(No Model.) 4 Sheets—Sheet 1.

B. H. THWAITE.

HIGH TEMPERATURE FURNACE FOR STEEL MELTING OR ANALOGOUS PURPOSES.

No. 515,452. Patented Feb. 27, 1894.

Fig. 1.

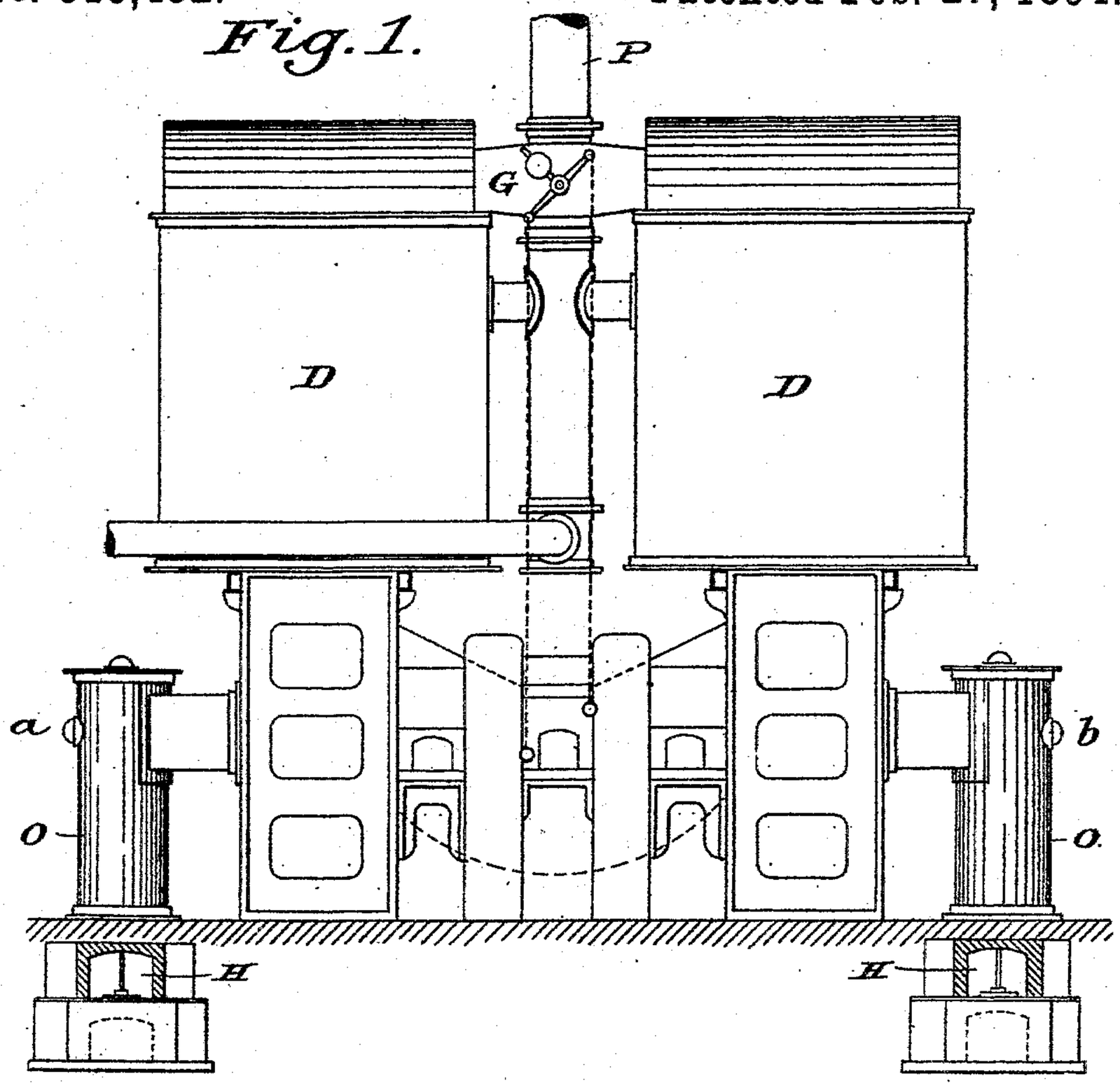
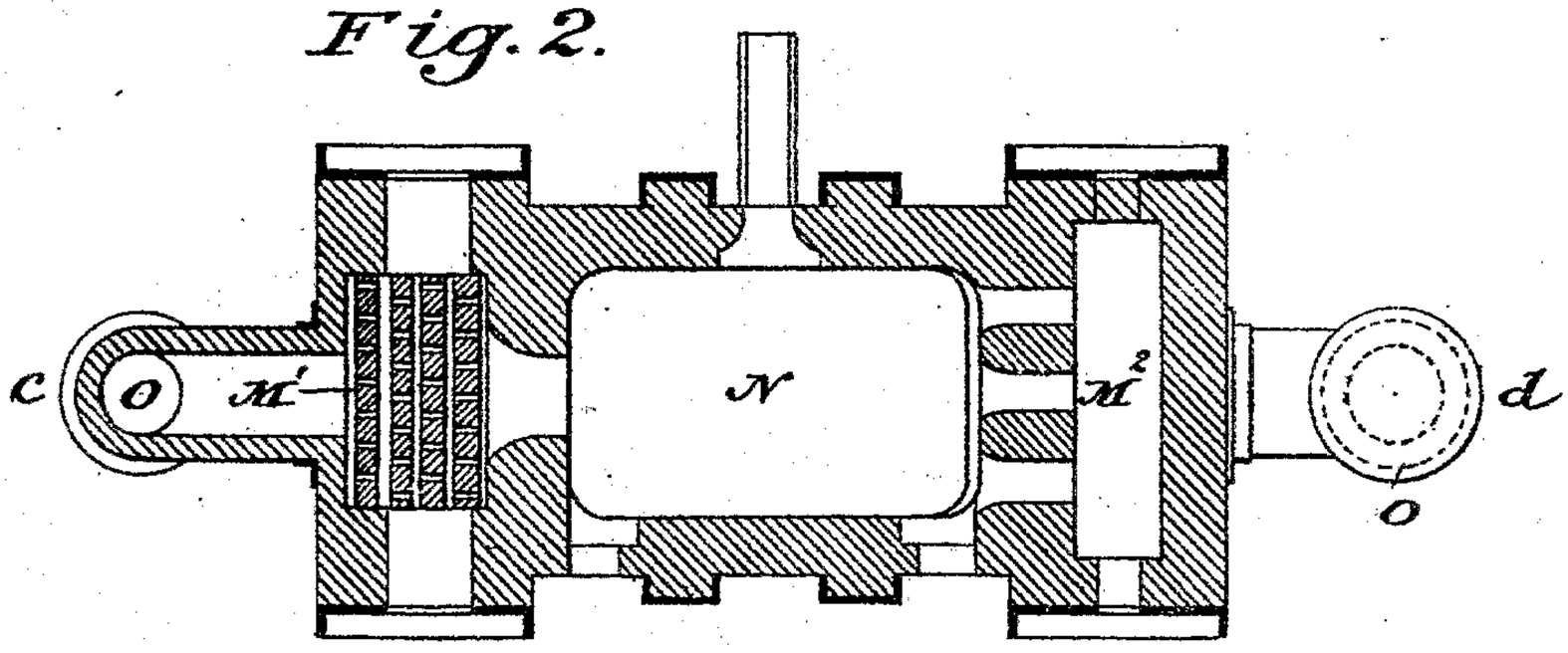


