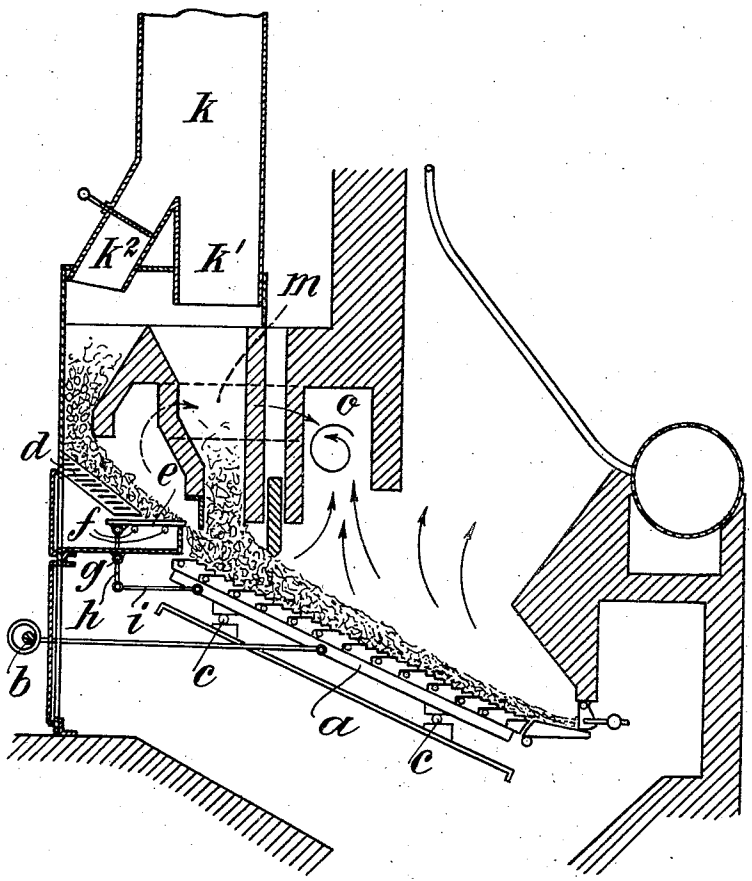
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FURNACE

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Fig. 1.




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Fig. 2.

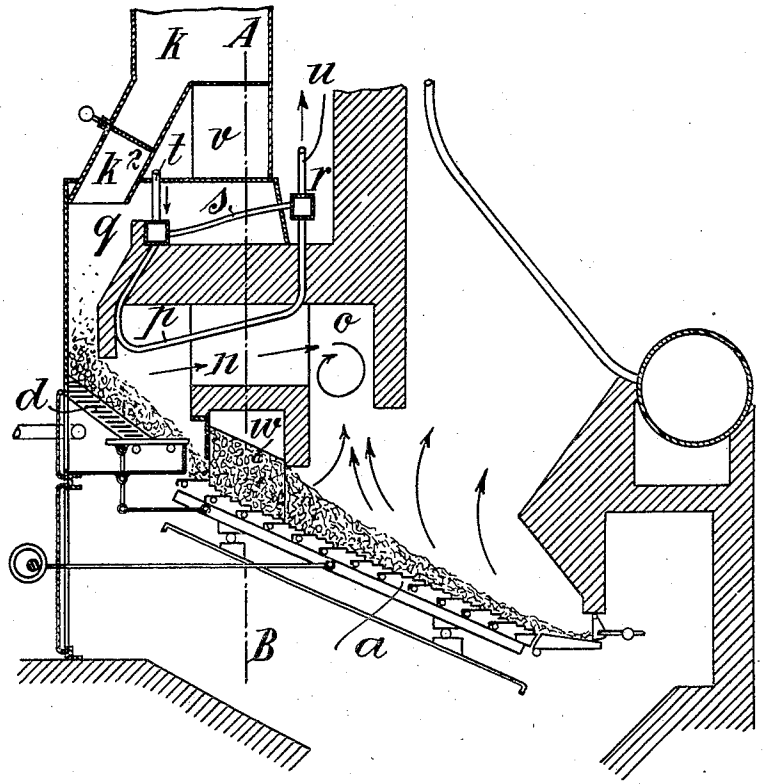
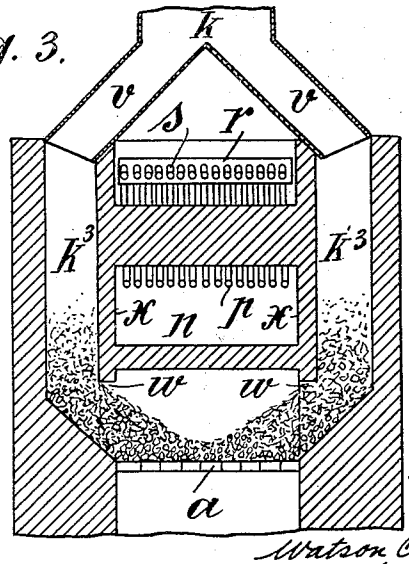



Fig. 3.




