

No. 695,904.

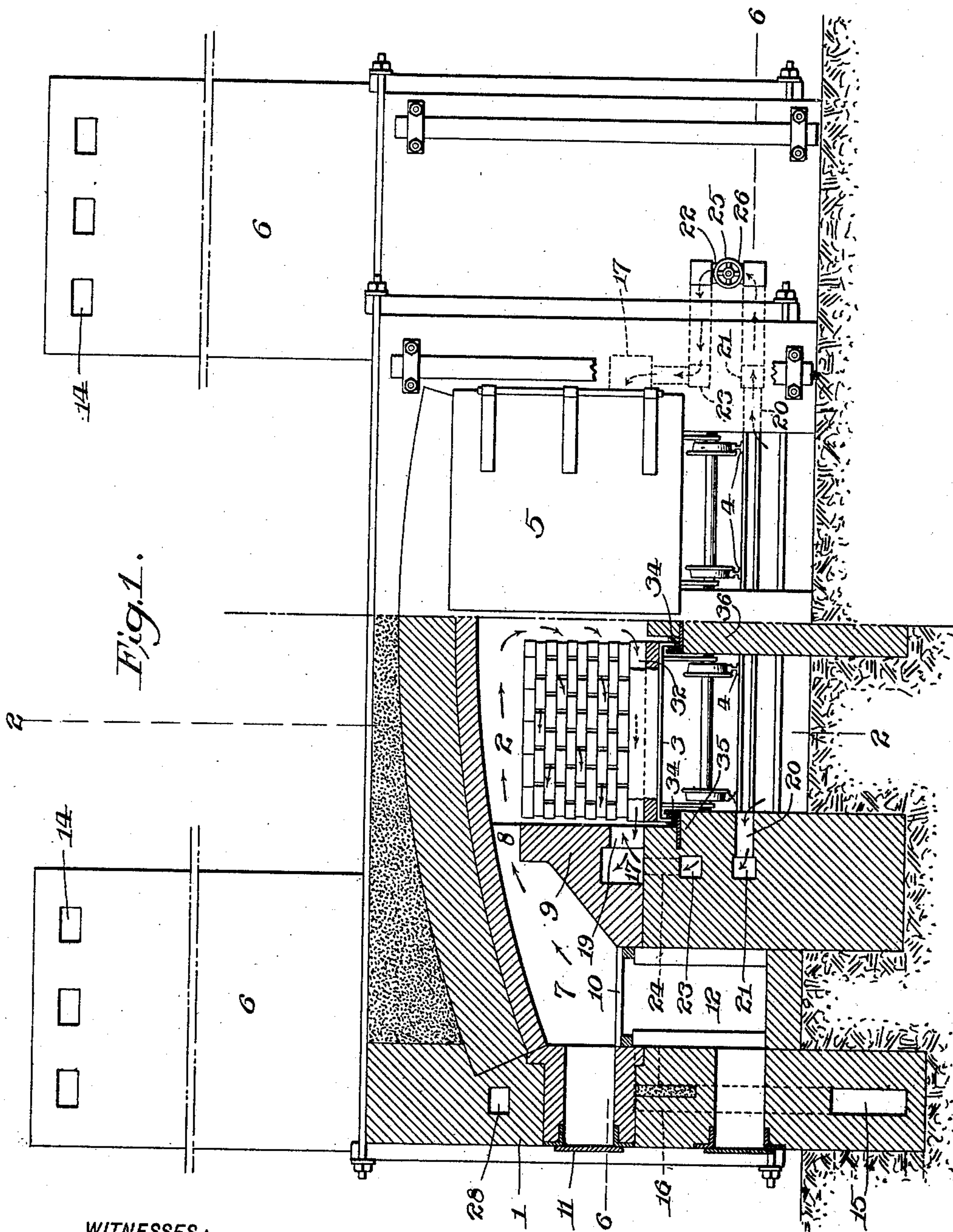
Patented Mar. 25, 1902.

E. C. BRICE.
KILN FOR BURNING BRICKS, &c.

(Application filed June 7, 1901.)

(No Model.)

3 Sheets—Sheet 1.



WITNESSES:

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3 Sheets—Sheet 2.

Fig. 5.

