3 Sheets—Sheet 1.

H. GUTHRIE.

Machinery for Manufacturing Bricks, &c.

No. 215,606. **Patented May 20, 1879.**

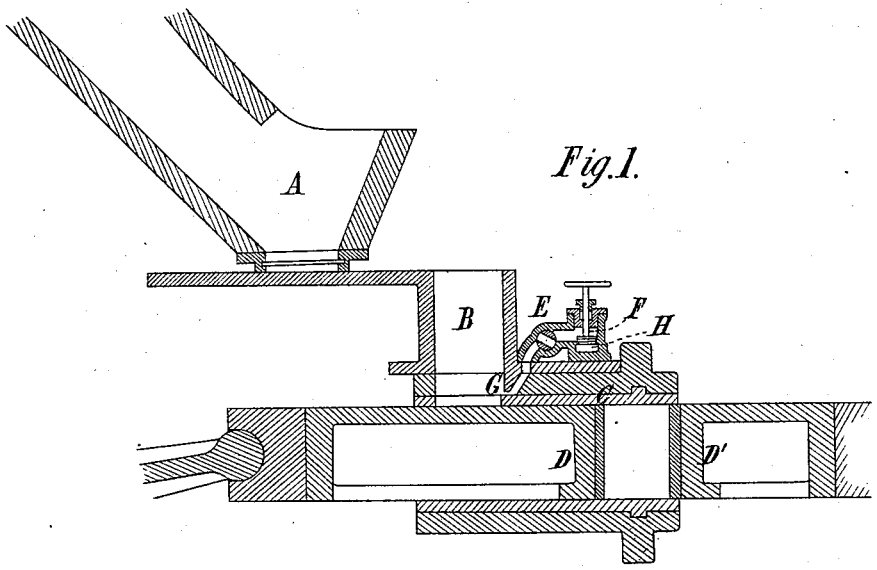


Fig. 1.

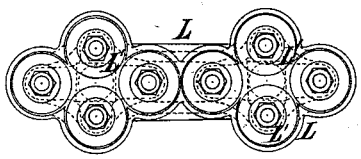
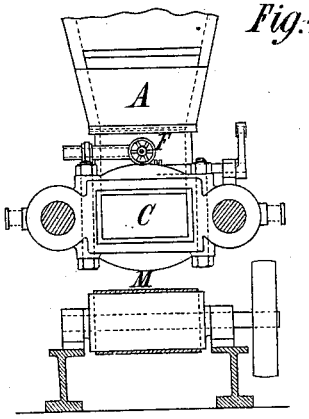


Fig. 4.



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3 Sheets—Sheet 2.

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Fig. 2.

