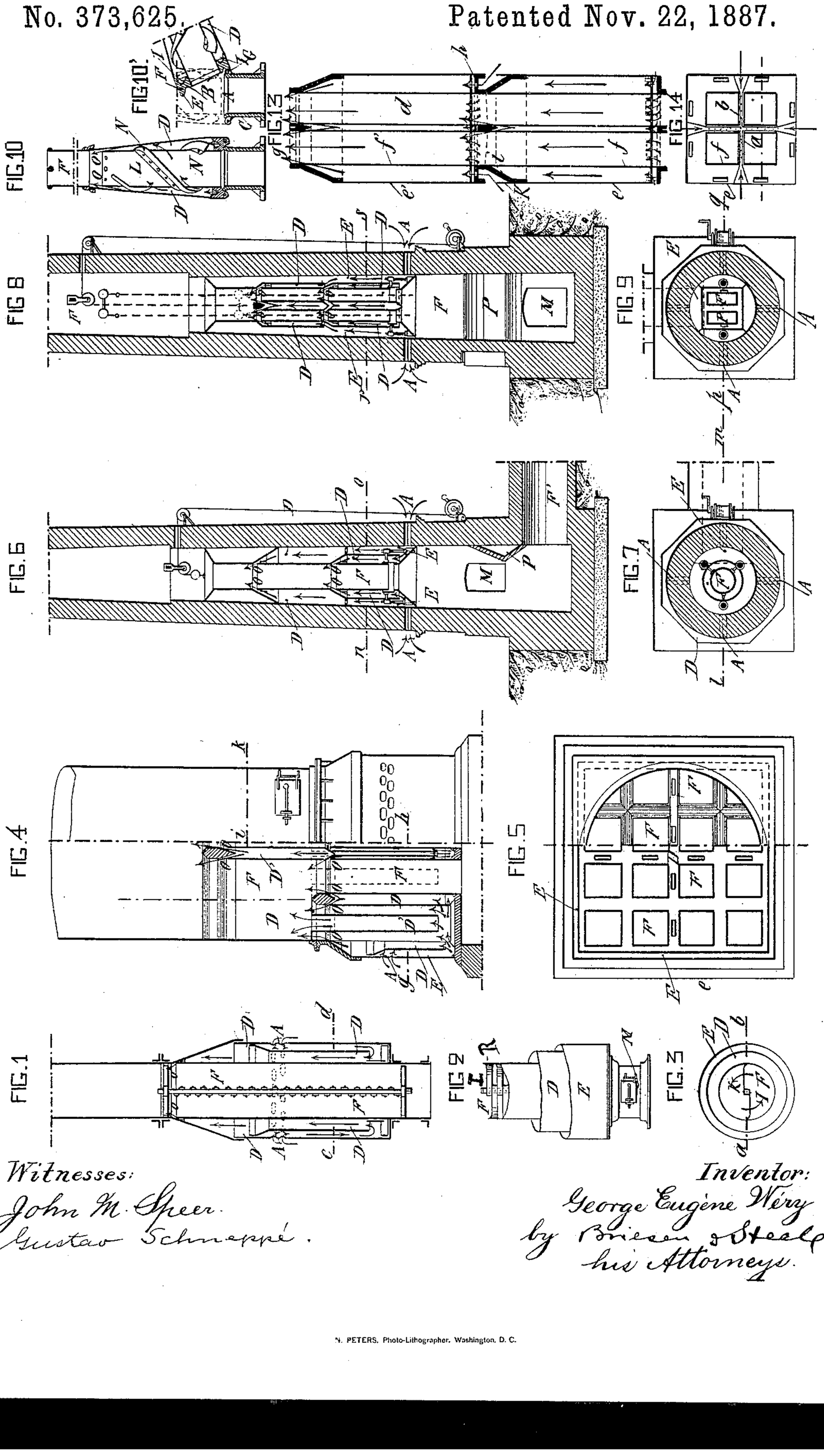
(No Model.) 2 Sheets—Sheet 1.

G. E. WERY.

SMOKE CONSUMING FURNACE.

No. 373,625. Patented Nov. 22, 1887.



Witnesses:
John M. Speer.
Gustav Schmeppé.

Inventor:
George Eugène Wéry
by Briesen & Steele
his Attorneys.

(No Model.) 2 Sheets—Sheet 2.

