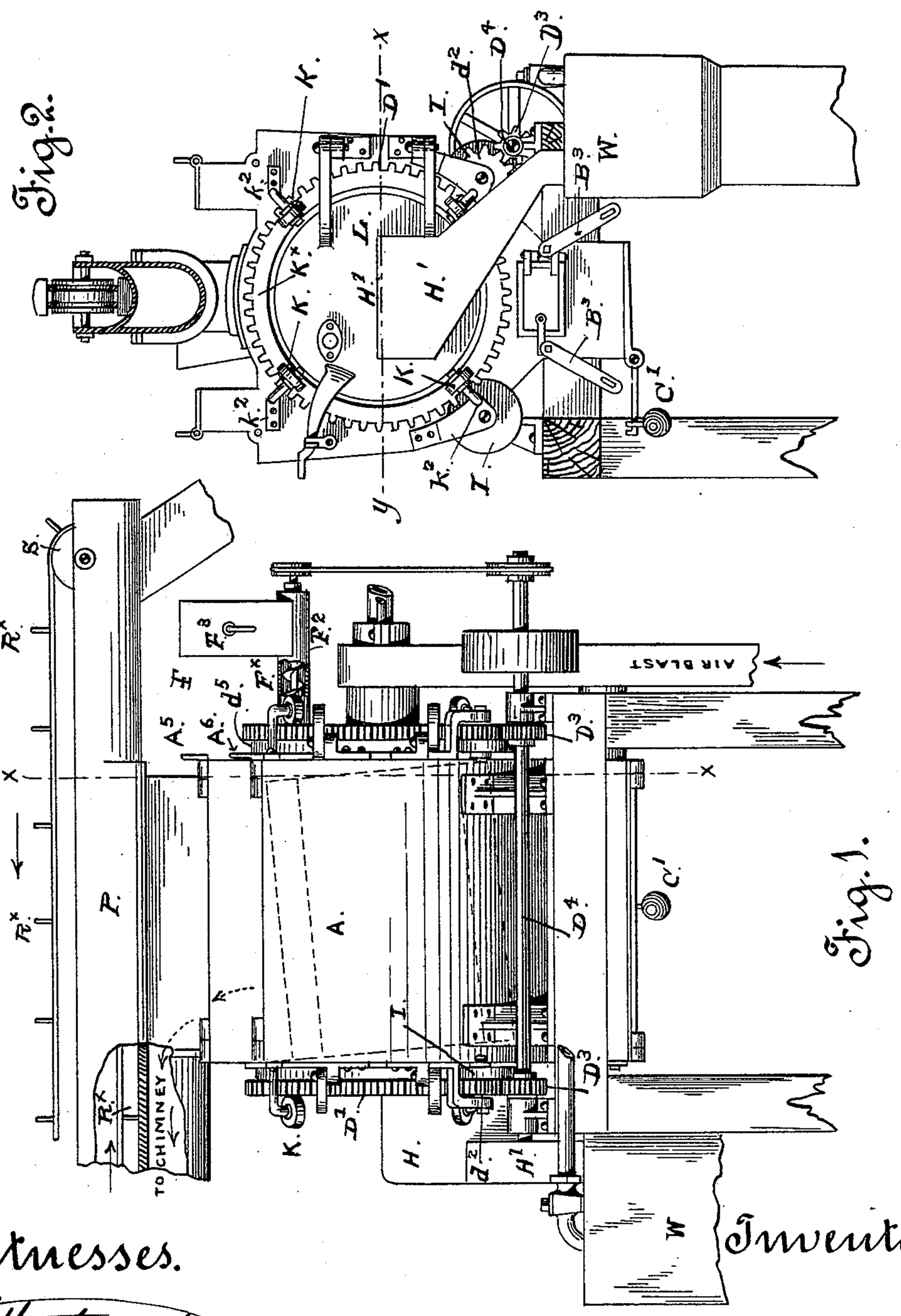
(No Model.)

