No. 832,358. PATENTED OCT. 2, 1906.

F. J. BERGENDAL.

FURNACE FOR CALCINING OR BURNING BRIQUETS OF ORE.

APPLICATION FILED APR. 8, 1905.

2 SHEETS—SHEET 1.

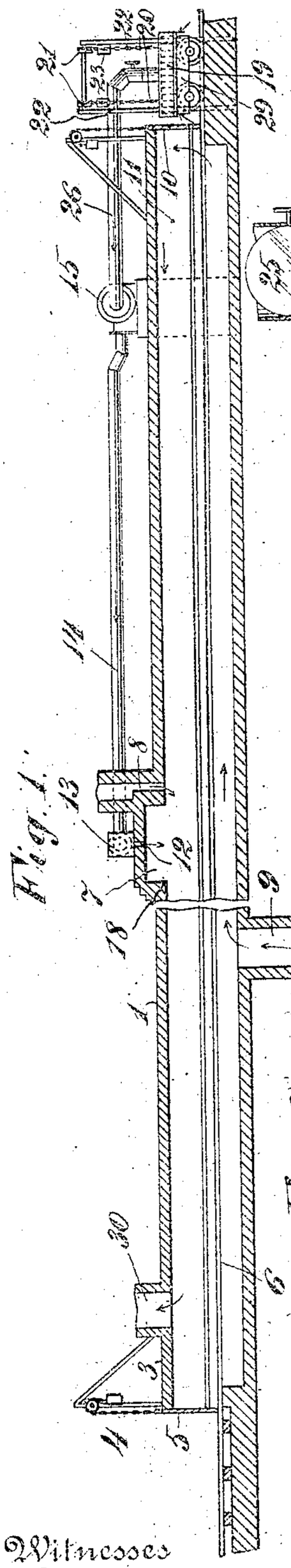

Fig. 1.

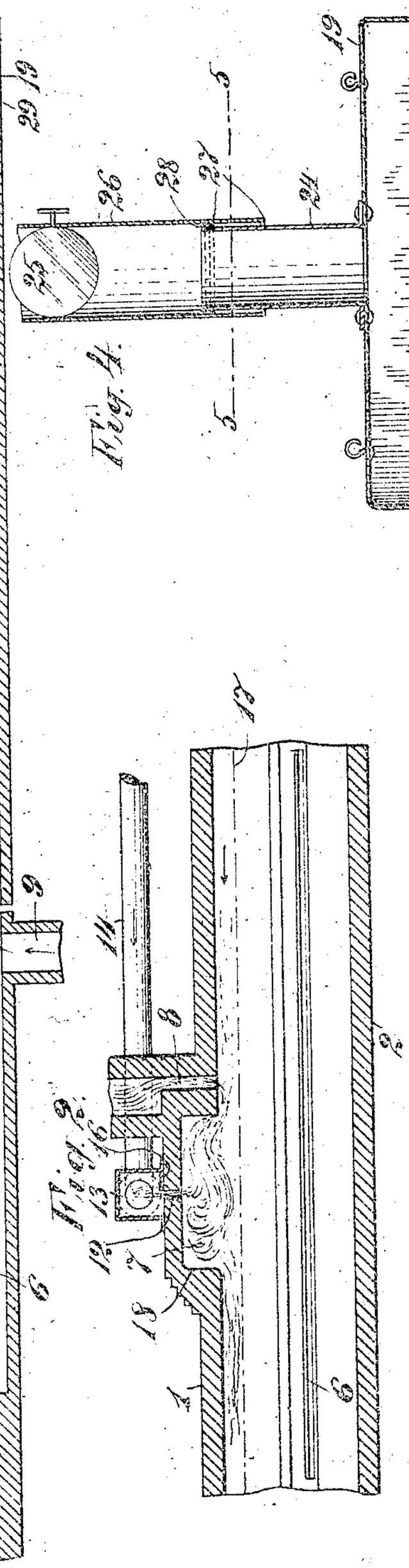

Fig. 4.

