F. SIEMENS.

FURNACE.

APPLICATION FILED MAR. 18, 1910.

1,017,181. Patented Feb. 13, 1912.

Fig. 1.

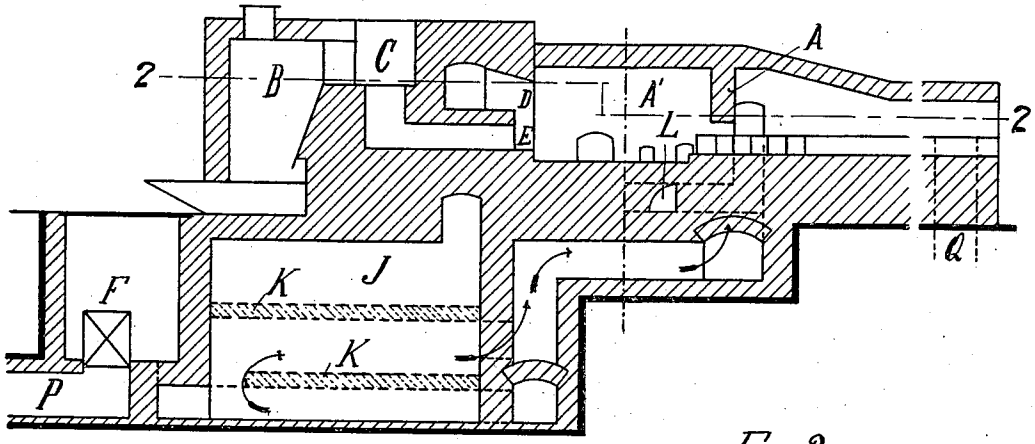
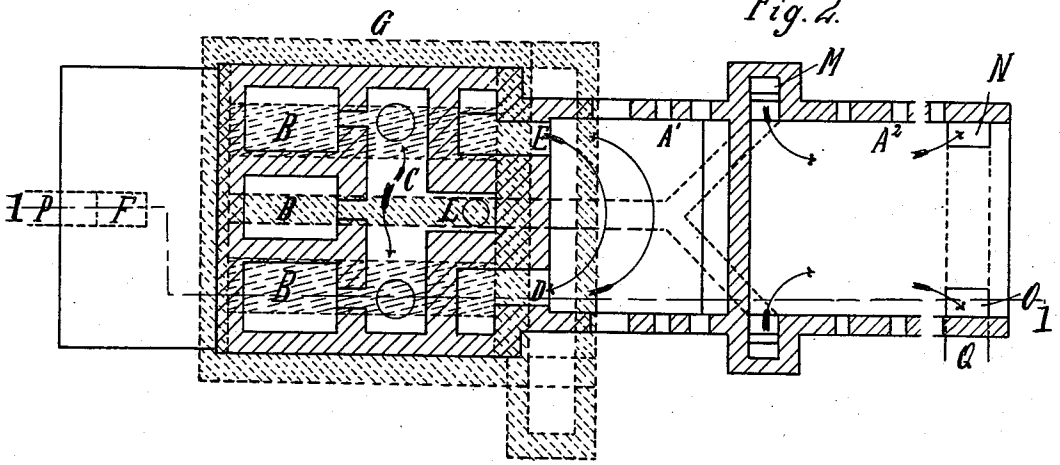


Fig. 2.



WITNESSES:

John C. Sanders

John A. Percival.

INVENTOR:

Friedrich Siemens

By

ATT'Y.

UNITED STATES PATENT OFFICE.

FRIEDRICH SIEMENS, OF BERLIN, GERMANY.

FURNACE.

1,017,181. Specification of Letters Patent. Patented Feb. 13, 1912.

Application filed March 18, 1910. Serial No. 550,212.

To all whom it may concern:

Be it known that I, FRIEDRICH SIEMENS, a subject of the German Emperor, and residing at Berlin, Germany, have invented certain new and useful Improvements in Furnaces, of which the following is a specification.

My invention relates to regenerative continuous furnaces for metallurgical purposes, and to cement rotary-furnaces, calcining furnaces, and the like.

