(No Model.) 4 Sheets—Sheet 1.

H. ADAMS & H. EISERT.

DRYING FURNACE FOR BREWERS' GRAINS, &c.

No. 507,085. Patented Oct. 17, 1893.

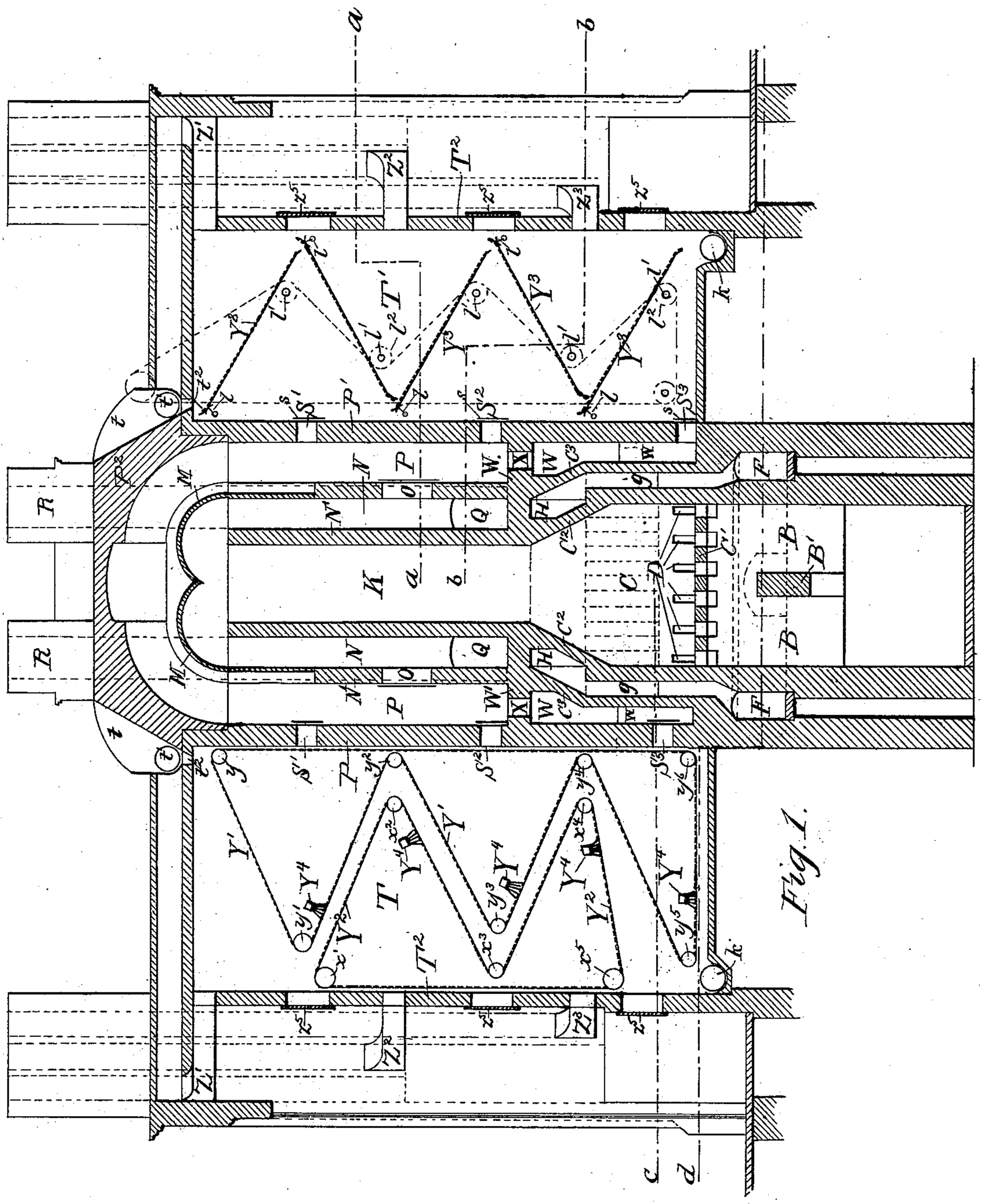

Fig. 1.

Witnesses.
Chas. H. Parker
J. F. Barker.

Inventors.
Henry Adams, and
Hermann Eisert
by H. N. Low atty.