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FIG. 16

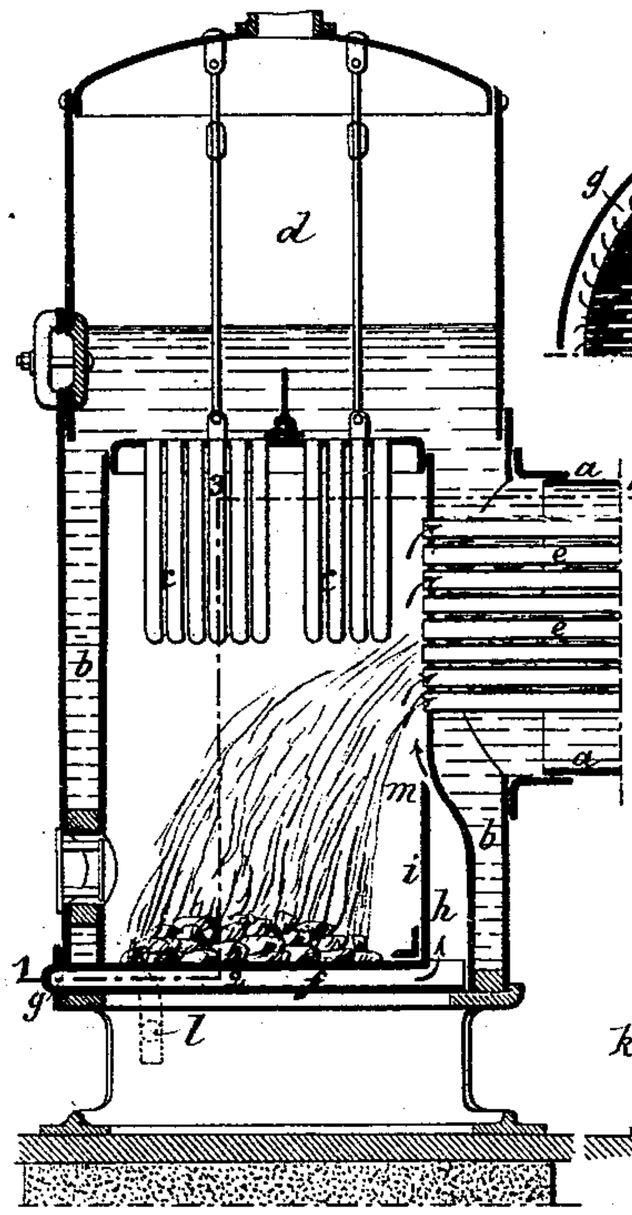


FIG. 17

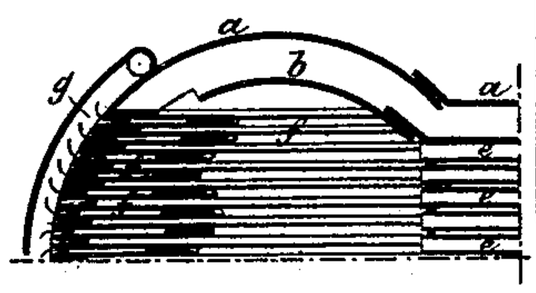


FIG. 18

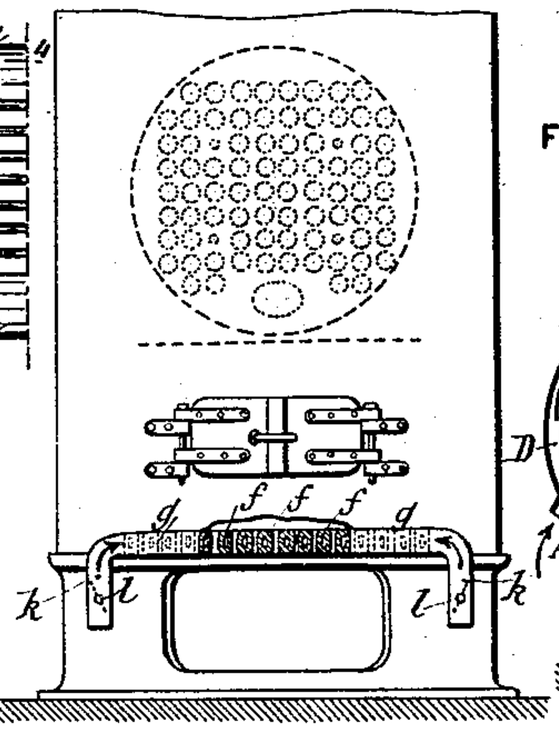


FIG. 21

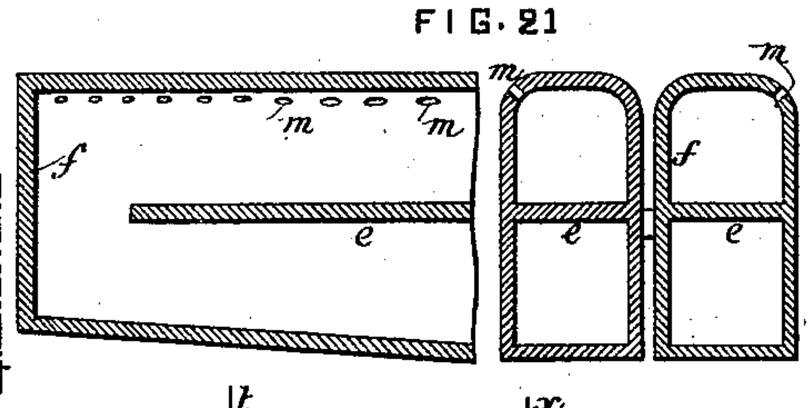


FIG. 11

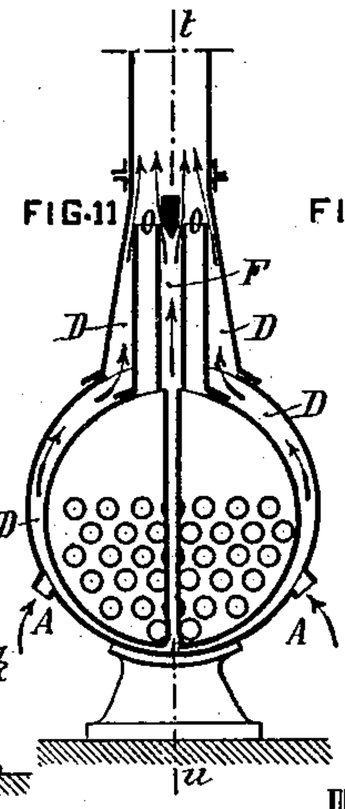


FIG. 12

