No. 804,330. PATENTED NOV. 14, 1905.

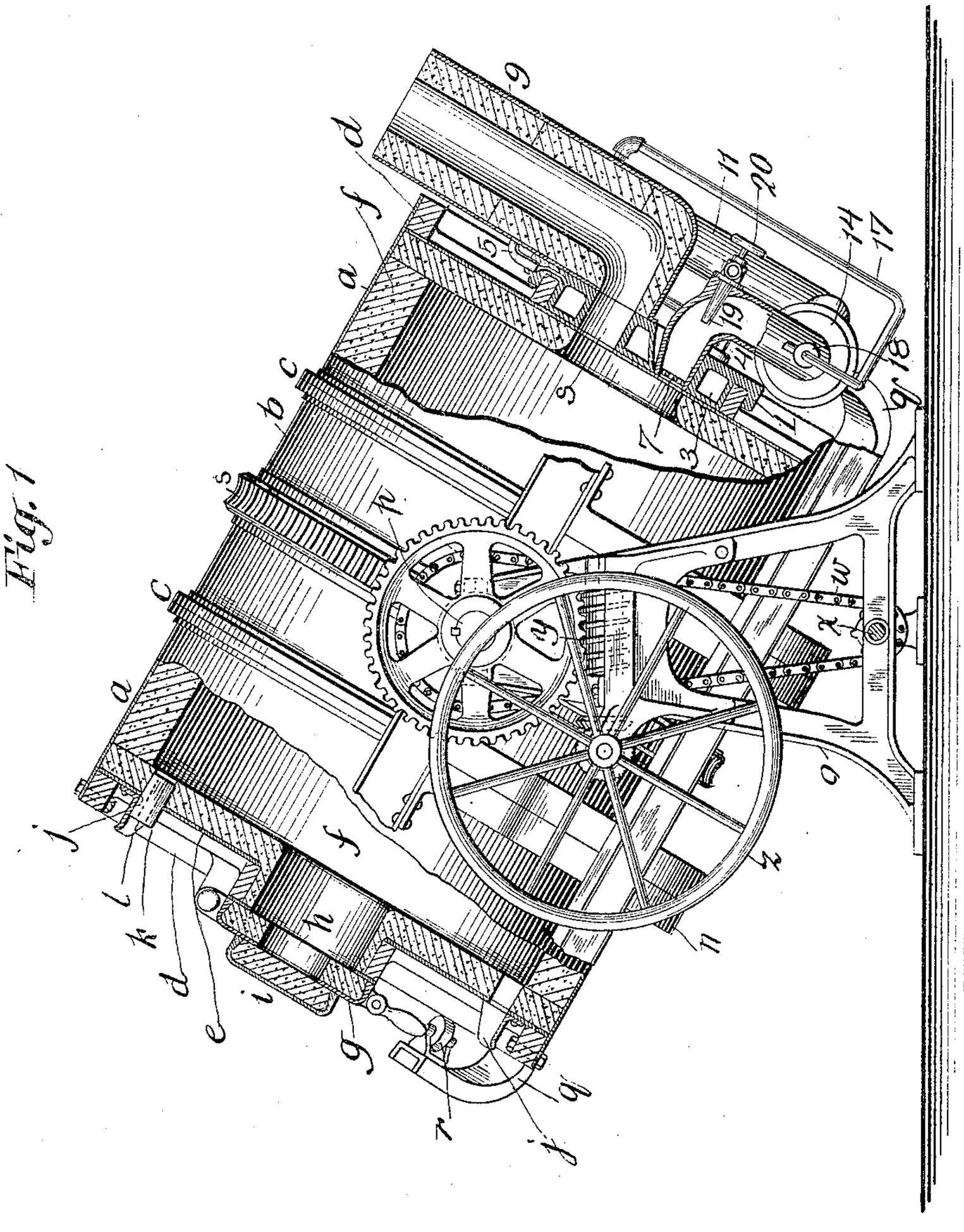
C. C. MEDBERY.

COMBINED SMELTING AND REFINING FURNACE.

APPLICATION FILED JAN. 17, 1905.

