May 10, 1927. 1,627,841

C. DRESSLER

CONTINUOUS KILN AND DRIER

Filed Feb. 21, 1920 3 Sheets-Sheet 1

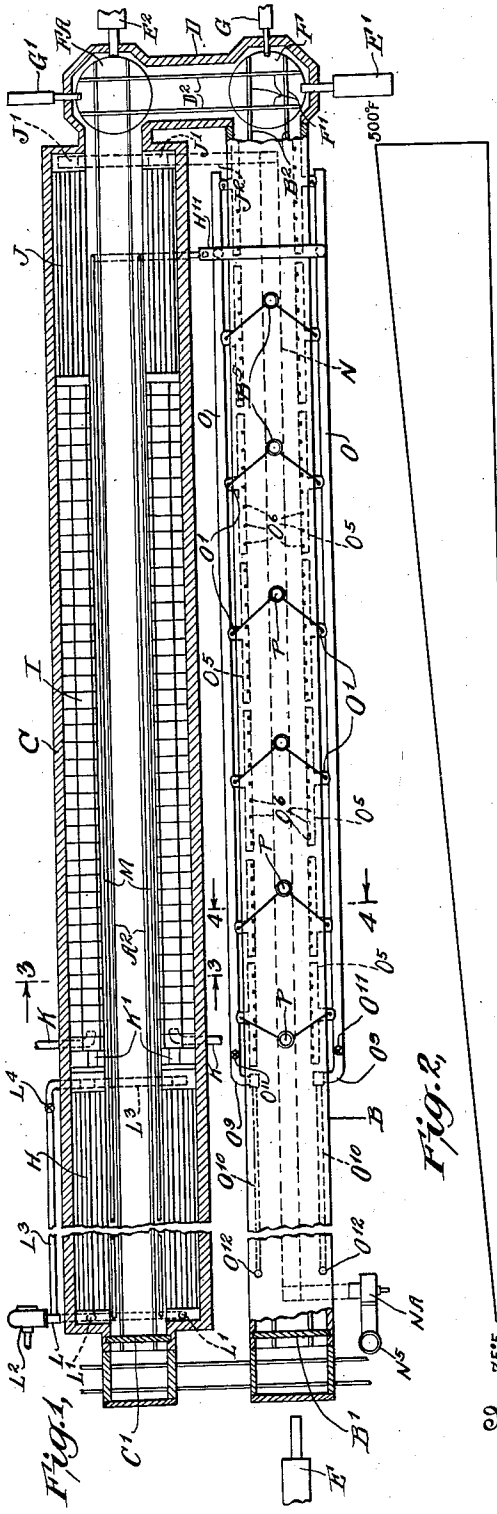


Fig. 1.

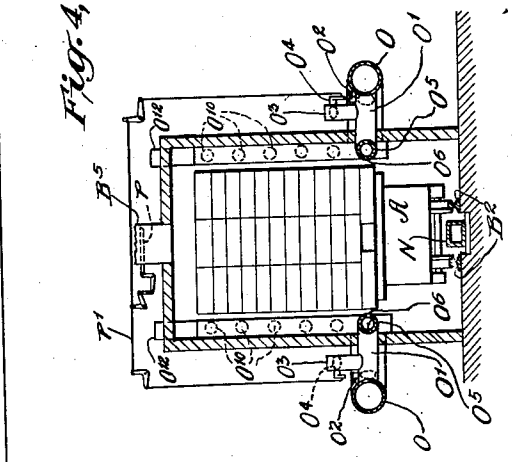


Fig. 4.

