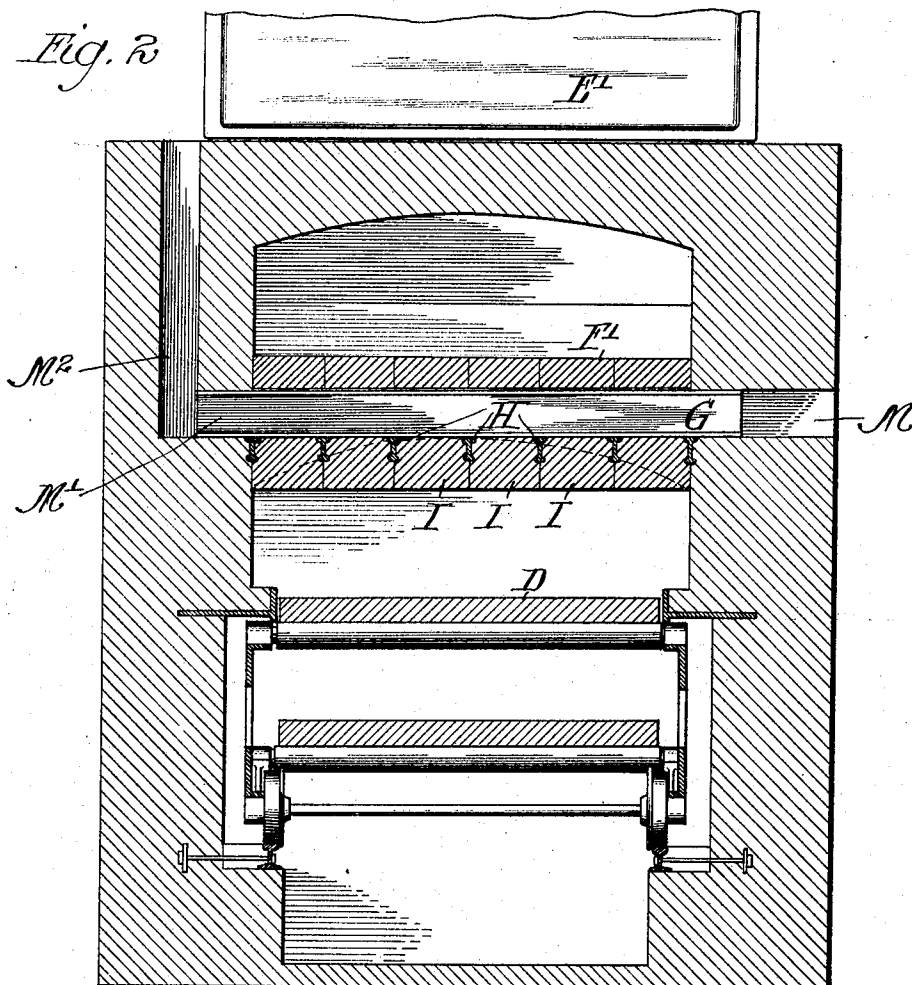
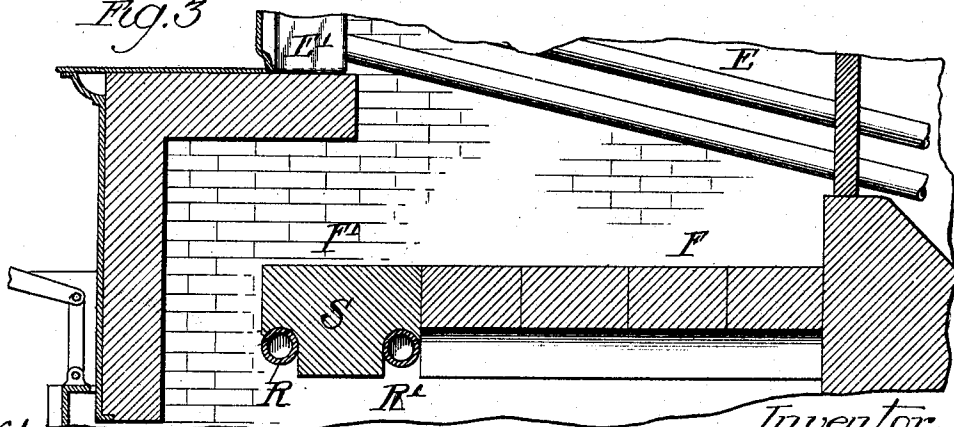


