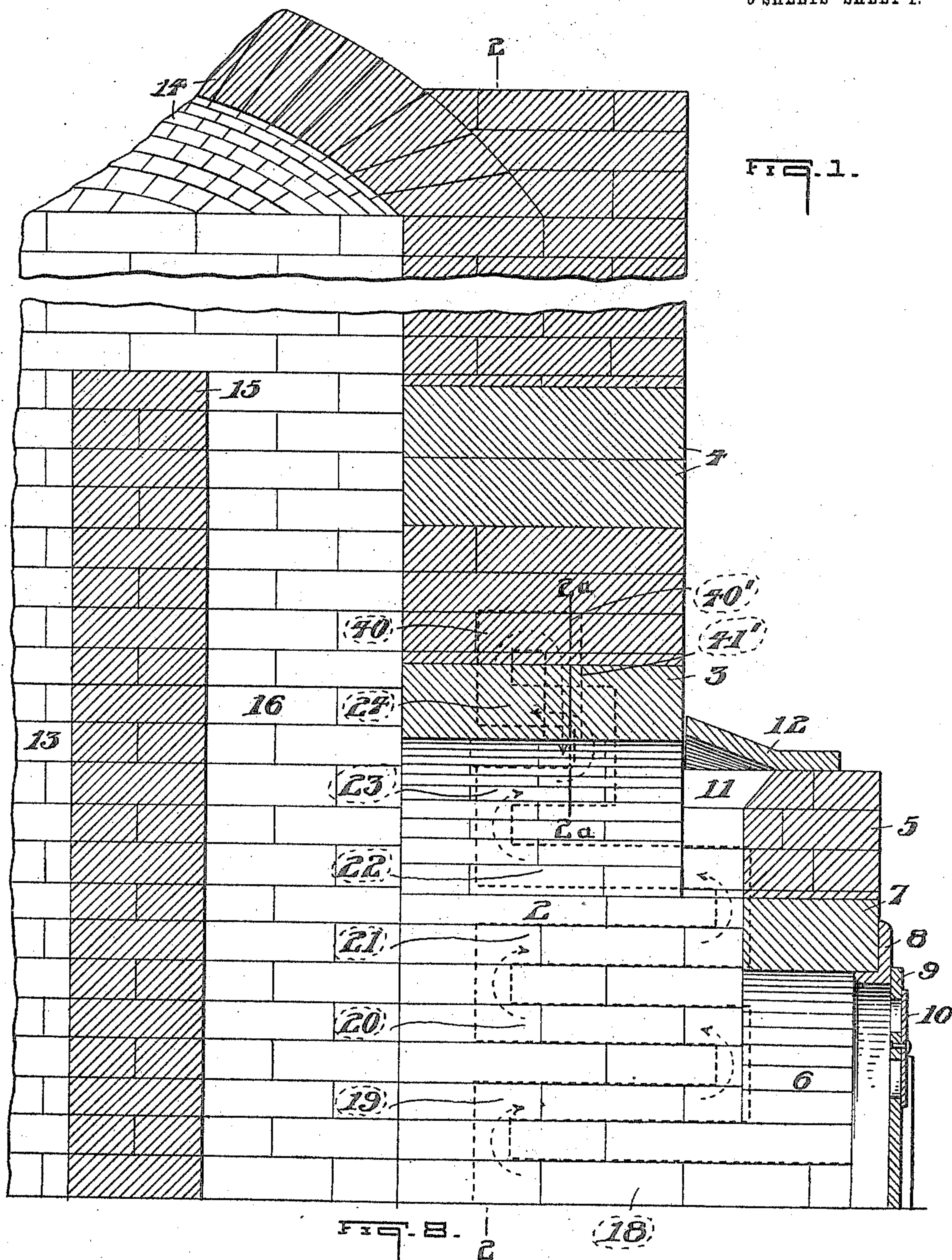


No. 816,877.

PATENTED APR. 3, 1906.