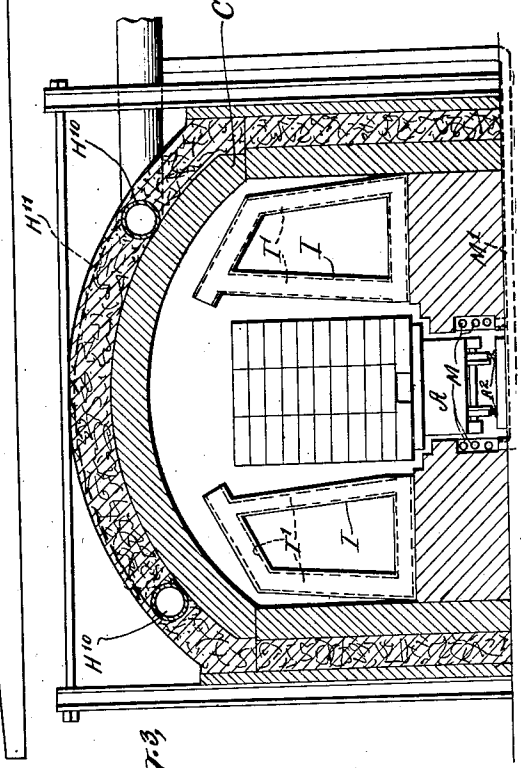


Fig. 3.

Fig. 2.

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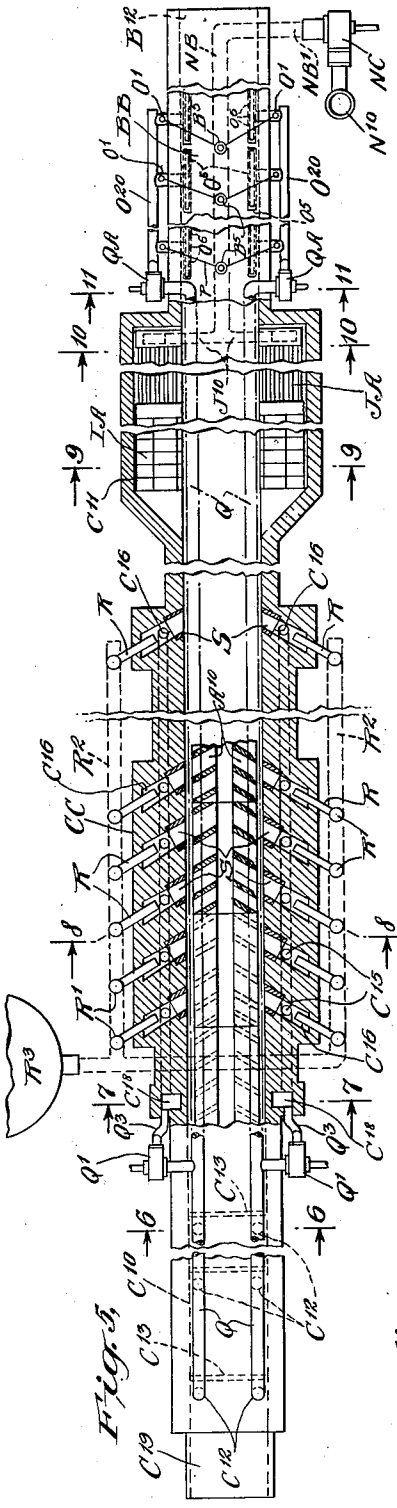


Fig. 5.

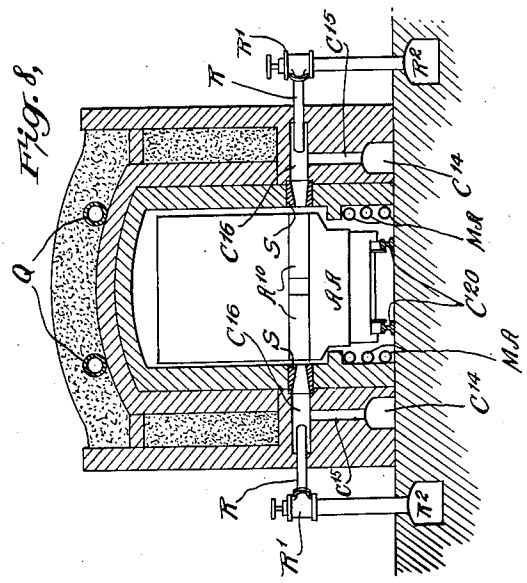


Fig. 8.

