No. 695,503. Patented Mar. 18, 1902.

C. W. STAUSS.

FURNACE.

(Application filed July 1, 1901.)

(No Model.)

Fig. 1.

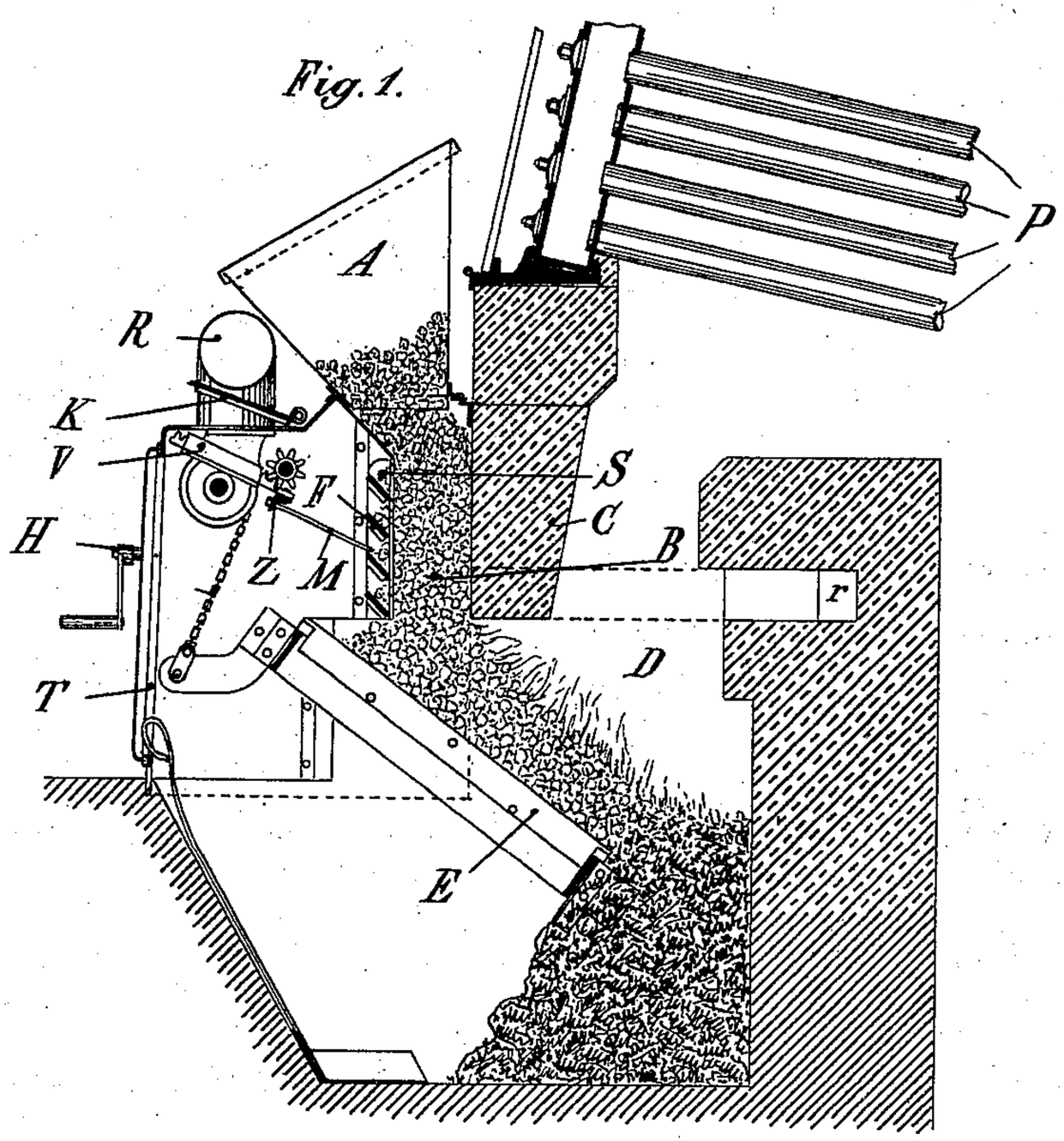
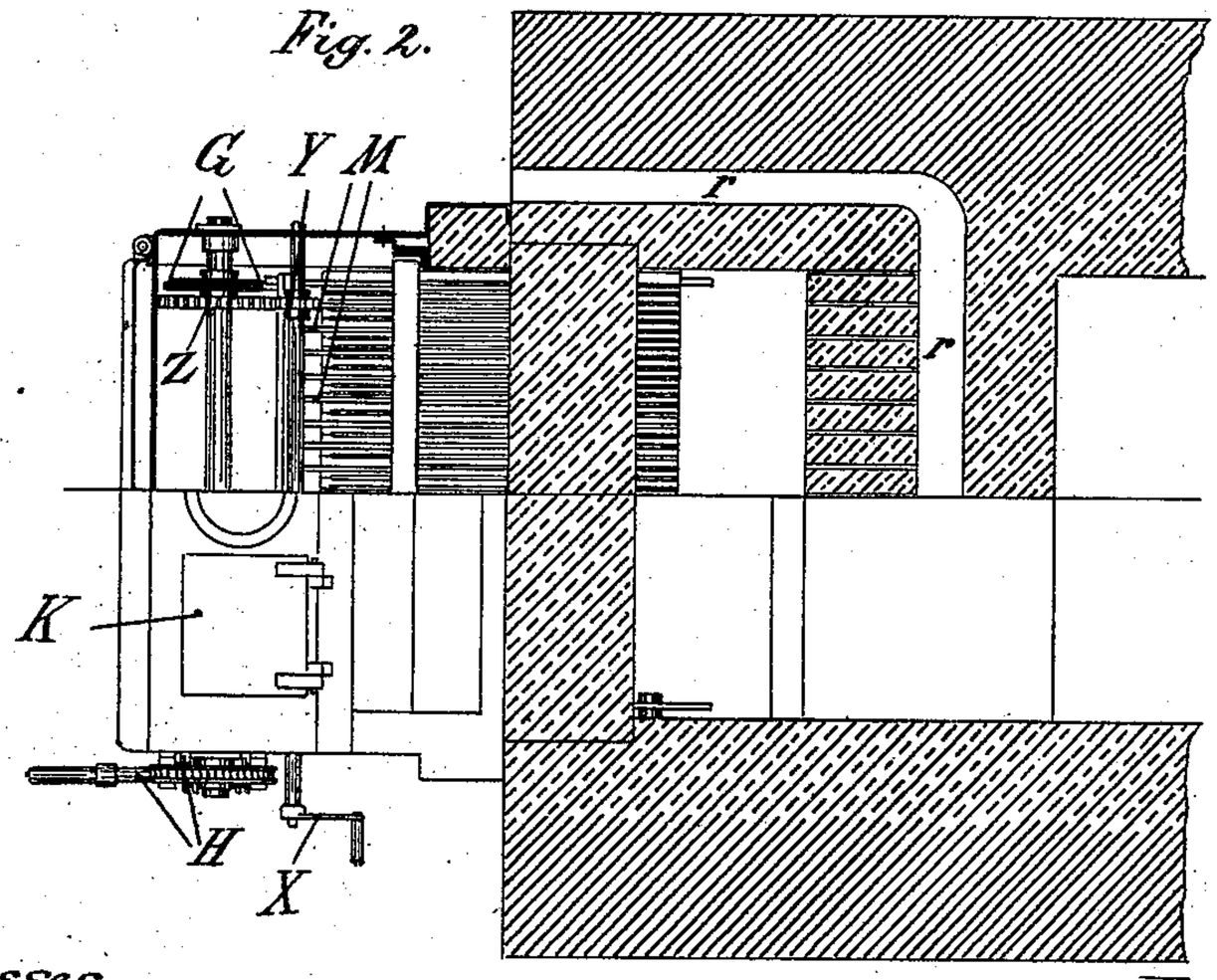


