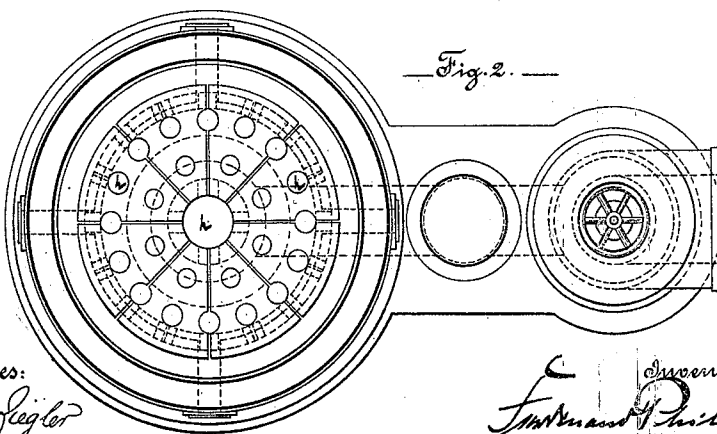
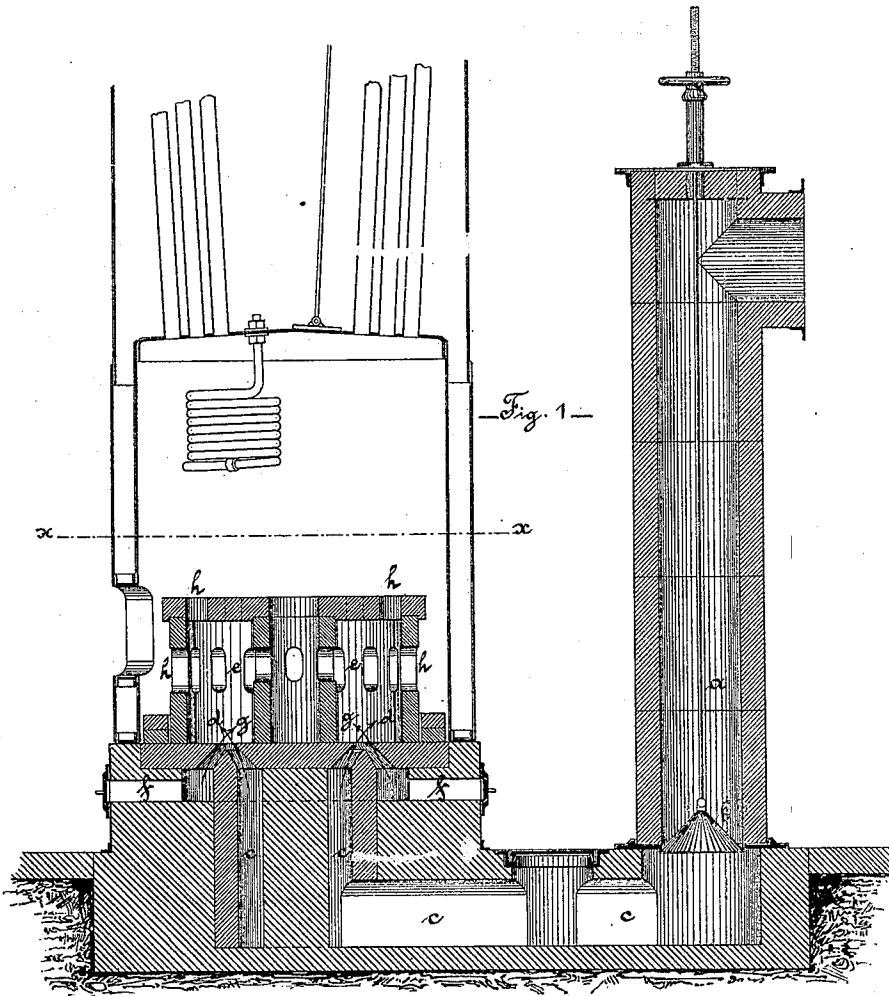


F. PHILIPS.
APPARATUS FOR BURNING GASEOUS FUEL.

No. 337,516.

Patented Mar. 9, 1886.