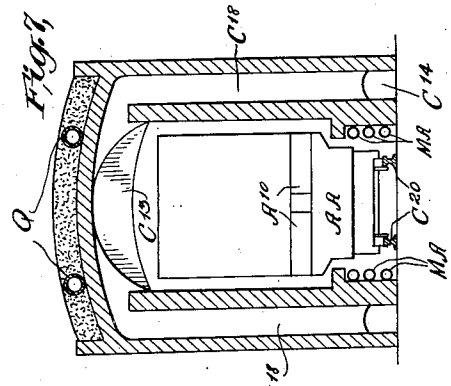


Fig. 7.

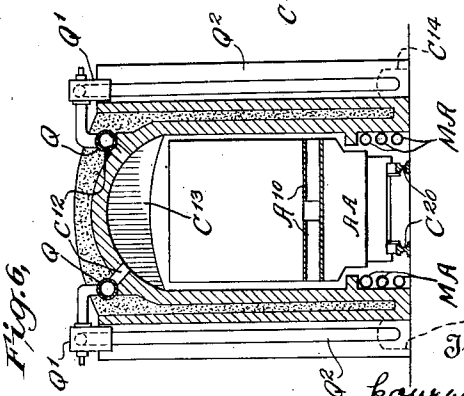


Fig. 6.

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CONTINUOUS KILN AND DRIER

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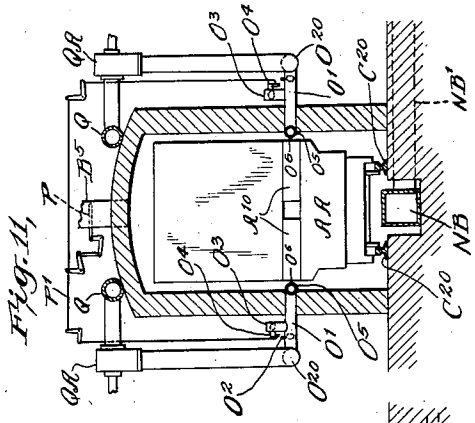


Fig. 11.

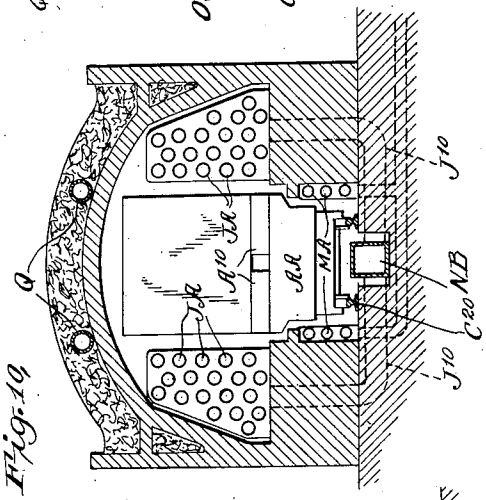


Fig. 10.

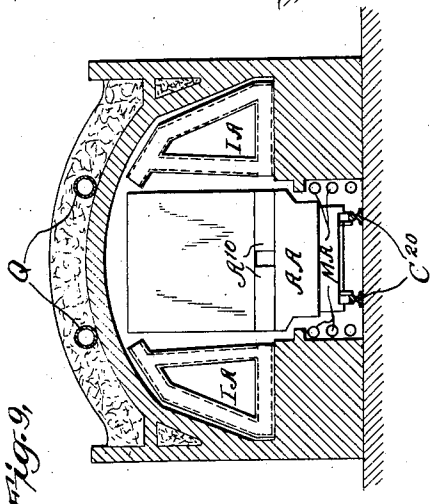


Fig. 9.

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UNITED STATES PATENT OFFICE.

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CONTINUOUS KILN AND DRIER.

Application filed February 21, 1920. Serial No. 360,505.

The primary object of my present invention is to provide a novel and effective combination of a continuous kiln with a drying chamber, and particularly with a continuous drying chamber, whereby brick or other material to be dried and then subjected to a temperature much higher than the drying temperature, may be passed first through the drying chamber and then through the kiln proper, and the necessary heat for the drying operation may be, in whole or in large part, waste heat from the kiln proper.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, and the advantages possessed by it, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred embodiments of my invention.

