June 17, 1930. P. A. MEEHAN 1,764,460

TUNNEL KILN

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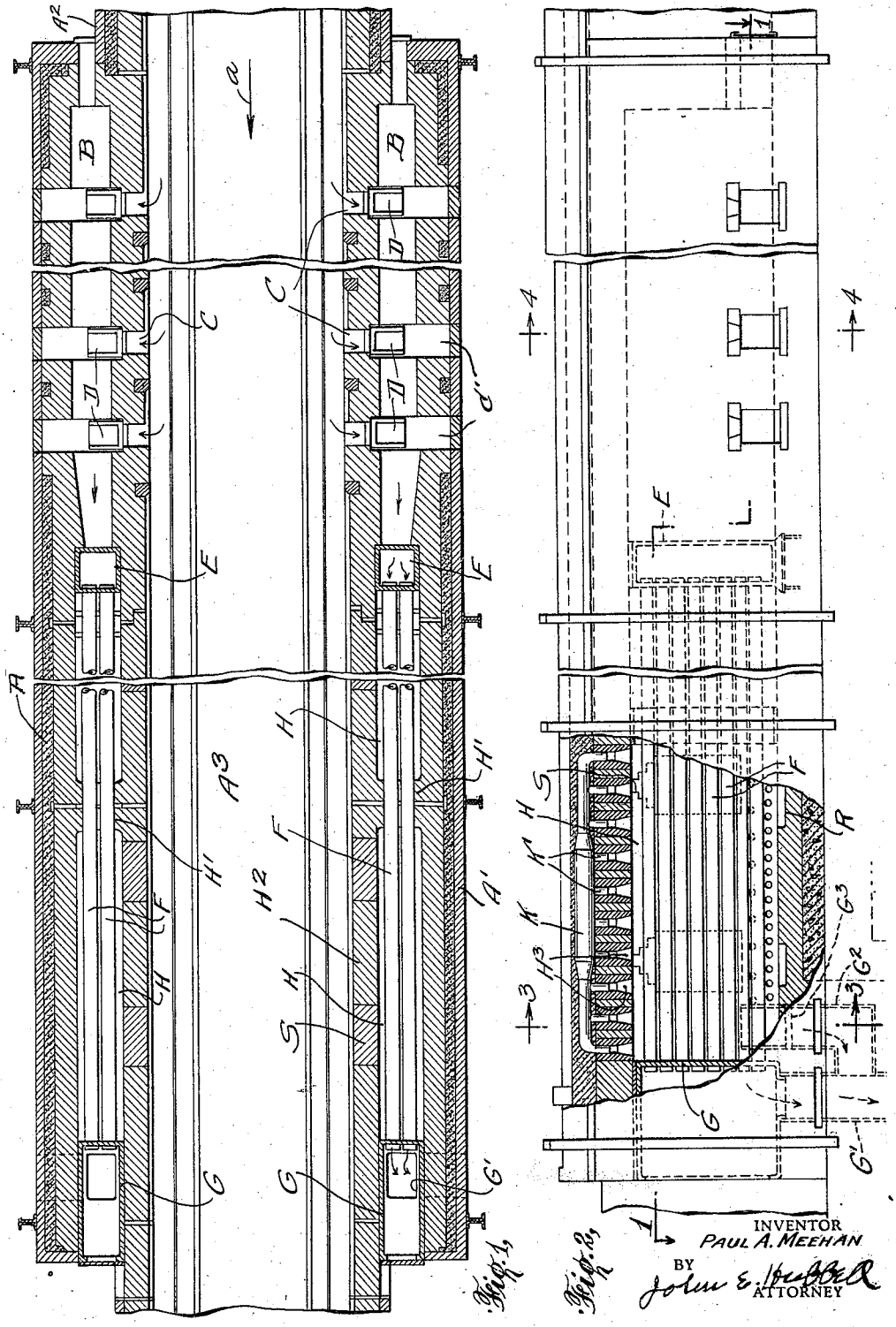


Fig. 1.

Fig. 2.