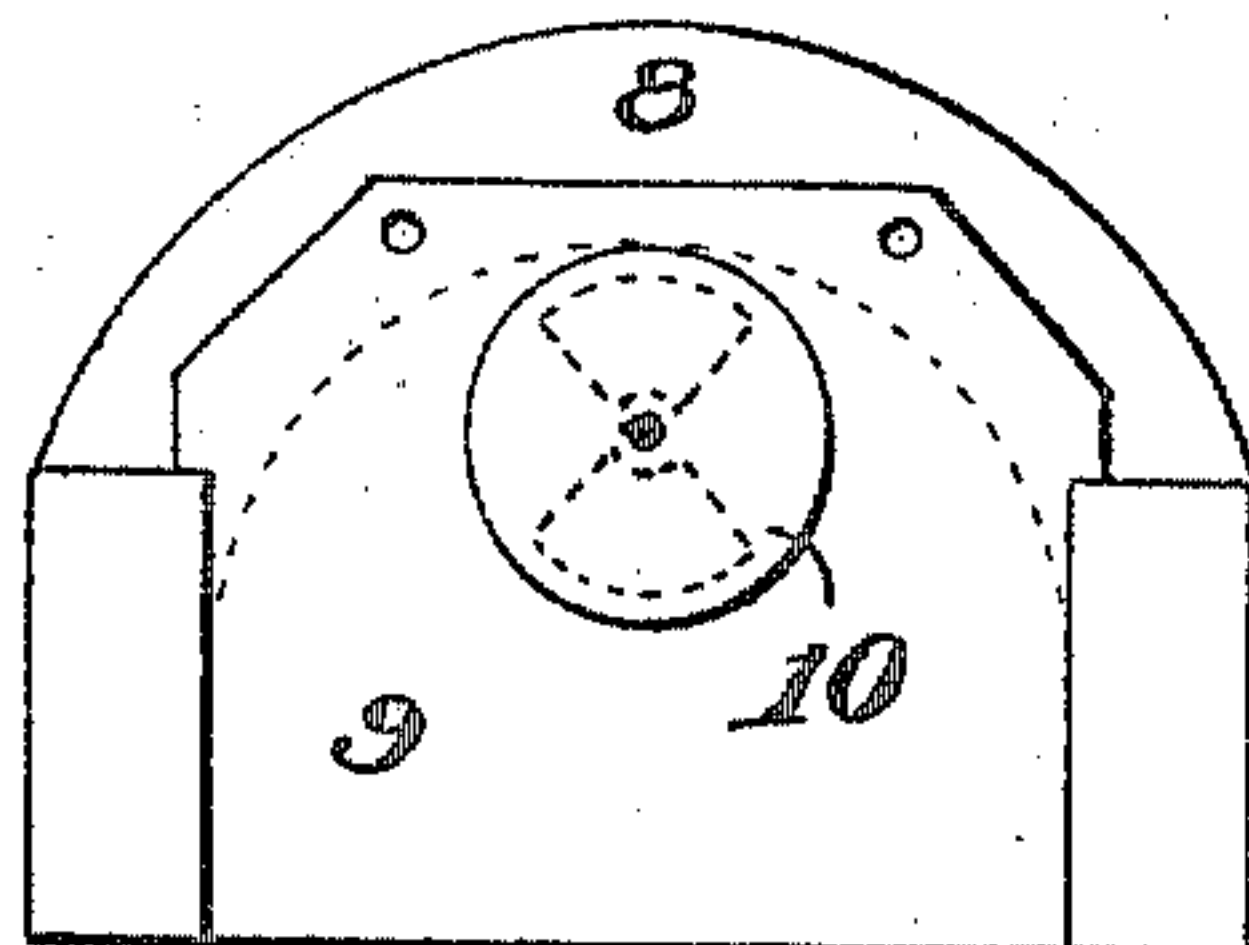
J. M. McCLAVE.  
HOT BLAST FURNACE.  
APPLICATION FILED JAN. 21, 1905.

3 SHEETS—SHEET 1.



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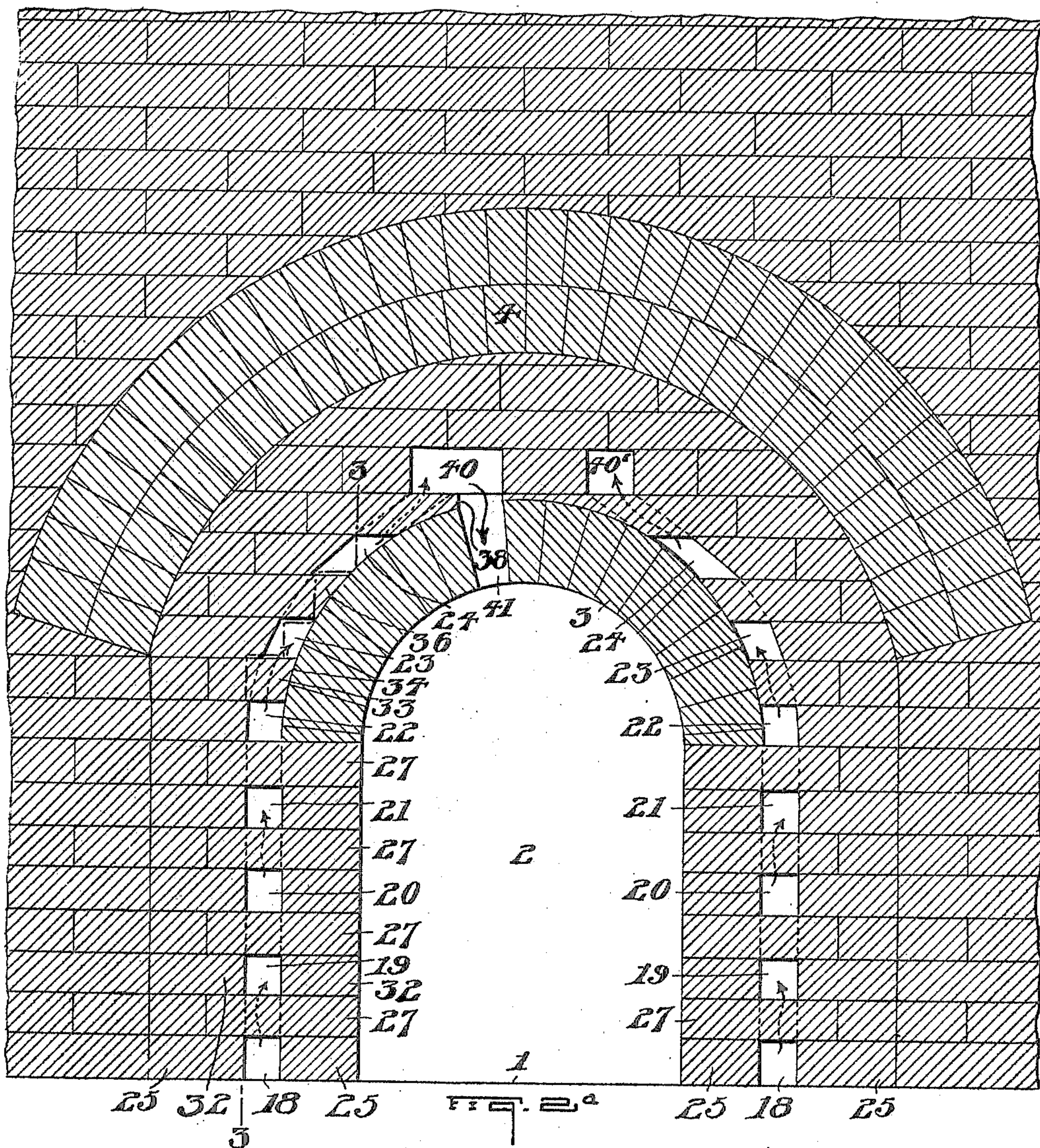
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3 SHEETS—SHEET 2.