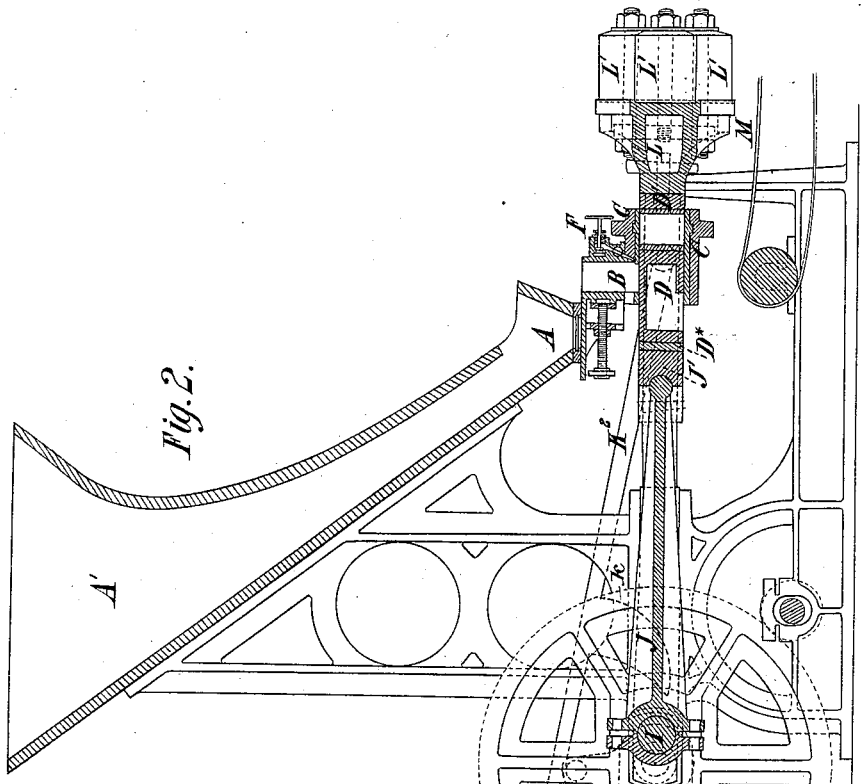

Fig. 3.

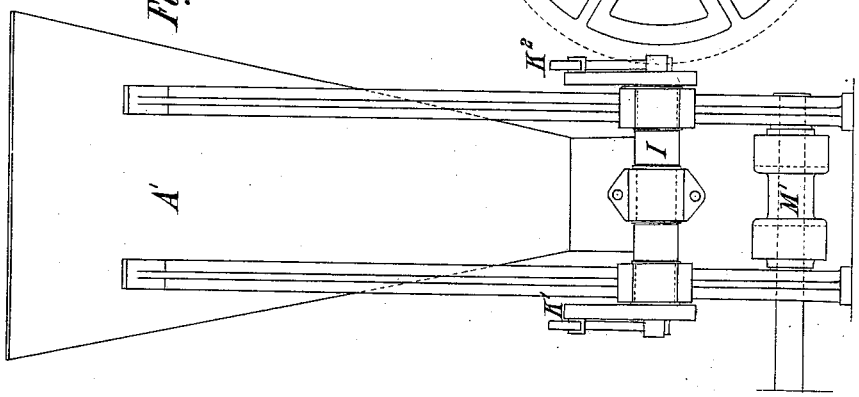

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Fig. 7.

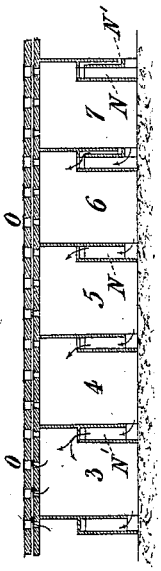


Fig. 6.

