

(No Model.)

3 Sheets—Sheet 1.

A. M. HAY.

APPARATUS FOR UTILIZING HEAT OF FURNACE PRODUCTS.

No. 582,587.

Patented May 11, 1897.

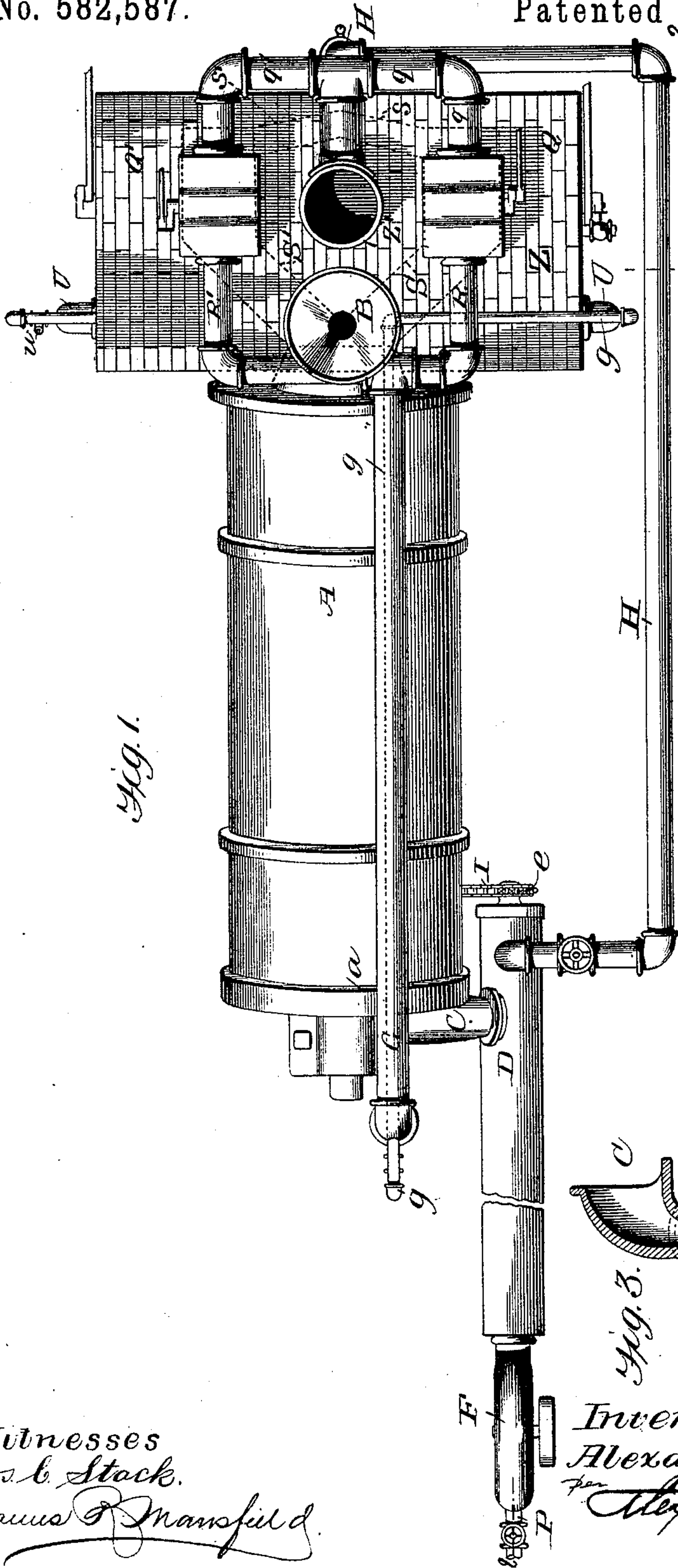


Fig. 1.

