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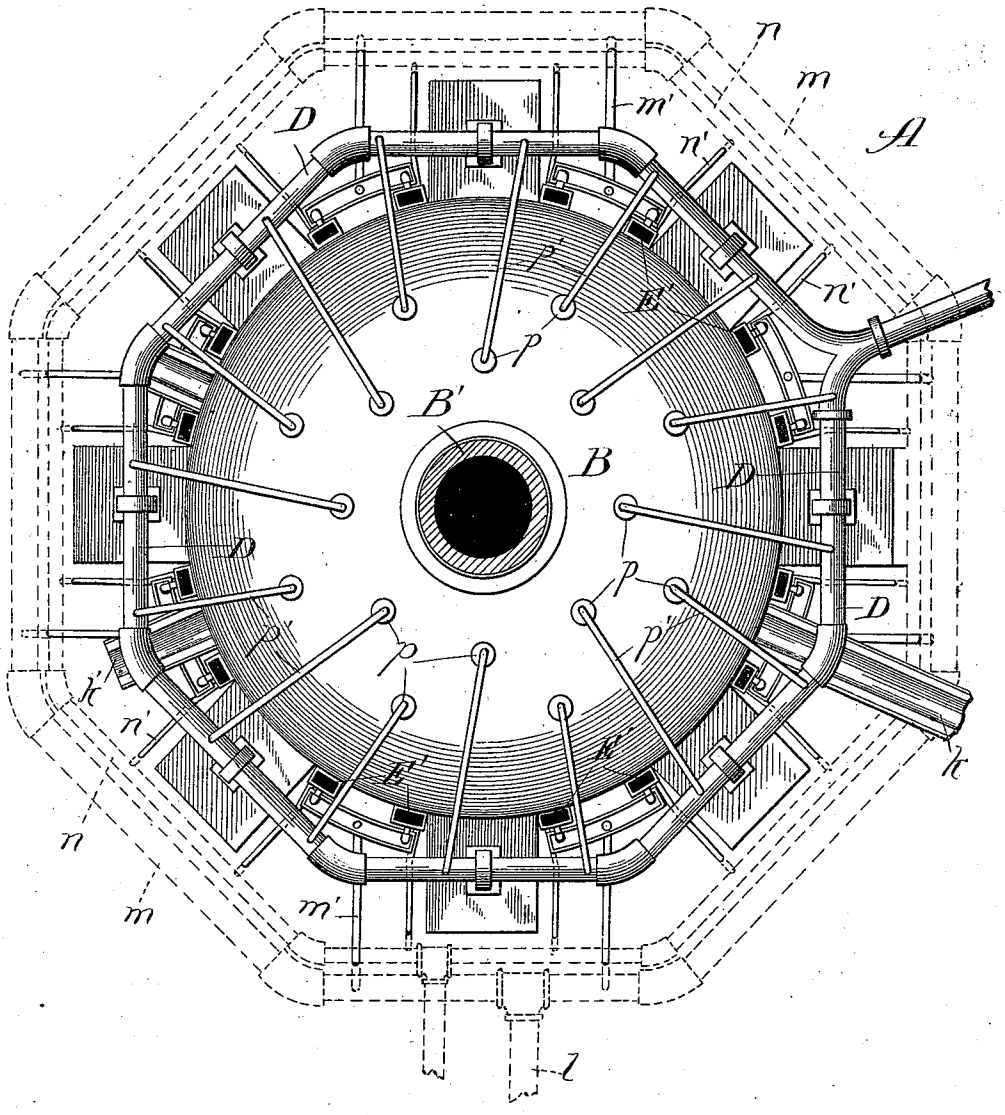
W. A. KONEMAN.

METAL REFINING APPARATUS.

No. 560,414. Patented May 19, 1896.

Fig. 1.



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(No Model.) 4 Sheets—Sheet 2.

