C. H. ZWERMANN.

KILN.

APPLICATION FILED JUNE 8, 1918.

1,275,352.

Patented Aug. 13, 1918.

3 SHEETS—SHEET 1.

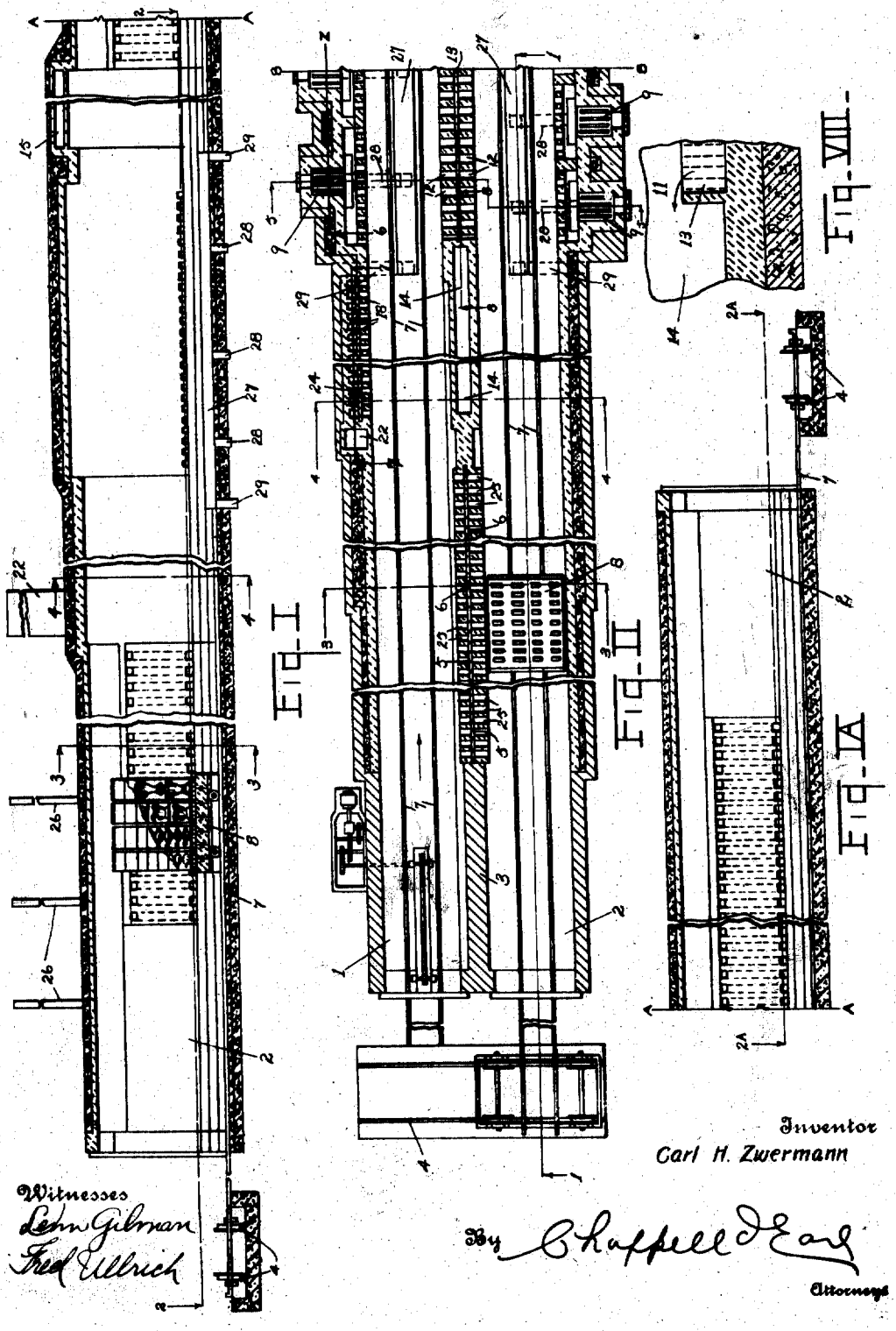


Fig. I

Fig. II

Fig. IA

Fig. VIII

Witnesses

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3 SHEETS—SHEET 2.

