

No. 826,831.

PATENTED JULY 24, 1906.

F. W. BUTTERWORTH.  
KILN FOR BURNING CLAYWARE.

APPLICATION FILED OCT. 19, 1906.

3 SHEETS—SHEET 1.

Fig. 1.

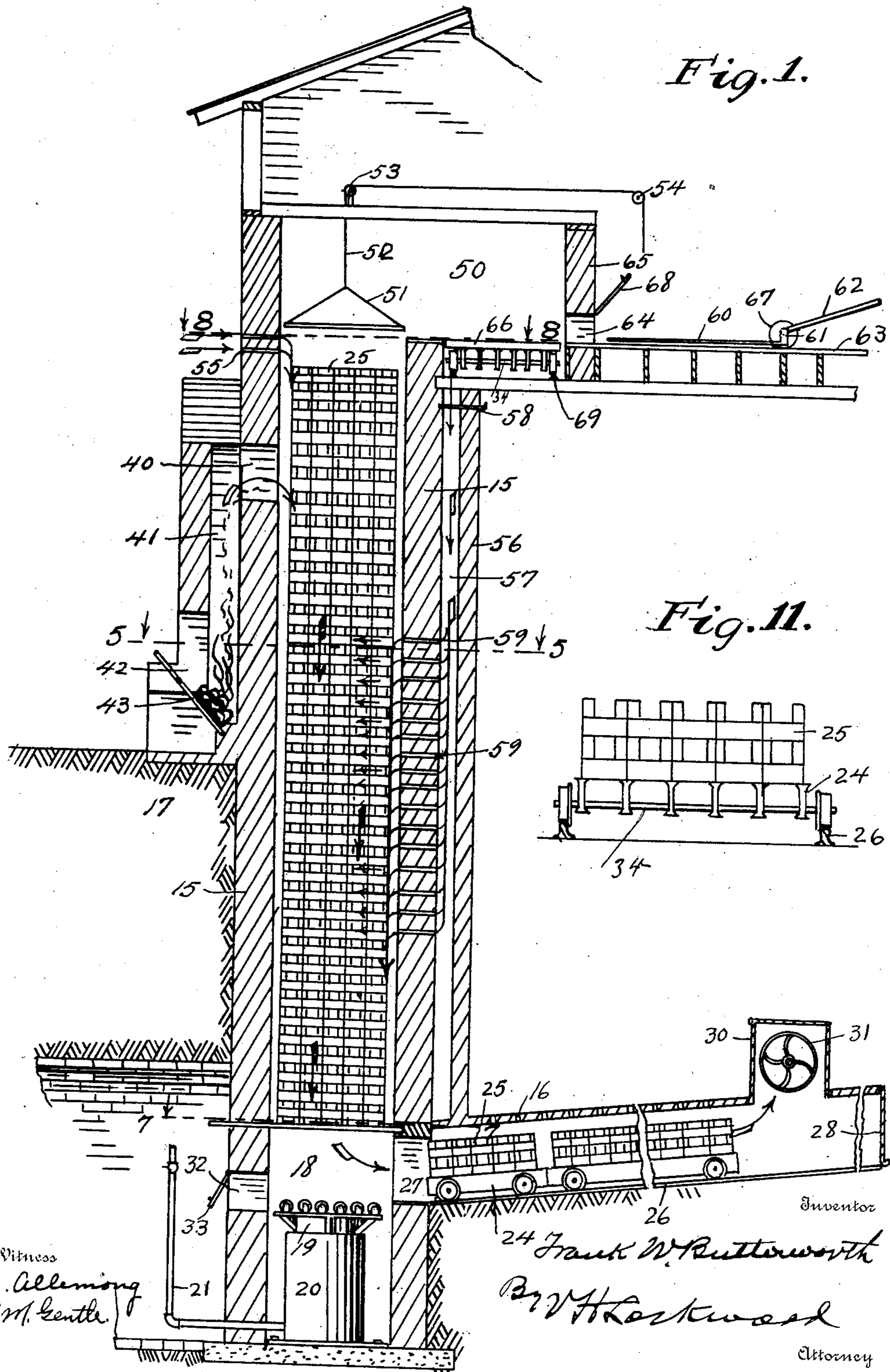
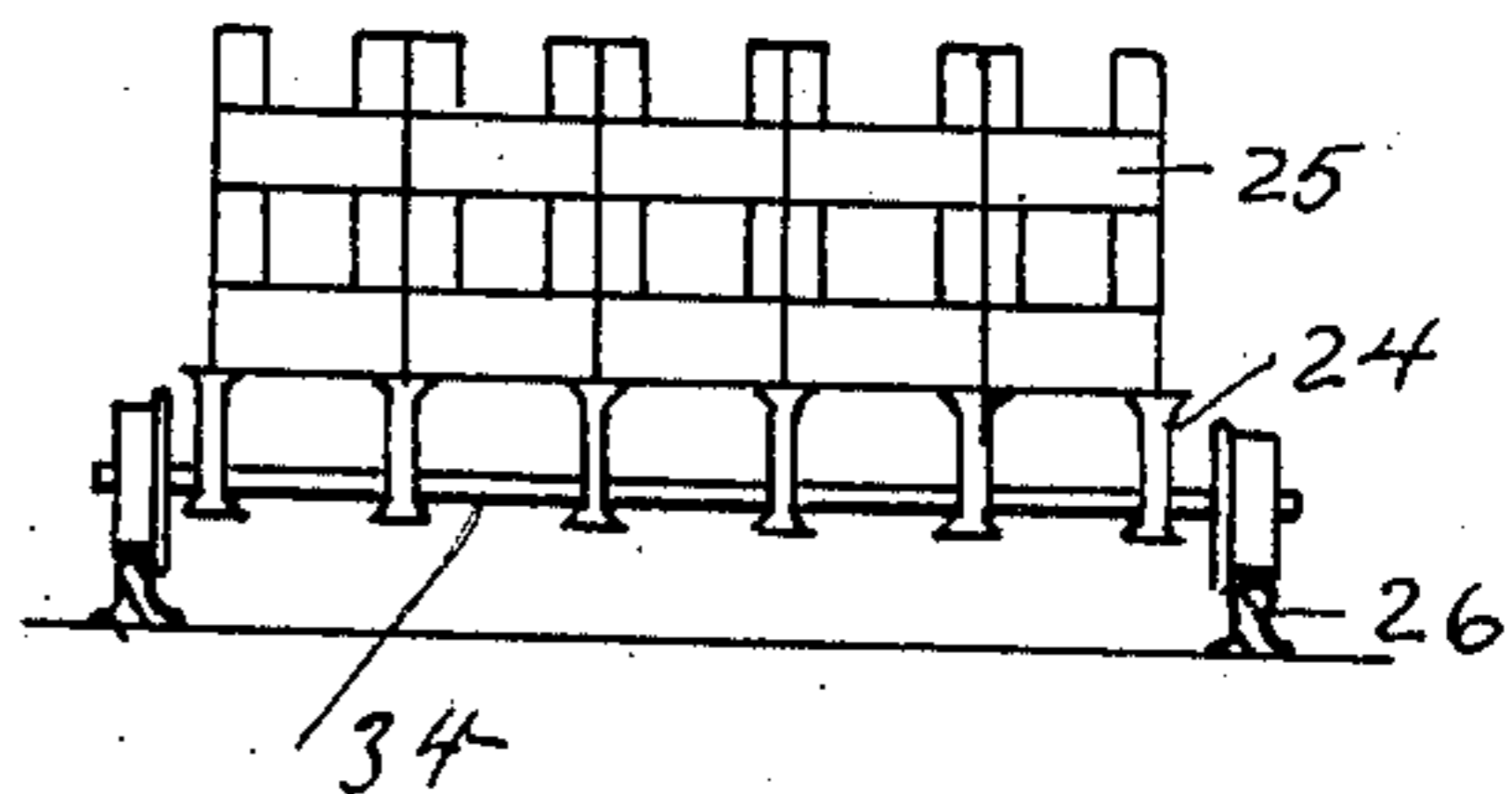


