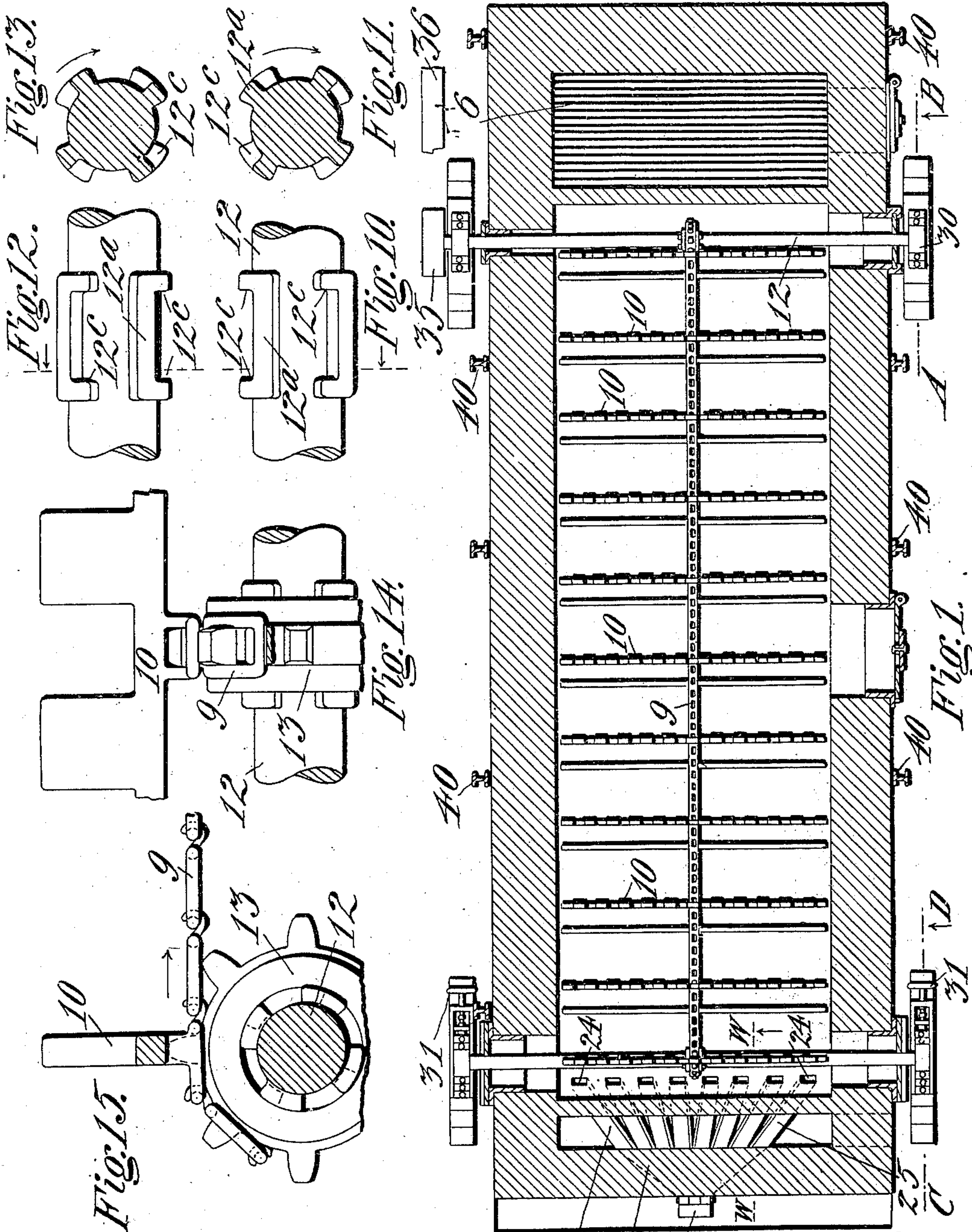


J. A. BENTLEY.  
ROASTING FURNACE.

(Application filed Feb. 19, 1900.)

(No Model.)

3 Sheets—Sheet 1.



Witnesses,  
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Grace Mytinger

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By *[Signature]*  
Attorney.

