(No Model.) 2 Sheets—Sheet 1.

J. R. SEARS.

ROASTING FURNACE.

No. 562,158. Patented June 16, 1896.

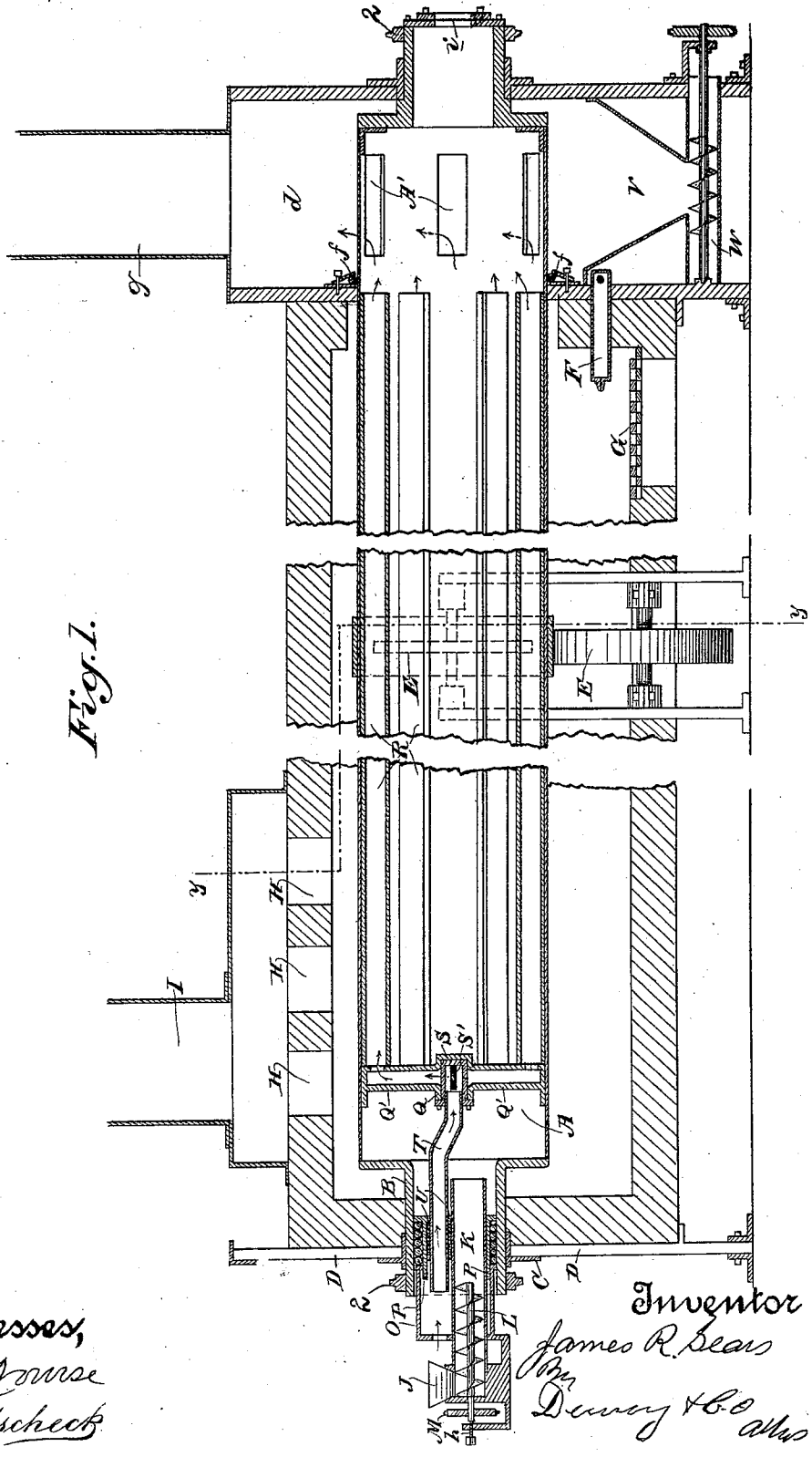

Fig. 1.

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(No Model.)

2 Sheets—Sheet 2.

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ROASTING FURNACE.

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Fig. 2.

