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W. A. KÖNEMAN.

SMOKE PREVENTING FURNACE.

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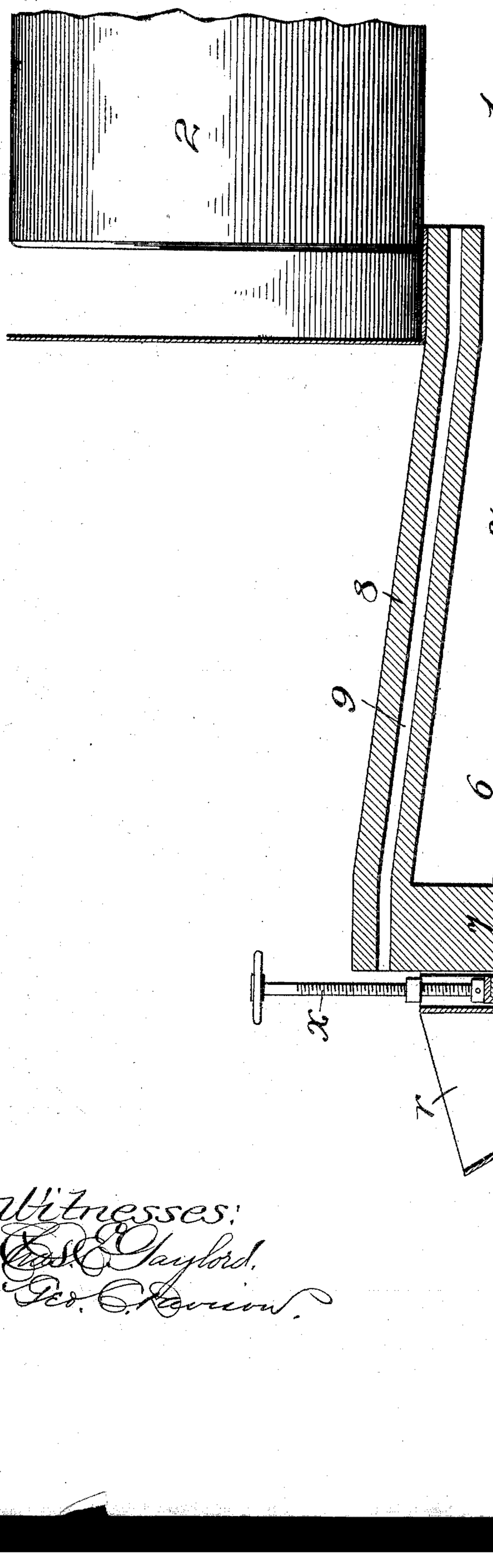
NO MODEL.



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UNITED STATES PATENT OFFICE.

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SMOKE-PREVENTING FURNACE.

SPECIFICATION forming part of Letters Patent No. 767,066, dated August 9, 1904.

Application filed January 30, 1904. Serial No. 191,291. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. KÖNEMAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Smoke-Preventing Furnaces, of which the following is a specification.

My object is to provide certain improvements in the construction of furnaces generally, and boiler-furnaces especially, for the purpose more particularly of adapting them to burn the cheaper grades of bituminous coal without the production of smoke. To obtain this end, I have found that it is necessary to avoid as far as possible contact with cooling-surfaces of the combustibles while in process of combustion. Thus in a boiler-furnace the hot products of combustion should not be permitted before substantially complete combustion has taken place to contact with the surface of the boiler. It is also necessary as far as possible to regulate the entrance of air which supplies combustion, so that heat dilution due to excess of air will be avoided. It is further necessary to so limit and regulate the supply of fuel that all its volatile constituents may be subjected to complete combustion within the furnace itself before being directed against a cooling-surface, such as a boiler, and such regulation can only be performed with desired certainty by mechanical means.

