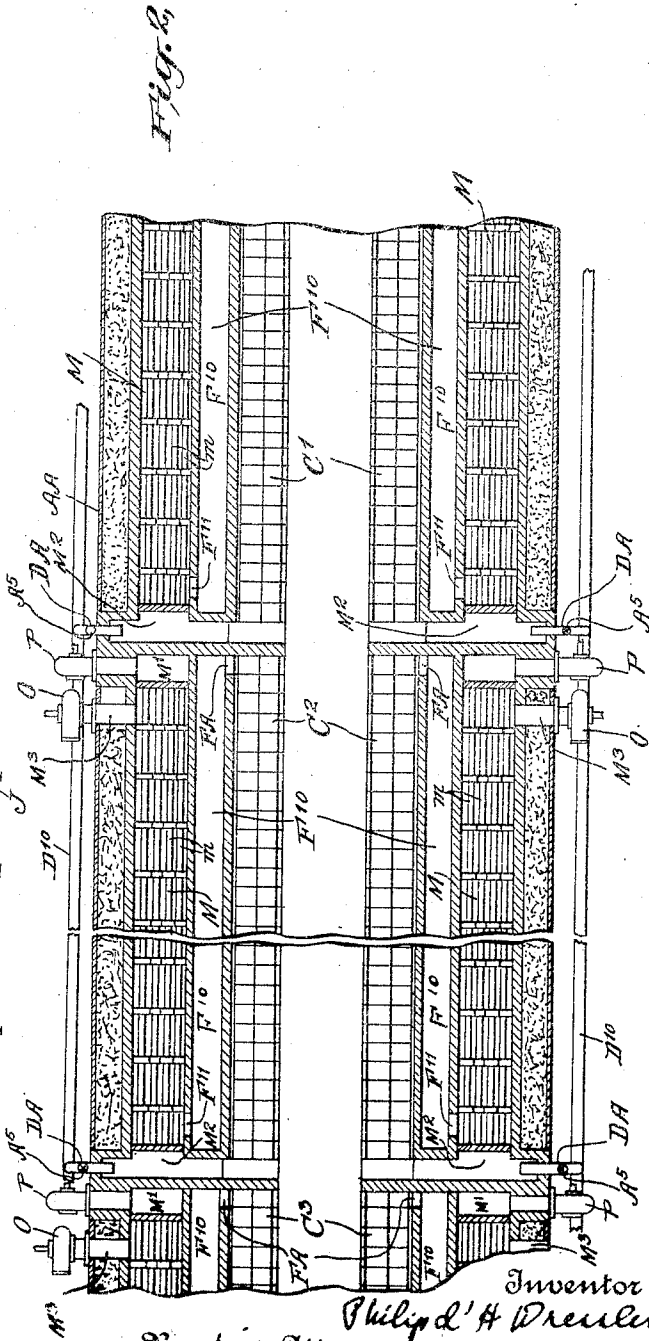
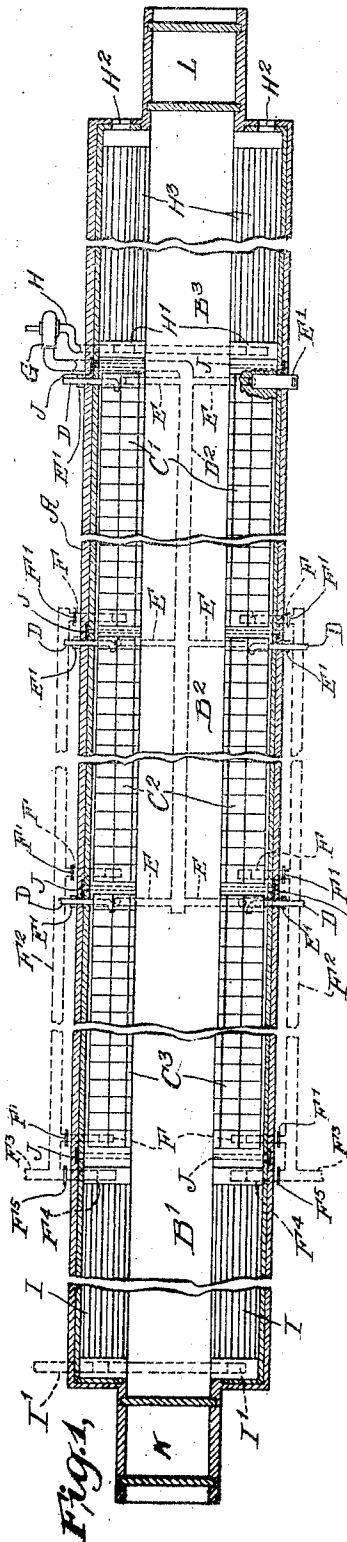


P. D'H. DRESSLER.
TUNNEL KILN WITH SECTIONAL COMBUSTION CHAMBERS.
APPLICATION FILED MAR. 27, 1920.

1,384,435.