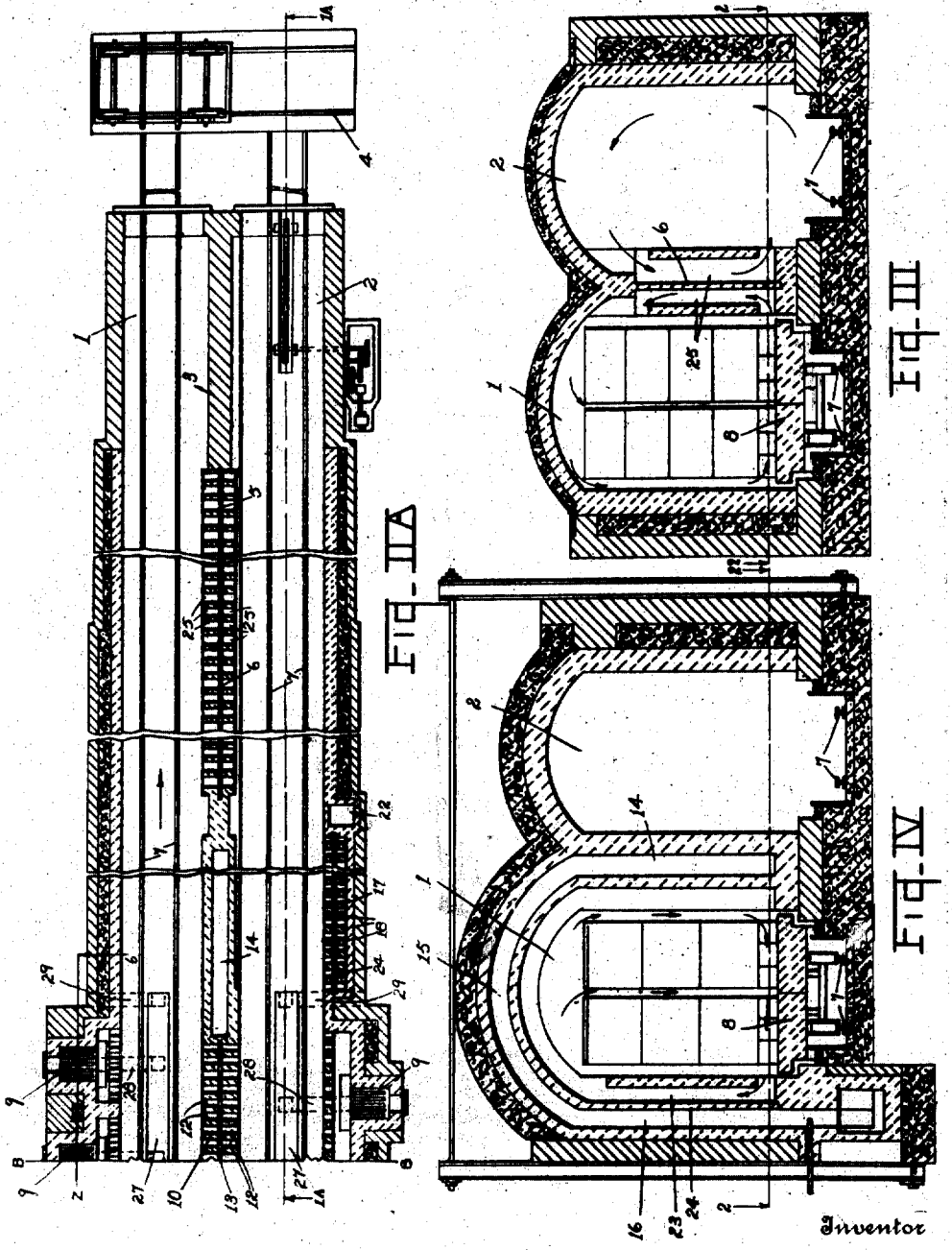


Fig. IIA

Fig. III

Fig. IV

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3 SHEETS—SHEET 3.