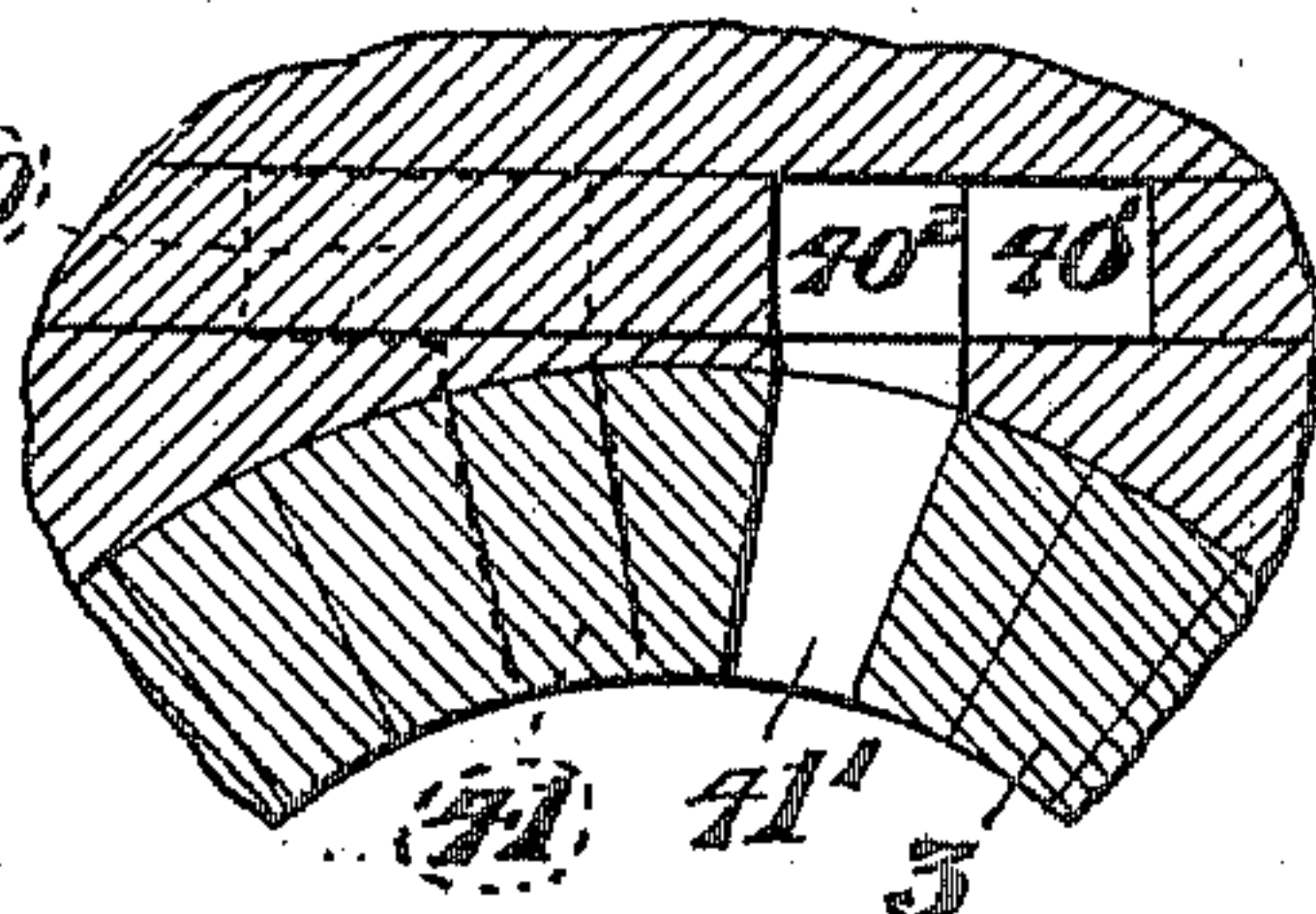
Fig. 2.



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3 SHEETS—SHEET 3.

FIG. 3.