Patented July 12, 1921.

2 SHEETS—SHEET 1.



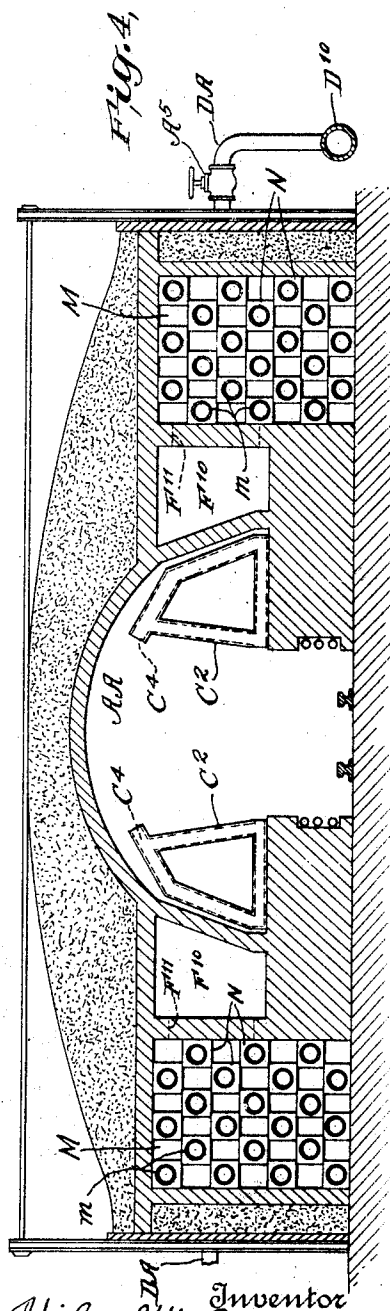
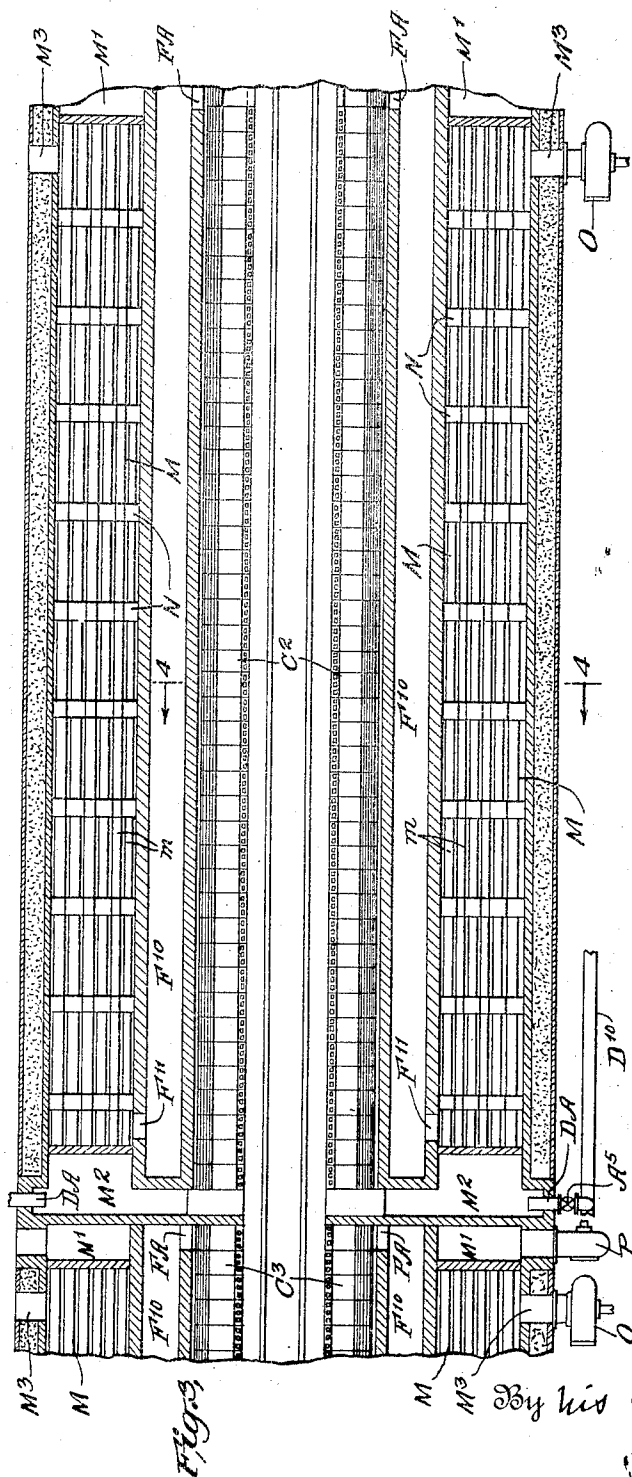
Inventor
Philip D'H. Dressler
By his Attorney
John E. Hubbell