Fig. 11.



Witness  
N. Allen  
W. M. Gentle

Inventor  
Frank W. Butterworth  
By W. H. Lockwood  
Attorney

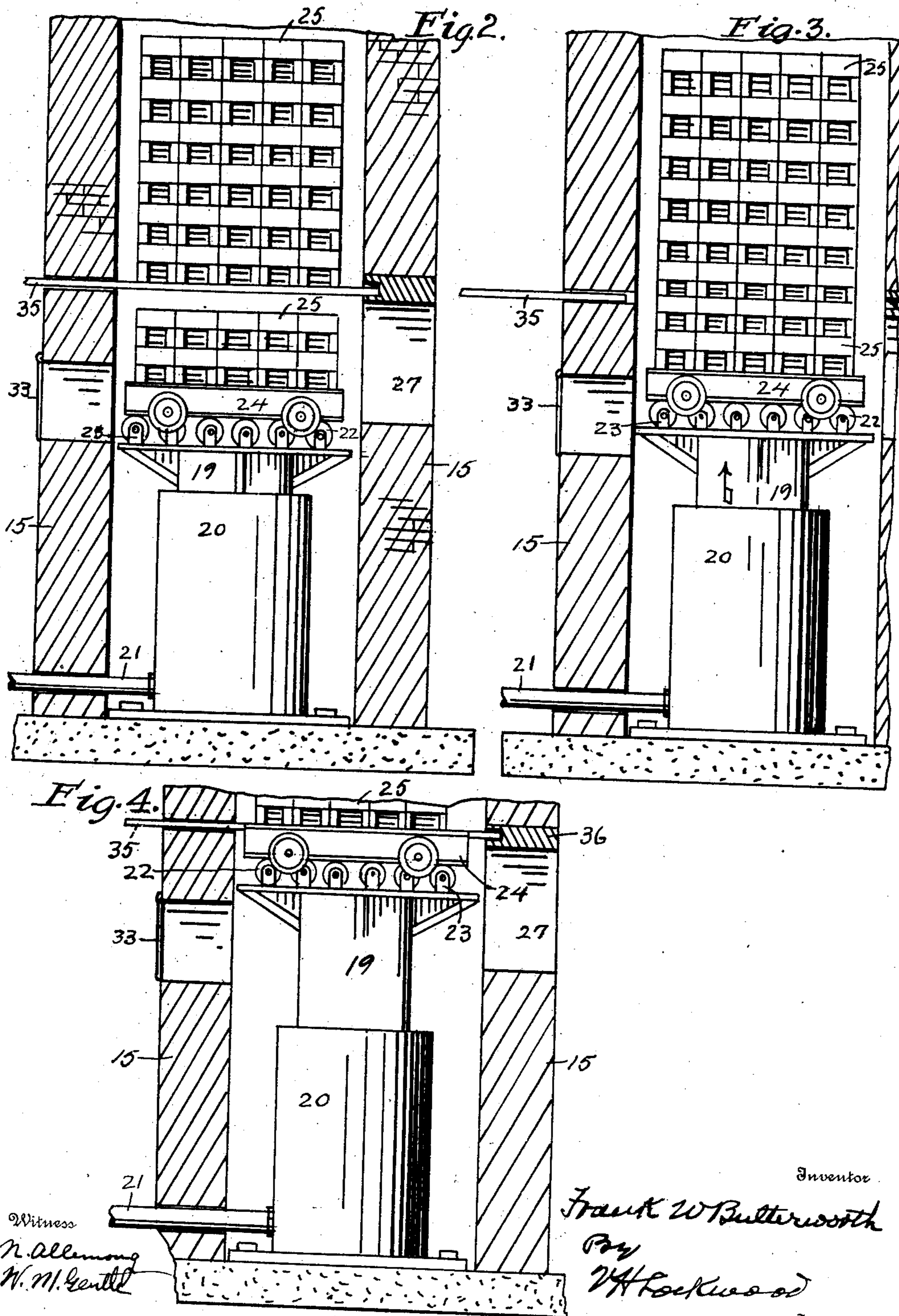
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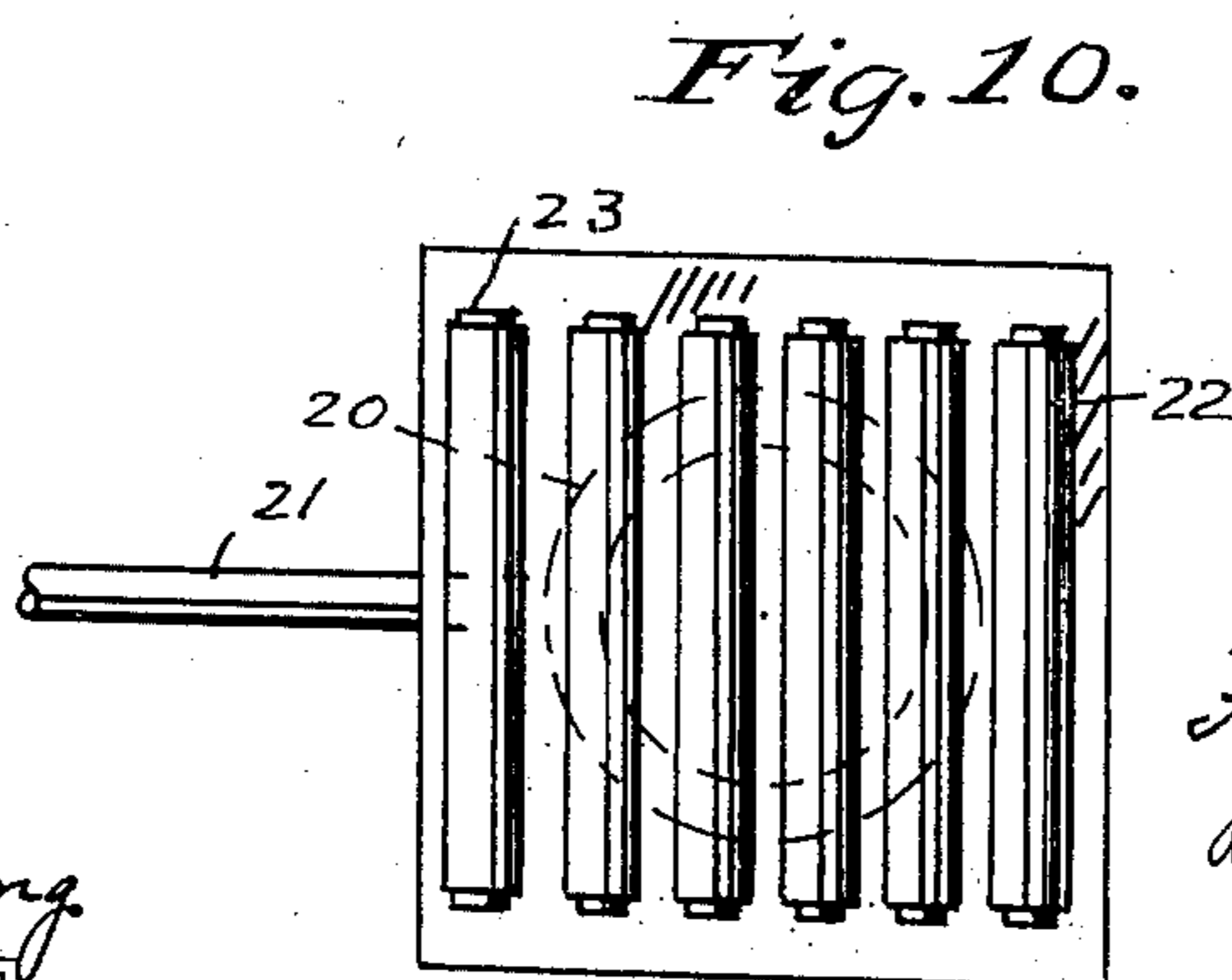
