(No Model.) 3 Sheets—Sheet 1.

B. F. TAYLOR.

METHOD OF AND APPARATUS FOR PROMOTING COMBUSTION.

No. 546,259. Patented Sept. 10, 1895.

Fig. 1.

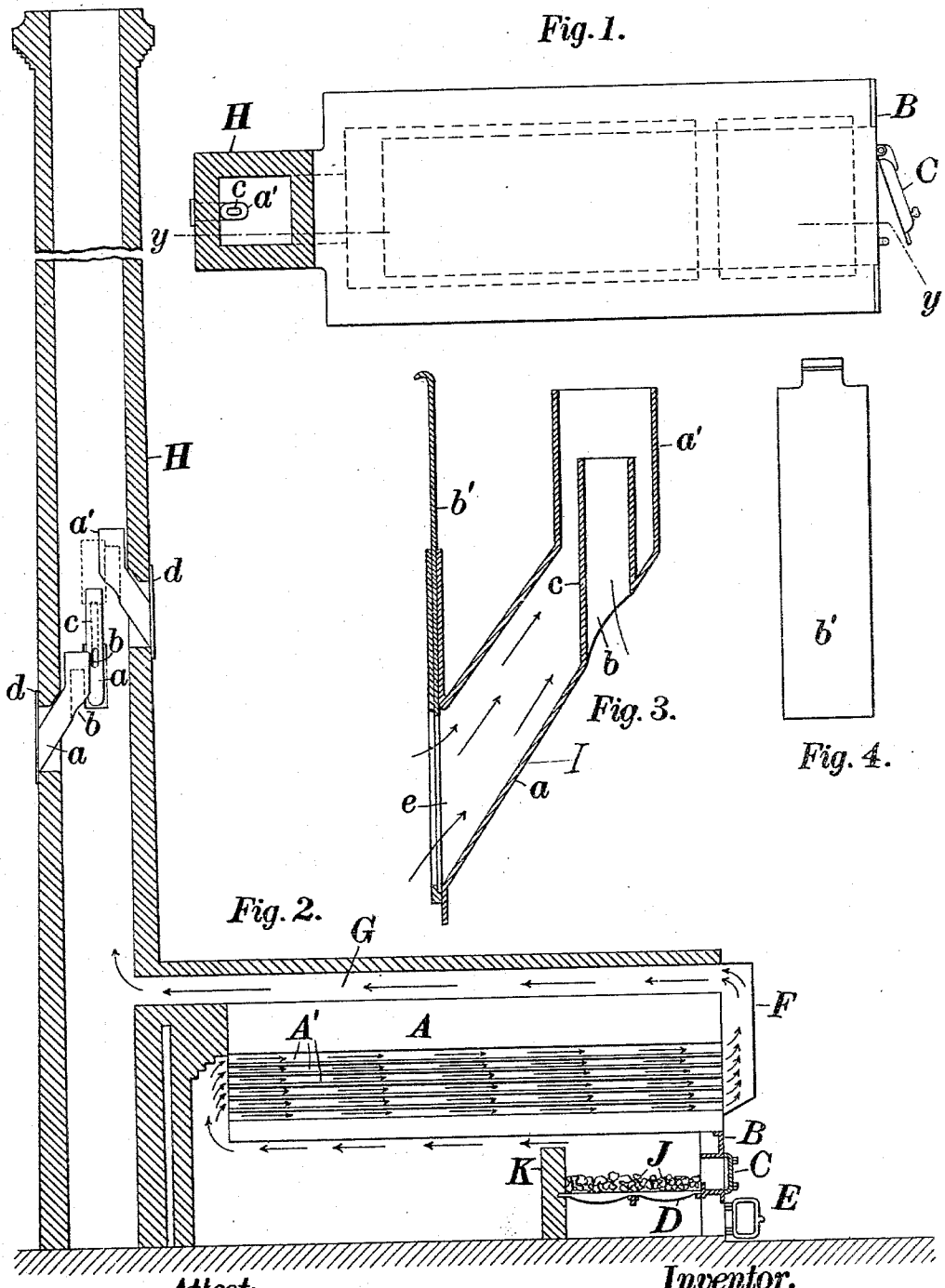

Fig. 2.

Fig. 3.

Fig. 4.