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Fig. 5,

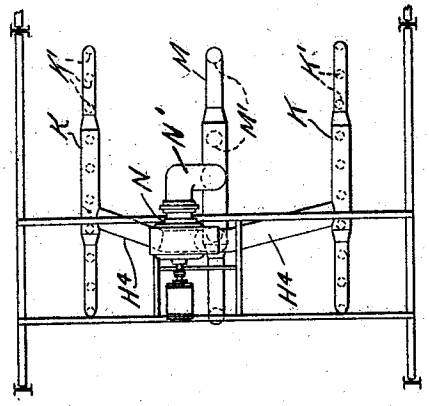


Fig. 4,

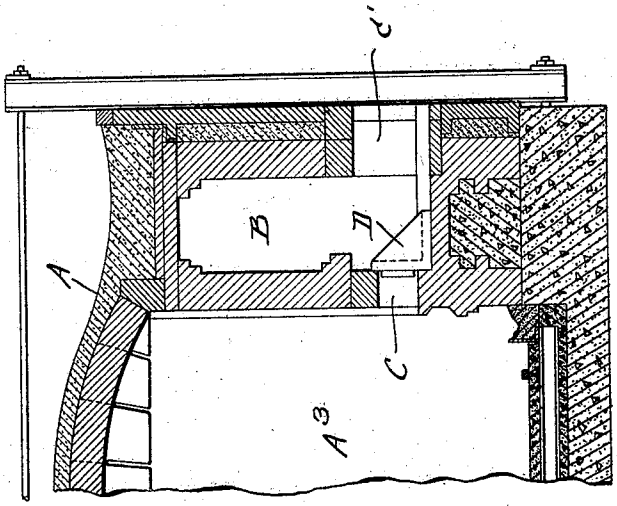
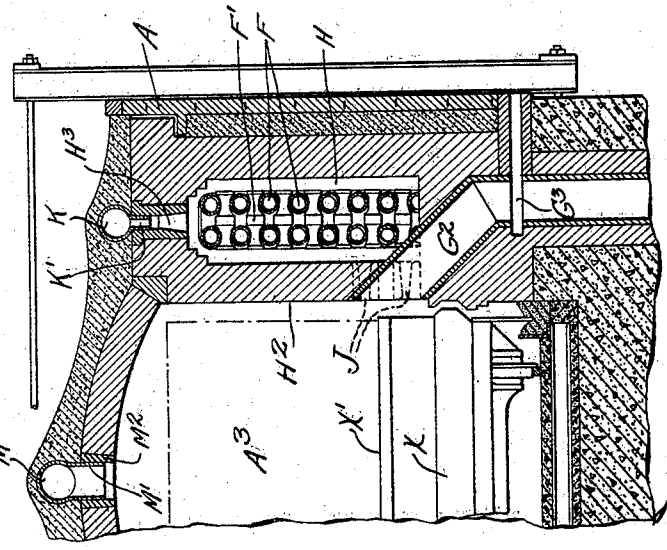


Fig. 3,



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Patented June 17, 1930 1,764,460

UNITED STATES PATENT OFFICE

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TUNNEL KILN

Application filed April 3, 1928. Serial No. 266,922.

The object of my present invention is to provide an improved construction and arrangement of the provisions for supplying heat to the ware while in the preheating section of a continuous tunnel kiln. More specifically, the object of my invention is to provide simple and effective provisions for maintaining a positive circulation of the kiln chamber atmosphere in the preheating zone and supplying heat to the circulating gases in said zone from another portion of the kiln.

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, 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 the invention.

Of the drawings:

Fig. 1 is a section through the kiln taken on the line 1—1 of Fig. 2;

Fig. 2 is a side elevation with parts of the kiln side wall broken away;

Fig. 3 is a section on the line 3—3 of Fig. 2;

Fig. 4 is a section on the line 4—4 of Fig. 2; and

Fig. 5 is a plan view of one of the fan units.

