

(No Model.)

3 Sheets—Sheet 1.

C. C. PRUDEN.
BOILER FURNACE.

No. 546,029.

X Patented Sept. 10, 1895.

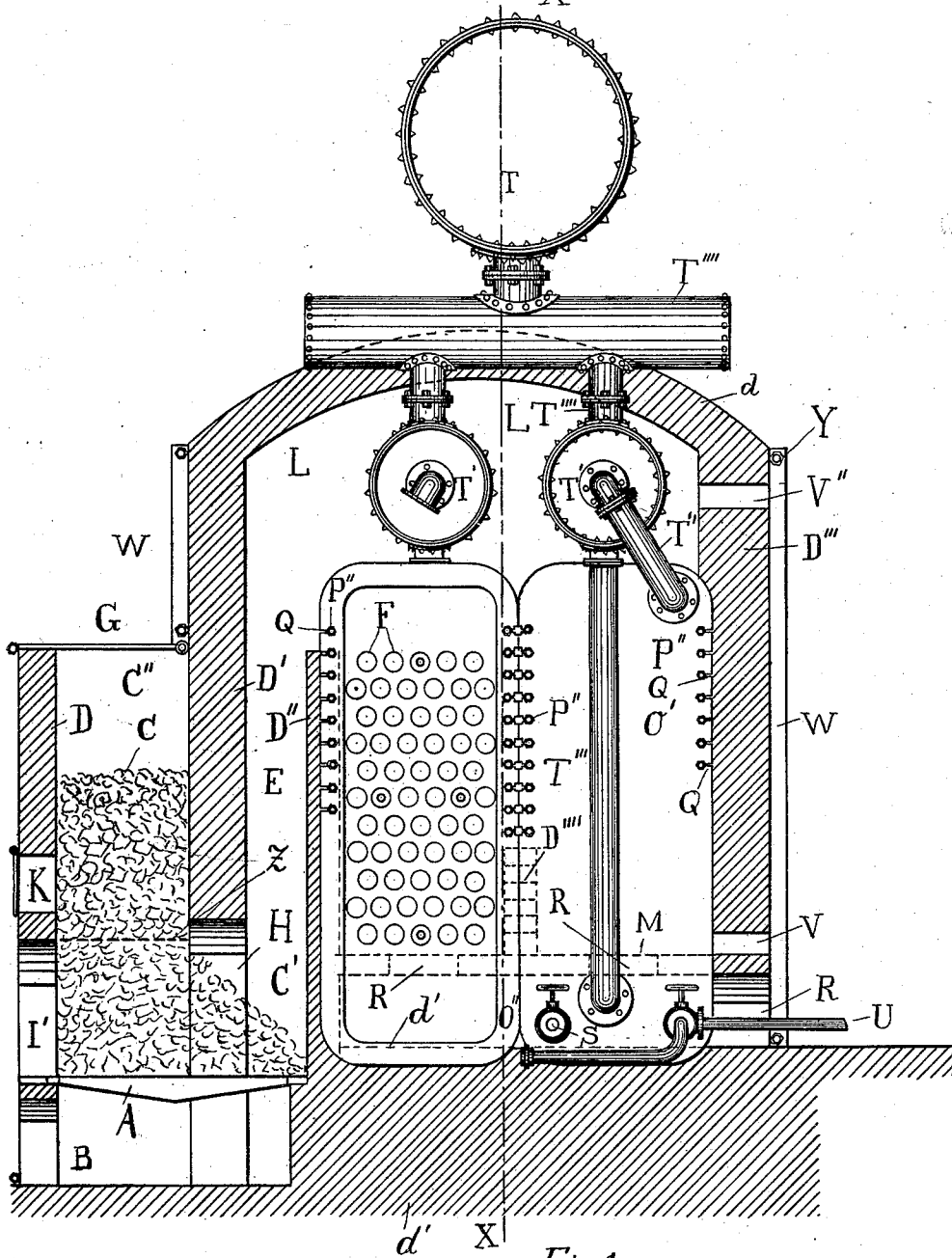


Fig. 1.

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a. l. Jeff.

