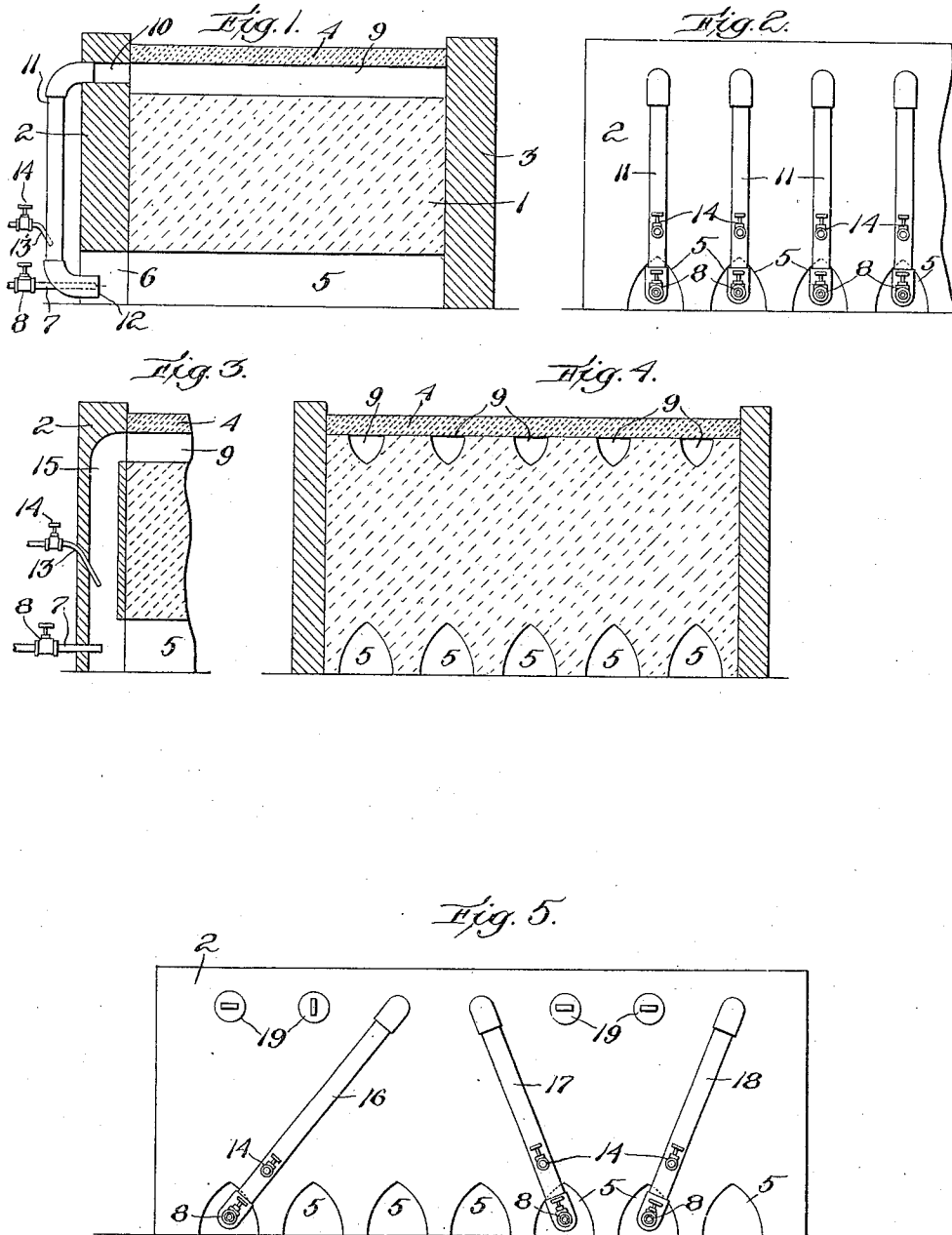


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BRICK KILN AND PROCESS OF BURNING BRICKS.
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UNITED STATES PATENT OFFICE.

