

No. 612,319.

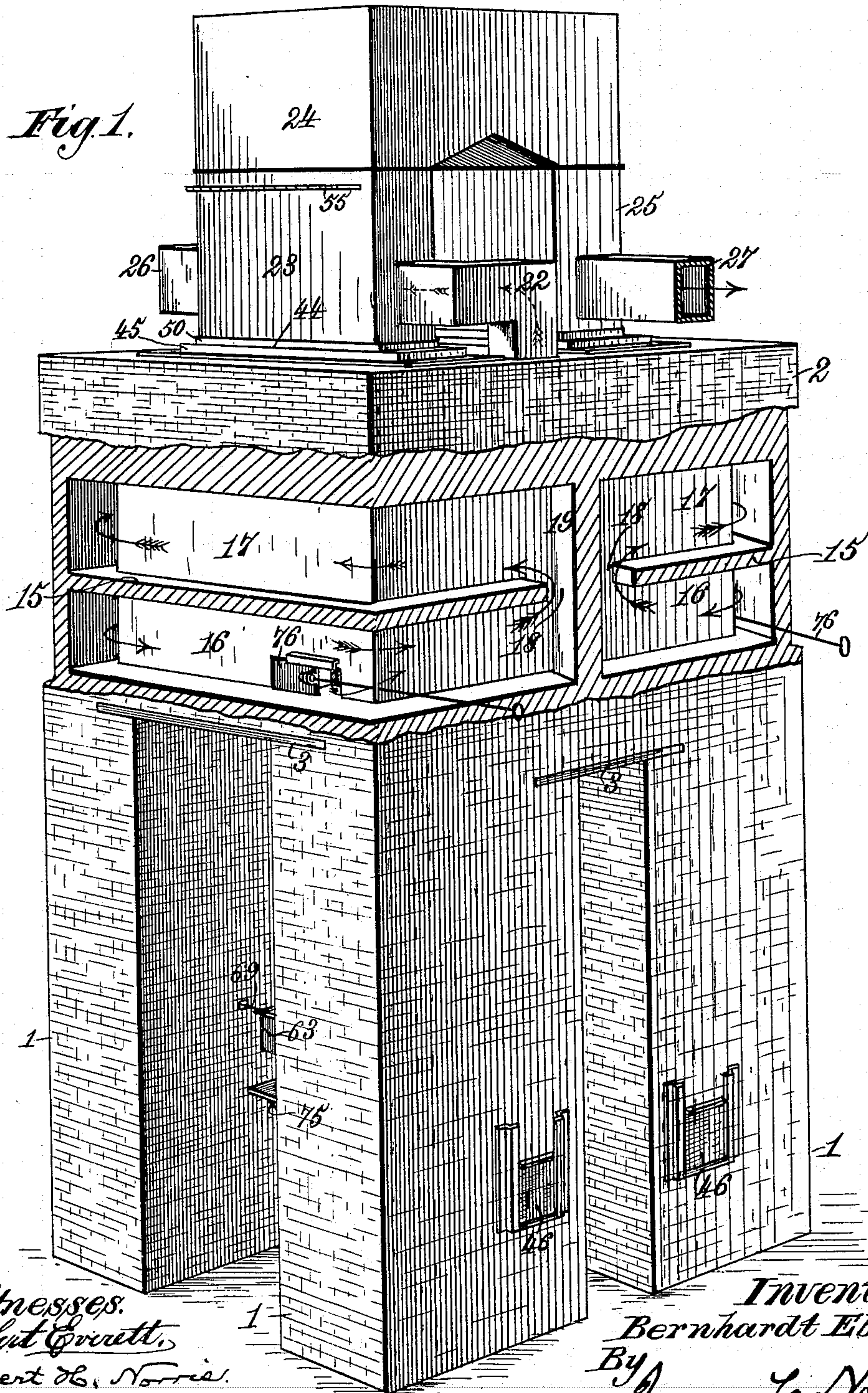
Patented Oct. 11, 1898.

B. EBA.  
BONE BLACK KILN.

(Application filed Mar. 26, 1898.)

(No Model.)

6 Sheets—Sheet 1.



Witnesses.  
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No. 612,319.

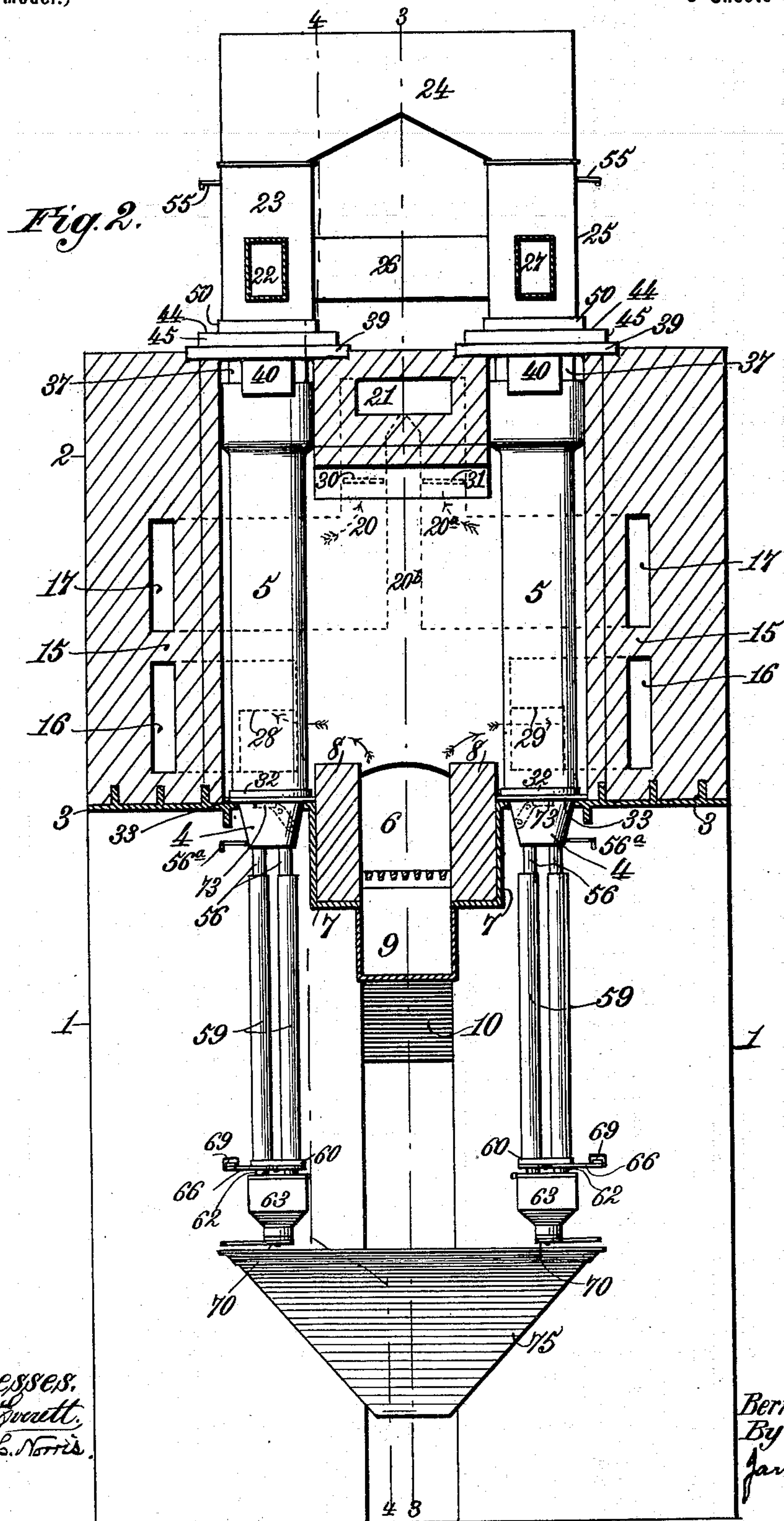
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6 Sheets—Sheet 2.