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UNITED STATES PATENT OFFICE.

PHILIP D'H. DRESSLER, OF ZANESVILLE, OHIO, ASSIGNOR TO AMERICAN DRESSLER TUNNEL KILNS, INC., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TUNNEL-KILN WITH SECTIONAL COMBUSTION-CHAMBERS.

1,384,435.

Specification of Letters Patent.

Patented July 12, 1921.

Application filed March 27, 1920. Serial No. 369,414.

To all whom it may concern:

Be it known that I, PHILIP D'H. DRESSLER, a subject of the King of Great Britain, and a resident of Zanesville, in the county of Muskingum and State of Ohio, have invented certain new and useful Improvements in Tunnel-Kilns with Sectional Combustion-Chambers, of which the following is a specification.

My present invention comprises improvements in continuous tunnel kilns heated by internal combustion chambers, devised with the general object in view of making possible the effective combustion of a larger amount of gas and a consequent greater generation of heat in the combustion chambers of such a kiln than is possible with the ordinary kiln arrangements heretofore employed and at the same time securing a desirable control of the heating of the kiln in different sections along its length. Another object of the invention is to provide an improved arrangement for utilizing the heat in the escaping products of combustion to preheat the air supplied to support combustion. My improved air preheating means while of an especial value in connection with the apparatus devised for carrying out the main object of my invention is not restricted to such use.

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 and specific objects obtained with it, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

Of the drawings:

Figure 1 is a diagrammatic plan with parts broken away and in section of one form of kiln embodying my present invention;

Fig. 2 is a view taken similarly to Fig. 1 of a portion of a modified construction;

Fig. 3 is a sectional plan on a larger scale of a portion of the apparatus shown in Fig. 2; and

Fig. 4 is a section on the line 4—4 of Fig. 3.

In Fig. 1 I have illustrated the use of my invention in a tunnel kiln comprising a

heating-up zone B', a hot zone B² and a cooling zone B³. The hot zone B² of the kiln is heated by combustion chambers C', C² and C³ at the opposite sides of the pathway for the goods carrying cars. The combustion chambers shown, individually considered, are of the type and arrangement commonly employed in the well-known Dressler tunnel kiln, shown for example in the patent of Conrad Dressler No. 1,170,428, in that they are arranged on masonry benches or ledges at the side of the pathway of the goods carrying car (as shown in Fig. 4) and are formed with open ended passages C⁴ in their walls whereby the kiln atmosphere is caused to circulate upward through the passages C⁴ past the combustion chamber proper, and down through or along the goods between the combustion chambers at the opposite sides of the kiln. My present invention is distinguished from the ordinary type of Dressler kiln however, by the arrangement of a plurality of relatively short combustion chambers C', C² and C³ in an end to end series at each side of the kiln and extending the length of the hot zone B² of the kiln; whereas in the ordinary arrangement there is a single combustion chamber at each side of the kiln extending the full length of the hot zone.