Fig. 2.



Witnesses
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UNITED STATES PATENT OFFICE.

CARL WILHELM STAUSS, OF BERLIN, GERMANY.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 695,503, dated March 18, 1902.

Application filed July 1, 1901. Serial No. 66,746. (No model.)

To all whom it may concern:

Be it known that I, CARL WILHELM STAUSS, a subject of the King of Prussia, Emperor of Germany, residing and having my post-office address at Spenerstrasse 23, Berlin, Germany, have invented a certain new and useful Improvement in Furnaces, of which the following is a specification.

This invention relates to an improvement in furnaces.

All the attempts made hitherto to improve furnace plant used for industrial purposes have led to no result which can be recognized as a useful improvement novel in principle. The fundamental disadvantage of the furnaces hitherto used lies in their intermittent stoking, which leads to further disadvantages. The latter are—

First. The frequent opening of the furnace-doors for the purpose of adding fresh coal. While this is being done, large quantities of cold air enter the flues and reduce the temperature of the body being heated and its durability. The more finely grained the coal is the thinner must be the layers thereof placed upon the grate and the more frequently must the doors be opened.

Second. After each stoking operation the temperature of the furnace has become cooler, so that the gases then freed do not ignite, but escape through the chimney in the form of smoke or soot. Air is also required to enable the said gases to burn, the entrance of such air being impeded by the coal thrown in.

Third. The body being heated is covered with a layer of soot, which reduces the amount of heat given off by the heating-gases, which leads to an increased consumption of coal.