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BRICK-KILN AND PROCESS OF BURNING BRICKS.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, WILLIAM H. FRANCIS, a citizen of the United States, residing at Cherryvale, in the county of Montgomery and State of Kansas, have invented an Improvement in Brick-Kilns and Processes of Burning Bricks, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention is a method of and apparatus for burning bricks (which term I use generically to include the application of heat in the manufacture of ceramic material for the production of what are sometimes called broadly, burnt clay products), and has for its primary objects the economy of fuel and more uniform heating and burning of the bricks, whereby not only is much fuel saved, but a considerable portion of the loss of bricks by uneven and improper burning is eliminated.

Explaining my invention more particularly in connection with an up-draft kiln, I provide openings in the form of ditches or valleys across the top of the stack of green bricks between the latter and the usual splatten or platted layer of bricks or other draft-preventing material, said openings being preferably directly above the fuel arches which are commonly provided across the bottom of the kiln beneath the stacked green bricks. In connection with these stacks provided with top ditches or valleys and with the bottom arches, I provide connecting flues, either permanently in the kiln or removably mounted in connection therewith, whereby a more or less complete and continuous circulation of air is provided through the separate portions of the burning bricks. Preferably also in connection with these flues I provide means for introducing more or less steam and also promoting more or less forced draft therein. In operation the circulation is not only maintained much more rapid and complete than in the ordinary manufacture of bricks, but the volume is very largely increased and the localizing and distribution of the heat throughout all portions of the stack of burning bricks is rendered highly effective and is moreover subject to the accurate control of the operator.

My invention will be more fully explained and the advantages thereof pointed out more at length in the course of the following de-

scription taken in connection with the accompanying drawings, in which I have illustrated a preferred embodiment of the invention as applied to up-draft kilns.

In the drawings, Figure 1 is a transverse vertical sectional view of a kiln embodying one form of my apparatus; Fig. 2 is a fragmentary view thereof in side elevation looking toward Fig. 1 from the left; Fig. 3 is a fragmentary view similar to Fig. 1 showing a modified construction, Fig. 4 is a central longitudinal view of the kiln; and Fig. 5 is a view similar to Fig. 2 showing a further adaptation of my invention.

Referring to the drawings, in which it will be understood that I have not undertaken to go into all the well known constructional details of brick kilns but have confined the drawings to those features which are necessary to an understanding of my invention and which constitute the apparatus portion of my invention, a stack 1 of green bricks is shown as in proper place between the usual side walls 2, 3, of a common form of up-draft kiln. A splatten 4 is provided above the stack of bricks and beneath the same or in the lower portion of the stack, usual fire arches 5 are provided, communicating with openings 6 in the adjacent side wall 2 through which I have herein shown the fire as delivered from oil burner nozzles 7 controlled by valves 8. I have shown this form of fuel supply as convenient for purposes of description, but do not limit my invention in any way thereto. In the upper portion of the stack and preferably at the very top thereof, I build or form openings, herein shown as ditches or valleys 9, preferably extending transversely of the stack and preferably corresponding in number to the arches and located directly above the same. As shown in Figs. 1 and 2, I provide in the wall 2 in alinement with these ditches or valleys transverse openings 10 and at the outer end of these openings I connect pipes 11 which terminate at their lower ends 12 in the openings 6 or arches 5. Preferably the fuel delivery nozzles or burners 7 pass into the lower ends 12 of the pipes and terminate within the same for the double purpose of creating draft and mixing more effectually with the current of air passing through the pipes 11. Also preferably means is provided for delivering a jet of steam into the pipe 11 at some point back from its outlet, said means being herein

shown as consisting of a nozzle 13 regulated by a controlling valve 14, said nozzle being deflected downwardly into the pipe 11 just back of its lower end. Preferably a single pipe 11 and the adjuncts just explained are provided to connect each valley vertically with the fire arch or fuel supply opening immediately below, as clearly shown in Fig. 2.

Instead of providing the independent pipes, corresponding flues 15 may be built in the side wall 2, as shown in Fig. 3. My invention may be still further amplified with corresponding advantages by providing removable connections, preferably pipes, as shown at 16, 17 and 18 in Fig. 5. Certain of the openings or valleys may be covered by caps 19 and various lengths of pipes provided so as to connect different arches and valleys diagonally or in such order as may be required throughout the kiln, this provision enabling the operator to direct special heat to special portions of the kiln and to smother or modify the heat at other portions which possibly are being overheated. In other words, this provision makes it possible to regulate the heat to a nicety in different parts of the kiln while yet having the advantage of the free circulation, great volume, etc., of my method as will now be explained more at length.

