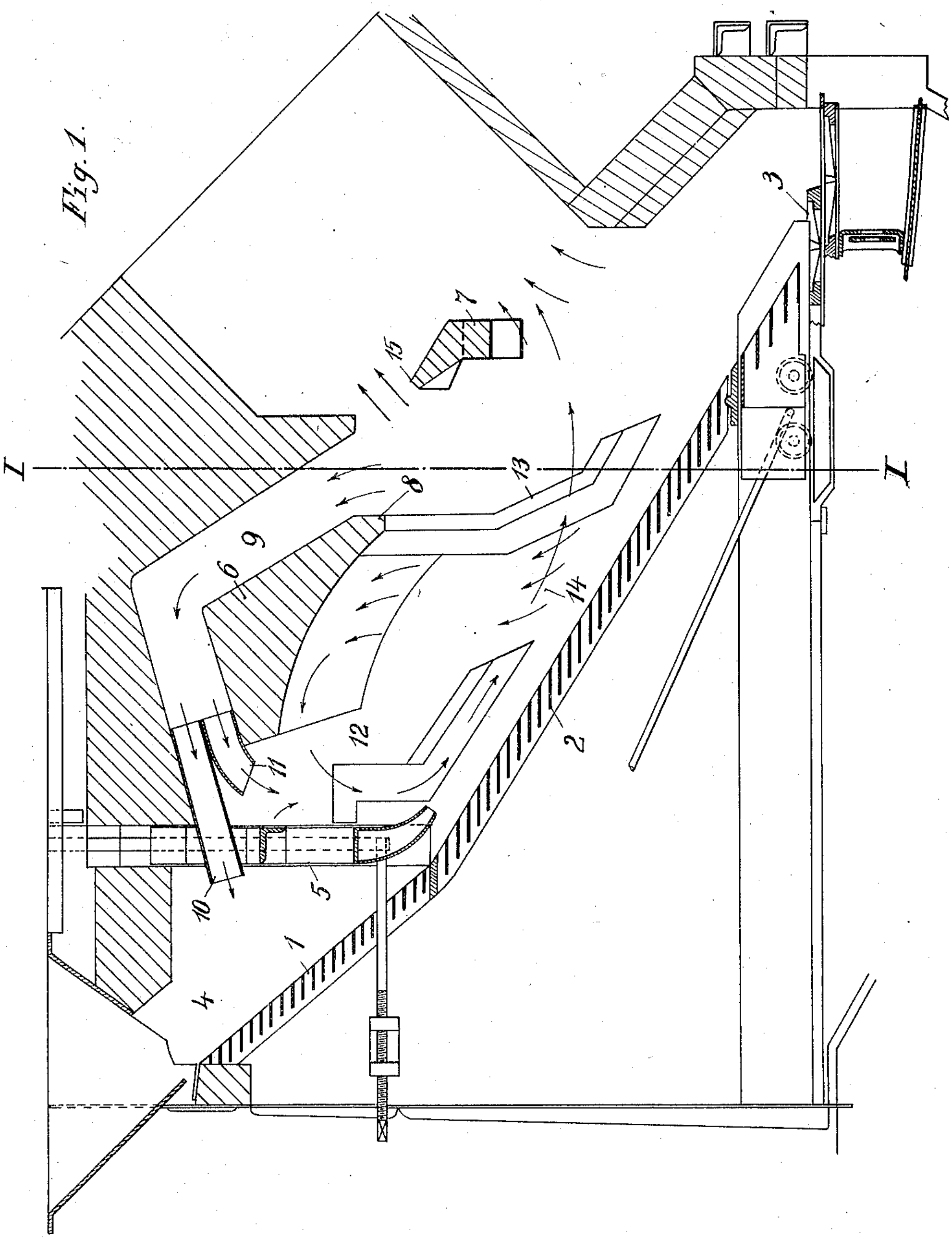
COMBUSTION METHOD FOR FUELS

Filed March 1, 1923 5 Sheets-Sheet 1



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COMBUSTION METHOD FOR FUELS

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Fig. 1.