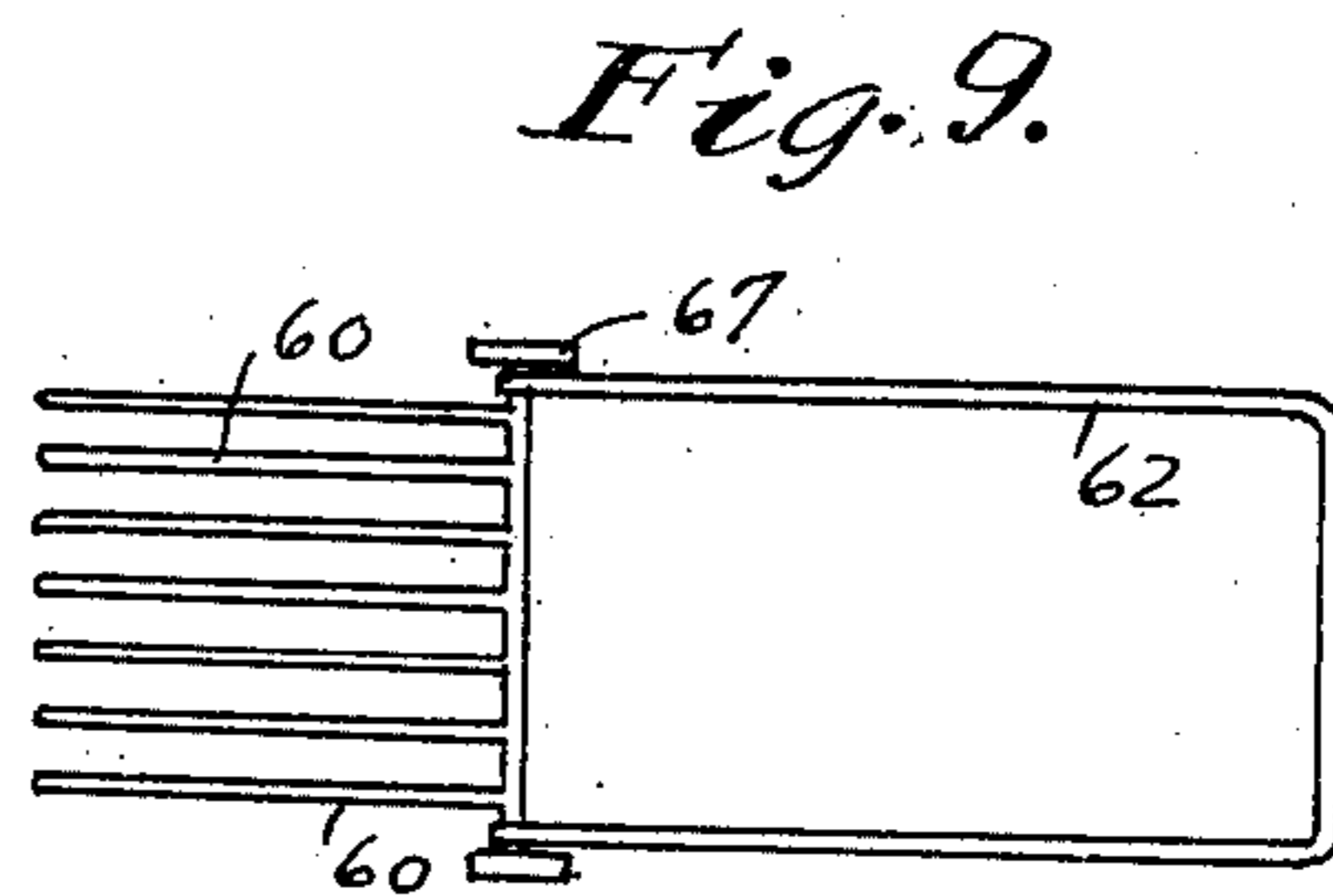
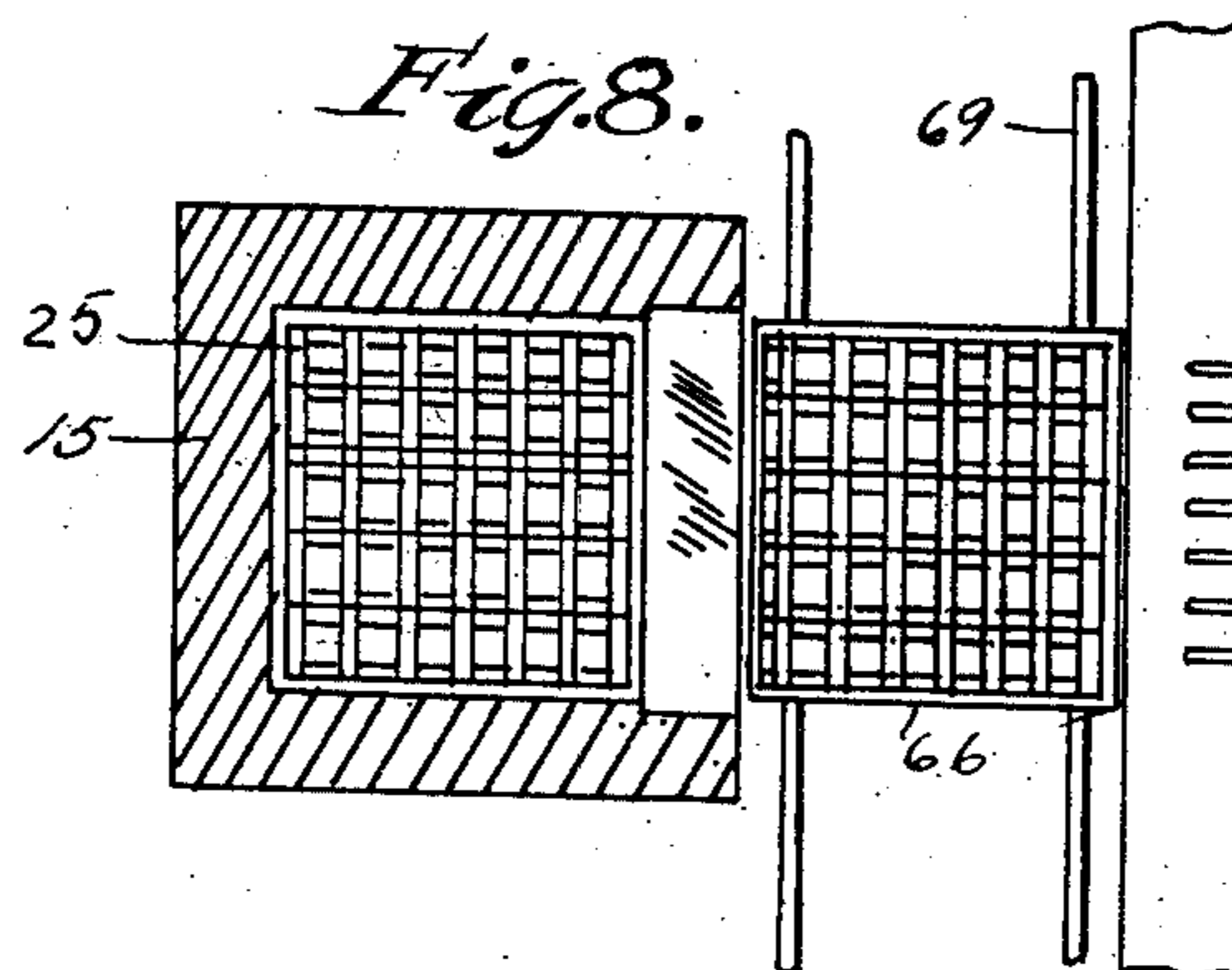
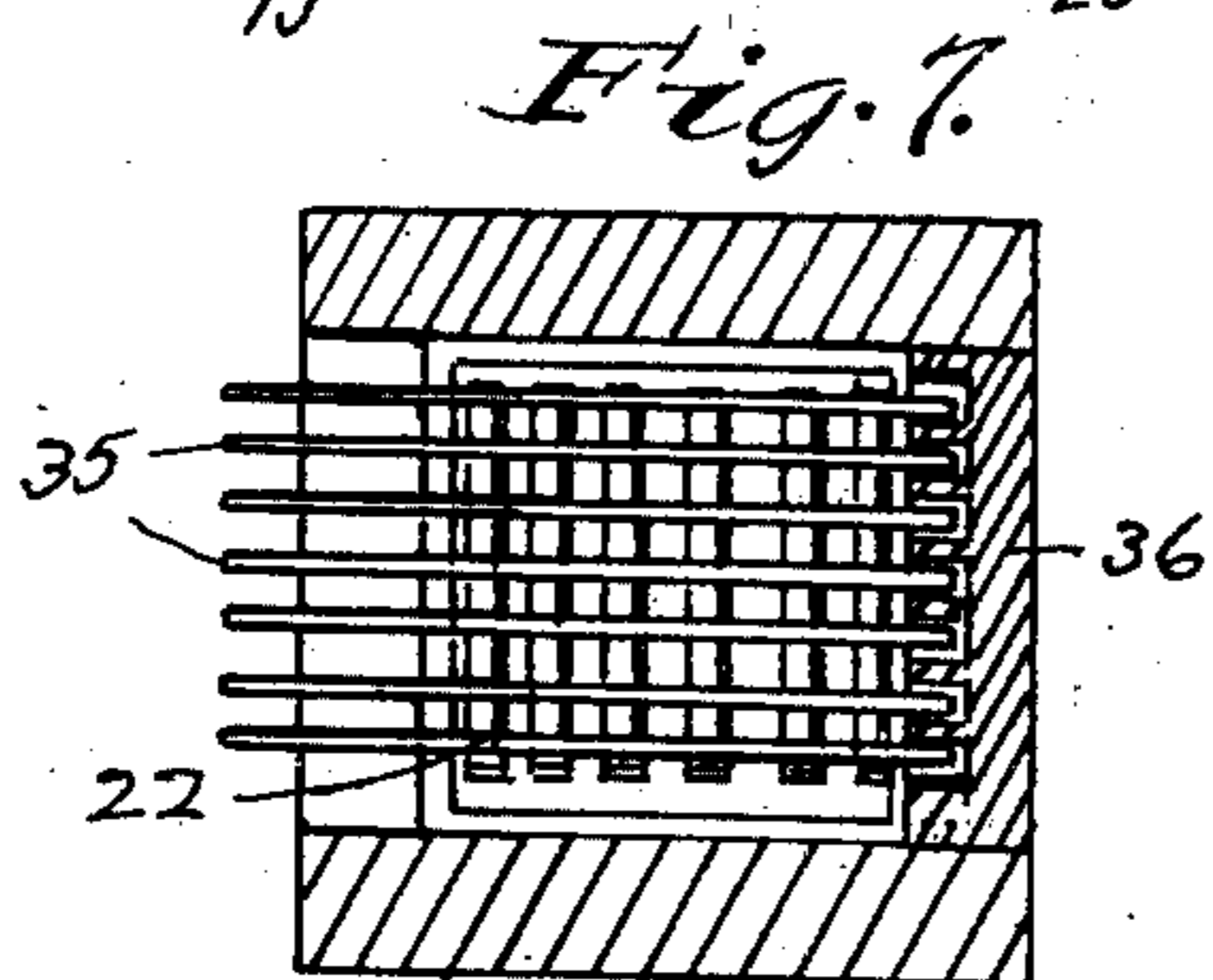
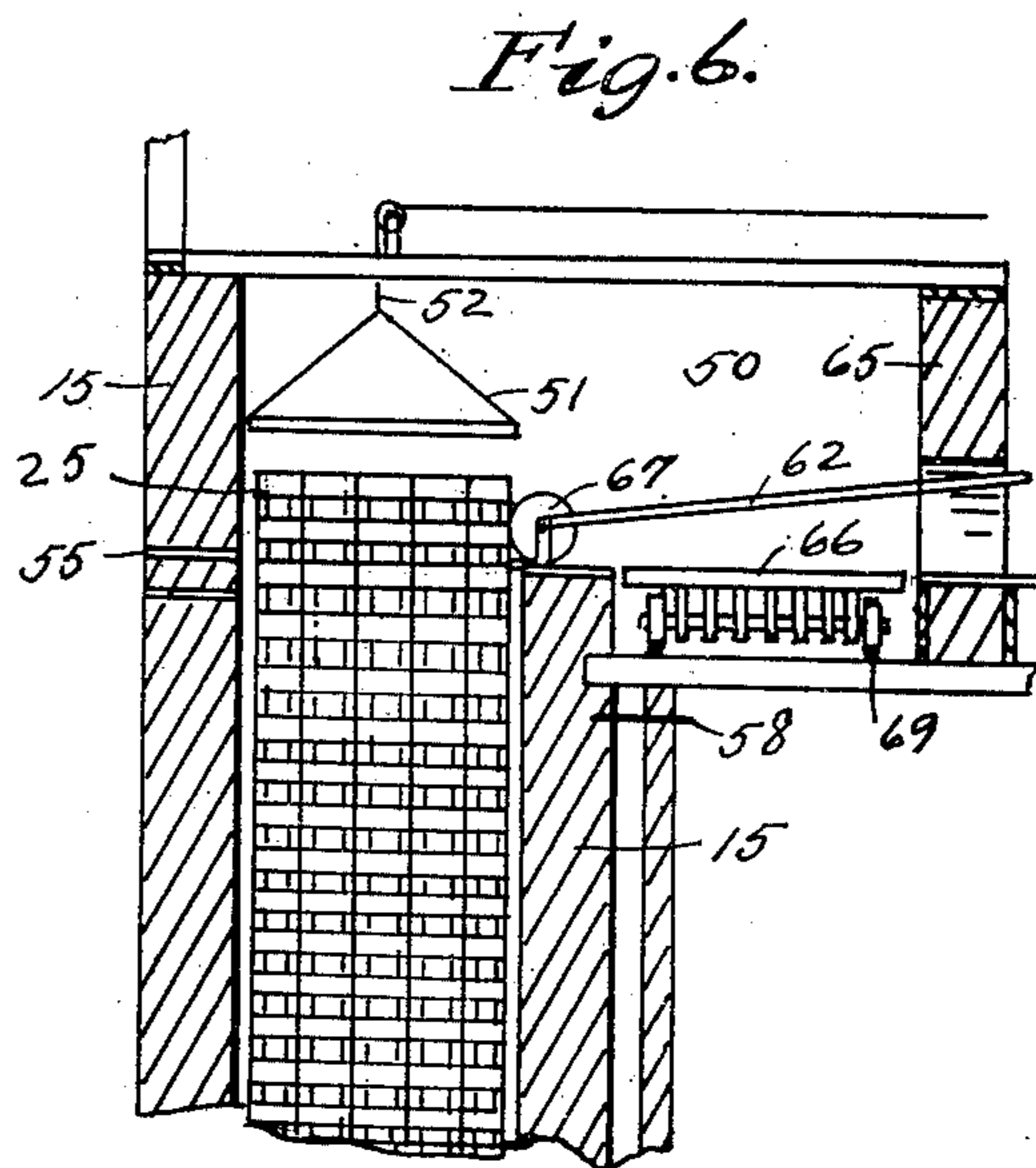