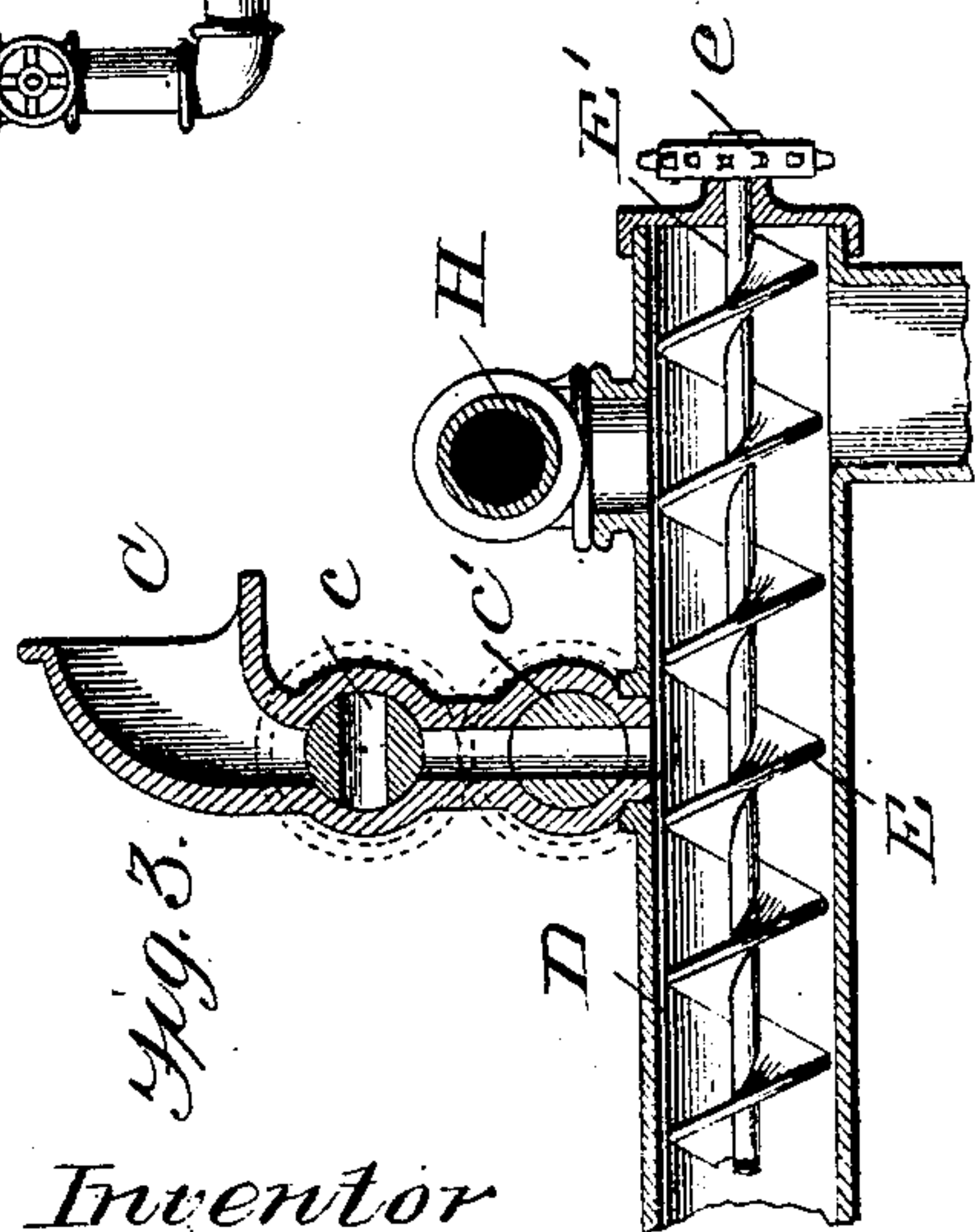


Fig. 3.

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(No Model.)

