(No Model.) 2 Sheets—Sheet 1.

J. H. MATHEWS.

APPARATUS FOR TREATING ORES WITH SUPERHEATED STEAM.

No. 313,748. Patented Mar. 10, 1885.

Fig. 1.

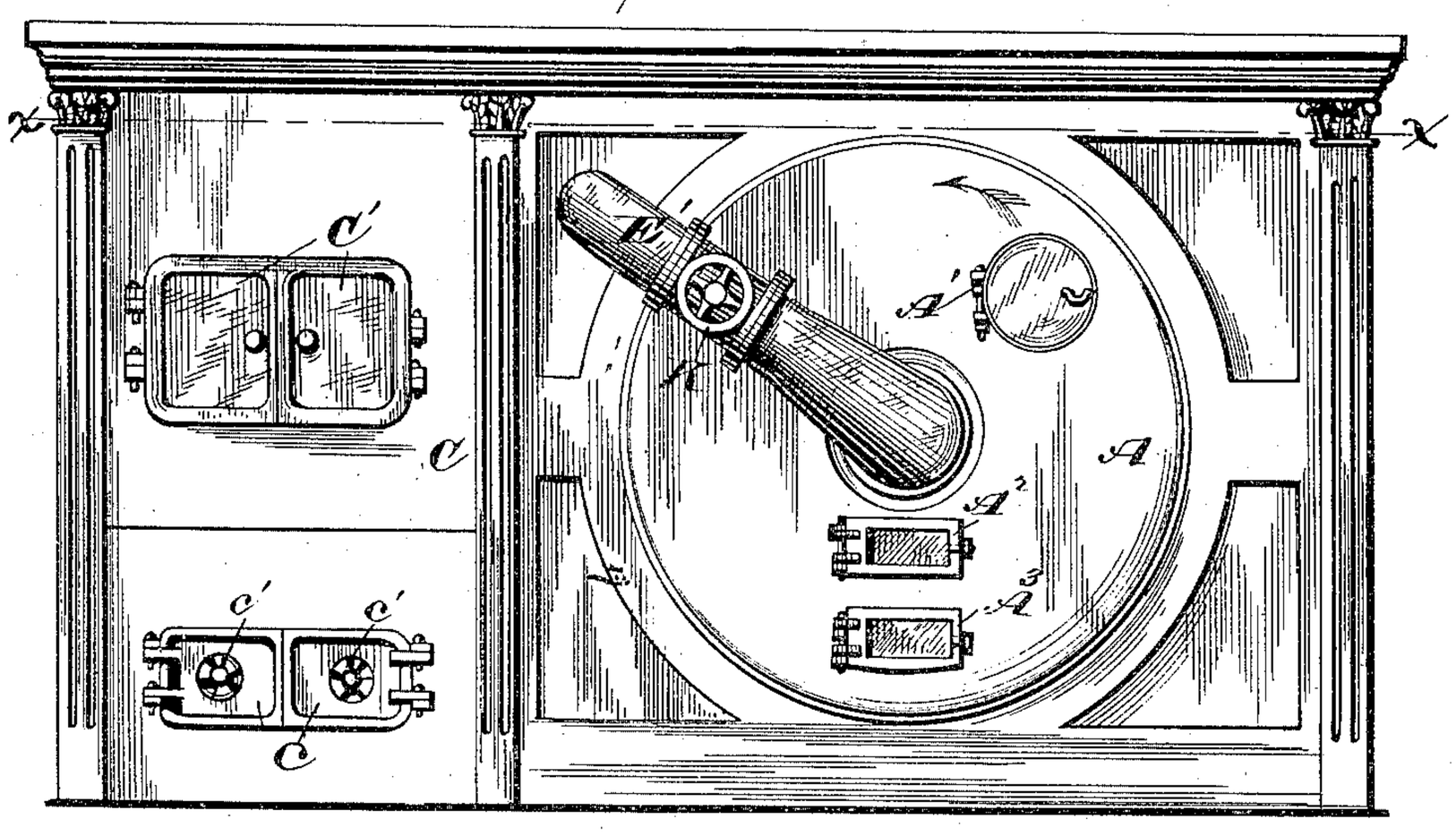
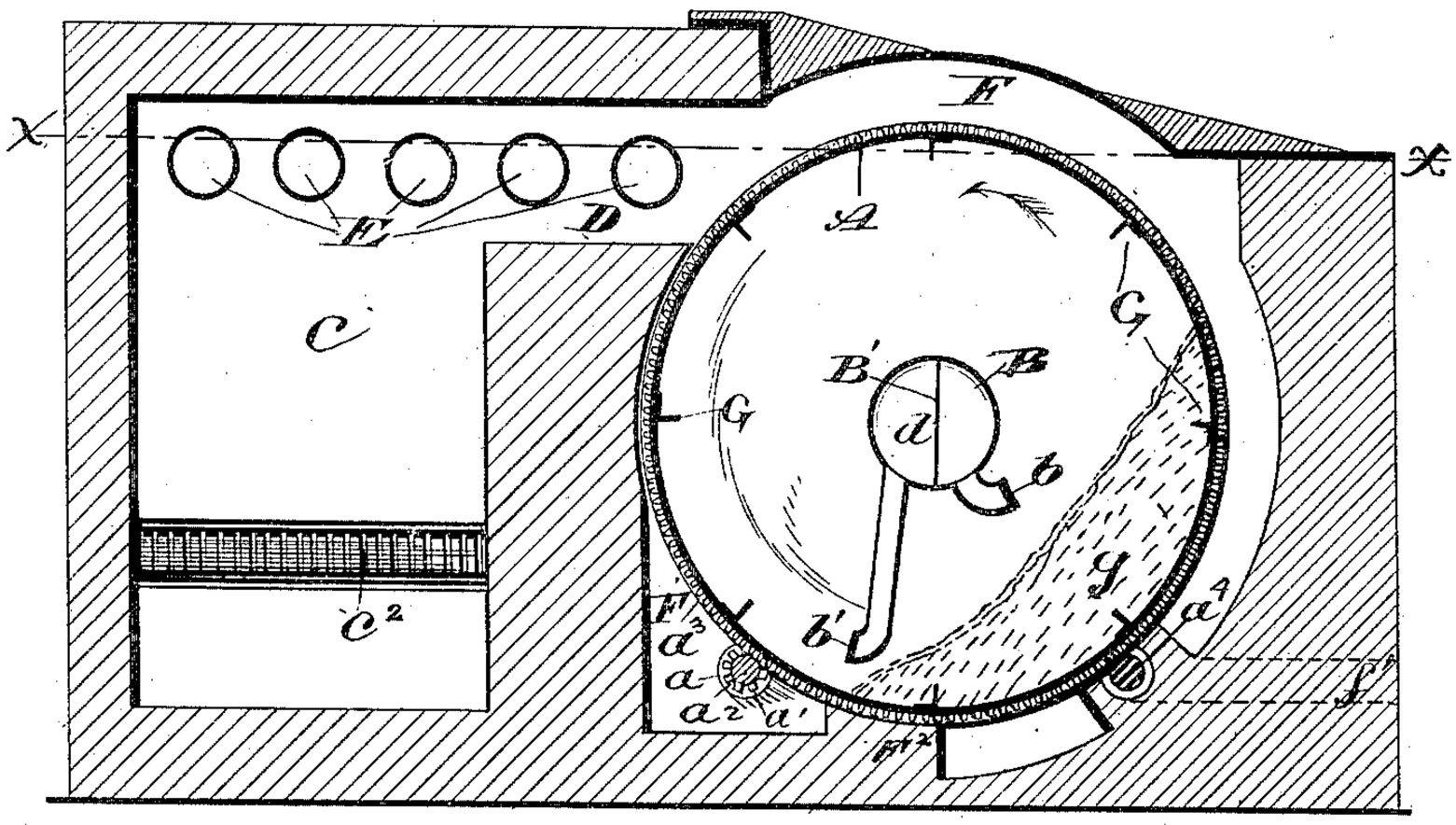


Fig. 2.