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# UNITED STATES PATENT OFFICE

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## FURNACE

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As in inclined and stepped grates the specific efficiency decreases with the length, a separate so-called ante-grate has been used on which a portion of the total fuel has been burnt.

According to the present invention the arrangement is such that the parts, which leave the ante-grate, pass on to the second inclined grate in an incandescent or burning condition in such a manner that they there serve as an under layer for the fresh fuel supplied to the second grate. Each grate is therefore supplied with fuel but in such a manner that the fuel supplied to the second grate comes into contact with already burning or incandescent fuel supplied thereto from the first grate.

In this manner provision is made with certainty that the burning action on the second grate takes places immediately at the beginning thereof.

The arrangement, however, has further advantages. First it is not necessary to consider the utilization of the fuel with which the ante-grate operates as everything which is not burnt thereon will certainly be burnt on the second grate.

Further, in connection with the ante-grate, it is not necessary to consider whether the gases developed thereon are immediately completely consumed as these gases can be conducted into the combustion chamber of the second grate and there burnt with certainty.

Two forms of construction in accordance with the invention are illustrated by way of example in the accompanying drawings, wherein:

Fig. 1 shows a longitudinal section of the first form of construction.

Fig. 2 shows a second form of construction in longitudinal section, and

Fig. 3 shows a cross section on the line A—B of Fig. 2.

The main grate *a* which may take the form of an inclined grate, consists for example, of a number of steps arranged side by side which in the known manner, are reciprocated on their roller bearings by a shaft *b* provided with eccentrics. At a short distance above the grate *a* is located the so-called ante-grate which is in the form of a stationary stepped or inclined grate *d*. At its lower end a plate *e* is supported on roller bearings *f*. The plate *e* is in the form of a grate so that ashes reaching the plate from the grate *d* can fall between the spaces thereof, and is connected by a lever *h*, mounted at *g*, and a link rod *i* to a suitable part of the main grate *a*, so that it can be thereby reciprocated.

The plate *e* may be formed of as many strip-shaped parts, arranged side by side, as the second grate *a* has steps arranged side by side, and moved relatively in the known manner. The separate parts of the plate *e* are then connected to the corresponding steps of the grate *a*. If then a step of the grate *a* moves to the left, therefore rearwardly, the corresponding part of the plate *e* moves to the right, i. e. forwardly, so that the fuel falling over the front edge of the part of the plate *e* in question, will reach the corresponding step of the grate *a* with certainty. If the ante-grate *d* is so constructed that its lower end extends suitably beyond the upper end of the grate *a* then the intermediate plate *e* may be omitted entirely. In this case the ante-grate *d* may then be constructed of separate relatively reciprocating steps in a similar manner to the main grate *a* and then the steps of the two grates may be connected together in such a manner that they may be reciprocated from a single point of operation, for example, by the eccentric shaft *b*, shown in Fig. 1.

The coal hopper *k* has its lower end formed with two discharge pipes so that the pipe $k^1$ supplies coal to the main grate *a* and the pipe $k^2$ supplies fuel to the grate *d*. The coal supplied by the pipe $k^1$ passes on to the grate *a* after this has been covered with a layer of incandescent fuel from the grate *d* by the plate *e*.

The construction described enables the ante-grate *d* to operate as a high power grate without considering its efficiency, as the combustion gases generated thereon, even if they do not enter into combustion immediately, will enter into complete combustion in the main combustion chamber above the second

grate *a*, for which purpose the main grate *a* may be operated with a predetermined excess of air. In the form of construction according to Fig. 1 gases generated on the ante-grate *d* and which are not burnt immediately pass through the lateral passages *m*, shown by broken lines, into the chamber *o*, which is only open at the bottom, into the combustion chamber into which enter from below the hot gases from the main grate *a*. The firing operation can therefore be adjusted from the start with advantage in such a manner that less $CO_2$ but mainly CO, is produced on the ante-grate *d*.

Many kinds of coal have the disadvantage that the coal, at too high a temperature of firing readily fuses together on the surface so that here large clinkers are formed which are impervious to air and thus hinder combustion; such clinker formation is also deleterious because the parts which have fused together, if they pass from the ante-grate to the main grate under the layer of fuel thereon, obstruct the supply of air.

Such undesirable actions are eliminated by the form of construction according to Figs. 2 and 3.

Instead of the passages *m*, located on both sides of the firing as shown in Fig. 1, which connect the firing space of the ante-grate *d* with that of the main-grate *a* or with a combustion chamber *o* for buring gases provided in this, the brickwork in front of the ante-grate *d* is broken away, i. e. a larger or smaller part thereof is removed. In this manner the gases generated on the ante-grate have direct admission to the combustion chamber. In this connection it is particularly important that the brickwork from which a direct heat radiation to the ante-grate takes place, which particularly assists in the clinker formation above referred to, is eliminated.

The passage formed by breaking away the brickwork may be provided with cooling pipes and then it is also possible, with a high power ante-grate, to keep the temperature in the combustion chamber of the ante-grate at a permissible value, and the effectiveness of this arrangement may be increased by the provision of a low pressure draft.