Of the drawings:

Fig. 1 is a diagrammatic plan with parts broken away and in section of a muffle heated kiln and drier;

Fig. 2 is a temperature or diagram chart showing the character of the temperature gradations which are desired in the driers;

Fig. 3 is a transverse section on the line 3—3 of Fig. 1;

Fig. 4 is a transverse section on the line 4—4 of Fig. 1;

Fig. 5 is a diagrammatic plan with parts broken away and in section of a combination open fire heated kiln and drier;

Figs. 6, 7, 8, 9, 10 and 11 are transverse sections taken on the lines 6—6, 7—7, 8—8, 9—9, 10—10 and 11—11 of Fig. 5.

In Figs. 1, 3 and 4 of the drawings, I have illustrated apparatus especially devised for drying and burning brick in which the brick are dried in an elongated drying chamber B and are then burned in an elongated muffle heated kiln C. The brick are carried through the drying chamber B and kiln C on cars A which enter the drying chamber B at one end of the latter past doors B^1, and pass through the chamber B on the track rails B^2 at the bottom of the latter. At the exit end of the drying chamber B, the latter is connected to the adjacent end of the kiln C, which in this form of my invention is arranged alongside the drying chamber, by a transverse covered passage D. The cars A, entered one at a time in the chamber B, are pushed into the latter by a car pusher E which may be of the usual form employed in pushing cars into and through tunnel kilns. At each operation of the pusher E, a car is pushed into the drying chamber, and the train of cars normally filling the chamber is advanced one car length. As each of these cars A is brought to the exit end of the chamber B it is engaged by a car puller G which centers it on a turntable F. The latter is provided with two sets of track rails F^1 which are arranged at right angles to one another so that one set may register with the track rails B^2 while the other set registers with the track rails D^2 of the chamber D. In consequence, when a car is centered on a turntable F and the latter is given one-fourth of a turn, the car may be pushed off the turntable on to the rails D^2 and the turntable is left in position to receive a subsequent car from the drying chamber B. The cars are pushed off the turntable F and through the chamber D by a pusher E^1. At the junction of the passage D with the adjacent end of the kiln C is located a turntable FA which may be identical in construction to the turntable F and has associated with it a car puller G^1 for drawing a car from the adjacent end of the passage D and centering it on the turntable FA, and a pusher E^2, by which, after a quarter turn of the turntable FA, the car may be pushed into the kiln C and at the same operation the train of cars normally filling the kiln C may be advanced one car length.

The kiln C shown in Figs. 1 and 3 is of the well-known Dressler tunnel kiln type shown for example in my prior Patents 1,023,628 and 1,170,428. The kiln comprises a cooling zone with cooling pipes H at the sides of the pathway for the goods, a hot zone with combustion chambers I at the sides of the goods pathway, and a heating-up zone at the end adjacent the turntable FA with pipes J at the sides of the goods pathway. The cooling fluid passing through the pipes H is air supplied by a fan or blower L^2 and a conduit L opening through ports L^1 to the headers into which the ends of the pipes H adjacent the exit end of the kiln are connected. A portion of the air passing through the pipes H is passed into combustion chamber I through ports K^1 and a portion of the air heated in the

pipes is passed to the drier through pipes H^{10} (see Fig. 3) resting upon the roof of, and extending longitudinally of the kiln C for a considerable portion of its length. The air supply ports K^1 and fuel gas supply connections K open into the combustion chambers I at the ends of the latter adjacent the exit end of the kiln. The combustion chambers I as shown are of the type commonly employed in Dressler tunnel kilns, the walls of each combustion chamber being formed of hollow tile. The passages I^1 in the combustion chamber walls are open ended so that the current of the kiln atmosphere may flow upward past the combustion chambers through these passages and then downward through the goods carrying space. The pipes J pass the products of combustion, delivered to them from the combustion chambers I, through ports J^1 and a transverse conduit J^2 to a conduit N running longitudinally of the drying chamber and shown as arranged between the track rails B^2 of the drying chamber. The conduit N may well be made of galvanized iron or other good heat conducting material. The products of combustion are drawn out of the conduit N and delivered to the atmosphere by an exhaust fan NA located adjacent the entrance end of the drying chamber B and serving to regulate the draft through the combustion chambers I and the pipes and conduit connections connecting these chambers to the exhaust fan NA.