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(No Model.)

2 Sheets—Sheet 2.

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Fig. 3.

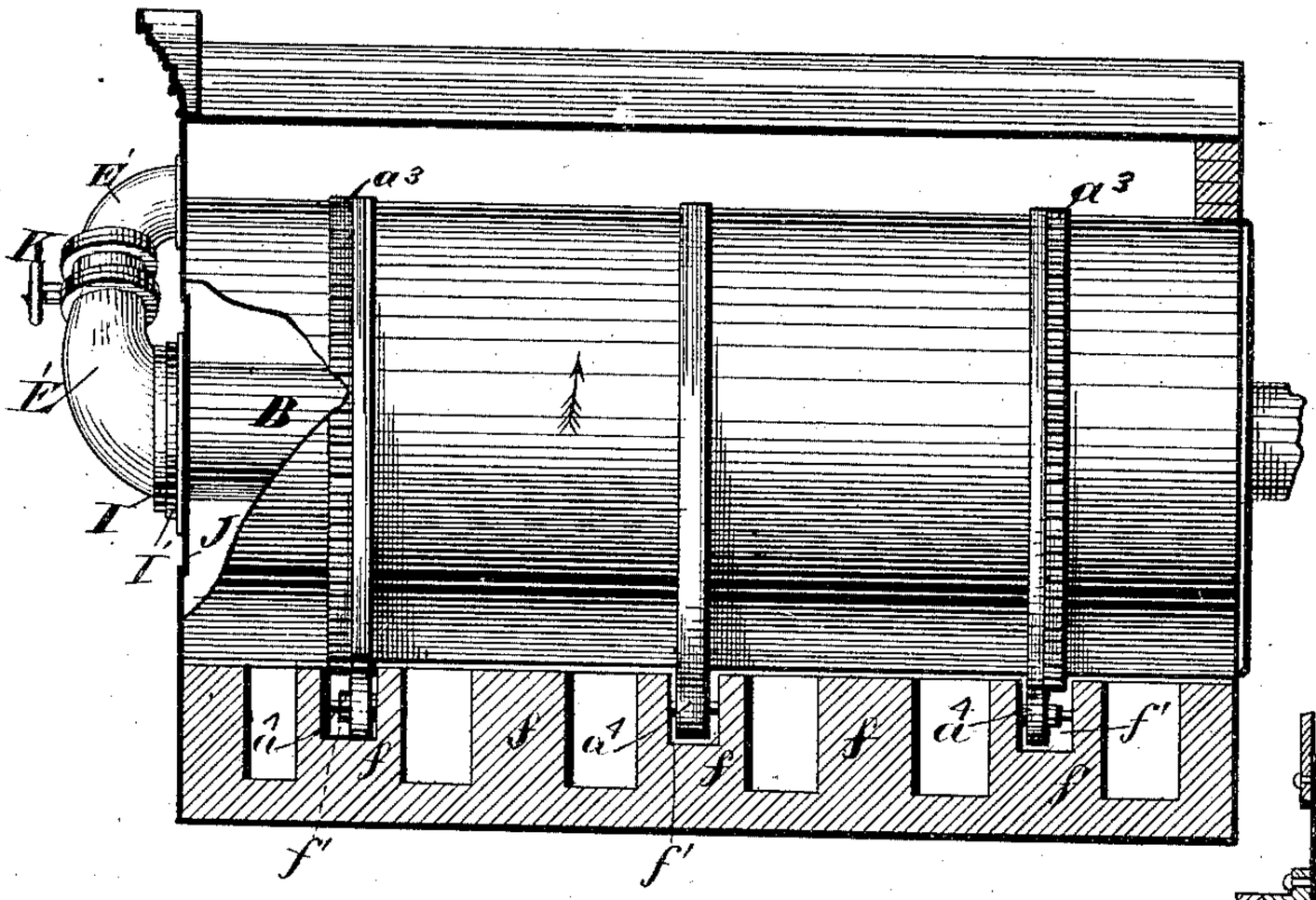


Fig. 6.

