

No. 685,499.

Patented Oct. 29, 1901.

S. W. VAUGHEN.  
BLAST FURNACE.

(Application filed Dec. 29, 1899.)

(No Model.)

Fig. 1.

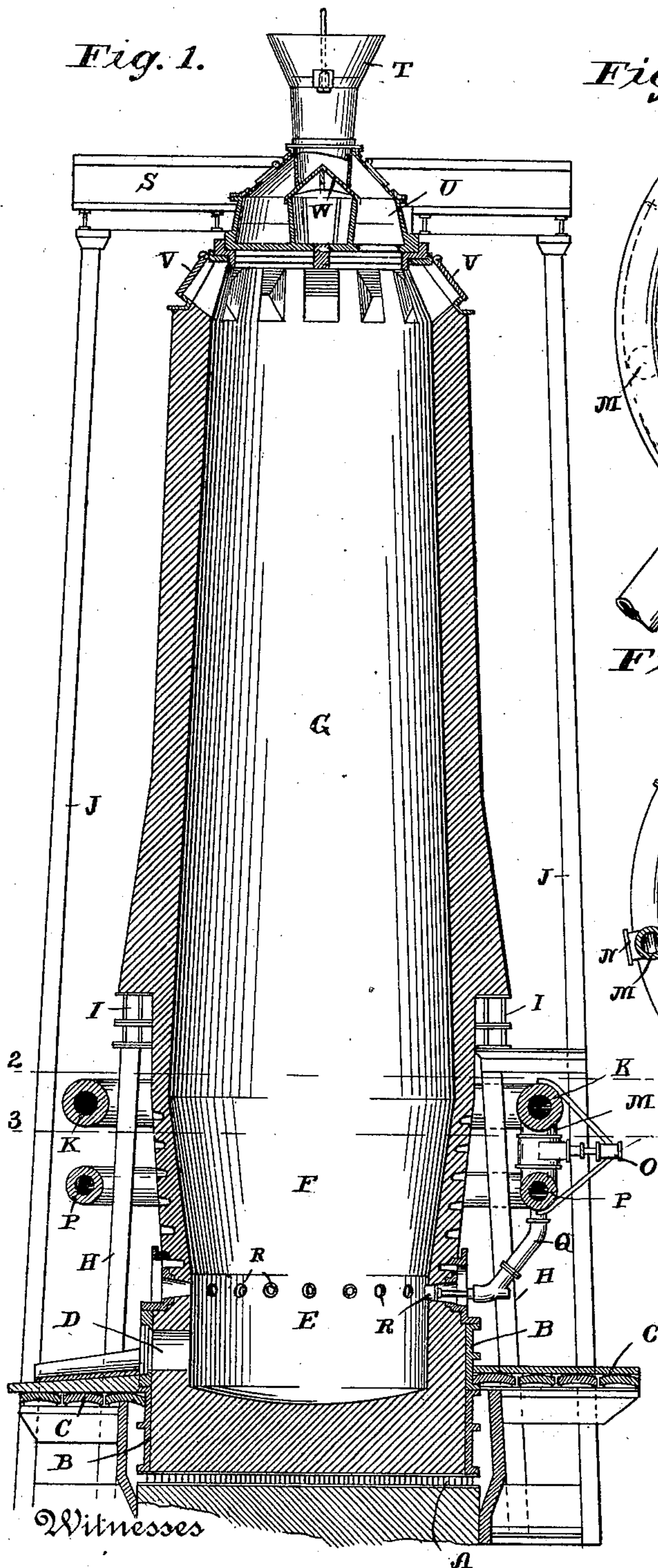


Fig. 2.

