H. W. KENT & E. H. LICHTENBERG.

ORE ROASTING FURNACE.

APPLICATION FILED MAR. 8, 1909.

947,337.

Patented Jan. 25, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

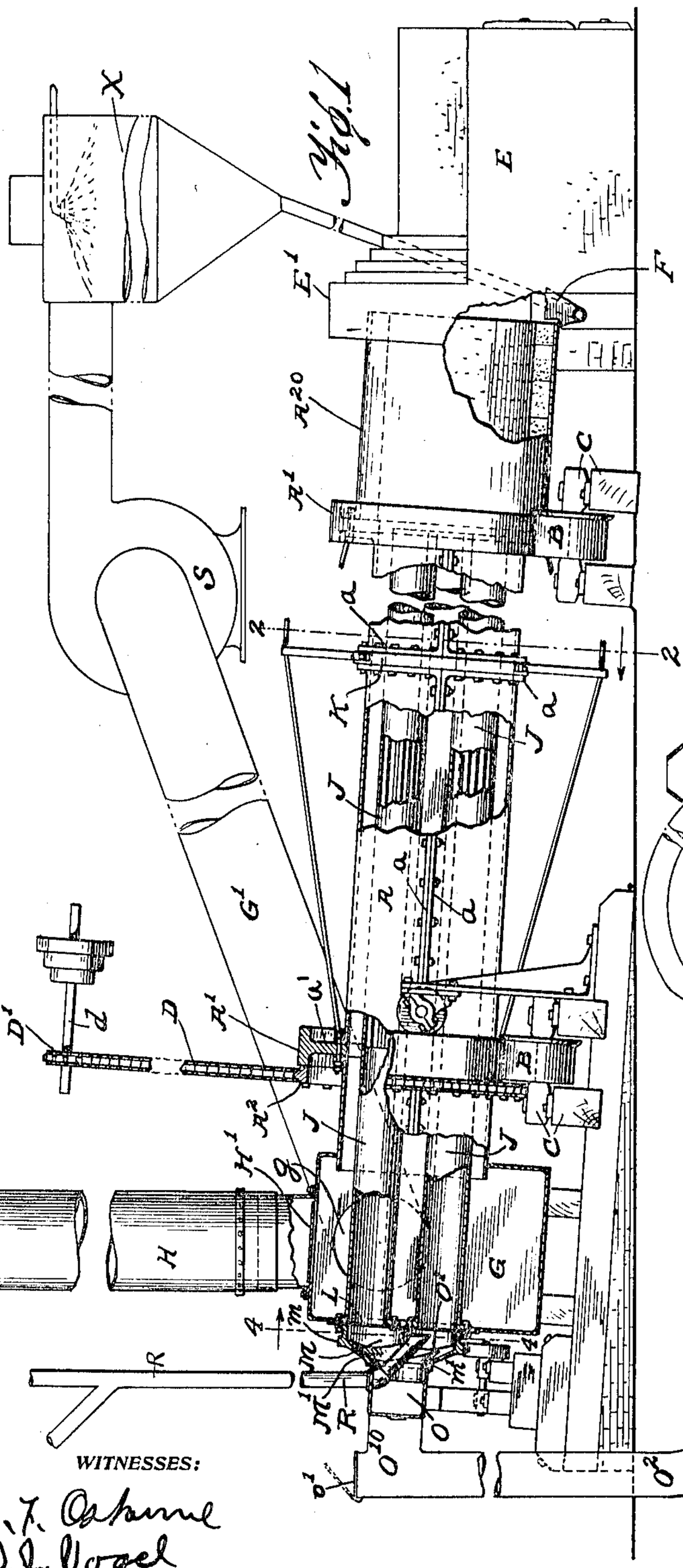


Fig. 6.

