C. C. MEDBERY.

UNIVERSAL ORE TREATING FURNACE.

APPLICATION FILED MAY 11, 1908.

912,394.

Patented Feb. 16, 1909.

4 SHEETS—SHEET 1.

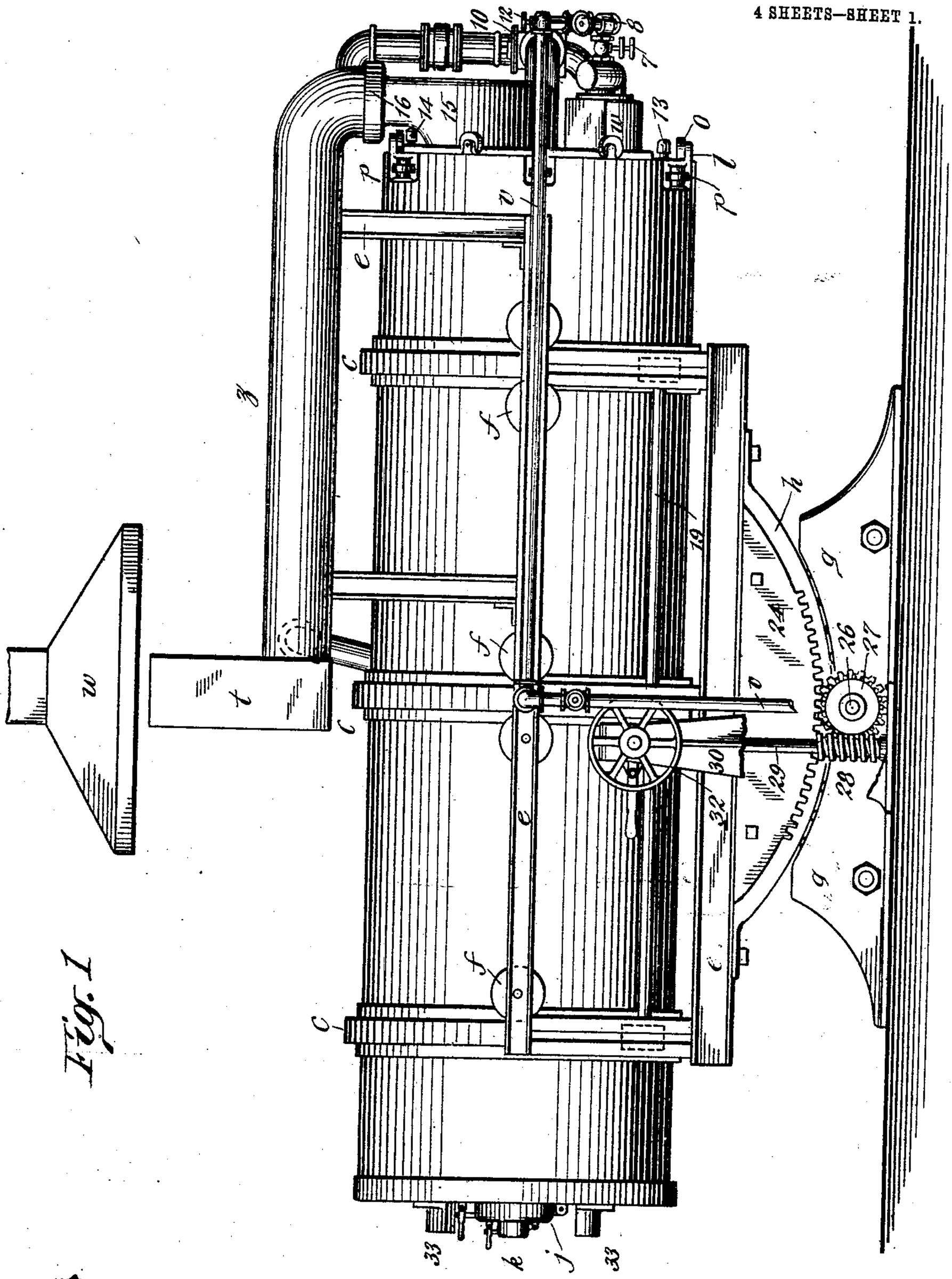

Fig. 1.