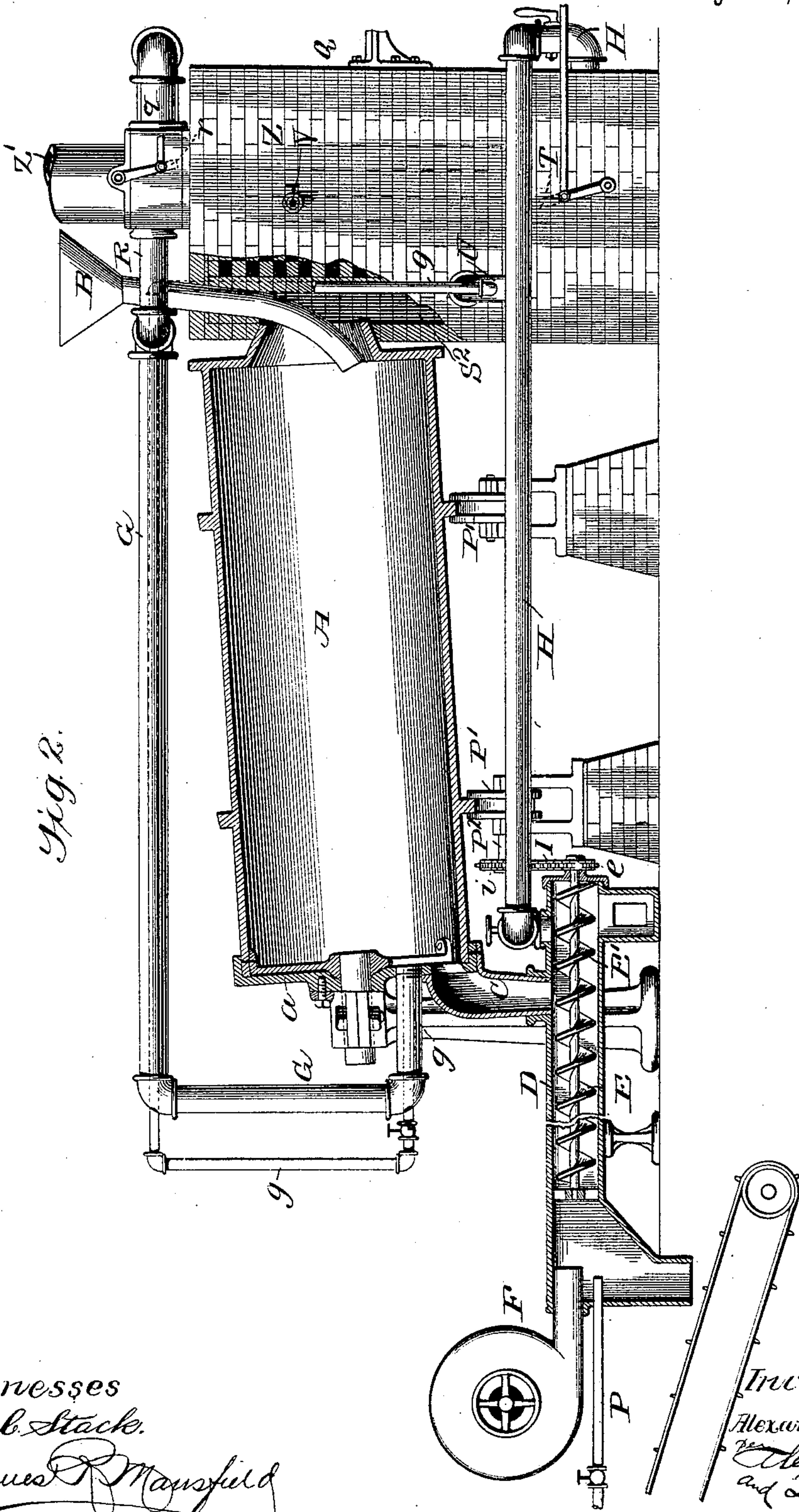
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