Fourth. As combustion of the coal proceeds the quantity of air admitted increases in an uncontrollable manner and becomes largest when it should be least, so that the heating effect is decreased, and least when it should be largest—*i. e.*, immediately after the furnace has been stoked. The conditions as to the supply of air to the fuel are therefore exactly the reverse of those which should exist in order to obtain the best heating capacity.

Fifth. Long grates of two meters length and over are difficult to stoke and keep free from slag, and with the length of grate the above-mentioned disadvantages increase.

Sixth. In connection with steeam-boilers the variations in the temperature of the furnace lead to variations in the steam-pressure the more so the greater the load is.

Some of these disadvantages can be reduced to a certain extent by good stoking and by means of devices for preventing smoking and regulating the draft; but owing to the lack of skilled men such devices have, as is known, in most cases not proved of any practical value and can only be regarded as makeshifts.

A furnace for heating with coal in its natural condition must answer the following requirements: First, it must be simple of construction and easy to attend to and not require a too large amount of intelligence and observation and work on the part of the stokers; second, its temperature must be as even as possible; third, the grate must for that reason be kept covered evenly and automatically, and only that amount of air must be admitted to the fuel which is necessary for the complete combustion of the latter, so that its heating capacity is utilized to the utmost; fourth, the removal of slag from the fire must not require too great exertion; fifth, the combustion even of coal extremely rich in gas must be smoke and soot free. A method of and apparatus for firing answering these requirements is hereinafter described, and illustrated in the annexed drawings, in which—

Figure 1 is a vertical section of a furnace of improved construction, and Fig. 2 is a horizontal section in two different planes.

Coal or other fuel is placed in a hopper A, which can be closed by means of a cover. From this hopper the coal falls into a gasification-chamber B and spreads gradually over the coals already on a preferably inclined grate E according to the combustion taking place on the latter. Between the part D of the furnace and the gasification-chamber B a bridge C, made of the best fire-brick, is arranged. This bridge is rendered red-hot by the fire-gases ascending from the said inclined grate E and in this condition partially gasifies the coal in the gasification-chamber adjacent thereto. The gasification is actively assisted by the red-hot coal on the inclined grate. In front the chamber is bordered by a vertical grid F, through which air for combustion is freely admitted.

The inclined grate E is suspended by two

chains G and can be easily raised and lowered by means of a suitable worm-gearing H. Change in the position of the grate is principally necessitated by the differences in the quality of coal used, but is also necessary when work is to cease, when the grate must be raised to prevent air from entering the furnace between the grate and the bridge C.

In front the furnace is shut off by an iron structure, the front wall of which is closed when the furnace is working, but can be removed at other times in order to clean the grate.

The position of the inclined grate E with regard to the lower front edge of the bridge C is so chosen that at the bottom the grate is always covered by the gradually-descending coal to the thickness of about twenty centimeters, while at the top the layer of coal should always be about thirty centimeters thick. A thinner layer of coal of only ten centimeters thickness would prevent the regular descent of coal, since its volume increases during the gasification. In very small furnaces—for instance, those used for heating rooms—the grate will also be completely covered if it is horizontal, since it is very small and the coal will slide on down the incline it forms itself.

The layer of fuel on the grate of the new furnace being at least double the thickness usual with horizontal and inclined grates enables reduction of the length of the grate by one-half, since in the improved furnace as much fuel lies on one square meter area of grate as on two square meters in the older constructions. A high thick layer of coal to which a strong current of air is conducted also develops a higher temperature than a layer only one-half the height, the supply of air to which cannot be regulated, since the layer frequently admits the passage of more air through it than is necessary for combustion. This is especially the case when the pieces of coal are of unequal size—*e. g.*, when rough coal is employed.

In order to supply the thick layer of coal with the quantity of air necessary for intense combustion, according to this invention air is introduced under pressure through the pipe R, so that inferior fuel can also be used with advantage and the heating effect can be easily controlled. Carbonic oxids and carbureted hydrogen are completely burned in the furnace by heated secondary air entering the furnace through conduits *r*. (See also Fig. 2.)

If the plant is small and the fuel does not lie closely and is not heaped up high, the ordinary atmospheric pressure is sufficient, and the air for combustion is admitted through the doors K, Fig. 1.

The vertical grid F is suspended with capability of turning on the axis S. The grid must be so turned when working is stopped, and this is done by opening the door T and seizing one of the bars of the grid F with a firing-hook or the like, turning it so far forward about the axis S until all the coal in hopper A and chamber B rolls onto the grate E. By means of the worm-gearing H and chain G the grate E must then be raised as high as possible. The grate E and grid F should not be returned to their original positions until the next morning, the grate E being lowered before the fire is lighted, but the grid F not till after the fire is burning.