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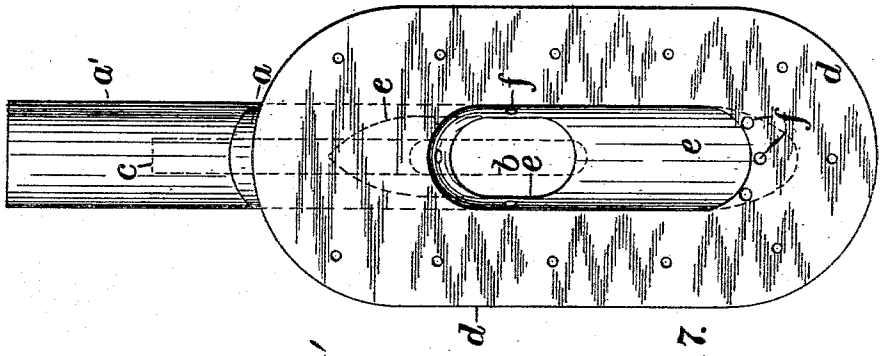

Fig. 7.

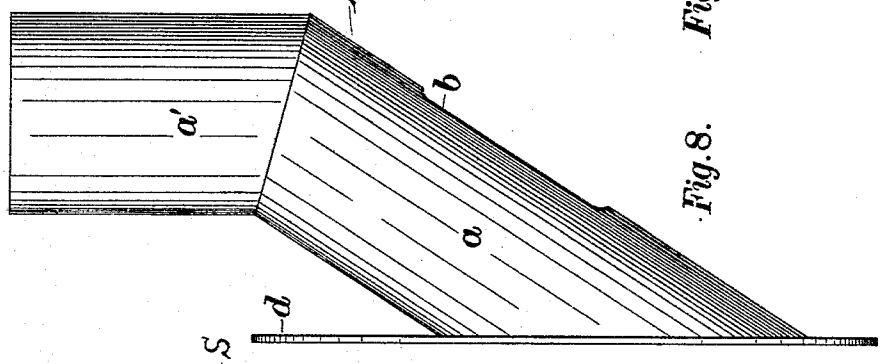

Fig. 8.

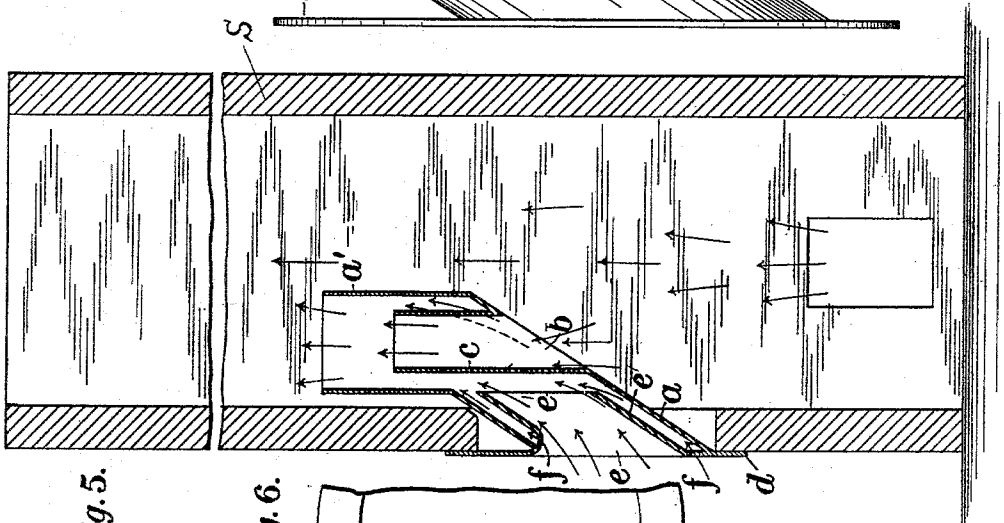

Fig. 5.

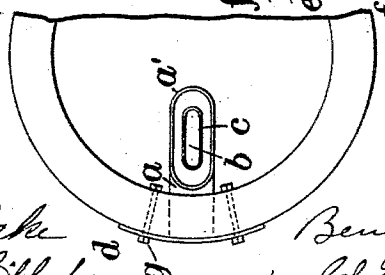

Fig. 6.