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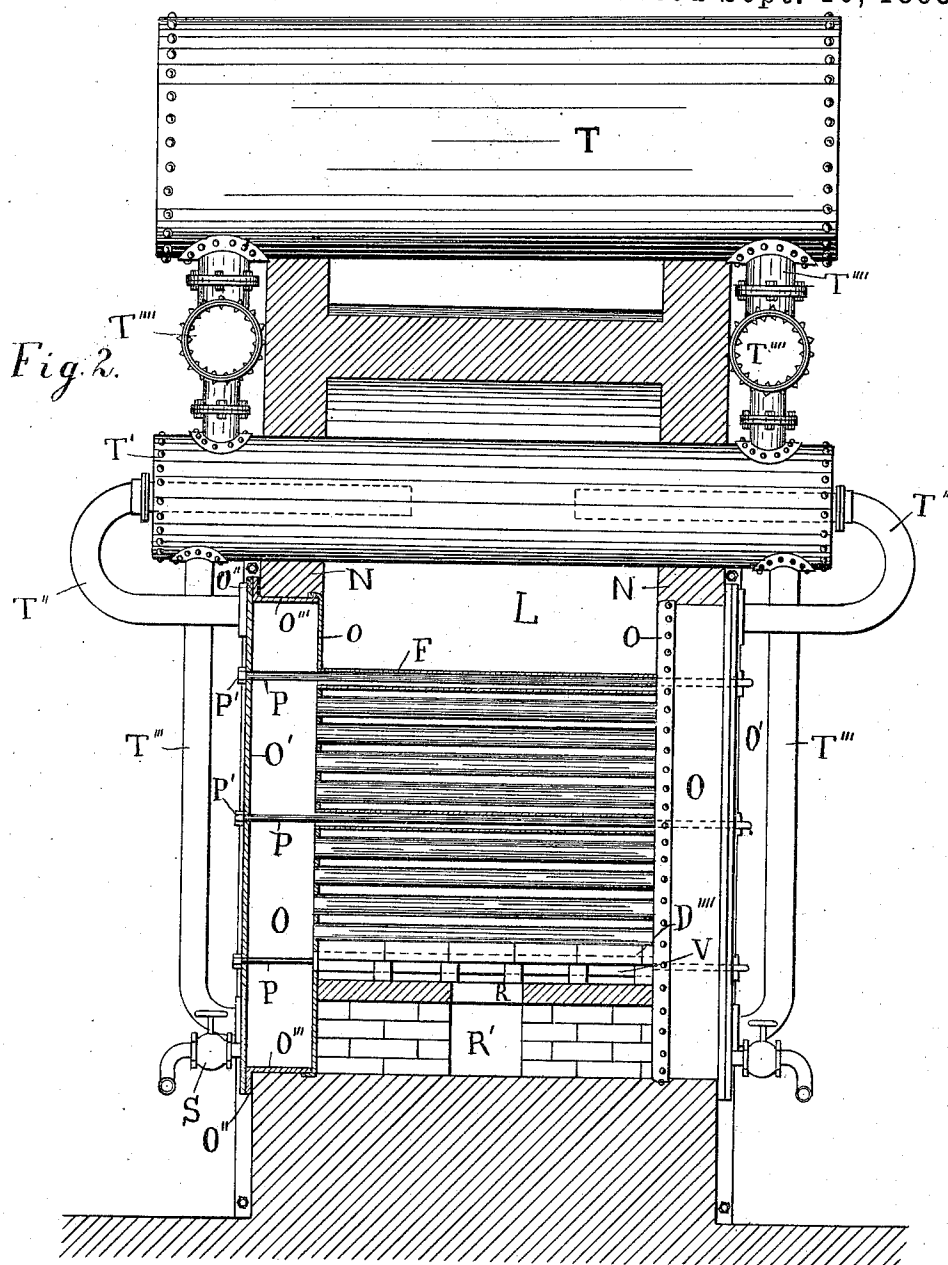
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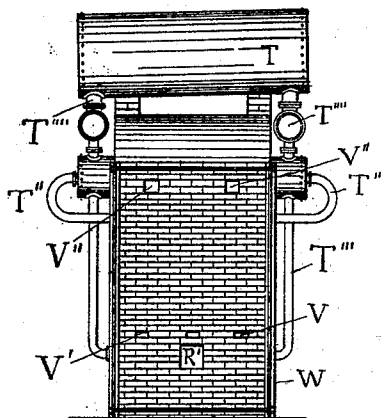