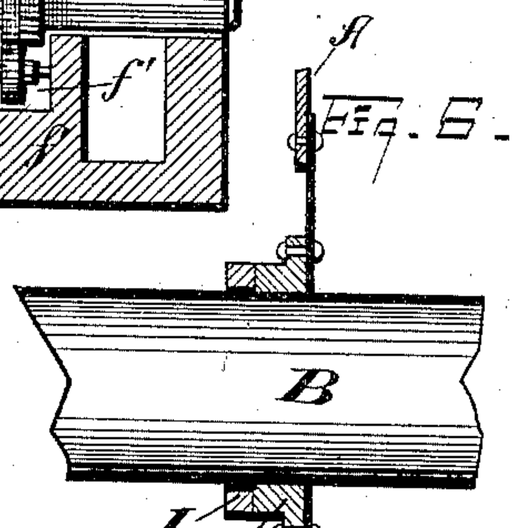
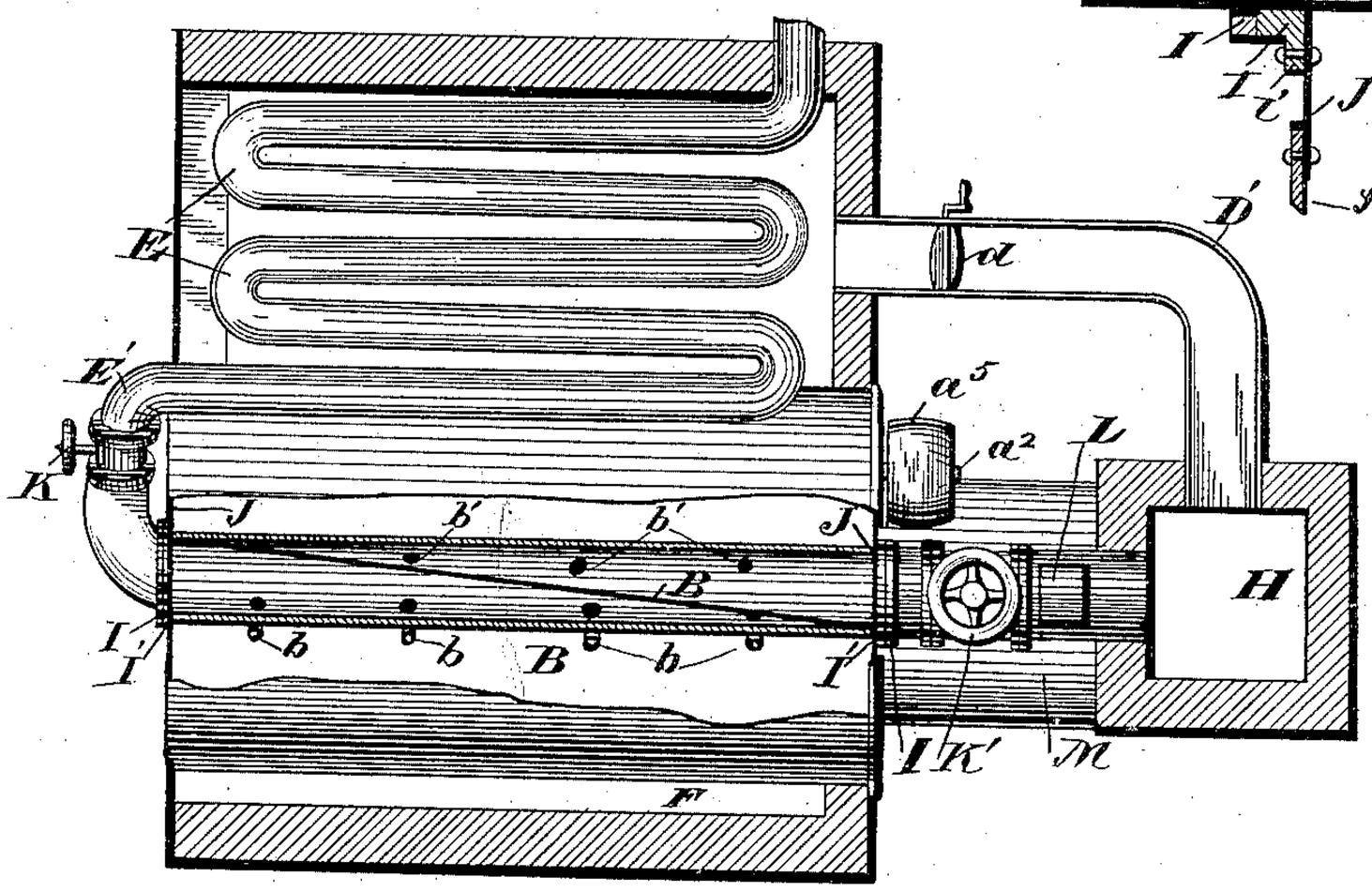