Fig. 2.



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(No Model.) 4 Sheets—Sheet 2

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HIGH TEMPERATURE FURNACE FOR STEEL MELTING OR ANALOGOUS PURPOSES.

No. 515,452. Patented Feb. 27, 1894.

Fig. 3.

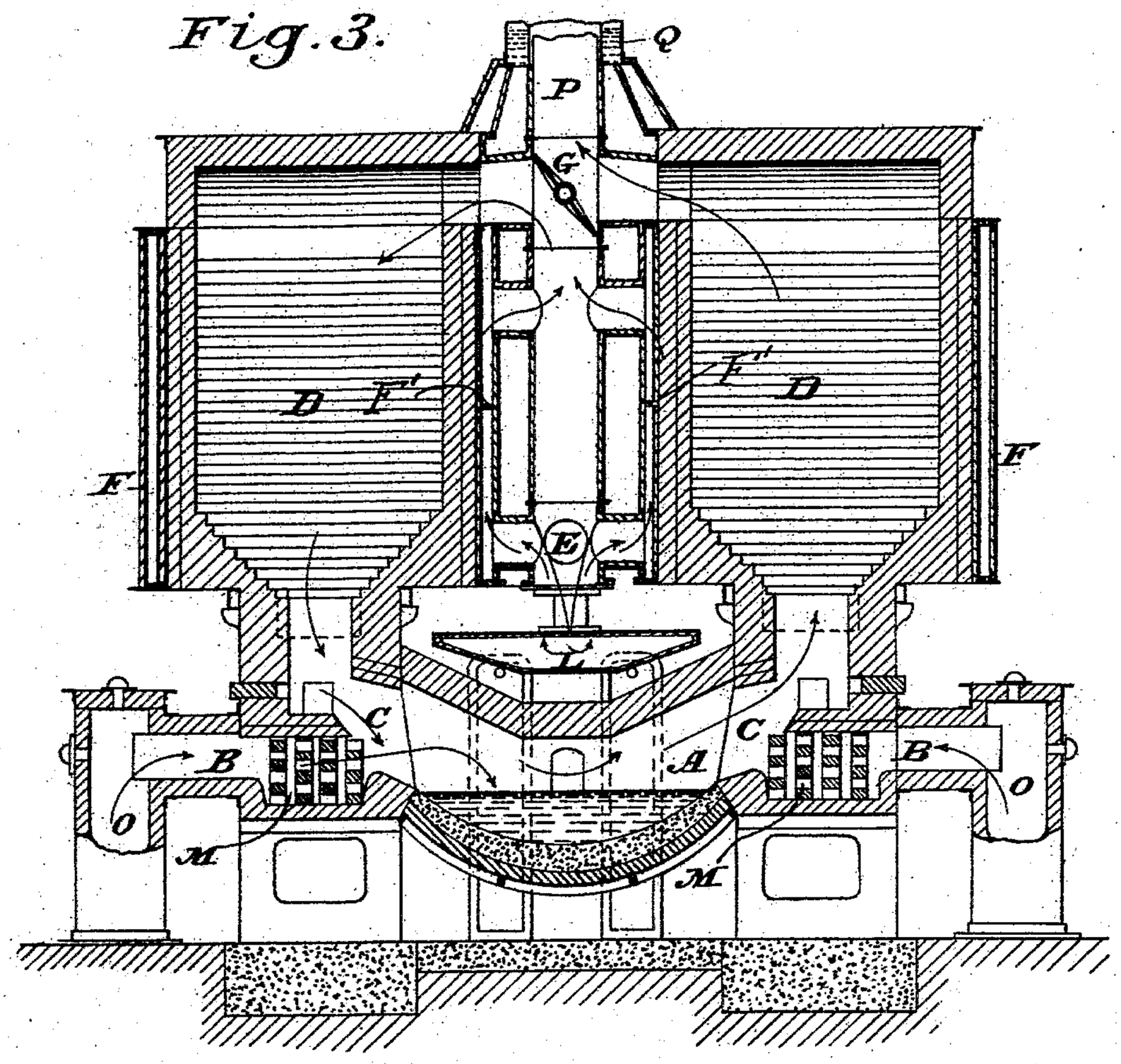
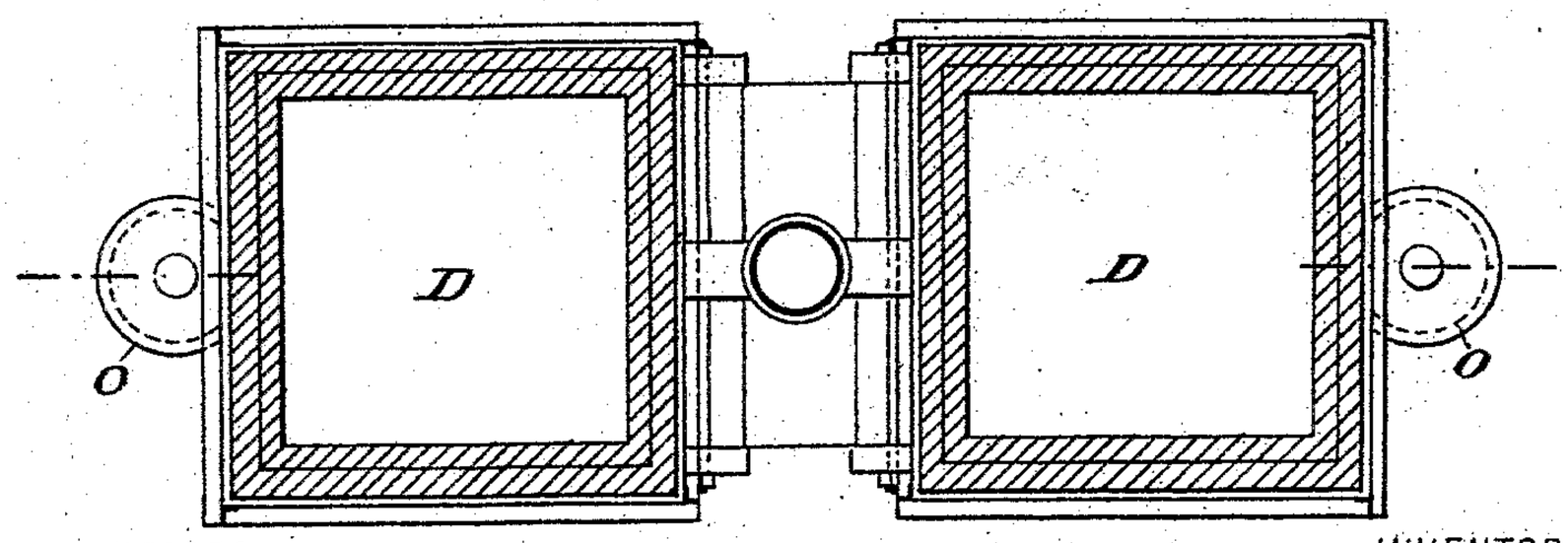