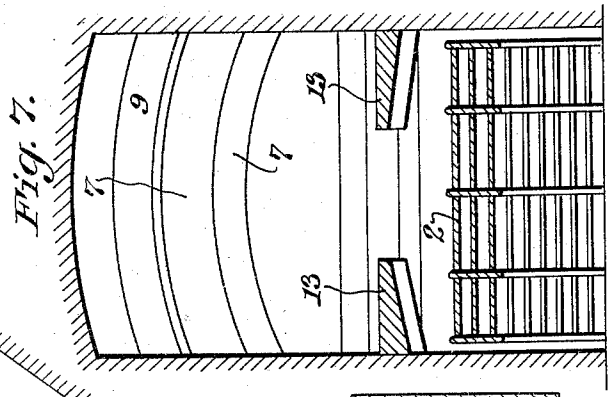
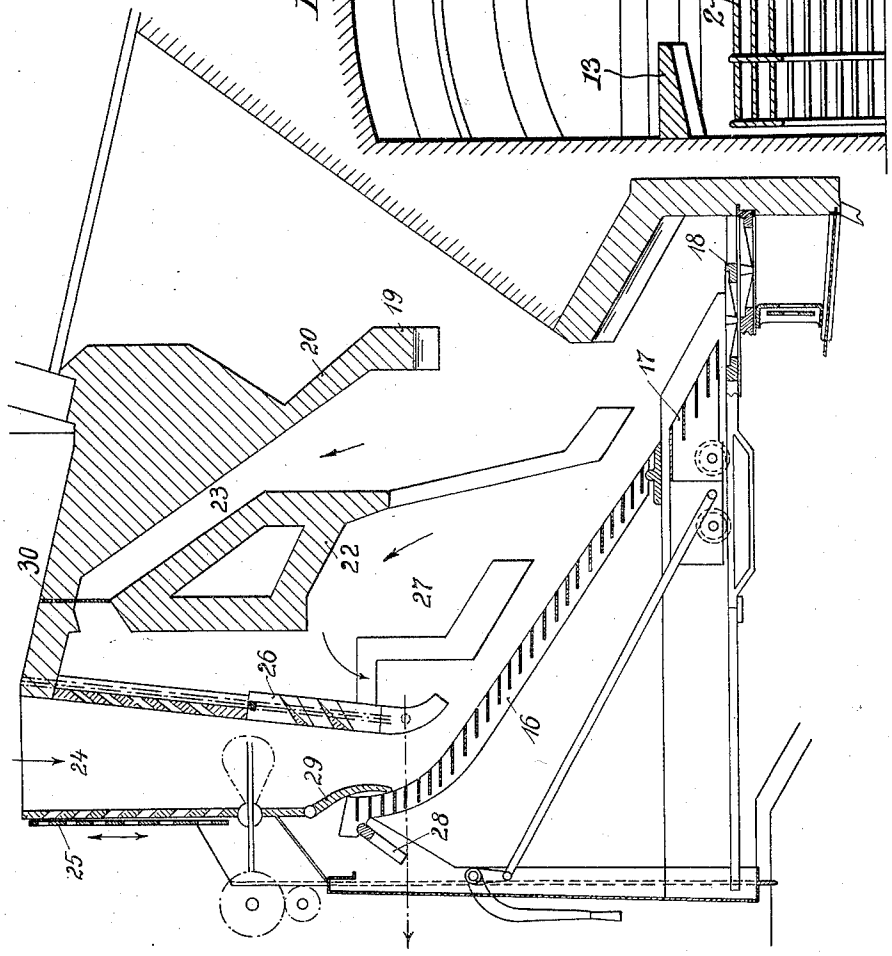


Fig. 2.