To prevent overheating of the goods carrying cars A and the track rails for the latter, the usual cooling pipes M are arranged at the sides of the pathway for the cars through the high temperature portion of the kiln C. As shown, these pipes M are supplied with air by the blower L^2 through the conduit L^3 which is advantageously provided with a regulating valve L^4. The pipes H^{10} which, as before stated, rest upon the roof of the kiln C for the major portion of the length of the latter, may advantageously be buried in the kieselguhr or other heat insulating material covering the roof proper of the kiln. At their ends adjacent the transverse passage D, the two pipes H^{10} are connected to a conduit H^{11} which is connected in turn to suitably insulated hot air pipes O located at opposite sides of the drying chamber A. The outlet connection M^1 from the car cooling pipes M also delivers hot air into the conduit H^{11}.

The conduits O are provided with outlets O^1 opening into the interior of the drying chamber at intervals along the length of the major portion of the latter, except for a portion adjacent its inlet end. This last mentioned portion forms a mild warming or initial heating zone which is heated by the corresponding portion of the conduit N supplemented when necessary in the construction illustrated by the heating effect of a set of internal heating pipes O^{10}, at each side of the pathway for the goods, which receive air from the corresponding pipes O, each through a connection O^9 and in an amount determined by the setting of the damper O^{11}. The air passing through the pipes O^{10} ultimately passes to the atmosphere thru the outlets O^{12}. Each outlet O^1 to the interior of the drying chamber is preferably provided with a regulating damper O^2 and with an air inlet passage O^3 through which atmospheric air may be drawn into the drying chamber in amounts dependent on the setting of a damper O^4. To avoid concentrated jet deliveries of air to the drying chamber, each outlet O^1 is connected within the chamber to a corresponding distribution pipe O^5 which has discharge orifices O^6 distributed along its length. At intervals along the length of the hotter portion of the drying chamber B, the latter is provided with outlet openings B^5 for the moisture laden air. Advantageously, as shown, a themostat P is arranged in each of the outlets B^5. Each thermostat P operates thru suitable connections P^1, shown as comprising levers and links to control an adjacent pair of dampers O^4.

In the preferred mode of use of the apparatus shown in Figs. 1, 2, 3 and 4 the brick or other material to be dried are preferably heated in their passage thru the drying chamber B in a uniform manner as indicated by the temperature curve of Fig. 2, from the entrance atmospheric temperature of say 75° F., to an exit temperature of say 500° F. During the passage of the brick thru the initial heating-up zone of the drying chamber B, the brick are subjected to a gradual warming action attended with little drying, because the walls of the drying chamber fit closely around the sides of the goods as shown in Fig. 4, so that there is but small convection current or other circulation of the kiln atmosphere. With the slight air circulation in this portion of the drying chamber, its drying action is comparatively slight. This is important, as surface drying of the brick while their interiors are still cold inevitably results in considerable breakage or cracking of the brick.

As the brick pass through the section of the drying chamber into which the outlets O^1 from the pipes O discharge hot air, the brick or other material is heated both directly by the air thus admitted and also by the heat derived from the conduit N. The air passing upward through the drying chamber and to a certain extent longitudinally thereof from the pipes O to the outlets B^5 absorbs moisture from the brick. The extent of the drying action of this air is dependent both on the temperature of the air and on its vol-

ume. The volume of air is controlled in part, as is its temperature, by the setting of the dampers O^4 which are controlled by the thermostats P. Each of the latter opens and closes the dampers O^4 controlled by it, accordingly as the temperature to which the thermostat is exposed rises above, or falls below, a predetermined temperature. The desired heating and drying effect is one which will not only bring about the desired increase in temperature of the brick as indicated in the temperature chart, Fig. 2, but will insure the proper rate of drying. As the temperature of the brick rises and the drying operation progresses, the drying action may advantageously become more and more energetic. The control of the air supplied to the drying chamber described, obviously permits of any desired regulation of the heating and drying operation.