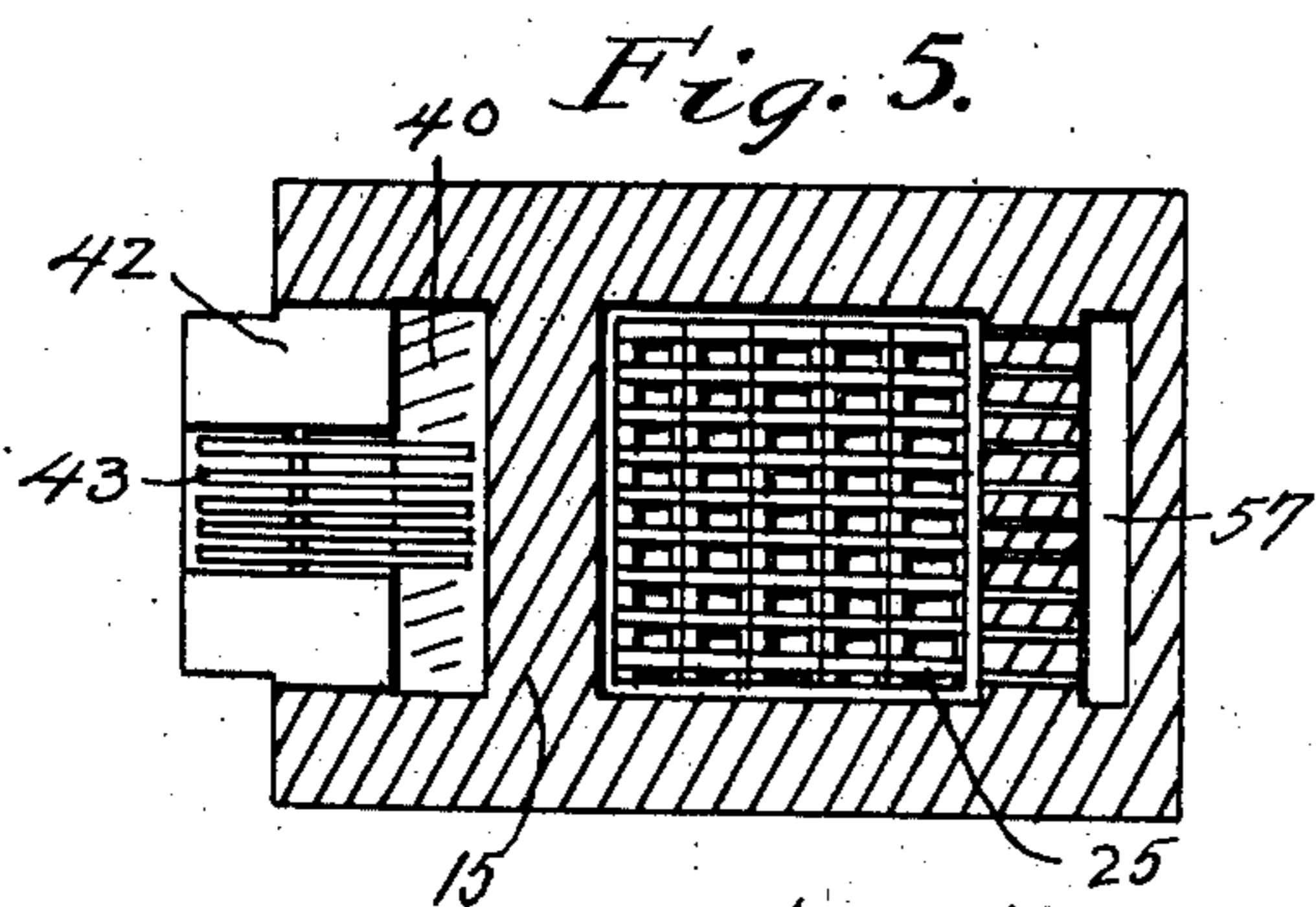
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3 SHEETS—SHEET 3.