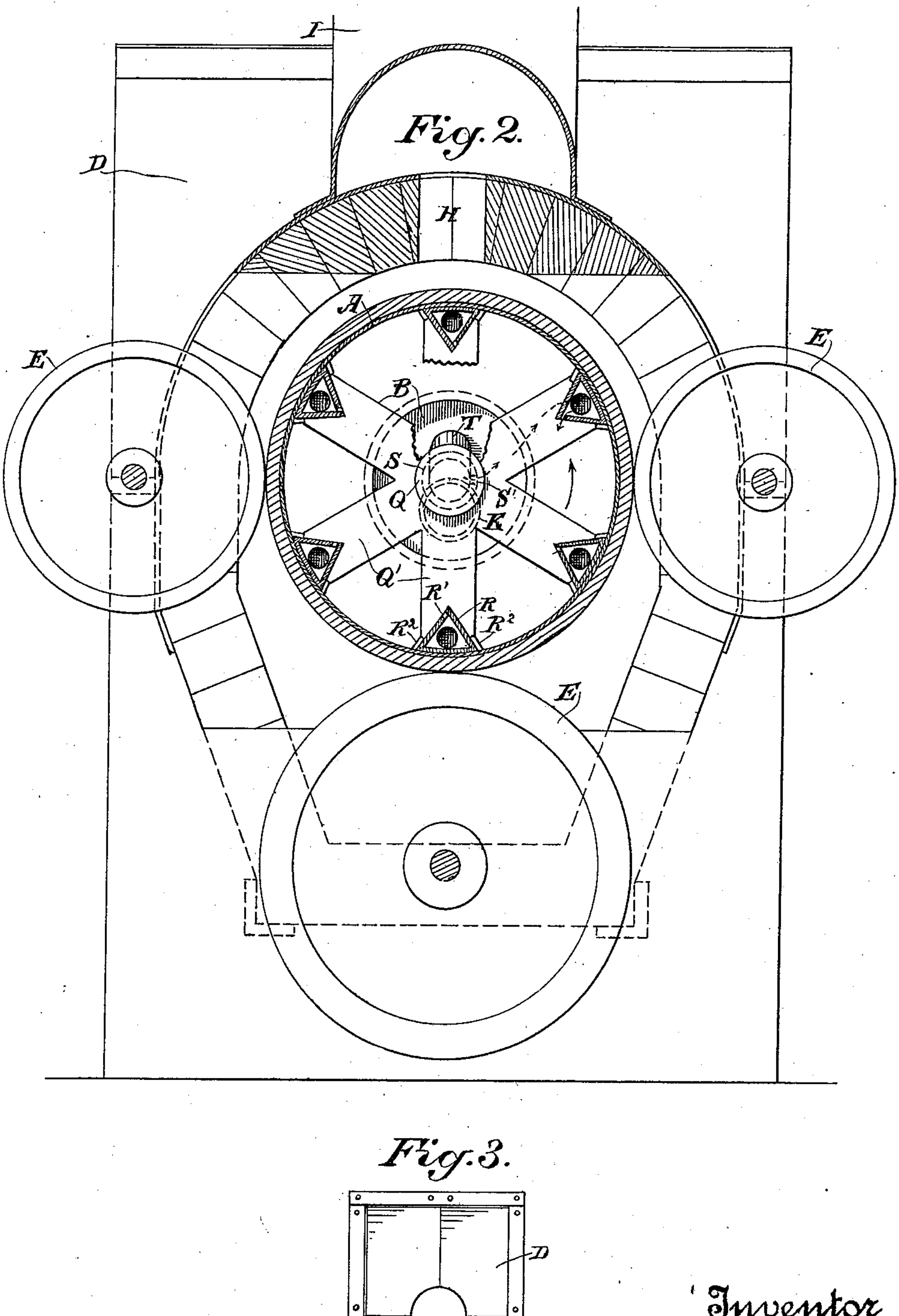
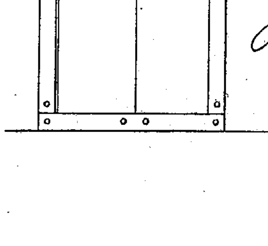


Fig. 3.



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UNITED STATES PATENT OFFICE.

JAMES R. SEARS, OF STOCKTON, CALIFORNIA, ASSIGNOR OF ONE-HALF TO DON C. MATTESON, OF SAME PLACE.

ROASTING-FURNACE.

SPECIFICATION forming part of Letters Patent No. 562,158, dated June 16, 1896.

Application filed September 13, 1895. Serial No. 562,429. (No model.)

To all whom it may concern:

Be it known that I, JAMES R. SEARS, a citizen of the United States, residing at Stockton, county of San Joaquin, State of California, have invented an Improvement in Roasting-Furnaces; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to improvements in furnaces for roasting ores.

It consists of the parts and the constructions and combinations of parts hereinafter described and claimed.

Figure 1 is a longitudinal vertical section of my apparatus. Fig. 2 is a transverse vertical section on the line *y y* of Fig. 1. Fig. 3 is a front view of the plate supporting the front of the apparatus.