3 Sheets—Sheet 1.

J. R. MOFFITT.

ROTARY RETORT FURNACE.

No. 583,116. Patented May 25, 1897.



Witnesses.

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(No Model.)

3 Sheets—Sheet 2.

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No. 583,116. Patented May 25, 1897.

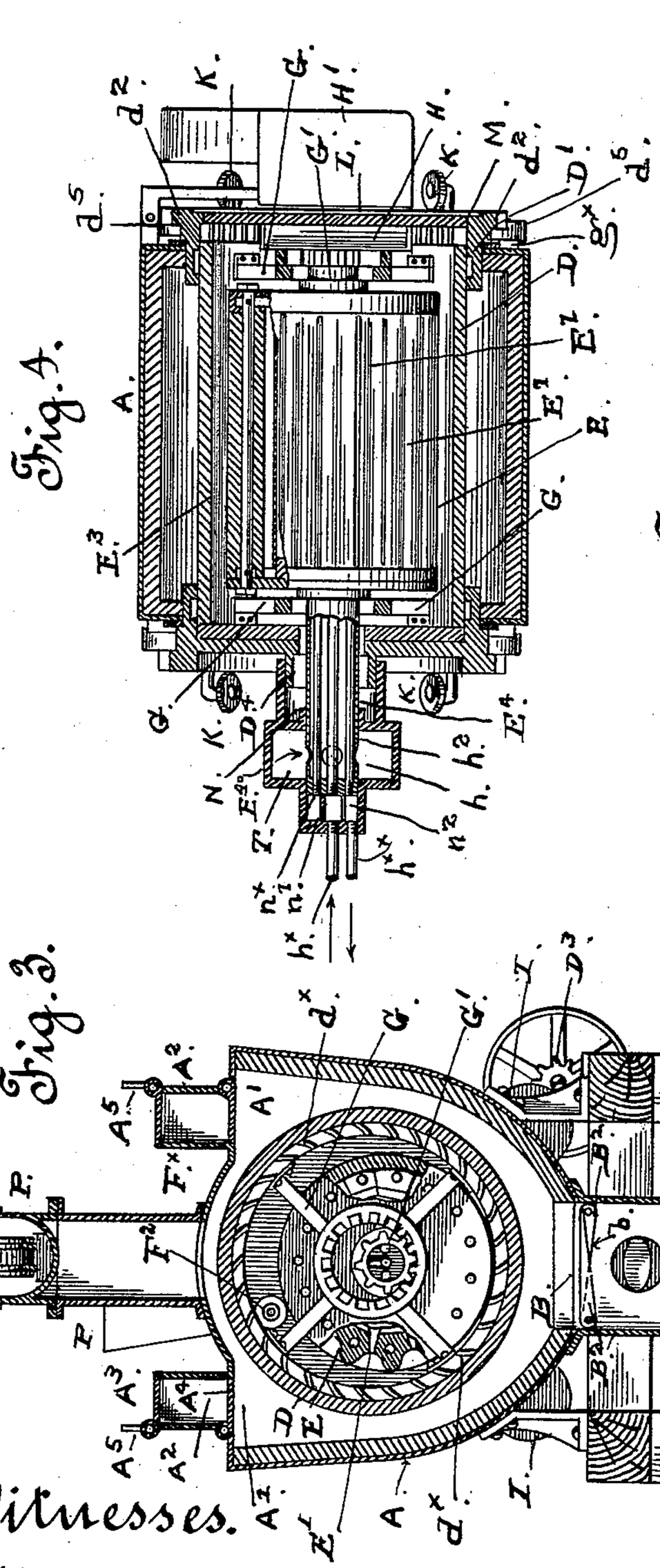

Fig. 4.