Witness  
N. Allemong  
W. M. Lenth.

Inventor  
Frank W. Butterworth  
By V. H. Lockwood  
Attorney

# UNITED STATES PATENT OFFICE.

FRANK W. BUTTERWORTH, OF DANVILLE, ILLINOIS.

## KILN FOR BURNING CLAYWARE.

No. 826,831.

Specification of Letters Patent.

Patented July 24, 1906.

Application filed October 19, 1905. Serial No. 283,385.

*To all whom it may concern:*

Be it known that I, FRANK W. BUTTERWORTH, of Danville, county of Vermilion, and State of Illinois, have invented a certain  
5 new and useful Kiln for Burning Clayware; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which like figures refer to like  
10 parts.

This invention relates to a kiln for burning brick, tile, sewer-pipe, and all kinds of clay products.

The object of the invention is to reduce the  
15 manual labor required during the drying, setting, burning, and drawing periods of the manufacture; to subject all individual pieces of clayware to exactly the same conditions as to temperature, &c.; to shorten the time re-  
20 quired in drying and burning; to eliminate the cooling between the drying and burning by making the latter steps in the operation continuous; to control perfectly the temperature at all portions of the kiln; to provide  
25 fresh cool or heated air, as required, to assist in the oxidizing and dehydrating steps in the process; to provide means for drawing the ware from the kiln at a temperature too high for human endurance; to utilize the heat gen-  
30 erated during the cooling process for the purpose of combustion either directly with coal or in connection with gas, thus making combustion regenerative or for drying the ware.

In the ordinary process of drying and  
35 burning clayware there are several separate and distinct steps, such as the partial drying at first, so the ware will stand handling, and cooling the same to the temperature of the atmosphere prior to placing it in the kiln,  
40 next placing the ware in the kiln-chamber, called "setting," then drying the ware by raising the temperature and driving off the physically-combined water, next raising the temperature to a high degree for driving off  
45 the chemically-combined water, which is followed by the oxidizing and dehydrating period, then raising the temperature to a vitrifying heat and vitrifying the ware, and, finally, cooling and removing the same.

50 In an ordinary kiln each of these ten steps in the process must be completed practically as to all the ware in the kiln-chamber before the next period or step can be entered upon.

In these various steps the ware close to the  
55 place where heat is admitted becomes fully

treated long before the ware farther away; yet it is necessary for the entire kiln to be held to the same temperature until each particular piece of ware has been sufficiently  
60 treated. Although it is quite possible to dry and burn to vitrification an individual piece of ware in every twenty-four to forty-eight hours, yet the time consumed in ordinary kilns and dry-houses in accomplishing the same results may require as many as twenty  
65 days.

One feature of my invention consists in providing a vertically-disposed kiln and means for causing a downdraft through the same and moving the clayware constantly or  
70 intermittently upwardly through a kiln.

Another feature of the invention consists in providing a vertical kiln with a substantially horizontal or inclined chamber leading to the bottom of the vertical portion of the  
75 kiln, a furnace with the heated gases and flame entering near the upper part of the vertical portion of the kiln and being drawn downwardly through the vertical portion of the kiln and outward through the horizontal  
80 portion thereof and moving the clayware through the horizontal portion to the lower end of the vertical portion and then gradually up through the vertical portion of the kiln and removing the same at the upper end  
85 of the vertical portion of the kiln. Therefore by my invention there is a constant movement or frequent intermittent movement of the clayware through the kiln, so that there is a substantially constant opera-  
90 tion and a constant discharge or removal of the completely-treated ware. By placing the furnace near the upper portion of the kiln the ware when highly heated, almost to the flux condition, supports but a very slight  
95 weight, because there is not much ware above the same, and therefore the ware is not injured. Where the ware is fed downward in a vertical kiln and the vitrifying takes place near the lower end, the ware is often injured  
100 or crushed by reason of the very heavy load of ware above the highly-heated ware. By drawing the heated gases through the horizontal portion of the kiln the treatment of the ware begins early in the movement there-  
105 of through the kiln, so that it can be moved more rapidly through the kiln and rapid work done.

These and the various other features of the invention will be understood from the accom-  
110

panying drawings and the following description and claims.

In the drawings, Figure 1 is a vertical section through the kiln with parts broken away and the elevator being depressed and without any load. Fig. 2 shows the lower part of the vertical portion of the kiln in vertical section, on an enlarged scale, with the elevator in its lowest position and carrying a load. Fig. 3 is the same as Fig. 2 with the elevator moving upward and supporting the entire body of brick in the kiln. Fig. 4 shows the lower part of Figs. 2 and 3 with the elevator in its upper position and the brick-supporting rods in place. Fig. 5 is a transverse section on the line 5 5 of Fig. 1. Fig. 6 is a section of the upper part of the kiln, showing the brick-remover in position to remove a load of brick. Fig. 7 is a section on the line 7 7 of Fig. 1. Fig. 8 is a section on the line 8 8 of Fig. 1. Fig. 9 is a plan view of the brick-remover. Fig. 10 is a plan view of the elevator. Fig. 11 is a transverse section of the truck.

While the drawings herein show a device for burning bricks, still the invention is not limited to the treatment of bricks, but is adapted to any kind of clayware. The main body of the brick-kiln is the vertical portion 15, into the lower part of which a substantially horizontal, but downwardly-inclined, portion or tunnel 16 leads. This tunnel in the lower part of the vertical portion is preferably below the surface of the ground 17.