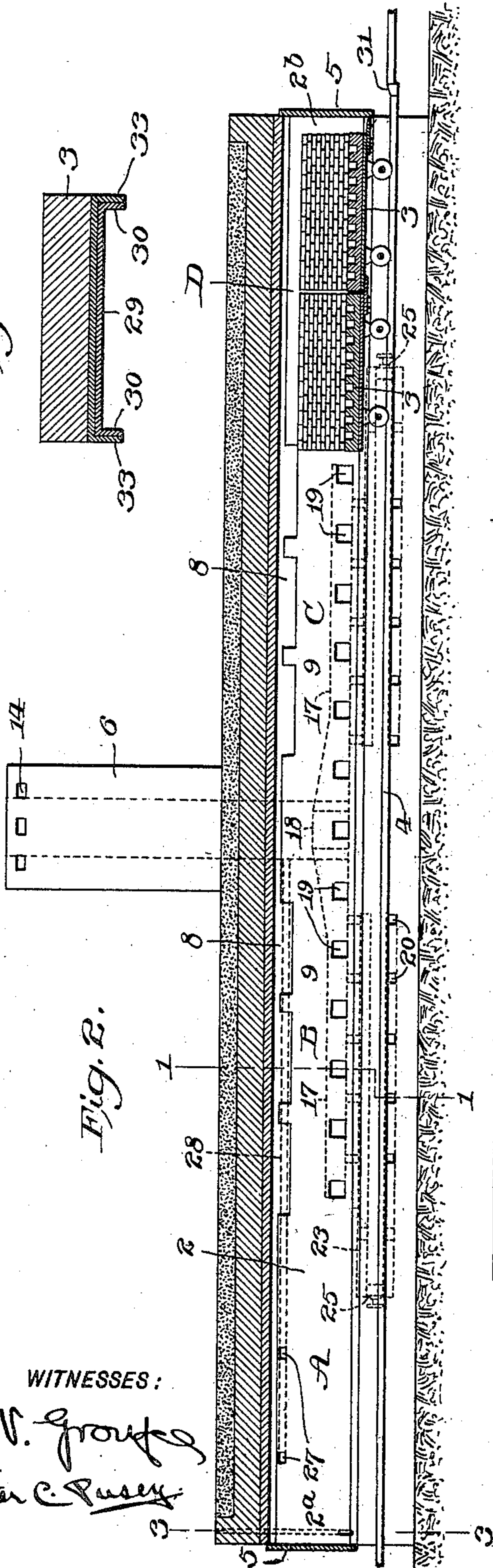


Fig. 2.

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Fig. 4.

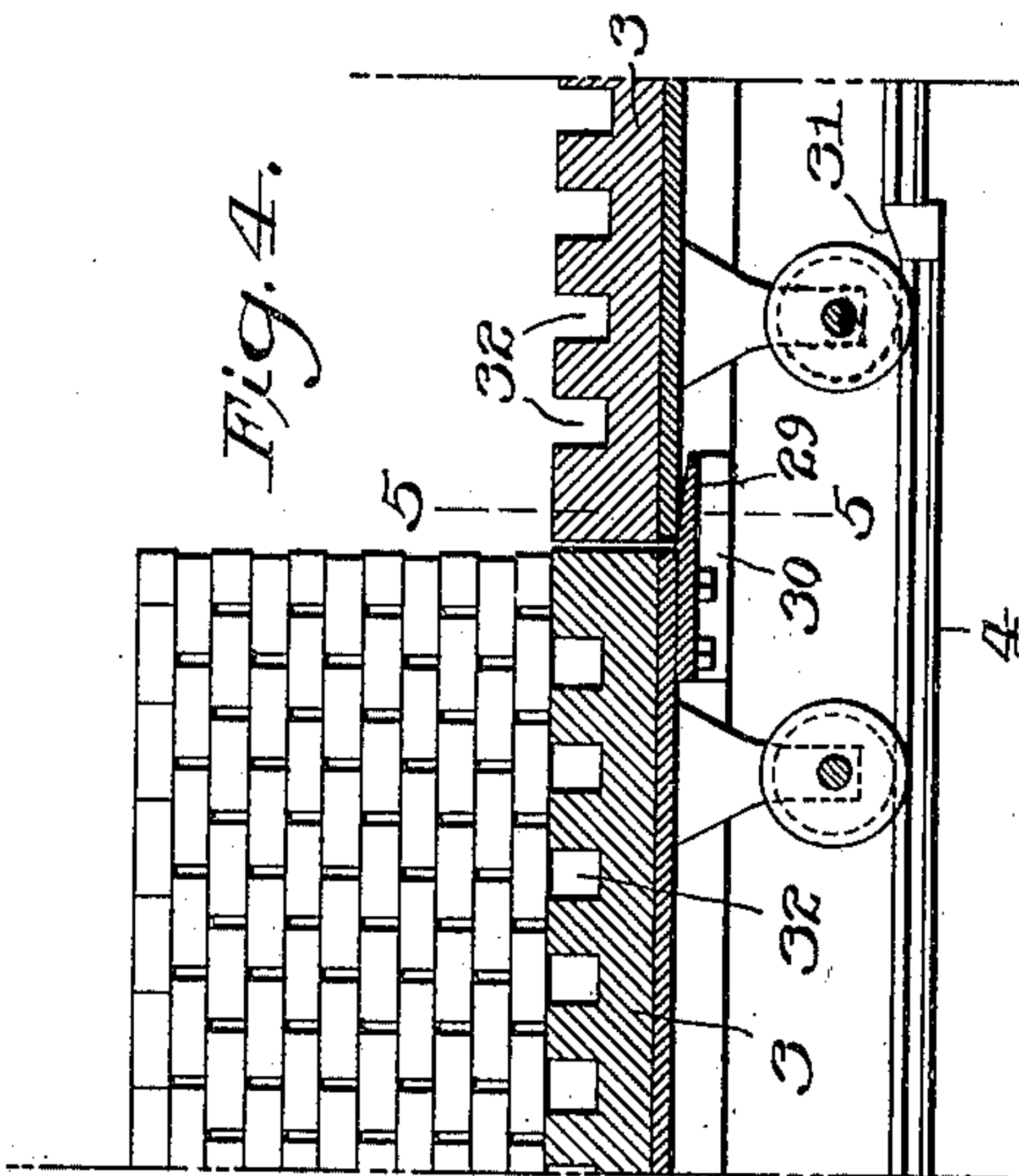
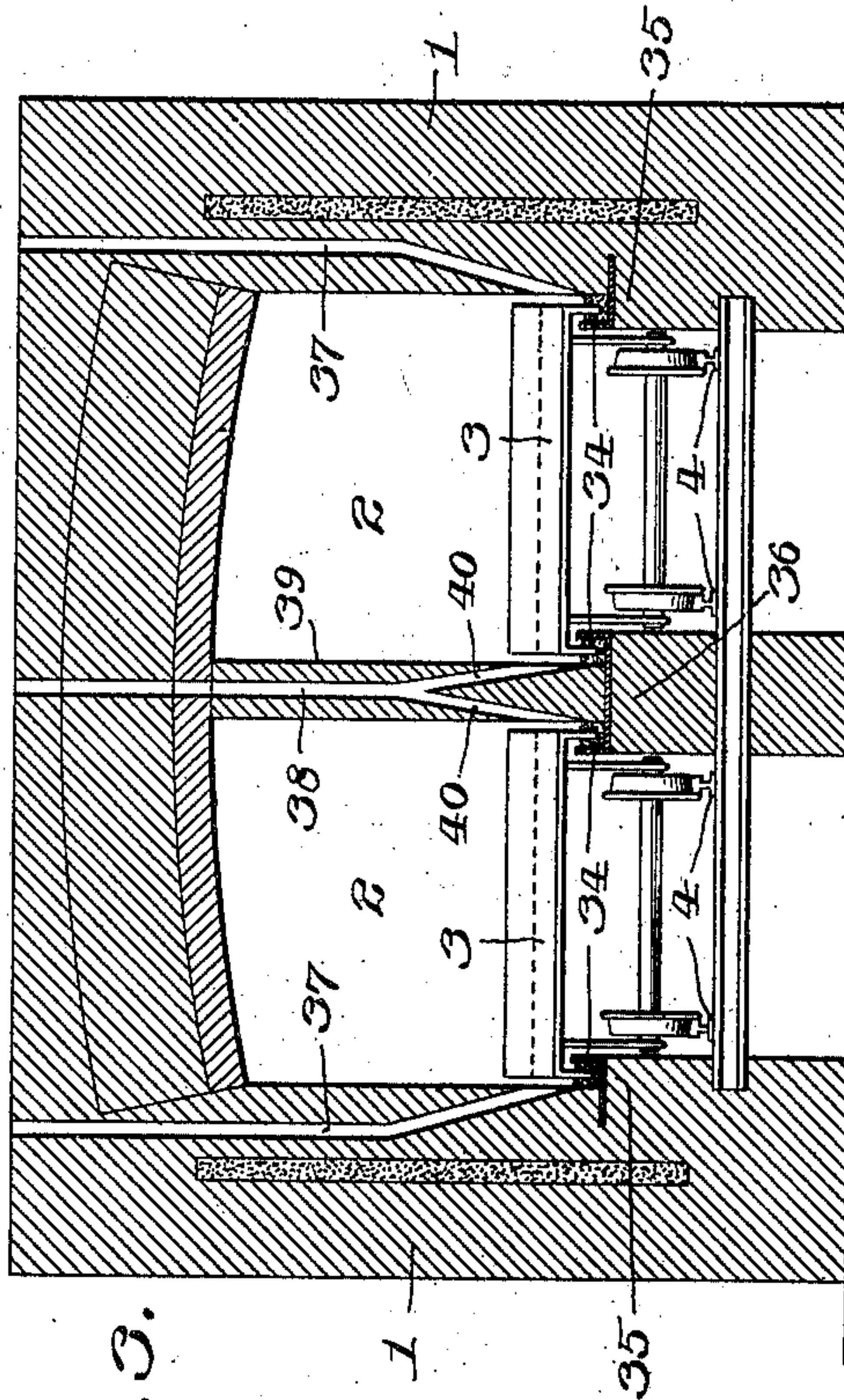