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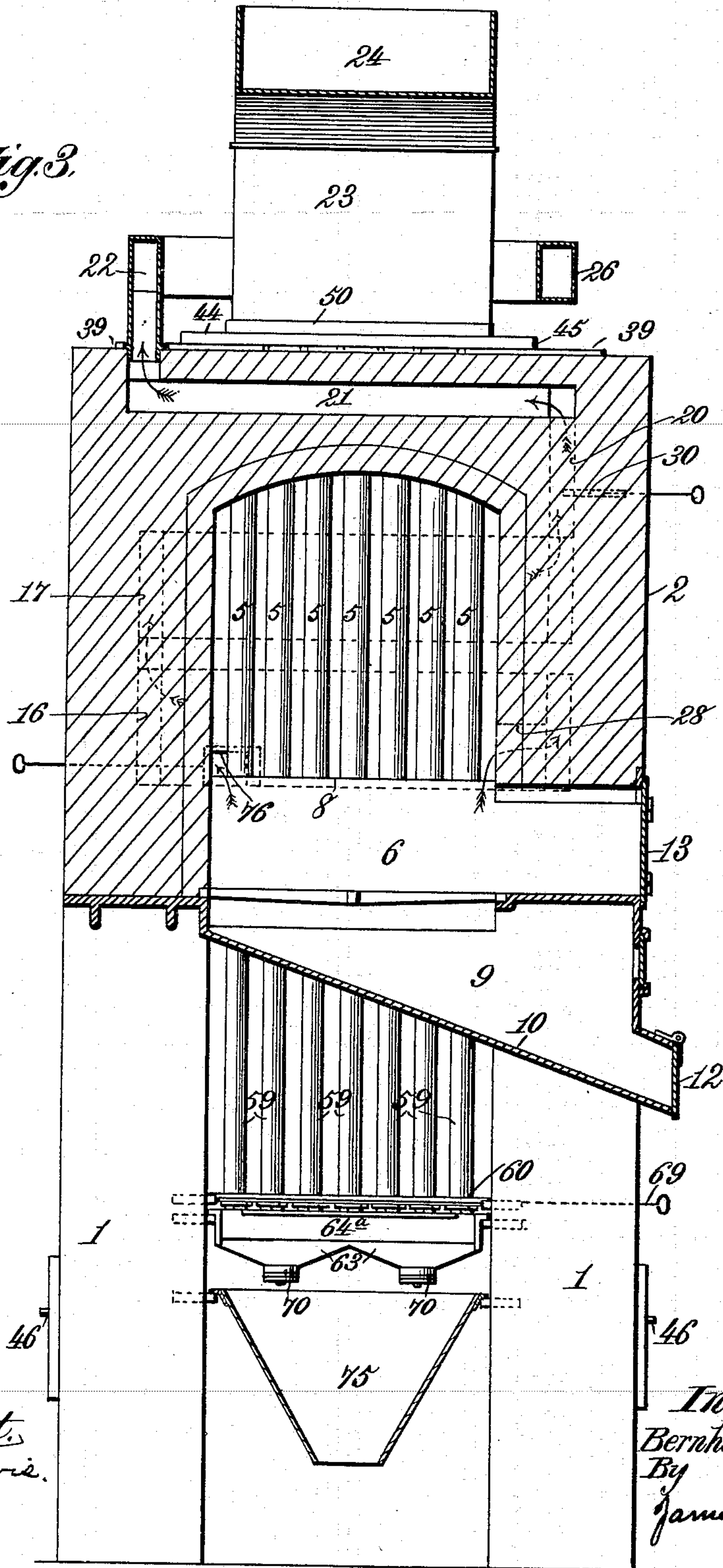
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(No Model.)

6 Sheets—Sheet 3.

*Fig. 3.*



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No. 612,319.

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B. EBA.

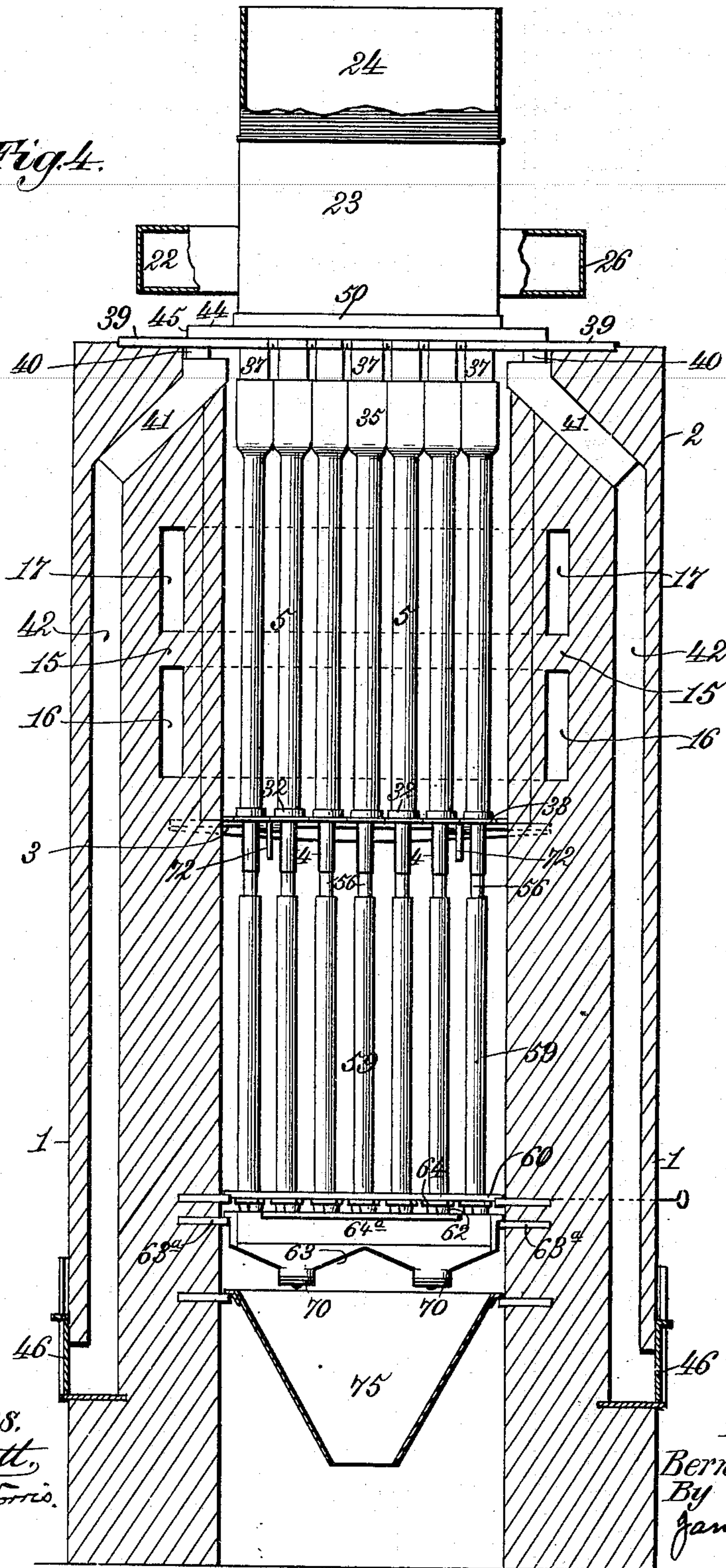
BONE BLACK KILN.

(Application filed Mar. 26, 1898.)

(No Model.)

6 Sheets—Sheet 4.

*Fig. 4.*



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No. 612,319.