4 SHEETS—SHEET 1.

Fig. 1

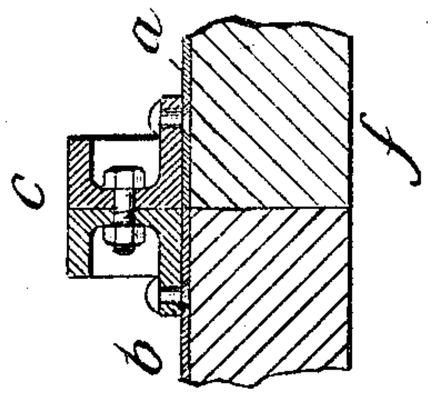


WITNESSES:

M Neil.

Arthur C. Platz

Fig. 4.



INVENTOR

Channcey C. Medbery

BY

Alfred Theobald

ATTORNEY

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4 SHEETS—SHEET 2.

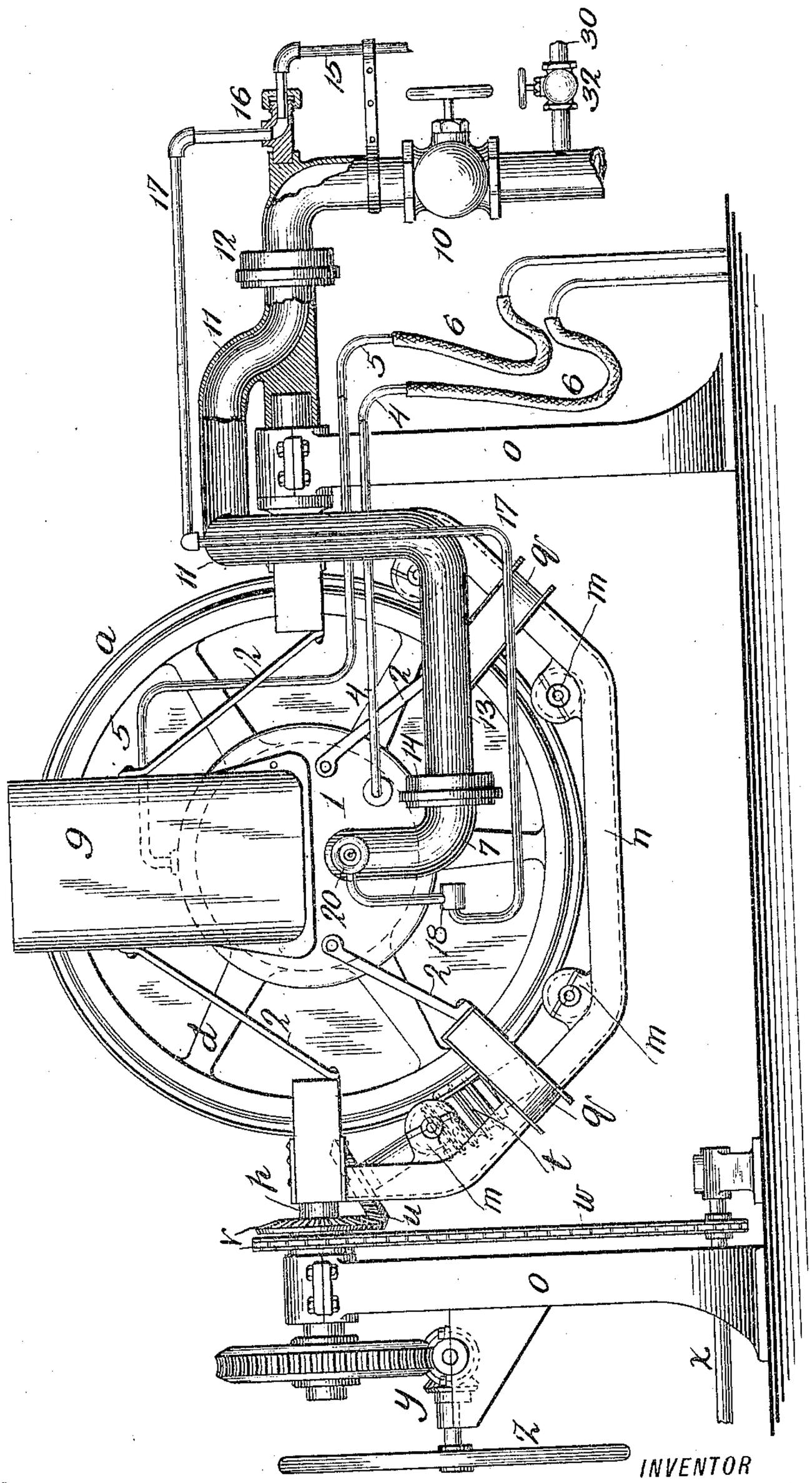

Fig. 2.