(No Model.) 4 Sheets—Sheet 2.

H. ADAMS & H. EISERT.

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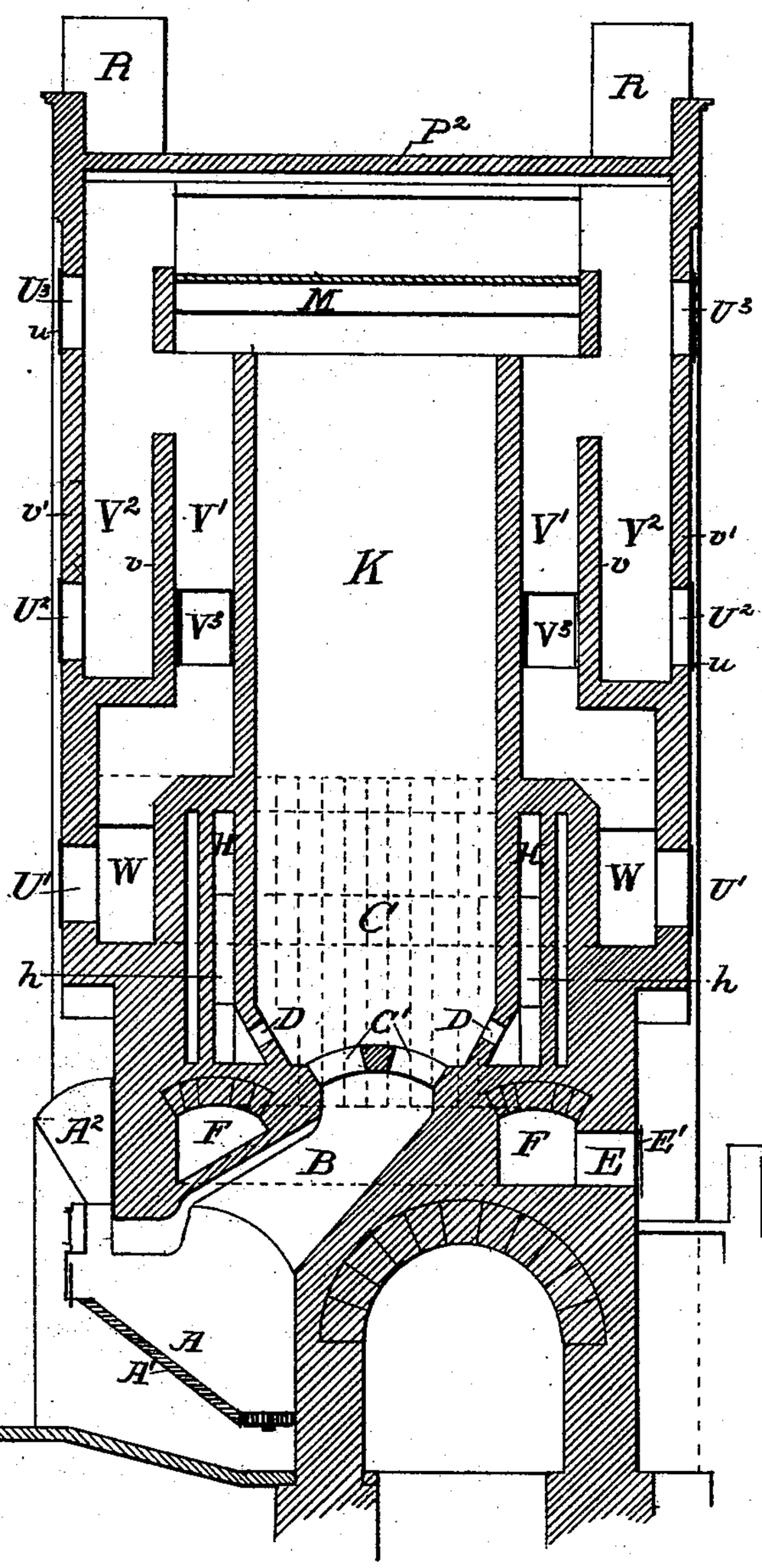

Fig. 2.

Witnesses
Chas. W. Parker
J. L. Burke

Inventors.
Henry Adams, a/s
Hermann Eisert
by H. N. Lovell Atty.

(No Model.)