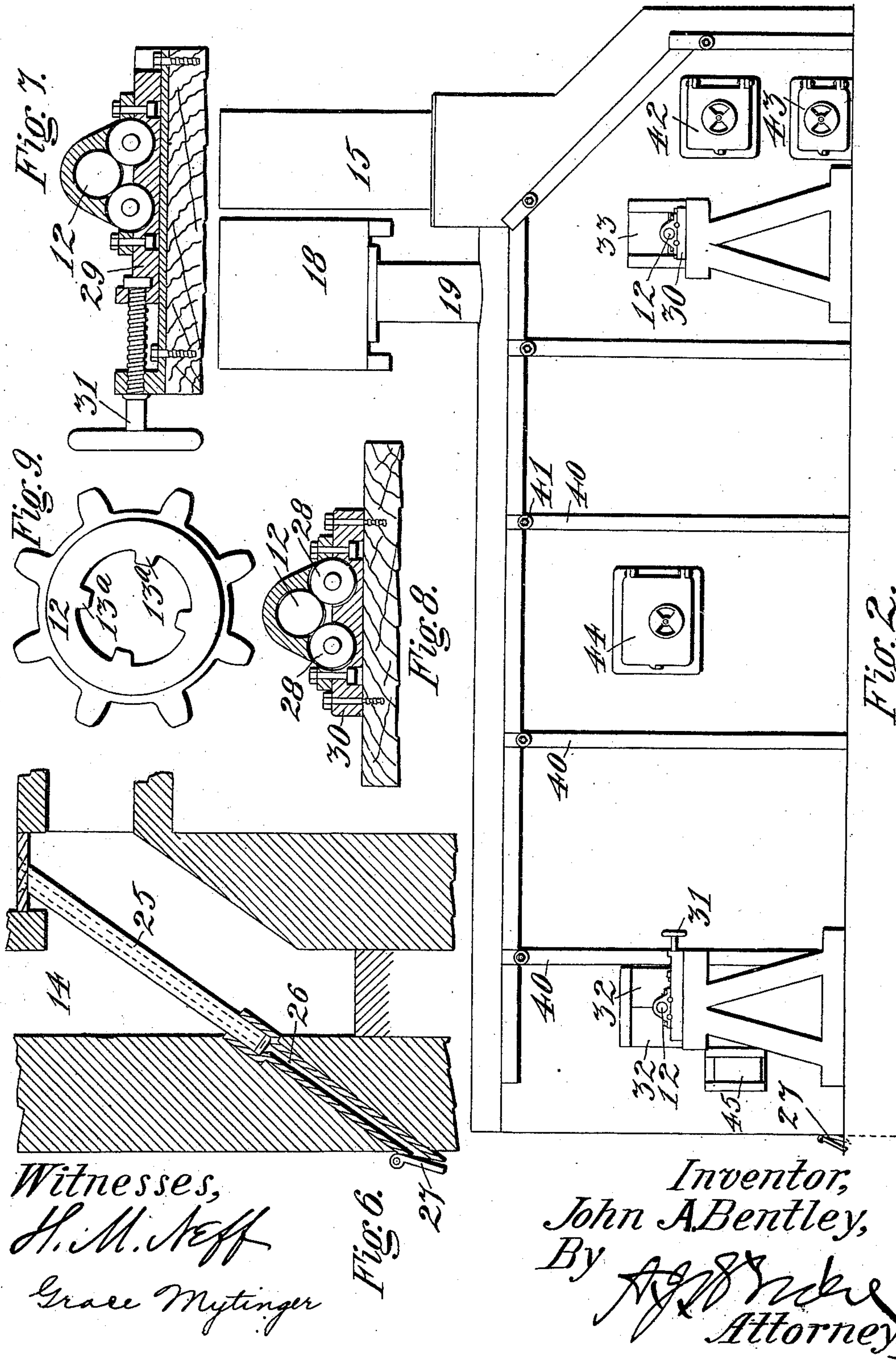


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3 Sheets—Sheet 2.