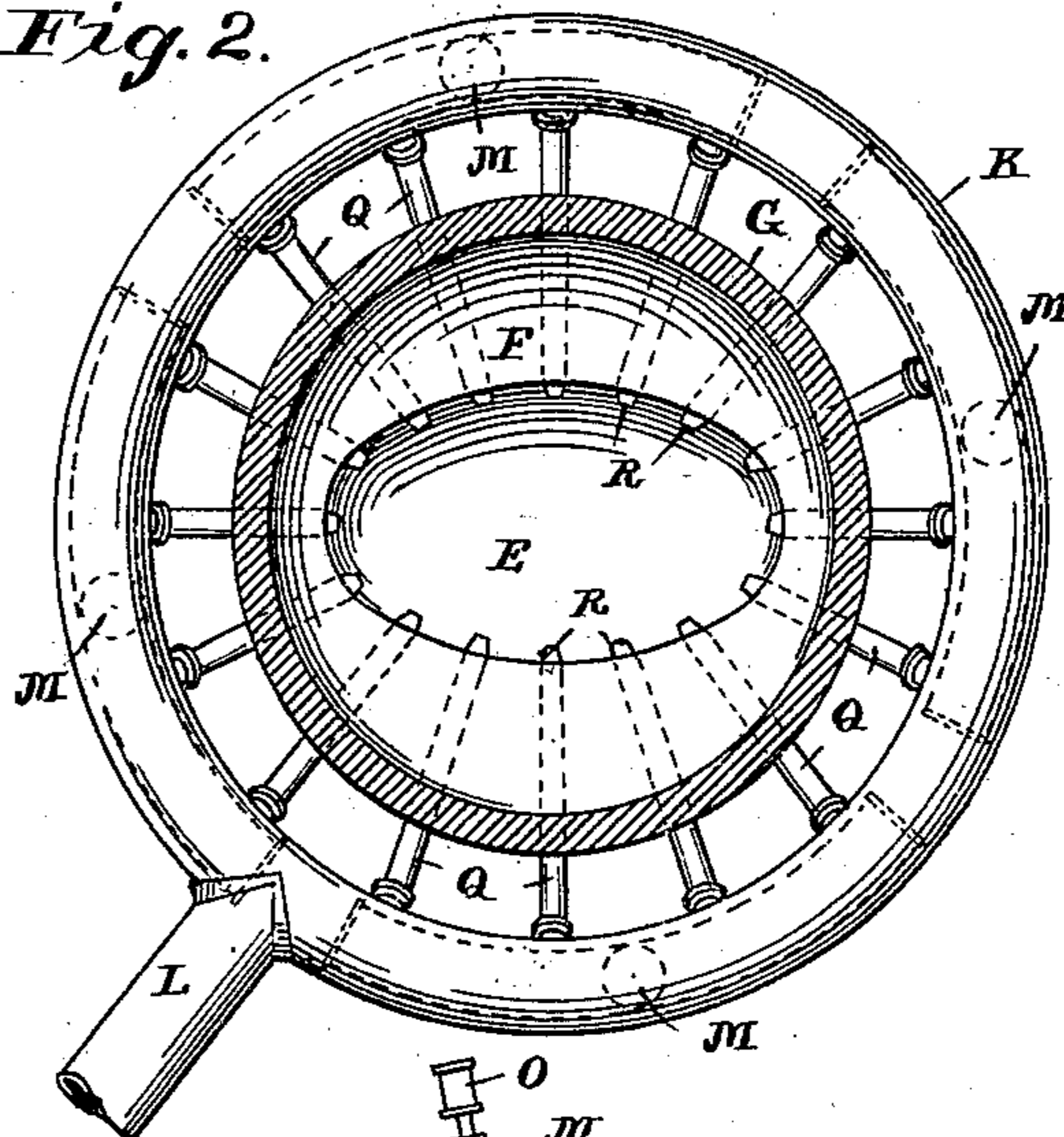


Fig. 3.