4 Sheets—Sheet 3.

H. ADAMS & H. EISERT.

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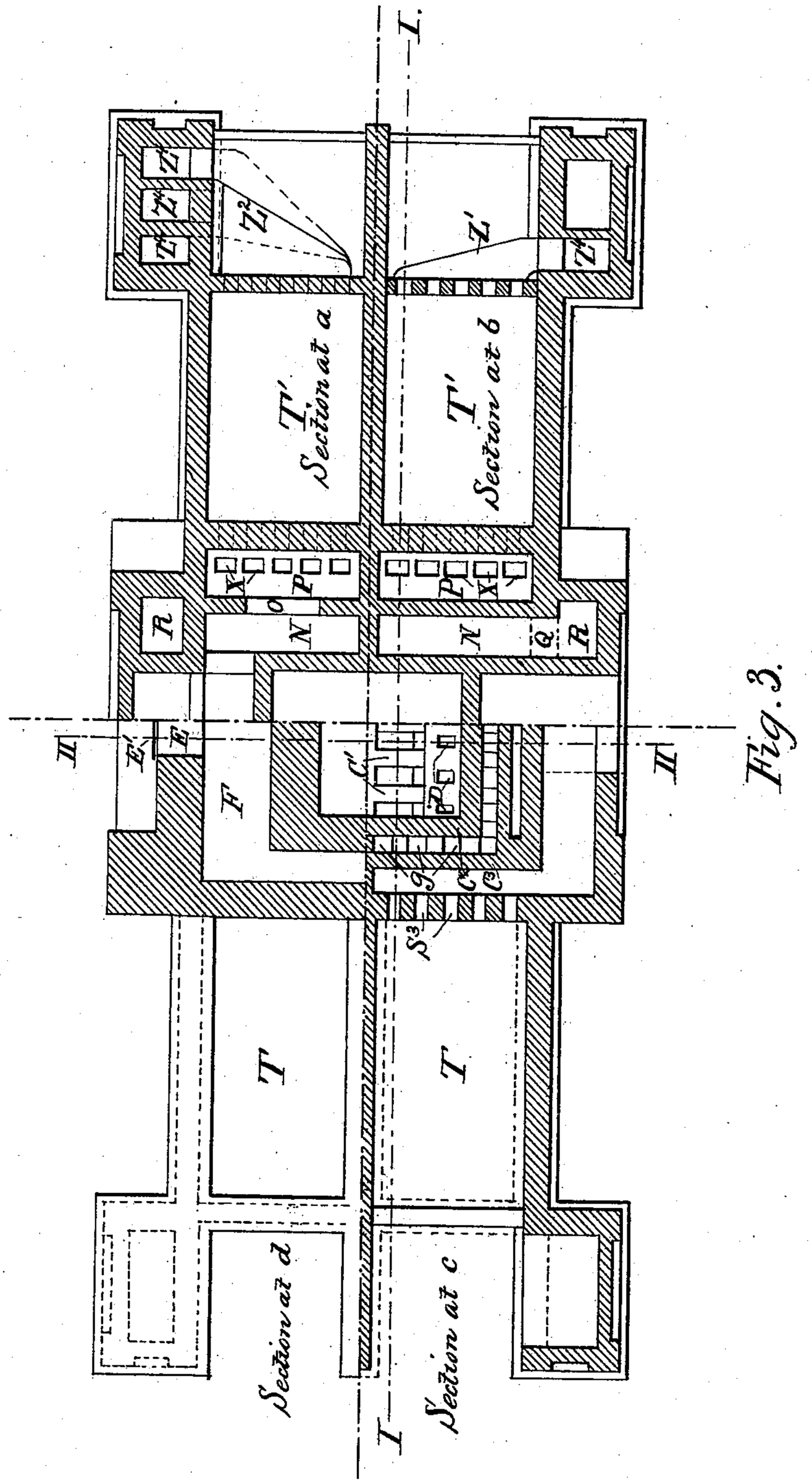

Fig. 3.

Witnesses
Chas. W. Parker
J. D. Parker.

Inventors.
Henry Adams, and
Hermann Eisert,
by H. N. Low atty.

(No Model.)

4 Sheets—Sheet 4.

H. ADAMS & H. EISERT.

DRYING FURNACE FOR BREWERS' GRAINS, &c.