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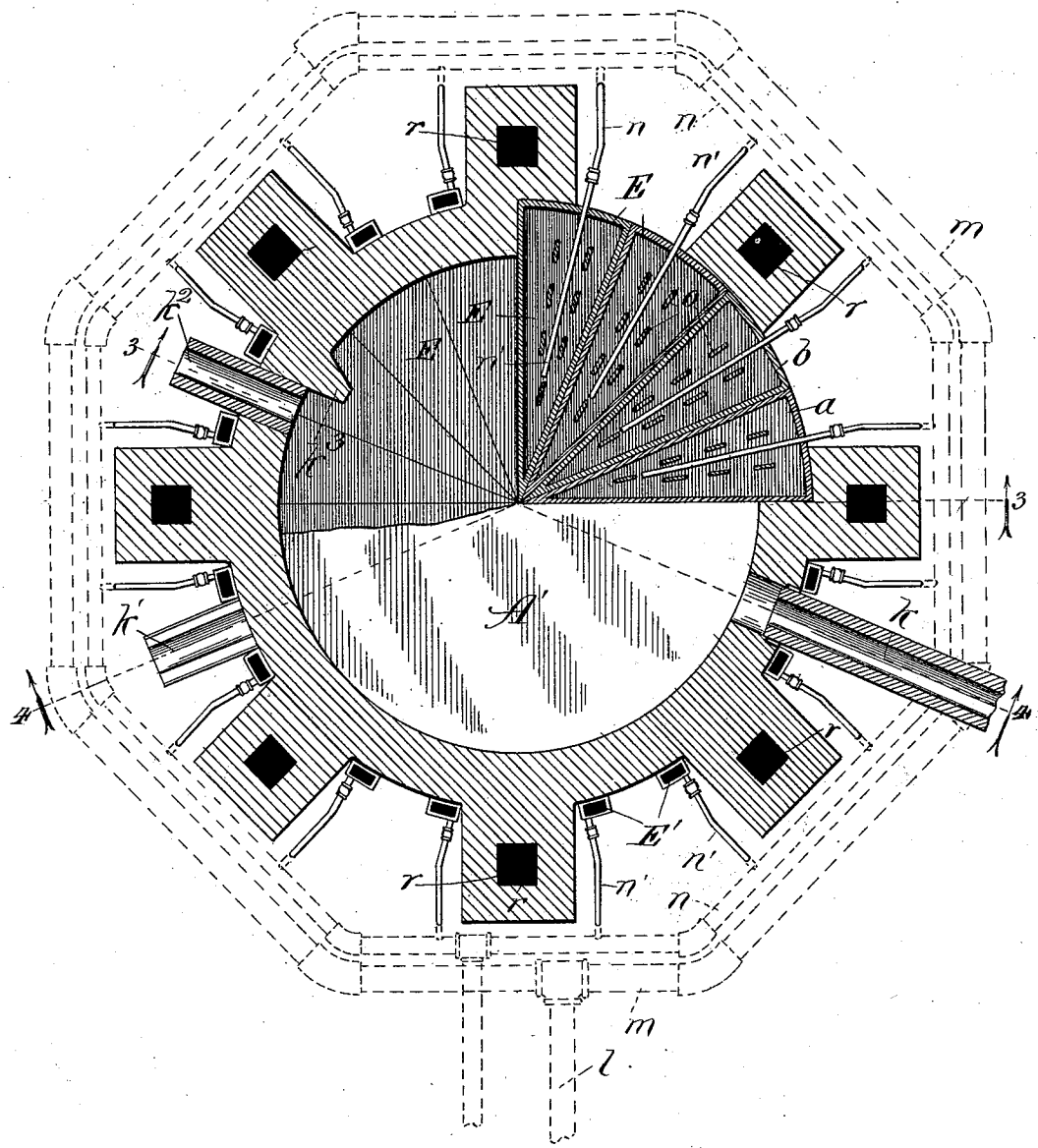
Fig. 2.