The object of my invention is to provide improvements in that class of roasting-furnaces in which the body of ore is slowly passed from end to end through a rotating cylinder.

A is a cylinder of my furnace which may be of any suitable dimensions. A proportion of twenty feet in length by eighteen and one-half inches in diameter is very suitable, but these proportions may be changed to suit conditions. At each end of the cylinder is a closing-head having a central opening, and hollow trunnions B, extending beyond the head and adapted to turn in suitable journal-bearings, as shown at C. These bearings are formed in plates D, which are preferably made in two or more sections divided on lines radial from the center and suitably secured together. These sections allow for the expansion and contraction of the plates by heat without undue strain or tendency to break or buckle. Around the trunnions at one or both ends of the furnace are fixed sprocket-wheels 2, and chains passing around these wheels, and other suitable driving sprocket-wheels serve to apply power to rotate the cylinder upon its journals.

It will be understood that gearing or other forms of driving may be employed, if preferred.

The body of the cylinder is inclosed in a brick or masonry structure forming a furnace-chamber within which it is revoluble. At some point or points within this chamber are journaled bearing and guiding wheels or rollers E, which serve to steady and support the rotating chamber at points intermediate between the trunnions. This inclosing chamber is heated, preferably, by the use of petroleum or other liquid hydrocarbon which is injected into the furnace through any suitable spraying delivery-tubes or well-known apparatus for the purpose, as shown at F.

G represents grated openings adjacent to the fuel-inlet through which air is supplied for combustion. This fuel-inlet is situated near the discharge end of the cylinder and the greatest heat will naturally be at that point, decreasing toward the inlet end of the cylinder. The upper part of the furnace-chamber, at the opposite end, is provided with openings or passages H, through which heat escapes into a connecting-chamber and from this the products of combustion pass off through a stack or chimney I.

The feeding device consists of a hopper J, into which the ore is fed in a sufficiently-pulverized condition, and this delivers it into a horizontal cylinder K, having within it a spiral conveyer L, the shaft of which extends out through the end of the chamber, and has a sprocket-wheel M fixed upon it to receive a driving-chain from the main driving-shaft, the proportions of the sprockets being such as to feed the ore with any desired degree of rapidity.

The screw conveyer L extends only part way through the tube K, that portion of the tube between the end of the screw and the interior of the cylinder being unoccupied by the feed-screw, so that there will always be a considerable body of ore between the end of the screw and the inner discharge end of this tube which serves as an air-lock to prevent air escaping in this direction. The box or casing O through the end of which this feed-tube extends is fixed and supported exterior to the roasting-cylinder and it extends into the interior of the hollow trunnion at this end. Within the trunnion is an annular flanged cylinder P of sufficiently smaller diameter than the trunnion to form a space into which the flanged end of the part O extends, and between the flange of O and the interior flange of P is a chamber which is

adapted to receive any suitable packing material which will not be affected by the action of heat, but which will form a joint at this point, so as to allow the roasting-cylinder to expand and contract without affecting the other exterior connecting portions of the apparatus. Within the cylinder, near the end which receives the ore, is a structure composed of a hollow hub Q with hollow radial arms Q′. These arms may be as many in number as may be desired and their outer ends communicate with the interior of hollow ribs R, which are fixed around the interior periphery of the roasting-chamber. These ribs R may be made of any suitable or desired form. In the present case I have shown them of triangular section having the bases fitting against the interior of the cylinder and the apex of each extending toward the center. Just beneath the apex of each is a slot or channel R′, which extends the entire length of the rib and is adapted to discharge air in a continuous sheet from one end to the other of the roasting-cylinder when the ribs reach the proper point for the purpose, the air being cut off at all other points during the rotation of the cylinder, as will be hereinafter described.

The direction of rotation of the furnace will be as shown by the arrow in the transverse section, so that the sides of the hollow ribs in which the slot is made are lowermost. The upper sides, being continuous, serve to lift the ore which accumulates upon them as they pass the lower portion of the cylinder, and they begin to discharge the ore before they reach the center of the side and will have completed the discharge a short distance above the center on account of the angle at which they stand. During this discharge of the ore which is falling from the rib to the bottom of the cylinder the air-inlet is opened and air is discharged through the falling ore. This air-inlet will be closed as soon as the discharge of ore ceases and no air is admitted into the ribs during the remainder of the rotation of the cylinder.