No. 507,085. Patented Oct. 17, 1893.

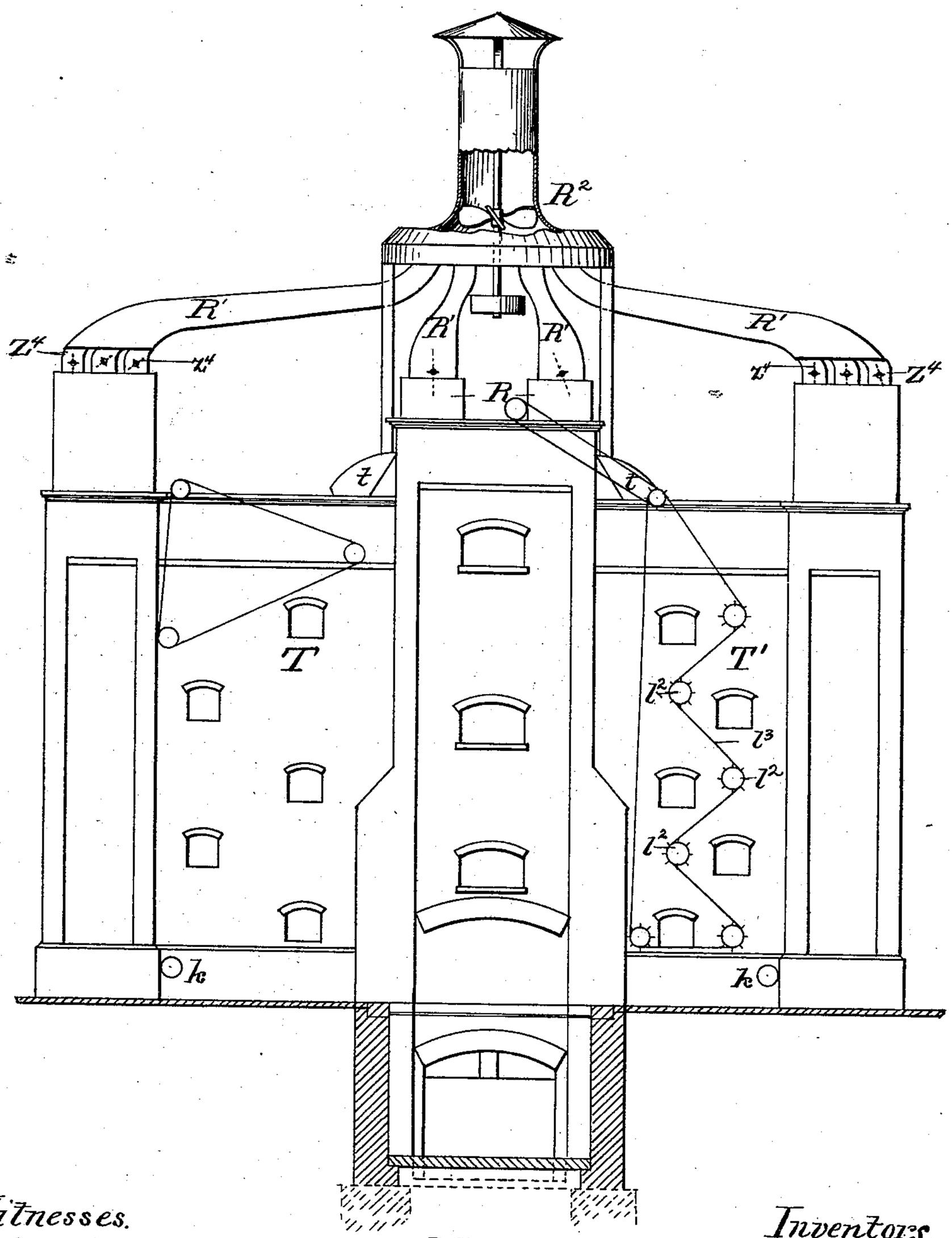

Fig. 4.

Witnesses.
Chas. W. Parker
J. S. Parker

Inventors.
Henry Adams, and
Hermann Eisert,
by H. N. Low
atty.

UNITED STATES PATENT OFFICE.

HENRY ADAMS AND HERMANN EISERT, OF BALTIMORE, MARYLAND.