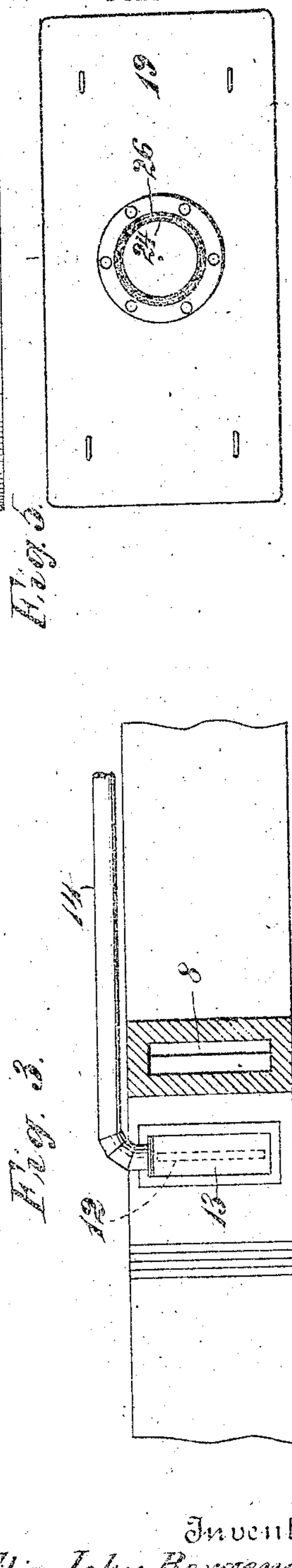

Fig. 5.

Fig. 2.

Fig. 3.

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2 SHEETS—SHEET 2.

Fig. 7.