Fig. 3



Witnesses:

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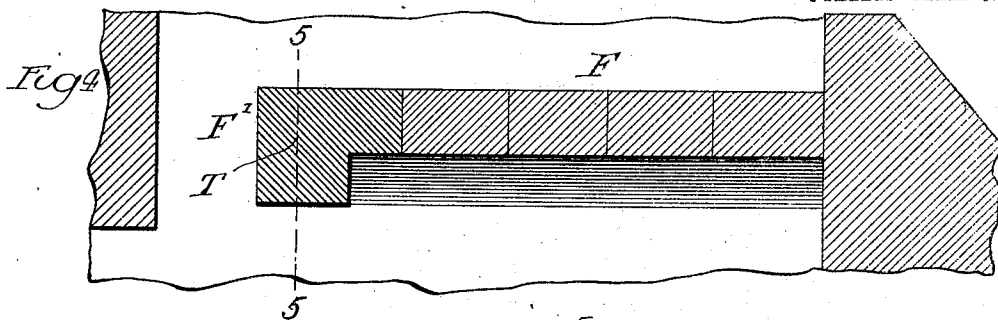
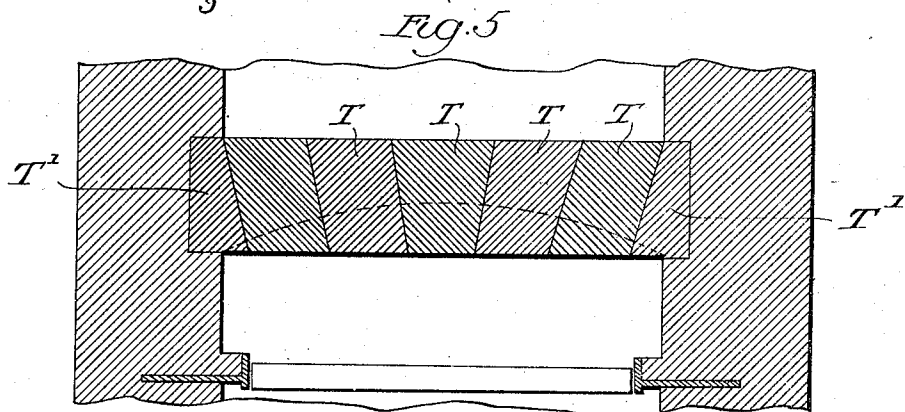
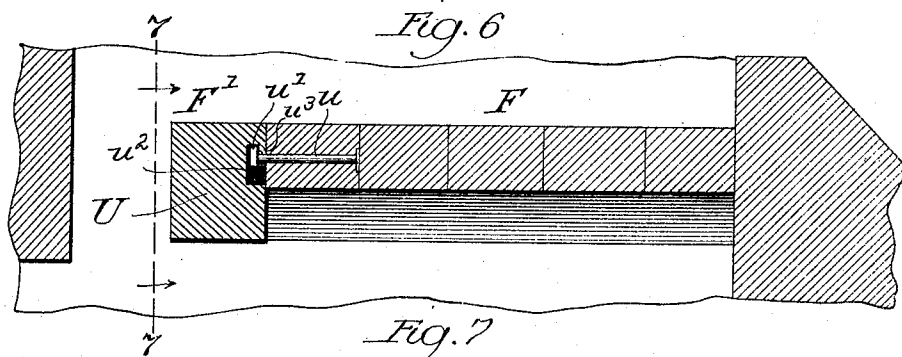
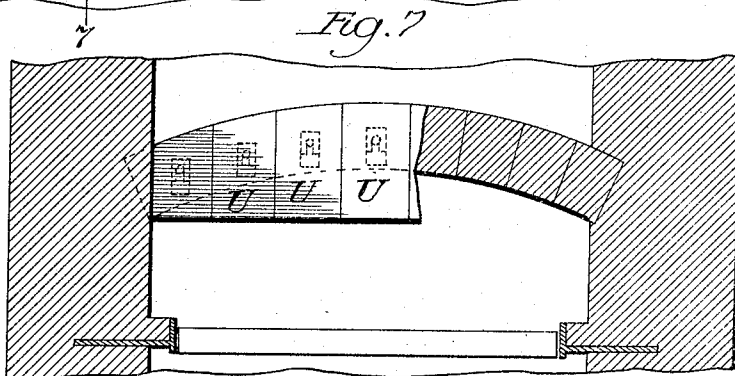
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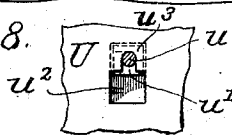
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3 SHEETS—SHEET 3.