Having built up the bricks in the kiln in the manner above explained, the splatten is then put on the kiln over the whole top the same as usual. The ditches or valleys can be of any width or depth desired, according to the special exigencies of any particular plant, it being remembered that it is not desirable to decrease the amount of the brick any more than possible and yet they should be of sufficient size and number to promote the circulation and to localize the heat to the desired extent. The pipes, when removable, are sealed tightly into the valleys with mud, in the manner frequently employed by brick makers in other relations. As soon as the fires are lighted, the gas pressure flame exerts sufficient driving impulse at the lower ends of the pipes to start the circulation, thereby energizing the heat which would otherwise simply circulate in well known manner through the stack of bricks up to the splatten and more or less through the latter, so that instead of having a sluggish circulation and simply wriggling out through the crevices of the splatten, the heat now circulates back through the pipes (or wall flues, Fig. 3) into the fire arches again, where it is mingled with the new fire being delivered thereto from the oil burner nozzles 7 and again driven forcibly through the stack of bricks. It is to be noted that the waste heat or products of combustion delivered through the pipes 11 are used for circulation and preferably not at all for new

flame. The oil or gas from the pipes 7 produces the flame and constitutes the fuel supply, and the waste heat is returned to the kiln, not at a point prior to the flame (so as to mix with and thereby constitute a part of the fuel, as in a usual mixing valve or Bunsen burner), but at a point where the flame has already taken place, but yet sufficiently near to the flame to get the influence of its rapid movement and preferably to envelop or mingle directly with the new volume of heat or flame being thus introduced. An amount of the products of combustion or gases approximately equal to the amount of new fire or flame thus introduced, escapes through the splatten. Fresh air is used exclusively for combustion (as is common and well-known with usual oil burners, typified at 7), and the gases from pipes 11 are used solely for volume and circulation. They may be introduced wholly above the burner, as in Fig. 3, or around the burner, as in Figs. 1, 2 and 5. In the case of coal fuel they would be introduced above the fire and not as a part of the draft supply.

In carrying out my method in its preferred and most complete manner, I do not plat the splatten air tight at the start but leave it somewhat open, preferably confining its open character to a strip longitudinally through the center, *i. e.*, transversely of the valleys 9. Also to still further improve the fuel saving and heat distribution I introduce more or less steam through the steam nozzles 13. The steam is not only hot and thereby contributes its heat to the flow of gases through the pipes or flues, but it has beneficial results in tempering the heat so that better burning effects are produced. Also the steam jet coöperates with the pressure of the natural gas or vaporized oil delivered through the fuel pipes to assist the circulation. The valleys tend to draw the heat and circulation toward them, thereby compelling the proper distribution of the latter from one end of the kiln to the other. The looseness of the splatten down the center tends to prevent the too rapid passage of the heat and the general arrangement produces a circulation whereby the waste heat is returned again substantially to the same body of bricks through which it first circulated, by means of the combustion energy its course being subject however to slight variation within the discretion of the operator and according to the needs of the particular material and special kiln in which my method is being employed.

While my invention is adapted to all kinds of fuel it is especially serviceable with gas burning, which requires particularly full circulation with large volume of air in addition to the relatively small amount of mixed air and gas which directly supplies the flame. Accordingly I consider as among

the principal advantages of my present invention the fact that it supplies this large volume of circulation without the necessity of introducing any cold air and without any tendency of pulling in cold air throughout the splatten, all of said large circulation being supplied through the waste heat.

It has been commonly considered necessary, in burning ceramic material, to introduce a large amount of cold air to play on the material first touched by the fire, and to depend upon this cold air for supplying a volume of circulation, the aim having been thus to heat as little as possible the material which is first reached by the fire, and to heat as much as possible the material which the fire touches later. I have discovered that if only the volume is sufficient and possesses sufficient speed, very little or no cold air need be admitted to keep the nearest ware from scorching, and that said volume may best be provided by means of the waste heat (preferably from the same kiln) which, when moved along at said high speed and added to the new flame or new heat (which is continuously supplied the same as before) gives not only the protection required for the ware, but even burning, and surprising efficiency and economy. The special means and manner of distributing and maintaining the vertical areas of heat circulation is of value irrespective of whether used in connection with this other main feature of my invention or not. I mention this in order that neither may be considered as necessarily limited by the other (except in certain of the claims). I supply all of the fresh outside air to the burner that is required for the gas or that the oil will take, and the combustion is immediate and practically complete. In other words, I make no alteration in the fuel burner, supply, and combustion, which all remain exactly as before, but I feed the waste heat directly into the arch (not through the mixer of the oil burner, nor through the grate of the coal fire) so that the volume and speed are secured through the medium of this hot air and thereby practically all the cold air is eliminated. By supplying the products of combustion for the volume of circulation, and by keeping them at a relatively high speed of continuous circulation, I get rid of all the use of cold air.