DRYING-FURNACE FOR BREWERS' GRAINS, &c.

SPECIFICATION forming part of Letters Patent No. 507,085, dated October 17, 1893.

Application filed March 9, 1893. Serial No. 465,265. (No model.)

To all whom it may concern:

Be it known that we, HENRY ADAMS and HERMANN EISERT, citizens of the United States, residing at Baltimore city, in the State of Maryland, have invented certain new and useful Improvements in Drying-Furnaces for Brewers' Grains and other Substances; and we do 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.

Our improvements relate to that class of drying apparatus especially adapted for the treatment of brewer's grain, malt, wheat or other grains, with a view to extracting the moisture therefrom, be it much or little, with the greatest possible rapidity and to the exact degree desired.

Our improvements have for their object to apply air of different temperatures to the material to be dried at the different stages of its progress, as may be found most effective and beneficial for producing the result desired. For this purpose we provide a drying apparatus in which the air supplied to the material in its different stages may be very nicely regulated in temperature without necessarily diminishing or increasing the volume of the air so supplied.

A further important object of our invention is to conserve and utilize the heat of the generator to the greatest possible degree, resulting in economy of fuel and rapidity of action of the apparatus.

A further object of our invention is to make the apparatus as compact and economical in construction as possible, considering its great efficiency.

With such objects in view our improvements consist in the novel parts and combinations thereof hereinafter particularly set forth.

In order to make our invention more clearly understood we have shown in the accompanying drawings means for carrying the same into practical effect without however intending to limit our improvements in their useful applications to the particular construction which, for the sake of illustration, we have delineated.

In said drawings—Figure 1 is a vertical sectional view of a drying furnace embodying our improvements, taken on the line I—I, Fig. 3. Fig. 2 is a vertical sectional view of the same on line II—II, Fig. 3. Fig. 3 is a horizontal sectional view, the four quarters of which are taken respectively upon the four lines *a*, *b*, *c*, *d* of Fig. 1. Fig. 4 is an elevation of the apparatus.

Referring to the drawings, A indicates the fuel chamber of a furnace of which the grate is indicated at A′. This furnace is preferably constructed of brick, and lined with fire brick in the usual manner. Fuel such as coal is supplied through a hopper A^2 to the chamber A.

B, B are two passages through which the fuel gases arising from the imperfect or partial combustion in the chamber A, to which a limited amount of air is supplied, pass upward into the combustion chamber C. The passages B are partly separated from each other by a strengthening arch or partition B′, and the lower end of the combustion chamber C is partly closed by arches C′. Above the latter arches atmospheric air is admitted to the chamber C through passages D and enables a perfect combustion of the fuel gases to take place. The air thus admitted is highly heated preliminarily to entering the combustion chamber by its passage and circulation through the uptake passages *g* which are formed between the walls C^2 of the combustion chamber and an outer partition C^3. These passages are formed on two sides of the furnace, the right and left in Fig. 1, and at their upper ends communicate with a peripheral passage H which extends horizontally around the combustion chamber within the partition C^3. With the passage H communicate a series of downtake passages or ducts *h* through which the said air flows and is still further heated. These ducts *h* are formed upon the opposite sides of the combustion chamber other than those sides at which the passages *g* are situated (the right and left in Fig. 2) and terminate in the inlet openings D already referred to. Air is supplied to the passages *g* from a duct F which passes around the furnace from openings E and extends beneath the lower end of, and communicates with, said passages. The openings E are provided with dampers E′ by which the ingress of the outside air may be accurately

regulated. We thus produce what is practically a regenerative furnace of very efficient character and one which is especially adapted for use in a drying apparatus.

From the combustion chamber C the products of combustion pass up the shaft K, which is also preferably constructed of fire brick, being exposed to a very high degree of heat. The shaft K is somewhat flattened in form—that is to say two of its sides are longer than the others, and over said longer sides the products of combustion are caused to pass, being divided into two currents and deflected downward to the right and left by a cast iron hood M which has a double-arched form as best seen in Fig. 1. The hot gases thus deflected pass downward through vertical passages N which are formed upon each side of the shaft K by external fire brick walls N′. The passages N at their bottoms communicate by horizontal openings Q with flues R through which such part of the heated products of combustion as it is not desired to use for the purposes of drying may pass directly out of the apparatus. Such direct passage of the gases may be entirely, or partly checked by dampers R′ applied at suitable points, for instance across the openings Q.