Fig. 4.



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(No Model.) 4 Sheets—Sheet 3.

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HIGH TEMPERATURE FURNACE FOR STEEL MELTING OR ANALOGOUS PURPOSES.

No. 515,452. Patented Feb. 27, 1894.

Fig. 5.

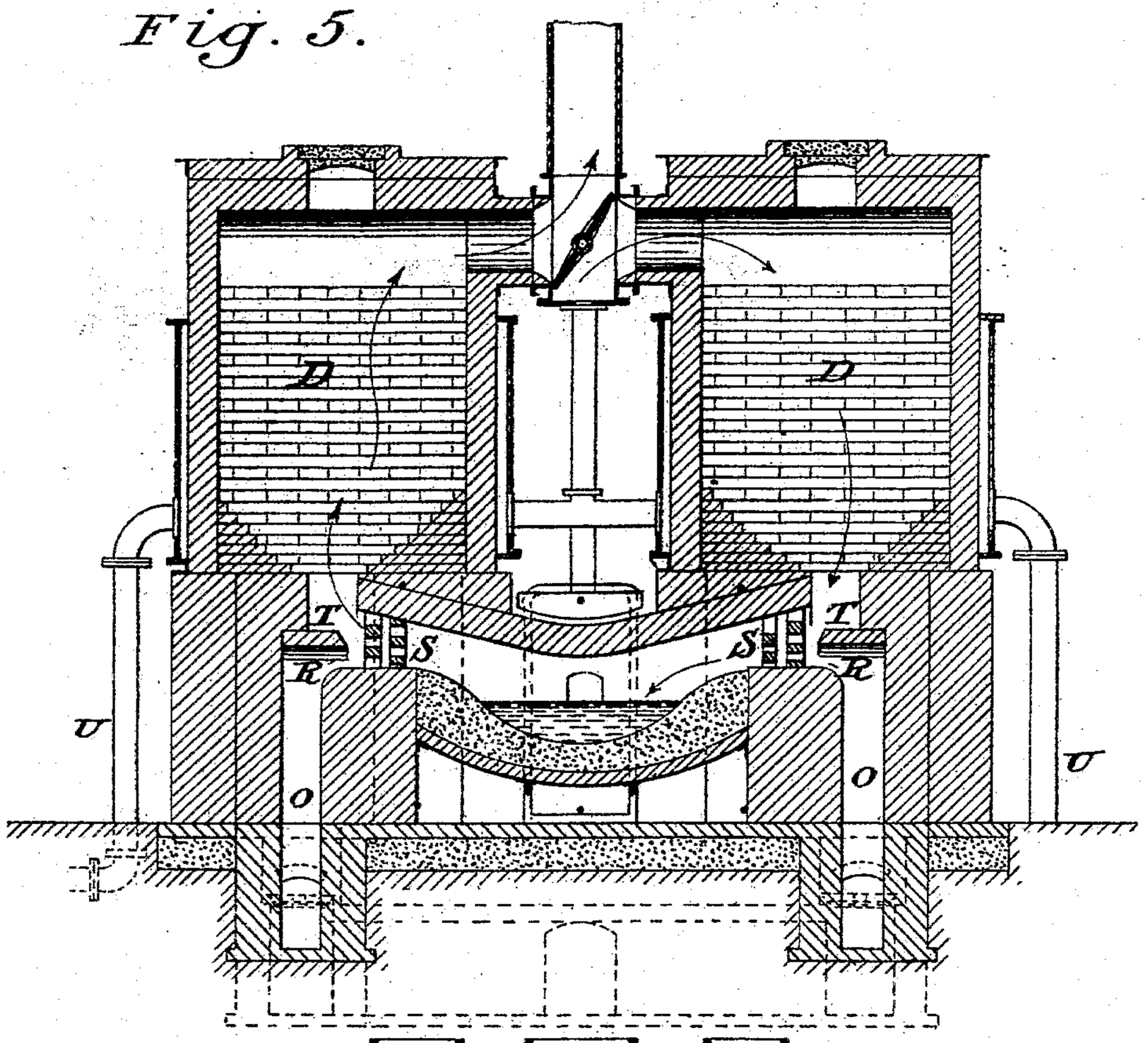