In the drawings I have illustrated a portion of a direct fired tunnel kiln A comprising a preheating zone A′ and a furnace or firing zone A^2. The furnace zone A^2 is heated by burners or grates located in the side wall thereof and the products of combustion therefrom normally pass longitudinally through the kiln chamber A^3 towards the entrance of the kiln where they are exhausted by suitable apparatus. The gases in their passage through the preheating section are utilized to dry and heat ware mounted on suitable ware supporting cars progressively moved through the kiln chamber. Tunnel kiln circulating systems of this type have been found disadvantageous in that the gases do not contact with all portions of the ware on the cars and in general flow over and around the ware stacks.

My improved provisions for heating the material in the preheating section A′ comprise means for maintaining a positive transverse circulation of the chamber atmosphere in that section of the kiln. In this system the heating gases from the furnace section of the kiln are utilized for heating the circulating chamber atmosphere without coming into direct contact with the ware being heat treated. As shown in Fig. 1, the direction of the heating gases from the burner zone is indicated by the arrow *a*. The kiln is enlarged on both sides of the kiln chamber and provided with longitudinally extending flues B, each of which is connected at one end to the kiln chamber by spaced horizontal ports C adjacent the flue bottom.

The connection between each port C and the flue B is closed by a damper D slidably mounted in a passage C′ in alignment with and forming an enlarged continuation of each port C. Each of the passages C′ is sealed at its outer end. The dampers D can be operated by any suitable mechanism (not shown) extending into the passages C′.

Each flue B is connected at its end adjacent the entrance end of the kiln with a vertical box header E into which a vertical bank of longitudinally extending pipes F are connected. The opposite ends of the pipes are connected into a second header G adjacent the entrance end of the kiln. The pipes F pass through a plurality of chambers H formed in each side wall of the kiln and which are separated by bulkheads H′. Each chamber is of substantially the same cross-sectional dimensions as the flue B. Vertical carrier frames F′ on which the pipes are supported are located adjacent each bulkhead as shown in Fig. 3. Each pipe bank is further supported on roller carriers located in the recesses R to permit longitudinal expansion and contraction of the pipe elements in operation. The pipes where required are made of cast iron, calorized steel or other material suitable for high temperature conditions. The bottom of the header G is connected to suitable exhaust apparatus (not shown) by a flue G′. A branch flue G^2 having a damper G^3 therein connects the flue G′ with the kiln chamber A^3.

Each chamber H is separated from the kiln chamber by a wall H^2 in the lower portion of which is formed a plurality of injector nozzles J. The injector nozzles J are shown as arranged in two vertically spaced horizontal rows, the upper of which is arranged to discharge at a level slightly above the ware supporting platform X′ of the kiln car X and the lower row slightly below the platform X′ as shown in Fig. 3. The individual nozzles are of the usual Venturi design. In some cases the platform X′ may be omitted and one or more rows of nozzles arranged to discharge along the floor of the kiln car. Spaced bulkheads S are formed in the wall H^2 to permit access to the interior of the chambers H.

A pipe K is mounted in the upper portion of the kiln side wall above each of the chambers H as shown in Figs. 2 and 3. A row of horizontally spaced vertical passages H^3 enlarged at their lower ends extend upwardly from each chamber H to points adjacent the corresponding pipe K. Each pipe K is provided with short vertical nozzles K′ mounted in the upper ends of the passages H^3.

A pipe M similar to the pipes K is mounted in the masonry above the kiln crown and provided with a plurality of short vertical extension pipes M′, each of which projects into a vertical passage M^2, the lower end of which is connected to the kiln chamber. As shown in Fig. 5 the central portion of each pipe M is connected to a corresponding exhaust fan N by a pipe N′. Similarly, the pipes K on each side of the kiln chamber corresponding in longitudinal position with the pipe M are connected to the fan N by inclined pipes H^4. The piping arrangement shown is the same for each pair of chambers along the preheating section of the kiln.

With the apparatus shown heating gases from the furnace zone A^2 pass toward the entrance end of the kiln. The gases are drawn from the kiln chamber through the ports C into the flues B by the suction thereon. The gases then pass through the bank of pipes F on each side of the kiln chamber into the headers G, from which they are removed by the exhaust apparatus. The kiln chamber atmosphere adjacent each pair of chambers H is drawn upwardly through the pipes M′ and M by the fan N connected thereto and passed through the fan outlet to the pipes K on each side of the kiln. The chamber atmosphere is then directed downwardly through the openings H^3 into the chambers H where it contacts with and absorbs heat from the pipes F carrying the furnace gases. The heated atmosphere is then injected into the kiln chamber through the injector nozzles J.