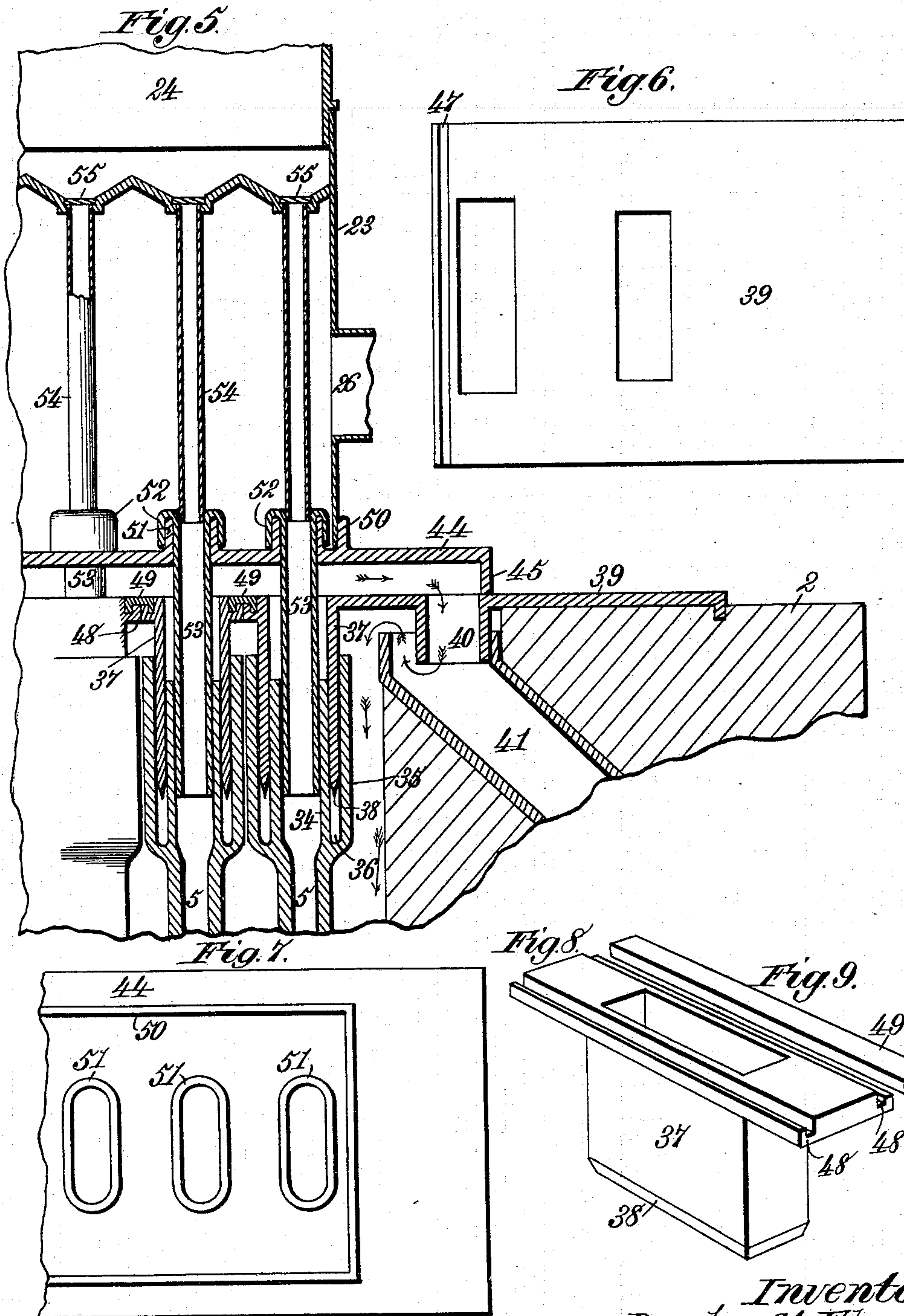
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(Application filed Mar. 26, 1898.)

(No Model.)

6 Sheets—Sheet 5.



Witnesses.  
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BONE BLACK KILN.

(Application filed Mar. 26, 1898.)

(No Model.)

6 Sheets—Sheet 6.

Fig. 10.

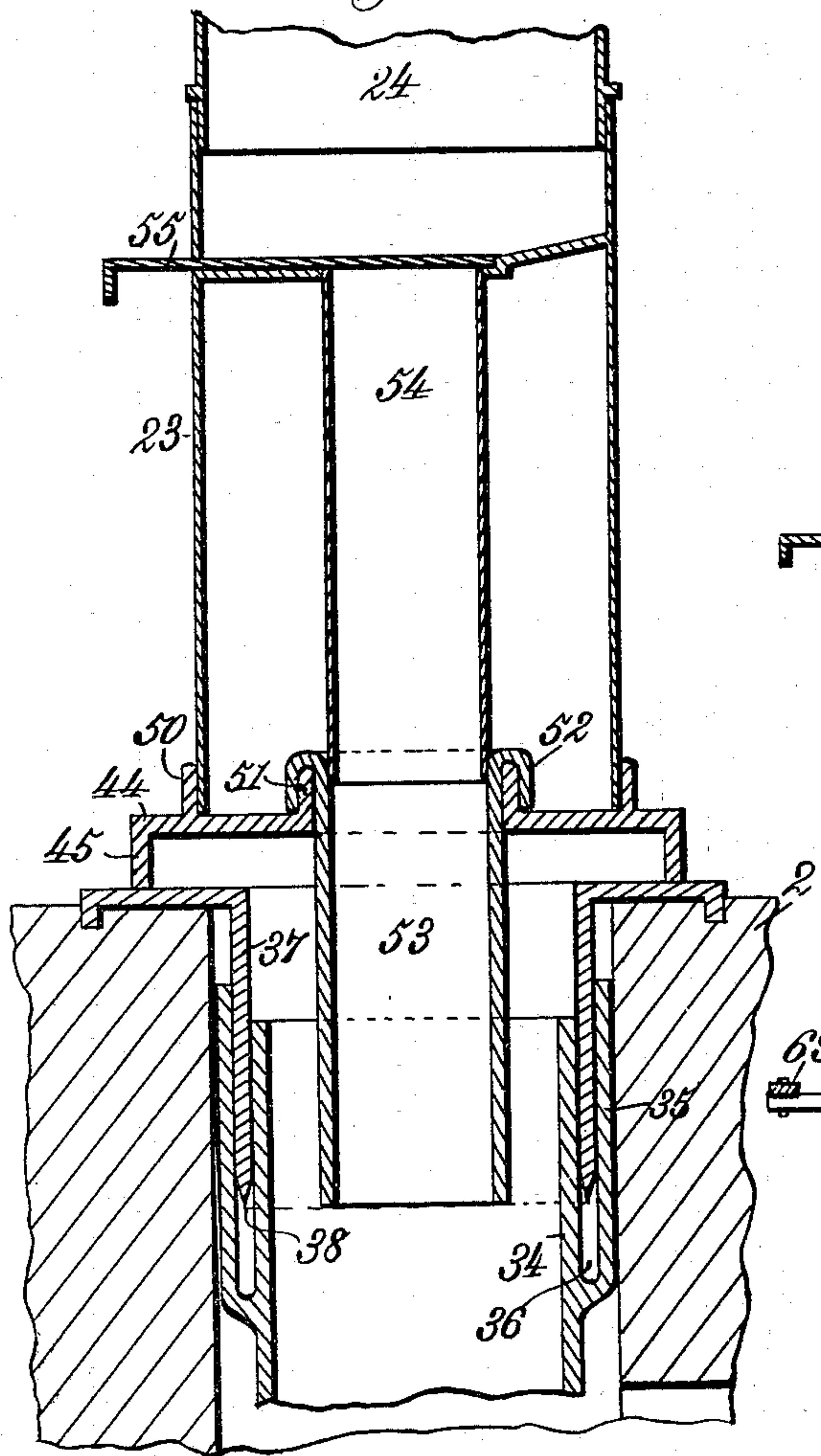


Fig. 11.