Fig. 4



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UNITED STATES PATENT OFFICE.

JOSEPH H. MATHEWS, OF CANTON, OHIO.

APPARATUS FOR TREATING ORES WITH SUPERHEATED STEAM.

SPECIFICATION forming part of Letters Patent No. 313,748, dated March 10, 1885.

Application filed May 29, 1884. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH H. MATHEWS, of Canton, in the county of Stark and State of Ohio, have invented certain new and useful Improvements in Apparatus for Treating Ores with Superheated Steam; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

My invention relates to improvements in apparatus for treating ores with superheated steam, the object being to provide a horizontal rotating closed cylinder in which the ore is placed and subjected to the action of superheated steam. A further object is to provide a central tube extending through the center of the cylinder from end to end, provided with suitable packing-rings to form tight joints with the cylinder-heads, and the said tube provided with a diagonal internal division-wall so arranged that one part of the tube serves as an induction-pipe to admit steam into the cylinder, and the other part as an eduction-tube through which the steam and gases escape from the cylinder. A further object is to provide branch induction-tubes with their outlets so arranged that the jets of steam on entering the cylinder are directed toward the upper portion of the mass of ore that is undergoing treatment. A further object is to provide branch eduction-tubes leading from the main eduction-tube to near the bottom of the inside of the cylinder, by means of which the heavy gases formed in the cylinder are forced out by the pressure of steam above them. A further object is to provide a furnace and flue leading therefrom to a heating-chamber partially surrounding the cylinder, and so arranged that the products of combustion first come in contact with and pass over the upper portion of the cylinder, and thence down around the ascending side and under the cylinder, and from thence are discharged through a suitable flue to the smoke-pipe, to the end that the steam-space in the cylinder is kept at a high temperature, and also that the ascending side of the cylinder is so heated that the ore in contact therewith is heated as it is carried up, so that as the top portion of the mass of ore falls by gravity the fresh ore thus exposed is in a proper heated condition to be quickly oxidized by the action of the superheated steam. A further object is to provide a valve to regulate the quantity of steam admitted to the cylinder, and a valve to regulate the discharge of steam and gases from the cylinder, to the end that the required pressure may be had inside of the cylinder.

With these objects in view my invention consists in certain features of construction and in combination of parts hereinafter described, and pointed out in the claims.

In the accompanying drawings, Figure 1 is an end elevation of my improved apparatus. Fig. 2 is a transverse vertical section of the same. Fig. 3 is a side elevation of the cylinder, a portion of which is broken away to show the central tube inside with the walls of the setting in vertical section. Fig. 4 is a horizontal section through the upper portion of the furnace, flue, and heating-chamber, on the line of $x\ x$, Fig. 1, showing a plan of the cylinder with portions broken away and a horizontal section of the central tube below. Fig. 5 is a longitudinal section of a portion of the central tube and a transverse section of the packing-rings, diaphragm, and a portion of the attached cylinder-head.