In order to clear the grate of slag during working or to rapidly extinguish the fire, owing to sudden deficiency of water or for other reason, a device is provided for retaining the coal in hopper A and chamber B. This device consists of a rake M, connected with a rack Z, working in a guide V and reciprocated by means of a toothed wheel Y and crank X, so that the complete rake M can be advanced between the bars of the grid F into the chamber B for the purpose of separating the coal at the top of the hopper and chamber from that below. After this has been done the grate E is sunk into its lowermost position, and the burning coal or the slag, as the case may be, can be removed from it through the door T. It is obvious that this simple method of firing is applicable to any industrial plant. In small furnaces consuming only about fifty kilograms of coal per hour the arrangement for raising and lowering the grate E can be dispensed with.

The chief feature of a furnace of this kind is that the heating-gases generated at an even temperature ascend steadily from the glowing fuel, since the latter forms a continuous obstruction to the driving through of the said gases. When used for heating a steam-boiler P, the devices for obtaining draft hitherto used can be dispensed with, while the heat conducted to the boiler is utilized to the utmost extent. With this system, in fact, such devices would have only a bad effect, since the heating-gases conducted to the boiler first spread out in the upper part of the furnace and then gradually descend as they give off heat to the boiler and are replaced by gases of higher temperature, to be expelled finally through an orifice (not shown in the drawings) in the lowest part of the furnace. If the furnace is provided with a close well-insulating jacket the heating-gases are utilized in this manner to the utmost extent, since it is possible to remove them at a temperature not higher than that of the steam.

Further advantages yielded by this invention are, first, a considerable reduction of the quantity of ash deposited in the furnace and on the body being heated; second, avoidance of the formation of soot, which interferes with the absorption of heat by the said body; third, facility of cleaning the outside of the boiler, the latter being located free of access in the furnace without flues and the like.

If thorough combustion is to take place in the furnaces at present in use, the grate must only be slightly covered. Since large boilers require large grates, permanently even me-

chanical stoking cannot in practice be satisfactorily effected with such boilers. It is therefore unavoidable that the heating-gases are driven through the flues mixed with much unburned and therefore injurious air and do not have time to give off their heat to the boiler, so that they pass out through the chimney at a temperature surpassing that of the steam by from 150° to 250°. The volatile heating-gases take the shortest course through the flues, so that dead-angles are formed in which ash is deposited and heating-gases stagnate and the cleaning of the boiler is difficult. The temperature in the chimney is frequently so high that the expansion resulting from it causes the walls to crack. These are irrefutable proofs of great waste of heat or coal, which is prevented in a simple manner by the system of firing and heating described hereinbefore. The economic advantages derived therefrom, representing a saving of coal of approximately twenty-five per cent., are obtained, stated briefly, from the following circumstances: first, the continuous automatic supply of fuel to the grate, renewed gradually as combustion proceeds, and the thickness of the layer of fuel; second, the arrangement of the gasification-bridge; third, the application of compressed air to a thick layer of fuel; fourth, the free position in the furnace of the object to be heated without the arrangement of flues.

What I claim is—

1. The combination with a grate of a hopper for feeding fuel thereto, a gasifying-chamber between the hopper and grate, a fire-brick bridge situated directly above the grate and adjacent to said chamber for imparting heat thereto, a vertical grid forming a boundary to said chamber, means for admitting air under pressure through said grid to the chamber and also to the grate, means for raising and lowering the latter, a reciprocating rake for retaining the fuel in the hopper and gasification-chamber when desired, means for operating said rake, an inclosing casing provided with doors for admitting air to the furnace, and means for admittance of secondary air, substantially as described.

2. The combination with an inclined grate of a hopper for feeding fuel thereto, a gasifying-chamber between the hopper and grate, a fire-brick bridge situated directly above the grate and adjacent to said chamber for imparting heat thereto, a vertical hinged grid forming a boundary to said chamber, a pipe for admitting air under pressure through said grid to the chamber and also to the grate, chains attached to the grate for raising and lowering same, means for operating said chains, a reciprocating rake for retaining the fuel in the hopper and gasification-chamber when desired, means for operating said rake, an inclosing casing provided with doors for admitting air to the furnace, and conduits for admittance of secondary air, substantially as described.

3. The combination with an inclined grate of a hopper for feeding fuel thereto, a gasifying-chamber between the hopper and grate, a fire-brick bridge situated directly above the grate and adjacent to said chamber for imparting heat thereto, a vertical hinged grid forming a boundary to said chamber, a pipe for admitting air under pressure through said grid to the chamber and also to the grate, chains attached to the grate for raising and lowering same, a device for operating said chains, a reciprocating rake moving in a guide for retaining the fuel in the hopper and gasification-chamber when desired, a rack, pinion and crank for operating said rake, an inclosing casing provided with doors for admitting air to the furnace, and conduits for admittance of secondary air, substantially as described.

In witness whereof I have signed this specification in the presence of two witnesses.

CARL WILHELM STAUSS.

Witnesses:

HENRY HASPER,

WOLDEMAR HAUPT.