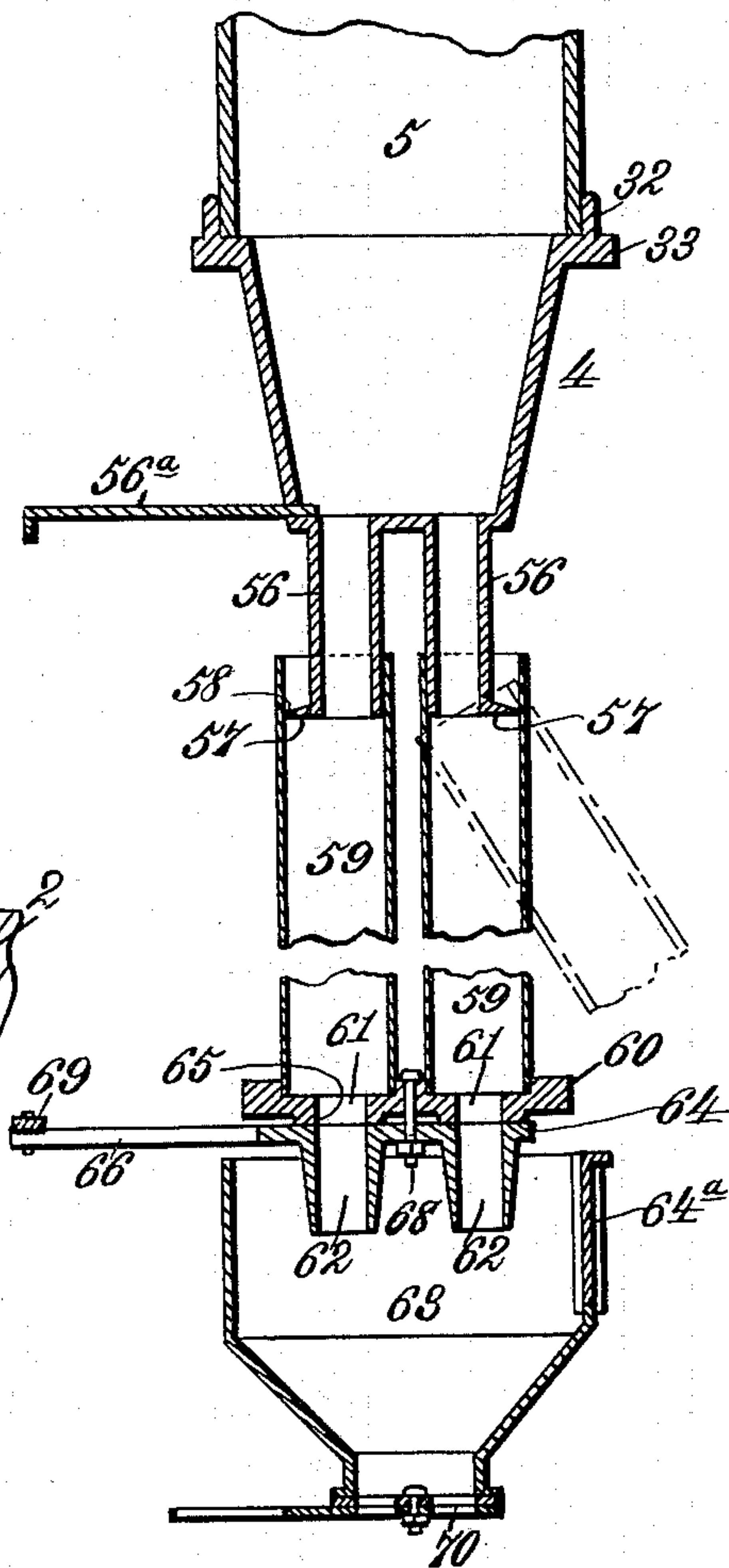


Fig. 12.

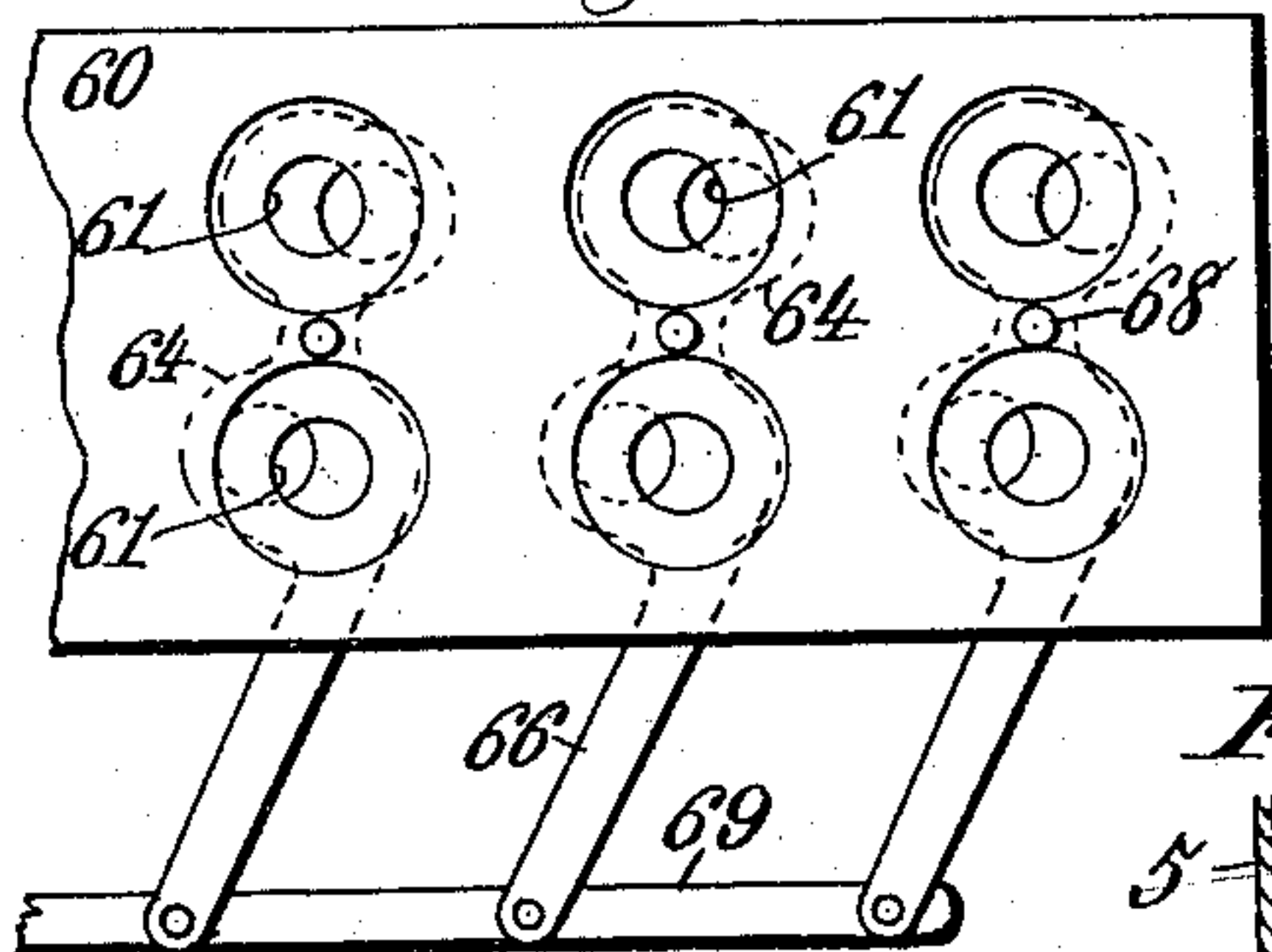


Fig. 13.