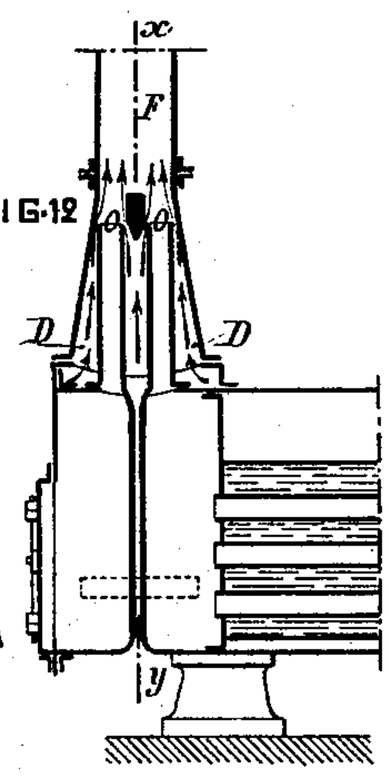


FIG. 19

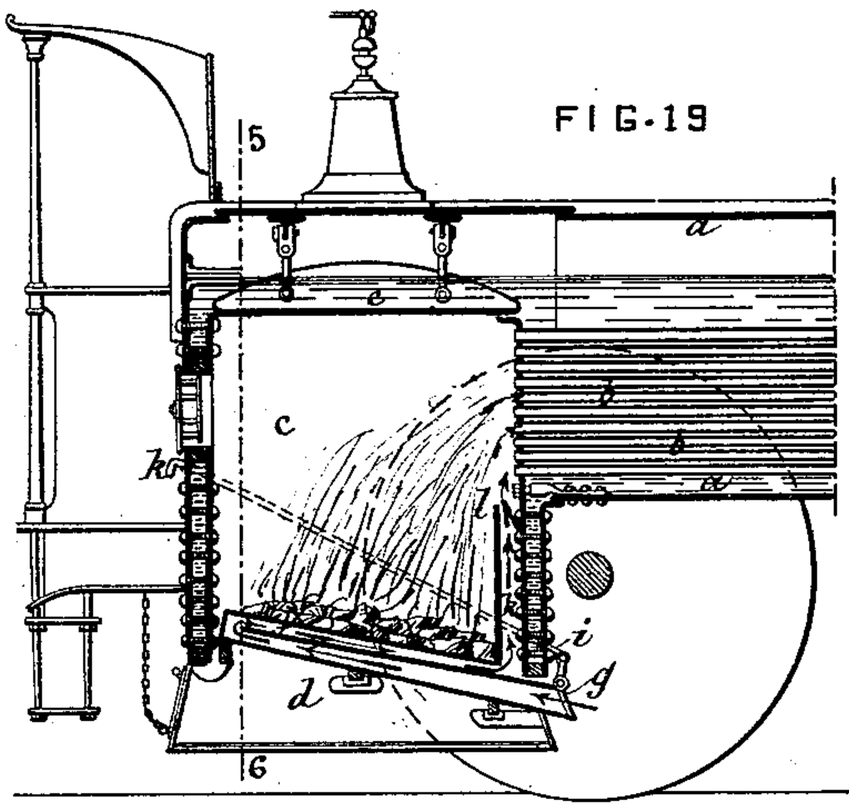


FIG. 20

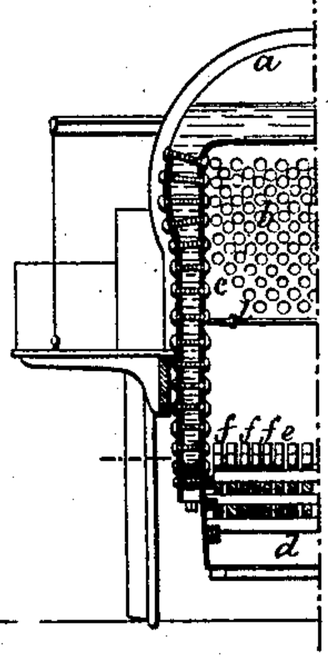
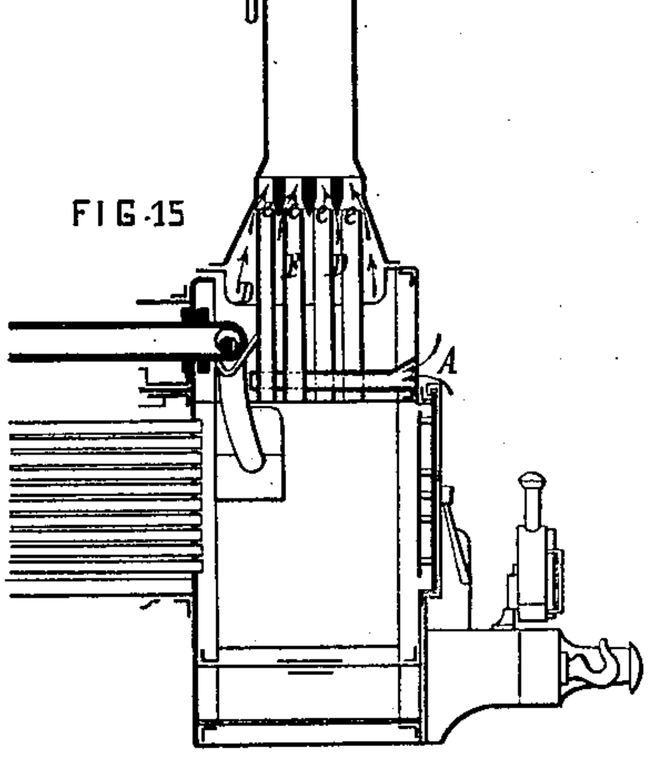


FIG. 15



Witnesses:

John M. Speer.
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Inventor:

George Eugène Wéry
by Briesen & Steele
his Attorneys.

UNITED STATES PATENT OFFICE.

GEORGE EUGENE WERY, OF PARIS, FRANCE.

SMOKE-CONSUMING FURNACE.

SPECIFICATION forming part of Letters Patent No. 373,625, dated November 22, 1887.

Application filed September 22, 1886. Serial No. 214,215. (No model.) Patented in France September 7, 1885, No. 171,063.