The former modes of employing the regenerative principle in connection with continuous furnaces for metallurgical purposes, cement rotary-furnaces, calcining furnaces and the like suffered from certain defects which will now be described with reference to a regenerative continuous furnace for metallurgical purposes:—The air for combustion could not be highly heated to at least 900° C., at which temperature the well-known advantages of regenerative gas-firing first become evident, in the construction of continuous furnaces for metallurgical purposes well-known heretofore, on the one hand because the burned gases to be utilized for pre-heating the air for combustion were too much cooled by flowing over cold ingots and, on the other hand, because the products of combustion had to be taken off at the ends of the long pushing bed, so that, on account of the charging door which is located at this place and is almost always open in a large furnace, cold air was drawn into the discharge flues of the products of combustion which, again, materially impaired the regenerating capability of the burned gases. Further, in continuous furnaces, known heretofore, whether according to the regenerative gas, recuperative gas, half gas or direct-fired system, the consumption by burning of the ingots was relatively increased by the flame, which impinged according to the counter-current principle on the most highly heated ingots, having to carry with it an excess of air, on the one hand in order to obtain the desired high temperature, and on the other hand to enable complete combustion of the entire quantity of gas over the entire length of the heating and finishing chambers. But precisely at this place it is of the greatest importance that an excess of air for combustion be avoided, both because the ingots already highly heated at this place oxidize particularly readily, and also because the air and gas directly behind the burner heads have not yet mixed and consequently currents of air could readily impinge on the hot ingots. Again, in the known makes of continuous furnaces, above all in those provided with regeneration or recuperation, it is exceedingly difficult to supply the sufficient quantity of air to the flame, because the charging door which is generally open allows atmospheric air to pass into the discharge flues and diminishes the draft of the furnace. Therefore it has been necessary heretofore to supply compressed air.

It has been proposed heretofore, in addition, to divide the continuous furnace into two parts, namely into the finishing chamber and the heating chamber, of which each was to be provided with a special furnace. But it is obviously not possible to work the heating chamber with a regenerative furnace because a reversal of the direction of the flames is not possible here, since such reversal would cause the ingots which have just arrived into the heating chamber to be temporarily impinged by the hot flame, while the ingots approaching the finishing chamber would have to be flowed over by the colder portions of the flame. On the other hand, the regenerative furnace of the finishing chamber is not sufficiently utilized. As the ingots are already heated to bright red heat as they enter into the finishing chamber, the flame in this part of the continuous furnace will have relatively little opportunity of giving up heat to the ingots. Therefore the flame will enter with the greatest portion of its heat into the regenerator chamber. On the other hand, thanks to the air being highly pre-heated, the finishing chamber will be able to work with a less quantity of air, so that consequently the air for combustion would take up only a small quantity of the heat stored in the regenerator chambers and therefore the burned gases would escape at a higher temperature into the smoke stack. In addition, when exclusively the air for combustion is preheated and the gas is employed at its temperature of production, as is generally the case at the present day, the quantity of gas (burned gases) giving off heat is more considerable in itself than the quantity (air for combustion) taking up heat. Thus when a regenerative furnace is used for the finishing chamber an excess of heat must result.

The same or similar defects are met with in cement rotary-furnaces, calcining fur-

naces and similar makes of furnaces, particularly in all furnaces, in which as large a fall of temperature as possible is to be obtained on a grate extended at full length as short as possible from the one end to the other, so that any material which is to be heated on the counter-current principle can be moved through the furnace from the cold charging end to its hottest discharging end. All these furnaces can be divided into two parts as in continuous furnaces, of which parts that located at the discharging end must have the highest temperature, while the other beginning with the charging end must have a gradually increasing, but fairly low, initial temperature.

My invention substantially consists in heating these two parts of the furnace differently by utilizing the heat of the part heated most highly for heating the other part which is to be heated less highly; this can be effected *e. g.* in a continuous furnace and a finishing furnace by using the excess heat of the regenerative furnace of the finishing chamber for the heating chamber. This idea, on which my invention is based, can be embodied in various forms in continuous furnaces and in finishing furnaces; by means of a cooled reversing valve I can use directly pre-heated air from the regenerators for feeding the flame in the heating chamber and conduct it to the burner heads in the heating chamber. Special channels or recuperators may be built into the regenerators of the finishing chamber, however, through which the air for combustion necessary for the heating chamber flame flows and is heated to the requisite temperature. The gas for the flame in the heating chamber is in this event taken from the producers of the finishing chamber.

My invention can also be carried into practice, however, by drawing away one portion of the flame of the finishing chamber into the heating chamber and consequently working this with a portion of the finishing chamber flame. In this event the balance of temperature in the regenerative furnace is guaranteed by only one portion of the flame flowing through the regenerators, while the other portion heats the heating chamber. This form of my invention is preferable, above all, for small makes of furnaces, thus where special heating of the heating chamber with burner heads specially provided therefor is done away with. It may, however, be combined in large furnaces with the previously described forms and be employed in such manner that, when the furnace is heavily loaded, the special means for heating the heating chamber are operated; if there is but little work, however, these special heating means are cut off and a portion of the finishing chamber flame is sucked through the heating chamber. Lastly, I can combine these different forms of my invention by supplying only a small quantity of gas and highly heated air for combustion to the heating chamber, and simultaneously drawing off a small portion of the finishing chamber flame through the heating chamber. In all these cases the balance of temperature is guaranteed in the regenerative furnace in the above described manner.