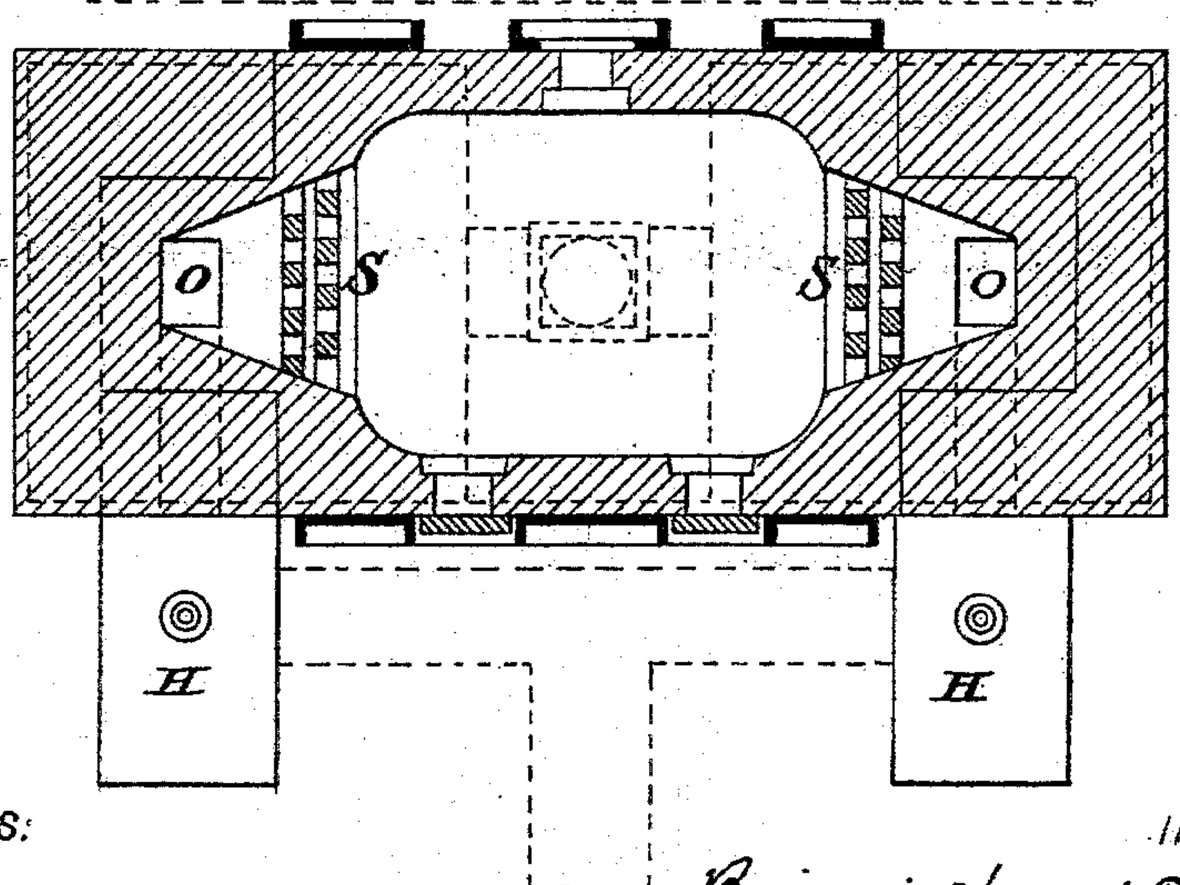


Fig. 6.



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(No Model.) 4 Sheets—Sheet 4.

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HIGH TEMPERATURE FURNACE FOR STEEL MELTING OR ANALOGOUS PURPOSES.

No. 515,452. Patented Feb. 27, 1894.