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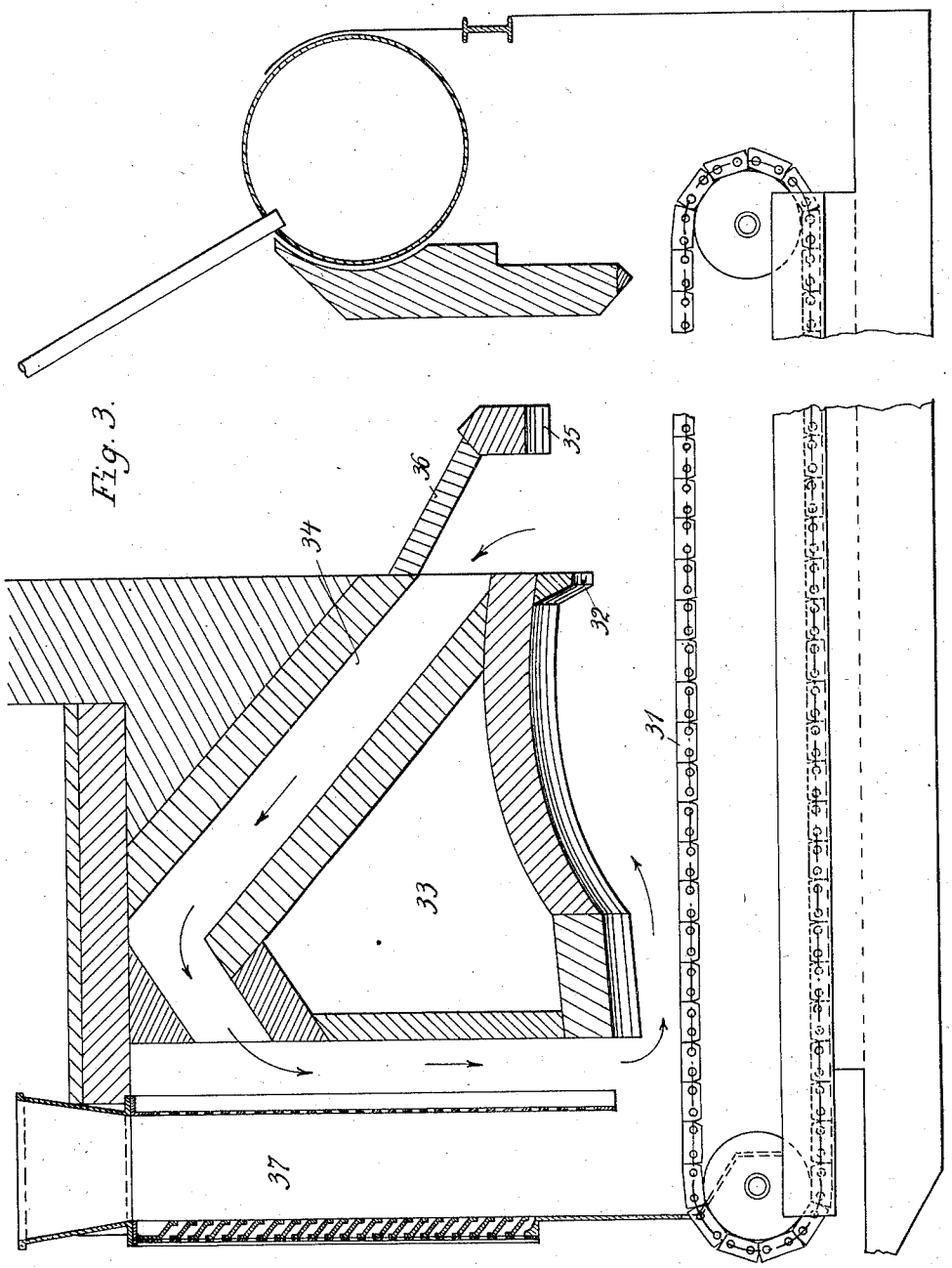

Fig. 3.

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Fig. 5.

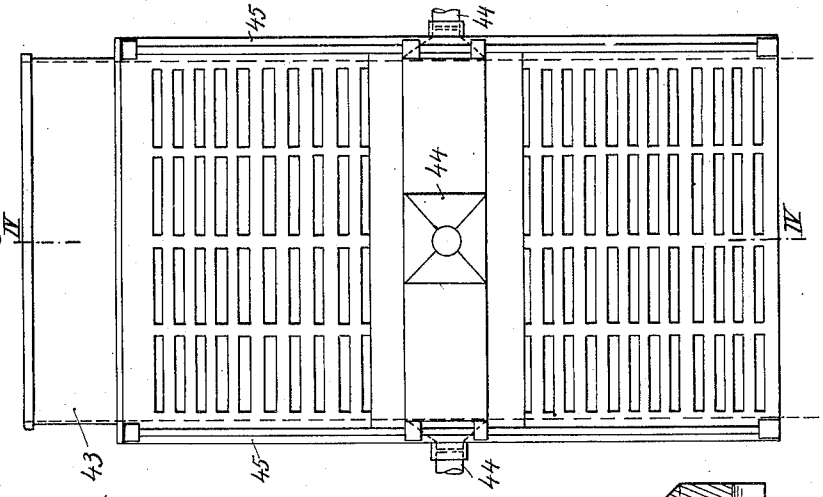

Fig. 4.

