No. 741,630. PATENTED OCT. 20, 1903.

H. W. CROFT.

BRICK DRYING FLOOR.

APPLICATION FILED AUG. 8, 1902.

NO MODEL.

Fig. 1

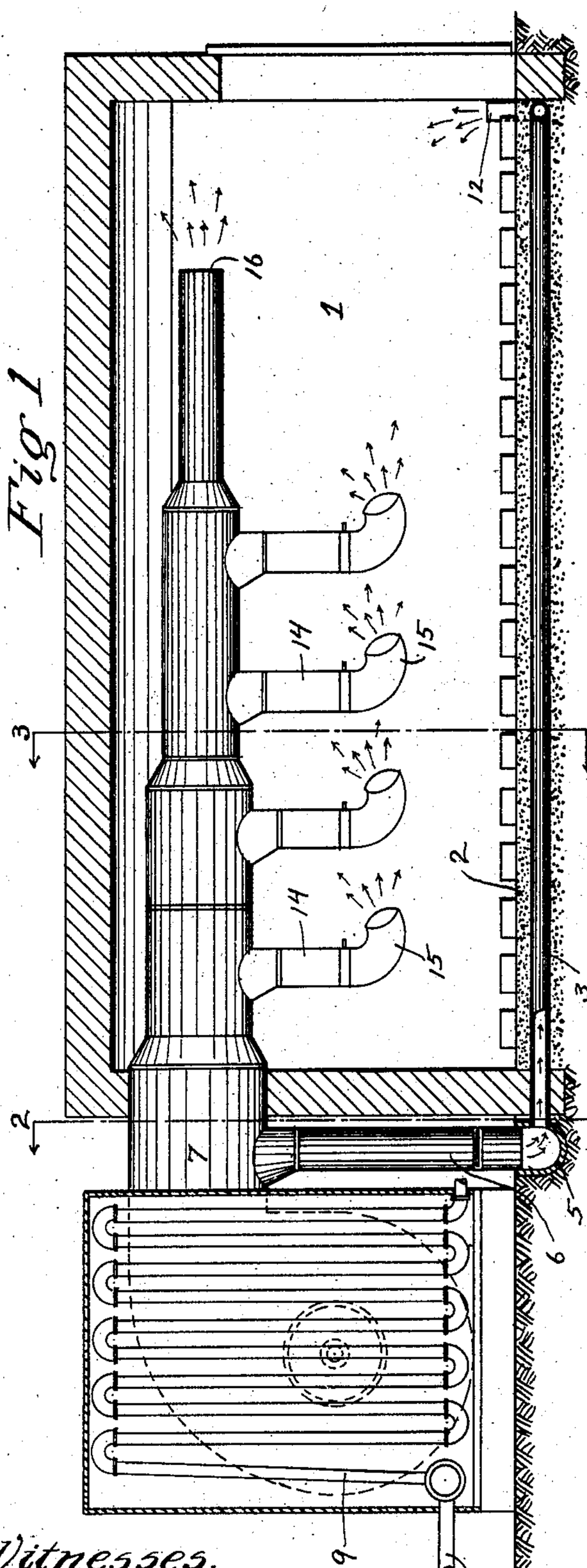

Fig. 3

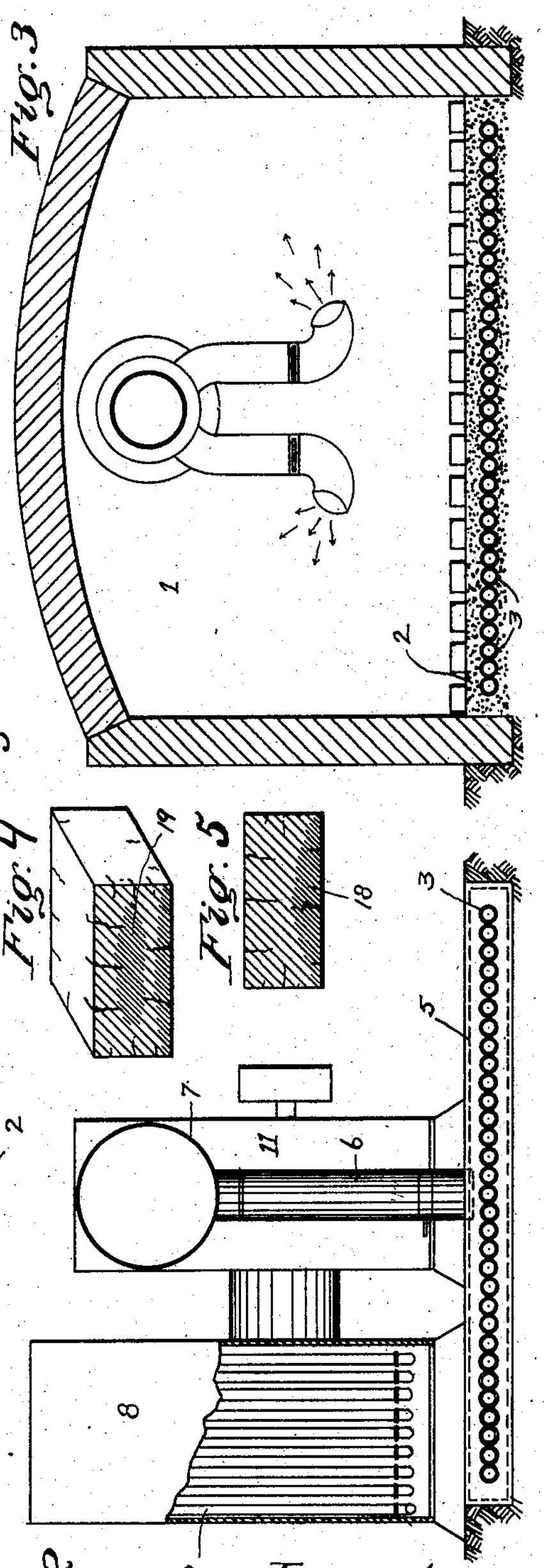

Fig. 4

Fig. 5

Fig. 2

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No. 741,630. Patented October 20, 1903.

UNITED STATES PATENT OFFICE.

HARRY W. CROFT, OF PITTSBURG, PENNSYLVANIA.

BRICK-DRYING FLOOR.

SPECIFICATION forming part of Letters Patent No. 741,630, dated October 20, 1903.

Application filed August 8, 1902. Serial No. 118,878. (No model.)

To all whom it may concern:

Be it known that I, HARRY W. CROFT, a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Brick-Drying Floors; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to apparatus for drying bricks preparatory to burning.

The object of my invention is to provide apparatus for drying brick whereby the tendency of the brick to crack during the drying process is entirely or largely overcome, thus producing a stronger and more lasting brick and in the case of fire-brick making it possible to use a smaller proportion of bonding material in conjunction with the refractory material.

My apparatus is of especial value in the manufacture of fire-brick; but it is equally as well adapted for the manufacture of brick of any kind or description.

In the manufacture of fire-brick it is customary to grind the material, add water, and temper the mass by various methods, and then it is molded into the desired shape, after which the molded brick are partially dried, then pressed, and finally are thoroughly dried preparatory to burning. The first drying is accomplished by laying the brick singly on a hot floor heated by fire-flues or steam-pipes laid therein. The floor is heated as highly as possible, the temperature varying from 150° to 200° Fahrenheit, so that the preliminary drying of the brick is accomplished in from two to five hours. The floor only is heated, so that the temperature at the floor is materially higher than the air in the chamber just above the same. This preliminary drying removes only a part of the moisture in the brick, the latter being left in such condition that they will not crumble or break in pressing. After being pressed the brick are again dried by