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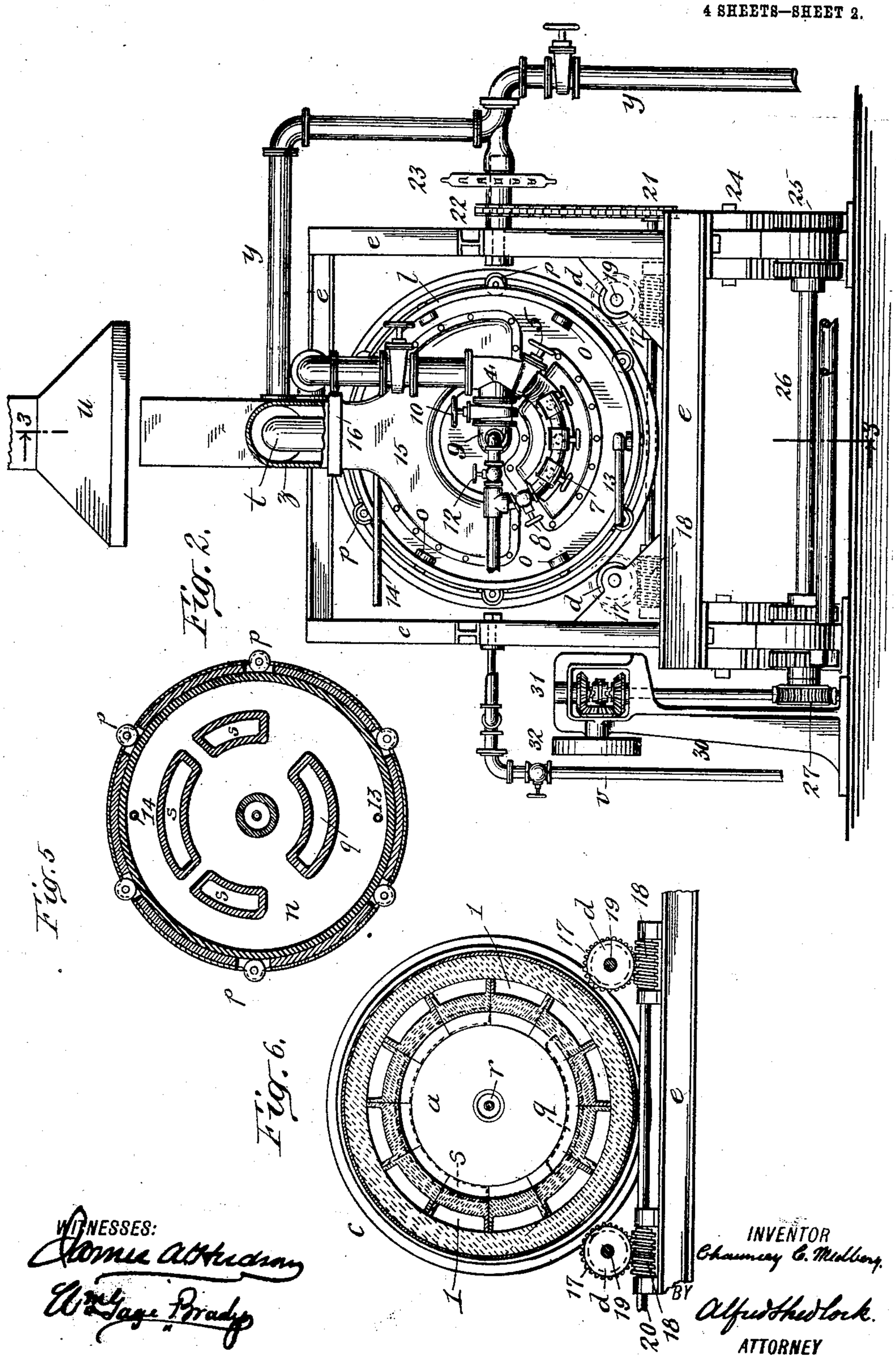

Fig. 2.

Fig. 5

Fig. 6.

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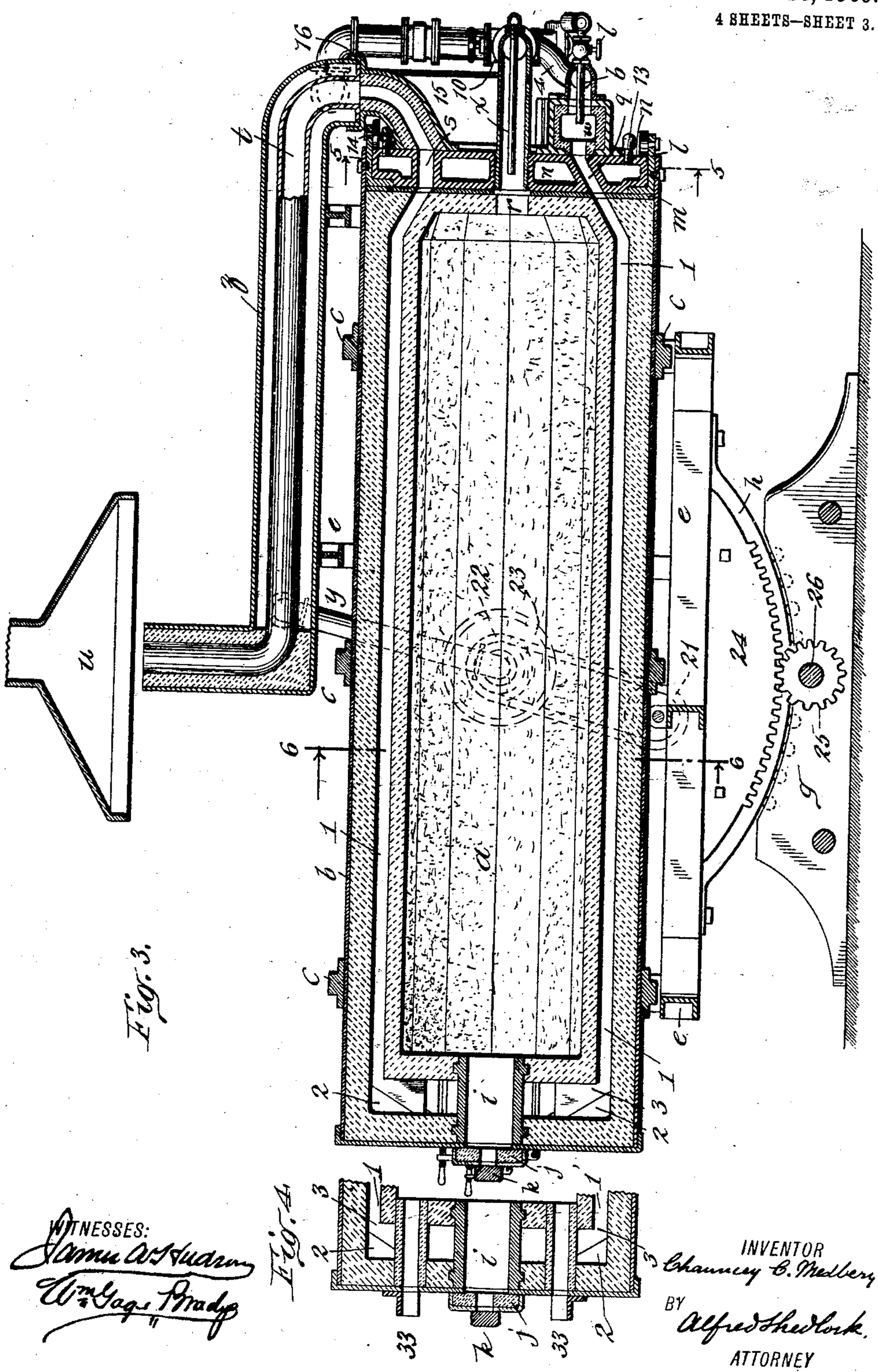