Witnesses:
Charles F. Fiegler
J. W. Douglas

Inventor:
F. Philips

(No Model.)

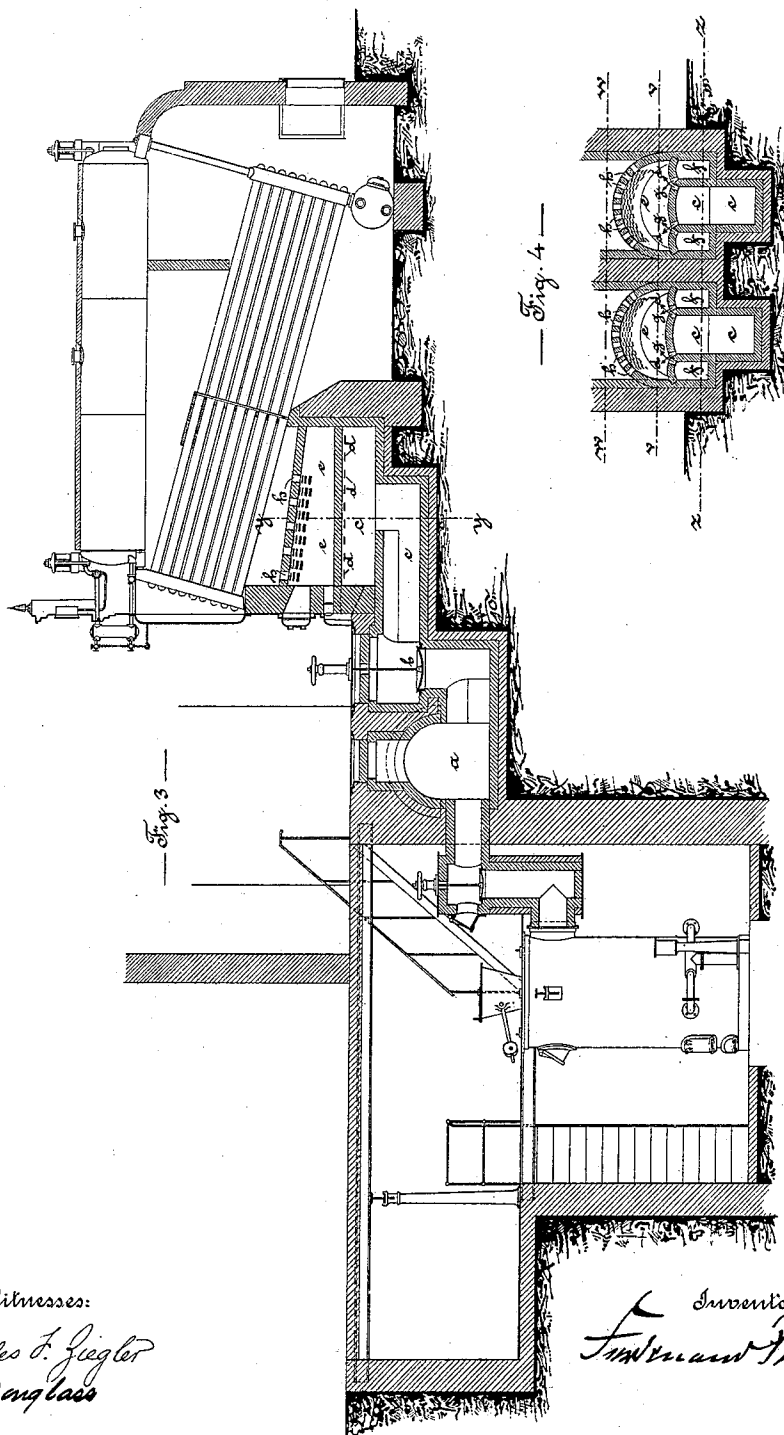
5 Sheets—Sheet 2.