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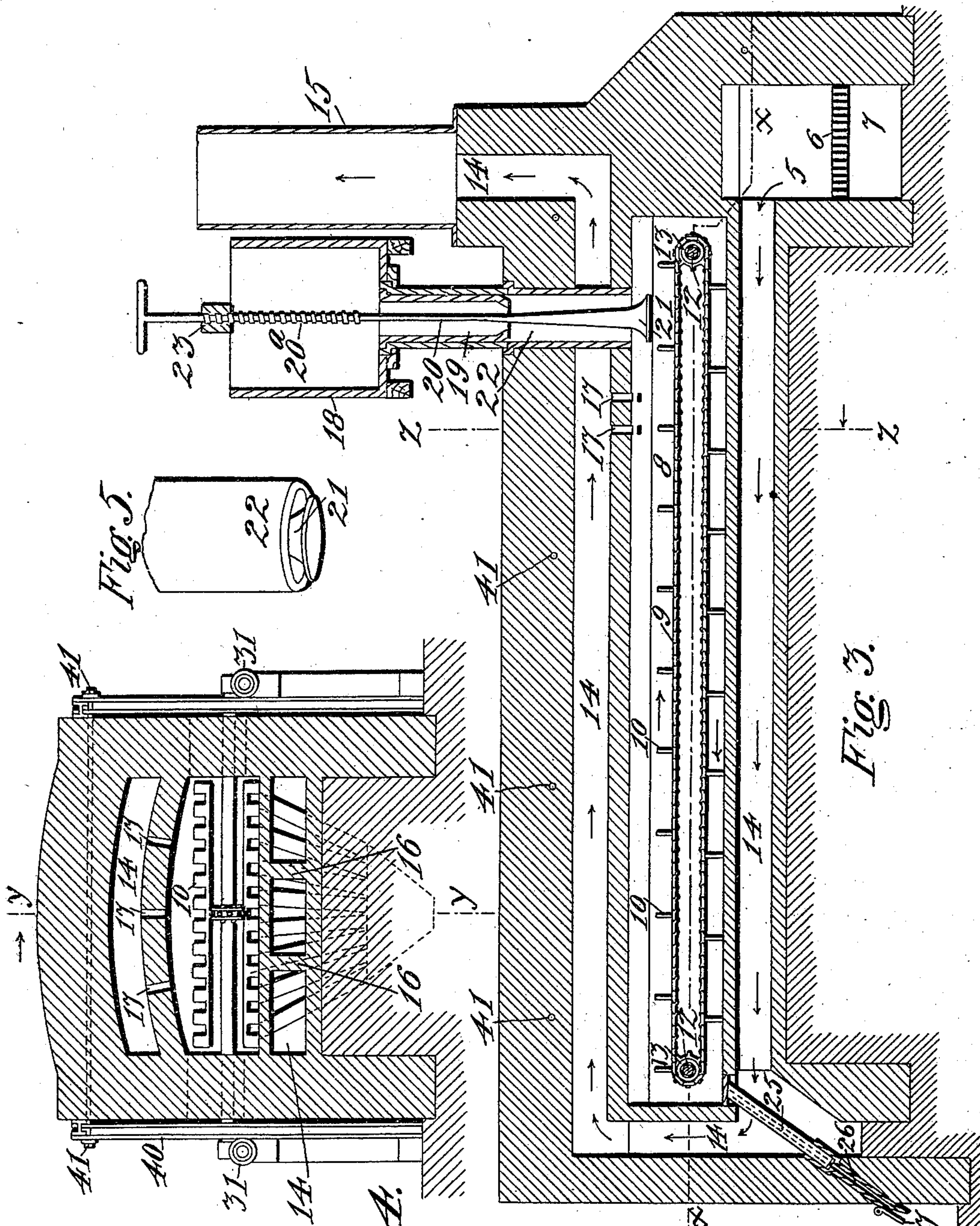


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3 Sheets—Sheet 3.



Witnesses,  
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Fig. 4.

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# UNITED STATES PATENT OFFICE.

JOHN A. BENTLEY, OF DENVER, COLORADO.

## ROASTING-FURNACE.

SPECIFICATION forming part of Letters Patent No. 685,903, dated November 5, 1901.

Application filed February 19, 1900. Serial No. 5,846. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN A. BENTLEY, a citizen of the United States of America, residing at Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Roasting-Furnaces; and I do 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 appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in muffle roasting-furnaces, more especially adapted for use in roasting ores in course of treatment, but which may be employed for roasting or drying other substances.

My object is to provide a furnace adapted to the roasting of ores by means of indirect heat equipped with a feed-channel, through which a continuous and regulated volume of ore may be fed into the oven, and a mechanism by which to agitate and move the ore along on the oven-floor while roasting and discharge it when roasted and be reliable, durable, and efficient in use; and to these ends the invention consists of the features, arrangements, and combinations hereinafter described and claimed, all of which will be fully understood by reference to the accompanying drawings, in which is illustrated an embodiment thereof.