A represents a horizontal closed cylinder, the front head of which is provided with the doors A′ A^2 and A^3. The cylinder is supported on the rollers a and a^4. The former are mounted on the driving-shaft a^2, that is journaled in suitable boxes (not shown) located in the chamber F′. The rear end of the shaft is provided with the driving-pulley a^5.

On this shaft are secured the pinions a', that engage, respectively, the circular racks a^3, that are secured to the cylinder, and by means of which the cylinder is slowly rotated in the direction indicated by the arrow. The rollers a^4 are each provided with short trunnions journaled in boxes, (not shown,) and are located in the recess f', that extends to the outside of the setting, as shown in dotted lines in Fig. 2.

C represents a furnace provided with doors C′ for firing, and the ash-pit door c, provided with dampers c' and grates c^2 in the usual manner.

D is a flue leading laterally from the upper part of the furnace into the heating-chamber F, that partially surrounds the cylinder, as shown in Fig. 2.

B is a steam-pipe leading through the center of the cylinder A, and is connected in front by the pipe E′ with the coil of pipes E, located in the flue D, and in the upper part of the furnace. This coil is connected with a steam-generator, (not shown,) that supplies steam for consumption in the cylinder in the treatment of the ore, and in its passage through the coil E the steam is superheated before it reaches the cylinder. The chamber of the pipe B is divided by the inside diagonal wall, B′, as shown in Fig. 4, so that the chamber on one side of the wall B′, and extending forward, serves as an induction-pipe, and is provided with any desired number of branch pipes, *b*, to admit steam into the cylinder. The chamber on the other side of the partition B, and leading rearward, serves as an eduction-pipe, and is provided with the desired number of branch eduction-tubes, *b′*, for discharging steam and gases from the cylinder, and terminate near the bottom of the cylinder, as shown in Fig. 2. The cylinder is provided with inside longitudinal flanges, G, that carry the ore *g* some distance up along the ascending side of the cylinder.

It will be observed that the position and shape of the tubes *b* would direct the current of steam admitted into the cylinder toward the upper portion of the mass of ore, while the tubes *b′* receive the steam and gases from the opposite direction, which, together with the fact that the size and number of these tubes *b′* are such that there is but little current to the escaping steam and gases, prevents any of the fine particles of ore being carried off through the eduction-pipes. The products of combustion from the furnace passing through the flue D come in contact first with and pass over the top portion of the cylinder, and then through the chamber F down around the ascending side of the cylinder to near the central part under the bottom of the cylinder, thence by the flue M to the smoke-pipe H. By this arrangement of parts the top portion of the cylinder that is filled with superheated steam is kept at a high temperature, as is also the ascending portion of the ascending side that is in contact with the upper portion of the mass of ore. The temperature of the cylinder gradually decreases from thence toward the bottom. If the chamber F were unobstructed, the products of combustion would take the shortest route to the flue M, and the rear portion of the chamber would receive more heat than the front portion. To remedy this difficulty, I build the piers *f*, so located that the products of combustion must pass between the piers before reaching the lower portion of the chamber that is in open relation with the flue M. By means of these piers the chamber F is so reduced in area at this part that the escaping gases must pass through all of the spaces, and the heat by this means is well distributed through the chamber. In these piers are located the recesses *f′*, in which the rollers a^4 are set and protected from the heat by the surrounding walls of the respective piers. The chamber F is protected from the heat by the wall F^2, that extends the length of the cylinder and joins the front and rear walls of the setting. A flue, D′, leads from the rear end of the furnace to the smoke-pipe H, and by means of a damper, *d*, more or less of the heat from the furnace may be allowed to pass direct to the smoke-pipe, and by this means the amount of heat admitted to the chamber F may be controlled.

I are collars that are fitted steam-tight around the tube B at either end.