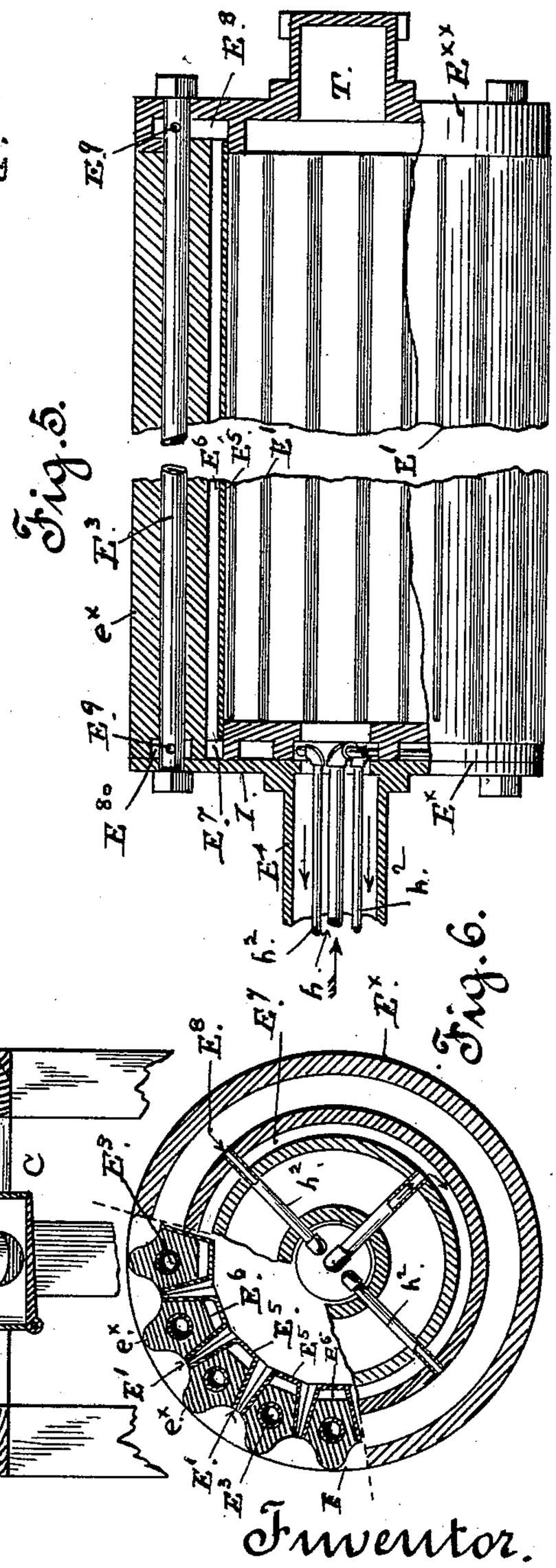

Fig. 5.

Fig. 6.

Fig. 3.

Witnesses.

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(No Model.) 3 Sheets—Sheet 3.

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ROTARY RETORT FURNACE.