O, O are openings formed through the walls N′ and furnish means of communication between the passages N and mixing chambers P which latter are inclosed between the partitions N′ and the main external walls P′ of the furnace. Said mixing chambers may communicate with each other at their upper ends over the hood M, where they are inclosed by the top arch P^2 of the furnace.

We will now describe the means for introducing and mixing outside air, in the desired proportion according to the substance to be treated with the said gases or products of combustion.

U′, U^2, U^3 are openings through the front and rear furnace walls, through which outside air may be introduced and which are controlled by dampers *u*.

V′, V′ indicate front and rear air chambers which are formed next to the front and rear of the shaft K and which communicate at their lower ends with the openings U′. Said air chambers are inclosed by partitions *v* which join the front and rear furnace walls *v′* as best seen in Fig. 2. Between the partition *v* and walls *v′* are formed external air chambers V^2 which communicate with the openings U^2 and U^3. The air entering through the openings U′, unless otherwise directed, as hereinafter explained, passes up through the chambers V′ and along the highly heated walls N′ of the shaft K, thence over the upper ends of the partitions *v* and into the outer air chambers V^2, thence over the hood M, and thence down into the mixing chamber P where it mingles with the products of combustion. The air which enters through the opening U^2, U^3 passes up through the air chambers V^2 and thence over the hood and into the mixing chambers in a similar manner.

V^3 are openings from the air chambers V′ directly into the passages N which openings are controlled by suitable dampers v^3.

W, W indicate horizontal air passages extending from the lower ends of air chambers V′ along the sides of the furnace outside of the walls C^3 and within the main walls P′. These passages W receive air from the openings U′ and deliver it through downwardly extending passages *w* and openings S^3 into the drying chambers hereinafter described. The inner and outer furnace walls are connected by a horizontal partition W′, through which are formed vertical passages X through which cool or slightly warmed atmospheric air may pass into the lower portions of the mixing chambers P.

T, T′ indicate the drying chambers constructed, one or more at each side of the furnace and contiguous to a mixing chamber P, with which they communicate by openings S′, S^2 through the walls P′. These openings are controlled by suitable dampers *s*. The grain or other material to be dried is deposited in a suitable hopper *t* formed at the top of the drying chamber, whence it is fed by a screw *t′* through an opening t^2 into the chamber.

Referring to the chamber T, Y′ is a traveling belt or apron preferably of reticulated material which passes over a roller *y* beneath the opening t^2, thence outward over a roller *y′* a little lower than the former, thence inward and downward over a roller y^2, and so on in a zig-zag path over rollers y^3, y^4, y^5, making as many traveling supporting shelves for the material to be dried as may be desired, or as may be permitted by the height of the apparatus. From the roller y^5 the apron passes to a guide roller y^6 and thence upward to the roller *y*, making an endless conveyer, which however does not support the material constantly but at intervals during its downward passage through the chamber. Y^2 is a similar traveling apron arranged in a zig-zag manner substantially parallel with the first apron and adapted to alternate with the same in carrying the material to be dried, as clearly indicated in Fig. 1. Said second apron is carried by rollers x', x^2, x^3, x^4 and x^5. The aprons are driven by pulleys on the ends of the shafts of certain of the supporting rollers and outside of the drying chamber.

Referring to the chamber T′, Y^3 indicates an inclined screen of reticulated material, a series of which screens, one below the other, is arranged in the drying chamber in such manner that the material to be treated will pass through the opening t^2 to the upper end of the uppermost screen, thence along said screen and to the end of the next screen below, and so on until the bottom of the chamber is reached. The material is agitated and

its passage along the screens Y^3 facilitated and hastened by any suitable movement of the screens.

The dried material is delivered at the bottom of the drying chambers to conveyers *k* by which it is carried laterally to the exterior of the apparatus.

Through the outer wall T^2 of the drying chambers are formed air-exit openings z', z^2, z^3, which communicate with a series of air boxes or trunks Z', Z^2, Z^3. The latter communicate with independent stacks or chimneys Z^4, having dampers z^4. R′ is an air box or conduit connecting the upper ends of the flues Z^4 and R with an exhausting fan or apparatus R^2. By this latter a strong and constant current of heated air, tampered at different points in the manner already described by the admixture of external air, is kept up through the various passages and flues of the furnace and through the drying room. By this means a forced draft can be given to the furnace of any desired degree of force and the maximum heat derived from it in a given time, care being taken not to make the draft so rapid as to withdraw the combustible gases before they are entirely consumed.