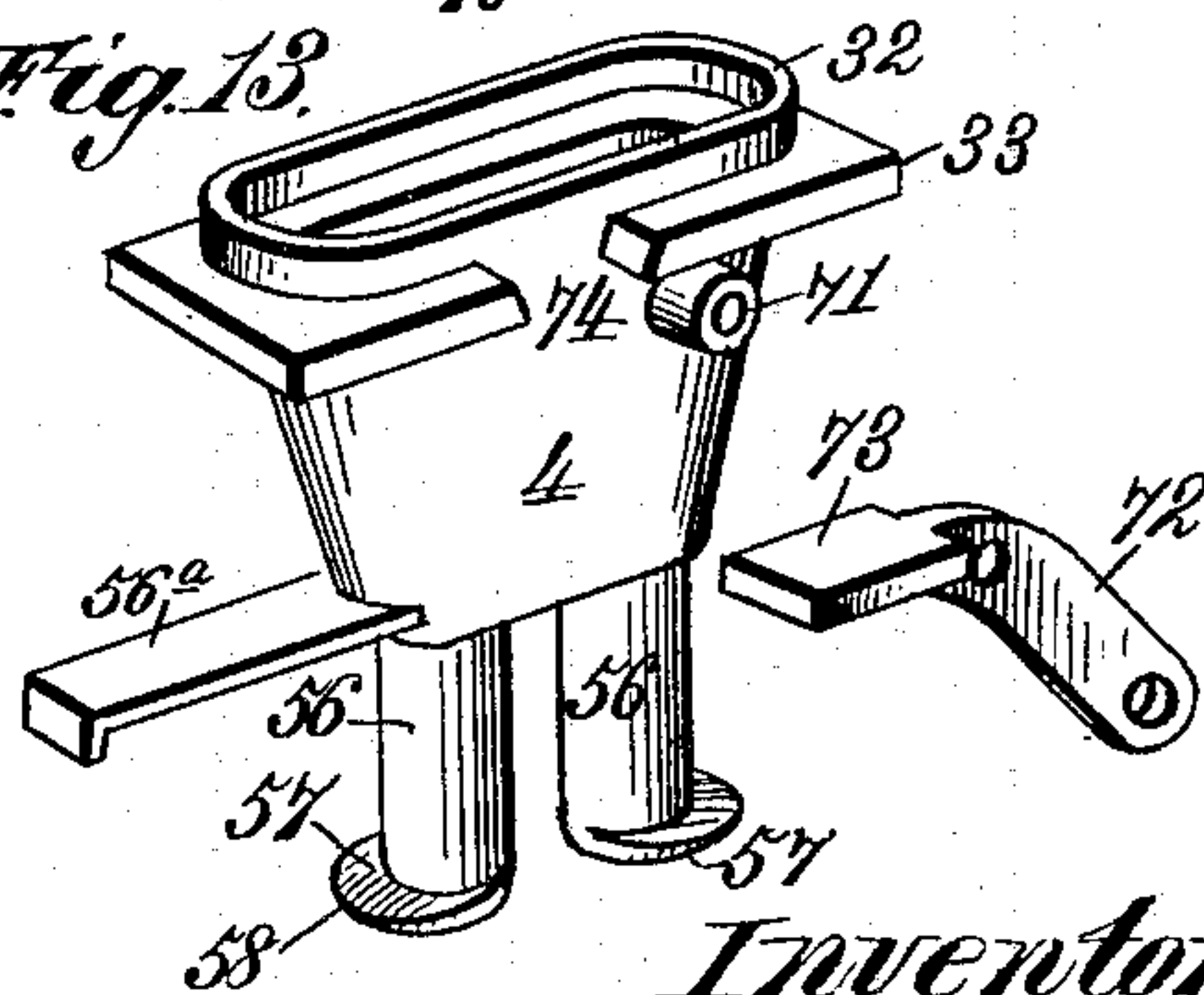
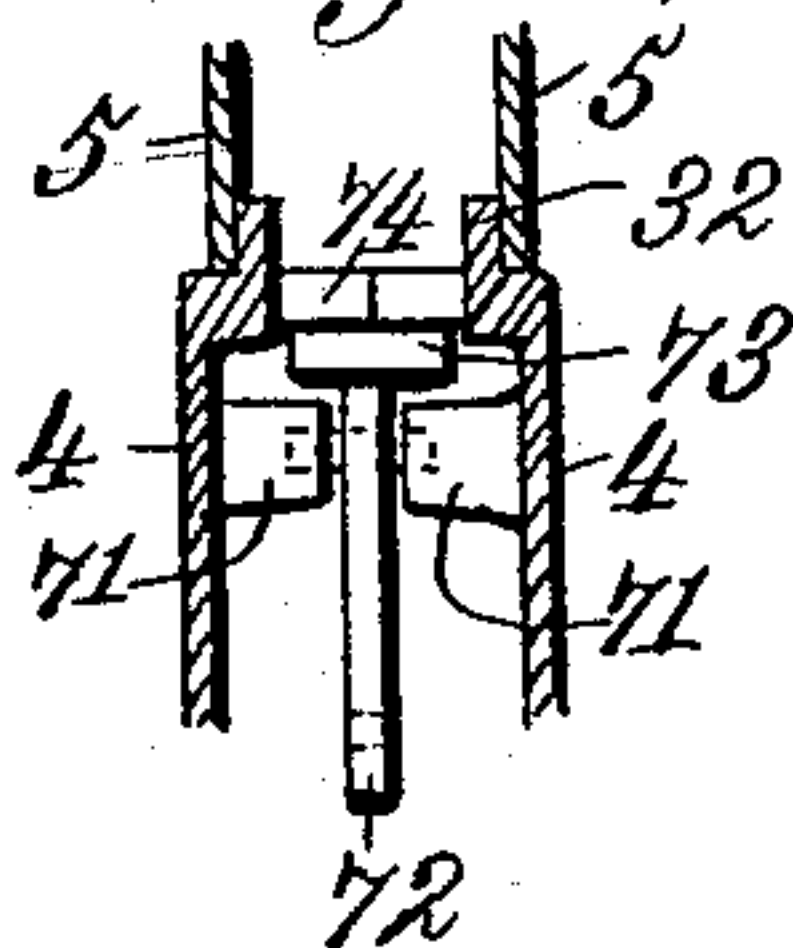


Fig. 14.



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# UNITED STATES PATENT OFFICE.

BERNHARDT EBA, OF WARREN, PENNSYLVANIA.

## BONE-BLACK KILN.

SPECIFICATION forming part of Letters Patent No. 612,319, dated October 11, 1898.

Application filed March 26, 1898. Serial No. 675,293. (No model.)

*To all whom it may concern:*

Be it known that I, BERNHARDT EBA, a citizen of the United States, residing at Warren, in the county of Warren and State of Pennsylvania, have invented new and useful Improvements in Kilns for Revivifying Bone-Black and Fullers' Earth, of which the following is a specification.

This invention relates more particularly to that class of apparatus or kilns for calcining or revivifying bone-black wherein the retorts supplied with the bone-black from a feed-hopper are in communication at their lower ends with perpendicular cooler-cylinders, which cool the bone-black sufficiently to enable it to be safely discharged in contact with the atmosphere.

The invention has for its object to provide a new and improved construction of flues in the brickwork of the kiln, whereby the products of combustion are compelled to pursue a circuitous course around the gangs of retorts to avoid the flow of products of combustion in a more or less direct course to the chimney or stack, to more effectually utilize the escaping products of combustion, and to uniformly heat the retorts and maintain them at the desired high temperature.

The invention also has for its object to provide the upper ends of the retorts with new and improved means whereby they are rendered susceptible of contracting and expanding to any extent they are liable to contract or expand without danger of breaking, damaging, or opening the joints at the top of the retorts, which, if it occurs, as is the case in some revivifying-kilns, permits the light stuff, such as fine bone-black or fullers' earth, to pass out at the joints into the fireplace, which is very objectionable.

The invention also has for its object to provide novel means for carrying to the base of the kiln any fine stuff that may blow out at the upper ends of the retorts, where they connect with the feed-hopper.

The invention also has for its object to provide new and improved means for withdrawing in measured or regulated quantities calcined or revivified bone-black or fullers' earth from the lower ends of the cooler-cylinders which communicate with the retorts.

The invention also has for its object to pro-

vide a new and improved connection between the upper ends of the cooler-cylinders and comparatively small receiver-hoppers, into which the calcined or revivified bone-black or fullers' earth passes from the retorts.

The invention also has for its object to provide novel and simple devices which can be opened by an attendant for the purpose of looking upward from a point below the fireplace where the coolers are located to inspect and ascertain the condition of the retorts whenever inspection is thought to be advisable or is desired.