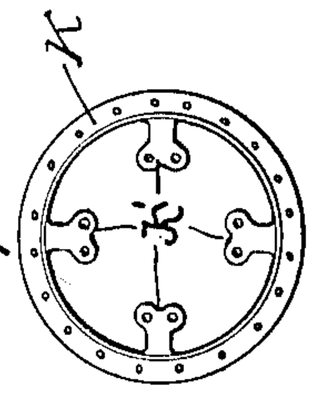
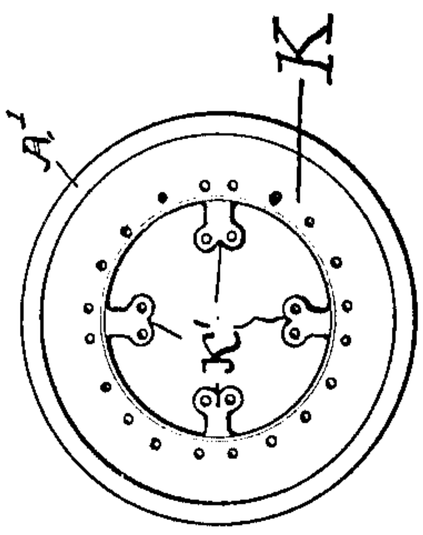
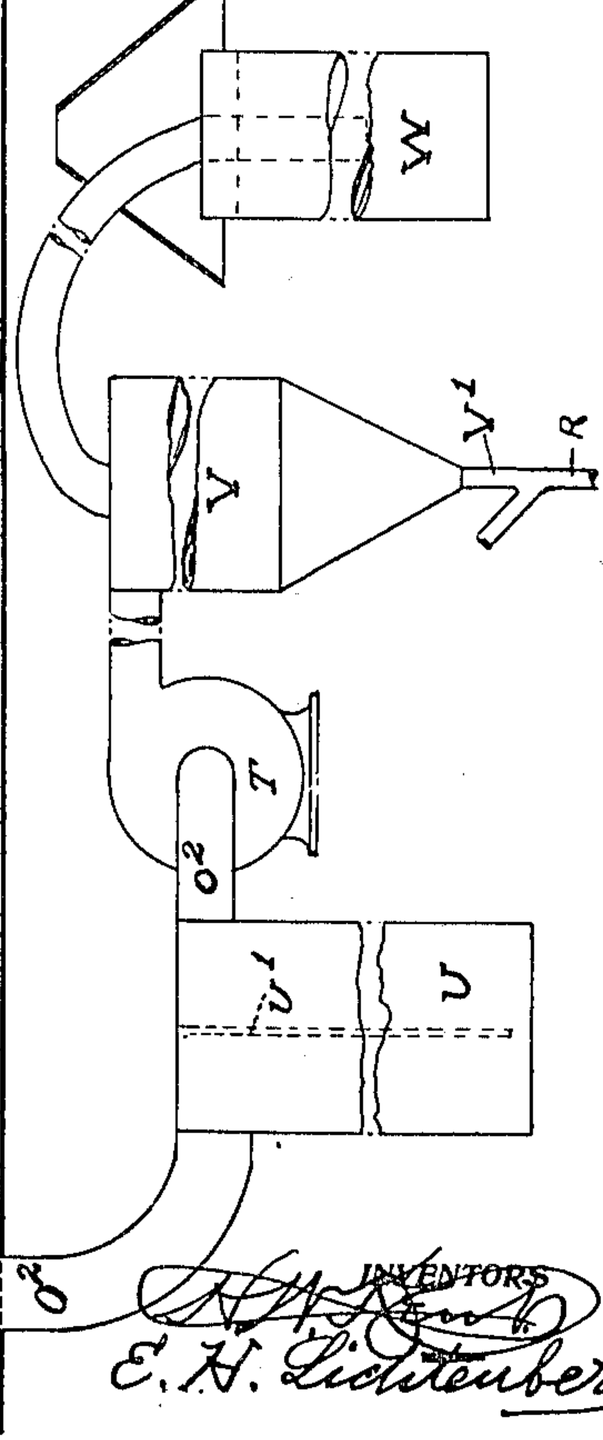


Fig. 7.





WITNESSES:

E. T. Osborne

O. J. Vogel

INVENTORS

H. W. Kent

E. H. Lichtenberg

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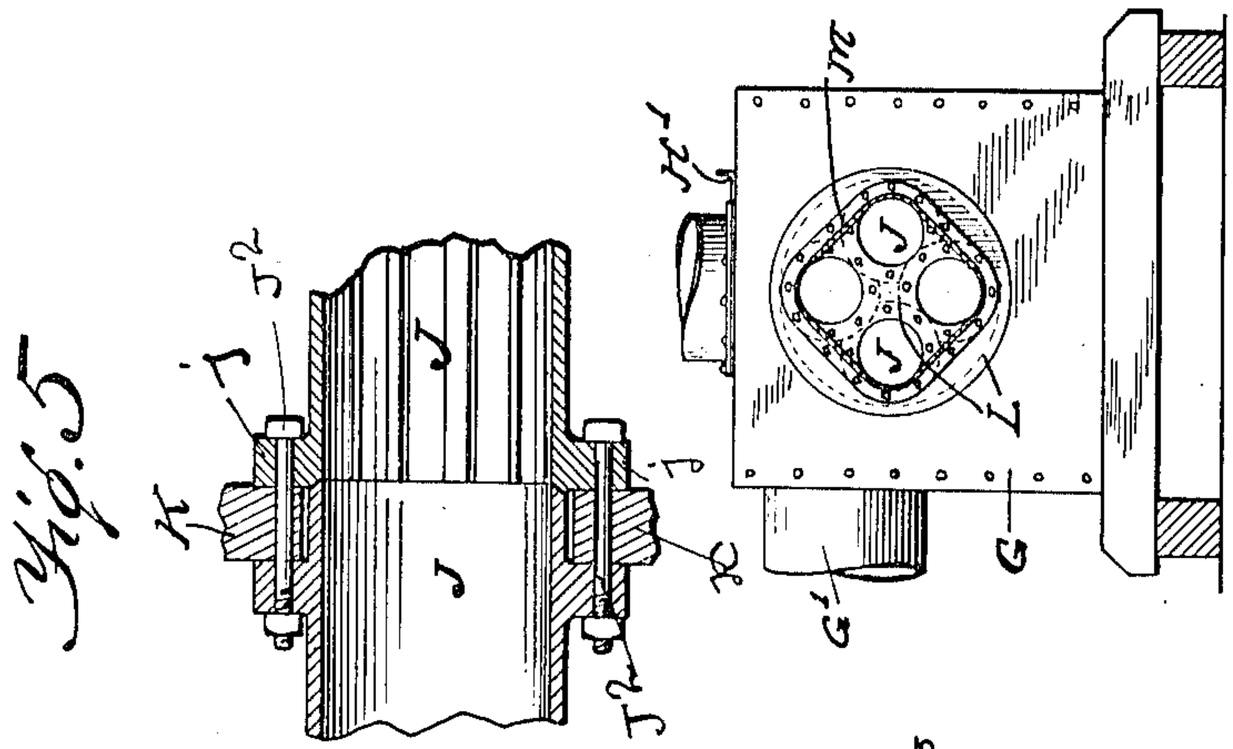