Each of the various combustion chambers C', C² and C³ is preferably provided with one or more separate valved gas supply connections D, a separate air inlet E and a separate outlet F for the products of combustion. Advantageously, as shown, each air inlet E is provided with an individual damper or regulating device E', and each outlet F for products of combustion is similarly provided with an individual regulable damper F'. As shown, the air inlets E for the different combustion chambers are supplied from the common pipe conduit D² which receives air from the outlets by a conduit H and the usual headers H' to the adjacent ends of the goods cooling pipes H³ in the cooling zone B³. These pipes receive atmospheric air at their opposite ends through the air inlets H². In the particular arrangement shown, the outlets for products of combustion from the combustion chambers C', C² and C³ at each side of the kiln are connected to a corresponding conduit F² connected at F³ to a stack or exhaust (not shown). A branch F⁴ from each con-

duit F², preferably controlled by the regulating damper F⁵ forms a means for passing products of combustion from the conduit F² to heat radiating pipes I located in the heating-up zone B' of the kiln. The ends of the pipes I adjacent the corresponding end of the kiln are connected by a conduit I' to a suitable stack or other device not shown in the drawing for drawing products of combustion through the pipes I.

In the operation of the apparatus shown in Fig. 1 the goods to be heated enter the kiln through the ante chamber K and are carried by cars or other suitable transporting means from the ante chamber through the kiln proper in a continuous stream, leaving the kiln through the exit chamber L. The goods are heated up more or less gradually as they pass through the heating-up zone B' and then kept at a high temperature which may or may not be constant, depending on conditions, in their passage through the hot zone B². In the subsequent passage of the goods through the cooling-off zone B³ heat in the goods and goods carrier is absorbed to a considerable extent by the pipes H³ and is utilized in preheating the air passing through these pipes and ultimately supplied to the combustion chambers C', C² and C³ to support combustion therein. Each of the combustion chambers C', C² and C³ is of a length, between its air and gas inlets at one end and the outlet for products of combustion at its other end which is several times that of the maximum transverse dimension of the combustion chamber. For example, with a kiln having combustion chambers of the ordinary form and proportions as shown in Fig. 4, in which the maximum internal dimension of the combustion chamber transverse to its length is in the neighborhood of three feet, I will ordinarily make the combustion chambers arranged in accordance with the present invention, each of a length of from fifteen to thirty feet. With these proportions it is possible to substantially fill each combustion chamber with burning products of combustion throughout a large portion of its length and to maintain a desirable rate of flow through the chamber while maintaining a pressure in the chamber differing only by a few millimeters of water from atmospheric pressure.

The replacement of the single long combustion chamber heretofore ordinarily provided at each side of the kiln and extending the full length of the hot zone, by a plurality of separate combustion chambers arranged in an end to end series makes it possible to supply more heat to an elongated hot zone in a kiln of given cross section of kiln chamber and combustion chamber than is practically possible where each combustion chamber runs the full length of the hot zone. The amount of gas or other fuel

which can be burned in a combustion chamber of given cross-section is obviously limited by the capacity of the combustion chamber to pass the necessary volume of gases without creating pressures which will result in excessive leakage through the walls of the combustion chamber which must be made of carborundum, fire-clay or analogous refractory material, and comprise joints through which leakage occurs with any appreciable difference between the pressure in the combustion chamber and the pressure surrounding the combustion chamber. With the present invention it is possible to maintain practically the maximum combustion chamber temperature throughout the length of an elongated hot zone, whereas with a single elongated combustion chamber extending the full length of a long hot zone, the combustion chamber is, in practice, inevitably substantially cooler at its outlet end than at the end at which combustion begins.

The division of the combustion chambers into sections not only makes it possible to maintain a substantial uniform combustion chamber temperature from one end of the hot zone to the other notwithstanding variations in the rate at which heat is absorbed in different portions of the hot zone but makes it possible to vary the combustion chamber temperature along the length of the hot zone as conditions may make desirable. Still another advantage of the sectional combustion chamber construction is that it makes it possible to take care of the expansion and contraction resulting from changes in the temperature of the high temperature portion of the kiln in a very simple and satisfactory manner. To take care of thermal expansion and contraction it is ordinarily necessary to divide the walls of the combustion chamber structure proper into sections separated by transverse expansion in joints J. With a kiln constructed in accordance with the present invention, I place one of these expansion joints between each pair of adjacent combustion chamber sections. In consequence, the relative movement between each such section of the kiln structure proper, and the combustion chamber located in it, is appreciably less than is the case where a single combustion chamber extends likewise through several sections of the kiln separated from one another by expansion joints.