In the drawings, Figure 1 is a horizontal section taken through the furnace on the line X X, Fig. 3, the endless chain and rabbles being shown in plan view. Fig. 2 is a side elevation of the furnace. Fig. 3 is a central vertical longitudinal section therethrough on the line Y Y, Fig. 4. Fig. 4 is a vertical cross-section taken through the furnace on the line Z Z, Fig. 3, the endless chain and rabbles being shown in elevation. Fig. 5 is a perspective view of the lower extremity of the feed spout or chute and its controlling-valve. Fig. 6 is an enlarged section taken on the line W W, Fig. 1, the ore-chute being shown in elevation. Figs. 7 and 8 are sections taken through the rabble-shaft bearings on the lines A B and C D, respectively,

Fig. 1. Fig. 9 is an elevation of one of the rabble-chain sprocket-wheels. Fig. 10 is a fragmentary side view of the driving rabble-shaft. Fig. 11 is a cross-section of the same. Figs. 12 and 13 are similar views of the driven rabble-shaft. Fig. 14 is a fragmentary view of the rabble mechanism. Fig. 15 is a side view of the same, partly in section.

Similar reference characters indicating corresponding parts in these views, let the numeral 5 designate the fire-box; 6, the grate; 7, the ash-pit; 8, the oven; 9, the endless chain carrying the rabbles 10; 12, the sprocket-wheels upon which the chain is mounted, and 13 the shafts carrying the sprocket-wheels.

From the fire-box a flue 14 passes rearwardly the entire length of the oven underneath its floor, upwardly at its rear extremity, forwardly above the arch or roof, and upwardly, communicating with the stack 15. The floor of the oven is supported by walls 16, which divide the hot-air flue 14 into a plurality of compartments beneath the oven. The roof of the oven is provided with vent-holes 17, communicating with the upper branch of the flue 14, for the escape of air, gases, vapor, and smoke from the oven.

The ore to be treated is fed to the oven from a bin or hopper 18, located above the forward extremity of the oven and communicating therewith by a vertical feed-channel 22, which connects ore-bin 18 with the oven, passing downwardly from the bin through the top of the furnace, the hot-air flue 14, and the roof of the oven. A funnel 19 is tightly fitted to and supported upon the interior walls of the feed-channel at a convenient point below the ore-bin. A cone-shaped valve 21, having a base larger than the opening in the lower extremity of the feed-channel 22 and protruding into the oven, is suspended at its apex by a stem 20, which extends upward centrally to the feed-channel through funnel 19 and through the screw-threaded orifice of its support 23, suitably mounted above the ore-bin. The upper portion of stem 20 is screw-threaded at 20<sup>a</sup> to fit the threaded orifice of its support, and its upper extremity is made T-shaped or otherwise suitably formed to enable the operator to manipulate the stem in its screw-threaded support and raise or lower valve 21,



which is proportioned to adapt it to close the funnel and the lower extremity of the feed-channel simultaneously and stop the flow of feed at both points at the same time, thereby enabling the operator to control and regulate the volume of feed or stop it altogether by manipulating stem 20 in its screw-threaded support 23. The described arrangement of the feed-channel 22, funnel 19, and valve 21 utilizes the feed-supply in the funnel and ore-bin to prevent the escape of hot air and gases from the oven and also exclude therefrom cold air through the feed-channel when the furnace is in operation. The feed falling from funnel 19 over the outside of valve 21 scatters upon the oven-floor.

The rear extremity of the oven is provided with discharge-openings 24, formed in its floor, from which lead downwardly-inclined individual chutes 25, passing through the hot-air flue 14 and communicating with a hopper-shaped opening 26, formed in the rear end wall of the furnace. The discharge extremity of this opening 26 is controlled by a hinged door 27, adapted to open as the ore engages it from the inside and being arranged to close automatically by gravity when the ore-pressure ceases to act. Atmospheric air is admitted into the oven through the discharge chute or chutes by raising said door 27. This air becomes highly heated by contact with the descending ore and with the walls of the chute or chutes.