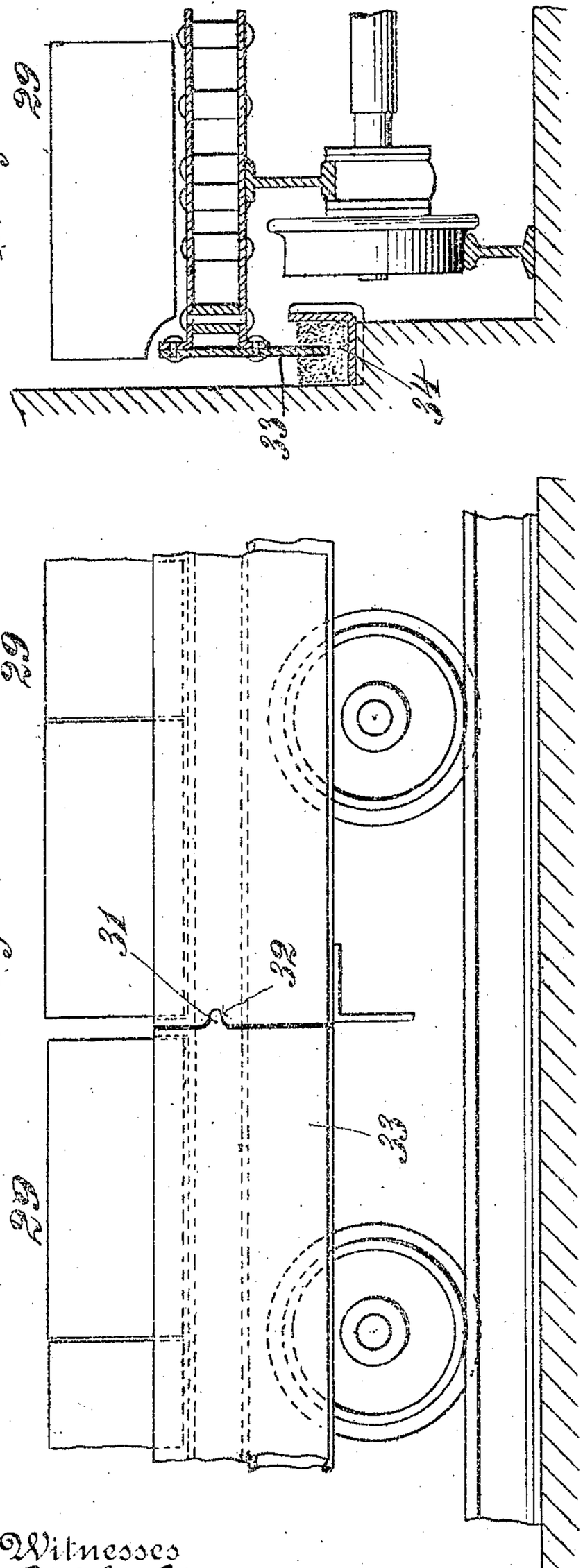
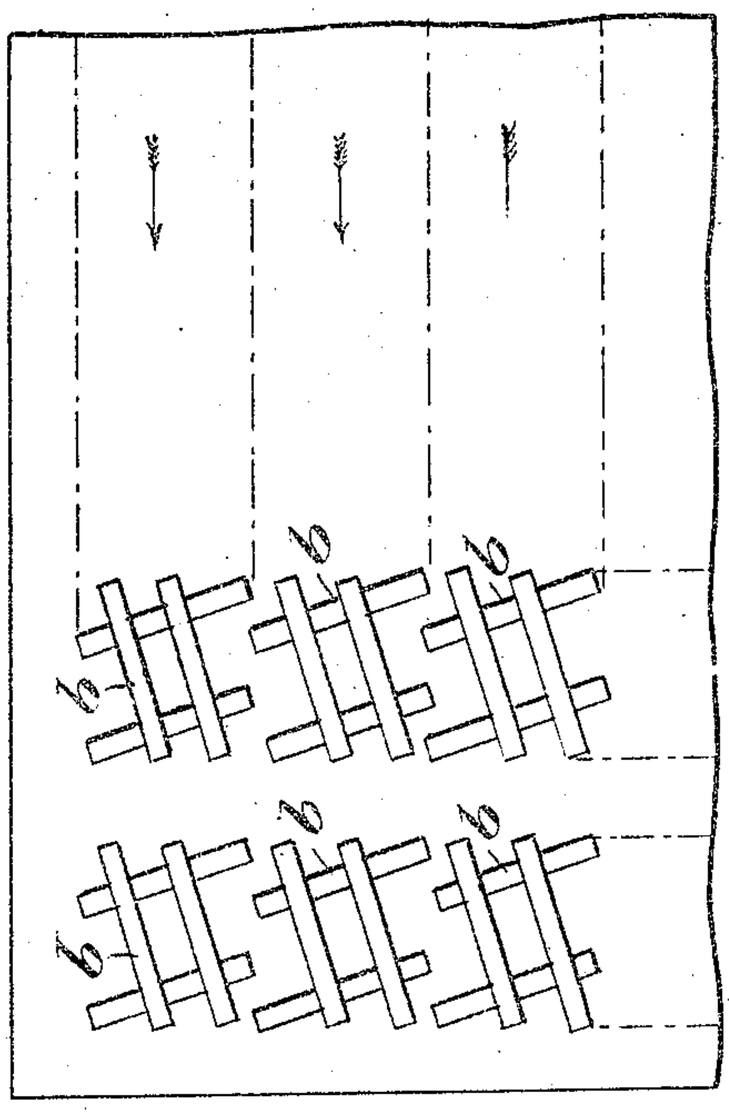


Fig. 8.



Witnesses

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Filip John Bergendal

By his Attorney

UNITED STATES PATENT OFFICE.

FILIP JOHN BERGENDAL, OF HERRÄNG, HÄFVERÖSUND, SWEDEN.

FURNACE FOR CALCINING OR BURNING BRIQUETS OF ORE.