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(No Model.) 4 Sheets—Sheet 3.

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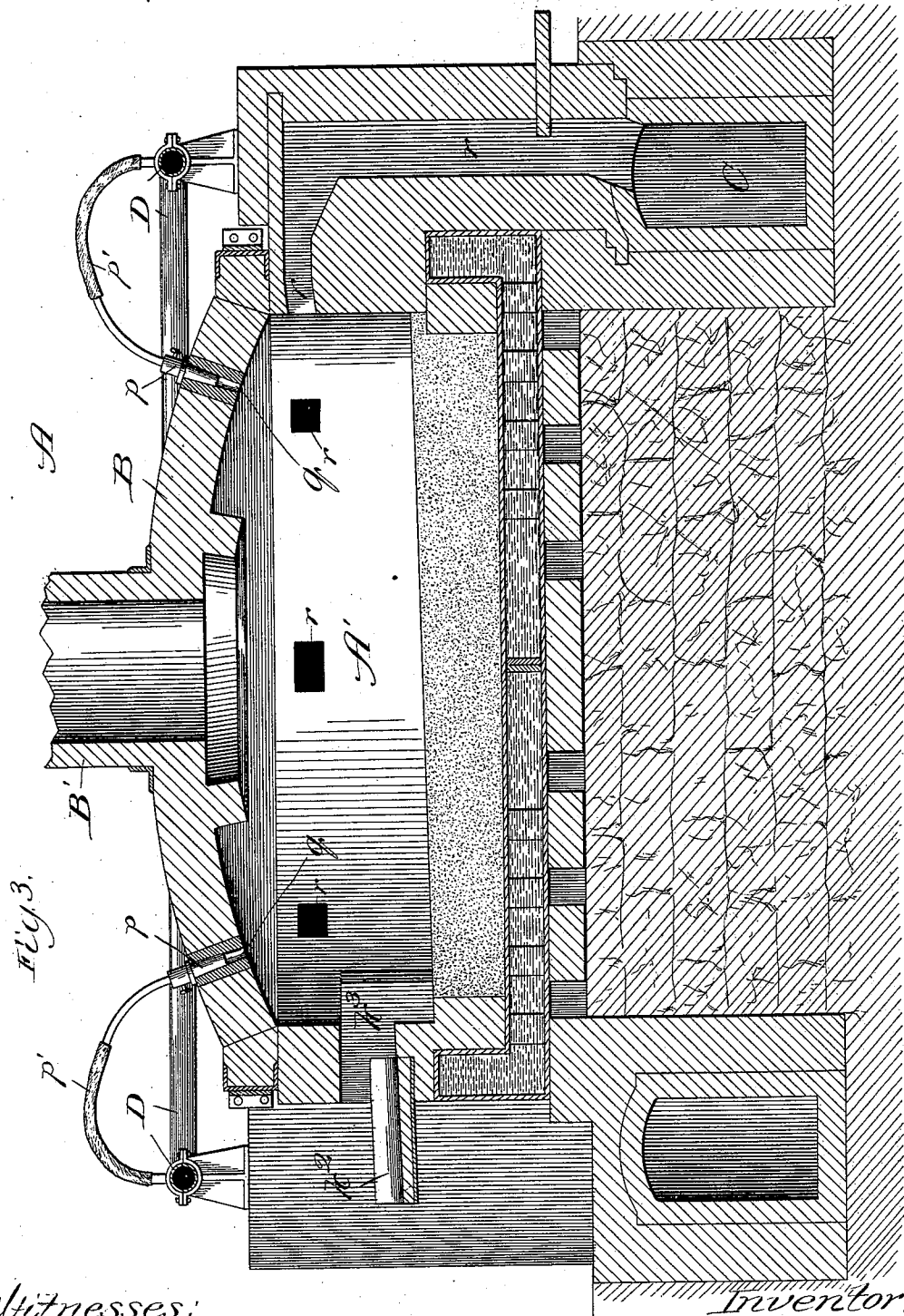

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(No Model.) 4 Sheets—Sheet 4.