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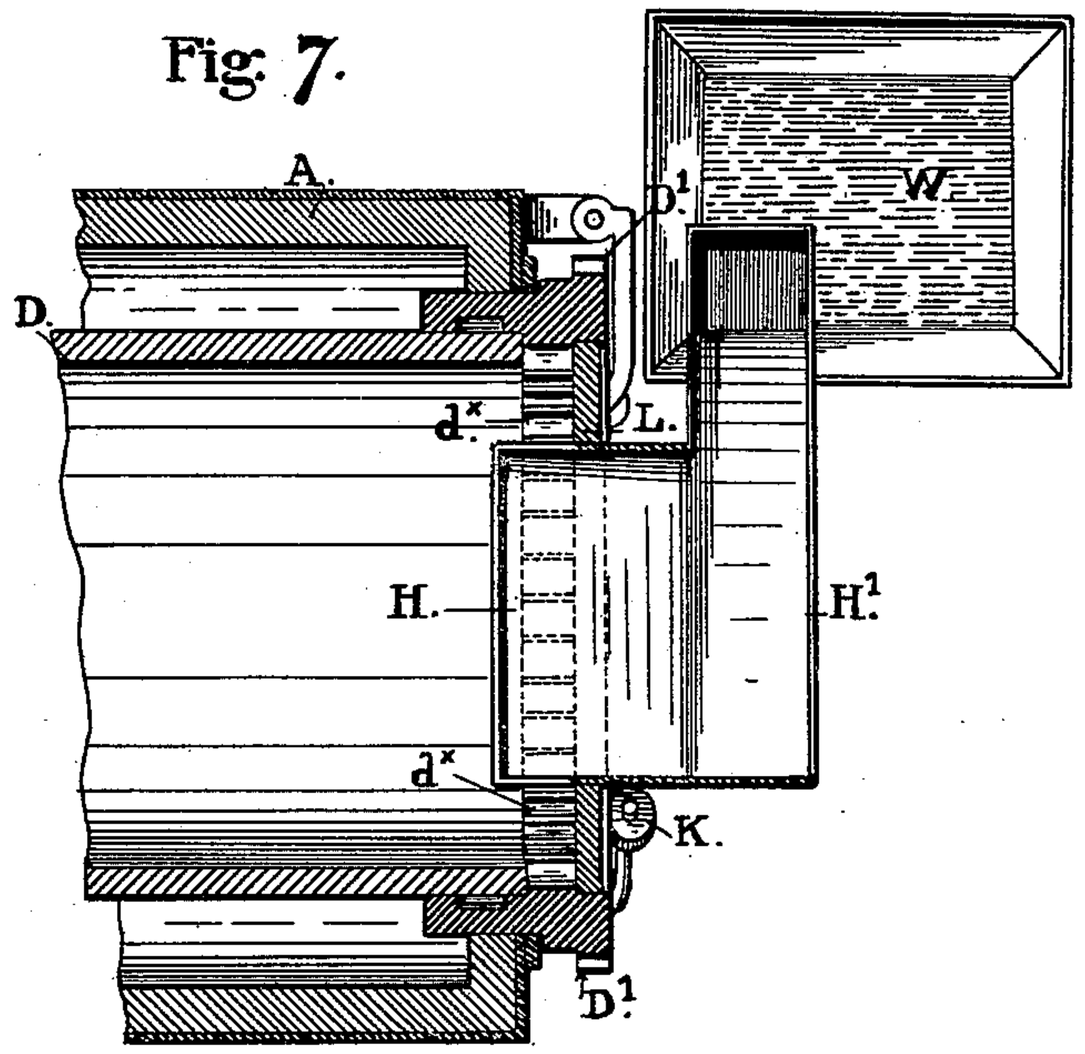
Fig. 7.



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UNITED STATES PATENT OFFICE.

JOHN R. MOFFITT, OF OMAHA, NEBRASKA.

ROTARY RETORT-FURNACE.

SPECIFICATION forming part of Letters Patent No. 583,116, dated May 25, 1897.

Application filed July 1, 1896. Serial No. 597,768. (No model.)

To all whom it may concern:

Be it known that I, JOHN R. MOFFITT, a citizen of the United States, residing in Omaha, county of Douglas, and State of Nebraska, have invented certain new and useful Improvements in Rotary Retort-Furnaces, of which the following is a specification.

My invention relates to an improved apparatus for separating the precious metals from their ores by the application of heat and jets of air under pressure; and it consists in certain novel construction and combination of crucible or retort rotating with continuous action in a furnace and means of feeding and of progressing the pulverized ore through the retort and of applying jets or streams of atmospheric air through the ore while it is in motion.

The invention comprises certain novel construction of retort and furnace, a means of applying the air directly against and through the ore, and a continuous feeding apparatus.

The following description explains the nature of my said improvements and the manner in which I proceed to construct and use the same, reference being had to the accompanying drawings.

Figure 1 of the drawings represents a side elevation of the apparatus. Fig. 2 is a front view taken from the left-hand side of Fig. 1. Fig. 3 is a vertical transverse section through the furnace and retort, taken through the line $x\,x$, Fig. 1. Fig. 4 is a horizontal section of the same parts. Fig. 5 is a central longitudinal section of the inner cylinder, and Fig. 6 is a cross-section thereof. Fig. 7 is a horizontal sectional view on an enlarged scale, taken through the front end and a portion of the body of the furnace and the inclosed retort at about the line $x\,y$, Fig. 2.