My present invention is not restricted to use in apparatus in which the kiln is a muffle heated kiln, and in Figs. 5 to 11, I have illustrated a plant especially devised for drying and burning brick in which the brick are burned in a kiln comprising an open fire heated high temperature zone. In this embodiment of my invention the drying chamber BB is in alignment with and forms a direct extension of the kiln CC, and the brick carrying cars AA enters the drying chamber BB at the entrance end B^{12} and passes first through the drying chamber and then through the kiln on track rails C^{20} which run from the entrance end of the drying chamber to the exit end C^{19} of the kiln. In passing through the final or cooling portion of the kiln chamber, the bricks are cooled by atmospheric air drawn in through the open end C^{19} of the kiln chamber and drawn off from the roof of the cooling zone section of the kiln at intervals along the length of the latter through outlet ports C^{12} which are connected to conduits Q supported on the roof of the kiln chamber and which supply air to the drying chamber BB as hereinafter described.

The portion of the kiln chamber above the pathway for the goods in the goods cooling chamber is divided into a series of compartments open at their lower ends by transverse partitions or barriers C^{13}. The partitions or barriers C^{13} extend into close proximity with the stack of brick on the cars AA. The one of these compartments closest to the furnace zone of the kiln is connected by passages C^{18} to tunnels or conduits C^{14} at the opposite sides of the kiln. Blowers Q^1 drawing air from the pipes Q blow the air thus drawn through pipes Q^2 and Q^3 into the adjacent ends of the conduits C^{14}. The jet of air discharged into the ends of the conduit C^{14} by the pipes Q^3 exert a suction effect which causes hot air to be drawn downward through the vertical passage C^{18} and delivered to the passages C^{14}. At intervals along the length of the high temperature zone of the kiln, burner chambers C^{16} are provided in the side walls of the kiln. These receive air from the passages C^{14} each through a corresponding branch supply passage C^{15}. Each chamber C^{16} receives fuel gas through a supply connection R controlled by a valve R^1 from a corresponding gas supply passage R^2, one at each side of the kiln.

The gas supply passages R^2 are connected to a gas supply source R^3 which may be a gas holder or a producer. Each burner chamber C^{16} opens to the interior of the kiln chamber through a burner nozzle S, advantageously formed of carborundum or other highly refractory material and tapered and disposed so as to direct the burning jet into the kiln chamber at the level of the passages A^{10} preferably formed at the tops of the cars AA and open at their upper side to the interstices in the stack of brick mounted on the cars. Advantageously, the passages A^{10} which may be formed in the permanent portions of the cars or in the brick stacks, are arranged herringbone fashion, with each passage parallel to the direction of the jets discharged by the corresponding burner nozzles S and inclined at an acute angle to the direction of travel of the cars.

In the high temperature zone of the kiln, along which the burner chambers C^{16} are located, the inner walls of the kiln chamber fit quite closely to the sides of the stacks of brick on the cars. The portion of the kiln chamber adjacent the drying chamber BB however is laterally enlarged to provide space for muffle chambers IA located at opposite sides of the pathway for the goods. These chambers IA are shown as similar in construction to the combustion chambers I previously described, and each is connected at its end adjacent to the drying chamber to a set of pipes JA. These pipes JA are connected at their ends adjacent the drying chamber by passages J^{10} to a conduit NB which runs along the bottom of the drying chamber BB between the track rails and is connected at the entrance end of the chamber BB by a transverse passage NB^1 to a fan NC delivering products of combustion to a stack N^{10}.

The drying chamber BB may be supplied with heated air in a manner exactly analogous to that in which the chamber B first described is supplied with hot air. The supply pipes O^{20} which correspond to the pipe O of the construction first described, are connected to the outlets of the fans QA which draw air from the pipes Q and also from the car cooling pipes MA. The pipes O^{20} discharge air into the drying chamber BB through outlets O^1 having controlling

dampers O^2 and cold air inlets O^3 controlled by dampers O^4 as in the construction first described. The dampers O^4 may be automatically adjusted as in the construction first described by the thermostats P located in the roof outlets B^5 of the drying chamber. The distribution pipes O^5 in this construction preferably have their discharge orifices O^6 inclined to the kiln axis as are the orifices.