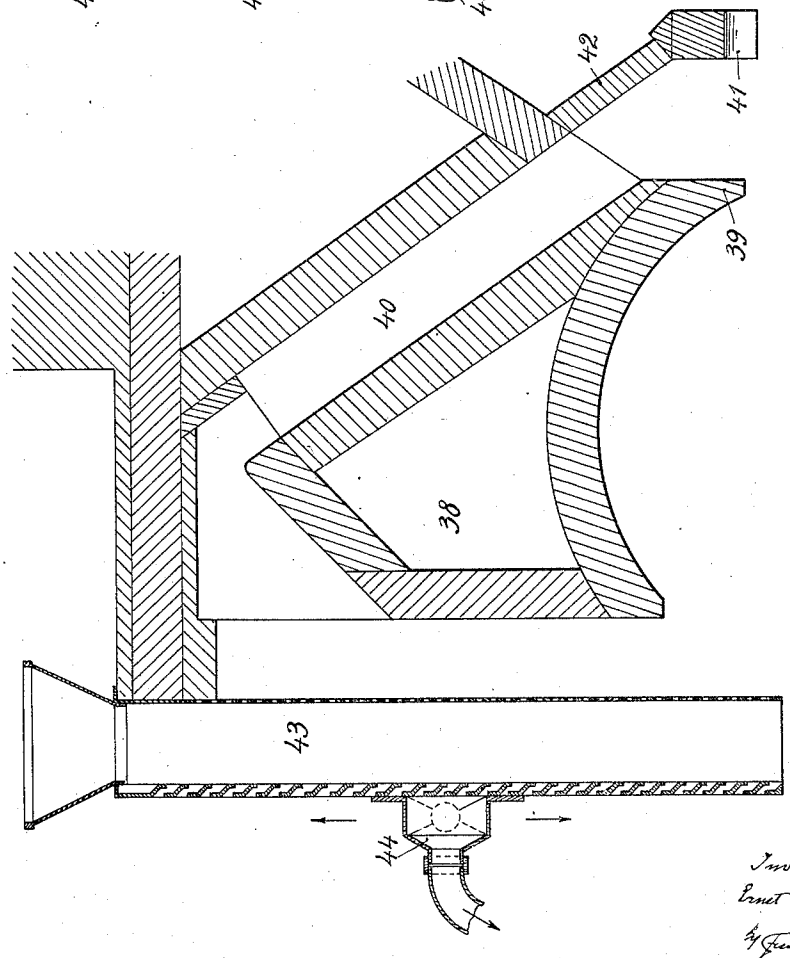

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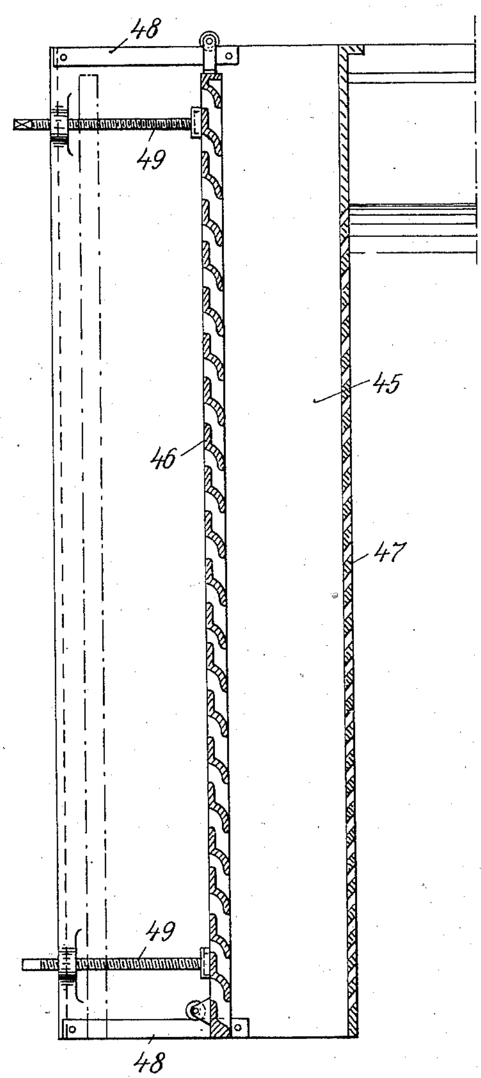
Fig. 6.