The ribs R are preferably removably secured within the cylinder by means of angular lugs R^2, which are secured to the interior of the sides of the cylinder at intervals from one end to the other, and the flanges which extend inwardly being at the same angle with the sides of the triangular ribs, the latter can be slipped into these spaces and will thus be held in place, but may be removed at any desired time. Within the hub Q is a cylindrical chamber S, having an opening or port S′ on one side, this port coinciding with the openings in the arms Q′, which radiate from the hub, when these arms arrive at the point where it is desired to admit air into the ribs R, as previously described. Air under pressure is admitted into this chamber S through a pipe T, which extends axially out from the chamber S a short distance, and then is curved so as to pass outside of the feed-tube K. As this pipe is fixed to the chamber S within the hub Q and is therefore movable longitudinally by the expansion and contraction of the roasting-cylinder, I have shown a packing-chamber formed within the annular chamber P, through which this tube T is slidable and around which is placed any suitable packing U, which would prevent air-leakage at this point while allowing the tube to slide and adjust itself within the outer stationary chamber O. Air, under pressure, is admitted into the outer part of the chamber O from a blower or any suitable source of supply, and, passing through the tube T, will be delivered into the chamber S, passing thence through the port S′ whenever the arm Q′, through which the air is to be delivered to its rib R, is in line with this port, the supply being cut off as soon as the rotation of the cylinder has carried it beyond the port. The supply and pressure of air is regulated by passing it through a chamber, with any suitable safety-valve set to the desired pressure.

The discharge end of the cylinder projects into an open chamber *d*, which surrounds this portion of the cylinder, and is separated from the furnace by suitable packing-rings *f*. This discharge end of the cylinder has longitudinal slots or openings A′ made in it, so that when the ore arrives at this point, the heavier portion will fall through these slots into the hopper V, and thence into the screw-conveyer chamber W, from which it is removed by the screw conveyer rotated by connection with the sprocket-wheel *a* upon the cylinder-trunnion at this end. An air-lock is formed at this point, similar to that shown at the feed end of the apparatus, by continuing the tube beyond the screw so that it will always contain a mass of ore between the screw and the discharge-opening. The end of the trunnion at this end of the cylinder is closed by a cap which is provided with a mica or other transparent covering *i* for a central opening therein so that the interior of the roasting-chamber may be inspected from this point.

Any dust or fumes arising from the ore and not falling into the hopper V and carried off through the screw conveyer will pass out through a discharge-pipe *g*, the end of which is bent over and dips beneath the surface of the water in the usual form of condensers, so as to condense any valuable substances which may have been vaporized during the process of roasting.

In order to relieve the conveyer-shaft of pressure against the interior end of the cylinder K in which it revolves, and thus prevent wear at this point, I have shown a thrust-bearing consisting of a screw *h*, which passes through the fixed standard and presses against the end of the auger-shaft. By this screw the auger can be kept from pressing backward so as to wear against the inner end of its cylinder.

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

1. In a roasting-furnace, a horizontal cylindrical chamber extending approximately the length of the furnace, having closing-heads at its ends provided with central openings, hollow trunnions extending from said heads to and beyond the outer walls of the furnace, and journaled in bearings in said walls, said cylinder having its discharge end slightly lower than its receiving end, a driving mechanism connected with the trunnions at points exterior of the walls of the furnace whereby the cylinder is rotated from the ends, a heating-chamber within which the body of the cylinder is inclosed, and through which the trunnions project, supporting-rollers at the center of the cylinder, for supporting that portion thereof, while the opposite end portions are supported by the trunnions, and a petroleum-burner delivering a hydrocarbon fuel into the furnace beneath the discharge end of the cylinder and passages through which air is admitted through the bottom and sides of the furnace-chamber adjacent to the burner.

2. In an ore-roasting furnace, a hollow cylinder, horizontally disposed and declining slightly from the receiving to the discharge end, said cylinder having end closing-heads provided with central openings, hollow trunnions extending from said heads and through and beyond the walls of the furnace, and supporting the ends of the cylinder, a furnace-chamber inclosing the cylinder, supporting-rollers journaled in said furnace-chamber and supporting the cylinder intermediate of its ends, a feed mechanism consisting of a fixed tube entering one of the hollow trunnions, a hopper delivering into the outer end of the tube, a screw conveyer extending a portion only of the length of the tube to enable the body of one to accumulate between the end of the screw conveyer and the inner end of the cylinder to form an air-lock, and a packed or air-tight joint through which the tube passes.