The shafts 12 pass through openings formed in the furnace-walls and engage externally-located antifriction-rollers 28. These rollers 28 and the shaft-journals engage journal-boxes 29 and 30, respectively. The rear journal-boxes are longitudinally adjustable by means of screws 31 for the purpose of regulating the tension of the endless rabble-chain 9. The openings in the walls of the furnace, through which the shafts 12 pass, are tightly closed around the shafts by sliding doors 32 and 33 to prevent the escape of hot air, gases, vapor, and smoke and the ingress of cold air. The shafts 12 are provided with ribs 12<sup>a</sup>, having shoulders 12<sup>c</sup>. These ribs engage lugs 13<sup>a</sup>, formed on the inner periphery of the sprocket-wheels 13. The position of these ribs on the forward shaft is the reverse of that on the rear shaft, for the reason that in the one case the shaft is acting on the sprocket-wheel and in the other case the sprocket-wheel is acting on the shaft. The sprocket-chain is preferably made up of detachable links of similar form, each link having side bars and cross-bars at each end. At one end the cross-bar is formed in a hook shape to engage upon the cross-bar of the opposite end of the connecting-link, being attachable and detachable at pleasure.

The rabble is formed in one piece, consisting of a head-bar made somewhat shorter than the width of the oven-floor in order that

it may traverse the oven when incorporated into the endless chain and not impinge the side walls thereof and having a series of teeth formed on one side and a link corresponding to the links of the rabble-chain formed centrally upon the opposite side. The teeth of the different rabbles are arranged on the head-bar in such position that when a series of rabbles are attached in the endless chain the teeth of each rabble will coincide with the spaces between the teeth of the rabbles next upon either side.

It is well known that metallic substances adapted to the construction of my endless rabble-conveyer expand and contract with the rise and fall of their temperature, some substances expanding more than others at the same temperature and the several pieces of the same mechanism often unequally. I therefore construct the several parts of my endless rabble-conveyer in such form that they are structurally connected and held together within the oven, thereby dispensing with the use of bolts and nuts, pins, keys, screws, or other common fastenings, simplifying and cheapening the mechanism and avoiding the breakage or other disarrangement of the parts and their fastenings incident to their expansion and contraction with the rise and fall of the temperature to which they are exposed.

In the operation of the machine the rabble-chain should travel in the direction indicated by the arrows in Fig. 3. In this case the forward shaft 12 is the propelling or driving shaft and is provided with a pulley 35, adapted to be connected with a line-shaft or motor by a belt 36. Assuming that the shafts 12 are turning in the direction indicated by the arrows in Figs. 11 and 13, the ribs on the forward shaft are in the position shown in Fig. 11 and the ribs on the rearward shaft are in the position shown in Fig. 13. When the sprocket-wheels are applied to the shafts, they are moved longitudinally thereon with their lugs 13<sup>a</sup> in position to pass between the ribs. As soon as the lugs are located intermediate the ribs the turning of the forward or propelling shaft causes the ribs 12<sup>a</sup> to engage the lugs of the forward sprocket-wheel, bringing the lug 13<sup>a</sup> intermediate the two shoulders 12<sup>c</sup> of each rib. Hence the turning of the forward shaft operates the forward sprocket-wheel, whose action on the chain moves the latter, which in turn operates the rear sprocket-wheel and draws the lugs 13<sup>a</sup> thereon to engagement with the ribs 12 of the rear shaft between the shoulders 12<sup>c</sup> of the ribs, and thus actuates the rear shaft. The movement of the chain operates the rabbles which agitate, spread, and drag the ore along on the floor of the oven until it is finally discharged at the rear extremity of the oven.

The furnace-walls are externally reinforced by means of buck-stays 40, connected by



transverse tie-rods 41, passing through the top of the furnace above the hot-air flue 14. The furnace is provided with doors 42, 43, 44, and 45, closing the fire-box, ash-pit, and manhole into the oven and opening into well of hot-air flue, respectively, formed in a side wall of the furnace.

The interior surfaces of the fire-box 5, hot-air flue 14, and the oven 8 are preferably made of fire-clay brick or slabs, except that the section of the furnace-floor containing the discharge-chutes is preferably made of cast-iron. The lower section of the feed-channel passing through the hot-air flue 14 and the roof of the furnace is preferably made of fire-clay and the conical valve of the feed-channel of cast-iron. Cast-iron is also preferably used in the manufacture of shafts, sprocket-wheels, sprocket-chains, and rab-

bles; for the reason that it will better withstand the heat required in the oven and resist the deteriorating influence of the gases and vapors generated by the roasting ore than other available material.