Fig. 3

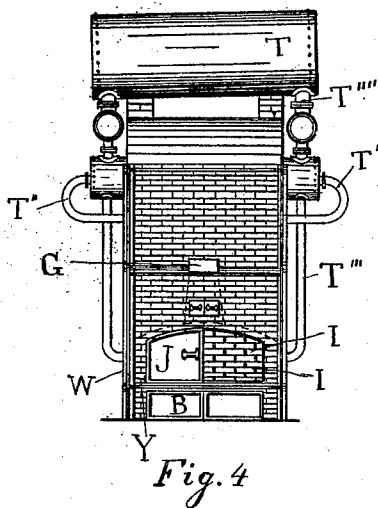


Fig. 4

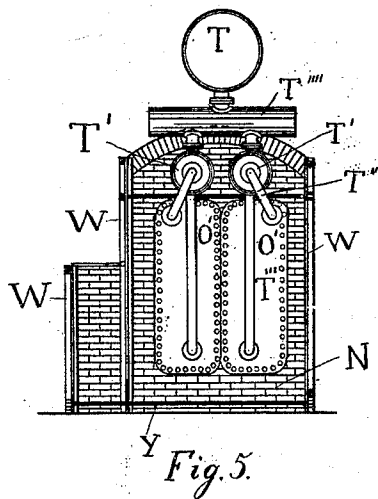


Fig. 5

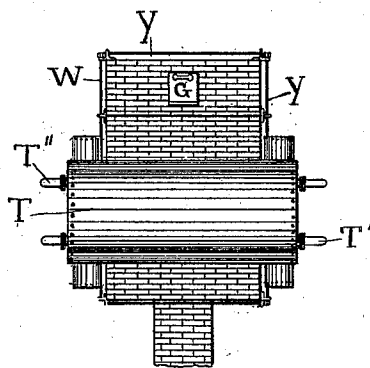


Fig. 6.

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UNITED STATES PATENT OFFICE.

CALEB C. PRUDEN, OF ELIZABETH, NEW JERSEY.

BOILER-FURNACE.

SPECIFICATION forming part of Letters Patent No. 546,029, dated September 10, 1895.

Application filed February 9, 1895. Serial No. 537,759. (No model.)

To all whom it may concern:

Be it known that I, CALEB C. PRUDEN, a citizen of the United States, and a resident of Elizabeth, county of Union, and State of New Jersey, have invented certain new and useful Improvements in Boiler-Furnaces, of which the following is a specification.

My present invention relates to the mechanical construction of a furnace adapted for generating steam to be used for driving steam-engines, heating purposes, or any other use to which steam may be applied.

The invention is described by referring to the accompanying drawings.

Figure 1 is a view mostly in vertical cross-section of so much of the furnace as at all involves my invention. Fig. 2 is an elevation partly in section at the line X X in Fig. 1. Figs. 3, 4, 5, and 6 are all on a greatly-reduced scale, Fig. 3 being an exterior rear elevation of the complete furnace, Fig. 4 being an exterior front elevation of that which is shown in Fig. 3, Fig. 5 being an exterior side elevation of that which is shown in Figs. 3 and 4, and Fig. 6 being a plan view of that which is shown in Figs. 3, 4, and 5.

Starting at the grate of the furnace, the same is lettered A and as usual is located over the ash-pit B, and the coal resting upon the grate is lettered C, which feeds downward to a certain location C', where it has its maximum temperature. Above the grate are located three vertical walls, the one D being the outside wall and rising from one end of the grate, the next D' being a wall between the fresh coal C, located in the feeding-channel C'', and the products of combustion, located in the furnace-flue E, and rising from a point between the ends of the grate A, and the third D'' being located between the furnace-flue E and the boiler-tubes F, which are directly behind the wall D'' and rising from the other end of the grate A. Beginning now at the wall D, it may be stated that it rises to such an extent above the grate that there is the desired length of feeding-channel C'' above the grate. At the top of this channel is a horizontal door G, which may be open for the purpose of introducing fresh coal into the channel C''. The door G spans the channel C'' from the first wall B to the second wall D'. The object of the door G, of course, is to