With the relatively large amounts of fuel which may be burned in the hot zone of a kiln constructed in accordance with the present invention, it will not ordinarily be practically possible to effectually utilize all the available heat in the waste products of combustion leaving the combustion chambers in the heating-up zone of an ordinary kiln. If all the waste products from the combustion chambers are passed through the heat-

ing-up zone, the goods will heat up too rapidly, unless the products of combustion are drawn through the heating-up zone in such manner that they still contain much available heat when withdrawn from the latter. With the large amounts of fuel which can be burned in a kiln constructed in accordance with the present invention, it is also practically difficult to preheat the air supporting combustion of fuel to a desirable high temperature solely by heat derived from the goods in the cooling-off zone of the kiln. On this account it is especially advantageous to provide means outside the kiln for utilizing heat in the escaping products of combustion to preheat air supplied to support combustion.

On this account, in the form of my invention shown in Figs. 2, 3 and 4, I associate with each combustion chamber a corresponding individual recuperator M which lies outside of the kiln proper and alongside of the combustion chamber. Interposed between the wall of the kiln chamber and each recuperator M is a waste products passage F^{10} connected to the corresponding combustion chamber at one end by a port FA through the wall of the kiln chamber proper. At the opposite end of each passage F^{10} a lateral port F^{11} communicates with the inter-tube space of the corresponding recuperator. Each recuperator M comprises a plurality of spaced apart tubular elements m which extend the length of the recuperator and open at their ends adjacent the corresponding port FA into an air inlet chamber M' . The latter, in the construction shown, is supplied with air by a fan or blower P. At their opposite ends the tubes m open into a chamber M^2 which is in direct communication with the interior of the corresponding combustion chamber. Combustion gas is supplied to each combustion chamber through a corresponding gas inlet DA shown as connected through a valve A^5 with a corresponding gas supply main D^{10} . The outlet M^3 for products of combustion from the inter-tube space of each recuperator M is located at the end of the recuperator adjacent the chamber M' and is shown as connected to an individual exhaust fan O.

The tubes m may be made of any suitable material such as carborundum, fire clay or iron. Iron is preferably employed because of its great heat conducting properties in the recuperator throughout or in the colder end of the recuperator when the temperatures normally prevailing in the hot end of the recuperator are too hot to be safely withstood by iron. In any event, the tubes m will ordinarily be made in sections each of a length less than the length of the recuperator, and preferably these sections are connected by thimbles N which, in conjunc-

tion with the tube sections entering them, form efficient expansion joint connections. The thimbles N are preferably of square or other polygonal outline in transverse sections, so that they may be stacked up on one another as shown best in Fig. 4. With the thimbles N thus stacked up at intervals along the length of the recuperator, the tubes m are correctly spaced apart, and the tubular structure as a whole, is stable. With the arrangement shown in Figs. 2, 3 and 4, the combustion in each combustion chamber may be independently regulated, and the desired amounts of air and gas may be burned in each combustion chamber without creating pressure differences tending to create undesirable leakage through the joints of the combustion chamber or recuperators. The recuperators M are not only inherently simple and effective, but are combined with the kiln structure in such a manner as to give a compact structure which is easy to effectively insulate against heat losses. The special recuperator construction disclosed but not claimed herein is claimed in divisional application, Serial No. 389,337, filed June 18, 1920.

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

1. In a continuous tunnel kiln, the combination with a kiln chamber having an elongated hot zone, of a plurality of combustion chambers arranged in an end to end series extending longitudinally of the hot zone and having air and gas inlets at one end and an outlet for products of combustion at the other end and of such proportions that the distance between the inlet and outlet of each chamber is several times the maximum transverse dimension of the chamber.

2. The combination in a tunnel kiln with a kiln chamber having an elongated hot zone and combustion chambers therein arranged in an end to end series, of a corresponding series of recuperators arranged outside the kiln chamber, one alongside each combustion chamber and connected to the two ends of the latter.

3. The combination in a tunnel kiln, with the kiln chamber and a combustion chamber therein, of an external recuperator, a conduit interposed between the recuperator and the kiln chamber alongside the combustion chamber and connected at one end to the recuperator and at its opposite end to the discharge end of the combustion chamber, and a connection between the inlet end of the combustion chamber and the recuperator.

Signed at Detroit, in the county of Wayne and State of Mich., this 23rd day of March, A. D., 1920.

PHILIP D'H. DRESSLER.