To accomplish all these objects, my invention involves the features of construction, the combination or arrangement of parts, and the principles of operation hereinafter described and claimed, reference being made to the accompanying drawings, in which—

Figure 1 is a central perspective view of my improved apparatus or kiln for revivifying bone-black or fullers' earth. Fig. 2 is a central vertical sectional view looking in a direction from the rear toward the front of the kiln. Fig. 3 is a central vertical sectional view taken on the line 3 3, Fig. 2, looking toward the left-hand side of the latter figure. Fig. 4 is a vertical sectional view taken on the line 4 4, Fig. 2, looking toward the left-hand side of the latter figure. Fig. 5 is a detail sectional view of the upper end portion of the kiln to clearly show the expansion-joints at the upper ends of the retorts and the construction of the upper fixed sections of the expansion-joints for the end retorts. Fig. 6 is a detail plan view of one of the lower plates which carry the upper sections of the expansion-joints for the end retorts. Fig. 7 is a detail top plan view of the top plate directly over the retorts and which supports the pendent tubes that connect the tubular limbs of the feed-hopper with the interior of the retorts. Fig. 8 is a detail perspective view of one of the upper fixed sections of the expansion-joints of the retorts intermediate the end retorts. Fig. 9 is a perspective view of the channeled bar or plate which serves to connect together the upper fixed sections of the expansion-joints which are intermediate the expansion-joints of the end retorts. Fig. 10 is a detail vertical sectional view in a plane at right angles to the plane of section,



Fig. 5, to more clearly illustrate the expansion-joints of the retorts and the connection therewith of the tubular delivery-limbs of the feed-hopper. Fig. 11 is a broken vertical sectional view showing the manner of connecting the cooler-cylinders with the small receiving-hoppers at the lower ends of the retorts and with the delivery-spouts which discharge the revived bone-black or fullers' earth into the measuring-boxes. Fig. 12 is a detail plan view to clearly illustrate the pivoted gates which control the withdrawal of the bone-black or fullers' earth from the cooler-cylinders. Fig. 13 is a detail perspective view of one of the receiving-hoppers at the lower end of the retorts, and Fig. 14 is a detail sectional view showing portions of two of the receiving-hoppers at the lower ends of the retorts and the movable device which enables an attendant to inspect the retorts whenever desired.

In order to enable those skilled in the art to make and use my invention, I will now proceed to describe the same in detail, referring to the drawings, wherein the numeral 1 indicate pillars of brickwork or any other material suitable for the purpose of a strong and substantial foundation for the various parts composing the improved kiln.

The furnace structure proper, of brickwork, surmounts the pillars and is indicated by the numeral 2, and in the latter are inserted strong and substantial metal plates 3, having projections embedded in the brickwork and serving at their inner edges to sustain comparatively small receiving-hoppers 4, with which the lower ends of the gangs of metallic retorts 5 connect, as will hereinafter appear. The retorts stand perpendicular and are approximately oval-shaped in cross-section, as this form or shape I have found to give the best results. There are two gangs of retorts, located, respectively, at opposite sides of the fireplace 6, each gang comprising any desired number of retorts, although I have illustrated and prefer seven retorts in each gang. The retorts of each gang are arranged in a row running from front to rear of the kiln, and the fireplace is located in proper relation to the lower ends of the retorts, between the two gangs thereof, as best seen in Fig. 2. The fireplace comprises a metallic jacket 7, lined with fire-brick 8, and beneath the grate is arranged an ash-chamber 9, having an inclined bottom wall 10, provided at its outer end with a suitable door 12. The fuel is supplied to the grate by a suitable door 13. The products of combustion rise from the fireplace between the gangs of retorts, and in transit to the escape-flue, which in practice connects with a chimney or smoke-stack, are caused to pursue a circuitous course by reason of the presence of a dividing-partition 15, disposed horizontally between the lower portions 16 and the upper portions 17 of the flues in the brickwork 2 of the furnace structure. The lower flue por-

tions 16 communicate with the upper flue portions 17 by breaks or openings 18 in the partition 15, these breaks or openings being at opposite sides of a vertical partition 19, Fig. 1. The construction of the upper and lower flue portions and the partitions is such that the products of combustion are first caused to travel horizontally entirely around the furnace structure through the lower flue portions 16, and thence ascend through the breaks or openings 18 of the partition 15 into the upper flue portions 17, in which they travel in a different direction from that first pursued entirely around the furnace structure to the escape-flues 20 and 20<sup>a</sup>, separated by a vertical partition 20<sup>b</sup>, Fig. 2, and rising for a short distance to a horizontal flue 21, common to both vertical flues 20 and 20<sup>a</sup>, and extending through the brickwork between the two gangs of retorts, as best seen in Fig. 2. The flue 21 opens at one end into an exterior flue 22, which delivers the products of combustion into a hollow boxing 23, Fig. 1, extending downwardly from a main feed or supply hopper 24, which is common to the hollow boxing 23, and to a similar hollow boxing 25, opposite the same. The products of combustion passing through the hollow boxing 23 enter a flue-pipe 26, which connects the boxing 23 with the boxing 25, and from the latter a delivery or discharge flue pipe or tube 27 extends and is designed to communicate with the usual chimney or smoke-stack. The products of combustion enter the lower flue portions 16 through opposite openings 28 and 29, Fig. 2, in the base of the furnace structure 2, a portion passing in one direction and a portion passing in the opposite direction around and through the furnace structure, as indicated by the arrows in the flue portion 16, Fig. 1. In the same manner a portion of the products of combustion flows in one direction and the remainder in the opposite direction in the upper flue portion 17, as indicated by the arrows, Fig. 1. By this means the products of combustion are divided into two parts, which travel twice in opposite directions entirely around and through the furnace structure 2 and highly heat the brickwork for the purpose of utilizing the escaping products of combustion, securing the effectual heating of the retorts, and maintaining them at the desired high temperature, which avoids the loss of heat incident to the flow of products of combustion in a more or less direct pathway through the flue or flues in the furnace structure to the chimney or stack.

The two vertical flues 20 and 20<sup>a</sup> are provided with dampers 30 and 31, by which the passage of the products of combustion through either or both flues can be nicely regulated for the purpose of regulating the heating of the two gangs of retorts. For instance, it is possible to more or less raise or lower the temperature of either gang of retorts by controlling the flow of products of



combustion through the proper vertical flue, which is effected by more or less opening or closing the damper of such flue, as will be obvious without further explanation.

5 As before stated, the metallic retorts are approximately oval-shaped in cross-section, and each one at its lower extremity is surrounded by an approximately oval-shaped collar or flange 32, rising from a rectangular  
10 horizontal plate 33 (best seen in Fig. 13) on the top portion of each small receiving-hopper 4. The horizontal plate 33 at the top of each hopper 4 is supported through the medium of the metallic jacket 7 of the fireplace  
15 and the inner edges of the metallic plates 3, secured in the base of the brickwork or furnace structure 2, as best seen in Fig. 2. The upper end portion of each retort is formed with what I will term the "lower" section of  
20 an expansion-joint, comprising inner and outer perpendicular flanges 34 and 35, separated from each other to provide an intervening space 36 and of different height, the inner flange 34 being of less height than the  
25 outer flange 35. The fixed upper section of each expansion-joint is in the form of a rectangular box 37, Fig. 9, having its lower extremity brought to a knife-edge, as at 38. The knife-edged box fits into the space 36 between  
30 the flanges 34 and 35. The fixed sections of the expansion-boxes for the end retorts of each gang are each formed integral with or otherwise provided on a lower plate 39, Figs. 5 and 6, having a pendent tubular extension  
35 40 extending into an inclined chute 41, running through the furnace structure 2, and thence descending vertically, as at 42, through the pillars 1 for the purpose of carrying off and depositing at the base of the  
40 kiln any bone-black or fullers' earth that may be blown out at the upper ends of the retorts into a chamber 43, disposed above the retorts and formed by the lower plate 39 and an upper plate 44, superimposed upon the  
45 lower plate through the medium of a flanged portion 45. The lower delivery ends of the perpendicular chutes 41 42 are each controlled through the medium of a suitable opening and closing door 46, through which the deposits in the chutes may be withdrawn from  
50 time to time.

The lower plates 39, which, as before stated, are located in relation to the end retorts, are each provided with a channeled flange 47,  
55 whereby the plates may be locked with similar channeled flanges 48 on the adjacent intermediate boxes 37 through the medium of channeled bars or plates 49. (Best seen in Fig. 9.) The channeled flanges 47 and 48  
60 and channeled bars or plates 49 enable all the fixed upper sections of the expansion-boxes to be rigidly connected together, the fixed sections of the expansion-boxes, which cooperate with the end retorts, being firmly  
65 held by the lower plate 39, which is planted upon and securely fastened to the top portion of the brickwork of the furnace structure 2.