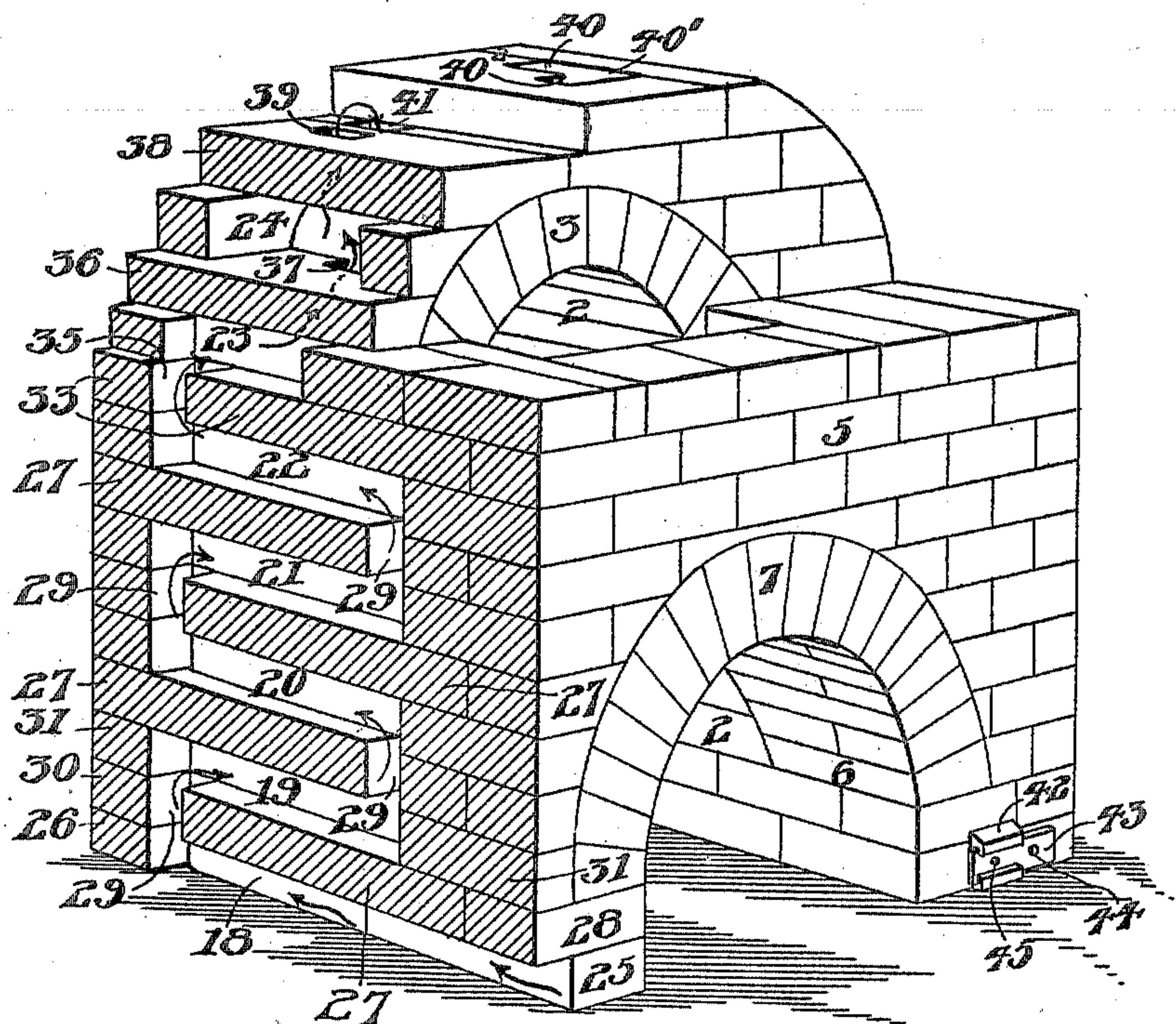


FIG. 4.

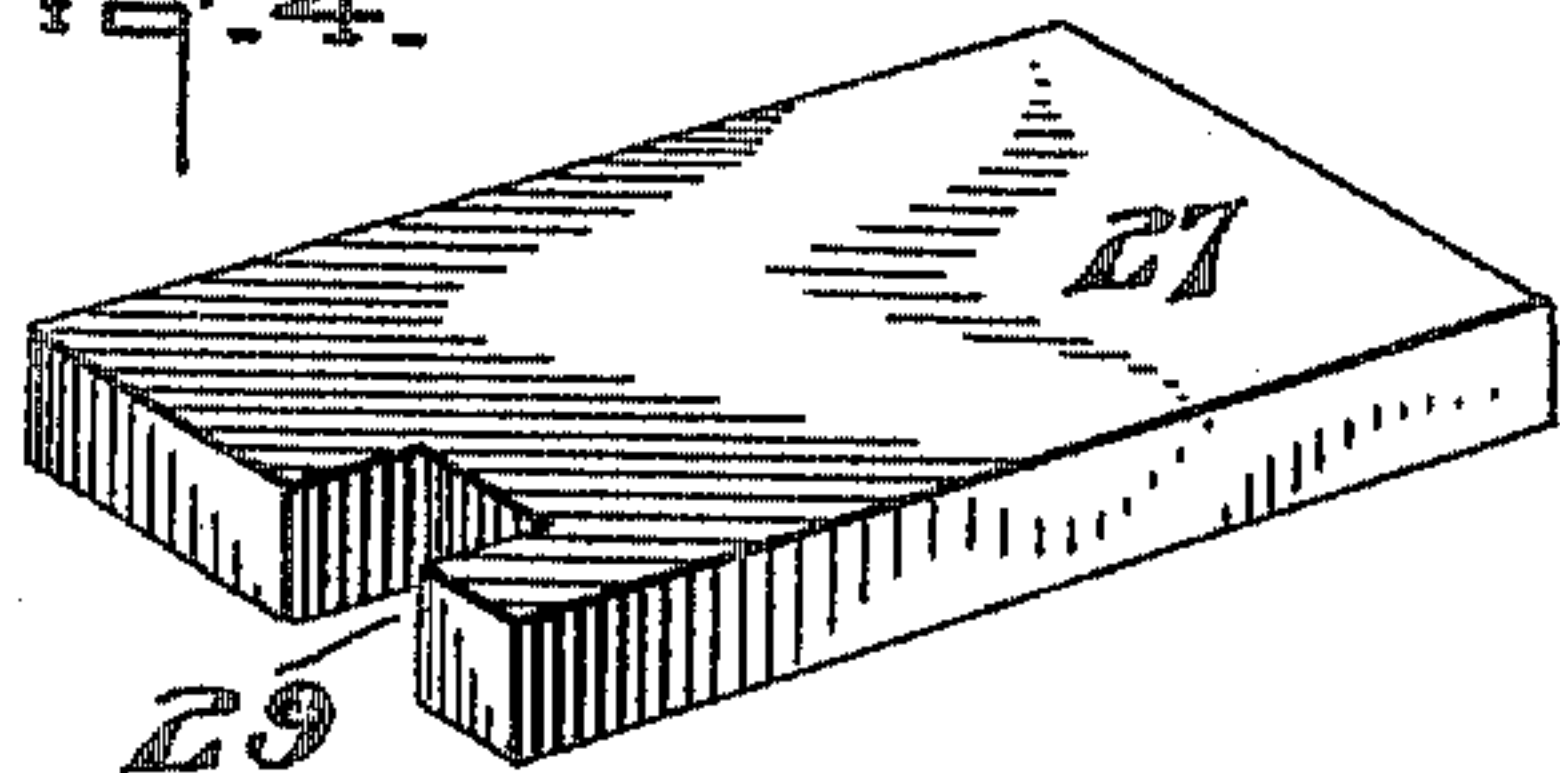


FIG. 5.