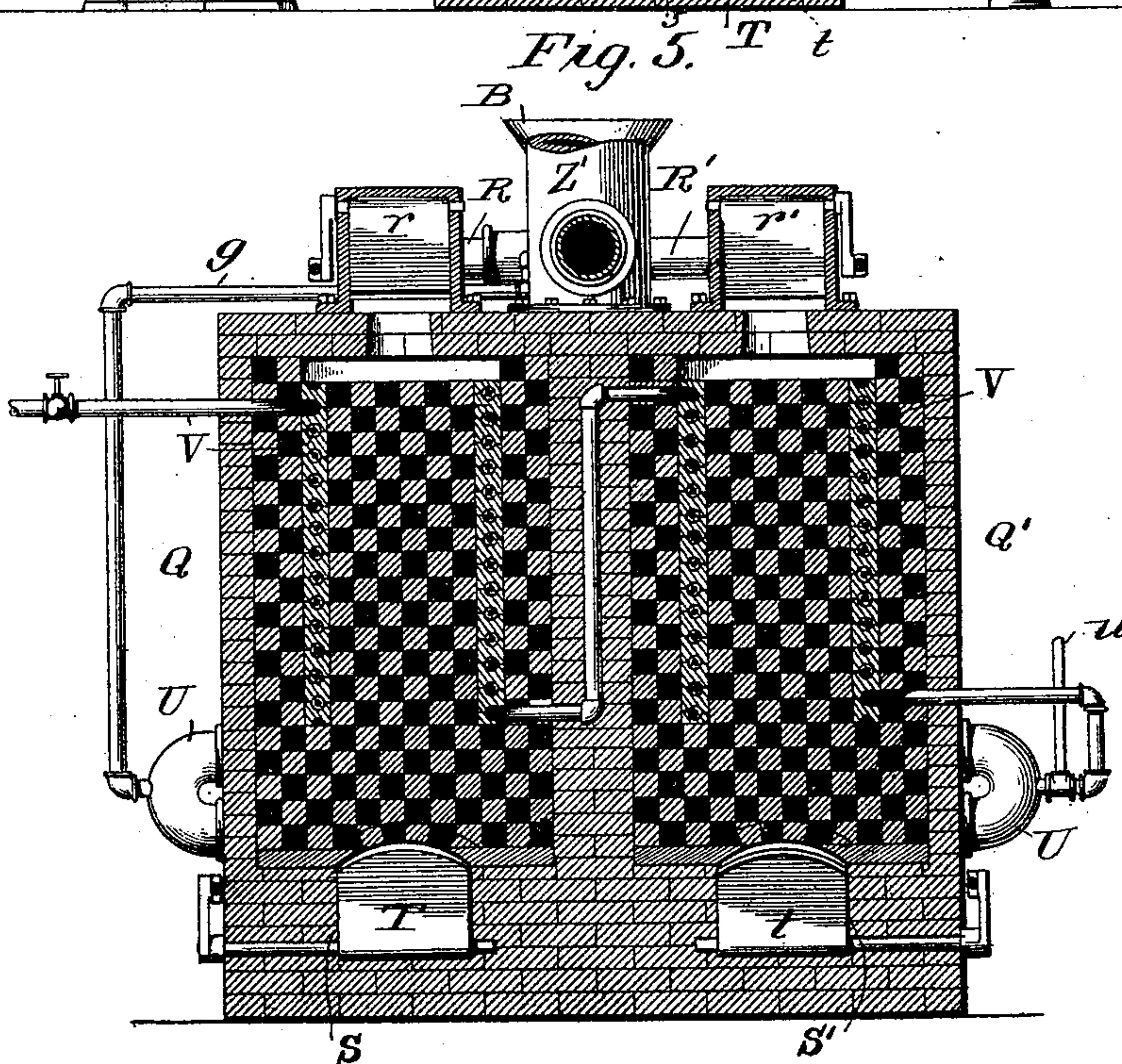
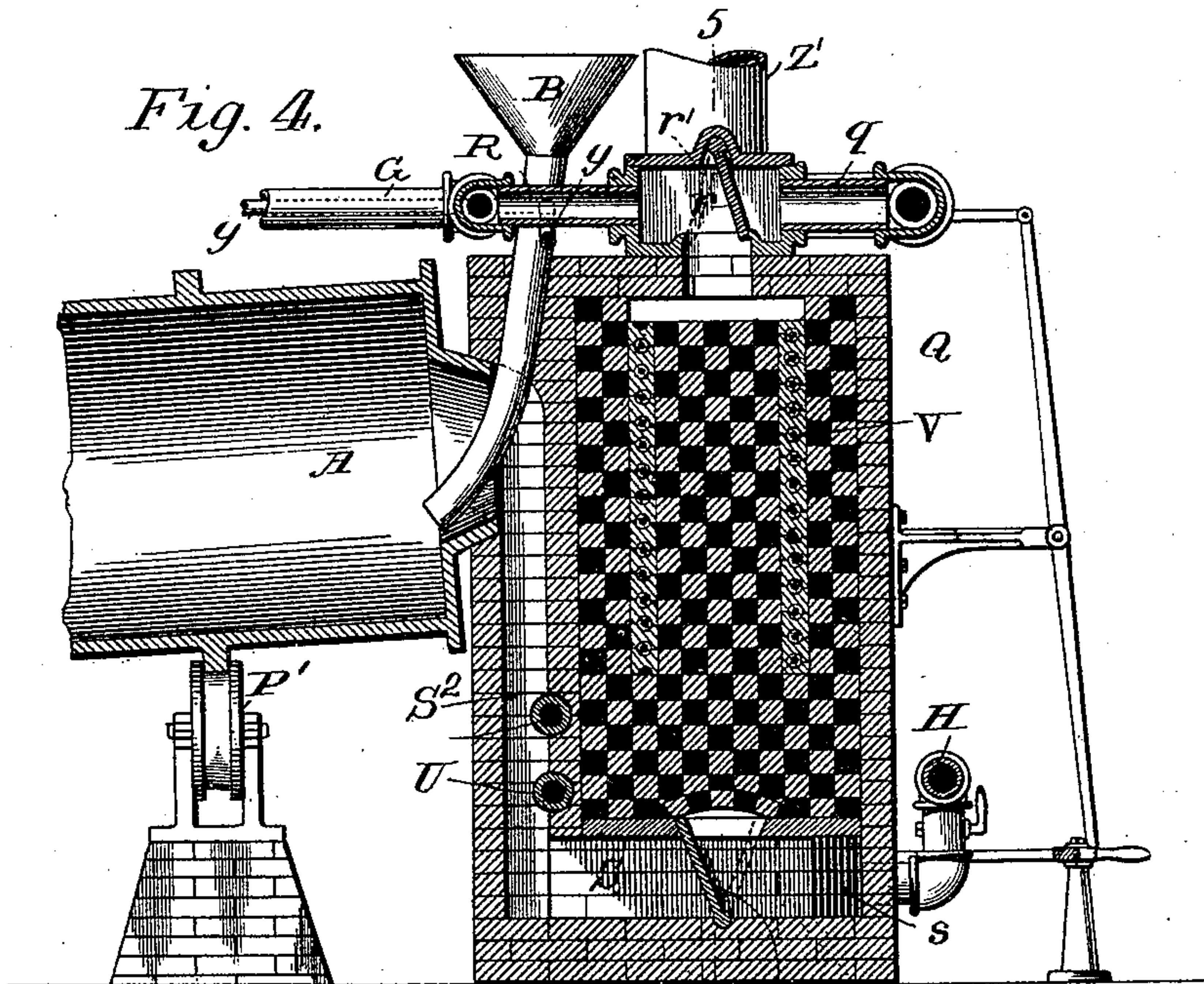
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WITNESSES