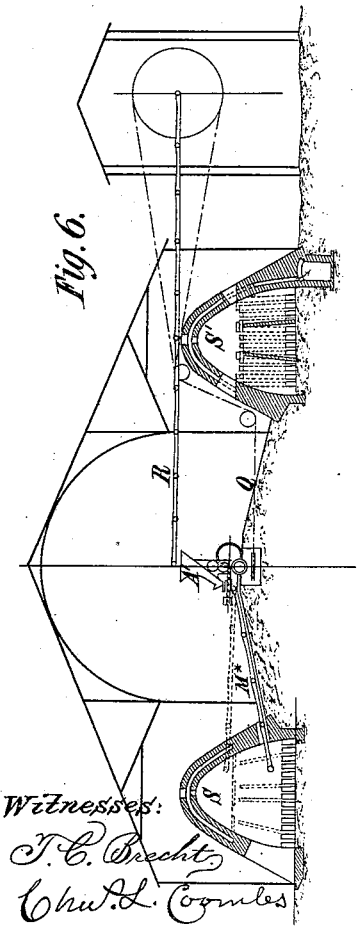
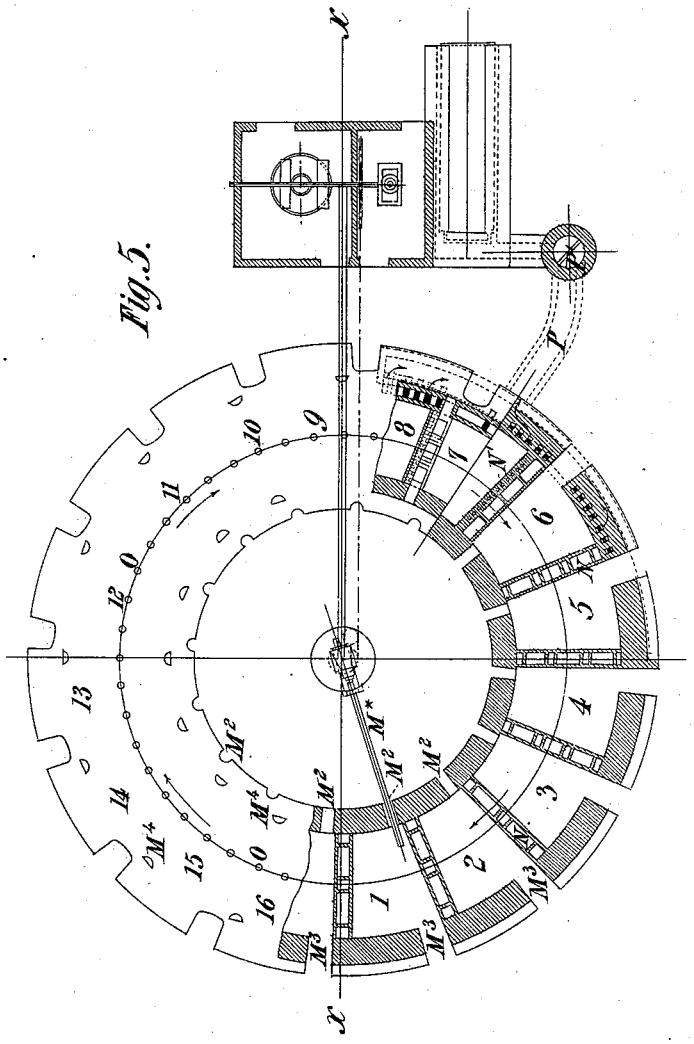


Fig. 5.



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UNITED STATES PATENT OFFICE.

HERBERT GUTHRIE, OF MANCHESTER, ENGLAND.

IMPROVEMENT IN MACHINERY FOR MANUFACTURING BRICKS, &c.

Specification forming part of Letters Patent No. **215,606**, dated May 20, 1879; application filed September 12, 1878; patented in England, September 16, 1876, January 9, 1877, and January 10, 1877.

To all whom it may concern:

Be it known that I, HERBERT GUTHRIE, of Manchester, England, civil engineer, have invented new and useful Improvements in Machinery and Apparatus for the Manufacture of Bricks and similar articles, and for analogous purposes, of which the following is a specification, reference being had to the accompanying drawings.

This invention relates to improvements in pressing-machines generally used for solidifying granular substances, such as fire-clay, coal-dust, or any other material of like nature, for making bricks, tiles, fuel-blocks, or similar matters; also to kilns and other apparatus for use in connection with such machines.

One part of this invention consists in an arrangement whereby steam is used to displace the air naturally in the interstices of the loose granular substances which this machine is designed to operate upon. A cavity or steam-passage is formed along one or more sides of the measuring-box, as close to the bottom as possible, so that the steam when admitted permeates through the measured charge and drives out the air before it. Then as soon as sufficient time has elapsed for the thorough impregnation of the charge, it is at once dropped into the mold and pressure quickly applied, the supply of steam then being shut off and the charge being inclosed in the mold. The steam so inclosed, along with the charge, condenses and tends to form a vacuum; but, owing to a heavy pressure being at this moment applied, no real vacuum is created, as the particles are closed against each other as fast as the steam condenses, thus forming a compact mass, which has no tendency to split on leaving the mold by the tension of compressed air in its interior.