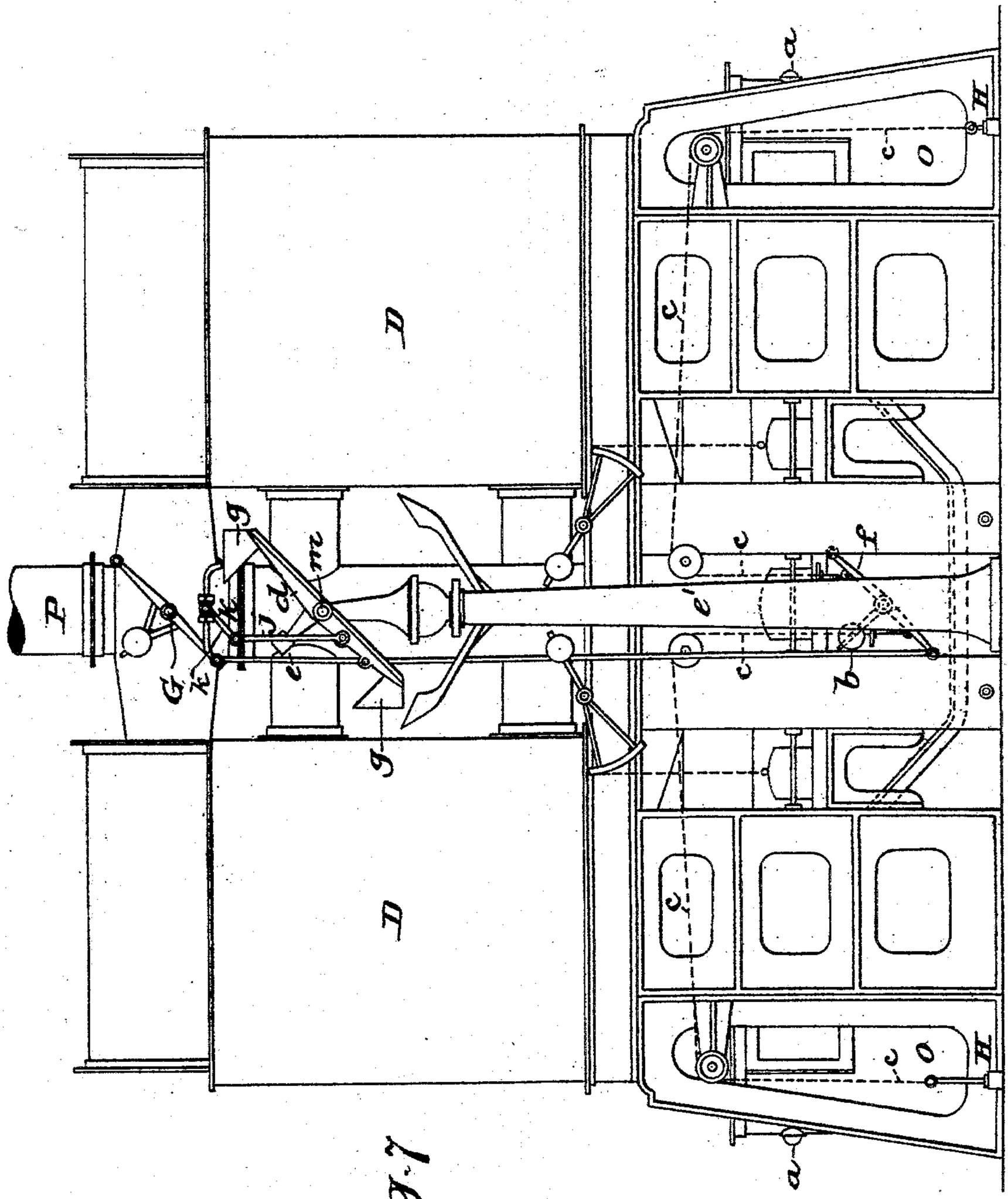

Fig. 1.

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UNITED STATES PATENT OFFICE.

BENJAMIN H. THWAITE, OF LONDON, ENGLAND.

HIGH-TEMPERATURE FURNACE FOR STEEL-MELTING OR ANALOGOUS PURPOSES.

SPECIFICATION forming part of Letters Patent No. 515,452, dated February 27, 1894.

Application filed July 8, 1893. Serial No. 479,924. (No model.) Patented in England January 22, 1891, No. 1,161.

To all whom it may concern:

Be it known that I, BENJAMIN HOWARTH THWAITE, a subject of the Queen of England, and a resident of Moorfield Chambers, No. 95 Finsbury Pavement, London, England, have invented certain new and useful Improvements in High-Temperature Furnaces for Steel-Melting or Analogous Purposes, of which the following is a specification.