It will be understood furthermore that a large circulation is necessary in burning bricks, because, for proper burning, a much greater heat is applied to the bricks than they can absorb and if this heat stays in one locality in the kiln as dead heat, it soon brings the bricks in that locality to a destructive temperature, whereas if this great heat is applied to the bricks throughout the kiln as a hot blast only, or in other words is prevented from settling or stopping at any

particular point, the burning of the bricks becomes more uniform because of this distribution of the heat over the entire kiln and there are less rejects or improperly burned bricks. For the preliminary water-smoking and in fact the initial burning of the stack, the splatten will ordinarily be first set loose together, to be tightened as the volume of fire is increased, and preferably also sealed tight with mud (except preferably as stated through the center).

It will be understood that while I have herein set forth my mechanism in its preferred embodiment, many changes in form, arrangement and combination of parts may be resorted to without departing from the spirit and scope of the invention in this particular, and the same explanation applies to a limited extent to the method, certain steps thereof being capable of advantageous use without the others, all as will be more apparent from the appended claims.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method, consisting of providing, in connection with a fuel flame for burning bricks, a large circulation-volume of hot air at relatively high speed, and delivering the latter under continuous forward movement adjacent and in the direction of the fuel flame but separate from and wholly distinct from the source of flame.

2. The method, consisting of providing, in connection with a fuel flame for burning bricks, a separate large circulation-volume of hot air, delivering said hot air into the course of the flame to be thereby accelerated in speed, and thence propelling said large volume of hot air and flame under continuous, rapid movement to and through the bricks.

3. The method, consisting of providing, in connection with an already mixed fuel flame from an oil or gas burner for burning bricks, a separate, large circulation-volume of hot air, and delivering said hot air at substantially continuous speed into the path of the flame from said burner and subsequent to the ignition mixture.

4. The method, consisting of providing, in connection with a fuel flame from an oil or gas burner for burning bricks, a separate, large circulation-volume of hot air, and delivering said hot air at relatively high and continuous speed about the nozzle of said burner, whereby said speed is accelerated by the jet of flame from the burner.

5. The method, consisting of providing, in connection with a fuel flame for burning bricks, a large circulation-volume of hot air at relatively high speed, and delivering the latter adjacent the fuel flame but separate from and wholly distinct from the source of flame, then passing the hot air and products of

combustion through the bricks and returning the same as the supply of hot air for said circulation-volume.

6. The method, consisting of producing
5 approximately vertical areas of continuous heat circulation throughout a series of substantially contiguous portions of a stack of bricks being treated, and maintaining said circulation by returning to the primary
10 source of heat a large volume of heat from the previously delivered and otherwise waste heat.

7. The method, consisting of producing approximately vertical areas of continuous
15 heat circulation throughout a series of substantially contiguous portions of a stack of bricks being treated, maintaining said circulation by returning to the primary source of heat a large volume of heat from the previously delivered and otherwise waste heat,
20 and introducing in the course of said circulation a restricted amount of steam.

8. The method, consisting of producing approximately vertical areas of continuous
25 heat circulation throughout a series of substantially contiguous portions of a stack of bricks being treated, maintaining said circulation by returning to the primary source of heat a large volume of heat from the previously delivered and otherwise waste heat,
30 and increasing said circulation by steam jets delivered in the direction of heat movement.

9. The method, consisting of supplying approximately vertical areas of continuous
35 heat circulation throughout a series of substantially contiguous portions of a stack of bricks being treated, maintaining said circulation by returning to the primary source of heat a large volume of heat from the previously delivered and otherwise waste heat,
40 and checking said circulation appreciably along the top center of the stack of bricks.