The steam is admitted intermittently by a valve worked from another part of the machine by an ordinary lever or tappet motion, and so arranged that it will open while the measuring-box is still closed at the bottom, but only so short a time before its opening as may be necessary to allow of the steam getting through the charge with as little as possible escaping beyond. A second valve is provided in the steam-way, so as to enable the quantity of steam to be regulated, as well as the duration of injection.

In the improved form of the machine constructed according to my invention I fix one die to a spring-bed, the other, by a connecting-rod, to the main crank of the machine, and the mold, by side rods, to crank-tappets on the same shaft as the main crank, and from which shaft all the movements of the dies and mold are directly obtained.

The moving die is worked directly from the crank by a compression connecting-rod. The mold is worked directly from the crank-tappet by side rods with hooks at their crank ends, formed in such a way that they catch the crank-pins as they come round, and are drawn by them to the end of the stroke. At this point they are stopped in their downward movement by dropping upon a projecting part of the shaft carried through the crank-tappets for that purpose. Being thus stopped they become free of the crank-pins, and are at liberty to traverse back at a quick rate by the tappets coming in contact with projections upon them, causing the mold to be closed by sliding onto the standing die ready for another charge. While standing thus the moving die retires sufficiently to allow of the impregnated charge in the measuring-box to drop down into the mold, and then comes back and squeezes the mass together till it is within a short distance of its maximum durations. The side rods are extended a little beyond the mold end, and so arranged as to come in contact with a stop fixed to the frame of the machine, under which stop they may slip free so soon as sufficiently depressed, and the crank-pin raising the other end, at which point the mold becomes liberated and allows the mold to slide by the friction of the charge in the direction of the standing die, thus making the corners of that face sound and strong. At the point of maximum pressure the side rods drop into gear with the crank-pins and cause the mold to be drawn off while the pressure remains upon the substance molded, part of which pressure is maintained by the spring-bed, causing the fixed die to follow the pressing-die any desired extent, and allowing time for the mold being

drawn quite free before the pressure is removed and the molded article allowed to drop upon the traveling band beneath.

The object of this peculiar arrangement is to solidify the corners and smooth the surface by a slight movement backward and forward during heavy pressure; also to maintain a pressure a sufficient length of time after the removal of the mold to allow of any residue of air in the interstices of the material to escape without splitting.

The aforesaid spring-bed to which the fixed die is attached is a further improvement, and serves a double purpose: first, that of receiving the whole of the pressure of the machine, and preventing breakage or undue strain that may come upon it; and, secondly, by giving part of the spring-bed a longer range, so that a portion of the pressure is maintained upon the material pressed till the mold is quite clear of it, and the whole of its sides exposed to the atmosphere, thus preventing splitting, as aforesaid, from internal pressure of air, and giving it ample time to disperse before being relieved.

Should this machine be required to work plastic material, a pugging-cylinder may be substituted for the hopper and measuring-box, the quantity of material being regulated by the die cutting off the supply at the proper time, which may be effected by the adjustment of the mold and its gearing.

A further improvement is in the kiln proposed to be worked in connection with my machine.

The said kiln, as shown in accompanying drawings, is of a circular form, and consists of a number of chambers working into each other in an endless series. The whole of the space encompassed by this series of chambers I devote entirely to the aforesaid machine and gearing immediately connected therewith, clearing out the usual flues and chimney occupying it, the *modus operandi* of which I more fully describe in three divisions, as follows:

First, in the center of this kiln I place a vertical shaft, driven under ground by a cord or strap, and round this shaft I place a turn-table for carrying the aforesaid or any other machine. The vertical shaft, coming up through this turn-table, is connected by suitable gearing to the machine, and communicates the necessary motion to it. On the cord or strap wheel, at the bottom of the vertical shaft, I attach a self-acting clutch, so arranged that should any undue strain come upon the machinery above it will at once be thrown out of gear, and all breakage prevented.