Fig. 3.



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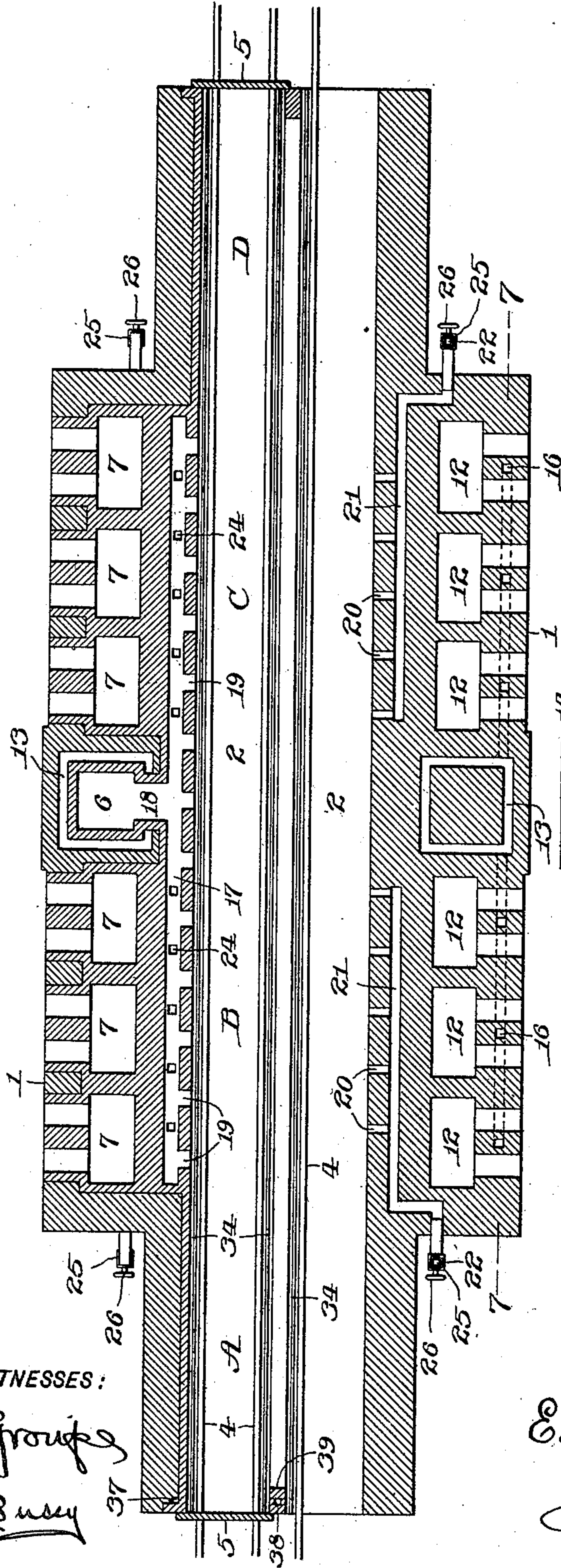
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3 Sheets—Sheet 3.