All these modes of working can obviously be applied in the same sense to cement rotary-furnaces, calcining furnaces, etc., in which the above described conditions are present. It may be preferable to widen that part of the furnace in which the flame of the regenerative furnace generates the highest requisite heat, in order to enable the flame to be guided as required.

One illustrative embodiment of my invention as applied to a continuous furnace comprising a heating and finishing chamber is illustrated by way of example in the accompanying drawing wherein:—

Figure 1 is a vertical longitudinal section through the continuous furnace on the line 1—1 of Fig. 2, and Fig. 2 is a horizontal section through the same on the line 2—2 of Fig. 1.

Referring to the drawing, the continuous furnace is divided by the partition wall A into two parts, namely the finishing chamber A^1 and the heating chamber A^2. This division can also be effected by bringing the arch correspondingly lower; further, the finishing chamber may remain not separated from the heating chamber when it is possible exactly to regulate the pressure and draft conditions in the furnace.

The finishing chamber, in which there is to be a high welding temperature, excess of air for combustion being avoided as much as possible, is heated by a regenerative gas flame. The gas is produced in the producer shafts B in immediate proximity to the bed and after passing a gas valve C operated from one side only passes into one of the two flues or passages D and E. The gas here meets with the highly heated air for combustion which has entered through an ordinary air valve F and has flowed into one of the regenerators G, J. By reversing the valves F and C the well-known regenerative principle comes into action. By regulating the smoke-stack draft and the gas-pressure it is possible to regulate the flame and limit it to the finishing chamber. The burner heads M are arranged in the heating chamber immediately behind the wall A either at the two sides of the chamber or together in the center of the arch. The gas for the flame in the heating chamber is brought by a branch L from the producers to the burner heads M and to the flues or passages. The air for combustion for the heating chamber is pre-heated in

the illustrative embodiment in channels or recuperators K built into the regenerators G and J. As previously mentioned, it is also possible to supply a portion of the air for combustion heated in these regenerators directly to the burner heads M for feeding the flame in the heating chamber.

In the case of small furnaces, as stated above, the special means for heating the heating chamber will not be necessary. The heating chamber is heated, as indicated above, by regulating the smoke-stack draft and the gas-pressure and drawing off a portion of the finishing chamber flame so that this portion of the flame can flow through the heating chamber.

The flame in the heating chamber is utilized owing to the greater length of the chamber. Recuperation of the burned gases which escape at N and O is unsuitable, on the one hand because the pre-heated air for the heating chamber must be heated higher than the temperature of the burned gases, and on the other hand because without recuperation of the burned gases of the heating chamber the charging door can be left open without the recovery of the burned gases being rendered difficult. The flame in the heating chamber is regulated by dampers arranged at the burner heads M. The two smoke-stack flues P and Q are provided with separate dampers but preferably open into the same smoke-stack.

As mentioned above, in the arrangement illustrated in the drawing several forms of my invention can be used and combined one with another. Thus it is possible entirely to close the burner heads M and to work the heating chamber A^2 by means of a portion of the finishing chamber flame which is drawn into the heating chamber. The burner heads M may, however, be partially open so that a certain quantity of gas and air flows in, a portion of the finishing chamber flame being simultaneously drawn off into the heating chamber. The hereinde-

scribed furnace can thus be worked in the most various ways according to the requirements at any time.

My invention can be applied constructively to other kinds of furnaces, as *e. g.* cement rotary-furnaces, calcining furnaces etc. in an exactly analogous manner, for which reason the same have not been represented on the drawing, and it is, of course, to be understood that the term "furnace" as used in the claims is to be considered in its broad sense.

I claim:—

1. In an apparatus of the class described, in combination, a furnace, means for heating a portion of said furnace by a reversing flame, and means for drawing off a portion of said reversing flame to heat another portion of said furnace.

2. In an apparatus of the class described, in combination, a furnace, a regenerator operatively associated with said furnace, means for heating a portion of said furnace by a reversing flame from said regenerator, and means for drawing off a portion of said reversing flame to heat another portion of said furnace.

3. In an apparatus of the class described, in combination, a furnace comprising a plurality of parts, a gas producer operatively associated with said furnace, a regenerator operatively associated with said furnace and with said gas producer, means for delivering heated gases from said producer and said regenerator to one part of said furnace to form a flame, and means for causing a portion of said flame to pass to one of the other parts of said furnace and for causing the remaining portion of the flame to pass into the regenerator.

In testimony whereof, I affix my signature in the presence of two witnesses.

FRIEDRICH SIEMENS.

Witnesses:

WOLDEMAR HAUPT,

HENRY HASPER.