The machine being thus placed can be turned in any required direction at the pleasure of the operator, delivering its goods at any part of the kiln. It is supplied with material by an overhead traveling band leading direct from the grinding apparatus to the hopper, and is relieved of the goods manufactured by another traveling band leading into the kiln through a small opening in the side wall left for that purpose. These goods being dry, or nearly so, are at once set for burning, neither the material nor the finished articles being touched by hand from the time the raw stuff is fed into the grinding apparatus to the delivering of the finished goods inside the kilns, thus saving all the manual and horse labor in carrying the raw materials to and from the different sheds, machines, and kilns, and dispensing with the bogies, tramways, or barrows necessary therefor, as well as reducing the breakage and distorted goods to a minimum.

Secondly, I improve upon the general construction of the chambers of the kiln and the flues connected therewith. The form of arch I prefer is the inverted catenary or arch of equilibrium, that being the one least liable to alter by variation of temperature and requiring the least amount of backing or other support. The abutments are formed in the ground, and are the foundations of the kiln. They are spread out into wide footings, and give the whole structure the necessary stability for resisting any unequal strain likely to come upon the arches. From these abutments or foundations the thickness upward is tapered till a point is reached about half-way to the crown, forming a springing, from which the independent arches rise. At one part of this work small flues are formed, running from the springing to the foundations, and forming a communication between a space above the inner arch and a collecting-flue below; otherwise the work up to this point is solid. This connection, however, may be made direct to the chimney without descending by placing the chimney close to the kiln-arch. Above this two separate arches are formed, one above the other, a space of only a few inches being left between them, serving the purpose of a collecting-flue as well as a cavity, into which the lower arch can expand without coming in contact with the outer arch and causing it to crack, and by means of the air-space preventing much radiation of heat. The first-mentioned use of this cavity is made by forming small apertures at or near the crown of the inner arch, through which the waste gases and steam ascend from the chamber of goods drying below, these apertures being opened or plugged up, at pleasure, with tiles or stoppers, openings also being left in the outer arch, opposite to these, to allow of the stoppers being attended to, and for the purpose of inspection, these outer openings being stopped in a similar manner.

Thirdly, I improve upon the system of firing and working the kiln by forming gas-producers in the divisions of the chambers. These gas-producers are small cavities open at the bottom to the chambers from which the draft is coming, and at the top to the chambers into which the draft is going, and have on one or more sides flues divided only by a thin wall, and open at the top and bottom similarly to

the producers. The producers and flues serve alike at the commencement of the operation, being mere passages through which the draft traverses on its way to the chimneys, and, like the goods in the adjoining chambers, collect heat from the waste gases passing through them. The system of collecting and dispersing heat being similar to the well-known Hoffman kiln, the gas-producers and adjoining flues are brought to a red heat before any firing is done in them, so that the fuel on being charged immediately ignites and distills over into the next chamber. These gas-producers are gradually filled up from the top, and are kept hot partly from their own combustion, working like an ordinary gas-producer, and partly by radiation from the adjoining flues, working like a retort.

The flues, as before stated, serve to heat the gas-producers by absorbing the heat from the hot air traversing them. This hot air, on reaching the top, mixes with the gas distilling from the producers, and both, being already very hot, combine and burn with great intensity. Thus all the advantages of the Hoffman kiln are retained, no heat whatever being lost except by radiation through the walls of the chambers, and this reduced to a minimum, while the finest goods may be burned without fear of stain from the fuel being mixed with them, as in the working of the kiln before named.

Fire-grates are not required, nor are any dampers required in hot places where they would be liable to damage or to get out of order, nor is any cold air admitted to the fires or chambers, as in the Ensor kiln.

The only dampers I use, besides the stoppers referred to, are one set placed across the top of the producers and flues of the chamber just being set, and which may be made of a few boards or sheets of iron, luted over with sand to prevent leakage of air.