No. 832,858. Specification of Letters Patent. Patented Oct. 9, 1906.

Application filed April 8, 1905. Serial No. 254,597.

To all whom it may concern:

Be it known that I, FILIP JOHN BERGENDAL, a subject of the King of Sweden and Norway, and a resident of Herräng Häfverösund, in the Kingdom of Sweden, have invented certain new and useful Improvements in Furnaces for Calcining and Burning Briquets of Ore and for Similar Purposes, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to improvements for effecting a better utilization of the heat and a more economical procedure in furnaces for calcining and burning briquets of ore and for similar purposes, especially in furnaces where the briquets, piled up on carriages, are carried through an extended furnace-chamber past a gas-combustion room or chamber arranged in the same in which the heat necessary for the calcining and burning process is generated. In furnaces of this class the air for combustion passes through the furnace in a direction opposite to that of the carriages, and after having passed over carriages with burned briquets and having been heated by the said briquets it arrives at the combustion-chamber, into which at the same time combustible gas is introduced.

In the accompanying drawings, which illustrate an embodiment of the invention, Figure 1 is a longitudinal vertical section of the furnace. Fig. 2 is a similar section, on a larger scale, of that part of the furnace where the combustion-chamber is located. Fig. 3 is a plan of the part of the furnace seen in Fig. 2. Figs. 4 and 5 are respectively a vertical and horizontal section, the latter at line 5 5 in Fig. 4, on a large scale, of a cover seen at the extreme right in Fig. 1. Figs. 6 and 7 are respectively a longitudinal and transverse section of the carriages for the briquets. Fig. 8 is a plan view or diagram showing the manner in which the briquets are stacked or placed on the carriage.

1 is the furnace, and 2 is its bottom. Carriages with briquets are introduced at the end 3, which is closed by a sliding counterbalanced door 5, suspended in chains 4 or the like. The said carriages are movable on rails 6, and in the end pieces of the carriage-frames a notch and a tongue, respectively, is provided in such manner that when the carriages bear upon each other in the row filling the whole furnace the frames fit air-tight against each other. From the longitudinal sides of the frames flanges project downward, running in troughs arranged in the furnace longitudinally to the same and filled with sand. By means of the said arrangements, which are all before known by those skilled in the art, the carriages on which a bricklayer is provided for protecting the framework from the heat form, with the bottom 2, a tight channel. The carriages with the briquets are successively moved past the combustion-chamber 7. Combustible gas in necessary quantities is introduced into the said chamber through a channel 8. Combustion-air enters the furnace through a channel 9, passes through the channel mentioned above and formed by the carriages and the bottom 2 to the rear end 11 of the furnace, which end also is closed by a sliding counterbalanced door 10, which turns round the free end of the outermost carriage of the row and then passes over the upper side of the carriages. Consequently the air passing over the hot briquets coming from the combustion-chamber 7 is heated by the same and finally arrives at the said chamber. The products of combustion pass over unburned briquets and leave the furnace through a channel 30 leading to the chimney.

In furnaces of this class hitherto used the combustion of the gas is not so lively as is necessary for creating the necessary intense heat with a moderate consumption of gas, which is the consequence partly of the fact that the combustion-chamber is too long and too great, so that the combustion of the gas takes place in too great a portion of the furnace and the whole great combustion-chamber must be heated to the necessary temperature, partly of the fact that the mixing of the gas entering through the channel 8 and the heated combustion-air is very defective owing to the fact that the said gas and the said air form two parallel currents. The mixing of the gas and the air is all the more defective as the lighter gas-current passes over the heavier air-current. Moreover, the combustion of the mixture is at the cost of intensity extended upon too great a portion of the furnace, and consequently cannot generate the great necessary heat unless great quantities of gas are used. The said disadvantages are prominent especially when gas from a blast-furnace poor in heat units is used, for the lively combustion of which the mixing with the air must be as intimate as possible and effected in a combustion-chamber as hot as

possible, which chamber, besides, must be so arranged that the mixture of gas and air strikes against a heated body of a material which is a bad conductor of heat, as fire-brick. The said disadvantages are removed by shortening the combustion-chamber 7 to about seven feet, corresponding to the length of a carriage, and as in accordance with this invention by introducing an air-current into the combustion-chamber in such manner that it cuts the currents of gas and heated air mentioned above, and thus forces the same into each other, mingling the same. Means for introducing such a mingling air-current is shown in Fig. 1 and in detail in Figs. 2 and 3.