10. The method, consisting of supplying approximately vertical areas of continuous
45 heat circulation throughout a series of substantially contiguous portions of a stack of bricks being treated, maintaining said circulation by returning to the primary source of heat a large volume of heat from the previously delivered and otherwise waste heat,
50 and shifting said areas as required to equalize or localize the heat for particular localities in the kiln.

11. The method, consisting of supplying
55 the main volume of gaseous matter required for the heat distribution in a kiln by returning with forced draft the products of combustion from said kiln to the fire delivery point of the same kiln in front of the flame and subsequent to the ignition mixture.
60

12. The method, consisting of supplying the main volume of gaseous matter required for the heat distribution in a kiln by delivering a large volume of the gaseous prod-

ucts of combustion to the primary source of heat near the fire delivery point, and supplying fresh air exclusively for the purpose of fuel combustion.

13. In a brick-kiln, means to provide a fresh fuel flame for burning bricks, a source
70 of hot air, means to deliver a large circulation-volume of said hot air near the flame delivery point and separate from the combustion, and means for propelling the fresh fuel flame and the said separate circulation-
75 volume at high speed to and through the bricks.

14. In a brick-kiln, means to provide a fresh fuel flame for burning bricks, a source
80 of hot air, means to deliver a large circulation-volume of said hot air near the flame delivery point and separate from the combustion, means for propelling the fresh fuel flame and the said separate circulation-volume at high speed to and through the bricks,
85 and means for maintaining the circulation thereof through the stack of bricks continuous.

15. In a brick-kiln, means to provide a fresh fuel flame for burning bricks, a source
90 of hot air, means to deliver a large circulation-volume of said hot air near the flame delivery point and separate from the combustion, means for propelling the fresh fuel flame and the said separate circulation-volume at high speed to and through the bricks,
95 and means for maintaining the circulation thereof through the stack of bricks continuous, said last mentioned means including means to return the waste gases to said delivery means to constitute the said circulation-volume.
100

16. In a brick-kiln, means to provide a fresh fuel flame for burning bricks, a source
105 of hot air, means to deliver a large circulation-volume of said hot air near the flame delivery point and separate from the combustion, means for propelling the fresh fuel flame and the said separate circulation-volume at high speed to and through the bricks,
110 and means for maintaining the circulation thereof through the stack of bricks continuous, said last mentioned means including a plurality of separate passageways for the return of the waste gases from the far
115 side of the kiln back to said delivering means.

17. In a brick kiln, means for producing a circulation of heat in a series of approximately vertical areas throughout the stack
120 of burning bricks, and means for returning from said individual areas portions of the heating medium and mingling the same in large volume with the primary source of heat, to be again delivered through the kiln.
125

18. In a brick kiln, means for producing a circulation of heat in a series of approximately vertical areas throughout the stack

of burning bricks, means for returning from said individual areas portions of the heating medium and mingling the same in large volume with the primary source of heat, to be again delivered through the kiln, and means for introducing steam into the heating medium.

19. In a brick kiln, means for producing a circulation of heat in a series of approximately vertical areas throughout the stack of burning bricks, means for returning from said individual areas portions of the heating medium and mingling the same in large volume with the primary source of heat, to be again delivered through the kiln, and steam-injecting means for accelerating the circulation.

20. In a brick kiln, means for producing a circulation of heat in a series of approximately vertical areas throughout the stack of burning bricks, and means for returning from said individual areas portions of the heating medium and mingling the same in large volume with the primary source of heat, to be again delivered through the kiln, including means to vary the course or

courses of the circulation to different portions of the bricks being burned.

21. A brick kiln, provided with a primary source of heat, and having a series of passages between its top and bottom affording communication for the passage of waste heat from the burning bricks to said primary source of heat, and steam jets opening into said passages in a direction to accelerate the flow of said waste heat and introduce steam thereto.

22. In a brick kiln, a series of passages for waste heat from the burning bricks to the primary source of heat, and means for delivering the primary source of heat under pressure in an outward direction at the outlet ends of said passages whereby the circulation is accelerated and the waste heat is forcibly mixed with the fresh heat.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

WILLIAM H. FRANCIS.

Witnesses:

W. G. BUCKLES,
H. A. WILTSE.