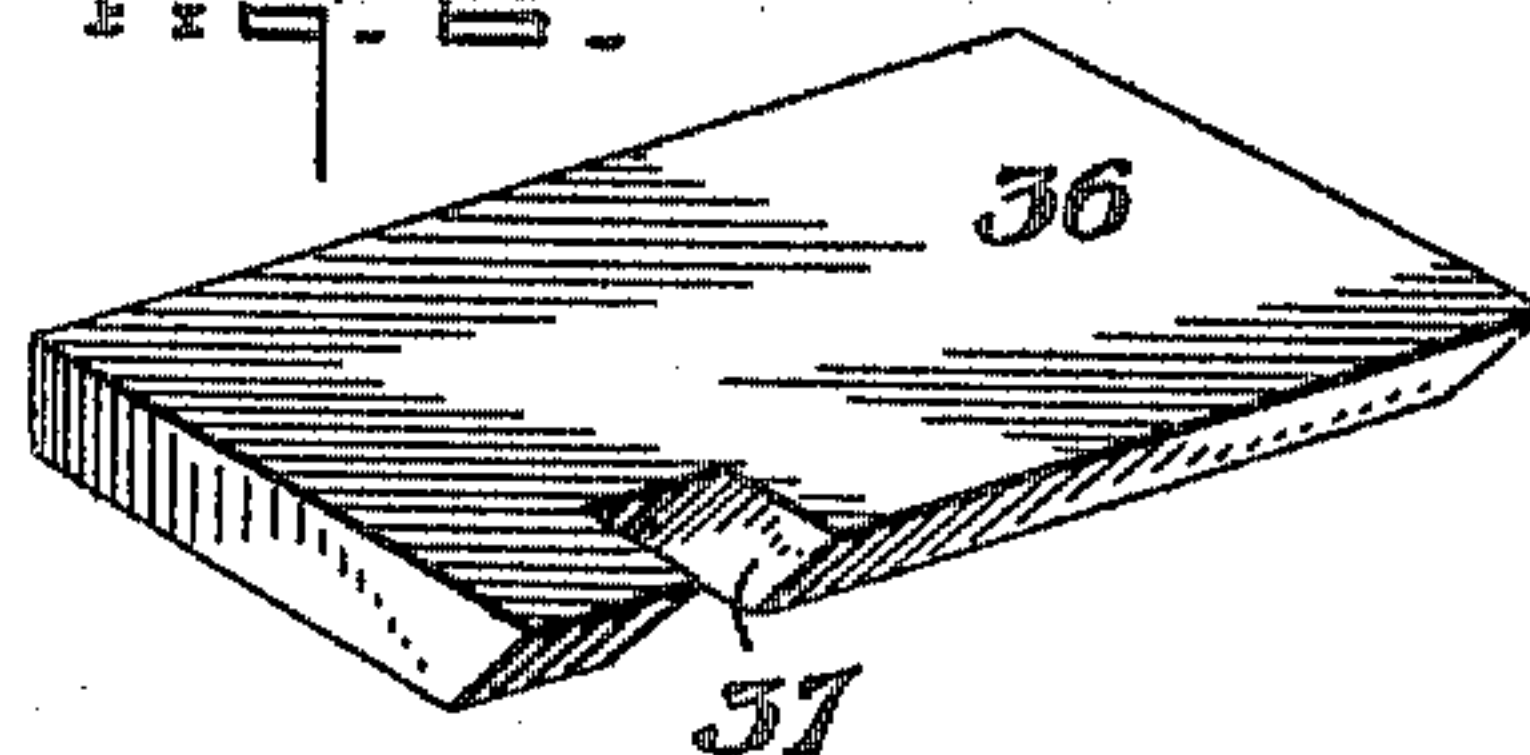


FIG. 6.