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UNITED STATES PATENT OFFICE

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COMBUSTION METHOD FOR FUELS

Application filed March 1, 1923, Serial No. 622,160, and in Germany March 23, 1922.

This invention relates to furnaces with inclined grate or with travelling grate which produce unfavorable combustion conditions if the furnace is used for the combustion of inferior fuel having a high percentage of moistness, for instance lignite. It has already been proposed to improve the combustion by sucking off by means of fans a portion of the flue gas and to conduct it to the front portion of the grate surface, no practically valuable result having, however, been obtained.

This invention relates to a new method for improving the combustion on the grate, according to which method a portion of the flue gases is automatically deflected by the action of the kinetic energy inhering in the flue gases and to conduct this deflected portion of the flue gases backward to one or several points of the front portion of the grate surface. This method might be modified by automatically branching off portions of the flue gases at different points on the rear part of the grate and to conduct these deflected portions to different points on the front part of the grate.

With this object in view the inner construction of the furnace is improved by arranging over the front half of the grate a resistance arch and preferably also a radiating vault having a concave lower surface and an inclined rear guiding surface in front of a return channel of the vault, said return channel being branched at the front end so that the gas flows can be conducted to separate sections of the grate.

It has therefore already been proposed to withdraw from the rear part of the grate a part of the flue gas by mechanical means, for instance by sucking off, and to conduct the same to the front part of the grate in order to improve the combustion upon this part of the grate. These experiments have however not given up to the present any favorable result.

The invention is based upon the idea to utilize the kinetic energy of the highly valuable flue gas for bringing back to the front part of the grate part of said flue gas with the aid of conveniently arranged guiding surfaces without the use of any mechanical means, in order to use this part of the flue gas at a convenient point of the furnace for improving and perfecting the combustion process, it being indifferent whether the furnace is supplied with solid, liquid or gaseous fuels.

Several embodiments of the invention are illustrated in the accompanying drawings, wherein:

Figure 1 shows in side elevation partly in section a half-gas fired furnace with inclined grate.

Figure 2 shows in side elevation partly in section a half-gas fired furnace with inclined grate and feeding chute.

Figure 3 shows in side elevation partly in section a furnace plant with travelling grate.

Figures 4 and 5 show a furnace with vertical feeding chute in longitudinal section and front elevation, respectively.

Figure 6 shows in cross section a vertical feeding chute of special shape.

Figure 7 is a vertical sectional view on the line I—I of Figure 1.

The furnace shown in Fig. 1 consists of the upper inclined grate 1, the lower inclined grate 2, the flat grate 3, the space 4 for the preliminary drying, distillation or degassing with the movable bridge 5, the radiating vault 6 and the resistance arch 7.

The radiating vault 6 has a concave lower surface and at the rear end an inclined downwardly and rearwardly projecting beak-shaped guiding surface 8. The radiating vault is traversed in longitudinal direction from one side to the other by a channel 9 which is branched off at the front end into two arms 10, 11 of which the one, 10, terminates in the degassing or distillation space 4, the other, 11, terminating in the furnace proper 12. The side walls of the furnace proper have projections 13 interrupted at 14 and the resistance arch 7 has a beak-shaped guiding surface 15 which extends in inclined direction upwardly and forwardly.

The guiding surface 8 of the radiating vault conducts part of the highly valuable flue gas under the radiating vault 6. Another part of this gas is conducted under the radiating vault by means of the narrow-

ing of the furnace produced by the projections 13 in flowing through the open parts 14. All these deviated highly valuable flue gases whirl in the direction indicated by arrows through the space situated between the radiating vault and the front surface of the grate and improve the combustion at this part of the furnace so that it becomes more intensive.

The resistance arch 7 situated on the path of the flue gases is surrounded above and below by the outflowing highly valuable flue gases in such a manner that approximately $\frac{8}{10}$th of the gases flow off below and $\frac{2}{10}$th above said arch. The beak-shaped guiding surface 15 of the resistance arch deflects part of the highly valuable flue gas (about $\frac{1}{10}$th) into the channel 9 of the radiating vault 6. In this channel the flue gas is separated into two currents, approximately $^1/_{20}$th flowing through tube 10 into the degassing space 4 and approximately $^1/_{20}$th through the nozzle shaped tube 11 into the furnace proper 12 where the gas flows along the rear wall of the bridge 5 sucking off gases of distillation from the degassing space 4 mixing intimately with these gases and finally admix with the above mentioned highly valuable flue gases.