WITNESSES:

M. Geil

Arthur C. Dodge

INVENTOR

Chauncey C. Medbery

BY

Alfred Sheelock

ATTORNEY

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4 SHEETS—SHEET 3.

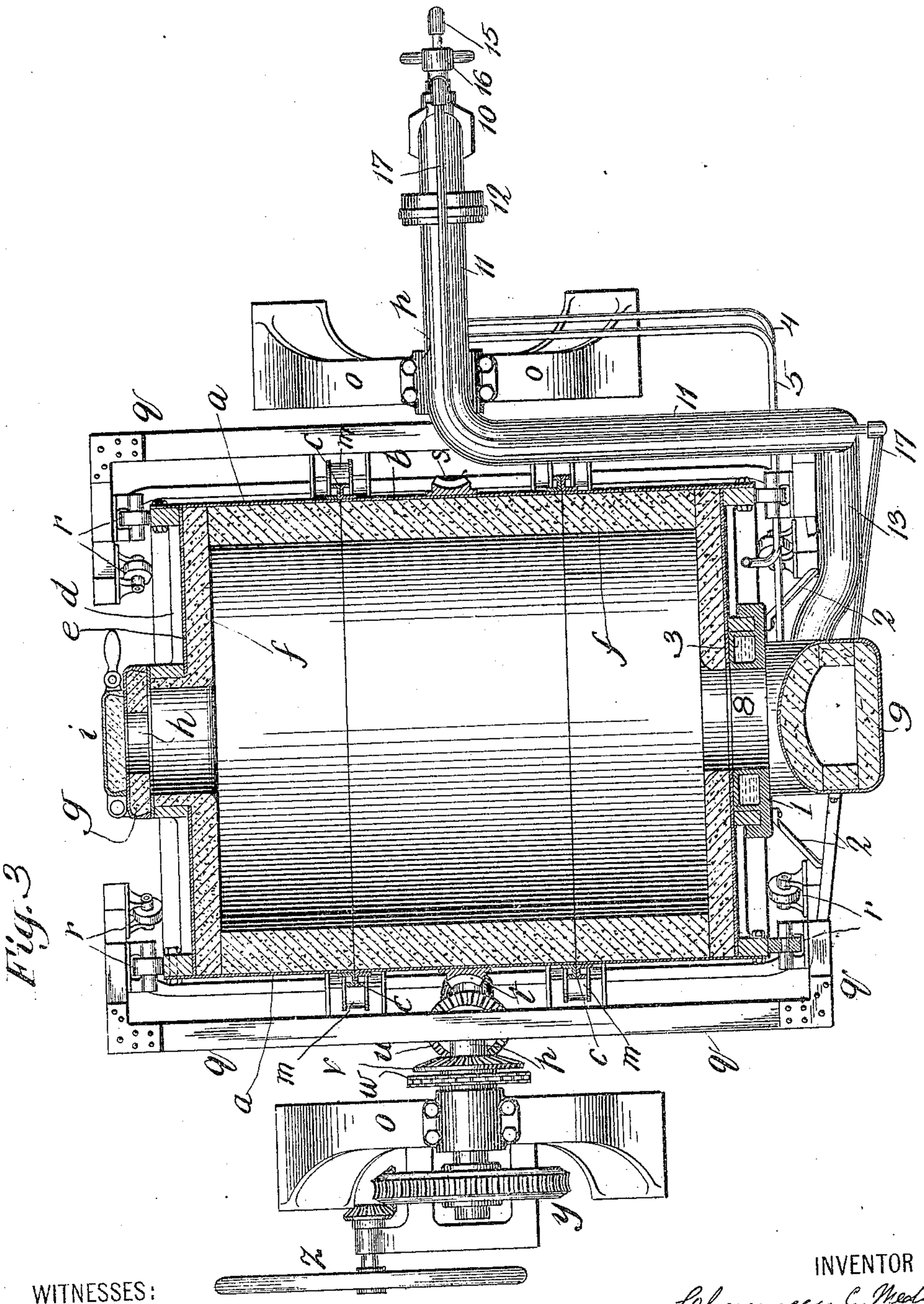

Fig. 3

WITNESSES:

M. Reil.
Andrew C. Blatz

INVENTOR
Chauncey C. Medbery.