I′ are collars that fit the tube loosely and abut respectively against the inside of the collars I. The collars I′ are provided with flanges *i*, to which are secured the diaphragms J, that are also attached to the heads of the cylinder. The openings in the cylinder-heads through which the tubes B pass are somewhat larger than the tube, and the space between the cylinder-head and tube is closed by the diaphragm and ring J, by which arrangement there is sufficient pressure of steam from the inside of the cylinder against the diaphragm J, which is of thin metal, to press the ring I′ against the ring I, and form a tight joint between the faces of the rings.

K is a valve located in the pipe E′, for regulating the amount of steam admitted to the cylinder.

K′ is a valve in the rear portion of the tube B, by means of which the escape of the steam and gases from the cylinder is controlled, so as to give the required pressure on the inside of the cylinder.

L is a door in the tube B, at the rear of the valve K′, by means of which the gases passing from the cylinder may be inspected to determine the progress made in the reduction of the ore.

When the cylinder is in the position shown in Fig. 1, ore may be conveniently thrown in through the door A′ by means of a scraper operated through the door A^2.

After the cylinder has been charged with (usually pulverized) ore and the doors closed, the cylinder is revolved very slowly and is subjected to heat from 600° to 1,200° Fahrenheit, more or less, according to the kind of ore that is treated. Meantime steam, superheated as aforesaid, is admitted to the cylinder. The first action of the steam on the ore will oxidize such portions of the ore on the surface as have been raised to the proper temperature, but will not readily penetrate much below the surface. Also, heavy gases are soon formed, that cover the lower portion of the ore. As the ore is carried up with the ascending side of the cylinder, the upper portion

will topple over and fall by gravity to the bottom, and thus expose ore next to the cylinder that is properly heated, and this newly-exposed ore will be almost instantly oxidized by the action of the steam. By the continuous rotation of the cylinder all of the ore will eventually be carried up in contact, heated, and exposed to the action of the steam and oxidized, but leaving the gold and silver in a free metallic state, suitable for amalgamation in a subsequent operation. Some pressure of steam is required to expel the heavy gases formed in the cylinder, which would otherwise cover the mass of ore and prevent the steam from contact with the ore; also, steam under pressure oxidizes the ore more rapidly; but only a low pressure is required—say, from ten to fifteen pounds per square inch. Sometimes even less will be found sufficient.

I am aware that it is not new to place the ore in a revolving cylinder into which superheated steam is admitted at one end, while the excess of steam and the products of the action of the steam upon the ore issue from the other end of the cylinder and pass into the chimney, and hence I make no broad claim thereto; but

What I claim is—

1. The combination, with a revolving cylinder for treating ores and a furnace for heating the cylinder, of a chamber partially surrounding the cylinder and a flue leading from the furnace to the said chamber, and the parts so arranged that the products of combustion first come in contact with the top part of the cylinder, and pass from thence on and down around the ascending side thereof, substantially as set forth.

2. The combination, with the chamber F, of the piers *f*, or equivalent devices, adapted to obstruct the hot-air current, to the end that the said chamber will be evenly heated, substantially as set forth.

3. In a revolving cylinder for treating ores, a central steam-pipe provided with a diagonal partition-wall dividing the pipe into two parts, and arranged in such a manner that the two parts may be used, respectively, as an induction and eduction pipe, substantially as set forth.

4. In a revolving cylinder for treating ores, a central tube arranged to operate as an induction and eduction pipe, and with suitable openings for discharging steam into the cylinder, and a series of eduction-pipes connected with the main eduction or discharge pipe, and so arranged that the discharged steam and gases enter this eduction-tube near the bottom of the cylinder, substantially as set forth.

5. The combination, with a central stationary tube extending longitudinally through a revolving cylinder, of the collars I and I′, the former secured with a tight fit to the central tube, and the latter fitting the tube loosely, and connected by the diaphragm J to the head of the revolving cylinder, substantially as set forth.

In testimony whereof I sign this specification, in the presence of two witnesses, this 5th day of May, 1884.

JOSEPH H. MATHEWS.

Witnesses:
CHAS. H. DORER,
GEO. W. KING.