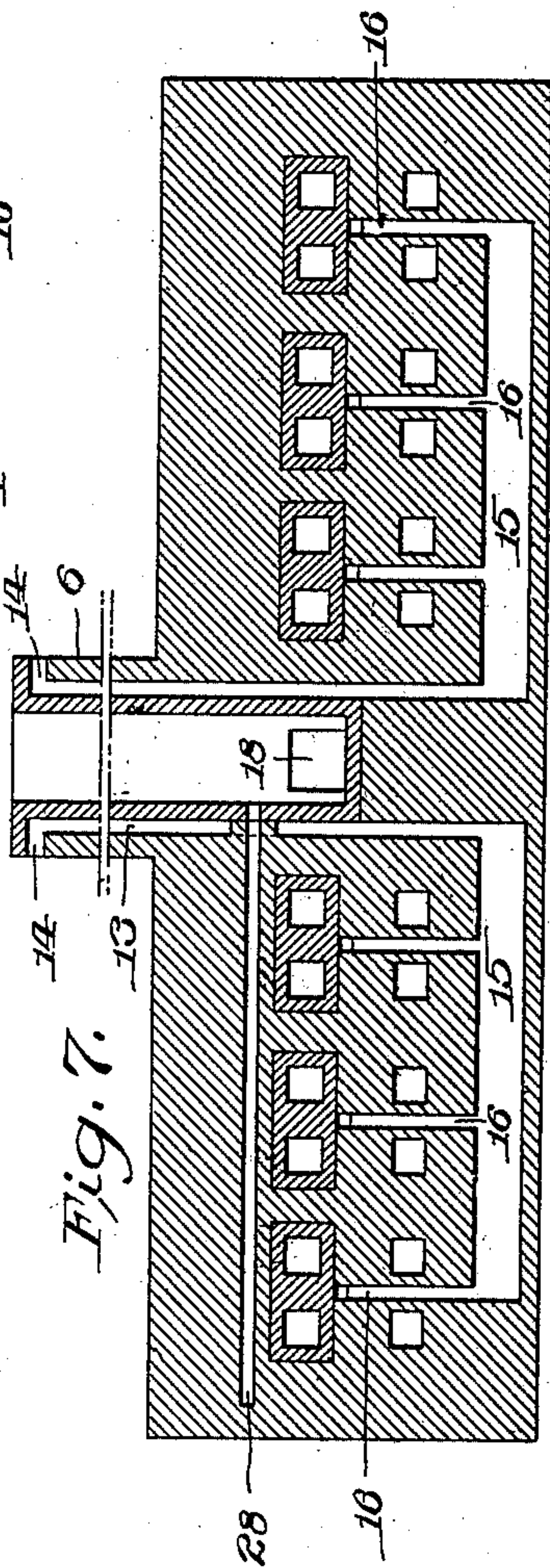
Fig. 6.



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Fig. 7.



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UNITED STATES PATENT OFFICE.

EDWARD C. BRICE, OF COLWYN, PENNSYLVANIA.

KILN FOR BURNING BRICKS, &c.

SPECIFICATION forming part of Letters Patent No. 695,904, dated March 25, 1902.

Application filed June 7, 1901. Serial No. 63,592. (No model.)

To all whom it may concern:

Be it known that I, EDWARD C. BRICE, a citizen of the United States, residing at Colwyn, Delaware county, State of Pennsylvania, have invented certain new and useful Improvements in Kilns for Burning Bricks and the Like, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, of which—

Figure 1, Sheet 1, is a front end elevation, one-half thereof being in section, as on line 1 1, Fig. 2. Fig. 2, Sheet 2, is a full longitudinal section as on line 2 2, Fig. 1. Fig. 3 is a full transverse section as on line 3 3, Fig. 2. Fig. 4 is a sectional side elevation of two contiguous trucks, showing certain details. Fig. 5 is a section on line 5 5, Fig. 4. Fig. 6, Sheet 3, is a sectional plan view taken on line 6 6, Fig. 1. Fig. 7 is a full vertical section on line 7 7, Fig. 6. Figs. 1 and 3 are to the same scale, Figs. 2, 6, and 7 on a scale reduced from Figs. 1 and 3, and Figs. 4 and 5 are enlarged from Figs. 1 and 3.