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METAL REFINING APPARATUS.

No. 560,414. Patented May 19, 1896.

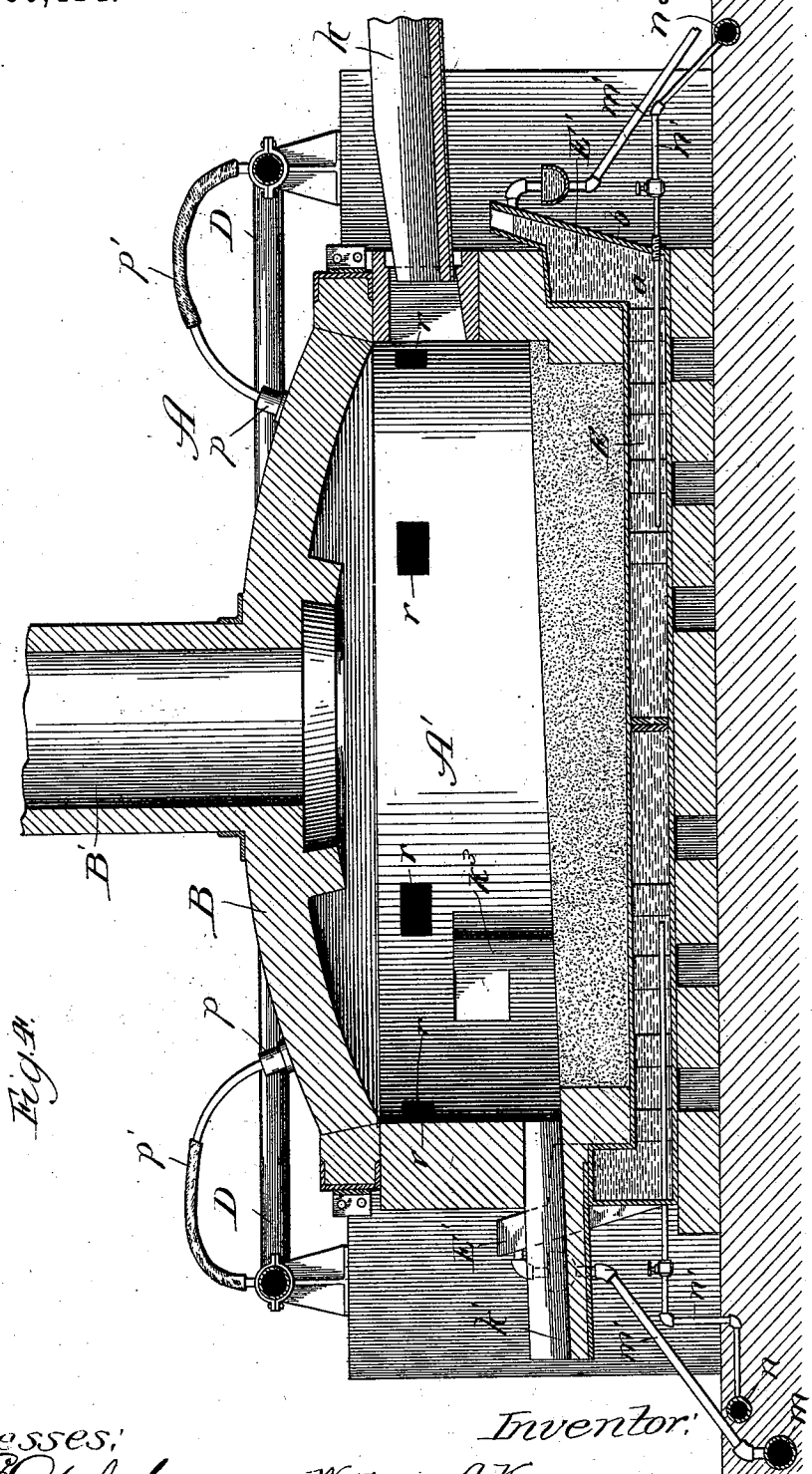

Fig. 4.