In the drawings, Figure 1 is an enlarged section of one of the improvements of my machine constructed according to this invention, showing the arrangement for impregnating the charge with steam. Fig. 2 is a longitudinal section through the center of the machine. Fig. 3 is an end view, the spur-wheels not being shown. Fig. 4 is a cross-section taken in front of the mold, and the view above it shows the springs and the girder carrying them. Fig. 5 is a general plan of the works, showing the annular kiln with the machine in the center and the grinding-apparatus engine and boiler outside. Fig. 6 is a vertical section on the line *x x*. Fig. 7 is a circumferential section through the chambers.

In Fig. 1, A is the bottom of the main hopper. B is the measuring-box. (The adjusting-screw is not shown.) C is the mold. D D′ are the dies or presses. E is the valve for regulating the period of injection. F is the valve for regulating the quantity injected. G is the lip for protecting the orifice from being choked, and H is the steam-passage leading from the boiler.

In Figs. 2, 3, 4, I is the actuating-shaft, from which all the motions are obtained, as before described. J is the connecting-rod, giving motion directly to the moving die. K^1 is the crank-tappet, governing the motion of the side rods K^2 to the mold C and measuring-box B. The connecting-rod is held at the sliding end by a slide, J′, upon which the moving die D is secured, a loose plate, D*, being placed between them, so as to allow of the easy removal of that die. L is the girder carrying the springs L′ L′ and the stationary die D′. The mold is made in halves for the easy removal of the lining.

The measuring-box is steam-jacketed, and has one adjustable side, regulated by a screw and hand-wheel.

The steam-injector is regulated by the small valve F, or by a small slide-valve. A′ is the hopper, under which the measuring-box slides to receive its charge. A small slide or damper is placed at the bottom of this hopper for the purpose of stopping the feed at any moment. A is the bottom of the main hopper, or a small supplementary hopper placed immediately over the damper and below the main hopper, having an opening for the purpose of watching the supply and clearing any obstruction. M is the kiln-band, onto which the goods are delivered and carried to the kiln, and which is driven by an ordinary wheel and strap from the pinion-shaft M^1. The double effect of the springs is obtained by forming collars on some of the bolts holding them, these collars being on the opposite side of the girder to the springs, so as to allow of their being tightened upon till they are almost home. Beyond these collars the bolts are prolonged, and run through holes in the standing frame, with nuts on the ends, an amount of length for sliding being left equal to the full range of the other springs minus the range remaining in these after being screwed up, as before stated, so that all the springs are brought up home at the same time, each bearing their share of the ultimate pressure. These other springs are held by ordinary bolts fixed at one end to the standing frame, and running through the girder like the first-mentioned bolts, but not having collars, so that the full pressure of these springs may be used, or any part thereof, by regulating the position of their nuts, the range being regulated by the position of the nuts on the sliding length of the first-mentioned bolts. Other springs may be used than those shown as long as they are arranged in similar manner.

I wish it to be understood that I do not intend to limit myself to the details given so long as the particular character of these inventions be retained. I may multiply the number of molds to any extent in one machine by placing them side by side, or by dividing them into sets, and placing them round

the same actuating-shaft, or any other similar variation. Or I may use any form of mold necessary for making bull-nosed, side-wedge molded, or other shaped bricks; square, octagonal, and such like form for tiles, embossed or plain, round or square; for the dry Portland-cement process, and artificial fuel, or, indeed, any other form desired. I also may vary the general form of the kiln, and, instead of making it annular, form it in two parallel lines, joined at the ends, or one single lever, making it semi-continuous, so long as the principle of construction and working is maintained.

In Figs. 5, 6, 7, I have shown the said machine placed opposite chamber No. 1, which is supposed to be filling. The band M*, upon which the finished articles are transferred from the machine to the kiln, is led right into the chamber, and, if necessary, right across the chamber, to any desired extent, the adjustment being made by a telescopic frame-work. The draft of the kiln is worked in the direction of the arrows, No. 2 chamber being set, say, yesterday, No. 3 the day before, and so on throughout the series.