BY
Alfred Shedlock
ATTORNEY

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C. C. MEDBERY.

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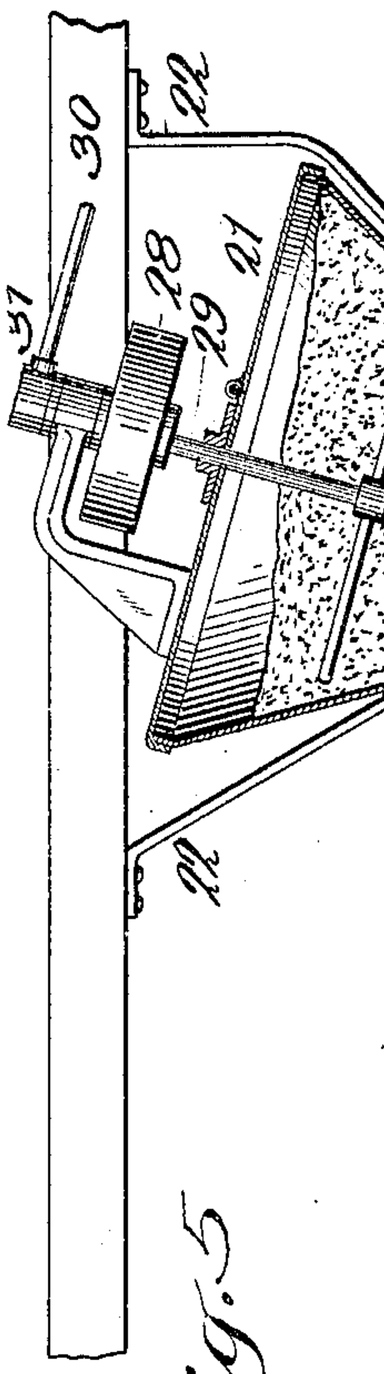

Fig. 5.

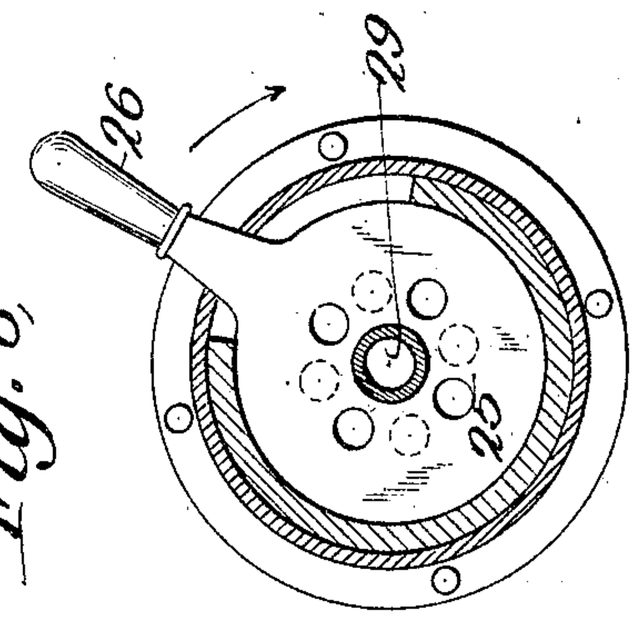

Fig. 6.

WITNESSES:

M. Geil.

Arthur C. Blatz

INVENTOR

Chauncey C. Medbery

BY

Alfred Shedlock.

ATTORNEY

UNITED STATES PATENT OFFICE.

CHAUNCEY C. MEDBERY, OF NEW YORK, N. Y.

COMBINED SMELTING AND REFINING FURNACE.

No. 804,330. Specification of Letters Patent. Patented Nov. 14, 1905.

Application filed January 17, 1905. Serial No. 241,454.

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 a Combined Smelting and Refining Furnace, of which the following is a specification.

This invention relates to an improved furnace adapted for use in all smelting and refining processes, and embodies novel features of construction whereby the smelting and refining of ores and other materials may be economically and fully consummated.