It has been usual in the construction of horizontal furnaces hitherto to provide the fire-chamber outlet for heat products of combustion at the rear end of the fire-chamber, though in some instances for special purposes the outlet has been provided at the forward end. In the use particularly of the lower grades of bituminous coal it is impossible to prevent waste and smoke when the firing is done by hand, and where furnaces have been fired by mechanical means it has been impossible to avoid waste by heat dilution, for the reason that the air to supply combustion drawn through the grate in the direction only of the rear or only of the forward end thereof meets as a rule with insufficient resistance to properly limit its quantity and insufficient incandescent carbon to consume its oxygen. In all updraft furnaces hitherto, so far as I am aware, unconsumed oxygen of the air that has been drawn in to supply combustion can only be utilized by the gases and free carbon in the smoke as they mix therewith while traveling toward the object to be heated.

It is usual to fire a furnace from the forward end of the combustion-chamber and to cause the products of combustion freed toward the forward end to pass in the backward direction over the bed of spent and partially-spent fuel toward the rear end of the chamber. In this practice it is impossible to avoid very material heat dilution. The initial temperature in a furnace is greatest when the minimum quantity of air necessary to produce perfect combustion is supplied, and as in boiler-furnaces when perfect combustion is obtained the proportion of heat utilized in steam production is approximately the difference between the temperature of the initial combustion and that of the chimney-gases it is important to prevent heat dilution with unnecessary air.

The primary object of my invention is to provide a construction in which such heat dilution will be prevented, and in practicing the same I take advantage of the well-understood phenomenon that heated oxygen in free air will, when brought in contact with incandescent carbon, readily combine therewith.

In carrying out my invention I cause the furnace-gases from the rear portion of the fuel-bed to pass in the direction of the forward or feeding end thereof across the unspent fuel, thus reversing the usual direction of the draft in the initial combustion-chamber. At the same time I avoid passing the furnace-gases from the rear portion into such close proximity to the fuel at the feeding end of the chamber as to effect too rapid distillation of the hydrocarbons near the front wall of the furnace or for the heat to cause the destruction of the feed-doors or other parts of the forward structure. In practicing my invention I increase incidentally the furnace capacity, because the freeing of the volatiles in the fresh fuel is accomplished with increased rapidity. Furthermore, all excess air carried forward from the rear is brought

into intimate contact with incandescent carbon along the central part of the fuel-bed to generate carbonic oxid or carbonic acid. In the furnace that I have devised for carrying out my invention a large quantity of carbonic oxid and free carbon is necessarily carried from the initial combustion-chamber; but this is all or substantially all converted into carbonic acid in an overlying chamber having means for supplying the necessary additional air for complete combustion before it reaches a cooling-surface, such as the boiler.

In the accompanying drawing I show a broken sectional view of a forehearth boiler-furnace constructed in accordance with my present invention.

The furnace has an initial combustion-chamber *a*, provided with a feed-opening *b* in the front wall *n*. Mounted upon a track *c*, extending through the opening *b*, is a truck-frame *d*, supporting a chain grate consisting of parallel slats *e*, linked together in endless series with draft-openings *f* between them. The chain grate passes around sprocket-wheels or the like *g h*, journaled, respectively, in opposite ends of the frame *d*, and the journal-boxes *i* of the forward wheels *g* are slidably mounted in guides *k* on the frame and adjustable by means of screws *l* to tighten or slacken the chain grate. Any suitable driving means may be provided at the shaft of the wheels *g* for moving the endless grate at desired speed in the direction of the arrow. The grate is of a length to extend, when in operative position, from a point near the rear wall *m* of the furnace to a point some distance beyond the front wall *n*. A space *p* is left at the rear end of the grate, through which ashes may drop to the ash-pit *q*.

At the front of the furnace over the forward end portion of the grate is a fuel-fed hopper *r*, having a valve *s* at its base operated by a screw *t*. A swinging door *v* closes the space between the hopper and forward end of the grate, and the opening *b* above the grate is provided with a vertically-sliding fire-door *w*, operated by a screw *x*.