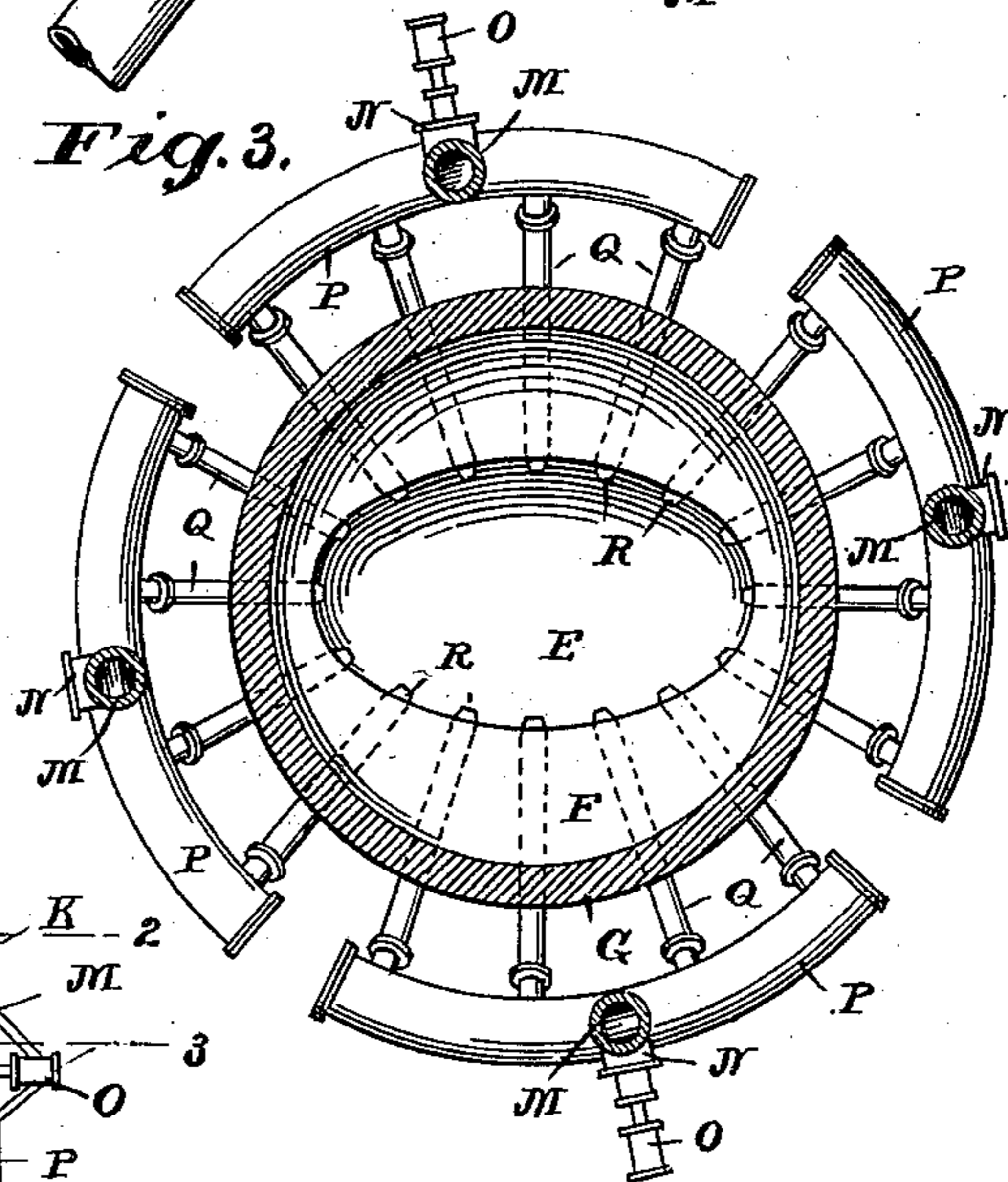
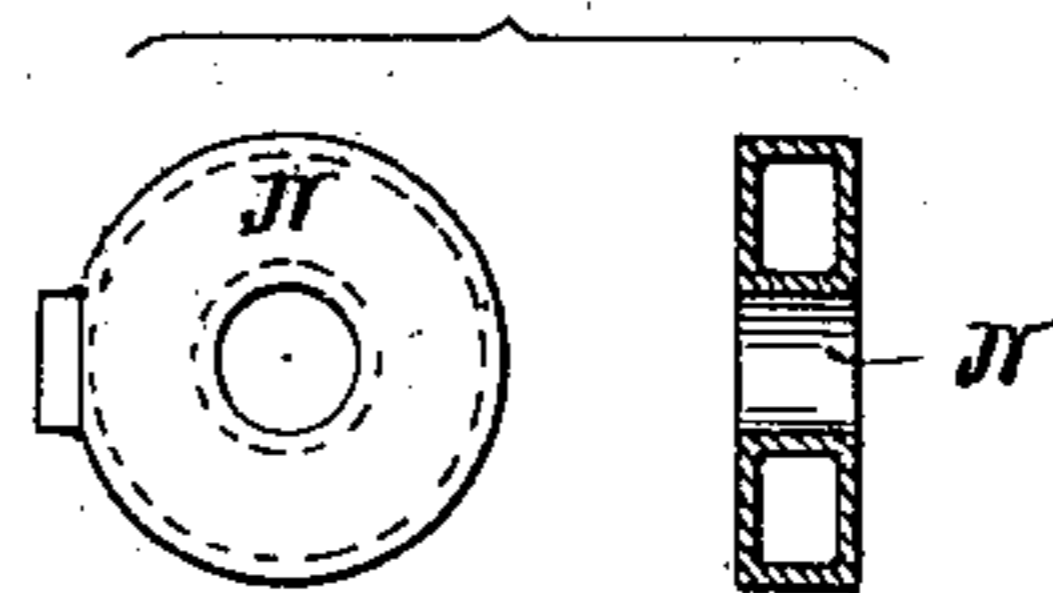