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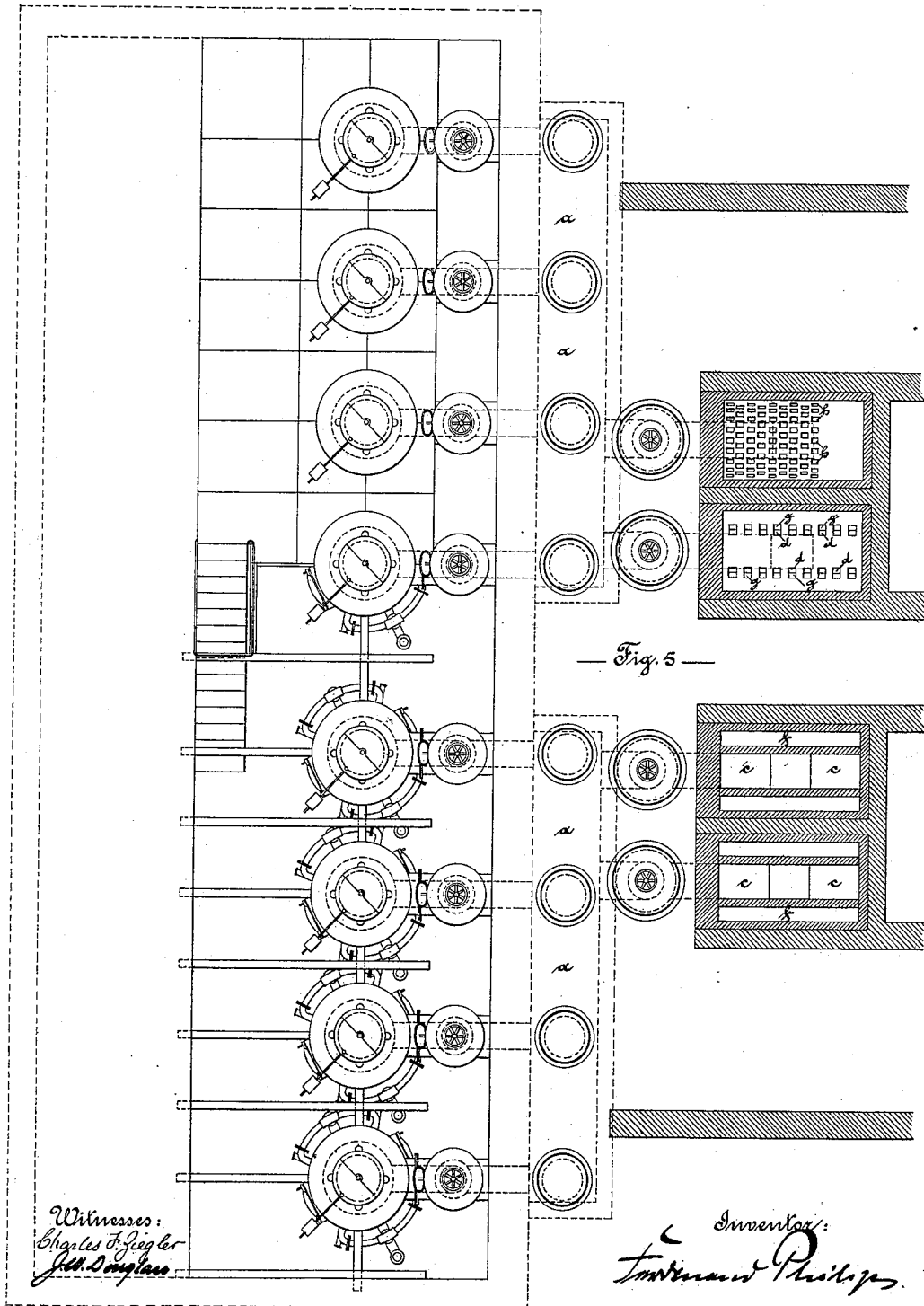
(No Model.)