This invention relates to that kind or class of kilns for burning bricks sometimes termed "tunnel-kilns," in which the bricks are suitably set or piled upon cars or trucks, which latter are entered at one end of the tunnel and when the burning operation is completed are removed from the other end of the tunnel.

The invention has more particular relation, however, to the kiln described and shown in United States Letters Patent No. 636,193, issued to me October 31, 1899, to which reference may be had, and it, my present invention, consists of various improvements in said patented kiln, although not necessarily confined to that precise construction.

The object of the leading features of my invention is to diminish the cost of burning the bricks in such a kiln by economizing the heat and fuel and shortening the time required to effect the burning.

The precise nature of my improvements will appear from the following description, the same being specifically pointed out in the several claims.

Referring now to the accompanying drawings, forming a part of this specification, 1 designates the side walls and the arched top wall of the kiln; 2, the tunnel, adapted in the present instance to receive two parallel trains of trucks 3, carrying the bricks to be burned, the wheels of the trucks running upon rails

4, that are supported at some distance above the bottom of the tunnel and extend at each end outside of the latter, as shown. The said trucks are entered in the end 2^a, Figs. 2 and 6, hereinafter termed the "entrance" end of the tunnel, and are passed out consecutively through the end 2^b, hereinafter termed the "exit" end. The said ends are each provided with a door 5, that closes that part of the tunnel above the plane of the bottom of the truck-platforms, which will be termed the "heating-chamber," the portion below said plane being open.

The kiln of my said patent is provided with three chimneys or smoke-stacks on each side, one being midway of the length of the kiln and the others near each end thereof. In my improved kiln I employ, for an important reason hereinafter explained, the midway stacks only, (marked 6 in the drawings hereunto annexed.)

For the purpose of convenient explanation of the construction and operation of my present improvements I shall divide the kiln into four sections, (designated, respectively, in Figs. 2 and 6 by the letters A, B, C, and D.) Sections A and D are of the same dimensions, and B and C are also of equal dimensions, the dividing-line between the latter, transversely, passing through the smoke-stacks. In the present instance the sections A and D are of a length equal to that of two contiguous trucks on each trackway of the tunnel, and the sections B and C are of a length equal to that of five similar trucks on each trackway. Two of the trucks when the kiln is in operation occupy section A, two section D, and five sections B and C, two of which latter being wholly within section B, two wholly within section C, and the intervening one being one-half in section B and one-half in section C of the tunnel portion. Sections B and C are the furnace or fire-box sections, the other two sections being devoid of fire-boxes. There are six of the fire-boxes (marked 7 in the drawings) on each side of the kiln, three of the same being at each side of the smoke-stacks, arranged equidistantly. These fire-boxes communicate with the upper part of the interior of the tunnel by openings 8 in the upper part of a vertical wall or partition 9, hereinafter termed the "tunnel-wall," that extends the full length of the tunnel. 10 represents the grates of the fire-boxes, to which

coal or other suitable fuel is supplied through doors 11, the ashes falling into the ash-pits 12.

Before proceeding further with the description of the kiln I remark that as the parts to one side of the middle of the kiln, both longitudinally and transversely, are duplicated on the other side the description of the parts on one side will apply equally to the other.

In the kiln of my said patent the natural external air was supplied to the fire-boxes by way of conduits leading into the ash-pits or spaces beneath the grates. In my present construction the air is heated before it is allowed to enter the ash-pits in the following manner: I provide an air-space 13 around a part of the smoke-stack, the upper end of which space is open at 14, Figs. 1 and 7, and its lower end communicates with a conduit 15, extending longitudinally in the base portion of the side wall of the kiln. From this conduit extend vertical conduits 16, whose upper ends lead into the ash-pits at a point a short distance below the grates 10. Thus the air heated by the smoke-stacks is distributed to the fire-boxes and economy of fuel is effected. The object of having the conduits 16 open near the grates is to obviate clogging of the same by the ashes that fall into the ash-pits.

Extending the length of sections B and C within the tunnel-wall 9 is a flue 17, hereinafter termed the "heat-flue," that communicates with the interior of the smoke-stack at the base thereof by an opening 18 of suitable capacity. The said flue also communicates at intervals by a number of short openings 19 through the tunnel-wall with the heating-chamber about on a line with the tops of the platforms of the trucks 3, as seen in Figs. 1, 2, and 6. A series of conduits 20 in said tunnel-wall leading from the space beneath the trucks communicates with a common conduit 21, that extends longitudinally in said wall. (See Figs. 1, 2, and 6.) The end of the latter conduit is given an L-shaped bend and is projected out through the end wall of the adjacent fire-box, as seen in Figs. 1 and 6, and has a vertical connection 22 (shown in said figures and indicated by dotted lines in Fig. 2) with a conduit 23, also extending into the tunnel-wall above and parallel with conduit 21. The said upper conduit has at intervals branches 24, that lead into the heat-flue 17. In the connection 22 I place a suitable valve 25, Fig. 6, for regulating the area of the opening in said connection, the same being operated by means of a hand-wheel 26, Figs. 1, 2, and 6. In the construction shown in my said patent the upper conduit 23 is not employed, the connection between the conduit 21 and the heat-flue being made directly, the sole purpose of my present construction just described being to afford a ready and convenient means for regulating the influx of air into the heat-flue.