The furnace devised by me is complete in itself, and so is of a portable character. It comprises a rotatable chamber having a continuous hearth; means for rotating the chamber and for rocking or tilting it, so that it may be readily manipulated, adjusted, and set in different angular positions to provide for the production of perfect results in smelting and refining operations; air and fuel supplying devices attached to one end of the chamber in such manner that the application of heat to the furnace may continue during the adjustment and setting of the chamber and in all operative positions in which it may be set; an opening at the other end of the chamber; means for muffling or partly closing and means for completely closing said opening; two or more tapping-holes at this end of the chamber and bricks or plugs for closing the same, which are perforated or provided with holes also adapted to be plugged; a flue or chimney at the end of the chamber where the fuel device is located; and with its outlet from the chamber adjacent to the fuel device, the said flue and fuel device being connected to the end of the chamber by a slip-joint, so that the continuous-hearth rotating chamber, with its other end fully closed, will be operated as a return-flue furnace, thus insuring great economy in the use of fuel, a considerable saving of time, and an improved and increased production resulting from the smelting and refining operations; a water-jacket for the slip-joint connection of the flue and fuel device with the chamber, and also other minor features of construction whereby all parts of the apparatus properly coact and the free and easy manipulation of the same is assured.

This new furnace is clearly shown in the accompanying drawings, in which—

Figure 1 is a side elevation with the ends of the heating-chamber broken away. Fig. 2 is an end elvation showing showing some of the pipe connections in section. Fig. 3 is a general plan view showing the heating-chamber in section. Fig. 4 is a detached sectional view of one of the supporting-rails of the chamber, also showing the manner in which the chamber is constructed. Fig. 5 is a sectional view of a device for feeding powdered fuel to the furnace; and Fig. 6 is a section of the same, taken on the line 6 6, Fig. 5, on an enlarged scale.

The main portion of the furnace—viz., the heating-chamber—consists of a metal shell composed of two end cylindrical sections *a a* and a central section *b*, to the adjacent edges of which are secured halves of two circular supporting-rails *c c*, the said halves of each of the rails being firmly secured together by bolts, as shown at Fig. 4, end pieces consisting of spider-frames *d* and sheet-metal pieces *e*, and an internal lining of refractory material, as fire-bricks *f*. This construction, providing for comparatively small pieces, meets all requirements of transportation. At each of the ends of the cylindrical chamber is formed a central opening, one of which is provided with a muffle-door *g*, the opening *h* of which is considerably smaller than the chamber-opening, and also with a solid door *i*, adapted to cover the opening *h*, and so fully close this end of the chamber, and this said end is also provided with two or more tapping-holes *j*, two being shown on Fig. 1, which holes will when the apparatus is in operation be closed by bricks *k*, which in turn will have the holes *l* closed by plugs.

As before stated, the heating-chamber is adapted to be rotated on its central axis and also to be tilted, and to this end its circular rails *c c* rest on rollers *m m*, having bearings in the saddle-frame *n*, supported in the standard-frames *o o* by suitably-formed trunnions *p p*, said frame also being provided with girders *q q*, at the ends of which are located rollers *r r*, arranged to bear against the outer edges of the spider-pieces *d d*, and so control the chamber endwise and assist in supporting the same when it is set or moved into inclined positions.

The rotation of the chamber is brought about through the medium of the toothed ring *s*, secured to the central section *b*, the worm *t* meshing therewith and fitted with its shaft

to rotate in an angularly-arranged bearing in the saddle-frame *n*, a pair of bevel-wheels *u*, one of which is secured to the shaft of the worm *t* and the other one fitted to rotate on one of the trunnions *p*, a sprocket-wheel *v*, secured to this bevel-wheel, and a chain *w*, connecting the sprocket-wheel *v* to a sprocket on the driving-shaft *x*, which may be in any way suitably located and be driven from any suitable source of power. The rocking movement of the saddle-frame and chamber is controlled by a screw-worm and worm-wheel *y*, the worm being rotated, by means of the hand-wheel *z*, through the medium of a pair of miter-wheels. These means afford a simple and efficient control of the movements of the chamber; but it will be understood that any suitable device or devices may be substituted for the particular mechanisms shown.

The opening in the cylinder end opposite the muffle-door opening is covered by the fuel-supply device and the outlet-opening to the flue or chimney in the following manner: In the interior of the inner ring of the spider-piece *d* is fitted the piece 1 in such manner that the chamber is free to rotate, while the said piece is held stationary relative thereto by being firmly braced to the girders *q* and other extensions from the saddle-piece *n* by means of suitable bars 2 2. To protect the piece 1 and other parts carried by it from the heat to which it will be subjected, it is proposed to form therein a water-space 3, to which water may be supplied and discharged therefrom by the pipes 4 and 5, respectively, which extend alongside of the chamber to near one of the trunnions of the saddle-frame, where they connect to stationary sections of pipes by flexible hose 6 6, thus providing for the free adjustments of the saddle-frame and chamber.