Fig. 5

Fig. 4

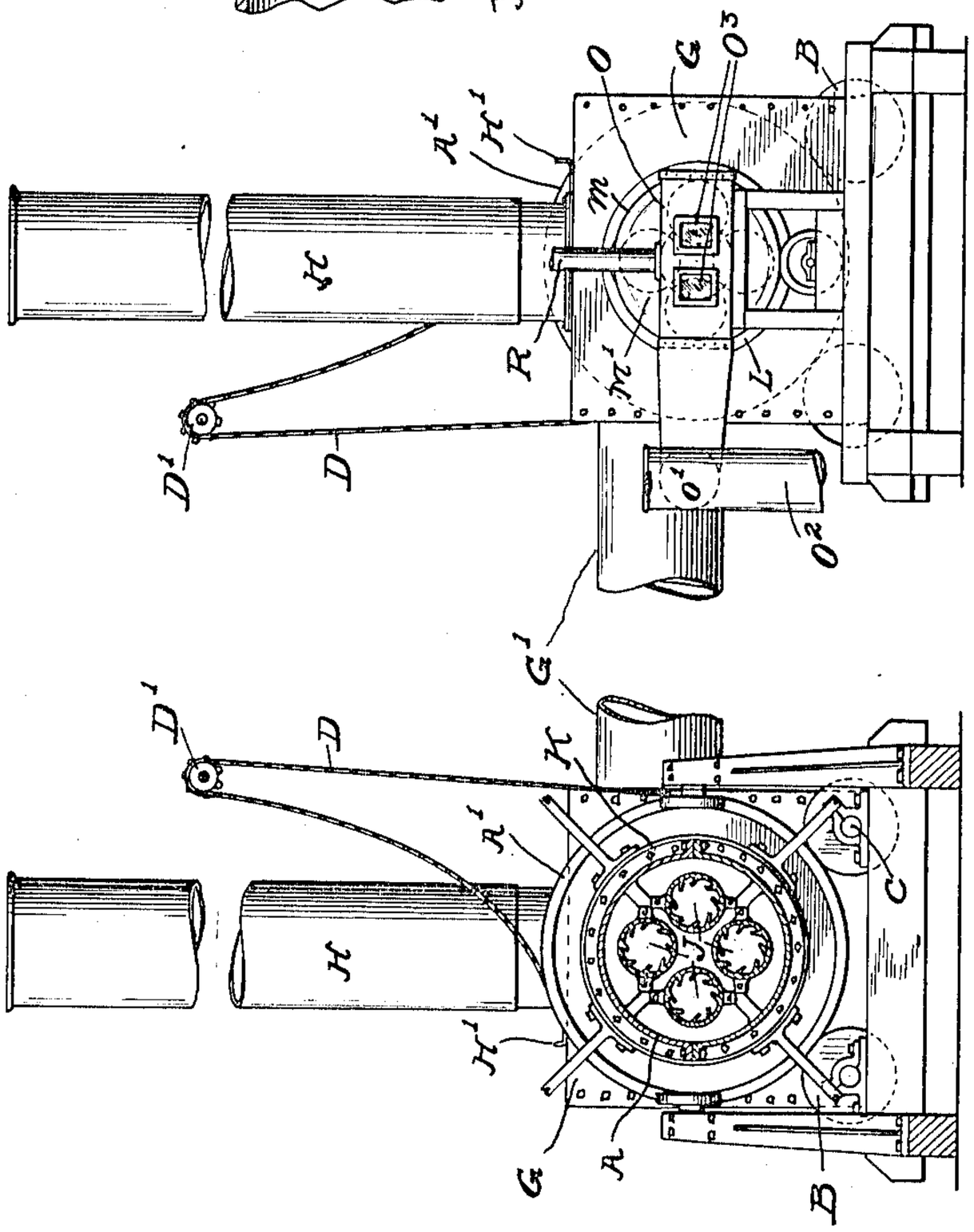

Fig. 3

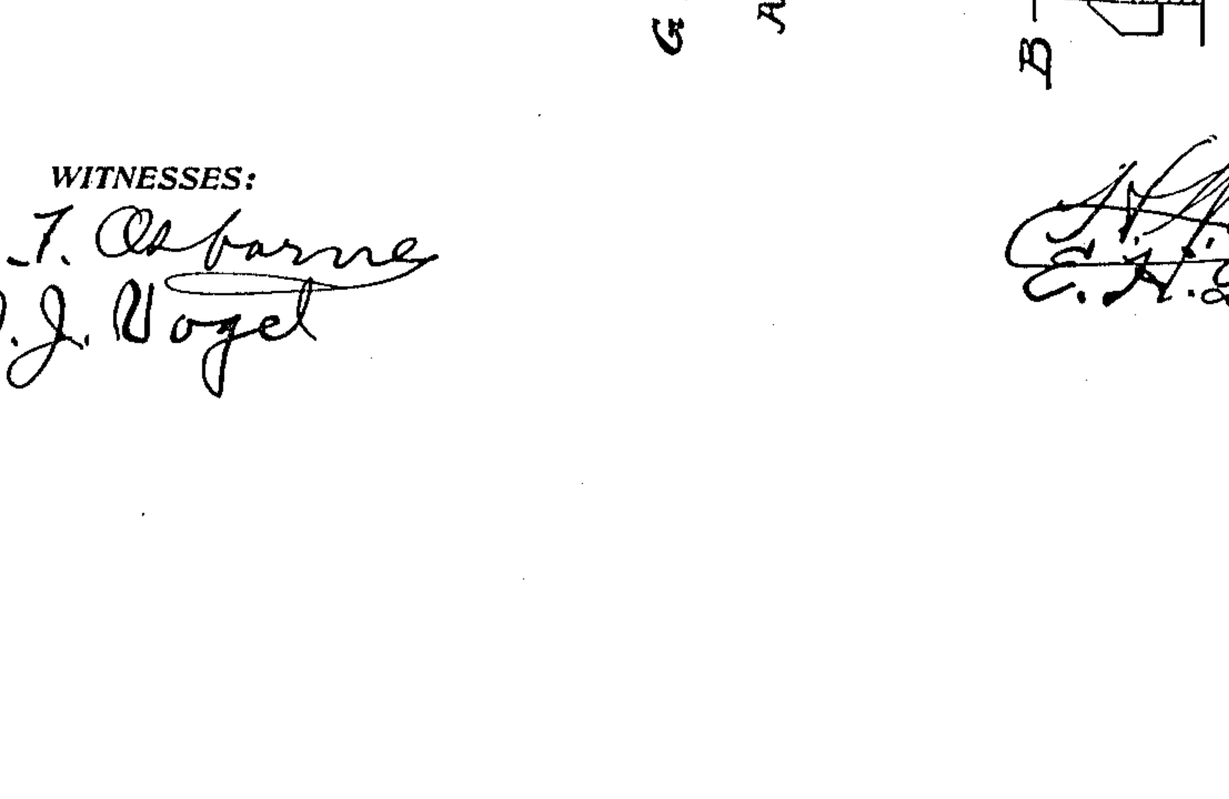

Fig. 2

WITNESSES:

E. T. Osborne

O. J. Vogel

INVENTORS

H. W. Kent

E. H. Lichtenberg

UNITED STATES PATENT OFFICE.

HENRY W. KENT, OF MILWAUKEE, WISCONSIN, AND ERICH H. LICHTENBERG, OF CHICAGO, ILLINOIS, ASSIGNORS TO KENT ORE REDUCTION COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ARIZONA TERRITORY.

ORE-ROASTING FURNACE.

947,337. Specification of Letters Patent. Patented Jan. 25, 1910.

Application filed March 8, 1909. Serial No. 481,996.