To all whom it may concern:

Be it known that I, GEORGE EUGENE WERY, of the city of Paris, France, have invented a new and Improved Smoke-Consuming Furnace, of which the following is a full, clear, and exact description, and for which I have obtained a patent in France, September 7, 1885, for fifteen years, No. 171,063.

This invention has for its object to effect the more perfect utilization of the combustible gases in furnaces generally, including those of stationary, locomotive, portable, and marine engine boilers, as well as domestic fire-places, by the introduction of air into the chimney or furnace in regulated quantity, the invention including the arrangements by which the air is distributed in a rational manner upon the surfaces on which it is to act.

The results obtained by this invention are, first, perfect consumption of the smoke; second, considerable saving in fuel in consequence of the more perfect combustion and a better utilization of the gases, and, third, when the air is introduced into the furnace itself the air is passed through bars of special form, whereby the preservation of the grate is insured.

In order that the invention may be more readily understood, I will proceed to describe examples of its application, with reference to the accompanying drawings, which show the particular arrangements adopted for each kind of furnace, and which are based on the following principle: The air is drawn from the exterior by the draft resulting from the difference between the external and internal temperature of the chimney or furnace, the air being first heated by contact with the walls of the passages, and then being drawn therethrough and caused to mingle with the hot gases. The air thus introduced produces a mechanical action, the effect of which is to carry off the lighter gases completely burned, and to retard the escape of the heavier gases yet unconsumed, which remain in suspension in the furnace until their complete combustion is effected. In this manner combustion of smoke is effected by the carrying off of none but the lighter gases completely burned, and a considerable saving of fuel is obtained by the retention of the heavier gases, whose complete combustion is thus secured.

In the drawings, Figure 1 is a vertical central section of a chimney constructed according to my invention. Fig. 2 is an elevation of same, partly broken away; and Fig. 3 is a plan view thereof. Fig. 4 is an elevation, partly in section, of the chimney of a marine-engine boiler; and Fig. 5 is a horizontal section of the same. Fig. 6 is a central vertical section of a factory-chimney constructed according to my invention. Fig. 7 is a horizontal section of the same on the line *n o*, Fig. 6. Fig. 8 is a central vertical section of a chimney of larger diameter than shown in Fig. 6, having my improvements applied. Fig. 9 is a horizontal section of the same on the line *p s*, Fig. 8. Figs. 10 and 10′ are vertical central sections of house-chimneys embodying my improvements. Fig. 11 is a vertical cross-section of a steam-boiler having my invention applied. Fig. 12 is a vertical longitudinal section of part of said boiler. Fig. 13 is a vertical central section of an arrangement of my invention for chimneys of large diameter. Fig. 14 is a horizontal section of the same. Fig. 15 is a vertical longitudinal section of part of a boiler embodying my improvements. Fig. 16 is a vertical section of the furnace of a horizontal stationary boiler embodying my improvements. Fig. 17 is a horizontal section taken on the line 1 2 3 4, and Fig. 18 an end elevation of the same. Fig. 19 is a vertical longitudinal section of a locomotive-furnace embodying my improvements. Fig. 20 is a vertical section of the same, taken on the line 5 6; and Fig. 21 is a horizontal and transverse section of a pair of grate-bars, drawn on a larger scale.

In the arrangement shown in vertical section, elevation, and plan in Figs. 1, 2, 3, the air drawn in at the orifices A in the external casing of the chimney first passes down the external annular space, E, between the double walls of the casing, and then up through the internal annular space, D, and escapes at O into the chimney at a very high temperature, and therefore at a considerable pressure. The inner pipe, F, may be made vertically adjustable in any suitable manner for the purpose of increasing or reducing the area of the aperture, and thus regulating the admission of the external air. The external surface of chimney F being in contact with the air introduced at a relatively-low temperature, and the internal

surface being licked only by the gases of combustion which are not yet mixed with the air introduced, there would be throughout the entire length of this tube F a less perfct combustion than at the upper part at which the air acts, and a considerable quantity of soot would consequently be liable to collect upon the inside surface of the chimney, which would prevent the transmission of heat, and therefore diminish to a corresponding extent the temperature of the air introduced and the rate at which it passes into the chimney. To obviate this objection a shaft, T, provided with blades R, is placed in the chimney F for the purpose of scraping the sides thereof, so as to cause the soot to fall to the bottom, whence it is removed at a door, M, provided for the purpose.