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# UNITED STATES PATENT OFFICE.

ALEXANDER MARSHALL HAY, OF DULUTH, MINNESOTA.

## APPARATUS FOR UTILIZING HEAT OF FURNACE PRODUCTS.

SPECIFICATION forming part of Letters Patent No. 582,587, dated May 11, 1897.

Application filed March 20, 1896. Serial No. 584,101. (No model.)

*To all whom it may concern:*

Be it known that I, ALEXANDER MARSHALL HAY, of Duluth, in the county of St. Louis and State of Minnesota, have invented certain  
5 new and useful improvements in apparatus for heating air for furnaces, &c., by the latent heat of products manufactured therein; and I do hereby declare that the following is a full, clear, and exact description thereof, refer-  
10 ence being had to the accompanying drawings, and to the letters of reference marked thereon, which form part of this specification.

This invention is an improved apparatus for utilizing the waste or latent heat in the  
15 corporeal products of furnaces, ovens, &c., which are delivered therefrom in a highly-heated condition for heating air, &c.

By this invention the products are sub-  
20 jected while hot to currents of air, steam, &c., or mixtures thereof which absorb the heat from the products, and the air, steam, &c., thus heated are used either in maintaining the combustion in the furnace or for other useful purposes in the arts, as may be desired.

25 In the accompanying drawings I have illustrated the invention as applied to a furnace of the rotary type for burning clinker for cement, roasting ores, &c., by which appli-  
30 cation I effect the triple result of oxidizing and cooling the product preparatory to its being crushed or otherwise dealt with and heating the air and steam prior to its intro-  
35 duction into the combustion-chamber of the furnace, which latter results in economizing fuel by maintaining a higher temperature in the combustion-chamber.

In the drawings accompanying this appli-  
40 cation, Figure 1 is a plan view of a rotary furnace and connected apparatus embodying my invention. Fig. 2 is a longitudinal ver-  
45 tical section through the same on line 2 2, Fig. 1. Fig. 3 is a detail. Fig. 4 is a vertical longitudinal section through the gas-making apparatus. Fig. 5 is a transverse section on  
50 line 5 5, Fig. 4.

The construction of this furnace forms no part of the present invention, and I shall give but a conventional description thereof.

55 In the drawings, A designates a combustion-chamber open at both ends and supported in any suitable manner, so that it can be axially rotated.

The material to be treated in the furnace

is fed into the rear end of the combustion-  
chamber A through a hopper B and (the  
55 cylinder being inclined, as shown) passes gradually down to the front end thereof, from which the cement clinker or roasted ore drops into a hopper C, which directs it into a  
60 casing D, in which it is moved forward by a screw conveyer E of any suitable construc-  
tion.

Preferably the delivery or front end of the  
combustion-chamber A is substantially closed  
65 by a stationary end plate *a*, which is fitted over the receiving end of hopper C, so as not to prevent the escape of the product to the  
hopper. Through this plate passes an air-  
pipe G, by which hot air or steam or mixtures  
70 of hot air and steam can be introduced into the cylinder along with gas injected through  
a pipe *g*, the mixtures igniting as they enter  
the combustion-chamber and producing an  
intense heat therein. The waste gases pass  
75 from the combustion-chamber into a gas-making and air-heating apparatus Z at the  
rear end of the furnace, of any suitable con-  
struction, wherein the heat of the waste gases  
is utilized in heating air and producing gas  
80 for consumption in the furnace, thus prac-  
tically making a complete gas making and  
consuming plant of the apparatus.

Any one skilled in the art would be able to  
make a proper gas-making apparatus for  
utilizing the air and generating gas from the  
85 common knowledge of the art, and so far as the present invention is concerned this gas-  
making apparatus would be a matter of se-  
lection rather than of invention, the only  
novelty being in introducing into the gas-  
90 making apparatus the products of combustion from the clinker-burning furnace instead of  
heating the gas-making apparatus by a self-  
contained fire; but gas-making apparatuses  
95 have been heated by products of combustion from smelting and other furnaces. I have  
shown, however, the preferred form of gas-  
making apparatus. This consists of a pair  
of regenerating-chambers Q Q', filled with  
100 checker-work and communicating at top through pipes *q q'* with the uptake Z' and  
through pipes R R' with a return hot-air pipe  
G, hereinafter referred to. Valves *r r'* are  
arranged over the outlets of the chambers  
Q Q' in such manner that they can be shifted  
105 by suitable levers so that communication is