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Fig. 12.

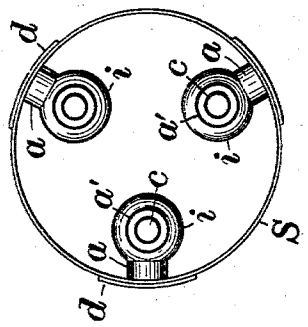


Fig. 10.

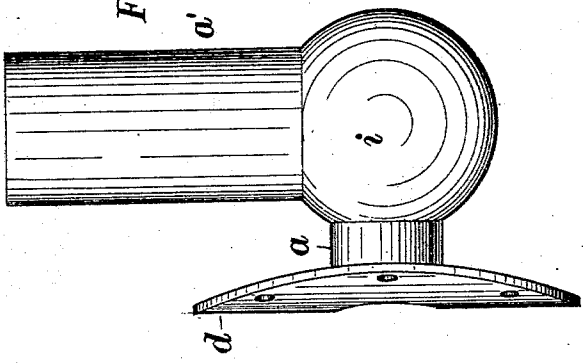


Fig. 11.

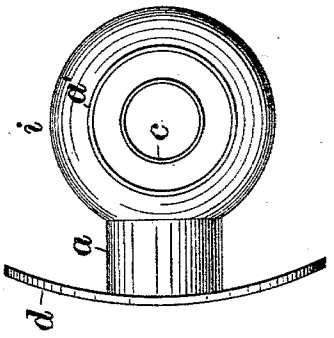
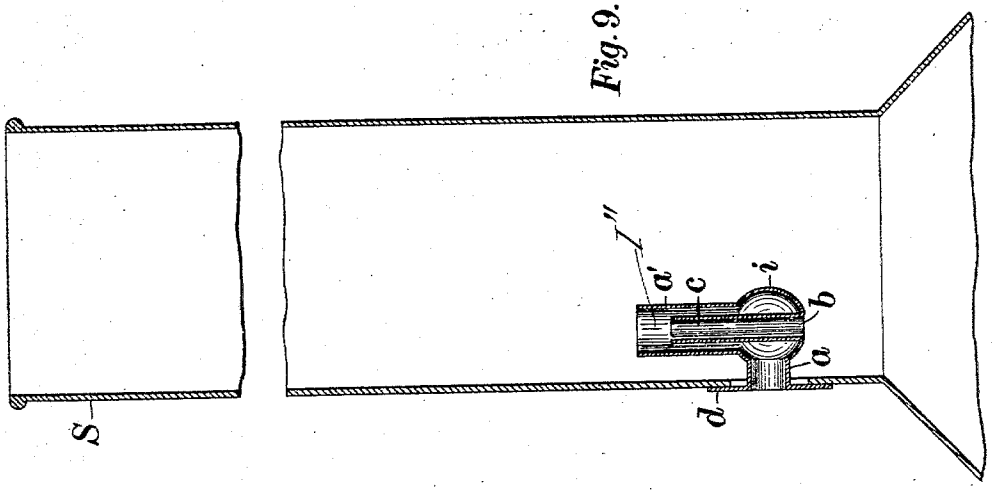


Fig. 9.



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UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR PROMOTING COMBUSTION.

SPECIFICATION forming part of Letters Patent No. 546,259, dated September 10, 1895.

Application filed March 30, 1895. Serial No. 543,812. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN F. TAYLOR, a citizen of the United States, residing in the city of Newark, county of Essex, and State of New Jersey, have invented a new, useful, and Improved Method of and Apparatus for Promoting Combustion, &c.; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it pertains to make and use the same.

That part of my invention which constitutes a method relates to the combustion of fuel, and its object is to insure the oxidation of the combustible gases, which, as is well known, constantly escape from the combustion-chambers of all furnaces without being consumed.

The structural features of my invention relate to furnaces, my aim having been to produce not merely an apparatus for performing the aforesaid method, but a simple and inexpensive device which may be applied to existing furnaces without changing their structures, and which will, when thus applied, cause these furnaces to operate in accordance with the principles of my invention.

The method, generally stated, consists in removing the products of combustion so as to relieve gases which are within the region of igniferous temperatures of the weight of said products, and in supplying to the combustible elements a measured or restricted supply of air.