being either piled from three to six high on a part of the hot floor, above described, and dried by the heat from the latter, or they are laid singly on pallets placed on cars and run into tunnels and there dried either by hot steam-pipes running underneath the cars or by a hot blast of air forced in at one part of the tunnel and taken out at another. The temperature during this second drying step is also practically as high as can be obtained, and it is customary to subject the brick to this temperature about twenty-four hours, so as to thoroughly dry out the same preparatory to burning.

The principal objection to the above method is that the brick are dried too rapidly, so that the exposed surfaces thereof, and especially the corners, become fixed or rigid, while the interior and bottom are still wet. As a consequence the surfaces and corners shrink more rapidly than the interior, thus producing cracks in the corners and surfaces of the brick, and when the moisture afterward leaves the interior the latter shrinks away from the rigid exterior crust, thus forming innumerable small cracks all through the body of the brick. The surface cracks usually extend into the brick for about one-half inch and can be readily detected. The cracks formed in the preliminary drying are to some extent obliterated in the pressing, so that they may no longer be visible, but the material being drier in the cracks than elsewhere does not firmly unite or knit, so that the cracks reappear after the second drying or burning. They destroy the adhesiveness of the mass, so that after the brick are burned instead of having a clear metallic ring they will have a dull lifeless sound, similar to that of cracked earthenware. As a consequence of these cracks a very large number of broken bricks or "bats" are usually produced, and even those that do not break when used as refractory linings for furnaces instead of wearing away uniformly chip or break away, and the life thereof is very much shorter than that of a brick free from cracks. In order to overcome this defect, it has been customary to use quite a large percentage of adhesive clay with the refractory material, thus increasing the bonding strength of the brick. This, however, results in reducing the refractory character of the brick.