To all whom it may concern:

Be it known that we, HENRY W. KENT and ERICH H. LICHTENBERG, citizens of the United States, residing, respectively, at Milwaukee, in the county of Milwaukee and State of Wisconsin, and at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Ore-Roasting Furnaces, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

The purpose of this invention is to provide an improved apparatus for roasting ores and disposing of the products driven off in the process.

It consists in the features of construction shown and described as indicated in the claims.

In the drawings:—Figure 1 is a side elevation of a furnace embodying this invention, being broken away in part to disclose interior structure and shown in vertical axial section at the stack end, said figure also comprising a partly diagrammatic representation of associated parts of the entire apparatus. Fig. 2 is a section at the line 2—2 on Fig. 1. Fig. 3 is a rear end elevation. Fig. 4 is a detail section at the line 4—4 on Fig. 1. Fig. 5 is a detail axial section of the meeting portions of two sections of one of the ore pipes within the furnace. Fig. 6 is an elevation of a spider which is interposed between consecutive sections of the shell. Fig. 7 is a similar view of such a spider comprising, in addition, a tread flange.

The roaster shown in the drawings comprises a long cylindrical rotary furnace chamber, A, mounted at an inclination of a few degrees from horizontal, provided with exterior tires, A^1, by which it is carried upon supporting rollers, B, journaled upon foundation supports, C, in a manner well understood and requiring no further detail explanation. A sprocket rim, A^2, adjacent to and rigid with one of the tires, A^1, is encompassed by a drive chain, D, driving power from any convenient source, as from a sprocket wheel, D^1, on an overhead shaft, *d*, for rotating the cylinder, A, slowly to cause the material which is fed into it or into the ore tubes within it, as hereinafter described, to advance slowly from the upper to the lower end. At the lower end the cylinder, A, has the enlarged section, A^2, interiorly lined with fire brick. Any suitable means for furnishing the furnace with flame entering it at the lower end,—that is, through the section, A^2, may be associated with the furnace at said lower end. The drawings represent conventionally a fire box, E, in which the flame may be generated from fuel in combustion or by any other means so as to emerge from the fire-box into the section, A^2, of the rotary element of the roaster. The element, of whatever form it may be, in which flame is generated, here represented by the fire box, E, comprises a hood, E^1, into which the lower end of the rotary element, A, protrudes for receiving the flame and for discharging the roasted ore which is delivered from the lower side of the rotary element into a receptacle, F, in which it is cooled by the action of water discharged thereinto, as hereinafter described, and which may also be provided with a continuously-operating conveying device for carrying away the ore, rendering the operation continuous. At the higher end of the rotary element, A, it intrudes into a fixed chamber, G, which is connected with a stack, H, by which a strong draft is produced through the entire length of the rotary element, A.

Within the rotary cylinder, A, and extending longitudinally therethrough from the enlarged section, A^2, but not extending within that section, there are mounted a plurality, and as illustrated, four ore tubes, J, which are all positioned eccentrically with respect to the cylinder and rigidly connected therewith by spiders, K. At the upper end, these ore tubes extend entirely across the chamber, G, and are connected to a plate, L, which is apertured coincidently with the ends of the tubes so that they open therethrough. This plate is circular and closes a circular opening in the rear wall of the chamber, G, so that the tubes, J, do not communicate with said chamber, G, nor with the stack leading therefrom, but only with a square chamber, M, which is formed upon the outer or rear side of the plate, L, encompassing the four openings therein through which the ore tubes communicate, said openings being at the four corners of the square chamber respectively. The wall, M^1, of this square chamber opposite the apertured plate, L, is

in general frusto-conical in form; that is, slopes from the four sides of the square chamber to a cylindrical flange, m^1, which terminates it co-axially with the rotary cylinder, A. To assist in sustaining the group of ore tubes at the upper end, where it will be observed they project for a considerable distance from the last spider by which they are supported within the rotary cylinder, A, the chamber, M, is provided with an exterior circular tire or tread band, m, which rides upon a flange of the supporting wall, M^1, suitably mounted upon the foundation supports. Upon said foundation support there is mounted a chamber, O, preferably cylindrical about the axis of the rotary cylinder, A, and necessarily so at the forward end which is open and intrudes into the chamber, M, passing through and fitting within the cylindrical flange, m^1, with which that chamber terminates. Within the frusto-conical head, M^1, of the chamber, M, the fixed cylindrical chamber, O, may be provided at its lower side with a downwardly sloping lip, O^1, to serve a purpose hereinafter explained. An ore supply pipe, R, leads from any source of ground or broken ore in the top of the chamber, O, and obliquely through its open end into the chamber, M, within which it discharges near the lower part thereof, but necessarily within the circumference of a circle which may be inscribed within the four-square walls of said chamber.