Fig. 3.

Fig. 4.

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4 SHEETS—SHEET 4.

Fig. 8

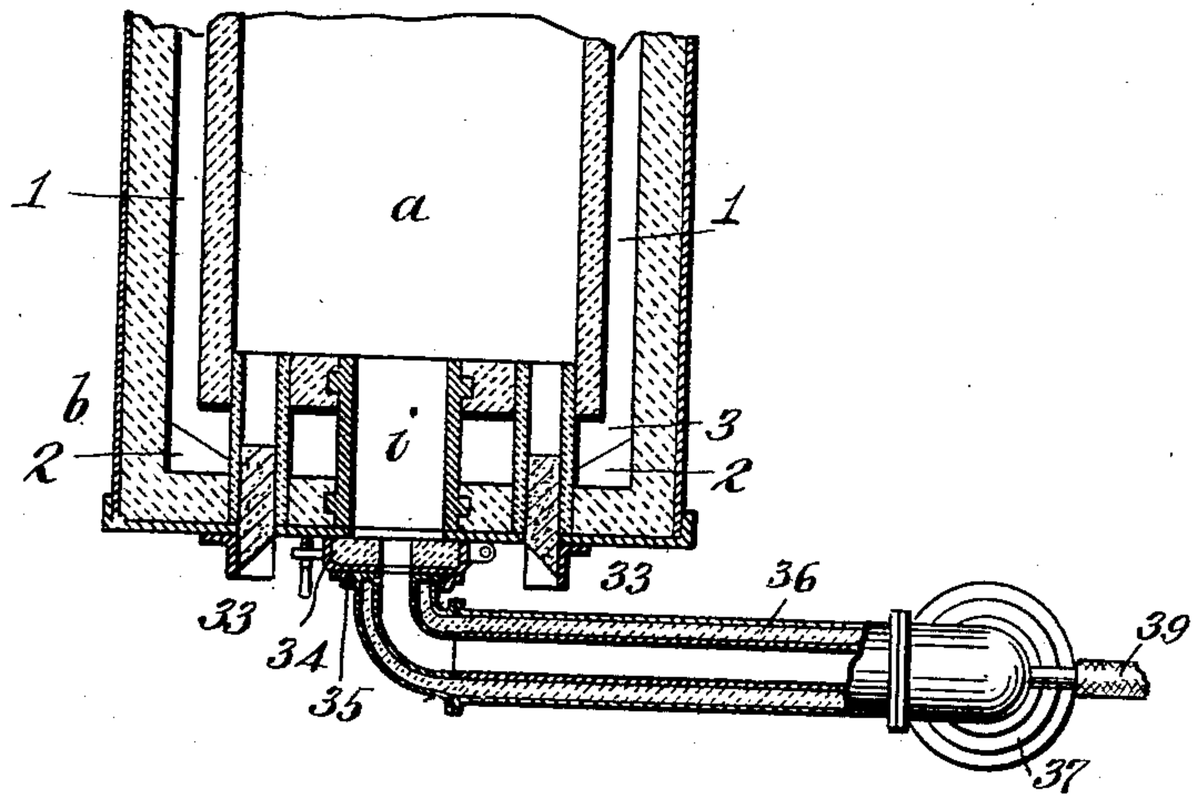
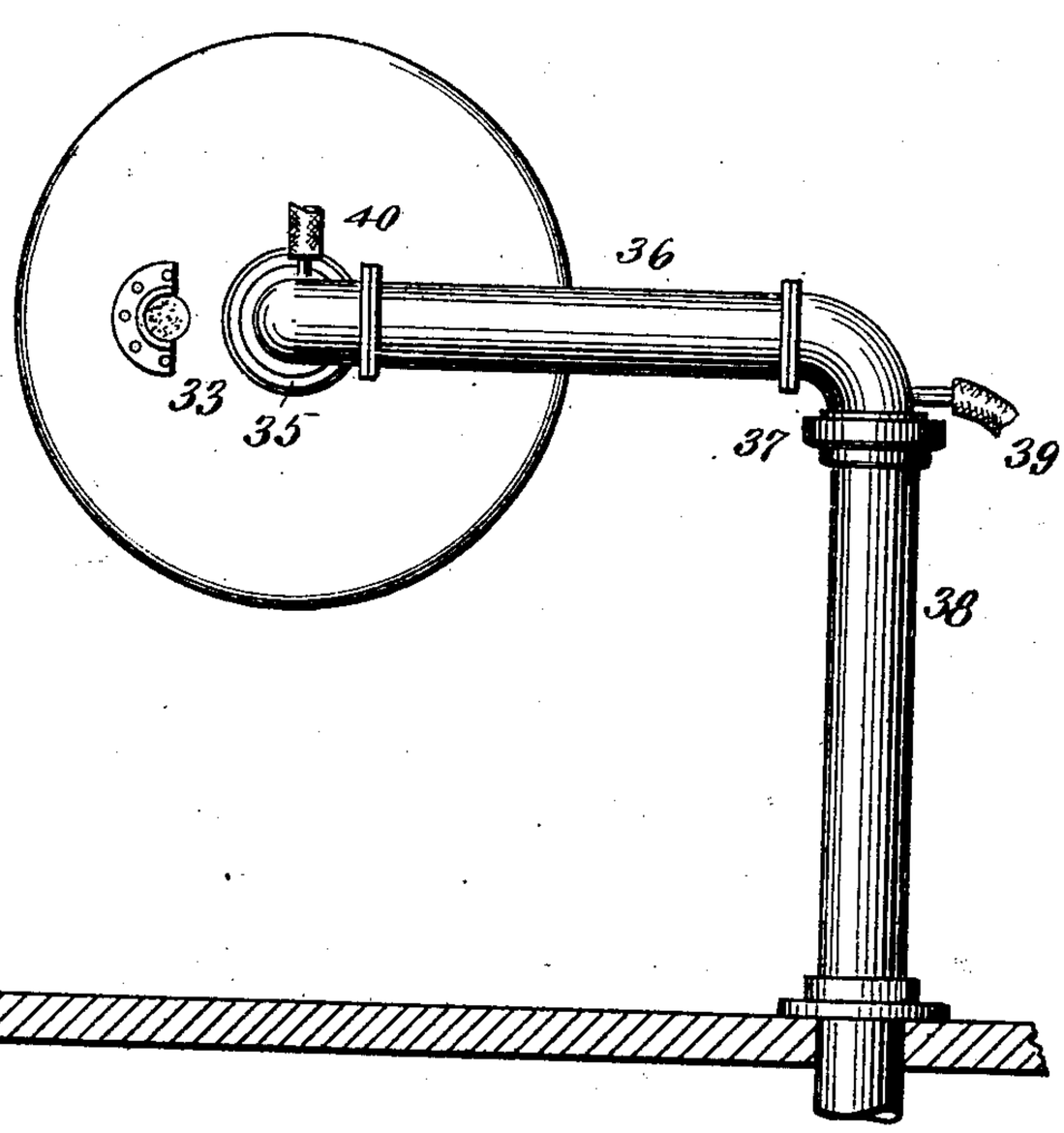


Fig. 7.



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UNITED STATES PATENT OFFICE.

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UNIVERSAL ORE-TREATING FURNACE.

No. 912,394. Specification of Letters Patent. Patented Feb. 16, 1909.

Application filed May 11, 1908. Serial No. 432,088.

To all whom it may concern:

Be it known that I, CHAUNCEY C. MEDBERY, a citizen of the United States, and a resident of New York, county and State of New York, have invented Improvements in Universal Ore-Treating Furnaces, of which the following is a specification.

This invention involves a special construction for a crucible furnace, that is a furnace having an inclosed ore treating chamber, and consists in forming heating flues through the longitudinal walls of the refractory lining of the furnace and preferably also of a passage in one of the end walls of the refractory lining into which all of the longitudinal flues open, combined with means located at the other end of the chamber for supplying fuel to some of the longitudinal flues and means for controlling the discharge of the products of combustion from other of the flues at this fuel supply end of the chamber.

In carrying this invention into practice it is thought desirable to embody it in the class of furnaces shown and described in the Letters Patent issued to me No. 788,546 of May 2, 1905, and No. 804,330 of November 14, 1905, whereby such furnaces are made of universal character, adapted for use in all metallurgical processes and treatment of all kinds of ores.