The apparatus, in its broad aspect, consists of a natural-draft furnace provided with a suitable air-feeder situated at some proper point between the combustion-chamber and the top of the stack and adapted to force the escaping gases upward, so as to maintain a good draft even when the ash-pit doors are partially closed.

It is a well-known fact that if the draft-doors are open far enough to permit atmospheric pressure to have its full or a proper effect upon the mobile matter within a furnace, excessive quantities of air will be supplied to the combustion-chamber; and that, on the other hand, if the said doors are so nearly closed that they will admit, at normal velocity, just the quantity of air that is needed for the purposes of combustion, the effect of atmospheric pressure and the consequent velocity of the air-current will be so greatly reduced that it will be impossible to maintain an adequate supply of air.

Atmospheric pressure is capable of doing a certain and fixed amount of work when permitted to exert itself in the direction of a place of given low pressure, and the work done, when considered with reference to a given quantity of air flowing to the place of low pressure, produces a maximum velocity in such current when there are no interposed obstacles to retard the flow. The size of an air-opening determines the factor of retardation, while the pressure within the air-opening varies the resistance. A lowering of the resistance effectuates a higher velocity and an increased flow of the air-current, because atmospheric pressure has then less work to do in forcing a given quantity of air through the opening. I propose for this reason to lessen the work to be done by atmospheric pressure at the draft-doors of a furnace, and this I accomplish by applying atmospheric pressure to the mobile matter at another point of the apparatus, so that the heavy gases beyond the combustion-chamber will be lifted out of the stack and thus exert little or no downward pressure upon the gases within the combustion-chamber. By pursuing this plan I am enabled to so regulate the supply of air to the combustion-chamber that excessive quantities of oxygen and nitrogen do not have to be heated by the igneous fuel.

The details of the invention are hereinafter fully described, and clearly pointed out in the claims.

Referring to the drawings, which illustrate the apparatus, Figure 1 is a plan view of a furnace and stack with one form of my attachment in position. Fig. 2 is a vertical sectional view of the same furnace, on the line *y y*, Fig. 1. Fig. 3 is a vertical sectional view of one form of my air-supplying device. Fig. 4 is a perspective view of one form of damper or slide to be used in connection with the device. Fig. 5 is a vertical sectional view of a stack with a modified form of air-supplying device attached thereto. Fig. 6 is a plan view of the stack and air-supplying device shown

in Fig. 5. Fig. 7 is a face view of the air-supplying device detached and enlarged. Fig. 8 is a side view of the device shown in Figs. 5 to 7. Fig. 9 is a sectional view of a stack with still another form of air-supplying device in position. Fig. 10 is a perspective view of the attachment shown in Fig. 9. Fig. 11 is a plan view of the attachment shown in the two preceding figures; and Fig. 12 is a plan view of the stack shown in Fig. 9, with three of the attachments in position.

Referring to Figs. 1 to 4, inclusive, the character A designates an ordinary return-flue boiler provided with the usual flues A′ and G. F is a breeching connecting the flues A′ and G. B designates the front of the furnace, which is provided with the ordinary fuel-door C and ash-pit door E. D designates the grate within the furnace upon which is supported the fuel J. K represents the bridge-wall usually found in such furnaces. H designates a stack with which the flue G connects. Openings are arranged in the side of this stack for the introduction of my air-supplying devices.