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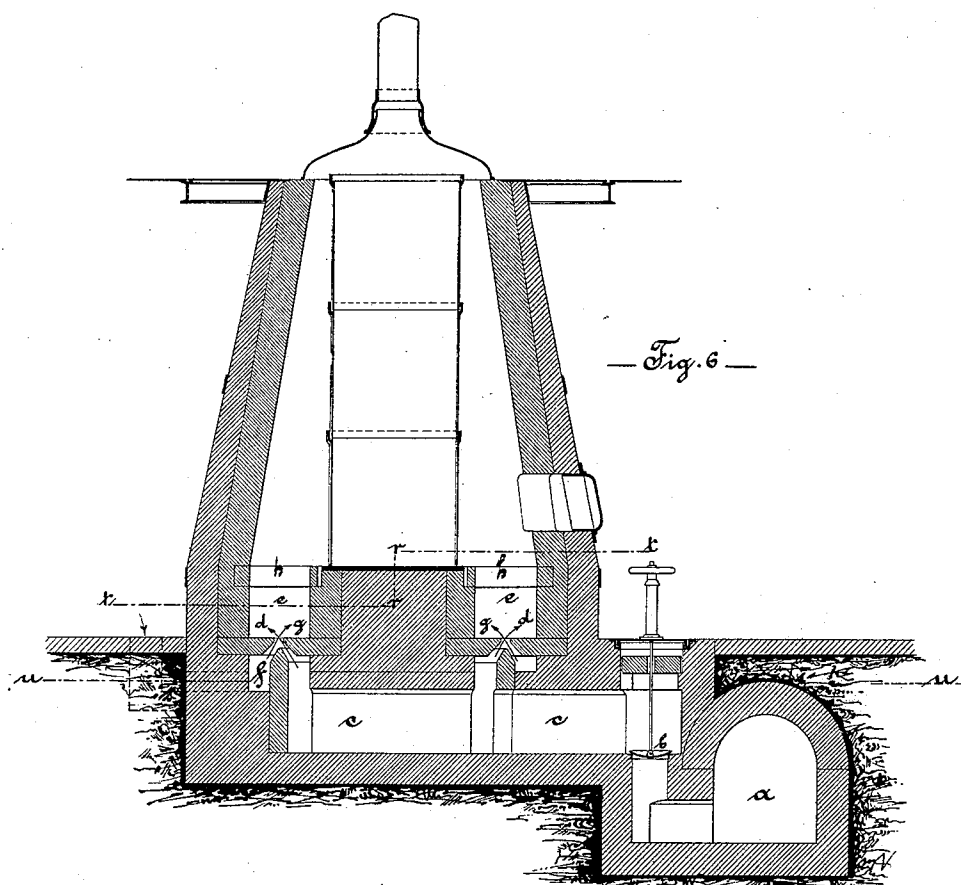
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F. PHILIPS.

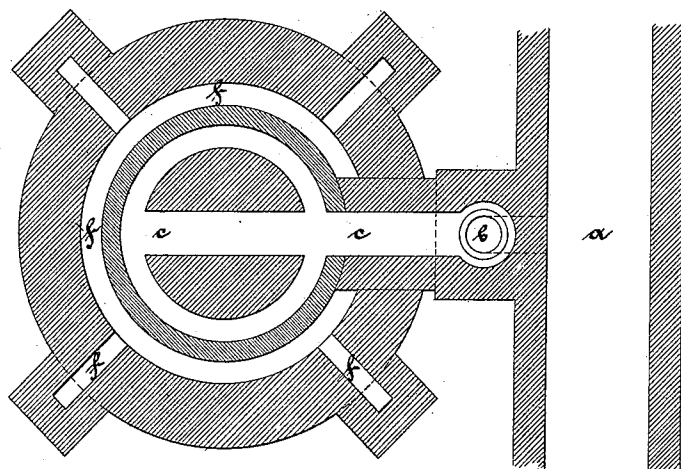
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— Fig. 6 —



Witnesses:
Charles F. Fiegler
J. W. Douglass

Inventor:
Ferdinand K. Schlegel

(No Model.)