The fuel is preliminarily dried, owing to the above described circulation of the highly valuable flue gases so far that it sticks no longer but slips down regularly and is inflamed easily. The radiating vault is further heated to red heat and its concave lower surface radiates the heat backward upon the inclined grate 2 and the bridge 5 for the indirect drying of the fuel. The mixed gases having completed their circulation in the furnace proper flow off over the grate 3 where they are burnt to form highly valuable flue gas.

The furnace shown in Fig. 2 consists of the inclined grate 16, the poking carriage 17, the flat grate 18, the resistance arch 19 with the backward guiding surface 20 and the passages 21, the radiating vault 22 with concave lower part, the channel 23 and the feeding chute 24.

The front and rear walls of the feeding chute 24 are interrupted by inclined slits and one or several registers 25 for regulating the admission of the air. Four registers are preferably arranged upon the whole front wall said registers being adapted to be adjusted singly or in pairs. The lower extension of the rear wall of the feeding chute forms a movable bridge 26, adapted to be operated from the stoker's stand and through which the gases of distillation flow from the distillation space into the front part of the furnace proper 27. The gap between the front wall of the feeding chute 24 and the inclined grate 16 adjustably mounted in a link 28 is filled by a flap 29 suspended so that it can freely swing and maintained in the closing position by the fuel on the feeding chute. The channel 23 of the radiating vault 22 is adapted to be shut off more or less by a register 30.

The current of flue gas flows in this form of construction along the same path as described with reference to Fig. 1. Part of the highly valuable flue gas is conducted by the beak-shaped extension 20 of the resistance arch 19 into the chamber 23 where it heats the radiated vault 22 and the rear wall of the feeding chute and of the bridge 26, sucks off the gases from distillation from the degassing space and forms, together with gases from distillation in the space 27, a mixture which is burnt upon the grate. As the fuel, owing to the arrangement of the bridge 26 and of the flap 29 has to travel a long way before arriving at the grate, the action of the deflected flue gas upon the fuel is increased. This action can be regulated by adjustment of the registers 25 and 30. At the same time irregularities in the feeding of the fuel are avoided and a uniform feeding of the grate is ensured so that no gaps in the fire on the grate nor idle burning of the fire can occur.

The furnace shown in Fig. 3 comprises a travelling grate 31, the radiating vault 33 with the concave lower surface and downwardly inclined beak 32 and channel 34, the resistance arch 35 with beak 36 upwardly directed in inclined position and the feeding chute 37 with perforated front and rear walls.

A part of the highly valuable flue gas is deviated in the direction indicated on the drawing by arrows and conducted backwards through the channel 34 of the radiating vault 33. When coming out of this channel 34 the deviated flue gas flows downward along the rear wall of the feeding chute so that the coal is dried, whereupon the flue gas, together with the gases from distillation, flows over the grate.

This installation is specially designed for inferior fuels for instance for lignite. With fuel of this kind travelling grates could hitherto not be used as the coal baked in the feeding chute and as the fire was interrupted upon the grate directly behind the feeding chute so that gaps in the fire were produced upon the grate. These inconveniences are avoided by part of the highly valuable flue gas being conducted back in accordance with the invention so that travelling grates may now be used also for lignite and similar fuels.

Part of the gas from distillation produced at the preliminary drying of the fuel does unfavorably influence, owing to its high percentage of steam, the general temperature in the furnace and consequently the combustion process as the preliminary drying and the distillation of the fuel are different in the several superposed zones of the feeding chute so that they increase in intensity the closer the zone is situated to the grate. The preju-

dicial action of the gases from distillation upon the efficiency of the furnace is particularly pronounced if part of the flue gas is conducted backward in accordance with the invention as in this case the preliminary drying of the fuel is more intense than hitherto.

According to the invention the gases from distillation are therefore subdivided and the noxious parts of the same are sucked off, the useful part being however conducted to the furnace as illustrated in Figs. 4 and 5.

This furnace comprises also the radiating vault 38 with concave lower surface, with beak-shaped guiding surface 39 and with channel 40, the resistance arch 41 with guiding surface 42 and the feeding chute 43. This feeding chute has, similar to the above described form of construction, a perforated front and rear wall. Upon the front wall a suction device 44 communicating with the main flue of the furnace is adjustably arranged in lateral guides 45 so that it extends over the entire height of the feeding chute.