3. In an ore-roasting furnace, a masonry furnace-chamber having an enlarged chamber at one end and having the upper portion of its opposite end provided with openings or passages, a chamber connecting with said openings or passages for receiving and conveying away the products of combustion, a petroleum-burner in the furnace-chamber, near the enlarged chamber thereof and means for supplying air thereto, a horizontally-disposed cylinder within the chamber and slightly inclined from its receiving to its discharge end, said cylinder having closing-heads with central openings, hollow trunnions extending from said heads through the walls of the chamber whereby the cylinder is supported at its ends, means engaging the outer ends of the trunnions and rotating the cylinder, rollers for supporting that portion of the cylinder intermediate of its ends, a box or casing fitted to one of said trunnions, an annular flanged cylinder within the trunnion and of sufficiently less diameter to form a space to receive the inner end of the box or casing, a feed-tube passing through the box or casing and the trunnion, and a screw conveyer passing through the feed-tube for a portion of its length only whereby a body of ore accumulates in front of the conveyer to form an air-lock.

4. In an ore-roasting furnace and in combination with a rotatable cylinder, a means for feeding air to said cylinder comprising a hollow hub located within the cylinder, arms projecting radially from said hub, ribs extending from the hub to near the opposite end of the cylinder, having their free ends open and adapted to discharge directly into said cylinder, said ribs being provided with a continuous air-discharge extending throughout their length and adapted to discharge air in a continuous sheet from one end to the other of the roasting-cylinder, and an air-pipe connecting with the hub and having a valve or passage so disposed within the hub that air escapes into one of the arms and its connecting-rib during the time that the ore is falling from said rib, and is cut off from all the others.

5. In an ore-roasting furnace, an approximately-horizontal cylinder having trunnions at opposite ends, and journaled to rotate within a furnace-chamber which incloses the body of the cylinder and through which heat is applied thereto, means connected with the trunnions exterior to said chamber whereby the cylinder is rotated therein, a fixed cylinder of smaller diameter extending into the end of the receiving-trunnion having flanges and an incombustible packing to form a joint between the two whereby the main cylinder is allowed to expand and contract longitudinally without leakage, a feeding device consisting of a horizontal tube extending into the end of the roasting-cylinder, a hopper discharging into the outer end of the tube, a screw conveyer and mechanism for rotating it whereby the ore is advanced within the tube, a hollow hub with hollow radial arms fixed within the cylinder near the receiving end, an air-pipe whereby air under pressure is delivered into said hub, hollow triangular ribs extending longitudinally along the inner surface of the cylinder, having continuous open slots made in them near the inner ends, said ribs being connected with the hollow arms so as to receive air therefrom and deliver it continuously from end to end of the cylinder.

6. In an ore-roasting furnace, an approximately-horizontal cylinder having hollow trunnions at opposite ends, journal-boxes upon which they are supported and a mechanism connected with said trunnions whereby the cylinders are rotated, a masonry furnace-chamber through which the body of the cylinder extends, a burner whereby exterior heat is applied near the discharge end of the cyl-

inder and a stack near the receiving end through which the products of combustion escape, an expansion-joint surrounding the receiving-trunnion to allow the longitudinal expansion and contraction of the cylinder, a screw conveyer rotating within a feed-cylinder adapted to deliver the ore into the interior of the cylinder, a hollow hub having radial arms fixed within the cylinder near the receiving end, hollow triangular ribs connecting with said arms extending longitudinally through the cylinder having continuous slots made in them to discharge air from one end to the other of the cylinder, an air-pipe leading through the trunnion connecting with the hollow hub and having a valve or passage so disposed within the hub that air escapes into one of the arms and its connecting-rib during the time that the ore is falling from said rib into the bottom of the chamber, and is cut off from all the others.

7. In a roasting-furnace, an approximately-horizontal cylinder having hollow trunnions at opposite ends and journal-boxes upon which they turn, means for applying power to said trunnions to rotate the cylinder, a masonry furnace-chamber through which the body of the cylinder extends and by which heat is applied to the outside of the cylinder, a screw conveyer rotating within a feed-tube so as to deliver ore within the interior of the cylinder through the trunnion at the receiving end, a joint formed between the trunnion and the exterior structure through which the feed-cylinder passes, whereby the main cylinder is allowed to expand or contract without leakage, a hollow hub with radial arms fixed within the cylinder near its receiving end, triangular hollow slotted longitudinal ribs extending from end to end of the furnace and connecting with said hollow arms, a tube connected with the hub having a valve or passage through which air under pressure is discharged into the hub and through the upwardly-moving rib only, so as to pass through the sheet of ore while it is falling from said rib, a surrounding packing or joint through which the tube passes parallel to the feed-cylinder into an outer chamber to allow expansion and contraction without leakage.

In witness whereof I have hereunto set my hand.

JAMES R. SEARS.

Witnesses:
GEO. H. STRONG,
S. H. NOURSE.