M^2 are the small doors through which the band is put, and which are stopped up with large tiles or a few bricks as soon as the chamber is filled. The large doors by which the chambers are emptied are marked M^3; the small doors through which the fuel is fed are marked M^4.

The gas-producers are marked N and the flues N^1, different arrangements being shown, any of which may be adopted, according to the goods to be burned. The small apertures for examination are marked O, the stoppers for which are shown in Fig. 7.

The main flue to the chimney is marked P, and traverses part of the circumference of the kiln, collecting the waste gases from the cavity between the arches by numerous small flues in the outer wall, as shown by the arrows, and leading them to the large chimney P′.

The sectional part of Fig. 5 is taken at different levels, chambers 1 to 6 being taken about three feet above the floor-line, chambers 7 and 8 being taken at the height of the feeding-doors and above the gas-producers, showing the surface upon which the dampers or boards are put.

The chamber 1, in Fig. 6, is shown in section at S on a line through the band and discharging doors. Q is the inner platform, raised and slightly conical, with the machine in the center over the pit in which the driving-gear is placed. The delivering-band in the said figure of the drawings is shown running through the small door formed for that purpose. The dotted lines above show another position of this band running through the feeding-door above, and is so placed when the chamber is nearly full to complete the filling at the top with as little handling as possible, the setter coming out at that door when finished and bringing the dampers or boards with him to place immediately on the producers of the next chamber; or a second set may have already been placed there.

The discharging-door and the band-door are both built up before the dampers are withdrawn, the setter having only to draw the dampers and place a large tile across the feeding-door as he comes out. This done, the band is placed in the next chamber, and the operation repeated. The long and short alternately-dotted line shows the cord or strap communicating motion from the engine to the machine, R being the overhead-band, leading the granulated material from the mill to the hopper of the machine. S′, Fig. 6, is a section through the gas-producers, between chambers 7 and 8, and through the feeding-doors, a small moving platform being placed opposite the doors then being fired, and shifted round as the firing is changed from one to another.

In Fig. 7 the division foward of chamber 3 shows a section through a flue between the gas-producers. A direct draft is not permitted to ascend from this flue, but is diverted over the gas-producers on either side by a covering placed a little above the side walls, as will be seen by the dotted lines in Fig. 6 at S, thus forcing an intimate combination of the gas and air. This covering also serves to prevent fuel dropping down the flues and stopping the airways. The other divisions are sections corresponding with the numbers and figures in the other views, and do not require further explanation, the form being slightly different, but the mode of working the same. In the chambers 2 and 3 the apertures in the crown of the arch are shown open, stoppers being removed in any number of chambers as may be found expedient.

What I claim is—

1. The method of preparing granular substances for compression herein described, the same consisting in forcing steam into such substances for the purpose of displacing air therefrom.

2. The combination, with the measuring-box, of the steam-pipe opening thereinto and the valves F and E, substantially as described, and for the purpose set forth.

3. The combination, with the measuring-box provided with the lip G, of the steamway extending obliquely behind said lip, substantially as described.

4. In a brick-machine, the combination of a stationary spring-die, a reciprocating mold, and a reciprocating die, substantially as described, and for the purpose set forth.

5. The combination of the dies D D′, mold C, rods K^2, having hooks on their ends and downward projections *k*, and the crank-tappets, substantially as described, and for the purpose set forth.

6. The combination, with the surrounding kiln, of the molding-machine mounted on a turn-table, and an endless belt or apron adapted

to communicate with the various subdivisions of the said kiln, substantially as described.

7. The combination, in a kiln, of a double arch, constructed as described, with a cavity or space between its walls communicating with the chimney, substantially as and for the purposes specified.

8. In combination with the chambers of the kiln, the gas-producers located between said chambers and adapted to operate substantially as described.

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