The same principle may be applied to the chimneys of marine-engine boilers, the arrangement adopted being that represented in part-sectional elevation and horizontal section in Figs. 4 and 5. The air in these figures takes the same direction as in Figs. 1, 2, and 3, entering at the orifices A, traversing the annular space E, and then through the several annular spaces D until it reaches the chimney. As, however, the total sectional area of the chimney would be very considerable, and the air would naturally tend to pass through the passages nearest to the air-inlet, the central flues might receive an insufficient quantity of air for the proper working of the apparatus. To obviate this supplementary air-passages D', opening near the base of the chimney, are placed within the flues D, and are so arranged and distributed as to create a strong draft and cause the air to be distributed uniformly in all the passages D. The air, as in the preceding arrangement, on leaving passages D, enters the chimney through the annular orifice O. The flues F may be cleaned out in the same manner as in the previous arrangement and with a similar object.

The arrangement preferably employed for the factory-shafts is shown in Figs. 6 and 7 as applied to an ordinary chimney and in Figs. 8 and 9 as applied to a chimney of larger diameter. The principle is the same as before; but in this case a series of cylindro conical superposed tubes are employed. The action is exactly the same as in the previous cases, and therefore needs no further description. It should, however, be added that in order to regulate the draft—that is to say, the area of the orifices O—adjusting-screws are employed, by which the pipe F may be raised or lowered for increasing or reducing the size of the orifice, as desired. The cleaning is effected by means of a pulley and chain worked from the base of the chimney, the operation being repeated more or less often, according to the quality of the fuel employed.

In order that the hot gases arriving from flue F' may pass direct to the center of the chimney F, a sort of bridge, of refractory material, P, is placed at the mouth of said flue, which diverts the course of the gases and causes them to take the direction desired. The same arrangement may be applied to chimneys of large diameter—such as represented in Figs. 8 and 9—and in order to distribute the current of air over its whole area one or more central draft-tubes D', similar to those for the chimneys of marine boilers, may be employed.

M are doors for cleaning out the flues.

Figs. 10 and 10' represent an arrangement specially adapted to house-chimneys, and in order in this case that the air may enter the chimney at a sufficiently-high temperature its contact with the heated inner wall of the annular space D is prolonged as much as possible by a spiral rib, N, formed upon the tube L, and extending to the external wall of the annular casing D. The air entering the annular space D thus takes a spiral course and escapes, as in the preceding arrangements, at the annular orifice O, where it becomes mixed with the hot gases and produces the upper draft.

C is a tubular cast-iron socket which is let into the brick-work in the place of the chimney-pot. The pipe may be hinged at its bottom end, G, so as to enable it to be lowered down.

Figs. 11 and 12 illustrate the application of the invention to the chimney of a portable or locomotive engine. In this case the smoke-box itself forms the inner wall of the annular space D, into which the external air is admitted through the openings A. The external envelope of the annular space D is formed by a metal casing placed eccentrically in the smoke-box. The air in escaping from space D, where it becomes heated, passes, as before, through the orifice O into the chimney and increases the draft at the upper part. In this case the arrangement represented in Fig. 15 may also be employed, wherein the air enters at A into a passage above the smoke-box, whence it is uniformly distributed by means of vertical flues D to the chimney and produces the effect above mentioned. In this, as in the other applications, the passage for the gases or smoke may be divided into any suitable number of compartments, and tubes may also extend from top to bottom of the fire box, which take in air from the exterior and serve as feeders for distributing the air to the compartments, suitable dampers being also provided to increase or moderate the draft of the furnaces. It is essential in all cases that the air should be introduced at as low a temperature as possible compared with the gases in the chimney, so that it may expand as much as possible, and thus produce a more considerable effect.

For chimneys of large diameter it is of advantage to employ the arrangement represented in vertical section in Fig. 13 and in horizontal section in Fig. 14. The chimney is divided into four compartments by vertical division-plates *a*, having perforations *b*, communicating with the outer air by channels *c* at their lower ends. The channels *b* conduct the air, heated by contact with the surfaces, into

the intermediate space, *d*, where it acts on the gases in the manner before explained. The chimney is provided with a double casing, *e f*, between which, also, the air enters at the lower end and passes out through the inclined passages *i'* into the chimney. The casing *e* is provided with a conical top, *k*, forming, with the casing *f*, a crown, *i*, which admits of air being introduced from the outside and of its circulating between the two casings *e' f'*, whence it passes to the upper part, *g*, of the chimney, to there effect the complete extraction of the lighter gases and enable the combustion of the heavy gases to be completed.