The object of my invention is to provide apparatus which will so dry the brick that the cracking thereof at the surface and corners and throughout the body thereof is entirely or largely avoided, thus making it pos-

sible to use a smaller percentage of adhesive material and correspondingly increasing the refractory character of the brick and producing a brick which in use will wear away gradually and not chip or crack off.

In the accompanying drawings, Figure 1 is a longitudinal section through my improved apparatus. Fig. 2 is an end view of the heating apparatus, the same being partly in section. Fig. 3 is a transverse view on the line 3 3, Fig. 1. Fig. 4 is a section through a brick after the preliminary drying according to the old method, and Fig. 5 is a section of brick after the second drying according to the old method.

My apparatus is constructed so as to dry the brick by subjecting them to a moderate heat and uniformly on all faces thereof. Any suitable apparatus for accomplishing this result may be employed. In the drawings I have shown a heating-chamber 1, provided with a floor 2, of porous material, preferably furnace-slag concrete. This floor is heated to a moderate temperature by any desired means—such, for instance, as hot-air flues 3 laid therein. These flues may be of any desired construction, but preferably are ordinary terra-cotta drain-tiles from three to four inches in diameter and laid in the furnace-slag concrete. The latter is first ground and mixed with water and then filled in underneath, around, and above the flues, and the top thereof presents a smooth firm surface which cannot be readily disturbed or disfigured. It is, however, quite porous, so that the moisture of the brick will be absorbed thereby. These flues may receive their heat from any suitable source, and I have shown one end thereof connected to a header 5, which latter is connected, by means of a flue 6, to a larger flue 7, the latter being connected to an air-heating chamber 8. The air in the chamber 8 may be heated to a moderate temperature by any desirable or convenient means, and I have shown for this purpose a coil 9, which has connected thereto a pipe 10, leading from the exhaust of a steam-engine or the like. The air is drawn through the chamber 8 by means of a fan 11 at such a rate that it will be maintained at a moderate temperature somewhat above 75° to 100° Fahrenheit and is forced by the fan into the flue 7 and from there passes, by means of the flue 6, to the header 5 and through the flues 3, embedded in the floor of the heating-chamber. The farther ends of the flues 3 communicate with the chamber 1 by means of the short sections of pipe 12. The flue 7 is projected into the heating-chamber 1, as shown, and at intervals has connected thereto depending pipes 14, which project downwardly and have their lower ends bent and directed somewhat upwardly, as at 15, so that the hot air coming therefrom will not be projected against the brick lying on the floor of the chamber. The flue 7 decreases in size, as shown, and its outer end is open, as at 16. The decrease in size of the flue 7 will insure the heat being about equally distributed through the various pipes 14 and the outlet 16, so that all portions of the chamber will receive approximately the same amount of heat.

It is essential with my invention to maintain a moderate and uniform temperature in the heating-chamber and floor, and this can be attained best by connecting to the air-flues some form of hot-air heating apparatus, as distinguished from fire-flues. With the latter the flame and waste products of combustion necessarily pass through the flues, so that the temperature is substantially the same as that of the flame. With my apparatus no flame or waste products of combustion or the like are mingled with the air passing through the flues, and consequently the temperature of the air can be accurately regulated and a very moderate temperature maintained.

By the terms "hot-air heater" or "hot-air heating apparatus" as used in the claims I do not intend to include fire-flues, but only apparatus whereby air is heated and introduced into the flues unmixed with the flame, steam, or other medium used for heating the air.

In Figs. 4 and 5 are shown sections of brick illustrating the defects occurring with the old drying apparatus. When the brick first come from the molds, they are necessarily very wet, and when laid on the hot floor of the old apparatus the intense heat rising from the floor quickly draws the moisture from the exposed surfaces, and particularly from the corners, of the brick, while the moisture from the lower portion of the brick, being unable to escape as rapidly as drawn out by the intense heat employed, collects underneath the brick, so that the lower part of the brick remains in a wet or moist condition, as indicated by the heavy shading at 18, Fig. 4, while the exposed surfaces, and especially the corners, of the brick will be full of minute cracks, as shown, there being a tendency especially to form about three large cracks on the upper surface, which extend down into the brick a considerable distance. This preliminary drying, as above stated, is not continued sufficiently long to thoroughly dry the brick, as the latter must be left sufficiently plastic to stand the pressing operation. During the pressing operation the wet or soggy portion at the bottom of the brick to some extent disappears, as the moisture scatters or becomes dispersed throughout the body of the brick. The pressure exerted on the brick during the pressing closes up the cracks in the brick, so that they are not so easily visible; but as the clay is somewhat drier in the cracks than elsewhere it is too dry to unite or knit together even under very great pressure, so that these cracks open up again more or less either in the drying-tunnel or when stacked on the floor three to six high