The part A is a stationary furnace with a grate B, and below the grate an ash-pit C, closed at the ends and the bottom. The shell of the furnace above the grate is carried out at the sides to correspond with the cylindrical shape of the retort, which is mounted in it over the grate, but the space below the bars is contracted and the shell at the bottom is quite narrow and of rectangular form in cross-section. In the top of the furnace are fuel-openings A′, one at each side, extending the entire length, and each one has a hopper A^2, with a hinged cover A^3 and a hinged bottom A^4. The sides of the shell are lined with fire-brick from the grate-surface up to the fuel-openings. The hinged cover A^3 is opened and closed by an arm or lever A^5 on the outside, and the hinged bottom is provided with a similar arm or lever A^6, properly weighted to hold up the bottom and to close it after every charge of fuel. These parts A^3 A^4 serve to close the fuel-inlet against the escape of gases during the operation of introducing the fuel. The hinged bottom is kept closed while the cover is raised to deposit the charge of fuel in the hopper, and the cover is then closed over the mouth of the hopper before the hinged bottom is dropped to discharge the fuel into the furnace.

The grate is formed of bars *b*, arranged in two sets, that are fixed at their outer ends on two rods B^2, the bars of one set alternating and setting between the bars of the other set, and all the bars of one set are fixed on the same rod. Bearings for the rods are provided in the ends of the furnace-shell, through which the rods extend to the outside, and levers B^3 are fixed on the ends of the rods for dropping the bars to clean out the grate and for raising the bars into position again. The bottom of the ash-pit is hinged at one side to drop and discharge the ashes. A lever with a counterweight C′ is fixed on the end of the rock-shaft that forms the hinge-joint for the bottom.

The retort is formed of two cylinders D E, one inside the other, and having a smaller diameter than the other, so that an annular space or chamber is left between the inner surface of the outer one and the cylinder surrounded by it. The two cylinders are set eccentrically with the bottom of the inner one in close relation to but not in contact with the bottom surface of the outer cylinder, so that a lunar-shaped space having its greatest width or height over the inner cylinder and gradually contracting toward the bottom is formed between the two cylinders. The pulverized ore is fed into this space at the top or widest part from a hopper F, and the feeding apparatus consists of a screw conveyer $F^{\times}$ in a closed tube F^2, one end of which sets into the end of the outer cylinder, while the hopper sets over the outer end portion and communicates with the tube through a narrow

opening, beneath which extends the screw. This feed is working continuously when the apparatus is in operation, and the pulverized ore fills up the tube around the blade of the screw, so that there is no outlet at that point for the gases to escape from the retort when the apparatus is working. To cut off the outlet, however, when the feed is thrown off or when the tube is not filled, a gate or slide-valve F^3 in the hopper is provided.

The two cylinders are inclined from the feeding-in end toward the opposite end, where the ore passes out, as seen in dotted lines, Fig. 1, and they are rotated with continuous motion and in the same direction. The outer cylinder carries the inner one and is the driver, but the inner one rotates on its own axis and separately from the outer cylinder. It can be rotated by gearing arranged as shown in Figs. 3 and 4. The heads of the inner cylinders are carried by spiders G, fixed in the outer cylinder near the ends. Each spider has an open center that forms a circular track for a flanged wheel or large journal with gear-teeth G′ on the head of the inner cylinder, and as the outer cylinder is rotated the movement causes the inner cylinder to revolve by virtue of the gears and the circular bearings on the parts G.

At the lower or discharge end of the outer cylinder there is a circular row of buckets $d^\times$ all around the circumference to catch the ore at the bottom and carry it upward as the cylinder rotates. As they pass above the center these buckets discharge into a stationary chute H on the head of the furnace having a closed spout or conductor on the outside that terminates in a water-tank W, and is kept sealed to confine the gases in the retort by carrying the end below the surface of the water.