The chamber, G, has a side opening, g, from which connection is made by the pipe, G^1, to an exhaust fan, S, which under certain circumstances for certain purposes may be operated to supply a draft in lieu of the stack, H, which would in that case be closed by a suitable damper conventionally indicated at H^1. From the rear side of the chamber, O, communication is provided either with the outer air or with a fan, T. For this purpose, a T-fitting, O^1, is connected with said rear end of the chamber, O, said fitting having its cross vertical, the upper end being provided with a hinge cover or valve, o^1, the lower end connected by a pipe, O^2, which communicates with the fan, T, but intermediately leads into a settling chamber, U, which is conventionally illustrated, the action being sufficiently indicated by the showing of the vertical diaphragm, U^1, around which the indrawn current is deflected and caused to deposit the dust which it may carry, the gases passing on by the outlet branch, o^2, of the pipe to the intake of the fan, T, as shown. The fan discharges into a dust collector, V, also conventionally represented by its outlines only. This dust collector has its dust discharge, V^1, leading into the ore-supply pipe, R, and it will be understood that the chamber, V, and other elements connected with the pipe, O^2, are so situated as to permit this discharge, and that the diagrammatic presentation in Fig. 1 is not to be understood to the contrary nor as indicating the supplemental devices in their correct proportions, either with respect to each other or with respect to the rotary furnace. From the dust collector, V, the gases pass into a vat where the absorbable elements may be absorbed, the remainder passing off freely. When the connection described is to be employed for giving communication with the outer air at the rear side of the chamber, O, the cover or valve, o^1, will be set open, and the draft induced either by the stack or fan, S, will then cause air to enter by way of the T-fitting, O^1, to the chamber, O, thence passing through the ore pipes, J, to the forward end emerging in the chamber, A^2, for assisting combustion, of which the products then pass back outside the ore tubes, J, to the outlet either into the stack or into the pipe, G^1, leading to the fan, S.

In order that the operator may at all times observe the condition of the ore in the ore tubes, the outer end or side of the chamber, O, is provided with two transparent panes, O^3, in such position that through them the operator can look lengthwise into each ore tube while it is at the middle point of its course passing up or down with the rotation of the furnace cylinder; that is, at the position at which the ore will be lying most nearly flat in the lower part of the ore tube so that its condition can be most readily observed.

The certain details of construction of the rotary furnace in connection with the ore tubes are of importance and will be now described.

Preferably, the rotary furnace chamber, A, is cast. It is difficult to obtain a correct cylinder of such size by casting in one piece or in complete cylinder sections of any considerable length, and the cylinder, A, in this construction is therefore preferably cast in half cylindrical sections, as seen in Fig. 1, each section being flanged at its ends and longitudinal edges for junction with the mating half and with the longitudinally adjoining section. At each junction between the longitudinally consecutive sections, one of the spiders, K, is interposed, these spiders being formed each as an annulus of suitable diameter to be thus interposed between the end flanges, a, of the sections of the cylinder, A, so as to be bound by the bolts which bind the sections together, taking through their end flanges, as may be clearly understood from Figs. 1, 5 and 6. At such of the junctions as are situated in proper position for location of a tread flange, A^1, by which the cylinder, A, is carried on the rollers, B, as described, the spider, K, is formed integrally with the tread flange, A^1, the web, a^1, which

connects it with the spider being the mere continuation of the annulus of the annular portion, *k*, of the spider. By this means, the weight of the cylinder carried by the tread rims resting on the rollers, B, is prevented from having any tendency to flatten the cylinder, which in fact is carried by the spider, K—A[1], whose rigidity in plane transverse to the cylinder is such that no appreciable flattening can occur, however great the load which the cylinder may at any time carry. The spiders, K, comprise, in addition to the annular element the short spokes, k^1, projecting inwardly for engagement between the lugs, *j*, of adjacent sections of the ore tubes, as seen in Figs. 2 and 5, and for effecting tight junction between such consecutive sections the tubes, J, are formed as shown in Fig. 5, with one end of each interiorly beveled and the opposite end exteriorly beveled, the lugs, *j*, being so positioned on the two adjacent ends and with respect to the interior and exterior beveled end surfaces that the bolts, J^2, taking through the lug, *j*, and the lugs, k^1, of the spiders will clamp said beveled surfaces together before being stopped by the intervening lugs, k^1, of the spiders, which, however, are only just slightly thinner than the interval between the opposed lugs when the beveled ends are closely clamped so that no perceptible looseness will exist at the junction.