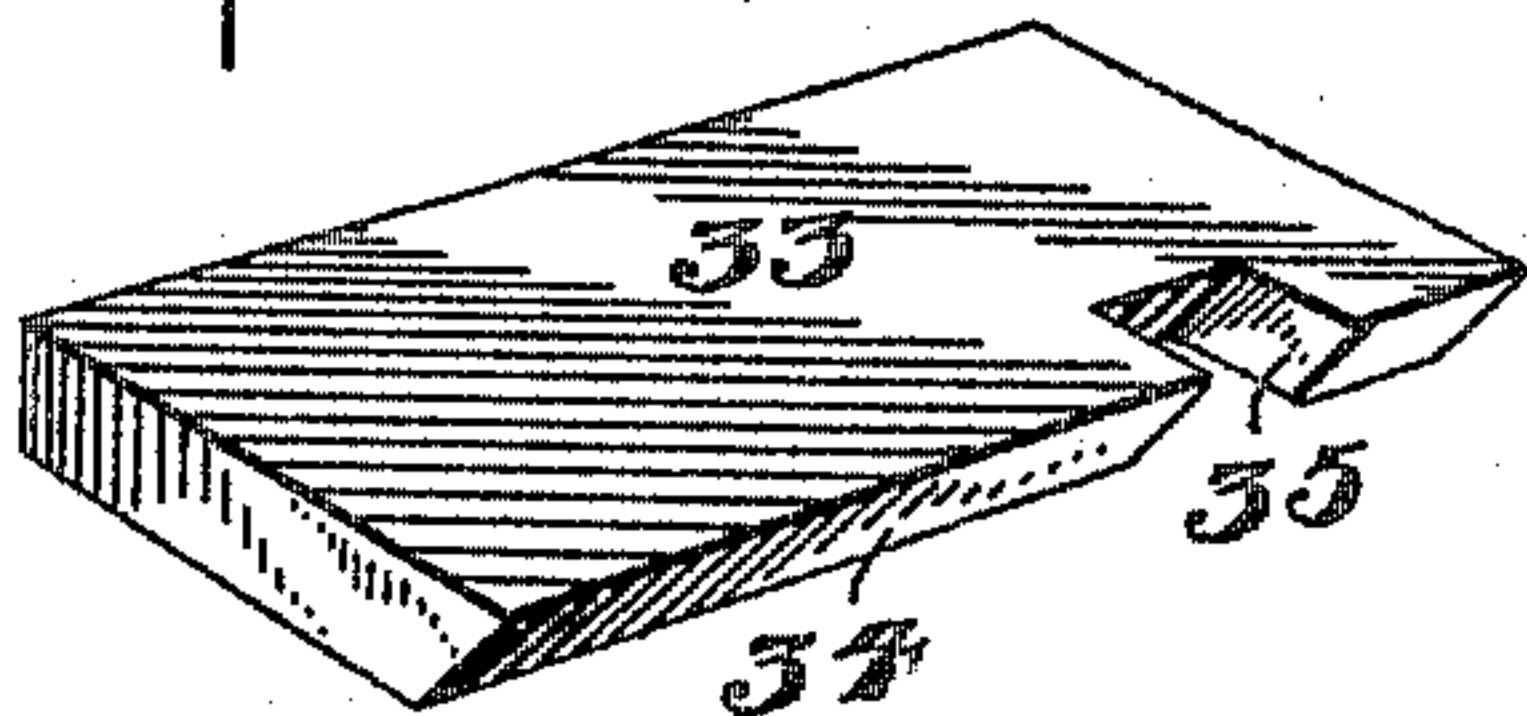
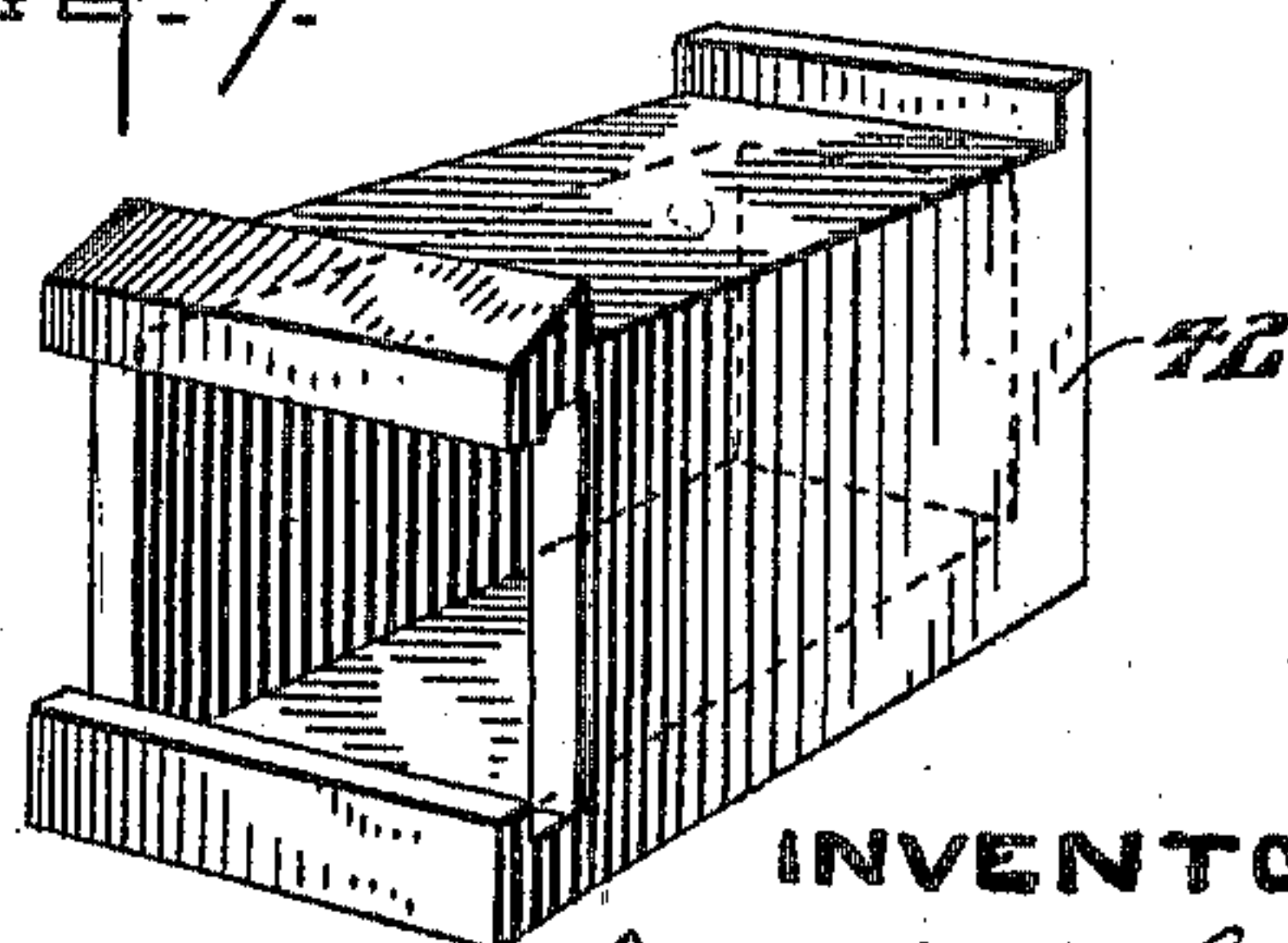


FIG. 7.