The dampers D are operated to regulate the flow of furnace gases into the flue B. Likewise the damper G^3 may be opened when a longitudinal gas circulation through the preheating zone is desired.

The arrangement of the fan units and the piping system provides a positive transverse circulation of the kiln chamber atmosphere in each section of the preheating zone. While the normal circulation is updraft through the ware and downdraft through the chamber H, the system may be reversed if desirable and a downdraft circulation through the ware and an updraft flow through the chambers H provided.

My invention is applicable as well to tunnel kilns of the muffle type. In such a construction the pipes F would form a prolongation of the usual combustion chamber and most of the advantages stated heretofore of having positive circulation of the atmosphere in the preheating zone as described would be also present in a muffle fired kiln.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of 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. A tunnel kiln having a kiln chamber therein for the passage of ware carrying cars therethrough, a preheating section, a longitudinally extending chamber in the side wall of said preheating section, means for passing heating gases through said wall chamber, and separate means providing a positive circulation of the kiln atmosphere in said preheating section through said wall chamber out of direct contact with said heating gases whereby said atmosphere absorbs heat from the heating gases therein.

2. A tunnel kiln having a kiln chamber therein for the passage of ware supporting cars therethrough, a preheating section, a longitudinally extending chamber in the side wall of said preheating section, means for passing heating gases at a high temperature in a horizontal direction through said wall chamber, and means for passing the kiln atmosphere in said preheating section in a vertical direction through said wall chamber whereby said atmosphere absorbs heat from the heating gases therein.

3. A tunnel kiln having a kiln chamber therein for the passage of ware supporting cars therethrough, a preheating section, a longitudinally extending chamber in the side wall of said preheating section, a bank of pipes mounted in said wall chamber, means

for passing heating gases at a high temperature through said pipe bank, and means for circulating the kiln atmosphere in said preheating section through said wall chamber in contact with said pipes whereby said atmosphere absorbs heat therefrom.

4. A tunnel kiln comprising a preheating section, a longitudinally extending chamber in the side wall of said preheating section, injector nozzles connecting the lower portion of said wall chamber with the kiln chamber, a gas distributing pipe above and connected to said wall chamber, a second pipe mounted in the kiln crown and connected to said kiln chamber, and means connected to said pipes providing a positive circulation of the kiln chamber atmosphere downwardly through said wall chamber and out through said nozzles.

5. In a tunnel kiln having a kiln chamber therein for the passage of ware supporting cars therethrough, a preheating section, a plurality of longitudinally extending chambers in the side wall of said section, a plurality of longitudinally extending pipe mains mounted in said side wall above said wall chambers, passages connecting each of said pipes to one of said wall chambers, a plurality of aligned pipes mounted in the kiln crown, a plurality of fans mounted on the top of said kiln, and piping connecting each of said fans with one of said crown pipes and one of said chamber mains, whereby the kiln atmosphere in different portions of said preheating section is positively circulated through different fan units.

6. A direct fired tunnel kiln comprising a preheating section and a furnace section, a longitudinally extending flue in the side wall of the kiln, longitudinally spaced ports connecting the kiln chamber adjacent said furnace section with said flue, a damper located in each of said ports, a plurality of separate chambers in said side wall, a bank of pipes extending through said wall chambers, means for drawing heating gases from said furnace section through said ports and said flue into said pipes, a series of pipe mains mounted in said preheating section above the kiln crown and connected to the kiln chamber, a second series of pipe mains mounted above said wall chambers and connected thereto, injector nozzles connecting each of said wall chambers to said kiln chamber, and a fan connected to a pipe main in each of said series, all of said elements being arranged to provide a positive circulation of the kiln atmosphere in said preheating section through said kiln chamber and around said pipes containing the heating gases.

Signed at Cleveland, in the county of Cuyahoga and State of Ohio, this 30th day of March, A. D. 1928.

PAUL A. MEEHAN.