The air and fuel supply burner 7 extends into an opening formed through the lower part of the piece 1, and an opening 8 of greater area is formed through its upper part and constitutes a communication between the interior of the chamber and the flue or chimney 9, which is formed of metal securely fastened to the piece 1 and lined with fire-bricks, as shown. Air from a suitable source of supply under pressure passes to the burner 7 through the valve 10, the bent section of pipe 11, which is secured to one of the trunnions *p* and which is provided with a slip-joint 12, and extends along the side of the chamber and around its end and is here provided in its horizontal portion 13 with a slip-joint 14, from which joint extends the curved or gooseneck-burner 7. This last-mentioned slip-joint 14 permits the burner 7 to be turned or swung away from the chamber when the same is receiving a fresh charge of material after having been heated, and so prevent the heated air and gases from the chamber passing into and through the air-pipes, for at such times the air-supply will be cut off. It also affords by a slight movement of the burner a means for a visual examination of the interior of the chamber during a run for a proper governing of the air and fuel supplies.

The fuel-supply means is shown in the main views of the drawings as pipes and slip-joints for the use of liquid fuels, comprising a stationary supply-pipe 15, which enters a slip-joint 16, attached to the air-pipe coincident with the axis of the trunnions *p*, a pipe 17, extending from this slip-joint along the side of and around the end of the chamber, a slip-joint 18 in this pipe in line with the slip-joint 14 of the air-pipe, and a branch from this slip-joint 18 to the oil-nozzle 19, which is secured to and enters the air nozzle or burner 7 in line with its furnace-opening and is provided with a stop cock or valve 20. This arrangement provides for the proper movement of the fuel-nozzle with the burner 7 without disarrangement of any of the oil-pipes and their connections.

In applying a charge of material to be treated the furnace will preferably be set in an angular position, as shown at Fig. 1, through the opening shown covered by the doors *g* and *i*, the air and fuel nozzles 7 and 19 being at such time swung away from the furnace if the furnace is in a heated condition and the air-supply cut off, as before pointed out. When duly charged, the chamber is set in about a horizontal position, the air and fuel being then applied with the doors *g* and *i* closed, or the door *i* may be temporarily left open and the flame muffled by the door *g* for it to be properly adjusted. With this end of the chamber fully closed the flame after passing over the material will return through the upper part of the chamber, and so finally the products of combustion will escape from the flue or chimney 9. Thus it will be seen that practically all of the heat due to the combustion of the fuel will be utilized, for that which would pass away through the end opening acts on and duly heats the continuous hearth, it being understood that the chamber is rotating. The material after being smelted may be refined with the necessary agents added to the charge and the fuel-supply properly adjusted, if the material be of such a character as to admit of this as a continuing process, or the furnace may be used for smelting or refining only. In operation the charging and discharging end of the chamber will be preferably slightly depressed, so that the metal as it deposits will accumulate at said end and be in right condition for withdrawal from one of the tapping-holes *l*, and after complete discharge the slag may be poured through the opening *j*, the brick *k* being withdrawn. The object of providing two or more tapping-places is to provide for

the contingency of the clogging of a tapping-hole, as sometimes happens, the chamber then being rotated to bring another tapping-place into position. The chamber may also by manipulating the hand-wheel 2 be oscillated on its trunnion-bearings during a smelting or refining operation, and so cause a thorough stirring or mixing of the material by causing it to flow back and forth in the chamber. The fumes escaping from the chimney 9 may be collected in any suitable recovering or precipitating chamber if the volatile products of a smelting or refining process involves a subliming proposition.