Fig. 4.



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# UNITED STATES PATENT OFFICE.

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## BLAST-FURNACE.

SPECIFICATION forming part of Letters Patent No. 685,499, dated October 29, 1901.

Application filed December 29, 1899. Serial No. 741,919. (No model.)

*To all whom it may concern:*

Be it known that I, SAMUEL W. VAUGHEN, a citizen of the United States, residing at Johnstown, in the county of Cambria and State of Pennsylvania, have invented certain new and useful Improvements in Blast-Furnaces; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present forms of blast-furnaces which are constructed for the purpose of reducing and smelting iron ores are made substantially circular in horizontal sections throughout, and in order to obtain the desired capacities required by modern practice the diameters become so large that their operation is difficult, irregular, and cannot be regulated with the same ease as the old furnaces of smaller dimensions.

It is generally conceded by those skilled in the art that the size and production of a furnace is limited not on account of the inability to reduce the ore rapidly, but by reason of the fact that the large-sized modern furnaces are unable to smelt the material as quickly as it can be regularly reduced. For example, in the case of a small furnace producing a large tonnage the stock or material passes through the furnace and is converted from the raw state into pig-iron, with the consequent formation of slag, &c., in about nine hours, and sometimes less; but this rate of driving cannot be attained in the larger furnaces, for the reason that to obtain the same relative hearth area in the large furnace as in the small one the hearth-diameter becomes very great, and in order that the blast may have the necessary penetration it should be forced into the hearth at a pressure much greater than is practicable with present appliances. In operating with hearths of large diameters when one part becomes clogged the free or open part gives passage to all the air, thus smelting and reducing the material much more rapidly in the open portion of the furnace, and this reduces the effective area in which the operation proceeds, so that a portion only of the large furnace becomes useful and its capacity for production is decreased, as may be readily understood. These difficulties with furnaces of large diameters make it impossi-

ble to obtain from them the large production which their size would seem to indicate; but by means of my invention in making the hearth oval these troubles are obviated, and I thus provide a furnace having the largest possible area requiring the least penetration of blast, and at the same time by means of my improvements the operation can be regulated in the different parts as required to insure uniform and thorough action in all portions of the furnace, thus maintaining the output to the maximum of which the construction is capable.