Through the upper part of the wall of section A are openings 27, that communicate with a conduit 28, that leads into the smoke-

stack, the purpose of which, as also in my said patent, being to carry off the water-smoke from the green bricks upon the trucks while they occupy that section.

It was found in the practical operation of the kiln constructed as shown in my said patent that sufficient air from the space beneath the trucks passed up through the openings between the abutting ends of the latter to unduly cool the bricks piled upon the trucks adjacent to the vertical line of said openings, and thus to a certain extent interfering with the proper burning of the bricks. In order to obviate this defect, I secure to the under side of the front of each truck a plate 29, whose free end projects forward beyond the platform, its upper side being in the same horizontal plane as that of the underside of said platform or preferably slightly above such plane. This plate is also provided with depending side flanges 30. When a truck is entered into the tunnel, it pushes forward the preceding trucks therein, whereupon the projecting end of the plate 29 passes beneath and in close contact with the under side of the platform of the immediately-preceding truck, thereby closing the opening between the platforms of the two trucks. The flanges 30 also close the openings between the contiguous ends of the truck side flanges 33 above the top of the sand within the troughs 34, hereinafter referred to.

In order to insure the passage of the plate under the truck-platform, I usually bevel off the upper side of the forward end of the same, as seen in Fig. 4. For a similar purpose I in like manner bevel off the ends of the side flanges 30. In order to prevent the forward truck that is to be removed from the kiln when the bricks carried thereby have been burned from dragging the contiguous truck or separating any two of the trucks by reason of the friction of a plate in contact with a truck-platform, I elevate the track-rails outside the exit end of the kiln and join these rails with the others by an incline 31, Figs. 2 and 4, so that when the wheels of said forward truck ride up on the elevated rails its platform will be raised above and so freed from the plate of the rear truck. The said incline is located at such point that when the train of trucks is pushed forward the one next to that moved out of the kiln will, immediately after the rear wheels of the latter truck have ridden up the incline, occupy the position within the kiln just vacated by the other. When the elevated rails and inclines are not used, the plates 29 may be secured to the rear ends of the trucks instead of to the forward ends.

In the construction of my aforesaid patent the lower course of the pile of bricks to be burned rested directly upon the truck-platforms, or rather upon a plane bed of refractory material whose surface was in the same horizontal plane as that of the bottom of the passage-ways 19, leading to the heat-flue.

This construction I found defective for the reason that the openings between the said lower course of bricks were inadequate for the proper flow of the gases, &c., from the fire-boxes from the inner side of the brick-pile to the side adjacent to the tunnel-wall. To correct this defect, I now provide the said bed of refractory material with a series of transverse channels 32, open at the top, whose bottoms are substantially in the plane of that of the said openings 19, as seen in Figs. 1, 2, and 4.

I usually form the bed of fire-bricks by laying courses of the same flatwise and endwise alternately. Across the channels 32 I lay the lower course of bricks, as shown, whereby the channels are made to constitute flues for the passage of the air and gases from the fire-boxes, as hereinafter described.

The several courses of bricks upon the trucks are set with spaces between them, as heretofore, with the exception of the top course, in which for an advantageous reason hereinafter appearing they are abutted closely together, as seen in Figs. 1 and 4, whereby that course forms a practically air-tight cover for the pile.

In my said patented kiln the side of the pile of bricks next to the tunnel-wall was such a considerable distance from the latter that the intervening space was in the nature of a downdraft-flue, with the result that a portion of the gases, &c., flowing from the fire-boxes into the tunnel immediately after passing through the openings 8 in the tunnel-wall were drawn downwardly through the said space, thereby interfering with the proper burning of the bricks in that the said gases, &c., coming into contact with the inner side of the highly-heated tunnel-wall 9 were thereby ignited, and the result was the burning of the bricks adjacent to and some distance within the upper portion of the pile, while those in the other parts of the latter were not sufficiently burned—that is to say, the part of the pile above a diagonal line, roughly speaking, extending from the upper corner of the pile to the lower corner adjacent to the tunnel-wall would be completely burned at the same time that those below said line would be but partly burned. I have remedied this defect by bringing the side of the brick-pile as close as practicable to the tunnel-wall—that is, leaving only sufficient space for safe clearance. As also in the construction of my said patent, the trucks are provided with side flanges 33, that extend down into troughs 34 of ledges 35 of the tunnel-wall and the trough of a medial wall 36, running between the two parallel trackways, these several troughs being filled with sand and the object being to make a practically tight joint to prevent the entrance of air from the space beneath the trucks into the heating-chamber above. As the trucks were moved forward from time to time, their flanges 33 carried along a portion of the sand to and out of the

ends of the troughs. It was of course necessary at intervals to replenish the troughs with sand to take the place of that which was thus carried out. To do this, it required the attendant to enter the tunnel, which he could not do until the kiln was out of operation and cool. In order to maintain a constant supply or feed of sand to take the place of that lost from the troughs, I provide in each of the side tunnel-walls, at the entrance end, a substantially vertical conduit or pipe 37, Fig. 3, open at the top and whose lower end communicates with the sand-trough. I also provide a similar pipe or conduit 38 for the two inner troughs. In the present instance this latter conduit is formed in a pillar 39, which I erect upon the medial wall 36 of the tunnel, it (the said conduit) having branches 40 at its lower end leading into the respective troughs supported by said wall. These several conduits are charged with sand, which descends by gravity and supplies sand to the troughs 34, as it may be required to take the place of that carried off, as before mentioned.