The separated flanges 34 and 35 and the pendent boxes 37, with their knife-edged lower  
70 extremities, constitute expansion-boxes at the upper ends of the retorts, which render the latter susceptible of contracting or expanding without any danger whatever of breaking or opening the joints at the top of  
75 the kiln where the retorts connect therewith, thereby preventing fine bone-black or fullers' earth blowing out into the fireplace or the combustion-chamber thereof. In the use of the kiln fine bone-black or fullers' earth will  
80 pass into the spaces 36; but this will not interfere with the expansion of the retorts, in that the knife-edged lower extremities of the fixed sections of the expansion-boxes will readily penetrate and pass down into what-  
85 ever fine material may have accumulated in the said spaces. The inner flanges 34 at the upper end of each retort are made of less height than the outer flanges 35, so that any fine bone-black or fullers' earth will more  
90 readily pass over the shortest flange, and consequently drop into the interior of the retort, rather than flow up over the highest flange into the fireplace or the combustion-chamber thereof.

The bone-black or fullers' earth to be cal-  
95 cined and revived is supplied to the main hopper 24, from which the hollow boxings 23 and 25 extend. The lower edges of each one of these boxings is engaged with a collar or  
100 flange 50, rising from the upper plate 44. This upper plate is also constructed near its opposite edges with rows of upwardly-projecting nipples or tubular extensions 51, over  
105 which are flanged, as at 52, the upper extremities of perpendicular feed-tubes 53. These feed-tubes are arranged in two gangs similar to the gang of retorts, and the tubes of one gang project down into the upper ends of one gang of retorts, as best seen in Fig. 5.  
110 The nipples or tubular extensions 51 are approximately oval-shaped, as best seen in Fig. 7, and likewise the flanged upper extremities of the feed-tubes 53 will be approximately oval-shaped when connected to the  
115 nipples, as before stated. The feed-tubes are fixed in position, but the flanges 34 on the upper ends of the retorts may slide more or less upon the feed-tubes, as is essential to enable the retorts to contract or expand, as  
120 will be obvious.

The gangs of feed-tubes 53 are placed in  
communication with the feed or supply hopper 24 through the medium of vertical feed-  
125 tubes 54, extending through the hollow boxings 23 and provided at their upper ends with slides 55, by which communication between the tubes 54 and the hopper is controlled. There is one gang of feed-tubes 54 in the boxing 23 and another gang in the boxing 25.  
130 The two gangs of tubes 54 connect, respectively, with the upper ends of the feed-tubes 53, which, as before stated, extend into the upper ends of the retorts. The feed-tubes 54 in the boxings 23 and 25 are heated by di-



rect contact with the products of combustion passing through these boxings, as before explained, and consequently the temperature of the bone-black or the fullers' earth is considerably raised before the material enters the retorts.

The weight of the mass of bone-black in the feed or supply hopper 24 tends to hold down the plates 39 and 44 upon the upper end of the brickwork or furnace structure 2 and materially aids in preventing breaking or opening of the joints at the upper end of the retorts.

The comparatively small hoppers 4 taper and diminish in size toward their bottom walls, and each of the latter is formed with two separated orifices communicating with two pendent tubular limbs 56, each having at its lower extremity a lateral flange 57, constructed with a knife-edge 58. The limbs 56 of each hopper 4 enter the upper ends of two separated cooler-cylinders 59 of comparatively small diameter, and the knife-edges of the lateral flanges 57 bear against the internal surfaces of the cylinders. The knife-edges are advisable in that they more effectually prevent fine stuff passing the joints between the limbs and the cylinders. The lateral flanges 57 are preferably at one side only of the limbs to facilitate placing the cooler-cylinders in position and removing the same by inclining them as indicated by the dotted lines in Fig. 11. The several retorts of each gang are each provided with an individual hopper 4, and each of said hoppers communicates by the two separate limbs 56 with two independent cooler-cylinders 59. The lower ends of the cooler-cylinders for each gang of retorts are fitted into circular seats in a horizontal supporting-plate 60, having pairs of orifices 61 for communicating with pairs of delivery-spouts 62, through which the cooled bone-black or fullers' earth can be delivered into a measuring-box 63, one of which is common to all the cooler-cylinders for one gang of retorts. The withdrawal of the material from the cooler-cylinders is controlled through the medium of a plurality of gates, each of which comprises a plate 64, from which two spouts 62 are suspended. The plate bears against offsets 65 of the plate 60 to reduce frictional contact between the gates and the plate. The plates 64 are also each provided with a horizontally-projecting lever-arm 66, and between the two spouts 62 each plate 64 is pivoted to the supporting-plate 60 through the medium of a pivot-bolt 68, passing through the two plates 60 and 64, as best seen in Figs. 11 and 12. The spouts 62 of each plate 64 can be made to register with the orifices 61 by moving the lever-arms 66 in one direction, while if the lever-arms be moved in the opposite direction the spouts are thrown out of coincidence with the orifices 61 and the latter are closed by solid parts of the plate 64. The lever-arms are connected by a rod 69, which

can be moved back and forth by an attendant to simultaneously swing all the gates, and thereby open or close all the orifices 61. When the rod 69 is moved in one direction, the gates are shifted to cause solid parts of the plates 64 to close the orifices 61, and when the rod is moved in the opposite direction the spouts 62 of the gates are made to register with the orifices 61, and the cooled bone-black or fullers' earth will descend from the cooler-cylinders through the spouts 62 into the measuring-boxes 63. These measuring-boxes are designed to contain definite quantities of the material, and consequently it is possible to withdraw measured quantities of the material whenever necessary, as the lower ends of the measuring-boxes are each provided with suitable valves, as at 70, Figs. 4 and 11, for discharging the material from the box. The valves 70 may be of any construction suitable for the purpose in hand—for instance, as disclosed in Letters Patent No. 557,498, issued to me March 31, 1896.

The two cooler-cylinders for each retort are important and desirable in that the mass of bone-black or fullers' earth delivered from each retort is divided into two parts and made to descend through two cylinders of comparatively small diameter, in consequence of which the material is more effectually and rapidly cooled than when delivered into a single cooler-cylinder of comparatively large diameter.

The passage of material from each hopper 4 through its limbs 56 is controlled through the medium of a slide 56<sup>a</sup>. (Best seen in Figs. 11 and 13.)

During the operation of a kiln for revivifying bone-black it is desirable at certain times to inspect the condition of the hot end retorts, and to enable this to be accomplished by an attendant from a point below the retorts I provide the simple means which I will now describe in detail. The adjacent sides of the hoppers 4, which connect with the end retorts, are provided with lateral pivot-bearings 71, Figs. 13 and 14, which receive and support a pivot-pin on which is mounted a swinging arm 72, provided at one end with a flat plate 73, designed to cover and uncover peep-holes formed by openings, as at 74, in the adjacent edges of the plates 33 of two end hoppers 4. The arm 72 extends downward below its pivot and overbalances the plate 73, so that the latter is normally held up against the adjacent edges of the plates 33 of two hoppers to close the peep-hole. If the arm 72 be swung upward, the peep-hole cover-plate 73 will be swung downward, thereby opening the peep-hole, so that an attendant standing between the pillars 1 may look upward into the space between the end retorts and thus inspect the condition thereof.

The measuring-boxes 63 may discharge the cooled material into any suitable receptacle, such as a car; but preferably they discharge



into a conical vessel 75, suitably supported by flanges extending from the pillar on which the furnace structure is mounted.

In the operation of the kiln gases rise from the bone-black as it descends into the retorts, and by my construction of parts these gases rise outside the feed-tubes 53 into the chamber created by the upper and lower plates 39 and 44, down the tubular extension 40, and around the latter into the fireplace, where the gases are consumed as fuel. The course of the gases is indicated by arrows in Fig. 5, and by reference to Fig. 10 it will be seen that owing to the oval shape of the retorts and the cylindrical form of the feed-tubes 53 there is ample space for the gases to rise at opposite sides of the said feed-tubes to pursue the course above set forth.

It is preferable to provide dampers, as at 76, Fig. 1, for the purpose of affording a vent in case of dead air in the corners of the retort-chambers, which dead air would tend to prevent the retorts being properly heated at such points.

The retorts, the upper sections of the expansion-joints, the comparatively small cylinders, and the measuring-boxes may all be of cast metal or be otherwise constructed of any metal suitable for the purpose in hand. The feed-tubes may be drawn or otherwise formed, and the coolers are preferably composed of thin sheet-metal cylinders.