We claim:—

1. In combination with a rotary furnace chamber, an ore tube extending longitudinally within said chamber eccentrically thereof and secured for rotation therewith; a fixed draft chamber in which the rotary furnace chamber discharges at one end and through which the ore tube extends, said draft chamber having the wall opposite the end of the rotary furnace chamber apertured in the path of rotation of the end of the eccentrically situated ore tube; a plate secured to said ore tube having an aperture coincident with the end of the tube and closing the said aperture in the draft chamber wall; a chamber beyond said plate encompassing the mouth of the ore tube and an ore chute discharging into the chamber.

2. In combination with a rotary furnace chamber, an ore tube extending longitudinally within said chamber eccentrically thereof and secured for rotation therewith; a fixed draft chamber in which the rotary furnace chamber discharges at one end and through which the ore tube extends, said draft chamber having the wall opposite the end of the rotary furnace chamber apertured in the path of rotation of the end of the eccentrically situated ore tube; a plate secured to said ore tube having an aperture coincident with the end of the tube and closing the said aperture in the draft chamber wall; a chamber mounted on and revolving with said plate outside the draft chamber having an aperture co-axial with the rotary furnace chamber; a fixed chamber having an aperture registering with said axial aperture; an ore chute leading through said fixed chamber into said axial aperture, and means for exhausting said fixed chamber.

3. In combination with a rotary furnace chamber, an ore tube extending longitudinally within said chamber eccentrically thereof and secured for rotation therewith; a fixed draft chamber in which the rotary furnace chamber discharges at one end and through which the ore tube extends, said draft chamber having the wall opposite the end of the rotary furnace chamber apertured in the path of rotation of the end of the eccentrically situated ore tube; a plate secured to said ore tube having an aperture coincident with the end of the tube and closing the said aperture in the draft chamber wall; a chamber mounted on and revolving with said plate outside the draft chamber having an aperture co-axial with the rotary furnace chamber; a fixed chamber having an aperture registering with said axial aperture; an ore chute leading through said fixed chamber into said axial aperture, and means for exhausting said fixed chamber, and independent means for exhausting the draft chamber.

4. In combination with a rotary furnace chamber, an ore tube extending longitudinally within said chamber eccentrically thereof and secured for rotation therewith; a fixed draft chamber in which the rotary furnace chamber discharges at one end and through which the ore tube extends, said draft chamber having the wall opposite the end of the rotary furnace chamber apertured in the path of rotation of the end of the eccentrically situated ore tube; a plate secured to said ore tube having an aperture coincident with the end of the tube and closing the said aperture in the draft chamber wall; a chamber mounted on said plate outside the draft chamber having sides converging about the mouth of said eccentrically situated ore tube, said chamber having a central aperture, and an ore chute discharging through such central aperture.

5. In combination with a rotary furnace chamber, an ore tube extending longitudinally within said chamber eccentrically thereof and secured for rotation therewith; a fixed draft chamber in which the rotary furnace chamber discharges at one end and through which the ore tube extends, said draft chamber having the wall opposite the end of the rotary furnace chamber apertured in the path of the end of the eccentrically situated ore tube; a plate secured to said ore tube having an aperture coincident with the end of the tube and closing the

said aperture in the draft chamber wall; a chamber mounted on said plate outside the draft chamber having two sides at an angle embracing the mouth of the ore tube and its outer wall, in general frusto-conical, and apertured about the axis of the rotary furnace chamber, and an ore chute discharging through such aperture.

6. In combination with a rotary furnace chamber, an ore tube extending longitudinally within the same eccentrically thereof and secured for rotation therewith; a fixed draft chamber into which the rotary furnace chamber discharges at one end and through which the ore tube extends; a fan for exhausting the draft chamber, said chamber having the wall opposite the end of the rotary furnace chamber apertured in the path of rotation of the end of the eccentrically located ore tube; a plate secured to the ore tube apertured coincidently with the end of the tube and closing said aperture in the draft chamber wall; a chamber encompassing the path of rotation of the ore tube outside said plate, said chamber having an air inlet; a fan for exhausting the draft chamber; a dust washer into which the fan discharges, the ore tube being open for discharge into the rotary furnace at the end opposite the draft chamber; an ore conduit into which said end of the rotary furnace discharges, and a conduit from the washer discharging into said ore conduit.

7. In combination with a rotary furnace chamber, a plurality of ore tubes extending longitudinally within said rotary furnace, each eccentric with respect thereto and secured for rotation therewith; a fixed draft chamber into which the rotary furnace discharges at one end, the ore tubes extending at one end through the draft chamber and being open at the other end for discharge within the rotary furnace chamber, the draft chamber having a wall opposite the end of the rotary furnace chamber discharging thereinto apertured in the path of rotation of the ends of the ore tubes; a plate secured to such ore tubes and apertured coincidently with their mouths respectively and closing said aperture in the draft chamber wall; a chamber beyond said plate encompassing the path of rotation of the ore tube mouths and an ore chute discharging into said chamber.