close the upper part of the channel, so that practically no air can enter the channel and pass through the coal. The plan view of this door may be seen in Fig. 6 at G and in Fig. 4. The coal C by gravity falls downward as it is consumed at C', passing through an arch H, located at the lower part of the wall D' and reaching downward to the grate A from a point suitably below the door G. As the coal reaches the top part of the arch H the weight of the surplus coal causes the coal below the top of the arch to have an inclined surface downward from the top of the arch H to about the foot of the wall D''. It should be understood that no draft comes through the door G downward through the coal C. It is assumed that it is desired to burn soft coal and yet be able to consume the smoke and not have any appreciable amount passing out of the chimney of the furnace. The draft for burning the coal on the slanting portion and on that portion which is at the right of the wall D' and in the arch H comes not only through the grate, but through the openings above the grate made in the lower part of the wall D. These holes are lettered I (see Fig. 4) and are formed by bricks laid without cement, so that unusually large crevices exist between them. It is important to notice that I provide means for regulating the draft through these crevices by means of doors J, one of which is shown in Fig. 4, while the other one is omitted. Both the doors and the bricks are omitted from the drawings in Fig. 1, but the opening for these bricks is indicated by I' in Fig. 1. The draft should not come from any points in the wall D at a level above the top of the arch H. The door K is located just above the level of the top of the arch H, so that if it is desired to bank the fire the unburned coal may be removed. For this purpose and for the purpose of saving the coal, and also for the purpose of poking the coal in case it jams, this door K is provided and should be kept closed, so that no draft can get through it. The wall D'' is compact throughout its whole height, so that the products of combustion must go first to the top of it, above which is located a storage-chamber L for the heat, the walls of the same and the atmosphere of the same being continually very hot, in view of the products of combustion. This chamber L extends

from the wall D' over to the opposite side of the furnace at the wall D''', and to the top of the furnace at the wall d, and to the lowest part of the furnace at the base d', past the perforated horizontal partition M, located above the base of the furnace D', which is all at the right of the foot of the wall D''. The description has now arrived at the point where I have shown provided a gaseous heating-chamber L, in which may be located the boiler. The wall D'' does not rise, of course, to the top of the furnace d, but stops far short of it, so that the products of combustion, or heated gases, may pass from the coal C' into the chamber L. Built in the side walls N of the chamber L are short wall-boilers O, a vertical sectional view of which is shown at the left of Fig. 2, a front elevation at the right of Fig. 2, and a side elevation in Fig. 5. These boilers O are no thicker, practically, than the walls in which they are located, so that one end of the wall-boiler is entirely outside of the furnace in the open air and the inside is exposed to the heated gases. Joining the boilers O are numerous boiler-tubes F, between which are spaces for the passage of the hot gases. The construction of this portion of the boiler consists of boiler-heads O', which face and press upon flanges O'', which are formed upon the sides O''' of the boilers O. The heads O' are held against the flanges by two sets of bolts, one of which P passes through the wall-boilers O and some of the tubes F, and these long bolts or rods are put under tension by means of nuts P', so that the boiler-heads O' are put under pressure against the flanges O''. In order to further tighten the heads O' against the flanges O'' there is a second set of bolts P'', which are short and pass merely through the flange and the edges of the boiler-head O'. It is my object to provide this construction having the wall-boilers O forming a portion of the wall of the furnace, so that a great deal of valuable time and labor may be saved in replacing defective tubes and in cleaning the boiler. This, it is evident, can be accomplished from the outside of the furnace by simply removing the bolts and taking off the boiler-heads O'. Instead of having rivets at the flange I have bolts P'', located in slots Q, so that work can be done very rapidly by merely loosening the nuts on the bolts P'' and sliding them out of the slots Q. In Fig. 1 a great many of the bolts P'' are not shown, but in practice they extend all around the flanges O''. It is very important to notice that the wall-boilers extend far below the partition M—that is, below the point of heating of the hot gases in the chamber L, it being necessary to state that the perforations R in the partition M are comparatively small holes located centrally in the partition, so that the lower portions of the wall-boilers O will always remain so cool that the sediments will not be baked hard and can be blown off through the valves S. The gases

which rush downward among the tubes F pass through the perforations R, which are comparatively small and are beginning to be cooled after having passed among the pipes F, and therefore the passage-way from the perforations to the chimney-opening R' is a comparatively cool intermediate compartment. Referring to Fig. 2, it will be noticed that the lower portions of the wall-boilers O are cool, because they are at the sides of the passage-way leading to the chimney, because the perforations R are centrally located and are at quite a distance from the wall-boilers O.

T is the steam-dome of the whole boiler. The steam-generating boiler is T', in which, when the boiler is in its normal operating condition, the water fills a portion thereof and steam the rest.