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UNITED STATES PATENT OFFICE.

WILLIAM A. KONEMAN, OF CHICAGO, ILLINOIS.

METAL-REFINING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 560,414, dated May 19, 1896.

Application filed May 8, 1894. Renewed October 24, 1895. Serial No. 566,785. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. KONEMAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Metal-Refining Apparatus, of which the following is a specification.

My invention is primarily intended for the treatment of copper-containing mattes from copper-matte or lead-bullion producing furnaces, though it may be employed with advantage for refining other metals. A well-known process of refining these mattes is the Bessemerizing method of subjecting them while in a molten condition to the oxidizing action of air under pressure, which is injected into the molten matte to oxidize the sulfur and iron and leave the copper in a metallic state, the air-blast being discontinued as soon as the copper-flame appears. The quantity of sulfur contained in the matte is not sufficient, however, to feed the combustion, so that the copper obtained by this process is only about nine hundred pure. It is desirable to first eliminate any contained lead from the matte and simultaneously the contained precious metals and then subject all the remaining ingredients accompanying the copper—such as iron, sulfur, arsenic, antimony, &c.—to a process of oxidation to drive off such of them as are volatile and convert all the resultant metallic oxids into the form of a fusible slag, adding therefor suitable flux. While the separation of the lead from the matte may be accomplished in various ways, I prefer to effect its removal by first subjecting the matte to roasting, and while it is undergoing the roasting operation, and immediately after the bulk of the sulfur has been expelled, mixing with the matte in the roasting-furnace granulated metallic iron in sufficient quantity to combine with the remaining sulfur, then to bring the mixture to fusion and add sufficient carbon for the complete reduction of the lead and to effect its separation, by settling, from the matte, together with such precious metal as may be contained in the lead.

To refine the matte with my improved apparatus, I provide for treating it, preferably with the lead removed, as stated, in a furnace, into which it is introduced either in a molten condition or wherein it may be brought to fusion, and subject it to the oxidizing action of injected air in a manner to cause the air to penetrate the molten mass from its upper surface, but introduce the air in excess of the quantity that can be consumed by the metal and utilize the surplus air to promote the combustion of carbon introduced in gaseous form into the furnace to be burned by mixture with it of the surplus air which has escaped after being in contact with the molten mass, and thereby generate and maintain an intense heat in the apparatus. In this way I utilize the heat of the molten mass for combustion in presence thereof of fuel for the purpose of maintaining an intense heat to keep the mass in the desired hot condition till the substances to be separated from the copper are completely oxidized.

My improved apparatus is illustrated in the accompanying drawings, in which—

Figure 1 is a plan view, partly broken and sectional, of a slag or matte refining furnace. Fig. 2 is a horizontal section of the same, taken at different planes in Fig. 1. Fig. 3 is a section taken at the lines 3 3 in Fig. 2 and viewed in the direction of the arrows, and Fig. 4 is a section taken at the lines 4 4 in Fig. 2 and viewed in the direction of the arrows.

A is the furnace, of generally circular form and having a somewhat-arched top B, covering the chamber A′ and provided with the central gas-outlet flue B′. At intervals about the exterior of the furnace-wall are formed upright gas-flues r, leading from a main C, surrounding the base of the furnace and communicating with a gas supply, preferably a generator of producer-gas, (not shown,) and at their upper ends the flues r lead horizontally into the chamber A′ near its top, the chamber being preferably of great horizontal area for the treatment of a large quantity of the molten matte, but in a comparatively shallow body, in order that it may be the more thoroughly penetrated by and subjected to the oxidizing effect of the air injected in the manner hereinafter described.