It is desirable in some cases to use a solid fuel in furnaces of this character, a convenient form of which being in a pulverized or finely-divided condition to be fed thereto by and with the blast of air. For this purpose it is proposed to use a device (illustrated at Figs. 5 and 6) in which the pulverized fuel, as powdered charcoal, is placed in a reservoir 21, permanently attached in position at or near the end of the furnace by suitable overhead supports 22 and which by a pipe connection 23 is connected to the air-nozzle 7 in place of the oil-nozzle 19. This pipe is provided with a sliding connection 24, by means of which the part that joins the air-nozzle may be disconnected from the reservoir to permit the nozzle to be swung away from the furnace in the manner and for the purpose of cleaning the same, &c., previously described. The pipe is also provided with a register-valve 25, as clearly shown in the enlarged view, Fig. 6, which by manipulation of its handle 26 will permit more or less of the fuel to pass through it or cut it off entirely. The fuel in the reservoir 21 is caused to flow or pass freely therefrom by the stirring-blades 27, driven by the pulley 28, and to insure the proper and uniform supply of the fuel to the furnace a blast of air is supplied through the shaft 29 of the stirrers 27, which is made hollow for this purpose and which by the pipe 30, connected to its upper end by a slip-joint 31, is placed in communication with the air-supply pipe through the valve 32. (Shown at Fig. 2.) The outlet of the hollow shaft 29 is just below the fuel-supply register-valve 25, and the current of air issuing therefrom acts on the injection principle, assists in feeding, and mixes with the fuel and carries it through the pipe 23 to the burner, where it is taken up by the main air-blast and fed and burned in the chamber. To insure the proper action of this device, it is necessary, or rather advantageous, that the pressure of the air which feeds the fuel from the reservoir 21 exceeds that of the main supply, and this is accomplished by taking the air through the valve 32 from the main air-supply pipe in front of the valve 10, which will be set to choke the supply to the burner 7, so that the air-pressure in the burner will be less than that of the air passing with the fuel through the pipe 23.

I claim as my invention—

1. In combination, a heating-chamber; means for rotating it; a slip-joint, comprising a part fitted to slide and held in a bearing at the central part of one of the heads of the chamber; a fuel-supply device connected to the sliding part of the slip-joint, adapted to supply fuel to the chamber while it is rotated; a chimney also connected to this sliding part of the slip-joint, and affording means for the escape from the furnace of the products of combustion; and means for holding the sliding part of the slip-joint and devices carried by it stationary relative to the rotation of the chamber and causing them to be otherwise moved with the chamber.

2. In combination, a heating-chamber; means for rotating it; a slip-joint, comprising a part fitted to slide and held in a hollow or chambered bearing at the central part of one of the heads of the chamber; water supply and discharge pipes connected to the chamber of the bearing; a fuel-supply device connected to the sliding part of the slip-joint, adapted to supply fuel to the chamber while it is rotated; a chimney also connected to this sliding part of the slip-joint, and affording means for the escape from the furnace of the products of combustion; and means for holding the sliding part of the slip-joint and devices carried by it stationary relative to the rotation of the chamber and causing them to be otherwise moved with the chamber.

3. In combination, a heating-chamber provided with a central opening at each end; a fuel-supplying device and a chimney located at the opening of one end of the chamber; a slip-joint comprising a part fitted to slide and held in a bearing at the central part of this end of the chamber and to which is secured the fuel-supplying device and the chimney; a door for closing the opening at the other end of the chamber; and means for rotating the chamber.

4. In combination, a heating-chamber provided with a central opening at each end; a fuel-supplying device and a chimney located at the opening of one end of the chamber; a slip-joint comprising a part fitted to slide and held in a bearing at the central part of this end of the chamber and to which is secured the fuel-supplying device and the chimney; a muffle-door for closing the opening at the other end of the chamber; a door for closing the muffle-opening of the muffle-door; and means for rotating the chamber.

5. In combination, a heating-chamber provided with a central opening at each end; a fuel-supply device and a chimney located at the opening of one end of the heating-chamber; a door for closing the opening of the other

end of the heating-chamber; two or more tapping-holes formed through this end of the chamber; perforated bricks for closing said tapping-holes; means for rotating the chamber; and means for setting the chamber in different angular positions.

6. In a metallurgical heating-chamber, in combination; two cylindrical end sections; a cylindrical middle section; two circular supporting-rails, each composed of two parts which are secured to the adjacent edges of the ends and middle sections; means, as bolts, for securing the parts of the two rails together; ends with central openings secured to the outer edges of the end sections; a refractory lining, as fire-bricks, applied to the interior of the chamber, and a frame provided with rollers upon which the chamber by its circular rails rests.