The extent to which the exhaust apparatus draws on the furnace will depend upon, and can be diminished by the admission of outside air as hereinbefore described.

We have thus produced a drying apparatus which, considering its great capacity, is most compact in arrangement and rapid, efficient, and economical in operation, and the action of which in all parts is completely under control.

The aprons Y', Y^2 are each provided with a series of brushes Y^4. These brushes are situated just at or immediately after the points in the travel of the aprons where they cease to convey the material, and we thus insure that immediately after each carrying portion of an apron has deposited its load it shall be efficiently cleaned so as to permit the free passage of drying air and access of the latter to those portions of either apron which are loaded with material to be dried.

z^5 indicates doors through which access may be had to the drying chambers T, T′ for the purpose of adjusting, repairing or removing the screens or aprons.

Having thus described our invention, what we claim is—

1. In a drying apparatus, the combination with the drying chambers of the furnace having the combustion chamber and flue K, the mixing chambers P intermediate between said flue and the drying chambers, means for directing the products of combustion from said flue into the said mixing chambers, and the air heating chambers situated at the other sides of the said flue K and communicating at their upper ends with the said mixing chambers, and openings for delivering the mingled air and the products of combustion from the said mixing chambers to the drying chambers, substantially as set forth.

2. In a drying apparatus the combination of a furnace, air passages therein and external to the combustion chamber, communications from said passages to the combustion chamber for supplying heated air to the latter, a shaft K for the products of combustion, air chambers at the sides of said shaft, mixing chambers at the other sides of said shaft, means for directing the air from said air chambers and the products of combustion from said shaft into the mixing chambers, and drying chambers communicating with the mixing chambers, substantially as set forth.

3. In a drying apparatus the combination of a furnace having the shaft K and mixing chamber P, the arch or hood M for directing the products of combustion from said shaft to the mixing chamber, means for conducting fresh air over the top of said hood to the mixing chamber, and a drying chamber communicating with the mixing chamber, substantially as set forth.

4. In a drying apparatus a furnace having the combustion chamber C, air passages F, *g*, H and *h* formed in the walls of the furnace and communicating with the combustion chamber for delivering fresh air thereto, the descending passages N for the products of combustion and communicating with the combustion chamber, a drying chamber having a communication with said passages N, air chambers in the walls of the furnace for receiving and heating fresh air and also communicating with said drying chamber, and means for causing a movement of the air and gases through the furnace and drying chamber, substantially as set forth.

5. In a drying apparatus the combination with a drying chamber or chambers, of a furnace adapted to deliver heated air thereto, said furnace being provided with the combustion chamber C, air passages formed in the walls of the furnace and communicating with the combustion chamber for delivering heated air thereto, the shaft K leading from said combustion chamber, a deflecting top above said shaft, passages N outside of said shaft, flues R communicating with said passages N, mixing chambers adapted to receive the products of combustion from said passages N, and means for supplying atmospheric air to said mixing chambers, the mixing chambers being in communication with said drying chambers, substantially as set forth.

6. In a drying apparatus a series of alternate oppositely inclined reticulated surfaces for supporting the material to be dried, and air heating and directing means for supplying heated air laterally to said series of surfaces so as to operate both upon the bottom and upon the top of said material, and exhausting appliance for drawing the drying air laterally through said reticulating surfaces and the material thereon, means for moving said surfaces to facilitate the passage of the air therethrough, and brushes situated at those

points of said surfaces where they cease to support the material, substantially as set forth.

7. In a drying apparatus the combination, in a chamber, of two parallel independent aprons, each apron being arranged with oppositely inclined or zigzag portions, independent sets of rollers supporting said aprons, air supply openings in the chamber opposite the inclined faces of one of said aprons and air exit openings at the other side of the aprons, substantially as set forth.

In testimony whereof we affix our signatures in the presence of two witnesses.

HENRY ADAMS.
HERMANN EISERT.

Witnesses:
M. M. GOWANS,
H. N. LOW.