In the roof of the combustion-chamber 7 a slot 12 is provided, extending across the chamber. A box 13 is mounted above the slot. The said box communicates with a fan 15 through a tube 14, which fan preferably sucks the air through a device for the heating of the same described in the following. The air pressed into the combustion-chamber through the slot 12, the quantity of which is adjusted by means of a suitable damper—as, for instance, a plate 16, loosely placed in the box—causes the gas coming from the channel 8 and the air heated by the briquets to mingle, as indicated in Fig. 2. In this figure the dotted line 17 indicates the tops of the briquets placed on the carriages. The briquets stand upright and are arranged in two layers, one above the other. The briquets of the lower layer have an oblique position to the air passing through the furnace. The briquets of the upper layer also have an oblique position, but in a direction opposite to that of the briquets in the lower layer. By the said arrangement (seen in Fig. 8) the main portion of the air is compelled to pass over the briquets. By the mingling operation effected by the air-current coming through the slot 12 and reverberation caused by the wall 18 of the combustion-chamber the combustion will become lively and confined to a smaller space—*i. e.*, it becomes more intense. The intensity of the combustion process is increased also by the well-mixed body of gas and air being forced against the strongly-heated wall 18 of the combustion-chamber. The combustion is greatly facilitated if the air entering through the slot 12 is heated. Such heating is effected according to this invention by a device by means of which the heat of the briquets withdrawn from the furnace is utilized. The said device consists of a cap or cover 19. (See Figs. 4 and 5.) The said cap is suspended in chains 20, running over rollers 21, journaled on uprights 22, the said cap being counterbalanced by means of weights 23. A tube 24 extends upward from the top of the cap and slides in a tube 26, of cast-iron, leading to the fan 15 and provided with a stop-valve or damper 25. The lower end of the tube 26 is of cast-iron and is provided with two inner flanges 27 27, guiding the tube 24 of the cap and tightening against the same. The tube 24 has an outer flange 28, also guiding the tube and forming a tightening means between the tubes. The cap is mounted at the discharge end 11 of the furnace. As a carriage 29 with hot briquets has been moved out of the furnace the cap is pulled down and placed over the briquets, so that it incloses the body of briquets by its side and end walls, and the roof of the cap rests upon the briquets or is at a short distance from the same. The side and end walls of the cap are so adapted that they do not reach to the frame of the carriage or the brickwork on the same when the cap is lowered, a slot of suitable width being left between the brickwork and the bottom edge of the cap. Consequently the air is sucked through the said slot, passes between the briquets, and finally arrives strongly heated into the tube 24, then passing through the tubes 26 14 and into the combustion-chamber 7. After the cooling of the briquets the damper 25 is shut and the cap 19 is pushed upward. A carriage with hot briquets having been again withdrawn, the same proceeding is performed as recently described. If in a plant with two or more furnaces the tubes 26 belonging to the same communicate, the running of the furnaces can easily be so regulated that a carriage with briquets always is being subjected to the cooling operation. In this manner the variations of the temperature of the heated air entering through the slot 12 are reduced.

In addition to the heating of the air by the briquets the advantage of a more lively oxidation of the briquets and cooling of the same is gained, which imparts to the briquets a considerably greater strength, the unloading of the briquets and the following treatment of the same being thus facilitated, as the briquets have been found to be stronger when in a cooled condition than in the heated one.