It will be apparent to those skilled in the art that the same effective use is made, in the drier of the apparatus shown in Figs. 5 to 11, of the heat recovered in the kiln in cooling the brick and in cooling the brick carrying cars and trackway, and of the available heat in the products of combustion as in the construction first described. The provision of the chambers IA overcomes in part a characteristic disadvantage of a simple open fire heated kiln as compared with a muffle heated Dressler kiln, by insuring a more uniform and gradual heating up of the goods than is possible of attainment in the heating up section of a simple open fire heated kiln. The open ended passage I^1 in the chambers IA causes a direct and substantial flow of the kiln atmosphere upward thru these passages along the chambers IA with a return downward flow thru the pathway for the brick which minimizes differences in temperature between the upper and lower ends of the stacks of brick, which differences are very pronounced in the heating up zone of a simple open fire heated continuous kiln.

The carborundum burner nozzles S form effective and durable means for giving the desired velocity and direction to the burning jets entering the kiln chamber thru them. These parts and other novel features of the burning kiln C disclosed but not claimed herein are claimed in my application Serial No. 407,116 filed August 31, 1920, as a division of this application.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

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

1. Brick drying and heating apparatus comprising in combination, a fire heated tunnel kiln in which the brick are burned, and a drying chamber in which the brick are dried, means for utilizing products of combustion from the tunnel kiln in heating the drying chamber, means for cooling the brick and brick transporting means in the tunnel kiln by the use of air thereby heated and means for injecting the air thus heated into the drying chamber at intervals along the major portion of the length of the latter to supply heat thereto and to serve as a vehicle for carrying moisture away from the brick and out of the chamber.

2. The combination with a tunnel kiln having provisions for burning fuel in the kiln to heat a high temperature portion thereof and provisions for causing a stream of air to flow through the goods cooling section of the kiln to cool the goods and for causing a second stream of air to flow through a high temperature portion of the kiln to cool the goods transporting means, of a continuous drier having its exit end connected to the entrance end of the kiln, a heat radiating conduit in the drier, provisions for passing the products of combustion formed in heating the kiln, into said conduit, and provisions for injecting air from both of said streams into the drier at distributed points along the length of the latter.

3. In a continuous drier, the combination with an elongated chamber having an entrance portion restricted to minimize circulation of the drying chamber atmosphere about the goods in said portion, a heat radiating conduit, heating said portion of the chamber, means for injecting heated air into a subsequent portion of the drying chamber, and outlets from said subsequent portion of the drying chamber for moisture laden air.

4. In a continuous drier, the combination with an elongated kiln chamber, having an entrance portion restricted to minimize circulation of the drying chamber atmosphere about the goods in said portion, a heat radiating conduit heating said portion of the chamber, means for injecting heated air into a subsequent portion of the drying chamber, outlets from said subsequent portion of the drying chamber for moisture laden air, and thermostatic means responsive to the temperatures in each of said outlets, for regulating the amount of heated air injected into a preceding portion of the drier.

5. The combination with a continuous tunnel kiln comprising fuel burning provision for heating a high temperature portion of the kiln and means for creating a flow of air through a portion of the kiln adjacent its exit end to cool the goods passing through the last mentioned kiln portion, of a goods drier, means for passing a portion of the air constituting said flow of air to the fuel burning provisions and for passing the balance to said drier, and thermostatic means for mixing cold air with the last mentioned air.

6. In a continuous drier, the combination with an elongated drying chamber, of means

for injecting heated air into the drying chamber at intervals along the length of the latter and for regulating the temperature of the air injected comprising a supply conduit extending longitudinally of the drying chamber, connections between said conduit and chamber, said connections being provided with inlets for atmospheric air, and means regulating the influx of atmospheric air into said connections through said inlets.

7. In a continuous drier, the combination with an elongated drying chamber provided with outlets for moisture laden air distributed along its length, of means for injecting heated air into the drying chamber at intervals along the length of the latter and for regulating the temperature of the air injected, said means comprising a supply conduit extending longitudinally of the drying chamber, connections between said conduit and chamber distributed along the length of said chamber and each formed with an inlet for atmospheric air, dampers regulating the influx of atmospheric air into said connections through said inlets and thermostatic means responsive to the temperature in each of said outlets for regulating the adjustment of a corresponding one of said dampers.

Signed at New York in the county of New York and State of New York this 16th day of February, A. D. 1920.

CONRAD DRESSLER.