The inner cylinder E is of novel construction in having pockets or cavities in its surface with apertures E′ at the bottom through which air is forced in thin jets or streams from the inside of the cylinder. A continuous inflow and pressure of air are maintained in the hollow center of the cylinder by connecting it at one end with an air-trunk T, to the lower end of which a fan or blower is to be attached, as will be understood.

The manner of making connection will be understood by reference to Figs. 4 and 6 of the drawings. The outer head of the cylinder D has a tubular extension D^4 turning in an air-tight casing N and extending from the air-trunk, and a smaller tubular extension E^4 on the end of the cylinder E sets into and is free to turn in the tube D^4, through which it extends, as well as through the trunk T, and within the latter the extension E^4 has lateral air-inlets, as seen. The air from the trunk thus passes into the hollow center of the inner cylinder. The air-outlets are narrow slits extending lengthwise along the bottom of the pockets.

To prevent the walls of the inner cylinder from being affected by heat in the retort, I maintain a continual circulation of water through its walls from end to end by forming water ways or passages longitudinally through it and ways or channels in the heads and then connecting these waterways with a service-pipe from the outside and also with a waste or discharge pipe.

The cylinder E is constructed of a number of tiles $e^\times$, held in place between two circular heads $E^\times$ $E^{\times\times}$ by long tubular rods E^3, that run through the tiles and through the heads to the outside, where they take nuts. Spaces are left between the tiles for the air-apertures. The tiles in cross-section are shaped as shown in Fig. 6, and each air-slit is in the bottom of a long pocket or cavity. The bottom of each tile sets into a trough-shaped metal piece E^5, which I have termed a "cradle," between the bottom of which and the tile is a closed channel or passage E^6. The passages connect at the ends with a circular groove or inlet-channel E^7 in one head and a wider return-channel E^8 in the opposite head. A water-pipe h extends into the head $E^\times$ from the outside through the tubular extension E^4 and into the circular channel E^7, through which the water passes into all the passages E^6 under the tiles and from them is returned by the channel E^8 on the opposite head through the tubes. There are openings E^9 in these tubes in line with the channel E^8 in the head $E^{\times\times}$, and the ends of the tubes are closed, so that the water finds its way into the tubes from the channel E^8, where it discharges into the opposite or outlet channel E^{80} at the other end of the cylinder, thereby circulating through the tiles from end to end. There is an outlet-pipe h^2 from the channel E^{80} to the outside, which pipe leads also through the tubular extension E^4 of the cylinder, and the supply and discharge pipes thus pass into and lead out from the same end of the cylinder.

The inner surface of the cylinder E is kept from being overheated by the continual circulation of water through the passage between the cradles and the heated tiles. The object of circulating water through these passages is to cool the surfaces with which the air comes in contact in passing through the cylinder and outlets, and the water inlet and discharge are placed at the same end, as being the more convenient manner of arranging the pipes. The tubular extension E^4 of the cylinder extends through the air-box T and is closed at the end by a circular plate $n^\times$, into which the ends of the pipes h h^2 are screwed. Over this plate is a stationary flanged cap n', having a circular channel n^2, with which the ends of the water-pipes h^2 are in line when the head is set over the circular plate. The cap n' is stationary, but the plate, being fixed on the end of the extension, revolves in the trunk. A water-tight joint is made between the rim of the plate and the surrounding cap. To the channel n^2 is connected the end of the waste-pipe $h^{\times\times}$, and to

the central passage through the channel the supply-pipe $h^{\times}$ is carried opposite the inlet waste-pipe h, as shown in Fig. 4 of the drawings.