The accompanying drawings illustrate all the essential features of the invention and will now be referred to in giving a full description thereof.

Figure 1 is a side elevation of a furnace embodying my invention. Fig. 2 is an end view of the same. Fig. 3 is a longitudinal vertical section, on line 3, 3 Fig. 2. Fig. 4 represents a section of the charging end of the furnace taken at right angles to Fig. 3. Fig. 5 is a transverse sectional view, on line 5, 5, Fig. 3. Fig. 6 is a transverse sectional view, on line 6, 6, Fig. 3. Fig. 7 represents the charging end of the furnace with a discharge pipe attached thereto for use when the furnace is used for subliming purposes, and Fig. 8 is a plan view of the same, showing the end of the furnace in section.

The heating chamber *a* is of a refractory material formed as a lining to the cylindrical metal shell *b*, which is provided with circular supporting guide rails *c*, *c*, resting on rollers *d*, *d*, fitted in bearings near the lower corners of the rectangular frame *e*. On the middle horizontal beams of this frame are mounted rollers *f*, *f*, arranged to bear against the sides of the circular rails *c*, *c*, as end thrust bearings for the cylindrical furnace to hold it in place when tilted. The frame and furnace with all attachments are carried by circular ways *g*, *g*, constituting the base, and provided with series of bearing rollers as beds for the corresponding circular supports *h*, *h*, secured to the lower horizontal beams of the rectangular frame.

An opening *i* at one end of the cylinder is covered by a muffle door *j*, the small opening through which is closed by a solid door *k*. At the other end of the cylinder is fitted and secured a flanged ring *l*, to which is also secured the end metal plate *m*, and in this ring is fitted a water-jacketed end *n*, held in place, so that the cylinder may rotate freely thereon, by rollers *o* bearing against its outer surface and rollers *p* bearing against its periphery. Through this water-jacket is formed an opening *q* at its lower part for the admission of fuel to the lining of the furnace, a central opening *r* for the admission of fuel to the treating chamber and openings *s* at the upper part for the escape of the products of combustion of the fuel to the chimney *t* which extends over the top and to about the central part of the cylinder under the smoke hood *u*.

The furnace as shown, is designed to be operated with a gaseous or liquid fuel, the supply pipe *v* of which is provided with a slip-joint coincident with the axis of the circular ways and supports *g* and *h*, and extend along the side of the furnace to the burners or combustion chambers *w* and *x* at the openings *q* and *r* of the water-jacket end respectively. At the other side of the furnace is located the air supply pipe *y*, also provided with a slip-joint coincident with the axis of the circular ways and supports *g* and *h*, and this pipe extends upwardly to the discharge end of the chimney *t*, and surrounds the horizontal part thereof as a casing *z*, and by pipe connections at the other end of the casing air, heated by the hot chimney, is supplied to the central and lower burners; details of which will be hereafter described.

The main distinguishing feature of this invention resides in lining the furnace with a refractory material to form a closed chamber and forming through the side walls and extending around the furnace a series of longitudinal flues 1, each at one end alining with the openings in the end plates *m*, and all of them at their other ends being in communication with a passage 2 formed in the wall of the lining at the charging end of the furnace. This lining may be built up by blocks or bricks suitably formed or perforated to make the flues, or in any convenient way, but it is desirable to have bracket pieces 3 arranged at the passage end of the chamber to properly strengthen and support the inner wall at this end; a pipe 4, also of refractory material, at this end forms the central opening for charging the chamber and for the escape of vapors or fumes of some processes carried out by the furnace. The furnace is practically a rotatable closed-end drum, the refractory lining is continuous throughout the chamber, that is it covers interiorly the ends and the cylindrical portion of the retaining shell or drum as an integral lining, and does not make any sliding or rubbing connection with any stationary part of the furnace, so that it is only submitted to wear due to the action of the charges of ore &c. in the chamber and the necessary heat to properly treat the charges.

The opening *q* at the lower part of the water-jacket, also shown by dotted lines in Fig. 6, is sufficiently long to extend over several of the openings of the flues 1, and on the outside of the water-jacket is secured burner or burner combustion chamber *w*, placed in communication with the space in the chimney air casing *z* by a pipe 4, provided with a stop valve 5, and through this pipe extend fuel nozzles 6, of any desired number, into the combustion chamber *w*, each one being provided with a regulating valve 7; the branch pipe which supplies them from the main fuel pipe *v* being provided with a valve 8, whereby the fuel supply to all of the nozzles can be controlled. A branch pipe 9 from the air pipe 4 supplies air to the central opening *r;* this pipe has a stop valve 10, and has extending into it a fuel nozzle 11, connected to the fuel supply pipe *v* by a branch pipe in which is a valve 12. There are other valves &c. shown, but as their functions are readily discernible it is unnecessary to describe them. The water-jacket end, which is held stationary relatively to the rotation of the furnace proper, is provided with water supply and discharge pipes 13 and 14. It has secured to its outer face a casing 15 with a refractory lining covering the discharge openings *s* from the flues 1, and by a sliding joint 16 it connects with the chimney *t;* this provides for the variable expansion of the different parts without injury thereto; the horizontal portion of the chimney with the air casing *z* being supported by and secured to the top beams of the rectangular frame *e*.