By my invention I provide a blast-furnace with an oval or elliptical hearth and a bosh the lower portion of which is of the same form as the hearth and which tapers upwardly from said hearth and joins to a cylindrical stack portion. I also arrange the blast-pipes so that the air can be directed into any quarter of the hearth which needs to be cleaned from obstructions or opened to insure rapid and continuous operation. In addition to the usual bustle-pipe encircling the furnace-bosh I provide a lower bustle-pipe made, preferably, in four sections, each connected with the main bustle-pipe by a short auxiliary connection-pipe, and in each of said connection-pipes I locate a stop-valve, so that the supply of air to each of the auxiliary bustle-pipes and their connections can be regulated as desired.

The oval or elliptical form of hearth which I propose to use is such that the blast can penetrate easily and equally into all portions of the furnace, and the entire area thus becomes effective, which is not the case in the older shapes of circular form of equal area.

A furnace built in my improved manner with a hearth about twelve feet wide, twenty feet long, a bosh diameter of twenty-four feet, a stock-line diameter of eighteen feet, and a total height of one hundred feet would have a capacity of about thirty thousand cubic feet, and by means of my construction this furnace could be rapidly driven and kept in regular operation throughout its area, so as to produce more than one thousand tons of pig-iron in twenty-four hours if charged with mixtures of material customary at this time, the ordinary output of a circular furnace of the same size being about six hundred tons as a maximum at present.

For the sake of completeness in the drawings I have shown a complete vertical section of my improved blast-furnace, including a top-charging device, (indicated by the letters S, T, U, and W;) but this charging device is no part of my present invention, as this forms the subject of another application which I have made for United States Letters Patent for improvements in blast-furnace tops filed December 5, 1899, Serial No. 739,247. For the sake of completeness of illustration I have also shown explosion-doors, (marked V upon the drawings;) but these do not form part of my present invention.

Having thus given a general description of my invention, I will now proceed to describe it in detail, with reference to the accompanying sheet of drawings, in which like letters refer to like parts.

Figure 1 is a central vertical sectional elevation showing my improved construction of blast-furnaces. Fig. 2 is a horizontal sectional plan taken on line 2 2 of Fig. 1. Fig. 3 is a horizontal sectional plan taken on line 3 3 of Fig. 1. Fig. 4 is a detail of the stop-valve N, showing its construction.

Referring now to the various letters of reference marked upon the drawings, A is the foundation-grillage, consisting of steel beams or similar material for the purpose of receiving and distributing the weight of the stack and contents to the foundations below.

B is the base of the hearth.

C C are platforms on the lower working level of the furnace, and D is an opening through the hearth-walls in which the tapping-hole is formed, the ordinary way of doing this being to fill said hole with refractory material and make a small opening therein.

E is an oval or elliptical hearth of my improved construction.

F is the bosh, which is elliptical in its lower cross-section, where it joins the hearth, and circular at its upper portion, where it joins the stack.

G is the stack or shaft of the furnace proper.

H represents the mantle-columns, and I is the mantle-ring.

J represents columns for supporting those portions of the hoisting apparatus which are located at the furnace-top, and said hoisting apparatus may consist of a skip or similar means for transporting the stock from the lower level and charging it into the distributing-hopper T; but as the stock-hoisting apparatus does not form any part of my present invention I have not shown it upon the drawings.

S is a girder resting upon the columns J for supporting those portions of the hoisting apparatus which are located at the furnace-top, and this part of the construction is kept independent from the furnace-stack proper, so as to allow slight movements or expansion and contraction of the latter without interfering with the hoisting apparatus.

K is the main bustle-pipe, encircling the bosh.

L is the main blast-pipe, supplying heated air under pressure to the main bustle-pipe K.

M represents pipes connecting the main bustle-pipe K to the auxiliary bustle-pipes P P P, and N is a gate or valve in the pipe M, connecting the main bustle-pipe K to the auxiliary bustle-pipes P.

As shown in Fig. 4, the gate or stop-valve N is provided with a small opening in its center, such that when it is closed there still remains a small opening for the blast, sufficient to keep the slag, &c., from going into the twyers with which it connects.

O is a fluid-pressure cylinder for operating the gate or stop-valve N, and said cylinder is provided with the usual connections, consisting of pipes and fittings, the regulating-valves of which may be located in a convenient position for operating from the lower platform C or elsewhere, as desired; but as such details are well known I have not complicated the drawings by showing them.