7. In combination, a heating-chamber, means for rotating it; means for setting it in different angular positions; a frame in which the chamber is held and rotated; a slip-joint connection attached to one end of the chamber, a burner-nozzle extending through this slip-joint connection; an air-pipe carried by the frame and supplying air to the nozzle; and means whereby said nozzle may be removed from the slip-joint connection and set away from the end of the chamber.

8. In combination, a heating-chamber; means for rotating it; means for setting it in different angular positions; a slip-joint connection attached to one end of the chamber, a frame in which the chamber is held and rotated, a burner-nozzle extending through this slip-joint connection; an air-pipe carried by the frame and supplying air to the nozzle; a fuel-nozzle carried by and entering the burner-nozzle; a fuel-pipe carried by the frame and connected to the fuel-nozzle; and means whereby said burner, including the air-supply connection and the fuel-nozzle, may be removed from the slip-joint connection and set away from the end of the chamber.

9. In combination, a heating-chamber; means for rotating it; means for setting it in different angular positions; a slip-joint connection attached to one end of the chamber, a burner-nozzle extending through this slip-joint connection; an air-pipe supplying air to the nozzle; an oil-nozzle carried by and entering the burner-nozzle; an oil-pipe for supplying oil to the oil-nozzle; a slip-joint connecting the burner-nozzle to the air-pipe; and a slip-joint in the oil-pipe; whereby the burner and oil nozzle may without disarrangement of parts be swung away from the end of the chamber.

10. In combination, a heating-chamber provided with a fuel-supplying device comprising a compressed air and fuel nozzles at one of its ends; a frame provided with trunnions and in which the chamber is longitudinally rotatably supported; means for rotating the chamber; means for rocking the frame; an air-pipe extending from one of the trunnions of the frame to the fuel-supplying device; a slip-joint in the air-pipe in line with the axis of the trunnions; and another slip-joint in said pipe adjacent to the nozzle, whereby said nozzle may be swung away from the end of the chamber.

11. In combination, a heating-chamber; means for rotating it; a fuel-supplying device connected to one end of the chamber and adapted to supply fuel thereto while it is rotated; and a chimney also connected to this end of the chamber for the escape of the products of combustion therefrom; and a sliding connection joining the fuel-supplying device and chimney with the chamber; an air-pipe connected to the fuel-supply device; and a slip-joint in said pipe adjacent to the fuel-supplying device; whereby it may be swung away from the end of the chamber.

12. In combination, a heating-chamber; means for rotating it; a fuel-supplying device connected to one end of the chamber and adapted to supply fuel thereto while it is rotated; and a chimney also connected to this end of the chamber for the escape of the products of combustion therefrom; and a hollow or chambered sliding connection joining the fuel-supplying device and chimney with the chamber; water supply and discharge pipes connected to said chambered connection; an air-pipe and an oil-supply pipe connected to the fuel-supplying device; and slip-joints in alinement in said air and oil pipes, whereby the fuel-supplying device may without disarrangement of parts be swung away from the end of the chamber.

13. In combination, a heating-chamber; means for rotating it; means for setting it in different angular positions; a slip-joint comprising a part fitted to slide and held in a bearing at the central part of one of the heads of the chamber; a burner-nozzle extending through the sliding part of the slip-joint; an air-pipe for supplying air to the burner-nozzle, and adapted to move with the chamber as it assumes different angular positions; a slip-joint in the air-pipe arranged so that the burner-nozzle may be set away from the end of the chamber; a fuel-nozzle carried by and entering the burner-nozzle; a fuel-supply pipe connected to the fuel-nozzle; and a sliding detachable connection in the fuel-supply pipe.

14. In combination, a heating-chamber; means for rotating it; means for setting it in different angular positions; a slip-joint connection at one end of the chamber; a burner-nozzle extending through this slip-joint connection; a chimney also located at this end of the chamber and extending through the slip-joint connection; an air-pipe supplying air to the burner-nozzle; a fuel-nozzle carried by

and entering the burner-nozzle; means whereby the said burner may be removed from the slip-joint connection and set away from the end of the chamber; a stationary source of fuel-supply; a pipe therefrom connected to the fuel-nozzle; and a sliding detachable connection in this pipe.

In testimony whereof I have hereunto subscribed my name this 16th day of January, 1905.

CHAUNCEY C. MEDBERY.

Witnesses:

M. ZEIL,

ARTHUR C. BLATZ.