T'' represents pipes which connect opposite ends of the generator T' with the upper portions of the wall-boilers O. These pipes T'' should extend throughout a large portion of the interior of the generator T', so that they will extend toward the hottest portion of the generator, which is between the walls N. Pipes T''' connect the lower or cooled portions of the wall-boilers O with the lower portions of the generator T'. The water being entered at the feed-pipe U, it fills the tubes F and wall-boilers O and a fractional amount preferably of the generator T. Circulation of the water takes place in well-known ways, so that steam which is formed passes into the steam-dome T, which is connected with the generators T' by means of pipes T'''. It will be noticed that there are two sets of tubes F and independent boiler-heads for each set. It is evident that the number of sets may be increased. Between the two sets is represented a wall D'''. There is necessarily without this wall a wider space between the two sets of tubes than between the tubes forming the sets, and without this wall a too large proportion of heated gases would go down between the sets. The wall forms a filling or obstruction between the sets, so that the tubes are more uniformly and effectually heated. The lower course of bricks in the wall D'''' is laid with openings V and the wall D'''' has openings V', which may be made by taking out a brick at each place of the openings V and V', so that by means of a rake or a hoe the floor or partition M may be cleaned. V'' represents holes for the reception of a steam-jet for blowing off and washing the tubes F. They may be closed by loose bricks or any convenient kind of door. I have omitted steam and water gages, anemometers, safety-valves, chimneys, and other appurtenances which are well known in the art and which have nothing to do with the present invention. The only remaining details which need to be alluded to are that the steam-dome T may preferably be inclined, so that any condensation will drain through the pipes T'''' into the generator T', and that W

represents angle-irons fastened upon the corners of the structure for the usual purpose of protection. They are stayed by bolts Y.

The operation of certain parts has been intimated, but now it will be set forth completely. One object of the invention is to be able to effectually provide for the automatic consumption of smoke in burning cannel coal or of any quality of soft coal, or generally any kind of bituminous coal, and that portion of the smoke which passes from the coal unconsumed is prevented by my construction from passing out of the chimney. Assuming that the fire-bed is kept well raked, all the coal below the level of the top of the opening I' and indicated by the dotted lines Z is burning coal—that is, coal which is undergoing final combustion and is being converted into carbonic-acid gas, water-vapor, marsh-gas, miscellaneous gases, and ashes. Approaching the line Z from the under side and above the line Z for a short distance at about the lower part of the door K, the coal is undergoing destructive distillation by which a kind of carbon or coke is formed which is combustible without smoke. I do not maintain that this coke is pure carbon, but so much so that a great amount of smoke is consumed which would be liberated without the provisions of my invention. That which is liberated, together with the hot gases, passes over the top of the wall D' and the larger particles of smoke settle on the partition M and on the base D', so that issuing from the chimney there is practically no smoke. A great portion of the smoke which may be liberated before the coking takes place will be consumed in passing through the mass of coal below the line Z and at or near the surface of the incandescent coal at C'. The heated gases upon leaving the bed of coals C' pass upward into the upper part of the heating-chamber L, and then instead of passing into a chimney they are deflected, and are drawn down ef-

fectually over the tubes F and all around the boilers T', the larger portions of which are located in the dome of the heating-chamber L. The most rapid boiling of the water takes place in the tubes on account of the large proportion of surface exposed to the hot gases.

I claim as my invention—

A boiler furnace, consisting of the combination with the grate, of a first outside wall rising from one end of the grate and provided with a variable opening at its lower portion, a second, or middle, wall rising between the ends of the grate and having a permanent opening at its lower portion, a third, or inner, wall rising from the other end of the grate several times higher than the top of the opening in the second wall and located in a heating chamber of which the said second wall forms one side, sets of boiler tubes on the opposite side of the said third wall from the second wall and parallel to the third wall, a fourth wall located between the sets of tubes, a horizontal perforated partition M, below the tubes and above the base of the heating chamber and above the entrance to the chimney, wall boilers forming a portion of the opposite side walls of the furnace connected by tubes and having boiler heads flush with the outside surfaces of the side walls of the furnace retained by two sets of bolts, one set passing through the tubes and the other set passing through slotted flanges upon the wall boilers, said wall boilers extending below the partition M, to the base of the heating chamber.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 4th day of February, 1895.

CALEB C. PRUDEN. [L. S.]

Witnesses:

EDWARD P. THOMPSON,
ROBERT S. CHAPPELL.