Having now described the construction of the kiln with my improvements, I shall proceed to describe the operation of those of the latter, the modes of operation of which have not heretofore been explained.

Let it be supposed that the tunnel is occupied by the full complement of trucks (nine in the present instance) upon each trackway, located as hereinbefore mentioned, and that the forward one of the trucks in section D is ready for removal from the kiln, the bricks carried thereby having been fully burned. The doors 5 at the ends of the tunnel are opened and a truck laden with green bricks is pushed forward on the rails, which, as before stated, extend outside the tunnel, until it (the said truck) is fully entered into section A. At the same time the other trucks will be correspondingly advanced, and the forward one in section D will pass out from the tunnel, its wheels running up the incline 31 onto the elevated rails. The tunnel-doors are now closed. Just prior to the entrance of the truck into section A the water-smoke had been driven off from the bricks upon the two trucks then in section A. The bricks on the trucks wholly in section B were partly burned, as also those on the truck partly in sections B and C. Those on the trucks wholly within section C were fully burned, while those in section D were cooling, although yet intensely hot, the heat therefrom, or rather the air heated thereby, flowing rearwardly, in the only direction open to it, toward the smoke-stacks and so aiding in maintaining the high temperature necessary to complete the burning of the bricks adjacent to that side of the smoke-stacks, thus effecting a considerable economy of fuel as compared with my previous kiln, wherein the end smoke-stacks were used.

In order to give a better understanding of the burning operation, I shall describe what

occurs to the green bricks on the truck that has just been introduced into the section A as the truck proceeds by stages through the kiln until it comes finally to occupy the forward part of section D as it is advanced by the introduction of new trucks from time to time. First, the water-smoke is driven off by the heat, the same passing off to the smoke-stacks by way of the openings 27 and conduits 28. At the next stage, still within section A, any remaining water-smoke is driven off and the temperature of the bricks continues to rise. When the truck passes on into section B, it may be said that the burning proper begins. The heated gases from the fuel in the fire-boxes 7, having no other outlet, flow up toward the arched top of the kiln through the openings 8 in the tunnel-wall, thence, as indicated by arrows in Fig. 1, over the top of the pile of bricks, down along the side of the pile farthest from the said wall, and thence through the flues formed by the channels 32 and the lower course of bricks, which channels or flues, it will be remembered, also communicate with the opposite openings 19, leading into the heat-flue. A portion of this gaseous stream after flowing over the top of the brick-pile passes laterally and downwardly through the spaces between the bricks, as indicated by arrows in Fig. 1. At the same time air is drawn from the space underneath the trucks through the conduits 20, &c., and a portion of the air passes into the openings 19 and there meets the gases of combustion rushing toward the latter through the said channel-flues and also through the pile of bricks. At about this point these gases become ignited from contact with the adjacent part of the tunnel-wall, (made of refractory material,) which had become exceedingly hot, first, from the heat from the fire-boxes and which is afterward increased by the heat generated by what may be termed a "secondary combustion"—that is, by the ignition of the gases or the explosions of the mingled air and gases. A continuous series of such explosions takes place with short intervals between them, producing quick to-and-fro pulsations, the effect of which is to heat the pile of bricks from the lower course upwardly. At the next stage of the advance of the truck whose course is being followed, it still being within section B, the heat is greater than in the first part of the section and the burning operation proceeds as before, but with increased rapidity. At the next stage one half of the truck will be in section B and the other half in section C, where the heat is the most intense, it being greatest in that part of the latter section. At the next stage the truck will be entirely within the section C. Here the bricks quickly settle, the burning being practically completed. The next advance of the truck is into the forward part of section C, next into the first part of section D, and then into the forward part of the latter section. In these last three positions the temperature of the

bricks gradually diminishes, the heat given off thereby flowing back toward the smoke-stacks with the important economical result hereinbefore mentioned.

It will be seen from the foregoing description of the progress of the truck through the kiln that the burning operation is progressive—that is, the heat to which the bricks are subjected increases up to a point a short distance past the smoke-stacks and that beyond that point the comparative cooling of the bricks takes place.

In the progress of the truck the close-laid top course of bricks thereon serves to retain the heat in the underlying courses for a time, until when the bricks of said top course shrink sufficiently the heat passes between the openings between the bricks, resulting from the shrinkage, and thus completes the burning of said course.

I have found that when the bricks are in section A of the kiln the smoke or soot from the fire-boxes gathers upon the bricks piled upon said trucks; but as they are advanced into the fire-box sections of the kiln this soot or smoke becomes ignited, and thus to a certain extent aids in the burning of the bricks.

By means of the hereinbefore-described improvements relating to or involved in the process of burning the bricks I am enabled to complete the burning within a comparatively short time—in fact, less than one-half the time required in the kiln described in my said patent with substantially the same consumption of fuel.