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Fig. 8.



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UNITED STATES PATENT OFFICE.

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FURNACE.

SPECIFICATION forming part of Letters Patent No. 783,133, dated February 21, 1905.

Application filed April 26, 1904. Serial No. 204,987.

To all whom it may concern:

Be it known that I, HERMAN A. POPPENHUSEN, a citizen of the United States, and a resident of Evanston, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Furnaces; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in means for promoting the combustion of fuel in furnaces of that kind provided with automatic stoking devices, or means by which the fuel fed to the furnace continuously advances into the furnace during the process of combustion.

The improvements constituting my invention are applicable to furnaces provided with endless traveling or chain grates, with grates downwardly and inwardly inclined and provided with rocking grate-bars adapted to facilitate the downward movement of fuel thereover, and all other forms of grates adapted to advance or move the fuel inwardly from the feed-opening of the furnace during the progress of combustion.

In furnaces of the kind referred to as heretofore constructed it has been usual to provide what is known as a "fire-arch" or "coking-breast" extending across or over the grate adjacent to the point at which the fuel is fed thereto and consisting of fire-brick or the like, such fire-arch or coking-breast being maintained at a high temperature by the burning of the gases given out by the fresh fuel and which by radiating heat upon the fresh fuel as it enters the furnace serving to promote the ignition thereof, and thereby lessen the production of smoke. Such a coking-breast or fire-arch is found to operate best when used with fuel containing a large percentage of volatile matter, but has been found less efficient in burning anthracite coals or bituminous or semibituminous coals, which have a small percentage of volatile matter and such as are known as "coking-coals." It has been found that in the use of such anthracite or coking coals especially the percentage of gases gen-

erated from the fresh coal when the same is first subjected to the heat within the furnace, which gases are liberated and burned beneath or in contact with the fire-arch or coking-breast, is not large enough to insure the continuous heating of said fire-arch or coking-breast and to thereby maintain such high temperature immediately adjacent to the feed-opening of the furnace as is necessary to produce constant ignition of the fuel as fast as it reaches the part of the grate adjacent to said feed-opening, it being of course understood that if the ignition of the entering fuel be not effected as rapidly as the fuel is advanced on or within the grate a greater or less quantity of unignited fuel will be carried inwardly upon the grate and a greater or less portion of the area of the fuel-supporting surface of the grate will be covered with such unignited fuel, with a corresponding loss in the heat-generating capacity of the furnace.

A furnace embodying my improvement is provided with a deflecting partition, wall, or arch which extends from the rear or bridge wall of the combustion-chamber or fire-box of the furnace forwardly over the grate to a point near the feed-opening of the furnace and which terminates at such distance from the front wall of the furnace, or that in which the feed-opening is formed, as to leave a relatively narrow space or passage for the burning gases or products of combustion between the forward edge of said wall, partition, or arch and the front wall of the furnace above said feed-opening. A deflecting wall, partition, or arch thus arranged may be used either with or without a coking-breast or fire-arch; but when such coking-breast or fire-arch is present it may be located over the opening between the front or forward edge of said deflecting partition, wall, or arch and the front wall of the furnace and at such distance above said division wall or arch as to afford ample space for the passage of burning gases and products of combustion between said fire-arch and the deflecting wall and partition or arch. Such deflecting wall, partition, or arch, whether used in connection with a coking-breast or fire-arch or not, serves to prevent the direct upward passage of the burning gases and products of combustion