The cylindrical shell *b* with all its connected appurtenances is rotated by motion imparted to the supporting rollers *d*, *d* through the medium of worm wheels 17 and worms or screw gears 18, said worm wheel being secured to shafts 19, each one carrying the set of rollers *d* on either side of the furnace, and the worms 18 are carried by a shaft 20 transversely arranged in bearings on the lower beams of the frame *e*, and having on one of its ends a sprocket wheel 21 which by a suitable chain is driven by a sprocket wheel 22 on a sleeve fitted to rotate on a rod or stud secured to the frame *e* coincident with the axis of the main circular supporting bearings *g*, *h* and to this sleeve is secured a drive wheel 23 actuated from any suitable source of power.

The means for tilting or rocking the furnace on the supporting bearings *g*, *h* consists of segmental gears 24 secured to the sides of the parts *h* of said bearings, and into which mesh pinions 25 carried by a shaft 26 having bearing in the base *g*, and one end of this shaft is provided with a worm wheel 27, actuated by a worm 28 on a vertical shaft 29 having bearings on a standard 30. This shaft 29 may be rotated in either direction by any suitable reversing gear; the ordinary bevel wheel and sliding clutch gear 31 is shown in the drawings, power being applied to the pulley 32.

At Fig. 4 is shown discharge spouts 33, and openings extending from the interior of the chamber *a;* these will be plugged, in the ordinary way, as shown at Fig. 8, when the furnace is in action.

Smelting and refining processes may be carried out by this furnace in manner described in my before mentioned patents, and furthermore it is designed for use in treating ores where a closed heated chamber or crucible construction is required. For such use the charge may be first subjected to the action of the burning fuel from the central burner at the opening *r*, the closed door *k* or muffle door *j* being open for the escape of the products of combustion of the central burner and for such of the volatile constituents of the charge as it is desired to drive off, any volatile constituent as can be utilized, condensed, may be collected in usual ways. A means for doing this is shown at Figs. 7 and 8, consisting of a perforated door 34 to be constituted for the door *j* and which is by a slip-joint 35 connected by horizontal pipe 36 having a downwardly extending bend at its other end, which is also provided with a slip-joint 37 forming its connection to a vertical pipe 38; and this pipe, by its lower end, discharges into a condensing chamber of condensing flues. To prevent excessive heating of the discharge pipe 36 it is provided with a water-

jacket, the water supply and discharge pipes being shown at 39 and 40. The central burner acting in the ore treating chamber may be used alone or in connection with the burners acting in the flues in the walls to preliminarily heat the furnace before or after the charge has been inserted; but with the use of the furnace as a crucible the central burner will be out of action; and if the process be one that calls for operation in a crucible simply, then the doors *j* and *k* will be closed, and the heat required be supplied from the lower burners acting in the flues as they pass during the rotation of the furnace before the combustion chamber of the burners. Now, if the process carried on in the crucible be a subliming proposition, then the discharge pipe arrangement shown at Figs. 7 and 8 will be utilized; the slip-joint 35 permitting the rotation of the furnace during such operation.

I claim as my invention:—

1. A furnace, comprising a retaining shell, a refractory lining therefor forming a continuous interior cover for its ends and longitudinal portions, constituting an ore heating chamber, flues formed in and extending through the refractory lining, means for supplying fuel under combustion to the flues in the lining, and a discharge opening for the escape of the products of combustion from the flues.

2. A furnace, comprising a cylindrical retaining shell, a refractory lining therefor forming a continuous interior cover for its ends and longitudinal portion constituting a closed ore treating chamber, flues formed in and extending through the refractory lining, means at one end of the chamber for supplying fuel under combustion to some of the flues in the lining, and a discharge opening at the same end of the chamber through which the products of combustion pass from other of the flues.

3. A furnace, comprising a cylindrical retaining shell, a refractory lining therefor forming a continuous interior cover for its ends and longitudinal portion constituting a closed ore treating chamber, flues formed in and extending through the refractory lining, means at one end of the chamber for supplying fuel under combustion to some of the flues in the lining, a discharge opening at the same end of the chamber through which the products of combustion pass from other of the flues, a central opening at the other end of the chamber for feeding ore thereto, and an opening for tapping molten metal and slag therefrom.

4. A furnace comprising a closed ore treating chamber cylindrical in form with its ends and cylindrical longitudinal walls integral of refractory material, longitudinal flues formed around the chamber through the longitudinal refractory walls, a passage formed in the refractory walls at one end of the chamber and into which all of the longitudinal flues open, means for supplying fuel under combustion to some of the longitudinal flues at the other end of the chamber, and a chimney at this end of the chamber for carrying off the products of combustion from other of the flues.

5. A furnace comprising a closed cylindrical ore treating chamber of refractory material with its end walls and cylindrical longitudinal walls integral, longitudinal flues formed around the chamber through the longitudinal refractory walls, a passage formed in the refractory walls at one end of the chamber and into which all of the longitudinal flues open, a central opening provided with a muffle door at this end of the chamber, means for supplying fuel under combustion to some of the longitudinal flues at the other end of the chamber, means for supplying fuel to the interior of the chamber through a central opening at this end of it, and a chimney at this end of the chamber for carrying off the products of combustion from other of the flues.