According to Figs. 2 and 3 a wide passage *n* connects the combustion chamber of the ante-grate *d* with the firing chamber of the main grate *a* or with the combustion chamber *o* of the latter in which they mix and burn completely with the gases from the main grate. In the passage *n* are provided cooling pipes *p* which at the top, outside the combustion chamber, terminate in chambers *q* and *r*. The cooling pipes *p* extend upwardly towards the chamber *r* and the chamber *r* is at a higher level than the chamber *q*; the steam generated in the pipes *p* is thus conducted away, and the return flow of water which has not been evaporated through the pipes to the chamber *q* is facilitated. The supply of cooling water takes place through the pipe *t* to the chamber *q*, whilst the steam which is generated is conducted away by the pipe *u*.

The coal for the main grate passes from the hopper *k* through the branch pipes *v* into the lateral passage $k^2$, from here it passes through the openings *w* from both sides onto the main grate *a*. The coal from the hopper *k* passes to the ante-grate *d* through the branch pipe $k^2$.

Should the action of the cooling pipes *p* be insufficient cooling pipes may also be provided at the sides *x* (Fig. 3) of the passage *n*. In some forms of construction it may under circumstances, not be necessary to conduct the cooling pipes *p* so close to the ante-grate *d* as shown in Fig. 2 it may be sufficient to limit the length of the cooling pipes *p* to that of the passage *n*. The invention, however, does not depend on such details, they are determined by the prevailing conditions.

With an ante-grate of a type hitherto known, a cooling action, as obtained by the pipes *p*, would be disadvantageous as it prevents combustion of the gases, the combustion being hindered by the cooling action on the burning layer. In the new construction described the reverse is the case as here it does not depend on obtaining complete combustion on the ante-grate but on the fact of loading the ante-grate as much as possible in order thus to suitably increase the efficiency of the entire firing.

It may be observed that the operation of the grate is materially improved and more uniform consumption of fuel is obtained when the fuel is supplied to the sides of the grate. It is found that when the fuel is delivered across the entire width of the grate, the reciprocation of the grate parts results in the distribution of fuel to a uniform depth over the entire width of the grate. Thus as the fuel moves through the furnace, the action of the highly heated incandescent walls of the side of the grate results in rapid consumption of the fuel disposed adjacent thereto, and thus the draft through the denser portion of the bed of fuel is materially reduced. When fuel is delivered to the sides of the grate, a sufficient layer of fuel is present, even at the discharge of the grate, to ensure uniform combustion, this being a feature of the arrangement shown in Figure 2.

In order to further increase the output of the ante-grate *d*, it is preferably operated by low pressure draft, as is well known; if the main grate *a* and the ante-grate *d*, therefore both, are operated with low pressure draft then a higher air pressure is used for the ante-grate than for the main grate.

I claim:—

1. In combination a main inclined grate,

a secondary inclined grate arranged above the main grate for delivering incandescent fuel thereto, means for supplying fuel to both grates, so as to form a burning layer on the main grate on which fresh fuel is supplied, a combustion chamber for said secondary grate, a combustion chamber for said main grate, brickwork in which said grates are located, said brickwork having a passage formed therein, said passage forming a means of communication between said combustion chambers, and cooling pipes located in said passage to retard combustion in the chamber for the secondary grate.

2. In combination a main inclined grate, a secondary inclined grate arranged above the main grate, means for supplying fuel to both grates, the secondary grate supplying incandescent burning fuel to the main grate, so as to form a burning layer thereon on which fresh fuel is supplied, a combustion chamber for said secondary grate, a combustion chamber for said main grate, brickwork in which said grates are located, said brickwork having a passage formed therein, said passage forming a means of communication between said combustion chambers, and cooling pipes located in said passage, said cooling pipes extending into the combustion chamber of said secondary grate to retard combustion therein, means for supplying cooling water to said cooling pipes, means for conducting steam from said cooling pipes, and pipes for forming a return flow between said cooling pipes.

3. In combination a main inclined grate, a secondary inclined grate arranged above the main grate, means for supplying fuel to both grates, the secondary grate supplying incandescent burning fuel to the main grate, so as to form a burning layer thereon on which fresh fuel is supplied, a combustion chamber for said secondary grate, a combustion chamber for said main grate, brickwork in which said grates are located, said brickwork having a passage formed therein, said passages forming a means of communication between said combustion chambers, and cooling pipes located in said passage to retard combustion in the chamber for the secondary grate, a chamber to which said cooling pipes are connected at one end, a second chamber to which said cooling pipes are connected at the other end, said second chamber being at a higher level than the first chamber, pipes between said chamber, means for supplying water to the first chamber, and means for conducting steam from the second chamber.

4. In combination a main inclined grate, a secondary inclined grate arranged above the main grate, means for supplying fuel to the secondary grate and to the sides only of the main grate, the secondary grate supplying incandescent burning fuel to the main grate so as to form a burning layer thereon on which the fresh fuel is supplied, a combustion chamber for said secondary grate, a combustion chamber for said main grate, and means of communication between said combustion chambers.

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