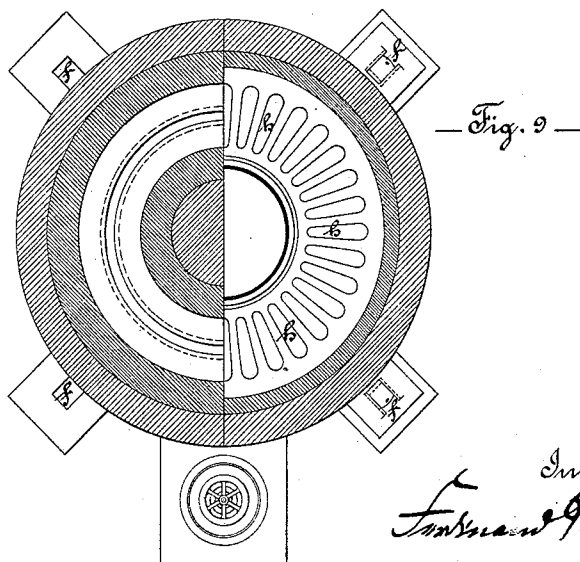
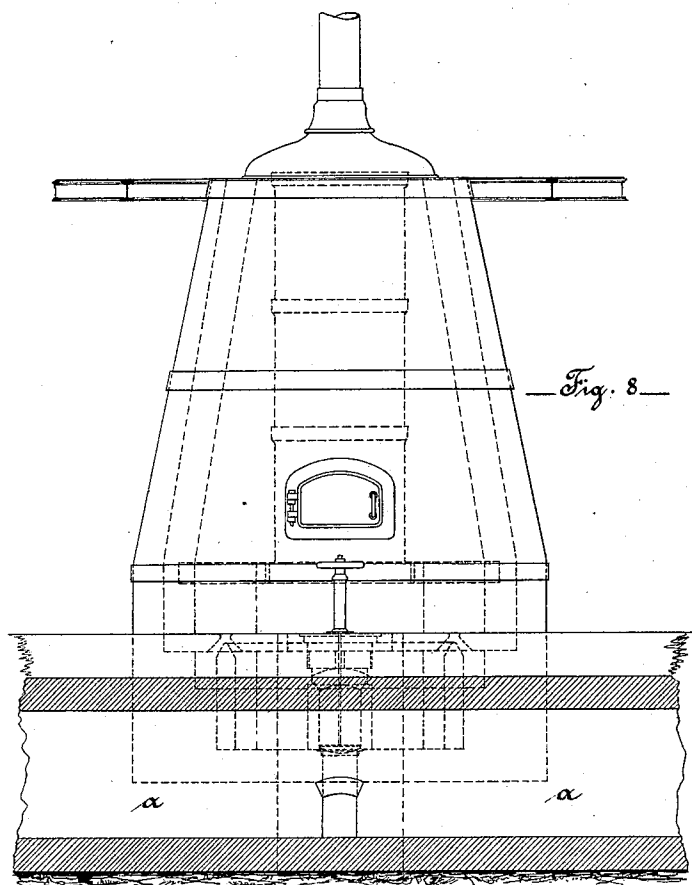
5 Sheets—Sheet 5.

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No. 337,516.

Patented Mar. 9, 1886.



Witnesses:
Charles F.iegler
J. W. Douglas

Inventor:
Frankman Philips

UNITED STATES PATENT OFFICE.

FERDINAND PHILIPS, OF PHILADELPHIA, PENNSYLVANIA.

APPARATUS FOR BURNING GASEOUS FUEL.

SPECIFICATION forming part of Letters Patent No. 337,516, dated March 9, 1926.

Application filed June 18, 1884. Serial No. 135,274. (No model.)

To all whom it may concern:

Be it known that I, FERDINAND PHILIPS, a subject of the Emperor of Germany, residing at the city of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a certain new and useful Improvement in Apparatus for Burning Gaseous Fuel Under Boilers, Kilns, Furnaces, &c., of which improvement the following is a specification, reference being had to the accompanying drawings, which form part hereof.

My invention appertains to the use of gaseous fuel in connection with furnaces, &c., when the well-known regenerative system is not available—that is to say, where the waste products of combustion are not sufficiently hot to effect any preheating of the incoming gas and air, such preheating constituting as is well understood the element essential to the most perfect combustion of the gaseous fuel.