alternately established between one chamber and the uptake and with the other chamber and the air-pipe G. The lower ends of chambers Q Q' communicate by separate passages S S' with the outlet-passage S<sup>2</sup> from the combustion-chamber, and also communicate by passages s s' with an air-supply pipe II, hereinafter referred to. Valves T t are placed beneath the chambers in such position that they can be shifted so that communication is alternately established between one chamber and the combustion-chamber and between the other chamber and pipe II. The valves T t are preferably operated by a system of levers also arranged to operate valves r r', and the result is that at the will of the operator products of combustion can be directed through chamber Q (or Q') to the uptake Z' and simultaneously air directed from pipe II through the other chamber Q' (or Q) to the pipe G. Practically the valves are shifted at intervals so that the chambers Q Q' are alternately heated by the waste products of combustion and then utilized to heat air.

Athwart the passage S<sup>2</sup> is a retort U, to which oil can be supplied from a pipe u, and within each chamber Q Q' is a coil V for superheating steam supplied from any convenient source, the superheated steam being admitted into retort U with a proper quantity of oil and a water-gas made as in the well-known gas-making apparatus. The gas from the retort can be passed through either chamber Q or Q', (through which the products are not passing,) if desired, to be fixed, and thence led off to be utilized, or the gases may be carried directly to the furnace through a pipe g, hereinafter referred to.

As this particular gas-making apparatus forms the subject-matter of an application for patent filed by myself and J. B. Archer April 24, 1896, Serial No. 588,954, further description thereof in this application is unnecessary.

In passing through the casing D the clinker or ore is subjected to a blast of air moving toward the combustion-chamber and forced through the casing by a blower F of any suitable construction. The blades of the conveyer stir up the clinker or ore and cause the air to impinge thereagainst and rapidly cool it. The casing D should be of such length and the current of air passed through the casing of such volume that the clinker or ore will be practically cooled before it escapes from the casing into the crusher or other suitable receptacle.

The practical point to be attained here is the oxidizing and reduction of the temperature of the corporeal products which leave the combustion-chamber A in a superheated condition to such a point that they can be immediately crushed.

In cement-burning furnaces it is important that the clinker be oxidized and cooled after it leaves the combustion-chamber to put it in

condition for crushing. This is generally accomplished by exposure to the atmosphere in order to slake off any extraneous lime which may be associated with the clinker, and the time required for this purpose varies with the atmospheric conditions, damp weather facilitating the process. I accomplish this oxidizing and slaking of the clinker simultaneously with the cooling thereof by introducing into casing D along with the air a jet of steam from a pipe P, supplied with steam from the boiler or engine. (Not shown.) In practice it may be found that this steam-jet can be utilized to force air through the casing also. The steam facilitates the cooling of the clinker and oxidizes it very rapidly, so that by properly regulating the feed of clinker through the casing or making the latter sufficiently long the clinker will be thoroughly oxidized and slaked ready for the crusher. At the same time the steam as it nears the combustion-chamber becomes superheated and more or less decomposed into its constituent gases, which are of great value in making combustible gases or for combining with gaseous liquid or solid hydrocarbons in the combustion-chamber to support combustion therein. Thus by this apparatus air or steam or mixtures thereof can be utilized to cool, oxidize, and slake the clinker or products while being thereby raised to a temperature which renders them admirably adapted for advantageous use in making combustible gases or for assisting in combustion of fuel in the combustion-chamber.

When the heated air, steam, or mixtures thereof are introduced directly into the combustion-chamber A, to support combustion therein, they may be led therein to and through hopper C, or, if desired, they may be carried off and used elsewhere or led back to the gas-making apparatus Z and further heated or utilized therein. When the hot air, steam, &c., are thus diverted, double valves c c' are put in the throat of hopper C above the screw conveyer, the valves being opened and shut alternately by any suitable mechanism, so that while the clinker will be dropped into the casing D the flow of air through the hopper will be cut off and the air and steam, &c., pass out through a lateral pipe II, connected to the receiving end of casing, said pipe extending back to the gas-making apparatus Z, as shown in Fig. 1.