The furnace-chamber *a* is provided with a low arched top, above which is an overlying or secondary combustion-passage *z*, opening at its rear end into a space 1 beneath a boiler 2. About midway between the forward and rear ends of the fire-chamber *a* or somewhat forward of that point is an opening 3, approximately the full width of the chamber and extending to the secondary combustion-passage *z*. The opening 3 separates the top of the fire-chamber into what I term the "coking-arch" *y* and "reverberating arch" *y'*. In the arch *y'* are longitudinally-extending air supplying and heating conduits 4, communicating at the rear end portion of the furnace through a conduit 5 with the outside air. The passages 4 discharge into the passage 3 at the rear side of the latter. In the arch *y* and extending in the forward direction from the opening 3 are air supplying and heating conduits 6, communicating at their forward ends with a duct 7, extending to the outside air at the front of the furnace. The conduits 6 discharge into the passage 3 at the forward side of the latter. Extending longitudinally through the top wall 8 are air supplying and heating conduits 9, open at their forward ends to the outside air and discharging at their rear ends into the space 1 over the rear end of the passage *z*.

In practice the grate *e* should be moved at a speed and the valve *s* and door *w* opened to an extent which will cause fuel from the hopper *r* to be carried through the opening *b* at the desired speed and in desired quantity. Substantially all the air to support combustion in the initial combustion-chamber *a* enters at the front beneath the door *v* and passes upward through the spaces *f* between the grate bars or slats *e*. To prevent an undue amount of air from rushing to the chamber *a* from the ash-pit through the space *p* at the rear end of the grate, I provide, preferably, a series of swinging doors 10, hinged at their tops upon a counterweighted shaft or equivalent supporting means 11. The doors 10 swing backward under the force or weight of ashes and cinders carried thereto by the grate, but prevent any material quantity of air from passing in the forward direction to the chamber *a*. Air entering beneath the door *v* must necessarily pass through the chain grate to reach the chamber *a*, thereby exerting a cooling influence upon the lower stretch of the chain grate and becoming itself heated to a high degree before passing through the openings *f* in the upper stretch of the grate. That portion of the grate between the chamber *a* and door *v* forms an initial coking-hearth, where the finer particles of fuel or the mass of fuel, if it is all fine, is initially coked to a degree which prevents its dropping to any material extent through openings *f*. Consequently all the said openings *f* back of the wall *n* will remain unclogged for the free upward discharge of air to support combustion. The forward part of the chamber *a* beneath the coking-arch *y* also forms a coking-space. The feeding operation should be so timed that all available constituents of the fuel will have been set free by the time that a change reaches the rear end of the grate, so that only spent material will fall from the rear end into the ash-pit. All the fuel-gas generated in the initial combustion-chamber *a* must escape through the passage 3, thereby causing the draft from the forward end portion of the grate to be in the backward direction and the draft through the rearward portion of the fuel-bed to pass forward. The arch *y'* of the said combustion-chamber is purposely low to cause reverberation of the forward traveling products of combustion, so that the heated oxygen

in any free air is forced into intimate contact with the incandescent carbon along the bed beyond the coking-space. The fuel coking and being initially consumed between the forward end of the chamber and passage 3 is not subjected to this reverberation from the rear part of the furnace, this being carefully avoided in the present construction to prevent excessive heat at the forward end of the furnace, which would be destructive to the feed mechanism and forward part of the furnace structure. The hot products of combustion rising from the fuel beneath the reverberating-arch y' meet at the passage 3 all unconsumed particles arising from the forward or coking bed of the furnace, and substantially all the air entering the initial combustion-chamber a is decomposed and utilized in the production of carbonic acid for the most part and of carbonic oxid to a lesser degree. Controlled drafts of air enter through the conduits 4 and 6 and become highly heated therein before discharging into the passage 3. These air-currents being forced from opposite sides into the hot products of combustion rising through the passage 3 are intimately mixed therewith and the mixture moves and reverberates in the passage z. The air-currents thus further supply combustion, so that practically or nearly all the free carbon will have been consumed before the products of combustion reach and are subjected to the cooling influence of the boiler-surface. A limited amount of air passing through the heated conduits 9 will mingle with the products of combustion at the outlet from the passage z and supply final combustion of any unconsumed particles of carbon escaping from the passage z before they reach the boiler-surface. The supply of air passing through the conduits 4, 6, and 9 may be easily regulated to merely supply combustion, as desired, without lowering or diluting the heat. Thus practically all the heat units of perfect combustion of the fuel undiluted by any material quantity of free air plays against the boiler and after contributing the greater part of its heat to the production of steam passes off in the form of invisible chimney-gas. By locating the passage 3 near the center of the initial combustion-chamber to provide the coking-arch y and reverberating-arch y', as described, much better results are obtained than by locating said passage at the rear end of the fire-chamber, as shown in my aforesaid patent, or by locating it at the forward end of said chamber. It causes the products of combustion from the rear end portion of the grate to reverberate against the fuel along the central portion for the purpose mentioned without subjecting the forward end of the furnace to excessive heat and too rapid distillation of the hydrocarbons of the fuel at and near the initial coking-hearth portion. The draft being partially backward and partially forward in the initial combustion-chamber tends materially to balance in a sense the working of the furnace, and thus contributes very materially toward rendering the furnace smokeless.