A part of this invention has been patented in Great Britain under date January 22, 1891, No. 1,161.

This invention has for its object the improvement in furnaces intended for using either gaseous or solid fuel, but especially for the former fuel—and where temperatures of combustion equivalent to the degree required for the fusion of steel of low carbon quality is desired.

In my furnace I use air recuperators. Around a whole or part of such recuperators (external sides), I provide an air jacket through which by plenum or aspiration I pass the air to support combustion. These air recuperator chambers debouch directly into the air and gas mixing chamber, the area of the passage serving as connection, having rather less than the area of the inlet flue; this permits an equal pressure of air to be established throughout the chamber. I connect the two air recuperator chambers when placed above the furnace at the upper ends, by means of a central reversal valve, through the aid of which the air is alternately directed into one chamber and then into the other. This same central reversal valve also connects the chimney to one or other of the two recuperator chambers as the process requires. I make the valve connecting the passages as short as possible and I provide cleaning out arrangements. For the central valve I use by preference the type of valve known as the butterfly valve, built up of steel plates. I may connect the chimney to the upper branch or end of the reversal valve. I may convert the chimney for the purpose of steam raising, according to the system adopted for puddling furnaces, or I may force the residual gases from combustion through a head of water so as to abstract the necessary sensible heat, or I may employ, in order to facilitate the removal of the gases, an exhaust fan or steam jet aspirator. In order to reduce the thermic radiation from the roof of furnace, I may suspend just over this roof a sheet iron plated vessel which I may connect up to the pipe through and by which the heat radiated from the furnace is transferred to the air, such sheet iron and castings may be of the lightest of iron scantlings.

Before referring in detail to the four sheets of drawings that accompany and are intended to form part of this specification, I wish it to be clearly understood that I do not intend to be confined to the exact details shown on such illustrations, as they may be modified very considerably without involving any departure or enlargement of the rights covered by my claims—as hereinafter set forth.

I will describe each set of illustrations showing a specific application of my invention—separately and with distinctive symbols of reference—instance the application shown on Sheets 1 and 2 of drawings.

Figure 1, in Sheet 1 is a front elevation of the furnace, and Fig. 2, is a plan in section, taken on lines *a b* of Fig. 1. Fig. 3, on Sheet 2 of drawings is a vertical section of furnace taken on line *c, d* of Fig. 2 of Sheet 1 of drawings, while Fig. 4, is a sectional plan on line *e, f* of Fig. 3. Fig. 5, is a vertical section of a modified form of furnace and Fig. 6, a sectional plan view of the same. Fig. 7, is a side view showing the means for operating the valves.

The following are the essential structural elements of the furnace.

The hearth itself in which the conversion is proceeded with, is marked A, the ports by which the fuel gas enters the furnace are marked B, the chambers in which the gas is mixed with the air are marked C. The two recuperators in which the air is heated by the flow of the products of combustion are marked D. The pipes and tubes leading the air from blower to the air recuperator jackets are marked E. The air jackets surrounding the air recuperators are marked F, said jackets having horizontal partitions F′. The air reversal valve is marked G, the two gas valves are marked H.

We will follow the cycle of combustion and the sequence of recuperation—the air enters the furnace by means of the inlet E, flowing

into the sheet iron formed chamber L, suspended over the furnace roof and becoming thereby highly heated. The air afterward flows around the recuperator chamber D, and finally flows into the air reversal valve G, and from thence into the interior of one or other of the recuperators D, which are filled with checker brick-work, this brick-work heated to a high temperature, transfers its heat to the air, flowing through the brick-work and before it reaches the *locale* of mixture of the air and gas—or the mixing chamber M—the air attains a very high temperature which adds to the temperature resulting from the combustion *per se*.

The gas and air mixing chamber M, may, or may not be filled, with checker brick-work—the general construction of this chamber is shown in Fig. 2, in which figure two alternative arrangements of mixing chamber are shown—one M′ being shown filled with checker work and the other M^2 being merely an empty chamber having contracted ports leading to hearth of furnace N.