The combustion-chamber A may be mounted on rollers P', one of which is mounted on a shaft P<sup>2</sup>, which can be revolved by any suitable means and may be rotated by a sprocket-chain I, passing over a sprocket i on the shaft P, and a sprocket e on the projecting inner end of the shaft E' of the screw conveyer E, which shaft E' can be driven at its outer end by any suitable prime mover; or, if desired, power can be applied to the combustion-chamber and the screw conveyer driven from the latter, if necessary.

It will be observed that the cold air, steam,



&c., entering the end of casing D contact successively with pieces of clinker or ore of successively higher temperatures, ultimately leaving the casing at a temperature about  
 5 equal to that of the product falling from the combustion-chamber, while the latter as it moves toward the exit end of the casing D is gradually oxidized and reduced in temperature and finally escapes at a normal tempera-  
 10 ture. By this arrangement I am enabled to furnish the combustion-chamber with heated air, steam, &c., for combustion, or by supplying the gas-making apparatus therewith I am enabled to obtain greater efficiency in said  
 15 apparatus for a given amount of fuel burned and utilized in the primary combustion-chamber, (cylinder A, for instance.)

While I have illustrated the invention as applied and especially adapted to a rotary  
 20 combustion-chamber gas-burning clinker-furnace, it is obviously applicable to other varieties of furnaces producing heated corporeal products.

By "products" of the furnace I refer to the  
 25 tangible products thereof—not products of combustion—with which the present invention has nothing to do, and where "products" is used alone in the specification and claims it refers to the thing produced by or operated on  
 30 in the combustion-chamber, not to gases produced by combustion therein.

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

35 1. In a cement-burning apparatus, the combination of the combustion-chamber, a gas-making apparatus at one end thereof into which the waste products of combustion are discharged; a receptacle at the other end of  
 40 the combustion-chamber into which the corporeal products are delivered and means for passing the said corporeal products through said receptacle in one direction, and means for forcing air or steam or mixtures thereof  
 45 through the corporeal products in the receptacle; with a pipe for conducting heated air from the receptacle to the gas-making apparatus; means for admitting air to the combustion-chamber; and pipes for conducting gas

from the gas-making apparatus to the combustion-chamber to support combustion therein, all substantially as and for the purpose described. 50

2. The combination of a combustion-chamber, a gas-making apparatus having an air-heating chamber at one end thereof, into  
 55 which the products of combustion are delivered; and a casing at the opposite end into which the corporeal products of the combustion-chamber are delivered while hot; means  
 60 for passing said corporeal products through the casing in one direction; means for forcing air through the products in said casing and thence to the air-heating chamber of said  
 65 gas-making apparatus; a pipe for conducting hot air from said air-heating chamber to the combustion-chamber; and a pipe for conducting gas from said gas-making apparatus to the combustion-chamber, all substantially as  
 70 and for the purpose set forth.

3. The combination in a cement-burning apparatus, of a rotary combustion-chamber A having a stationary end plate *a*; a feed-hopper B, and delivery-hopper C; a casing D communicating with the delivery-hopper;  
 75 means for moving the hot clinker through said casing in one direction, and means for forcing air through the clinker in the casing in the opposite direction; combined with a  
 80 gas-making apparatus having an air-heating chamber, substantially as described, at the rear end of the combustion-chamber heated by the hot products of combustion therefrom; a pipe H for conducting hot air from the casing to the air-heating chamber; an air-pipe  
 85 G for directing hot air from said gas-making apparatus to the combustion-chamber; and a gas-pipe *g* for conducting gas from said gas-making apparatus into the combustion-chamber, all substantially as and for the purpose  
 90 set forth.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

ALEXANDER MARSHALL HAY.

Witnesses:

VIRGIL W. BLANCHARD,  
 ARTHUR E. DOWELL.