from the burning fuel upon the main or inner portion of the grate and to deflect the same forwardly toward the inlet or feed opening of the furnace, so that all of said burning gases or products of combustion will be carried over or in contact with the fresh or unignited fuel as it enters the furnace, thereby insuring the prompt ignition thereof. In a furnace thus constructed, therefore, the heat from the burning gases and products of combustion arising from the combustion of the fixed carbon or non-volatile elements of the fuel will be used to effect prompt ignition of the fresh and unburned fuel entering the furnace. In the operation of a furnace provided with such deflecting wall, partition, or arch, therefore, prompt and rapid ignition of the fresh fuel is equally effected whether the fuel used have a low or high percentage of volatile constituents. It follows, therefore, that in a furnace constructed in accordance with my invention anthracite, semi-anthracite, and bituminous coals and such coals having a small or large quantity of volatile constituents may be burned with equal facility.

A deflecting wall, partition, or arch embodying my invention has its rear portion of sprung or arched form and its forward portion or that adjacent to the fuel-opening made or formed with its lower surface located in a horizontal line extending across the furnace and at the same distance above the fuel at the center as at the sides of the arch, so that the flames and products of combustion are adapted to act equally or uniformly on the fuel throughout the width of the grate.

My invention may be understood by reference to the accompanying drawings, in which—

Figure 1 is a view in central longitudinal vertical section of a boiler-furnace embodying my invention. Fig. 2 is a cross-section of the same, taken upon line 2 2 of Fig. 1. Fig. 3 is a detail section of the arch or partition only, showing a modified form of construction therein. Figs. 4 and 6 are views in longitudinal section of other forms of construction embodying the principal feature of my invention. Figs. 5 and 7 are cross-sections taken on the lines 5 5 and 7 7 of Figs. 4 and 6, respectively. Fig. 8 is an inner face view of a part of one of the arch-brick U of Figs. 6 and 7, showing the recess therein located.

As shown in the said drawings, A designates the front wall of the furnace; B, the bridge-wall thereof; C, the fuel-hopper located on the front wall of the furnace in connection with the fuel-inlet or feed-opening thereof, and D an endless traveling or chain grate of that class which is driven by suitable actuating devices so that the upper lap of the grate moves inwardly or from the feed-opening toward the bridge-wall of the furnace.

E designates a boiler, shown in said drawings as a water-tube boiler, having a front header E' and a plurality of water-tubes e,

which extend downwardly and rearwardly from said header.

The deflecting partition or arch of the furnace consists of a rear part F of sprung form and a front part F' in the nature of a flat arch. Said partition or arch as a whole extends from the bridge-wall B forwardly to a point near the front wall A of the furnace, a space being left between the forward edge of the front part F' and said front wall which constitutes the outlet-opening for the upward or outward passage of the products of combustion. The said bridge-wall B is extended upwardly past the top surface of the bridge high enough to join the rear margin of the rear part F of the partition. The deflecting-wall formed by the parts F and F' thus arranged serves to prevent the passage of the burning gases and products of combustion arising from the fuel on the grate directly upward and rearwardly and to deflect all of said burning gases or products of combustion forwardly or toward the feed-opening of the furnace, and all of said burning gases or products of combustion are therefore directed or carried over and into contact with the fresh or unburned fuel resting on the grate adjacent to the feed-opening, with the result that such fresh fuel is subjected to a high degree of heat and the prompt ignition of such fresh fuel as soon as it enters or shortly after its entrance to the furnace is thereby facilitated. After such burning gases and products of combustion pass around the forward edge of the deflecting-partition they pass upwardly and rearwardly and into contact with the heating-surface of a steam-boiler or to any other space or inclosure in which the heat thereof may be utilized.