Referring in detail to that form of air-supplying device shown in Fig. 3, I represents the structure as an entirety. It is composed of a tube *a* and a tube *a′*, so arranged as to form a continuous channel, the tube *a* communicating with the atmosphere and thereby forming a channel *e*. A plate *b′* is arranged to slide over the end of the tube *a*, so as to regulate the size of the passage *e* and thereby control the amount of air flowing through the feeder. A tube *c* is arranged inside of the tube *a′* and is provided with an opening *b* in its bottom, thus forming communication with the interior of the stack, so that a certain amount of the products of combustion will pass up through such tube. The tube *c* should terminate below the top of the tube *a′*, whereby a chamber is formed wherein those portions of the furnace-gases which enter the hole *b* are mixed with the atmospheric air which flows into the tube through the passage *e* in the side of the stack. These devices may be modified more or less in form, and two additional forms are illustrated herein, namely: that shown in Figs. 5 to 8, inclusive, and that shown in Figs. 9 to 12, inclusive. Referring to the figures which illustrate the first of these two modifications, S, in Fig 5, designates a stack of ordinary construction to which the attachment I′ is applied. The same reference characters are used in these figures to designate parts corresponding to those shown in Fig. 3. *a* designates the tube communicating with the atmosphere, and *a′* the vertical tube communicating therewith and arranged on the interior of the stack. *c* represents the smaller internal tube communicating with the stack and discharging into the tube *a′*, thus forming an opening *b* for the products of combustion to pass through. A flange *d* is provided to rest against the outer surface of the chimney, by which the attachment may be secured in position, as by bolts *g*, shown in Fig. 6. A tubular shield or nozzle *e′* is arranged to extend from the flange *d* into the pipe *a*, nearly to the side of the tube *c*. Holes *f* are arranged in the outer end of the nozzle *e′* to admit air between the nozzle and pipe *a*.

In Figs 9 to 12, inclusive, S designates a stack of ordinary construction, and I″ the attachment applied thereto. In this modification the character *a* designates a short horizontal pipe opening into the outer air and communicating with a bulb *i*, arranged within the stack. To this bulb *i* is attached a tube *a′*, open at both ends and thus forming communication between the bulb and the interior of the stack. The bottom of the bulb is perforated, and a tube *c* is arranged therein and extends up into the tube *a′* and nearly to the top thereof, forming an opening *b* for the products of combustion to pass therethrough. In this modification, also, *d* represents a flange arranged on the exterior of the stack, by means of which the air-supplying device is secured in position.

The action of each of the air-supplying devices which I have shown and described is like that of an injector. The atmospheric pressure outside of the stack is greater than the pressure of the rarified gases within the stack, and the outer air has, therefore, a preponderating force which compels it to seek the interior of the stack in the form of a current of considerable velocity, which current by inductive action entrains certain portions of the gases within the stack and forces them to leave the stack through the outlet at the top thereof. The inductive action is enhanced by the presence of the pipe *c* in each one of the several air-supplying devices. This pipe *c*, being in each instance shorter than the pipe *a′*, which constitutes the discharge-end of each of the air-supplying devices, there is a mixture of air and products of combustion in the said discharge end. The effect of this mixture is to prevent the air-current from continuing as a distinct current and escaping from the stack without doing the work of removing products of combustion. Of course certain portions of the products outside of the air-supplying device are entrained by the mixed current of air and products just referred to, and in this way there is produced an additional effect in respect to the removal of products of combustion from the top of the stack. The prime function of the air-supplying devices will thus be seen to be the removal of products of combustion from the upper portion of the stack, whereby there is a lessening of the work, which in furnaces of ordinary character has to be wholly accomplished by atmospheric pressure exerted through ash-pit doors or other and equivalent feed-openings for air—that is to say, the air-supplying devices, considered in their broadest aspect, are means for lifting out of the stack the upper portions of the gases therein; and, since a portion of the column of

gases within the stack and the combustion-chamber of the furnace weighs less than the whole column, it is obvious that the positive removal of a portion of the column in the manner specified will lessen the pressure at the base of the column which is within the combustion-chamber, and thereby reduce the force which is required to cause atmospheric air to enter said chamber. Since, however, atmospheric pressure is sustantially constant, the result will be an increase in the quantity of air admitted to the combustion-chamber; but an increased quantity of air is not desired, because an excessive quantity of nitrogen and oxygen means an increase in the quantity of heat-units absorbed by these gases and wasted by being carried from the apparatus through the stack. In order to obviate this difficulty the ash-pit doors or other feed-openings for air are closed to a considerable extent, so that the quantity of air supplied to the combustion-chamber at the new or higher velocity will be restricted to the amount which will give to the combustible elements the approximate or exact number of atoms of oxygen which combustion demands. This result cannot be accomplished where all the atmospheric pressure which causes the flow of gases through the furnace and stack is applied at the ash-pit doors, it being true, as experience has demonstrated to those who are familiar with the operation of furnaces, that the ash-pit doors of ordinary furnaces cannot be regulated so as to admit just the volume of air required for purposes of combustion and at the same time permit the action of atmospheric pressure that will effectuate a proper flow of products from the apparatus.