I remark that sometimes, as in burning cement-rock, iron ore, and limestone, and bricks made of certain kinds of clay, when a very high temperature is not required, but may be injurious, the air-conduits leading into the heat-flue may be dispensed with or the valve 25 in the conduit connection 22 may be closed. In such case the heat of the gases, &c., from the fire-boxes, in connection with such air as would, so to say, leak into the heating-chamber, would suffice to supply the required oxygen.

I may further state that I have sometimes found it desirable to in a measure obstruct the passage laterally of the gases, &c., through the pile of bricks by laying the bricks on the side of the pile adjacent to the tunnel-wall closely together, whereby part of the hot air and gases of combustion that would otherwise flow directly through the interspaces between the bricks on that side of the tunnel-wall and into the space between the latter and the pile are deflected downwardly, the result being that the air and gases are better distributed through the pile.

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

1. In a kiln of the character recited, the tunnel, the sections having the fire-boxes arranged at the sides thereof and communicating with the upper part of the tunnel, the end

sections of the kiln being devoid of fire-boxes; the smoke-stack midway between the ends of the kiln, the kiln being otherwise devoid of smoke-stacks, and the heat-flue communicating with the smoke-stack and having lateral openings leading into the tunnel adjacent to the side of the truck-platforms, all constructed, combined and adapted to operate substantially as and for the purpose set forth.

2. In a kiln of the character recited, the combination of the tunnel, the sections having the fire-boxes arranged at the side thereof and communicating with the upper part of the tunnel, the end sections of the kiln being devoid of fire-boxes, the smoke-stack midway between the ends of the kiln, the kiln being otherwise devoid of smoke-stacks, and the heat-flue communicating with the interior of the smoke-stack, and having lateral openings leading into the tunnel adjacent to the side of the truck-platforms; and having also conduits communicating with the space of the tunnel beneath the truck-platforms, substantially as and for the purpose set forth.

3. In a kiln of the character recited, the combination of the tunnel, the smoke-stack, the fire-boxes arranged at the sides thereof and having passage-ways leading into the upper part of said tunnel, the heat-flue communicating with the smoke-stack, and having lateral openings leading into the tunnel through the side wall thereof, and the trucks having the beds provided with transverse channels in substantially the same horizontal plane with said openings of the heat-flue, substantially as and for the purpose set forth.

4. In a kiln of the character recited, the combination of the tunnel, the smoke-stack, the fire-boxes arranged at the sides of said tunnel, and having passage-ways leading into the upper part of the tunnel, the heat-flue communicating with the smoke-stack and having the lateral openings leading into said tunnel, the trucks, the piles of bricks thereon, those bricks of the top course being set closely together and those of the underlying courses with interspaces between them, substantially as and for the purpose set forth.

5. In a kiln of the character recited, the combination of the tunnel, the smoke-stack, the fire-boxes arranged at the sides of said tunnel, and having passage-ways leading into the upper part of the tunnel, the heat-flue communicating with the smoke-stack, and having the lateral openings leading into said tunnel through the side wall thereof, the air-supply conduits leading into said flue, the trucks having the beds with the series of transverse channels in substantially the same horizontal plane with said openings, and the pile of bricks supported by and upon said truck-beds the bricks of the top course of which are set closely together and those of the underlying courses with interspaces between the bricks, and the side of said piles being closely adjacent to the inner side of the tunnel-wall, substantially as and for the purpose set forth.

6. In a kiln of the character recited, the combination of the tunnel, the fire-boxes arranged at the side thereof, and having passage-ways leading into the upper part of the tunnel, the smoke-stack, the heat-flue communicating with the latter and having the lateral passage-ways leading into said tunnel adjacent to the truck-platforms, and means for supplying heated air to said fire-boxes, said means consisting of the conduits leading to the latter from a hot-air space around the smoke-stack, substantially as and for the purpose set forth.

7. In a kiln of the character recited, the combination with the series of trucks, of the plates secured thereto respectively, and having the forwardly-projecting ends adapted to pass respectively closely under the platform of the contiguous truck in advance, and means for elevating the forward truck of the series above the plane of the platform of the contiguous rear truck, when the said forward truck is advanced out of the kiln, substantially as and for the purpose set forth.

8. In a kiln of the character recited, the combination of the series of trucks, the respective plates secured thereto, and having the forwardly-projecting ends adapted to pass closely under the platform of the contiguous truck in advance, the trackway within the kiln upon which said trucks are adapted to travel, the trackway in a plane above that of the first-mentioned trackway, and the incline connecting the former and the said elevated trackway, substantially as and for the purpose set forth.

9. In a kiln of the character recited, the combination of the series of trucks having the side flanges, the troughs into which said flanges depend, and means for supplying sand to said troughs consisting of the conduits whose lower ends lead into said troughs, respectively, at a point adjacent to the rear end of the latter, substantially as and for the purpose set forth.

10. In a kiln of the character recited, the combination of the tunnel, the fire-boxes arranged at the sides thereof and having passage-ways leading into the upper part of the tunnel, the heat-flue communicating with the smoke-stack and having the lateral openings leading into the tunnel through the side wall thereof, the conduit, 21, communicating with the open air, the conduit, 23, communicating with the latter conduit and having branches leading into the said heat-flue, together with the regulating-valve in the connection between said conduits, substantially as and for the purpose set forth.

In testimony whereof I have hereunto affixed my signature this 31st day of May, A. D. 1901.

EDWARD C. BRICE.

Witnesses:

ANDREW V. GROUPE,
WALTER C. PUSEY.