The rear part F of the arch is of curved form and consists of fire-brick shaped like the voussoirs of an arch, and the same rests at its side margins on the side walls of the furnace, the middle of the arch being higher than its sides, as common in such arches. The forward part F' of the partition or arch is made or built up as follows: G G designate two girders, preferably provided with stiffening-flanges at their upper edges, which extend across the furnace from side to side and rest upon their ends on the side walls of the furnace. Connected with said girders G G by any suitable means are a series of beams H H H, which extend below said girders at their lower edges. Said beams extend from front to rear of the furnace and are adapted for interlocking connection at their lower edges with a series of fire-brick or tile I I I, interlocking connection of said beams H H H with the tile being so constructed and arranged that the tile may be applied to and removed from the beams by sliding them endwise from or upon said beams, the parts in this respect being constructed in the same manner as disclosed in a prior patent granted to Green and

Gent, No. 676,606; granted June 18, 1901. The end brick I' I' of the series of fire-brick that are so engaged with or hung from the beams H are constructed to project upwardly over or cover the ends of said beams, as clearly seen in Fig. 1. In this respect also the arch is like that shown in the prior Green and Gent patent. In the particular construction shown and illustrated more particularly in Fig. 2 the said beams H H are provided with flanges at their lower edges, which engage grooves in the adjacent side faces of the fire-brick I I' I'; but said fire-brick may be otherwise interlocked with beams. On the ends of said beams H H, which project beyond or outside of the girders G G, are built fire-brick walls J J, which reach to the level of the top of the girders G G, and supported on the tops of said girders and making a close joint with the tops of the walls J J is a horizontal wall K, of fire-brick or tile, which may be supported in any suitable way upon the metallic structure, but as herein shown rests upon a horizontal plate L, which rests upon the tops of the girders G. The fire-brick I I', together with the end walls J J and the top wall K, constitute a complete inclosure for the metallic parts by which the front part of the arch is supported, said inclosure being of refractory material and adapted to prevent the transmission of excessive heat to the metallic supporting frame or structure.

If preferred or found necessary in any particular case, the ends of the space or passage formed between the girders G G and the top and bottom refractory walls formed by the fire-brick I and top wall K may communicate at one end with an inlet-opening M in the side wall of the furnace and at its opposite end with an outlet-opening M', formed in the opposite side wall, and which may communicate with an upwardly-extending outlet passage or flue M², as shown in Fig. 2. This construction affords means for producing a cooling-current of air through or over the metallic parts.

As shown in said Figs. 1 and 2, a wall N, of fire-brick or like refractory material, is built against the front wall A of the furnace above the feed-opening and protects the said front wall from heat, and an arch O extends rearwardly from the top of the wall G to a point beneath the header E of the boiler, said arch O corresponding generally with the fire-arch or coking-breast heretofore used, but being located a sufficient distance above the partition F to afford ample space for the upward and rearward passage of the products of combustion on their way to the stack or exit-flue of the furnace. Said fire-arch O to the extent to which it may be heated by the burning of the volatile matters passing upwardly along the wall E and into contact therewith serves to perform the same function as is performed by the fire-arch or coking-breast heretofore used. As illustrated in Figs. 1 and

2, the bottom surface of the front part F' of the partition is horizontal; but it may be more or less inclined from front to rear of the furnace, if desired. As shown in Fig. 3, however, the partition is made of somewhat-different form and as follows: In this instance the main rear portion F is made of sprung form, as before described; but the forward portion F' is formed by means of two transverse water-tubes R R', which extend at their ends through the side walls of the furnace and are supported in the same, and fire-brick or tile S, which are notched at their ends to engage said water-tubes. In both forms of construction illustrated the bottom surface of the front part F' of the partition extends below the level of the top or crown of the rear or sprung part F of the partition, so as to deflect or direct the flames or products of combustion downwardly and into immediate contact with the fresh or unburned fuel as it enters the feed-opening of the furnace. This construction, in which the part F' of the arch is supported by the water-tubes R R', may be found desirable in cases where the heat to which the forward edge of the arch is subjected is so great as to make desirable the use of water-tubes as supports for the arch.