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# UNITED STATES PATENT OFFICE.

JAMES M. McCLAVE, OF TORONTO, OHIO.

## HOT-BLAST FURNACE.

No. 816,877.

Specification of Letters Patent.

Patented April 3, 1906.

Application filed January 21, 1905. Serial No. 242,096,

*To all whom it may concern:*

Be it known that I, JAMES M. McCLAVE, a citizen of the United States, residing at Toronto, in the county of Jefferson and State of Ohio, have invented or discovered new and useful Improvements in Hot-Blast Furnaces, of which the following is a specification.

My invention relates to the burning of sewer-pipe, fire-brick, paving-brick, building brick or blocks, flue-linings, fireproofing, conduits, drain-tile, stoneware, white granite, porcelain, china, and other clay products, and can be used in connection with any kind of kilns in which clay products are usually burned.

The objects of my invention are to secure perfect combustion, to control the amount of air going into the kiln through the furnace, to control the temperature of the kiln at the different stages of firing, to prevent cold air from rushing into the kiln at any time, and to be able to produce an oxidizing or a reducing flame, as required.

Referring to the drawings, which form a part of this specification, Figure 1 is a central vertical section of my furnace, a portion of the kiln being shown and portions of the furnace being broken away; Fig. 2, a vertical cross-section of the furnace on the line 2 2 of Fig. 1; Fig. 2<sup>a</sup>, a similar section on the line 2<sup>a</sup> 2<sup>a</sup> of Fig. 1; Fig. 3, a perspective of my furnace, the doors and door-frame being omitted and the left-hand side being in section on the line 3 3 of Fig. 2; Figs. 4, 5, and 6, perspective views of special forms of bricks which I prefer to use; Fig. 7, a perspective of one of the damper-guide boxes for the air-flues, and Fig. 8 a front view of the frame and doors of the furnace-mouth.

In the drawings, 1 represents the floor of the furnace or combustion-chamber 2, whose roof is composed of the arch 3. The front of the furnace extends on up above the arch 3 and contains the arched courses 4 of brick.

The front of the furnace has the projection 5, whose upper end is preferably slightly below the arch 3 and contains the ash-pit opening 6, having its bottom on a level with the floor 1 and its roof composed of the arch 7. The opening 6 has fitted to its front the frame 8, provided with the door 9, on which the rotary draft-regulator 10 is mounted.

The rear surface of the extension 5 stands a short distance in front of the arch 3, and the space 11 is left for feeding fuel to the furnace and is covered by the removable door 12,

which has its rear edge arched to fit against the arch 3.

13 represents a portion of the kiln which has the roof or dome 14 and is separated from the furnace proper by the bag-wall 15. The heat from the furnace ascends the flue or space 16 between the bag-wall and the rear of the chamber 2 and passes over the top of the bag-wall, which serves as a bridge-wall.

In the walls at the sides of the furnace are zigzag conduits or passages which begin at the front at the floor-line and run alternately toward the rear and front, rising at each reversal. The horizontal portions of the left-hand passage are designated by the numerals 18 to 24. The passage 18 is formed by the floor, the two side bricks 25, the rear brick 26, and the top bricks 27 and 28, the brick 27 being shown in Fig. 4. The passage 18 leads to the passage 19 through the notch 29 in the brick 27. A brick 30 lies at the rear of the notch.

The passage 19 is formed by the top and bottom bricks 27, the end bricks 31, and the side bricks 32. The upper brick 27 is reversed end for end from the position of the lower brick 27, so that the notch 29 lies at the front end thereof. The passages 20 to 22 are formed substantially the same as the passages 18 and 19.

The brick which constitutes the horizontal division or partition between the passages 22 and 23 is shown in Fig. 5 and is marked 33. Its edge 34 fits against the outer surface of the arch 3 and has the lateral notch 35, which lies toward the rear of the brick and leads up to the passage 23. The top of the passage 23 is formed by the brick 36, (shown in Fig. 6,) having the notch 37, corresponding to the notch 35, toward the forward end of the brick, this notch leading up into the passage 24. The roof of the latter passage is formed by the brick 38, having the hole 39 therein leading up into the flue or passage 40, which extends toward the center line of the furnace and descends down through the arch 3 by the passage or flue 41, close to the top of the arched chamber 2 and at the rear of the center thereof.

The air-passage at the right of the chamber 2 is the same as at the left until the passage or flue 40 is reached. In the right-hand air-conduit the passage 40 has the forward extension 40', having at its front end the off-set extensions 40<sup>2</sup>, leading toward the center



line of the furnace, the extension 40<sup>2</sup> connecting with the passage 41', which leads into the chamber 2 at the right of the center line of the furnace, but nearer the front of the furnace than the passage 41.

Into the front of the air passages or ducts 18 are fitted the boxes 42, each having the upper and lower guide-slots for the horizontally-slidable damper 43, which has therein the holes 44 and 45, the former larger than the latter.