As instances of the application of my invention, I have shown in the accompanying drawings its operation in connection with a tubular boiler, and with a horizontal sectional boiler, and with a kiln for annealing wire, as hereinafter more fully explained with reference to said drawings, respectively. Heretofore there has been but little done in this system of firing such boilers, &c., with gaseous fuel, and when it has been done the gas has generally been taken from a blast-furnace, or more recently it has been natural gas from a bored well. In most cases, so far as I know, the gas has been led under the boilers into the space between the boiler and the floor of the boiler-house, while the air is let in through openings in the front wall of the boiler furnace, and they are thus brought together directly under the boiler or in the furnace itself, the combustion thus induced of course heating the boiler as far as practicable under such conditions, but much of the heat generated being absorbed by the floor of the boiler-house; and it is obvious that this involves a very considerable loss of even the cheapest by-product, as the gas from the blast-furnace, while it is notably wasteful in cases when the gas is made from fuel in a producer, or is obtained from the even more costly source of a bored well.

As heretofore commonly used, in the ab-

sence of any regenerative system, the gas and the air have entered the combustion-chamber, or rather the space in which they were ignited, through comparatively large apertures and without due resources to ample preheating, and they were consequently neither thoroughly mingled nor ignited at such high temperature as to promote complete combustion and afford the best economical results; and it is the object of my invention to obviate these drawbacks so as to make available in the highest degree the economical and efficient application of gaseous fuel in such cases as I have indicated.

The combustible gas obtained from the gas-producer is generally mixed with about two-thirds of incombustible matter, and air contains about eighty per cent. of incombustible matter. The gas and the air being each thus greatly diluted and their affinity for each other weakened, they do not mingle with avidity when brought together at low temperature and in full volume, but require to be mixed in their streams or jets and under the energetic action of heat. On this fact I have based my invention, the first part of which consists in introducing the gas and air into a combustion-chamber, which is so placed above the gas and air inlet culverts that the entire area of its bottom is utilized for radiating heat downward into these culverts. This heat is taken up by the gas and air during their passage through these culverts.

The highly-heated bottom of the combustion-chamber is provided (according to its form) either with a narrow annular slit or with a series of narrow slits for the air and with another similar slit or series of slits for the gas, the air and gas slits intersecting each other. The thin streams of air and gas entering the combustion-chamber through these highly-heated slits are thus made to cross each other and to be so thoroughly mingled at high heat as they enter the combustion-chamber that they are energetically ignited and consumed in a most efficient manner.

It will be obvious that the combustion-chamber becomes very highly heated in all its parts, and that its bottom, which I purposely construct of as thin a layer or series of arches of refractory material as is consistent with durability, will cause the incoming air and gas,

while yet in the underlying culverts to absorb considerable heat, which is still further increased during their entrance through the narrow slits in the highly-heated bottom of the combustion-chamber, whereby I establish all the conditions requisite for the economical use of gaseous fuel—that is to say, I introduce the gas and air in thin streams and at a high temperature. I mingle them very thoroughly in the combustion-chamber, so as to induce the most thorough combustion and to derive more heat from a given amount of gas and air.

In order to still further enhance the economy of my improved apparatus and to prevent the escape of any unburned gases into the chimney, I provide the second part of my invention—that is to say, instead of conducting the products of combustion out of the combustion-chamber in one mass or volume, as has heretofore been practiced, I pass these hot products, together with any unconsumed gas that may still be present, through the numerous outlet-openings in the highly-heated sides or roof, or both, of the combustion-chamber, from which they pass into the space immediately under the boiler or around the kiln (see Fig. 6) or into the furnace, as the case may be.

In the accompanying drawings, Figure 1, Sheet 1, is a vertical section of an upright boiler with my improvements applied thereto. Fig. 2 is a horizontal section above the combustion-chamber on the line xx of Fig. 1. Fig. 3, Sheet 2, is a vertical longitudinal section through a horizontal boiler, combustion chamber, gas-inlet valve, main gas-flue, and gas-uptake. Fig. 4 is a vertical cross-section through the combustion chamber on the line yy of Fig. 3. Fig. 5, Sheet 3, is a horizontal plan of Fig. 3, partly in section, on the lines zz , vv , and uu of Fig. 4. Fig. 6, Sheet 4, shows a vertical section of a wire-annealing kiln embodying the same principles of construction and operation. Fig. 7 is a section on the line uu of Fig. 6. Fig. 8, Sheet 5, is a front view of the same kiln; and Fig. 9 is a section on the lines $trrt$ of Fig. 6.