By my invention it is possible to conveniently regulate the heating of either gang of retorts, the heating effect of the products of combustion is utilized, the retorts are subjected to a more intense heat and can be maintained at the desired high temperature, the retorts can contract or expand without liability of breaking or opening the joints at the top of the retorts, the heating of the end retorts of the gangs can be regulated, the gases rising from the bone entering the retorts are delivered into the combustion-chamber where they are consumed, the material passing from each retort is divided and introduced into two coolers of comparatively small diameter for the purpose of more effectually and rapidly cooling the material, the withdrawal of the cooled material from each pair of cooler-cylinders is facilitated, the coolers can be readily removed and replaced, the fine stuff blowing out of the top of the retorts into the chamber 43 is carried off by a chute to the base of the kiln, and, finally, the condition of the retorts can be conveniently observed by an attendant looking upward from a point below the retort.

By reference to Fig. 4 it will be observed that the measuring-box 63 is provided at its end with flanges which rest upon metal plates 63<sup>a</sup> set in the pillars 1, and, as shown in Fig. 11, the measuring-box is provided at one side with a section 64<sup>a</sup>, designed to be removed so that the measuring-box can then be slid out

of position for gaining access to the spouts 62, as will be obvious.

Having thus described my invention, what I claim is—

1. A kiln, consisting of interior gangs of retorts, and a furnace structure surrounding the retorts and provided in its walls with upper and lower horizontal flue-sections each extending entirely around said structure, a horizontally - arranged partition separating said flue-sections and extending partially around the structure, a vertical partition arranged transversely in said flue-sections between the ends of the horizontal partition, opposite orifices for delivering the products of combustion from the fire to the lower flue-section, separated vertically-arranged flues leading from the lower flue-sections and having independent dampers, and a horizontal discharge-flue leading over the retorts from said vertical flues, substantially as described.

2. A kiln, consisting of gangs of retorts, an elevated feed-hopper, having opposite hollow boxings, feed-tubes connecting the feed-hopper with the retorts and passing vertically through the hollow boxings, a furnace structure surrounding the said retorts and provided in its walls with upper and lower flue-sections, a horizontally - arranged partition having breaks or openings separated by a vertically-arranged partition and placing the upper and lower flue-sections in communication at two points, opposite orifices for delivering the products of combustion from the fire to the lower flue-section, separate vertical flues having independent dampers, a horizontal flue leading from the vertical flues over the retorts, a flue-pipe connecting the horizontal flue with one of said hollow boxings, a flue-pipe placing the two boxings in communication with each other, and an escape flue-pipe for connecting one of the hollow boxings with a chimney or stack, substantially as described.

3. The combination with retorts, and means for supplying material to be revived thereinto, of a furnace structure surrounding the retorts and provided in its walls with upper and lower flue-sections, a horizontally - arranged partition having breaks or openings at one side of the structure, a vertical partition breaking the continuity of the upper and lower flue-sections and separating said breaks or openings, opposite orifices for delivering the products of combustion from the fire to the lower flue-section, the products of combustion flowing in opposite directions around the lower flue-section, thence through the breaks or openings to the upper flue-section and in opposite directions therein, separated vertical flues leading from the upper flue-section and provided with independent controllable dampers, a flue leading from said vertical flues over the retorts, hollow boxings inclosing said flue and flue-pipes for connect-



ing with a chimney or smoke-stack, substantially as described.

4. A kiln, provided with retorts, each having at its upper end an expansion-joint, consisting of inner and outer flanges of different height on the retort, and a fixed box entering the space between said flanges, and provided with a knife-edged extremity, substantially as described.

5. The combination with the furnace structure, of a bone-black kiln, of retorts, fixed boxes provided with channeled flanges and on which the upper ends of the retorts can move vertically, and channeled bars or plates engaging said channeled flanges and interlocking all the boxes together, substantially as described.

6. The combination with the furnace structure of a bone-black kiln, of plates at the top thereof, the lower plates planted upon the furnace structure and provided with pendent fixed boxes, and the upper plate supported above said lower plate to provide an intervening chamber, and an escape-chute communicating with said chamber for carrying to the base of the kiln any light material blown into said chamber, and retorts having their upper ends movable vertically upon the boxes of said lower plates, substantially as described.

7. The combination, in a bone-black kiln, of a furnace structure containing gangs of retorts and chutes extending from its top to its base portion, plates at the top of the furnace structure, the lower plates having tubular extensions to communicate with the said chutes, and provided with pendent boxes, and the upper plate supported above said lower plates to provide an intervening chamber in communication with the tubular extensions, and retorts having their upper ends provided with inner and outer flanges between which said boxes extend, substantially as described.

8. A retort for a kiln, having an expansion-joint at its upper end, consisting of inner and outer flanges of different height and having an annular space or recess between said flanges, and a box inserted between said flanges and upon which the latter can move, said box having a knife-edge formed upon its lower end, substantially as described.

9. A retort for a kiln, having an expansion-joint at one end, consisting of inner and outer flanges of different height separated by an intervening space, and a fixed box inserted into said space and provided with a knife-edged lower extremity, substantially as described.

10. The combination with the retorts of a bone-black kiln, of a hopper connected with the lower end of each retort and provided with a duplex delivery-limb for dividing the material delivered from each retort, a cooler consisting of a duplex cylinder the parts of which are mounted upon the parts of the said duplex delivery-limb, a measuring-box for receiving the material from both parts of the

cooler-cylinder, and a swinging gate arranged intermediate the duplex cooler and the measuring-box and provided with duplex openings adapted to register with the lower ends of the duplex cooler, said gate being centrally pivoted between the lower ends of said duplex cooler to control the withdrawal of the material from both parts of each cooler, substantially as described.

11. A retort for a bone-black kiln, having at its lower end a hopper provided with two separated delivery-limbs, combined with a cooler, composed of two cylindrical parts mounted, respectively, upon said separated delivery-limbs, a gate provided with a pair of connected delivery-spouts movable into and out of coincidence with the lower ends of the two parts of the cooler-cylinder, and means for moving said gate and spouts to control the passage of the material from the cooler-cylinder, substantially as described.

12. The combination with the retort of a bone-black kiln, of a hopper connected with the lower end of the retort and provided with two independent delivery-limbs, a cooler composed of two cylindrical parts mounted, respectively, upon said delivery-limbs, a plate supporting the lower ends of the parts of the cooler, and a centrally-pivoted gate carrying delivery-spouts movable into and out of coincidence with the two parts of the cooler, for withdrawing the divided mass of material delivered into the cooler-sections, substantially as described.

13. The combination with the retorts of a bone-black kiln, of hoppers connected with the lower ends of the retorts and each having a pair of independent delivery-limbs constructed with lateral flanges, a cooler for each retort, composed of two cylindrical sections slipped over the lateral flanges at the lower ends of said delivery-limbs, a plate supporting the lower ends of the cooler-sections, and a gate for controlling the withdrawal of material from both parts of each cooler, substantially as described.

14. The combination with the retorts of a bone-black kiln, of a cooler for each retort, consisting of two independent sections, a plate supporting the lower ends of the coolers, and pivoted gates for controlling the withdrawal of the material from the cooler-sections, each gate consisting of a flattened plate having a lever-arm and two discharge-spouts located at opposite sides of the pivot of the gates, substantially as described.

15. The combination with the retorts of a kiln, of hoppers connected with the lower ends of the retorts and provided with lateral flanges constructed with openings to constitute peep-holes, and peep-hole covers pivoted to said hoppers and serving to open and close the peep-holes, substantially as described.

16. The combination with the retorts of a bone-black kiln, of hoppers connected with the lower ends of the retorts and provided



with peep-holes, swinging arms pivoted beneath the peep-holes, and cover-plates carried by the upper ends of the arms, said arms overbalancing the cover-plates and normally  
5 holding the latter in position to close the peep-holes, substantially as described.

In testimony whereof I have hereunto set

my hand in presence of two subscribing witnesses.

BERNHARDT EBA.

Witnesses:

A. H. McKELVY,  
JOSEPH A. SCHOFIELD.