The ash-pit doors may, when my devices are in operation, be regarded as means for measuring the air which is used for the purposes of combustion, because the ash-pit openings are at such time deprived of their usual and principal function of permitting atmospheric pressure to move the column of gases in accordance with the well-known method of producing draft.

As above indicated, the furnace is of a very ordinary construction. I have made no change therein except to add the air supplying and forcing devices just referred to, and yet it has been demonstrated in practice and by scientifically conducted experiments that this simple addition produces a surprising economy of fuel.

The air-feeding devices must be situated so far away from the furnace that they will not operate to produce secondary combustion. The best results have been attained by placing the devices in a staggering position, from two to three feet one above the other, and at an average height of a little less than one-third the distance between the uptake and the top of the stack, so that they will not impair the velocity of the upward-going column. The amount of air to be admitted to the chimney varies with the heat of the escaping gases and with the velocity with which they ascend, as well as according to the difference in the kinds of coal used, since I have found that the draft-pressure varies according to the differences in chemical composition of the coals as well as according to the degree of heat with which the escaping gases make their exit from the furnace. The pressure within the combustion-chamber being lessened by the lifting of the upper portion of the column of escaping gases, diffusion of the air and combustible gases within the furnace is enhanced and a better and more economical combustion thereby obtained, it being a well-known law that gases diffuse more rapidly under low than under high pressures.

The operation of my invention can perhaps be explained by giving an illustration. Take a plant with a chimney ninety feet in height, close the ash-pit doors, and the ascending column of escaping gases leaving the furnace moves very slowly, and if the ash-pit doors are left closed long enough the fire will die down. Now, insert the device in the manner heretofore described. Immediately the necessary supply of air will be conveyed into the chimney, and the injector-like action or spiral motion produced in the column of air above the air-feeder will act like a suction on that portion of the escaping gases below the air-feeder and on the fire in the furnace. The ash-pit doors, being further closed during this operation, the gases formed by the distillation of the fuel will be consumed before they can be carried away. The chimney proper virtually terminates just below the the air-inlets and the portion above, including the air-inlets or devices, unites and may be considered as an appliance for removing products of combustion by suction.

Having thus fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The method of promoting combustion which consists in removing products of combustion so as to relieve gases which are within the region of igniferous temperatures of the weight of said products, and in supplying to the combustible elements a measured or restricted supply of air, substantially as described.

2. The method of promoting combustion which consists in positively removing products of combustion which have passed beyond the region of igniferous temperatures, so as to relieve gases still remaining within said region of the weight of said products, and in supplying to the combustible elements a measured or restricted quantity of air, substantially as described.

3. The method of promoting combustion which consists in removing products of combustion which have passed beyond the region of igniferous temperatures by means of a blast, so as to relieve gases still remaining within said region of the weight of said products, and in supplying to the combustible

elements a measured or restricted quantity of air, substantially as described.

4. The method of promoting combustion which consists in removing products of combustion which have passed beyond the region of igniferous temperatures by means of a blast of air, so as to relieve gases still remaining within said region of the weight of said products, and in supplying to the combustible elements a measured or restricted quantity of air, substantially as described.

5. The method of promoting combustion which consists in removing products of combustion which have passed beyond the region of igniferous temperatures by means of a blast of air produced by preponderating atmospheric pressure, so as to relieve gases still remaining within said region of the weight of said products, and in supplying to the combustible elements a measured or restricted quantity of air, substantially as described.

6. The combination with a natural draft furnace and stack of means for lifting or removing products from the top thereof, and means for restricting or measuring the supply of air to the combustion chamber of the furnace, substantially as described.

7. The combination with a natural draft furnace and stack of an injector for lifting or removing products from the top thereof, and means for restricting or measuring the supply of air to the combustion chamber of the furnace, substantially as described.

8. The combination with a natural draft furnace and stack of an atmospheric injector for lifting or removing products from the top thereof, and means for restricting or measuring the supply of air to the combustion chamber of the furnace, substantially as described.

9. The combination with a natural draft furnace and stack of an atmospheric injector and smoke and air mixer for lifting or removing products from the top thereof, and means for restricting or measuring the supply of air to the combustion chamber of the furnace, substantially as described.

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