In order to preserve the grate-bars, while at same time effecting the complete combustion of the gases, produce a higher temperature, economize fuel, and consume the smoke, the arrangements represented in Fig. 16 and following figures are employed, which are applicable to the grates of all kinds of furnaces, such as metallurgical, boiler, locomotive, and other furnaces.

In Figs. 16, 17, and 18, *a* is the boiler shell; *b*, the fire-box; *c*, pendent water-tubes; *d*, the steam-dome, and *e* the boiler-tubes. The fire-grate has hollow bars *f*, which communicate at one end with a pipe, *g*, curved to the circular form of the boiler-front. The other ends of the hollow bars *f* communicate with a chamber, *h*, comprised between a vertical partition-plate, *i'*, and the back of the fire-box *b*. The collecting-pipe *g* is bent downward at the ends, so as to form tubular legs *k*, which are provided with valves, cocks, dampers, or other regulators, *l*. Cold air enters at the legs *k* under the control of the valves and traverses the whole of the hollow grate-bars, as indicated by the arrows, where it becomes heated and expanded and enters the collecting-chamber *h*, whence it escapes by one or more openings, *m*, and mixes with the products of combustion, which become completely utilized.

In Figs. 19, 20, and 21 the principle is similar; but the fire-bars are different in their form and arrangement. In these figures *a* is the boiler-shell; *b*, the tubes; *c*, the fire-box, and *d* the ash-pit. The fire-bars *f* are made hollow, as before, but divided longitudinally by a partition, *e*, into upper and lower passages, communicating at one end, as in Fig. 19, and the lower passage projecting beyond the fire-box, the inlet thereto being controlled by a valve, *g*, operated from the foot-plate by a rod, *i k*, or other means. The cold air entering at *g* traverses the bars to and fro, as shown, until it reaches the collecting-chamber *k'*. The expanded air collected from all the bars passes out at the upper part of chamber *k'* through one or more openings, *l*, where it mixes with the products of combustion before they pass out of the fire-box. In this manner complete combustion is insured and the production of smoke avoided.

As seen in Fig. 21, the bars *f* are placed in pairs side by side, and along their upper part at regular distances apart are formed lateral openings *m*, gradually increasing in size toward the point of greatest incandescence, so as to equalize the production of heat over the whole area of the furnace and permit of a certain portion of the expanded air escaping into the midst of the mass of fuel. These openings *m* are inclined, and the motion of the engine causes a current of air to be injected in the form of crossed jets which, by intermingling in the midst of the fuel, render its combustion more perfect. The bars may in some cases be pivoted at any suitable point of their length, so as to admit of their being rocked by any suitable means for the purpose of preventing the formation of clinkers.

It will be readily understood that the forms, dimensions, and details of these hollow fire-bars and collecting-tubes may be considerably varied according to the nature of each application without in any way departing from the principle of the invention, and they may also be applied to furnaces generally.

I claim—

1. In a smoke consumer, the combination of a central flue for the products of combustion, and a series of annular chambers connected to each other and surrounding said flue, the inner chamber being connected with the flue and the outer one with an air-inlet, substantially as described.

2. In a smoke-consumer, the combination of a central flue for the products of combustion with a series of annular chambers surrounding said flue, a passage from the inner chamber to the flue near the upper end of the latter, means for varying the area of said passage, and an air-inlet into the outer chamber, substantially as described.

3. The combination of a smoke-flue and an air-chamber surrounding and having an opening into said flue with means for varying the area of said opening, substantially as described.

4. The hollow grate-bar *f*, having a dividing-partition, *e*, and the openings *m m*, leading into the fire-chamber, said openings increasing in area toward the point of greatest incandescence, combined with the pipe *g*, having the legs *k k* at its ends for receiving air, and with an air-chamber opening into the fire-chamber, the grate-bar *f* opening at one end into the pipe *g* and at the other end into said air-chamber, substantially as described.

The foregoing specification of my improved means of consuming smoke and economizing fuel in furnaces and fire-places signed by me this 19th day of July, 1886.

GEORGE EUGENE WERY.

Witnesses:
EDWARD P. MACLEAN,
GEORGES COQUET.