In the lower part of the vertical portion in the chamber marked 18 there is an elevator 19. It may be a hydraulic elevator consisting of an outer stationary cylinder 20, into the lower part of which the pipe 21 leads from any suitable source of fluid-supply under pressure. The elevator operates piston-like in said cylinder, whereby it is elevated to the position shown in Fig. 4. The details of construction are not shown and will not be described, as they will be understood by all persons skilled in the art. Upon the upper part of the elevator I mount a series of rollers 22 in bearings 23, as shown in Figs. 4 and 10, adapted to receive a truck 24 as the latter with a load of brick 25 thereon rolls down the inclined tracks 26 in the tunnel or horizontal portion. The truck moves by gravity and passes through an opening 27 in the lower part of the vertical portion of the kiln upon rollers 22. These trucks are introduced into the tunnel one after the other. The tunnel has at its outer end a door 28, through which the trucks are introduced and which may be closed. The top of the horizontal portion or tunnel 16 is perforated or provided with ventilating-openings through which air may enter the tunnel. A door 30 extends upward from the tunnel, and there is a fan 31 constructed in the side of it for exhausting the contents of the vertical and horizontal por-

tions of the kiln and causing a downward draft through the vertical portion and also drawing the heated gases and air through the horizontal portion. An opening 32 is provided in the lower part of the vertical portion, which is closed by a door 33. It is on a level with the lower position of the elevator 19, and hence through said opening the elevator and the truck-rollers thereon, as well as the truck when on the elevator, are all accessible.

The trucks 24 are formed of longitudinally-extending I-beams mounted on or secured to the axle 34, that carries the wheels, so that there is space between the I-beams; but they are close enough together to place bricks transversely thereon. The bricks are built up in the form of open-work, each layer lying transversely of the layer below. The distance between the wheels on each axle of the truck is greater than the length of the rollers 22, so that the wheels will ride astride the rollers and the I-beams rest thereon, as shown in Figs. 2, 3, and 4. In this way the frame of the truck, with its load, will rest directly upon the elevator instead of upon the wheels. This is important in view of the fact that at times, as shown in Fig. 3, the frame of the truck supports the entire column of brick above, so that it is desirable to relieve the wheels and axle of such strain.

After a truck is moved in upon the conveyor the latter is operated and moved, as shown in Fig. 3, upward to the position shown in Fig. 4, which illustrates the limit of movement of the elevator. While in that position, supporting-rods 35 are inserted through suitable transverse holes in the wall of the vertical portion of the kiln, (seen in Fig. 7,) between the I-beams of the truck and under the bricks thereon until the inner ends of said rod 35 rest in notches in the metal block 36. (Shown in Figs. 4 and 7.) There is one of these rods 35 inserted between each pair of I-beams of the truck, seven being shown herein. These support the brick when the truck is loaded. They also support the column of brick, as shown in Fig. 2, when the elevator is not performing that function, as shown in Fig. 3. Therefore brick are supplied to the kiln by placing them on trucks, running the trucks into the tunnel or horizontal portion of the kiln on the elevator, and then moving them up above the rods 35, and as each truck-load of bricks is added to the bottom of the column the column is moved up correspondingly, so that there is a constant intermittent upward feeding or movement of the column of brick as the truck-loads are introduced.

Near the upper end of the vertical portion 15 of the kiln there is an opening 40, leading from the flue 41, that leads from the furnace 42, and in that furnace there are inclined grate-bars 43, on which the coal is deposited.

This furnace is at the top of the ground 17 in the form shown herein. The draft is carried by the fan 31, which draws the heat from the furnace through the opening 40 into the vertical portion of the kiln and down through the column of bricks and then through the horizontal portion or tunnel 16 to the fan. The bricks near the top of the column are subjected, therefore, to the highest degree of heat when near or opposite the opening 40. The temperature diminishes slightly as the column of heated gases passes downward, so that the bricks on the truck in the tunnel are not subjected to the highest degree of heat. Hence from the time the bricks on the truck enter the heated draft until the same bricks reach a position opposite the opening 40 in the vertical portion of the kiln they are moved through zones of gradually-increasing temperatures. By extending the tunnel one can obtain not only a convenient means for introducing the bricks to the base of the vertical portion of the kiln, but also a very long heated course through which the bricks are to pass in reaching the highly-heated position opposite the opening 40 in the vertical portion of the kiln. This enables one to utilize more completely the heat coming from the furnace, as it continues to affect the bricks through such a very long course. It also enables one to operate or move the bricks more rapidly than if there were no arrangement whereby the heat would be carried through the horizontal portion or tunnel into contact with the bricks therein. It also dries and hardens the bricks on the truck, removing the mechanically-combined water therefrom by the time they reach the bottom of the vertical portion of the kiln and before they are subjected to compression on the rods 35, while they are supporting the column of bricks above. Likewise the bricks during the vitrifying period, while near or opposite the opening 40, are near the upper end of the column of bricks, and therefore they are not supporting much of the load above and are not subjected to much compression, so that they will not be pressed out of shape or deformed.

After the burned brick passes above the opening 40 they pass out of the heated zone and immediately begin to cool. As soon as some cold air is drawn by the fan in through the top of the vertical portion or passage-way of the kiln the bricks at the top are rather rapidly cooled, so that they may be conveniently handled and removed after they have passed into the removing-chamber 50 at the top of the kiln. The amount of incoming cool air at the top of the kiln may be regulated by the lid 51, that is adapted to close the top of the vertical passage-way in the kiln. It is suspended and elevated by a cable 52, running over pulleys 53 and 54 to some convenient position for handling. Likewise transverse openings 55 are made in the wall

of the vertical portion of the kiln near the upper end to admit constantly a small portion of air for combustion purposes, it commingling with the heated gases that enter through the opening 40. During the oxidizing and dehydrating periods it is desirable to admit quantities of fresh air and especially if the clay is high in carbon and chemically-combined water. For this purpose a supplementary wall 56 is constructed adjacent and parallel with one side of the wall 15 of the kiln, so that there is a vertical chamber 57 alongside the vertical portion of the kiln, the lower end of which is closed permanently, but the upper end is open excepting when closed or regulated by the damper 58. Hence cold air enters said chamber 57 through the top when the damper is open and passes in among the bricks through a large number of holes 59, as indicated by arrows in Fig. 1. When fresh air is not needed, the damper 58 will shut it out, and when it is needed the quantity may be regulated by said damper. This provides a convenient means for supplying fresh air. The air which enters the chamber 57 is warmed by contact with the wall 15 before it comes in contact with the bricks.