PPPP are the lower auxiliary bustle-pipes, each of which is connected to the main bustle-pipe, as shown, and is provided with four blowpipes Q, connecting with a similar number of twyers R.

T is a receiving hopper into which the stock, consisting of ore, fuel, flux, &c., is charged. U is a revoluble distributing-chamber for supplying said stock to the upper portion of the furnace-stack. W is a closing and distributing cone forming part of the receiving-chamber U, and V V are explosion-doors formed in the upper portion of the furnace-stack; but these portions T, U, V, and W of the construction do not form part of my present invention, as heretofore explained.

In operating my improved furnace the stock is charged into the top through the devices above described, the arrangement of which is such that the distribution of said stock in the furnace will be as uniform as possible and there will be the greatest possible surface presented to the reducing action of the gases and at the same time give the least resistance to the ascending currents. As the stock passes downward through the furnace-stack the ore becomes reduced, and as it approaches the bosh the smelting action begins, and this is completed as the material reaches the hearth. If for any reason the action of the furnace becomes different in various parts of its cross-section, I can increase the blast to those portions which most require it and shut off the blast from the other portions, thus correcting the difficulties without delay or inconvenience, and I thereby maintain the operation of the furnace constant and regular throughout all of its portions.

The hearth of my furnace may be oval, elliptical, rectangular with rounded corners, rectangular with rounded ends, or any combination of forms which will produce a sec-

tion which is shorter in one direction than in the other direction at right angles thereto, the effect desired being to produce a hearth of given area into all parts of which the air-blast will penetrate with greater ease than into a circle of similar area.

The lower auxiliary bustle-pipes may be made in more or less than four sections, as shown and described, and the blast-regulating valves may be operated in any manner desired.

Although in certain of the claims herein I refer to the cross-sections as "oval" for the sake of simplicity in description, this term is intended to include all forms which approximate the oval or elliptical shape, as referred to above.

I do not limit myself to the exact construction or detail shown and described, but may make such modifications therein as are fairly included in the scope of my invention as set forth in the claims herein.

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

1. In a blast-furnace provided with a hearth oval in cross-section, a stack circular in cross-section, and a bosh connecting said hearth and stack and conforming to their sections where it is joined to them, the combination of a main bustle-pipe encircling the furnace, and a number of auxiliary bustle-pipes connected to the main bustle-pipe, each of said auxiliary bustle-pipes being provided with one or more blowpipes and twyers connected to said blowpipes.

2. In a blast-furnace provided with a hearth oval in cross-section, a stack circular in cross-section, and a bosh connecting said hearth and stack and conforming to their sections

where it is joined to them, the combination of a main bustle-pipe provided with a source of air-supply, a number of auxiliary bustle-pipes each having one or more twyers connected thereto, and connecting-pipes provided with valves between said main and auxiliary bustle-pipes.

3. In a blast-furnace provided with a hearth oval in cross-section, a stack circular in cross-section, and a bosh connecting said hearth and stack and conforming to their sections where it is joined to them, the combination of a main bustle-pipe, a number of auxiliary bustle-pipes each having one or more twyers connected thereto, connecting-pipes between said main and auxiliary bustle-pipes, and a stop-valve in each of said connecting-pipes, the gate of said valve being provided with a small opening therethrough.

4. In a blast-furnace provided with a hearth oval in cross-section, a stack circular in cross-section, and a bosh connecting said hearth and stack and conforming to their sections where it is joined to them, the combination of a main bustle-pipe, a number of auxiliary bustle-pipes, connecting-pipes between said main and auxiliary bustle-pipes, a stop-valve in each of said connecting-pipes provided with a fluid-pressure cylinder and means for operating the same, said auxiliary bustle-pipes being provided with one or more blowpipes and twyers connected to said blowpipes.

In testimony whereof I hereto affix my signature in the presence of two witnesses.

SAMUEL W. VAUGHEN.

Witnesses:

GEO. E. THACKRAY,  
D. J. JONES.