The air being preferably forced into recuperator chambers by means of a Roots blower, fills every part of the recuperator and is in sensible contact with every brick contained. It is obvious that the gas supply must establish a pressure equal to that of the air—and I arrange that such a pressure of gas supply is provided. The fuel gas enters into the mixing or combustion chamber M, entering by the vertical gas flues O which are closely connected to gas valves H. The gas entering into the mixing chamber M is thoroughly intermixed with the heated air—which having along with the chamber a very high temperature raises the intensity of combustion to a degree only limited by the limit of infusibility of the bricks that structurally constitute the furnace. The flame flows across the hearth, impinging on every part because the pressure of the gases of combustion is such as to balance the in rush of cold air into the furnace through the doors. The heated gases fill the mixing chamber M at the opposite end of furnace—charging them with heat—of a steel melting intensity—the gaseous products of combustion flowing through the recuperators D, charge their checker brick-work with heat—to nearly the same extent, but the temperature of course being less in the upper than the lower part of the chambers—the sensible temperature of the gases escaping into the reversal valve G, which is of the usual butterfly type—being very low.

The gas valves H are of the mushroom valve type (formed preferably of mild steel)—sitting on steel plates—having special seatings to enable a perfect joint to be formed.

The rising gas uptakes or flues O, I form of sheet iron internally lined with refractory material and so arranged as to be rapidly overhauled and renewed.

The chimney P, above the air reversal valve G, is of ordinary sheet steel or sheet iron—but I may surround it with a water space, for steam raising purposes, as shown at Q.

Fig. 4, shows a plan in section through recuperator chambers D.

Referring to Sheet 3 of drawings, Fig. 5 shows a vertical section of another form of applying my invention—and Fig. 6 shows a plan in section of same.

In this application there is the same disposition of essential parts as in the former arrangement just described. The principal difference is a structural one. The recuperators are supported on a solid block of brickwork containing in their center the vertical gas flue O which debouches at the point R, into the *locale* where the air meets the gas which in this application is a widening flue having across it a series of walls of checkers S.

In order to divert the gas on to the air and to prevent premature ignition a cover arch T is provided by which the gas is directed on to the checkers S.

In other essential details the arrangement is similar to the design already described, and the same letters of reference refer to identical parts. The air pipes U, lead the air to the jackets surrounding the recuperators, the air in passing through the jackets abstracts the heat radiated therefrom and before entering the air reversal valve G is very highly heated.

I may decide to automatically reverse the valves G and H, so as to insure absolute regularity of reversal action. I adopt a simple automatic water tilting gear shown in Fig. 7 which also shows one arrangement by an elevation of a furnace, built according to my invention and which I adopt for incasing the furnace with iron plates, to maintain the integrity of structural form of the furnace; the essential elements are indicated by the same reference letters indicating the same parts. The simple action of tilting serves to throw over the weighted lever which actuates the balanced and weighted levers of the upper air reversal valve G. These central weighted levers are connected by links to a central lower balanced lever *f*, that by other connections of chains *c*, to the gas valves H lowers and closes one valve and raises and opens another.

d marks the balanced lever and attached balance weight *e* at each end of the lever *a* there is a bucket *g*, as soon as the bucket is filled with water flowing from the valve *k* the weight of the water tilts the bucket, thus pulling the weighted lever *d* over the center line, the bucket and balance weight fall to their full extent the tilting action throwing out the water which by the reversal of the valve *k*, is diverted into the opposite bucket such reversal of valve *k* being effected by the links *j* that actuate the cross lever *k′* by regulating the flow of the water, the time of reversal can be precisely determined. It will be obvious that this arrangement can be worked by hand without any modification of

the gear being required. In order to obviate any difficulty from the presence of the supporting column e', the latter is placed some distance away from the furnace, the actuation of the valves being effected by the extension of a shaft m forming the center of the tilting lever, and the repetition of another tilting lever at the end of such shaft, the shaft being connected to the three reversal valve levers.

Of course there are other automatic reversal gears that I may decide to use in preference to the one described.

I claim—

1. In combination with the furnace, the air and gas supply conduits, the mixing chambers at the ends of the furnace, the air recuperators, the air jackets about them, the reversing valve G with its casing and the connection from said valve casing to the air recuperators and to the air jackets about the same, substantially as described.

2. In combination, the furnace, the gas supply conduits, the air supply pipe the mixing chambers and the air heating chamber of sheet metal connected with the air inlet pipe and suspended at the lower end thereof over the roof of the furnace, substantially as described.

3. In combination, the furnace, the gas supply conduit, the air supply, the mixing chambers, located at the ends of the furnace and to which the gas supply conduit leads the recuperators, connecting with the mixing chambers the air jackets extending about the recuperators, the air heating chamber L suspended above the roof of the furnace and connected with the air jackets the reversing valve G with its casing, and the stack, said casing being connected with the recuperators with the air jackets and with the stack, the said air supply being connected with the air jackets substantially as described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

B. H. THWAITE.

Witnesses:
E. A. WEST,
J. W. VICKERS.