Similar letters indicate similar parts in all the figures.

The gas coming from the main gas-supply a passes through a valve, b , in a small culvert, c , and enters the combustion-chamber e through a single narrow annular opening, d , in the bottom of this chamber, as in Fig. 1, Sheet 1, and Fig. 6, Sheet 4, or through a series of narrow slits, d , as in Figs. 3, 4, and 5, in the bottom of the combustion-chamber e . The air necessary for combustion is supplied by draft or blast through one or more openings, f , and proceeds to the combustion-chamber e through a narrow annular slit or through a series of narrow slits, g . Figs. 4 and 5, in a similar way as the gas, these air-inlets intersecting the gas-inlets, as shown, in order to insure a thorough admixture of the two currents thus passing into the combustion-chamber.

The combustion-chamber e is provided with

numerous outlet-openings, h , through its sides or roof, or distributed over both, of suitable aggregate area relative to that of the inlet-openings and with reference to the general proportions of the combustion-chamber, to prevent back-pressure of the expanding gases.

I have adopted as an approximate rule an aggregate outlet-area four times that of the combined gas and air inlets. Through these outlets the products of combustion together with any unconsumed gas pass from the combustion-chamber into the space immediately under the boiler or around the kiln (see Fig. 6) or into the furnace, as the case may be, and in this space the combustion is completed. It will thus be seen that the unconsumed gases in passing with the products of combustion through the numerous highly-heated outlet-openings are further mixed with heated air and also absorb further heat from the sides of these openings, so that they come to the boiler, kiln, or furnace in the best possible condition for thorough consumption. As the combustion-chamber gets hotter and hotter, the floor of this chamber, which is at the same time the roof of the gas and air inlet culverts, of course absorbs heat from the combustion in the chamber itself, and treats the incoming air and gas, which consequently burn with more energy and perfection of combustion than heretofore. Any unburned portions of the gases issue from the chamber e in a thoroughly-mingled and highly-heated state through the intensely-heated openings h , and are thus subjected to the most complete combustion above the same, and immediately under the boiler, kiln, hearth, or furnace, as the case may be.

Having thus described the nature and objects of my invention, I do not wish to be understood as claiming, broadly, a combustion-chamber interposed between the air and gas tunnels and the furnace or boiler, for promoting the mixture, ignition, and combustion of gaseous fuel, as such a combustion-chamber has been before used; but

What I do claim as new, and desire to secure by Letters Patent, is—

In an apparatus for generating heat by means of gaseous fuel, the alternate parallel tunnels for gas and air, divided by narrow partition-walls having outlet openings for gas and air, respectively, lying directly opposite to and intersecting each other, in combination with a combustion-chamber made of refractory material interposed between said tunnels and the boiler, kiln, or furnace in such a manner that the entire roof of said gas and air tunnels form part of the interior of the combustion-chamber, said combustion-chamber being provided with outlet-openings of prescribed area, and all arranged substantially as and for the purposes set forth.

FERDINAND PHILIPS.

Witnesses:

CHARLES F. ZIEGLER,
J. W. DOUGLASS.

It is hereby certified that in Letters Patent No. 337,516, granted March 9, 1886, upon the application of Ferdinand Philips, of Philadelphia, Pennsylvania, for an improvement in "Apparatus for Burning Gaseous Fuel," errors appear in the printed specification requiring correction, as follows: In lines 14, 31 and 48, page 1, the word "when" should be stricken out wherever the same occurs and the word *where* inserted; in line 76, same page, the word "their" should be stricken out and the word *thin* inserted; in line 95, page 2, the word "treats" should be stricken out and the word *heats* inserted instead; and that the Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 23d day of March, A. D. 1886.

[SEAL.]

H. L. MULDROW,
Acting Secretary of the Interior.

Countersigned:

M. V. MONTGOMERY,
Commissioner of Patents.