6. A furnace comprising a closed cylindrical ore treating chamber formed of a refractory material with its end walls and cylindrical longitudinal walls integral, means for rotating it, flues formed in the longitudinal walls of the chamber, means for supplying fuel under combustion successively to the flues, and a chimney for carrying off the products of combustion from the flues.

7. A furnace comprising a closed cylindrical ore treating chamber formed of a refractory material with its end walls and cylindrical longitudinal walls integral, means for rotating it, means for setting it in different angular positions, flues formed in the longitudinal wall of the chamber, means for supplying fuel under combustion successively to the flues, and a chimney for carrying off the products of combustion from the flues.

8. A furnace, comprising a cylindrical retaining shell, a continuous refractory lining covering the ends and the cylindrical walls constituting a closed ore treating chamber, means for rotating it, means for setting it in different angular positions, flues formed in and extending through the refractory lining, means at one end of the chamber for supplying fuel under combustion to some of the flues in the lining, and a discharge opening at the same end of the chamber through which the products of combustion pass from other of the flues.

9. A furnace comprising a cylindrical retaining shell, a refractory lining therefor forming a continuous interior cover for its ends and horizontal portions constituting a closed ore treating chamber, flues formed in and extending through the refractory lining, means at one end of the chamber for supply-

ing fuel under combustion to some of the flues in the lining, a discharge opening at the same end of the chamber through which the products of combustion pass from other of the flues, a central opening at the other end of the chamber for feeding ore thereto, and an opening for tapping molten metal and slag therefrom, means for rotating the furnace, and means for setting it in different angular positions.

10. A furnace comprising a closed cylindrical ore treating chamber of refractory material with its end walls and cylindrical longitudinal walls integral, means for rotating the chamber, means for setting it in different angular positions, longitudinal flues formed around the chamber through the longitudinal refractory walls at one end of the chamber and into which all of the longitudinal flues open, means for supplying fuel under combustion to some of the longitudinal flues at the other end of the chamber, and a chimney at this end of the chamber for carrying off the products of combustion from other of the flues.

11. A furnace comprising a closed cylindrical ore treating chamber of refractory material with its end walls and cylindrical longitudinal walls integral, longitudinal flues formed around the chamber through the longitudinal refractory walls, a passage formed in the refractory walls at one end of the chamber and into which all of the longitudinal flues open, a central opening provided with a muffle door at this end of the chamber, means for supplying fuel under combustion to some of the longitudinal flues at the other end of the chamber, means for supplying fuel to the interior of the chamber through a central opening at this end of it, a chimney at this end of the chamber for carrying off the products of combustion from other of the flues, means for setting the chamber in different angular positions, and means for rotating it.

12. A furnace comprising a closed cylindrical ore treating chamber of refractory material with its end walls and cylindrical longitudinal walls integral, longitudinal flues formed around the chamber through the longitudinal refractory walls, a passage formed in the refractory wall at one end of the chamber into which all of the longitudinal flues open, an air pipe connected to the other end of the chamber by means of a rotary slip-joint and arranged to discharge into some of the flues, a fuel supply nozzle in the discharge end of the air pipe, a chimney at this end of the chamber also connected to the slip-joint and into which other of the flues discharge products of combustion, means for rotating the chamber, and means for setting it in different angular positions.

13. A furnace comprising a closed cylindrical ore treating chamber of refractory material with its end walls and cylindrical longitudinal walls integral, longitudinal flues formed around the chamber through the longitudinal refractory walls, a passage formed in the refractory wall at one end of the chamber into which all of the longitudinal flues open, a central opening through this end of the chamber provided with a muffle door, an air pipe connected to the other end of the chamber by means of a rotary slip-joint and arranged to discharge into some of the flues, a fuel supply nozzle in the discharge end of the air pipe, means for supplying fuel to the interior of the chamber also carried by the slip-joint, a chimney at this end of the chamber also connected to the slip-joint and into which other of the flues discharge products of combustion, means for rotating the chamber, and means for setting it in different angular positions.

14. A furnace comprising a cylindrical shell, a refractory lining therefor constituting a closed ore treating chamber of refractory material, flues formed around the chamber through the longitudinal refractory walls, a passage formed in the refractory wall at one end of the chamber into which all of the longitudinal flues open, a water-jacket end held in the cylindrical shell at the other end of the chamber by an anti-friction slip-joint, and provided with an opening at its lower part communicating with some of the flues and openings at its upper part communicating with other of the flues, a chimney connection inclosing the upper openings, a combustion chamber inclosing the lower opening, air and fuel supply pipes arranged to discharge into the combustion chamber, and means for rotating the furnace.

15. A furnace comprising a cylindrical shell, a refractory lining therefor constituting a closed ore treating chamber of refractory material, longitudinal flues formed around the chamber through the longitudinal refractory walls, a passage formed in the refractory wall at one end of the chamber into which all of the longitudinal flues open, a water-jacket end held in the cylindrical shell at the other end of the chamber by an anti-friction slip-joint, and provided with a central opening extending into the ore treating chamber, an opening at its lower part communicating with some of the flues and openings at its upper part communicating with other of the flues, a chimney connection inclosing the upper openings, a combustion chamber inclosing the lower opening, air and fuel supply pipes arranged to discharge into the treating chamber, air and fuel supply pipes arranged to discharge into the combustion chamber, and means for rotating the furnace.