The waste heat from the furnace is utilized to dry the ore before crushing by extending the uptake horizontally for some distance beyond the ends of the furnace and setting upon it or forming its top into a trough P. A chain-carrier R, with blades or buckets $R^{\times}$, is arranged on sheaves S to travel in the trough from end to end with a slow movement, and the crushed or broken ore being dropped into the trough at one end is advanced slowly by the carrier to the opposite end, where it is discharged into a pulverizing-mill. A smoke-pipe at the end of the uptake connects with a stack or chimney.

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

1. In a retort-furnace, the combination of a suitable frame, two hollow cylinders set eccentrically and having a chamber between them which is closed to the furnace, the inner cylinder being perforated, a means for continuously introducing ore into the upper part of said chamber without escape of heat therefrom, a continuous discharge for the ore from the lower part of said chamber at the opposite end, means for introducing air into the inner cylinder, and means for rotating said cylinders from the outside, substantially as hereinbefore described.

2. The combination in a stationary furnace, of two closed hollow cylinders set eccentrically and having a space between them forming a chamber which is closed to the furnace, a screw conveyer turning in a closed tube for continuously introducing ore into said chamber without permitting the escape of air, an air-supply trunk or conductor connected with the hollow space in the inner cylinder, exit-slots in the sides of this cylinder, a means to rotate said cylinder, and a single discharge for the air and the products from the chamber to the outside, substantially as hereinbefore described.

3. The combination in a stationary furnace, with two closed hollow cylinders set eccentrically and having a space between them forming a chamber which is closed to the furnace, means for rotating said cylinders, and means for introducing air into the hollow center of the inner cylinder; of means for feeding ore to said chamber without permitting the escape of air, buckets around inside the outer cylinder at the end opposite said ore-feed, this end of the outer cylinder being stationary, packing between the body of the cylinder and said end, and a stationary air and ore discharge chute extending through this end, substantially as described.

4. The combination with an outer revolving cylinder, means for heating it, and means for feeding ore thereinto; of an inner revolving cylinder having an internal air-chamber and air-slits through its walls, water-circulating passages within the walls of this cylinder, and grooves or channels in the heads thereof connecting said passages with each other and with the water supply and discharge pipes as and for the purpose set forth.

5. The combination with the outer revolving cylinder, means for heating it, and means for feeding ore thereto and discharging it therefrom, of an inner revolving cylinder having at one end a tubular extension passing through the head of the outer cylinder and provided with air-inlets, an air-supply trunk within which said extension rotates, slits in the walls of said inner cylinder, and an air-outlet in the opposite end of the outer cylinder, as and for the purpose set forth.

6. The combination with an outer revolving cylinder, means for heating it, and means for feeding ore thereto and discharging it therefrom; of an inner revolving cylinder having at one end a tubular extension passing through the head of the outer cylinder and provided with air-inlets in its sides, its end being closed, an air-supply trunk within which said extension rotates, the wall of the inner cylinder being formed of tiles spaced to produce slits, an air-outlet from the outer cylinder, water-circulating passages through said tiles between the slits, water inlet and outlet pipes connected with said passages and leading through the extension to and through the closed end thereof, a stationary cap over the end, and feed and discharge pipes connected with said cap, as and for the purpose set forth.

7. The combination with an outer revolving cylinder, means for heating it, and means for feeding ore thereto and discharging it therefrom; of an inner revolving cylinder having at one end a tubular extension passing through the head of the outer cylinder and provided with air-inlets in its sides, an air-supply trunk within which said extension rotates the wall of said inner cylinder being formed of tiles spaced to produce slits and set in cradles leaving passages below them, a small inlet-channel at one end a return-channel at the other end of the cylinder both connecting with said passages tubular rods leading through the tiles and connecting with said return-channel, an outlet-channel with which the opposite ends of said rods connect, water inlet and outlet pipes connected with said inlet and outlet channels and leading through the tubular extension, and feed and discharge pipes connected therewith, substantially as and for the purpose set forth.

In testimony that I claim the foregoing I have hereunto set my hand and seal.

JOHN R. MOFFITT. [L. S.]

Witnesses:
R. H. OLMSTED,
FRANK L. MCCOY.