In the use of the furnace the ore is fed from the bin or hopper 18 through funnel 19 and feed-channel 22, over the outside of valve 21, and falls scattered upon the forward end of the oven-floor. The volume of feed is controlled and regulated by the manipulation of stem 20 in its screw-threaded support 23, and thereby raising or lowering valve 21. The ore falling upon the floor of the oven is agitated, more equally spread, and moved gradually to the rear end of the oven by the slowly-traveling rabbles, where it is discharged through chute 25 and opening 26 properly roasted. The atmospheric air required in the roasting process is admitted into the oven through opening 26 and chute 25, the volume of which is regulated and controlled by opening and closing door 27 and is heated to a high temperature before reaching the oven by contact with the heated walls of chute 25 and with the roasted ore which is being discharged from the oven.

By using the furnace described, equipped with the feed and discharge apparatus, and the muffle-oven equipped with the endless rabble-conveyer I am able to feed the ore to be roasted into the oven in a continuous and regulated volume, mechanically agitate, spread, and move it along on the oven-floor to the place of discharge, and discharge it outside the furnace properly roasted by indirect heat at a comparatively low oven temperature and in a comparatively short time to exclude cold air from and introduce highly-heated atmospheric air only into the oven.

Having thus described my invention, what I claim is—

1. In a furnace, the combination of an oven, a hot-air flue surrounding the oven and communicating at one extremity with the fire-box and at the opposite extremity with the

stack, and a chute leading from the oven and passing through the hot-air flue for the discharge of ore from the oven and heating and admitting atmospheric air into the same.

2. In a furnace, the combination of an oven, a hot-air flue surrounding the oven and communicating at one extremity with the fire-box and at the opposite extremity with the stack, a discharge-chute leading from the oven and passing through the hot-air flue, and means for automatically closing the outer extremity of said discharge-chute.

3. In a furnace, the combination of an oven, a hot-air flue surrounding the oven and communicating at one extremity with the fire-box and at the opposite extremity with the stack, a chute leading from the oven and passing through the hot-air flue for the discharge of ore from the oven and heating and admitting atmospheric air into the same, means for feeding the ore to the oven, and an endless rabble-conveyer located in the oven.

4. In a roasting-furnace, the combination with a fire-box and stack, of a muffle-oven, a flue surrounding the oven at the bottom, top and one end, said flue communicating at one extremity with the fire-box and at the opposite extremity with the stack, a feed-channel passing through the flue into the oven, means for controlling the passage of ore through the feed-channel, and a chute leading from the oven and passing through the hot-air flue for the discharge of ore from the oven and heating and admitting atmospheric air into the same.

5. In a roasting-furnace, the combination of a muffle-oven, a fire-box, a stack, a hot-air flue surrounding the oven at the bottom, the rear end and the top, and communicating at one extremity with the fire-box and at the other extremity with the stack, a feed-channel communicating with the oven, means for controlling the volume of feed passing there-through, means for preventing the escape of hot air, gases, smoke and vapor and the ingress of cold air, through said channel, a chute leading from the oven through the hot-air flue and the furnace-wall for the discharge of roasted material and for heating and admitting into the oven atmospheric air, means for preventing the ingress of cold air into the oven through said chute, means for the exit from said oven of air, gases, vapors and smoke, and means for mixing and moving along upon the oven-floor the substances being roasted.

6. In a roasting-furnace, a fire-box, a stack, an oven, a hot-air flue surrounding the oven at the bottom, the rear end and the top, communicating at one extremity with the fire-box and at the other extremity with the stack, a feed-channel communicating with the oven, a discharge-flue leading from the oven to outside the furnace, an endless chain within the oven, a series of toothed rabbles attached to



said chain for mixing and moving along on  
the floor of the oven the substances being  
roasted, two parallel shafts passing through  
the oven over which said endless chain and  
5 rabbles pass, and means for applying power  
to the said shafts to operate said chain and  
rabblles.

In testimony whereof I affix my signature  
in presence of two witnesses.

JOHN A. BENTLEY.

Witnesses:

GRACE MYTINGER,  
A. J. O'BRIEN.