If the highest possible temperature of the air passing over the briquets, as well as of the air entering through the slot 12 is aimed at, it may be effected by increasing the length of the portion of the furnace in which the briquets are preheated—*i. e.*, from the charging end 3 to the combustion-chamber 7—while the length of the cooling portion is substantially the same as hitherto. By such an arrangement the speed of the carriages can be increased, so that carriages may be introduced into the furnace more frequently, while they will still remain in the preheating portion of the same for as long a period as hitherto. The period during which the carriages with burned briquets are in the cooling portion is, on the other hand, decreased. Owing to this fact, the air coming from the channel under the carriages will meet directly hot briquets and is consequently heated to a

higher temperature. There is, moreover, in the briquets when removed from the furnace a greater quantity of heat left, which is utilized in the manner stated above. Owing to these facts, the following advantages are gained: first, an increased production; second, a decreased consumption of gas; third, a more complete oxidation of the briquets; fourth, a more intense heat in the combustion-chamber and in consequence thereof a more reliable removal of the sulfur when necessary; fifth, in consequence of the great quantity of air which is sucked by the fan between the briquets on the carriage subjected to the cooling operation, and consequently come in more intimate contact with the heated briquets than the air passing through the furnace, the greatest portion whereof passes over the briquets, owing to their position on the carriages mentioned above, the disadvantage of an eventual dissociation of peroxid of iron—*i. e.*, loss of oxygen—caused by a high temperature for the removal of sulfur, for instance, will be perfectly eliminated, and, sixth, owing to the fact that the temperature of all the combustion-air is higher than hitherto it is possible to use gas poorer in heat units than gas hitherto employed.

According to the above description the air heated by the briquets under the cap is used exclusively in the furnace for the purpose stated. Evidently, however, a portion of the air or the whole quantity of air may be used, or its heat may be utilized also for other purposes—as, for instance, the heating of storehouses, for wet concentrates, and the like. The arrangements shown and described may be modified in many respects without exceeding the limits of this invention—as, for instance, a plurality of slots or openings, such as 12, may be employed. The invention has been described above as applied to furnaces for calcining and roasting briquets of ore. It may, however, be applied also to other furnaces for similar purposes.

The means whereby the carriages which fill the length of the furnace form a tight or substantially tight channel beneath or below them will be seen in Figs. 6 and 7. In Fig. 6, 31 is the tongue on the end of one carriage 29, engaging a notch or recess 32 in the other end of the next carriage 29. Each carriage will be provided at one end with a tongue 31 and at the other end with a recess 32. Fig. 7, which illustrates only one of the two like sides of the carriage, shows a pendent flange 33 on the frame of the carriage dipping into a trough 34 containing sand. In Fig. 8, *b* designates the briquets.

I am aware that in certain kinds of reheating (welding) furnaces blast-pipes are used at an angle to the gas-current and serve exclusively for the combustion of the gas, and for that reason I do not claim such a blast device broadly.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A furnace for the purpose specified, having an elongated main chamber, a combustion-chamber opening into said main chamber at its upper part, an inlet in the upper part of the main chamber for a combustible gas, means for compelling the flow of a current of combustion-air along the roof of said main chamber past said gas-inlet and to the combustion-chamber, and means for injecting into the combustion-chamber, at an angle to the axis of the main furnace-chamber, a current of aeriform fluid for effecting the proper mixing of the combustion air and gas.

2. A furnace for the purpose specified, having a combustion-chamber 7, provided with inlets for currents of combustible gas and air, and with an inlet 12 for aeriform fluid under pressure, means for compressing said fluid and supplying it to said inlet 12, the path of which inlet is disposed at an angle to the paths of said currents of combustible gas and air, a cap 19 adapted to be placed over the hot briquets withdrawn from the furnace, and a conduit connecting said cap with the induction side of the fluid-compressing means.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

FILIP JOHN BERGENDAL.

Witnesses:
ERNST SVANQUIST,
ROBERT APELGREN.