What I do in my furnace is first to separate the elements of the fuel by destructive distillation and then bring them together in such a condition and manner that they will unite, each helping the other step by step to perfect combustion and to perfect action on the clay. Clay is composed of or mixed with silica, alumina, iron, sulfur, and carbon, together with the following salts: potash, soda, saltpeter, and lime, combined or mixed with water. After the manufactured product is placed in the kiln and the latter has been closed up for the fire the following is the method of burning the same with my furnace: I kindle a fire on the floor of the chamber 2, which is also the ash-pit, as no grate-bars are used. The space 11 is closed by the cover 12, and the door 9 and the damper 43 are left open, so that air may freely enter the furnace and the air-passages. I am thus able to feed into the kiln warm air only, slightly warm at first, but gradually warmer as the firing proceeds. The air is obliged to pass over the fire in the ash-pit or chamber 2 and through the air ducts or passages, which gradually heats the air as it zigzags back and forth from the flues 18 to the flues 41 and 41'.

The fuel is passed through the ash-pit opening 6 at intervals and preferably in such quantities as will fill the ash-pit up to the arch 7 by the time the clay is thoroughly dried or, in the language of the fireman, till the water-smoking has been completed. At this point I close the door 9 and the furnace becomes air-tight except through the air-ducts 18 19, &c. From this time on the furnace is fed through the opening or space 11 and the air is wholly supplied to the furnace-chamber at the two openings 41 and 41' near the center of the arch 3, the latter being forward of the former.

When the furnace needs to be recharged with fuel, the cover 12 is removed and the fuel is dropped down close to the front wall of the chamber 2 and the cover at once replaced. The coal comes into contact with the red-hot coke already in the furnace, and destructive distillation begins immediately and carbon dioxid, marsh-gas, oxygen, hydrogen, &c., are set free. As they ascend in the furnace they come into contact with a hot blast of air pouring into the furnace through the air-duct nearest the front end of the furnace. This stream of hot oxygen im-

mediately aids the marsh-gas in combustion and forces the carbon dioxid and hydrogen down onto the hot coke which has accumulated in the furnace. The carbon dioxid is changed into carbon monoxid. The hydrogen is also rendered combustible. These gases are met by a second hot blast of atmospheric air pouring into the furnace through the air-duct opening nearest the rear end of the furnace, thus making complete combustion. The heat thus produced passes into the pocket or bag of the kiln, over the pocket or bag wall 15 into the kiln, where it is distributed through the kiln by means of flues in common use in kilns constructed for the purpose of burning clay products such as I have named. After "water-smoking" or evaporating the mechanical water from the clay the disposing of the salts and chemical water and the combustion of the carbonaceous matter is the next step.

In the old process of firing there was no control over the amount of air going into the kiln, and consequently there was no maintaining an even or desired temperature therein. With my furnace I absolutely control both the air and heat. By a steady and increasing oxidizing heat the salts are oxidized and freed from the clay and pass out of the kiln through the stack. The combustion of the carbonaceous matter requires great care and takes place about the same time the above-named salts are being disposed of. When combustion of the carbonaceous matter in the clay begins, we do not want to increase the heat in the furnace, but simply hold what we have until the combustion of the carbon in the clay is completed.

The front of my furnace being air-tight, I reduce the amount of fuel put into the furnace and allow the air to pass into the kiln through the air-ducts into the furnace, and thus hasten the burning of the carbon in the clay and also the oxidizing of the sulfur and iron therein. Having thus oxidized the clay or replaced the impurities with oxygen, we are now ready to change from an oxidizing to a reducing heat. In the old method of firing this is done by banking up the mouth of the furnace with coal in such a way as to exclude the air, except what passes through the bank of coal. This is both expensive and detrimental, as it interferes with combustion, as the carbon dioxid passes from the furnace into the kiln and coming in contact with the contents of the kiln discolors and otherwise damages the same. With my invention the banking of the furnace is not necessary, the process of firing being the same as heretofore described.

In order to change from an oxidizing to a reducing heat, I reduce the amount of atmospheric air entering the furnace through the air-ducts with the dampers 43, as shown in Fig. 3. The dampers are inserted into the



slots on the ends of the boxes 42, thus reducing the mouths of the air-ducts, so as to admit only sufficient air to support combustion until all the elements in the clay are  
5 firmly united or vitrified.

Having described my invention, what I claim is—

1. In a furnace, an ash-pit arch, means for regulating the admission of air through the  
10 same, a combustion-chamber arch at the rear of the first arch, a fuel-feeding opening above the first arch and in front of the second arch, means for closing said opening, and a zigzag hot-air flue on each side of the fur-  
15 nace and over the roof thereof, one flue opening through the roof into the forward portion of the chamber and the other through the roof into the rear portion thereof, the walls of the chamber being uninterrupted.

20 2. In a furnace, an arched combustion-chamber, a zigzag flue on each side thereof and over the roof, the passages from one horizontal passage to another being formed by the upper surface of the arch and a notch in  
25 the edge of the brick separating said horizontal passages.

3. In a furnace, means for closing the front of the furnace to the ingress of air, zigzag flues in each side wall for heating air, and flues leading the air from the first-named  
30 flues through the roof into both the front and the rear portions of the furnace-chamber the roof of the furnace being uninterrupted from front to rear.

4. In a furnace, a plurality of air-heating  
35 flues in the walls thereof, means for conducting the air in one flue through the roof only to the front portion of the furnace-chamber, and means for conducting the air in another flue through the roof only to the rear por-  
40 tion of said chamber the roof of the furnace being uninterrupted from front to rear.

5. In a furnace, a zigzag air-passage in the wall thereof, the vertical connection between  
45 consecutive legs of the passage being formed of bricks having notches therein.

Signed at Pittsburg, Pennsylvania, this  
20th day of January, 1905.

JAMES M. McCLAVE.

Witnesses:

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A. M. STEEN.