The chain grate forms a particularly desirable expedient for automatically feeding the fuel to and discharging the ashes from the combustion-chamber. Hitherto chain grates in furnaces have been generally considered objectionable, for the reason that the draft therethrough could not be properly controlled and very material heat dilution resulted. As this heat dilution is practically overcome in my improved furnace, a chain grate forms a very desirable feature of the construction. I do not limit my invention to any particular form of grate, and various changes in details of construction may be made in the furnace without departing from the spirit of my invention as defined by the claims.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a boiler-furnace, the combination of a primary combustion-chamber having a fuel-feed opening, a grate extending from said opening, with means for moving the fuel-bed over the grate in the backward direction, a coking-arch over the forward part of said chamber, a reverberating arch over the rearward part of said chamber, said arches forming between them an outlet-passage, an elongated secondary combustion-chamber, overlying said primary chamber, extending from said passage and leading to the boiler and adapted to be maintained incandescent during the operation of the furnace, whereby the hot products of combustion set free from the more nearly spent fuel in the rearward part of said primary chamber meet, impinge and mix in said outlet-passage with the hot products of combustion set free from the fresher fuel in the forward part of said chamber, and all the said products undergo complete combustion in their course through said secondary chamber before striking the boiler, and means for mixing hot air with said products in their course from said primary chamber.

2. In a boiler-furnace, the combination of a primary combustion-chamber having a fuel-feed opening, a grate extending from said opening with means for moving the fuel-bed over the grate in the backward direction, a coking-arch over the forward part of said chamber, a reverberating arch over the rearward part of said chamber, said arches forming between them an outlet-passage, hot-air inlets discharging into said passage, an elongated secondary combustion-chamber, overlying said primary chamber, extending from said passage and leading to the boiler and adapted to be maintained incandescent during the operation of the furnace, whereby the hot products of combustion set free from the more nearly spent fuel in the rearward part of said primary chamber meet, impinge and

mix in said outlet-passage with the hot products of combustion set free from the fresher fuel in the forward part of said chamber and all the said products undergo complete combustion in their course through said secondary chamber before striking the boiler.

3. In a boiler-furnace, the combination of a primary combustion-chamber having a fuel-feed opening, a chain grate extending through said feed-opening along the base of said chamber, a coking-arch over the forward part of said chamber, a reverberating arch over the rearward part of said chamber, said arches forming between them an outlet-passage, an elongated secondary chamber overlying said primary chamber, extending from said passage and leading to the boiler and adapted to be maintained incandescent during the operation of the furnace, and means for mixing hot air with said products in their course from said primary chamber, whereby the hot products of combustion set free from the more nearly spent fuel in the rearward part of said primary chamber, meet, impinge and mix in said outer passage with the hot products of combustion set free from the fresher fuel in the forward part of said chamber, and all the said products undergo complete combustion in their course through said secondary chamber before striking the boiler.

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In presence of—
WALTER N. WINBERG,
W. B. DAVIES.