16. A furnace comprising a cylindrical ore treating chamber, means for rotating it, an end piece carried at one end of the chamber

by a slip-joint, a fuel supply device connected to the end piece, a chimney connected to and extending upwardly from the end piece and then horizontally over the top of the treating chamber with its exit extending upwardly about centrally over the chamber, an expansion or slip-joint between the vertical and horizontal parts of the chimney, and means for holding the end piece from rotating with the cylindrical treating chamber.

17. A furnace comprising a cylindrical ore treating chamber, means for rotating it, an end piece carried at one end of the chamber by a slip-joint, a fuel supply device connected to the lower part of the end piece, a fuel supply device connected to the central part of the end piece, a chimney connected to the upper part of and extending upwardly from the end piece and then horizontally over the top of the treating chamber with its exit extending upwardly about centrally over the chamber, an expansion or slip-joint between the vertical and horizontal parts of the chimney, and means for holding the end piece from rotating with the cylindrical treating chamber.

18. A furnace comprising a cylindrical ore treating chamber, means for rotating it, an end piece carried at one end of the chamber by a slip-joint, a fuel supply device comprising air and oil supply pipes connected to the end piece, a chimney connected to and extending upwardly from the end piece and then horizontally over the top of the treating chamber, an air jacket surrounding the chimney, and a pipe connection therefrom to the air pipe of the fuel supply device, an expansion or slip-joint between the vertical and horizontal parts of the chimney, and means for holding the end piece from rotating with the cylindrical treating chamber.

19. A furnace comprising a cylindrical ore treating chamber, means for rotating it, an end piece carried at one end of the chamber by a slip-joint, a fuel supply device connected to the end piece, a chimney connected to and extending upwardly from the end piece and then horizontally over the top of the treating chamber with its exit extending upwardly about centrally over the chamber, an expansion or slip-joint between the vertical and horizontal parts of the chimney, means for setting the furnace in different angular positions, and means for holding the end piece from rotating with the cylindrical treating chamber.

20. A furnace comprising a cylindrical ore treating chamber, means for rotating it, an end piece carried at one end of the chamber by a slip-joint, a fuel supply device comprising air and oil supply pipes connected to the end piece, a chimney connected to and extending upwardly from the end piece and then horizontally over the top of the treating chamber, an air jacket surrounding the chimney, and a pipe connection therefrom to the air pipe of the fuel supply device, an expansion or slip-joint between the vertical and horizontal parts of the chimney, means for holding the end piece from rotating with the cylindrical treating chamber, and means for setting the furnace in different angular positions.

21. A furnace comprising a cylindrical ore treating chamber, a frame in which it is held, circular supports attached to the under side of the frame and corresponding circular ways constituting the base of the furnace, means for rocking the circular supports in the circular ways, an end piece carried at one end of the chamber by a slip-joint, a fuel supply device connected to the end piece, a chimney connected to and extending upwardly from the end piece and then horizontally over the top of the treating chamber with its exit extending upwardly about centrally over the chamber, an expansion or slip-joint between the vertical and horizontal parts of the chimney, and means for holding the end piece from rotating with the cylindrical treating chamber.

22. A furnace comprising a cylindrical retaining shell, a refractory lining therefor constituting a closed ore treating chamber, flues formed in and extending through the refractory lining, means at one end of the chamber for supplying fuel under combustion to some of the flues in the lining, a discharge opening at the same end of the chamber through which the products of combustion pass from other of the flues, a central opening at the other end of the chamber for feeding ore thereto and for the escape of volatile constituents of the ore, a muffle door for closing said opening, a pipe connected to the door by a slip-joint connection, means for rotating the chamber, and an opening for tapping molten metal and slag therefrom.

23. A furnace comprising a cylindrical retaining shell, a refractory lining therefor constituting a closed ore treating chamber, flues formed in and extending through the refractory lining, means at one end of the chamber for supplying fuel under combustion to some of the flues in the lining, a discharge opening at the same end of the chamber through which the products of combustion pass from other of the flues, a central opening at the other end of the chamber for feeding ore thereto and for the escape from the chamber of volatile constituents of the ore, a water-jacketed pipe with a slip-joint connection to a door adapted to cover the central opening, said pipe extending into a fume condensing chamber or flues, means for rotating the chamber, and an opening for tapping molten metal and slag therefrom.

24. A furnace comprising a cylindrical ore treating chamber, means for supplying fuel at one end of it, a central opening at the other

end, a perforated door adapted to cover the central opening a horizontal pipe with a slip-joint connection attached to the door and a vertical fume condenser pipe to which the horizontal pipe is connected by a slip-joint, and means for rotating the furnace.

In testimony whereof, I have hereunto subscribed my name this 7th day of May 1908.

CHAUNCEY C. MEDBERY.

Witnesses:
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