In Figs. 4 to 7 I have shown other forms of construction in an arch having a rear or inner sprung portion F and a forward portion F', having a horizontal bottom surface extending transversely of the furnace, which are included in my invention, considered in its broader aspect. As shown in Figs. 4 and 5, the rear or sprung part F of the arch is made in the same manner as hereinbefore described, while the part F' has a horizontal lower surface and consists of tapered fire-brick or voussoirs T T in connection with end fire-brick or skewbacks T', which are supported on or embedded in the side walls of the furnace. Some of the fire-brick T T may extend into and form part of the sprung part F of the arch, as is the case with the central or keystone fire-brick illustrated in Fig. 1. The lower horizontal surface formed by the several arch-brick T T in this instance is at a level below the sprung part of the arch and preferably in the same plane with the lower side portions of said sprung part. The forward straight part F' of the arch thus constructed has the same effect as the horizontal portions of the arch hereinbefore described, operating to deflect the flames and products of combustion downwardly toward and confining them adjacent to the fresh fuel near the feed-opening of the furnace as the said flames and products of combustion pass forwardly around the front end of the arch. In Figs. 6 and 7 the rear or inner part F of the arch is made of sprung form, while the forward part F' thereof, having a horizontal lower surface, is formed by a series of fire-brick or tiles U U, which are hung upon the front margin of the rear or sprung

part F, the lower horizontal surface of said part F' being below the crown of the sprung part of the arch as before. Devices illustrated in said Figs. 6 and 7 for supporting the fire brick or tile U consist of horizontally-arranged metal bolts *u*, which are inserted through the arch-brick of the sprung part F of the arch and project at their forward ends from the front faces of said arch-brick, having at their forward ends heads *u'*, which enter recesses *u''*, formed in the inner faces of the brick U. Said recesses *u''*, as seen in Fig. 8, are provided with flanges *u'''*, flush with the inner faces of the brick U and extending downwardly from the tops of the recesses, said flanges having downwardly-opening notches adapted to receive the ends of the bolts *u* when the heads of the bolts are located within the recesses behind said flanges. This construction permits the said fire-brick U to be readily hung upon the front margin of the arch, the fire-brick being thrust toward the face of the arch when elevated to permit the heads *u'* of the bolts to enter the lower part of the recesses *u''* and the fire-brick then being dropped until the notches engage the bolts and the heads are seated in the upper parts of the recesses. The metal bolts *u* in this construction are entirely inclosed and protected by the fire-brick, so that they will not be injuriously affected by the heat of the furnace.

I claim as my invention—

1. A furnace embracing a grate, means for advancing the layer of fuel over the grate, and a deflecting wall or partition which extends from the rear of the furnace forwardly over the grate, said deflecting wall or partition embracing a rear part of curved or sprung form, and a forward part the lower surface of which extends horizontally across the furnace below the level of the crown of the said curved rear part of the arch.

2. A furnace embracing a grate, means for advancing the layer of fuel over the grate, a deflecting wall or partition which extends from the rear of the furnace forwardly over the grate, said deflecting wall or partition embracing a rear part of curved or sprung form, and a forward part the lower surface of which extends horizontally across the furnace below the level of the crown of said curved rear part of the arch and consisting of metallic supports and fire-brick supported on the same.

3. A furnace embracing a grate, means for advancing the layer of fuel on the grate, and a deflecting wall or partition which extends from the rear of the furnace forwardly over the grate, said deflecting wall or partition embracing a rear part of curved or sprung form and a front part embracing metallic supports and fire-brick applied both above and beneath said metallic supports to cover the same.

4. A furnace embracing a grate, means for advancing the layer of fuel on the grate, and a deflecting wall or partition which extends from the rear of the furnace forwardly over the grate, said deflecting wall or partition embracing a rear part which is of curved or sprung form and a front portion embracing transverse girders which rest on the side walls of the furnace, longitudinal beams connected with the side girders and extending below the same, fire-brick hung upon said beams, a supporting-plate sustained on the top of said girders, and a fire-brick wall covering the said supporting-plate.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two witnesses, this 16th day of April, A. D. 1904.

HERMAN A. POPPENHUSEN.

Witnesses:

WILLIAM L. HALL,
GERTRUDE BRYCE.