In the top B are openings q, suitably numerous and which should all converge inward non-radially or toward different centers in the chamber A′, and in these openings are twyers p, to which lead pipes p' from an air-

conduit D, encircling the top B and communicating with a blast apparatus. (Not shown.)

Under the base of the chamber A′ are a circumferential series of V-shaped cast-metal boxes or water-legs E, radiating from the center of the apparatus and terminating at their outer ends, in and beyond the furnace-wall, in enlarged heads E′, the boxes having cast in them each a series of upright bracing-ribs *o*, extending between its top and bottom. Into each leg E there enters from its flaring end, near the base, a valve-controlled water-pipe *n′* from a main *n*, surrounding the apparatus and communicating with a water-supply, (not shown,) and from each head E′ at its upper contracted end there leads an inlet-pipe *m′* to a conduit *m*, encircling the apparatus and discharging through a pipe *l*, which may lead to a point of hot-water utilization, as to a boiler-feed. (Not shown.)

The operation is as follows: The matte is introduced, preferably in molten condition, through an inlet-spout *k* into the chamber A′, the discharge of copper being provided for at the spout *k′* and of the slag at the spout k^2, the slag being skimmed by a stationary projecting skimmer k^3. The body of the mass is maintained by a comparatively shallow proportion. Air (which may, if desired, be previously heated) is injected into the chamber through the twyers *p* and penetrates the mass, besides imparting to it a roundabout stirring, owing to the inclination of the air-inlet openings toward different centers, and the twyers *p* are adapted to introduce a quantity of air in excess of that which can be consumed by oxidation of the metal in the molten mass. The surplus of air comingles with gas introduced into the chamber A′ from the flues *r* and consumes the latter, thereby generating an intense heat in the chamber to maintain the material therein in an intensely-heated condition and permitting thorough oxidation by the penetrating action of the air-blast and separation of the foreign substances combined with the copper. By introducing an excessive quantity of fuel-gas into the chamber A′, I am enabled, moreover, to recover zinc, in a pure condition and without impairment of its color, from furnace-slag introduced into the chamber in molten condition. The gas eliminates the zinc from the slag by reducing the zinc and volatilizing it, and the vapors are oxidized by contact with the air. In this case, however, the gas should be injected through the twyers *p* to penetrate the molten mass, and the air may be introduced through the flues *r*. I find that for the perfect elimination of the zinc the slag requires to be kept hot by extraneous heat and that the vapor of zinc must be subjected to contact with the air in a highly-heated condition in order to ignite and reduce to ash the condensed and accompanying free carbon, which otherwise remains in and ruins the color and utility of the zinc-oxid product.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a metal-refining apparatus, the combination of a furnace having a chamber for molten matte or slag and provided with a gas-outlet flue, air-inlets communicating with an air-pressure supply and adapted to introduce air into the chamber in excess of the quantity required for oxidation of the metal, said air-inlets inclining and converging into the chamber to direct the air downward to different points against the upper surface of the molten mass to produce rotation thereof in the chamber, thereby to bring the oxidizable and consumable and combustible ingredients constantly to the surface, gas-inlets communicating with a combustible-gas supply and opening into said chamber to mix the gas, and burn it upon the molten mass, with the surplus of hot air, and a slag-skimmer in the chamber adjacent to its slag-spout and operating, by the rotation of said mass, to remove therefrom the resultant fluid impurities, substantially as described.

2. In a metal-refining apparatus, the combination of a furnace A having a chamber A′ for molten matte or slag and provided with a gas-outlet flue B′ and air and gas inlets inclining downward into the chamber, a series of V-shaped radiating water-legs E under the base of said chamber, terminating at their outer ends, beyond the furnace-wall, in enlarged heads E′, water-supply pipes leading into said water-legs and pipes *m′* leading from said heads to a conduit *m* having a discharge-outlet *l*, substantially as described.

WILLIAM A. KONEMAN.

In presence of—
M. J. FROST,
W. U. WILLIAMS.