8. In combination with a rotary furnace chamber, a plurality of ore tubes extending longitudinally within said rotary furnace, each eccentric with respect thereto and secured for rotation therewith; a fixed draft chamber into which the rotary furnace discharges at one end, the ore tubes extending at one end through the draft chamber and being open at the other end for discharge within the rotary furnace chamber, the draft chamber having a wall opposite the end of the rotary furnace chamber discharging thereinto apertured in the path of rotation of the ends of the ore tubes; a plate secured to such ore tubes and apertured coincidently with their mouths respectively and closing said aperture in the draft chamber wall; a chamber beyond said plate having its peripheral walls disposed substantially tangentially with respect to the apertures in the plate corresponding to the mouths of the ore tubes respectively and encompassing the path of rotation of said mouths, and an ore chute discharging into said chamber.

9. In combination with a rotary furnace chamber, an ore tube extending longitudinally within such chamber eccentrically thereof and secured for rotation therewith; a fixed draft chamber into which the rotary furnace chamber discharges at one end and through which the ore tube extends having its wall opposite the end of the rotary furnace chamber apertured in the path of rotation of the end of the eccentrically located ore tube; a plate secured to the ore tube apertured coincidently with the end thereof and closing said aperture in the draft chamber wall; a chamber beyond said plate encompassing the mouth of the ore tube and having an aperture in its wall opposite said plate axial with respect to the rotary furnace chamber; a fixed chamber with which said aperture communicates; an ore chute leading through said fixed chamber and discharging through said aperture; an exhaust fan connected with said fixed chamber; a separating chamber located between said fixed chamber and the intake of the fan; a dust collector communicating with the discharge of the fan and discharging into the ore chute.

10. In an ore roaster, in combination with a rotary furnace chamber; a plurality of ore tubes extending longitudinally within such chamber open for discharge into the chamber at one end and protruding without discharge thereinto at the other end; means for supplying ore to the last-mentioned end of the ore tubes; means for producing a draft through the rotary furnace chamber from the end at which the ore tubes discharge thereinto toward the opposite end, and means for admitting air into the ore tubes at the end at which the ore is supplied thereto in addition to the air entering with the ore.

11. In an ore roaster, in combination with a rotary furnace chamber, ore tubes extending longitudinally within said chamber for discharge at one end thereinto; a fixed draft chamber into which the rotary furnace chamber discharges at the other end, the ore tubes extending through said draft chamber and secured to a plate through which they open at the farther side thereof; a hood or chamber mounted on such plate encompassing the mouths of the tubes having its wall opposite the plate apertured axially with re-

spect to the rotary furnace; a fixed chamber with which said axial aperture communicates and a transparent window in the farther side of said fixed chamber.

12. In an ore roaster, in combination with a rotary furnace chamber, ore tubes extending longitudinally within such chamber, the rotary chamber being made of longitudinally successive cylindrical sections having flanged ends, and spiders consisting each of an annular rim adapted to be embraced between the flanges and inward projections for securing the ore tubes, the ore tubes being made with lugs for securing them to such inner projections of the spiders.

13. In an ore roaster, in combination with a rotary furnace chamber and ore tubes extending longitudinally within such chamber, spiders for securing the ore tubes to the rotary chamber, such chamber being made in longitudinal sections having flanged ends, the spiders each comprising an annular rim adapted to be engaged between the flanged ends of the rotary chamber sections and having inwardly extending lugs, the ore tubes being made in longitudinally consecutive sections with matched ends, and lugs proximate to the ends positioned for engaging lugs of the spiders and bolted together embracing said spider lugs between them.

14. In an ore roaster, in combination with a rotary furnace chamber, ore tubes extending longitudinally within such chamber; spiders by which the ore tubes are secured to the rotary chamber, the chamber being made in longitudinally consecutive sections with flanged ends, the spiders being formed with an annulus adapted to be engaged between the flanges of the rotary chamber sections, certain of said spiders being extended outwardly beyond such engageable annulus and provided with an exterior tread rim, the rotary chamber sections being secured together by bolts through their flanges taking through and binding the spiders to the chamber at such junction.

15. In an ore roaster, in combination with a rotary furnace chamber, ore tubes extending longitudinally within said chamber for discharge at one end thereinto, such ore tubes each comprising a plurality of sections joined end to end; spiders by which the ore tubes are secured with respect to the rotary furnace chamber, such spiders being formed for constituting couplings connecting the adjacent ends of the ore tube sections.

In testimony whereof, we have hereunto set our hands respectively, at Chicago, Illinois, this 2d day of March, 1909.

HENRY W. KENT.
ERICH H. LICHTENBERG.

Witnesses:
JULIA S. ABBOTT,
M. GERTRUDE ADY.