The burned bricks are removed at the top in quantities substantially as large as the truck-loads introduced at the bottom by introducing the rods 60 of the removing-frame 61 through the column of brick, said rods readily passing under and between the bricks, as shown in Fig. 6. Said frame 61 has a handle 62 for operating the same. It is pushed in over the floor 63 through an opening 64 in the wall 65 at the top of the kiln and over the removing-truck platform 66 and over the top of the wall 15 and through the column of brick. The rod 60, handle 62, and the removing-frame 61 are all rigidly secured to each other, so that by depressing the handle 62 a quantity of bricks will be elevated, and then the frame may be withdrawn until the bricks are deposited upon the truck 66. The removing-frame 61 has rollers or wheels 67 to make it readily movable under a load. The opening 64 may be closed by a door 68 when not removing bricks. After the bricks are deposited on the truck 66 it is moved away from the kiln and another truck is moved into its place for the next load. Therefore with this kiln there is constant removal of the burned brick at the top and constant introduction of unburned brick at the entrance to the tunnel 16.

I do not wish to be limited to a coal-furnace, for any other well-known means for heating may be substituted, nor do I wish to be limited to the forms of construction shown herein, as the features that give my invention great value are the means for providing a downward draft and introducing the heat near the top of a vertical column of bricks, and the constant vertical movement of the

bricks through said heat, and also the combination, with horizontal and vertical courses of bricks, of means for passing the current of heat backward through both the vertical and horizontal portions of the kiln.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a kiln for burning clayware, the combination with a vertical chamber in which the clayware may be placed, of means for maintaining a downward draft of heat through said chamber.

2. In a kiln for burning clayware, the combination with a vertical chamber for receiving the ware, means for gradually moving said ware vertically through said chamber, and means for maintaining a downward draft of heat through said ware.

3. In a kiln for burning clayware, the combination with a vertical chamber, of means for moving the clayware upwardly through said chamber, a furnace, a flue from said furnace entering said chamber near its upper end, and means for directing the current of heat downward through said chamber.

4. In a kiln for burning clayware, the combination with a vertical chamber, of means for moving the clayware upwardly through said chamber, a furnace, a flue from said furnace entering said chamber near its upper end, and a fan for drawing the current of heat downward through said chamber.

5. In a kiln for burning clayware, the combination with a vertical chamber, of means for moving the clayware upwardly through said chamber, a furnace, a flue from said furnace entering said chamber near its upper end, means for directing the current of heat downward through said chamber, and a removable lid for closing the upper end of said chamber.

6. In a kiln for burning clayware, the combination with a vertical chamber, of means for moving the clayware upwardly through said chamber, a furnace, a flue from said furnace entering said chamber near its upper end, means for directing the current of heat downward through said chamber, a removable lid for closing the upper end of said chamber, and air passage-ways entering said chamber above the flue and below said lid.

7. In a kiln for burning clayware, the combination with a vertical chamber, of means for moving the clayware upwardly through said chamber, a furnace, a flue from said furnace entering said chamber near its upper end, a fan for drawing the current of heat downward through said chamber, fresh-air inlets into said chamber below said flue, and means for controlling the admission of air through said inlets.

8. In a kiln for burning clayware, a wall forming a vertical passage-way, means for moving the clayware upwardly therethrough, a furnace, a flue leading therefrom into said

chamber near its upper end, a wall parallel with the wall surrounding said chamber and forming thereby a fresh-air chamber, a damper for controlling the admission of air to said chamber, and openings from said fresh-air chamber into said clayware-chamber.

9. In a kiln for burning clayware, a wall forming a vertical chamber, a furnace, a flue from said furnace entering said chamber near its upper end, means for introducing clayware at the lower end of said chamber, means for elevating the clayware through said chamber, and means for removing the burned ware from the upper end of said chamber.

10. In a kiln for burning clayware, a wall forming a vertical chamber, means for moving the ware upwardly through said chamber, means for maintaining a downward current of heat through said chamber, a brick-remover mounted on rollers with rigidly-connected rods for entering the column of brick, and a rigidly-connected handle for operating the same on substantially a level with the top of said chamber on which said brick-remover may be operated.

11. A kiln for burning clayware having a wall forming a vertical chamber, means for moving the clayware upwardly therethrough, means for maintaining a downdraft of heat through said chamber, a room at the top of said vertical chamber with a closed opening therethrough on a level with the top of said chamber, a clayware-remover, and means substantially level with the upper end of said chamber on which said clayware-remover may be inserted through said opening in the wall of the room above for receiving a charge of clayware.

12. In a kiln for burning clayware, a wall forming a vertical chamber, means for moving the clayware upwardly therethrough, means for maintaining a current of heat downwardly through said chamber, a track beside the upper end of said chamber, a truck movable on said track and having a platform substantially on a level with the upper end of said chamber, a floor adjacent the position of said truck, and a clayware-remover movable on said floor and truck into position to receive a charge of clayware from the top of the movable column of clayware in said chamber.

13. In a kiln for burning clayware, a vertical chamber through which the clayware is moved while being burned, an elevator at the lower end of said chamber, rollers mounted on said elevator, trucks adapted to run in the lower end of said chamber upon said rollers, said truck being formed of beams adapted to rest upon said rollers and axles and wheels with the wheels sufficiently far apart to run astride the rollers, substantially as set forth.

14. In a kiln for burning clayware, the combination of a wall forming a vertical chamber, a horizontal chamber leading into the

lower end of the vertical chamber, means for moving clayware through said combined chambers, means for introducing heat at one end of said combined chambers, and means for withdrawing heat at the other end thereof.

15 In a kiln for burning clayware, the combination of a wall forming a vertical chamber and a wall forming a substantially horizontal chamber leading into the lower end of the vertical chamber, means for moving clayware through said combined chambers, a furnace, a flue entering the vertical chamber near its upper end, and an exhaust-fan at the remote end of said horizontal chamber for moving the products of combustion through said combined chambers.

16 In a kiln for burning clayware, the combination of a wall forming a vertical chamber and a wall forming a substantially horizontal chamber leading into the lower end of the vertical chamber, means for moving clayware through said combined chambers, a furnace, a flue entering the vertical chamber near its upper end, an exhaust-fan at the remote end of said horizontal chamber for moving the products of combustion through said combined chambers, trucks for carrying said clayware movable inwardly through said horizontal chamber, and means at the vertical end of said vertical chamber for receiving

and moving said clayware upward through said vertical chamber.

17 In a kiln for burning clayware, the combination of a wall forming a vertical chamber and a wall forming a substantially horizontal chamber leading into the lower end of the vertical chamber, means for moving clayware through said combined chambers, a furnace, a flue entering the vertical chamber near its upper end, an exhaust-fan at the remote end of said horizontal chamber for moving the products of combustion through said combined chambers, a track within said horizontal chamber, trucks for carrying clayware movable inwardly by gravity on said track, an elevator at the lower end of the vertical chamber in line with the lower end of said track in the horizontal chamber upon which the truck will run from said track, and horizontal rods insertible across the vertical chamber for supporting a column of ware thereon independently of said elevator.

In witness whereof I have hereunto affixed my signature in the presence of the witnesses herein named.

FRANK W. BUTTERWORTH.

Witnesses:

FLETCHER E. WILSON,  
E. T. JONES.