for complete drying preparatory to burning. In the second drying operation the brick are somewhat dry and are piled upon the floor from three to six high and are again subjected to the high temperature described. In this second drying the effect is considerably different from that in the preliminary drying, for the reason that the brick contain an appreciably less amount of moisture, so that the collection of the latter underneath the brick does not occur. As a consequence the under surface is dried very quickly and baked into a hard crust before the middle and upper portions are dried. The violent heat rising from the floor draws the moisture from the corners and exposed surfaces so rapidly that these also become baked, while the center of the brick still remains damp or moist, as shown by the heavy shading 19 in Fig. 5. When the interior afterward dries, it shrinks away from the fixed exterior crust, and this causes numerous small cracks to be formed throughout the body of the brick. The cracks are usually much more marked on the surface next to the floor and also much more marked in the tiers or layers nearest the floor, this being due to the fact that the temperature in the chamber decreases appreciably as the distance from the floor increases. Most of the broken bricks or bats come from the two layers nearest the floor.

In the use of my improved apparatus the wet brick after being molded are placed singly upon the floor of the chamber. Both the floor of the chamber and the air in the chamber itself are heated to approximately the same moderate temperature, from about 75° to 100° Fahrenheit, so that all surfaces of the brick are exposed to this uniform moderate temperature, and the moisture in the wet brick is absorbed or drawn out of the brick uniformly on all faces thereof and at such a slow rate that the moisture in the interior of the brick will have an opportunity to pass out before the exterior of the brick has become hard or baked. The blast-furnace slag comprising the floor is sufficiently porous to absorb the moisture from the lower face of the brick in a gradual and uniform manner and at about the same rate that it is being drawn from the brick, so that the wet or soggy under surface of the old method is avoided. As a consequence the shrinkage of the brick is uniform throughout and the cracks resulting in the old apparatus are absent. The preliminary drying at this moderate temperature is continued for about twenty-four hours, as compared to from two to five hours with the old apparatus. After the brick have been tempered as described at the uniform low temperature they are pressed in any suitable press and piled from three to six or eight high on the floor and allowed to remain until thoroughly dry, the drying again taking place slowly under the moderate and uniform temperature described and avoiding the severe heat of the hot blast or the concentrated heat of the drying-tunnel under the old processes and requiring three days instead of one day, as under the old methods. The result, however, is a brick which is free from cracks and which, therefore, is much stronger and has much greater wearing qualities than the old brick. Furthermore, it is possible to use a much smaller proportion of plastic or bonding clay in proportion to the refractory clays or flints. It has been proved by actual test that under my process brick containing ten per cent. of plastic or bonding clay are equal in strength, bond, and resistance to abrasion to brick made under the old method and containing twenty-five per cent. of plastic or bonding clay. The brick under my method, therefore, can be made of a much greater refractory character, and the number of broken bricks or bats, which are a dead loss, is very largely reduced. The moderate temperature employed does not evaporate the moisture from the surfaces of the brick any more rapidly than it can be supplied by capillary attraction from the interior thereof. As a consequence the brick will dry uniformly throughout. Furthermore, the moderate temperature enables a more uniform heat to be maintained in all parts of the chamber. These drying-chambers necessarily are very long, and a high temperature introduced in the flues underneath the floor will drop materially before it has traversed the entire length thereof, so that there will be very appreciable differences in temperature at the two ends of the floor. With a moderate temperature employed such marked differences do not exist. The use of hot air in the heating-flues is also advantageous, especially when used in terra-cotta flues, such as shown. The hot air has a very strong affinity for the moisture, being a dry heat, as distinguished from the wet heat of steam, and it will therefore draw the moisture from the under side of the brick through the porous floor and flues instead of causing the moisture to form a puddle and simmer, as is the case with a very hot non-porous floor or one heated by a moist heat, such as steam.

While my invention has been described particularly for use in the manufacture of fire-brick, it will be understood that it is equally as well adapted for the manufacture of ordinary clay building-brick or, in fact, for brick, blocks, or tiles of any kind or description.

What I claim is—

1. Brick-drying apparatus comprising a chamber provided with a porous floor, porous heating-flues laid therein, a flue leading into the chamber above the floor, and hot-air heating apparatus connected to said flues.

2. Brick-drying apparatus comprising a

chamber having a floor of porous material, heating-flues laid therein, a heating-flue projecting into the chamber above the floor, and hot-air heating apparatus connected to said flues.

3. Brick-drying apparatus comprising a heating-chamber, heating-flues laid in the floor thereof, a heating-flue projecting into the chamber above the floor, an air-heating chamber connected to said flues, and a steam-coil located in said air-heating chamber.

In testimony whereof I, the said HARRY W. CROFT, have hereunto set my hand.

HARRY W. CROFT.

Witnesses:
A. M. STEEN,
ROBT. D. TOTTEN.