The fuel in the vertical feeding chute is preliminarily heated by the back flowing flue gas which traverses the channel 40 of the radiating vault 38 and descends along the rear wall of the feeding chute. The adjustable suction device permits to determine by sucking off and analyzing the gas the limit, according to the kinds of fuel used, up to which the gases from distillation have a prejudicial effect and at which point of the feeding chute they have to be removed. Supposed the entire height of the feeding chute comprised five zones the gases from distillation will consist at the middle zone for the largest part of steam and of inferior coal gases from distillation which are ballast for the furnace and which for the largest part will therefore be directly conducted into the main flue by the suction device without other auxiliary means.

The most extensive utilization of the backward conducted highly valuable flue gas for the preliminary drying of the fuel will be possible if the distilling process per se is effected under the most favorable conditions. The distilling process depends on the kind of fuel, on the percentage of moistness of the fuel and on the thickness of the fuel layers in the feeding chute.

The unfavorable influence upon the distilling process of the kind of fuel and of the percentage of moistness which varies continuously under the influences of temperature must be compensated by variation of the thickness of the fuel layers.

According to the invention the feeding chute is therefore made with variable cross section as shown in Fig. 6.

The feeding chute 45 has a perforated front wall 46 and a perforated rear wall 47. The rear wall is bricked in solidly but the front wall 46 is adjustable upon fixed sliding rails 48 with the aid of screw bolts 49. The cross section of the feeding chute is therefore variable and consequently the thicknesses of the layers of fuel are variable also.

I claim:—

1. In a furnace, the combination with a grate for supporting fuel to be burnt in the furnace and an outlet flue in the rear of the furnace for the exit of hot gases from the furnace, of a deflecting member interposed in the path of the hot gases flowing through said outlet and guiding means arranged in the furnace adapted to co-operate with said deflecting member for guiding a portion of said gases to the front of the furnace so as to enable said portion of the gases to be returned thereto by their kinetic energy.

2. In a furnace, the combination with a grate for supporting fuel to be burnt in the furnace and an outlet flue in the rear of the furnace for the exit of hot gases from the furnace, and a radiating vault above said grate, said vault having a concave lower surface, of projections on said vault for whirling the hot gases in the space below said vault and guiding means, including a deflecting member interposed in the path of the hot gases flowing through said outlet, for guiding a portion of said gases to the front of the furnace so as to enable said portion of the gases to be returned thereto by their kinetic energy.

3. In a furnace, the combination with a grate for supporting fuel to be burnt in the furnace and an outlet flue in the rear of the furnace for the exit of hot gases from the furnace, of a flue for establishing open communication between the front and the rear of the furnace, said flue having its rear end terminating in close proximity to the said outlet, and a resistance arch extending across said outlet flue for intercepting a portion of the hot gases flowing to said outlet, said resistance arch having a guiding surface for deflecting said portion of the hot gases towards the rear end of said flue, for the purposes set forth.

4. In a furnace, the combination with a grate for supporting fuel to be burnt in the furnace, an outlet flue in the rear of the furnace for the exit of hot gases from the furnace, and a radiating vault above said grate, said vault having a lower concave surface, of a bridge arranged in front of said radiating vault, a flue for establishing open communication between the front and the rear of the furnace, said flue having its rear end terminating in close proximity to said outlet and its front end terminating behind said bridge, means for establishing open communication between said front end and the spaces in front of and behind said bridge, respectively, and a resistance arch extending across said outlet flue for intercepting a portion of the hot gases flowing to said outlet, said resistance arch having a guiding surface for deflecting said

portion of the hot gases towards the rear end of said flue, for the purposes set forth.

5. In a furnace, the combination with a grate for supporting fuel to be burnt in the furnace and an outlet flue in the rear of the furnace for the exit of hot gases from the furnace, of a flue for establishing open communication between the front and the rear of the furnace, said flue having its rear end terminating in close proximity to the said outlet, a register in said flue for throttling the passage of the hot gases therein, and a resistance arch extending across said outlet flue for intercepting a portion of the hot gases flowing to said outlet, said resistance arch having a guiding surface for deflecting said portion of the hot gases towards the rear end of said flue, for the purposes set forth.

In testimony whereof I affix my signature.

ERNST VÖLCKER.