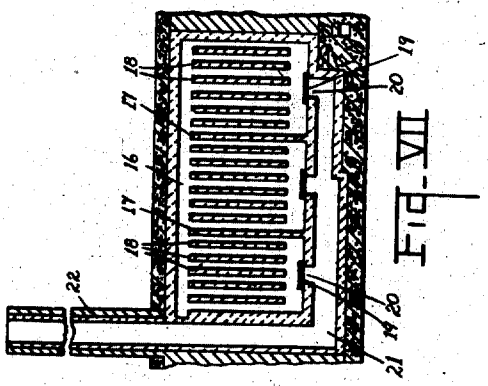


Fig. VII.

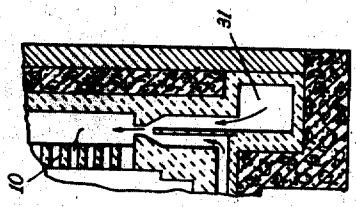


Fig. X.

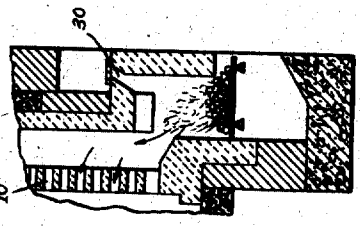


Fig. IX.

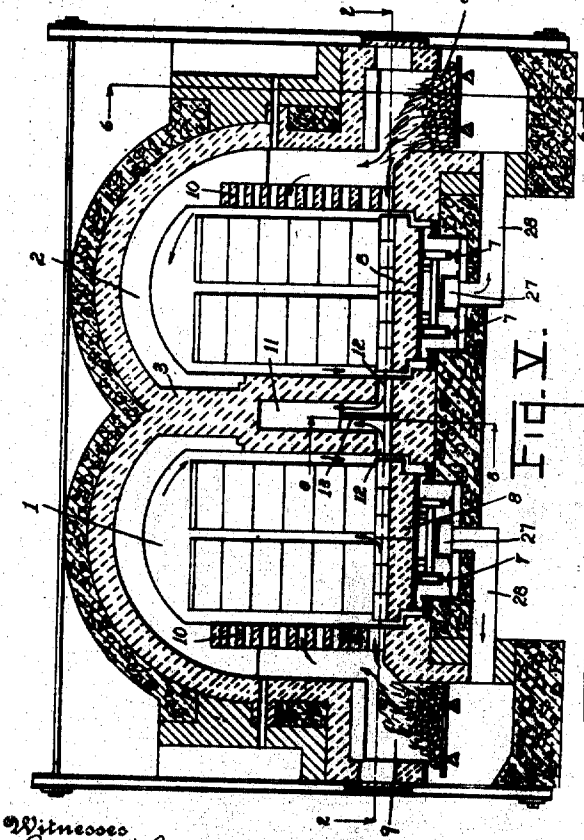


Fig. V.

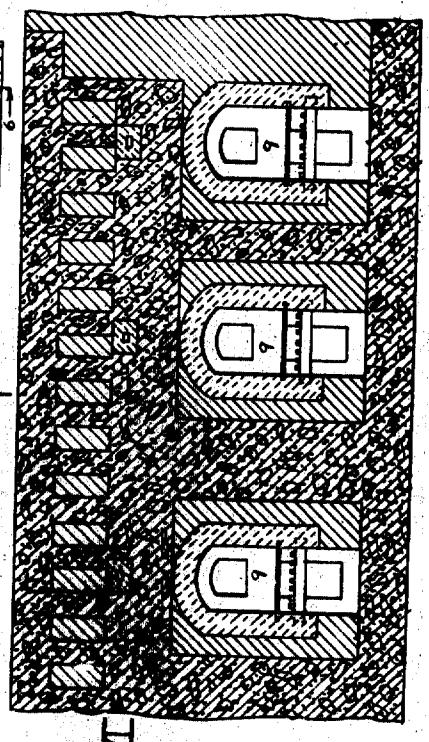


Fig. VI.

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UNITED STATES PATENT OFFICE.

CARL H. ZWERMANN, OF KALAMAZOO, MICHIGAN.

KILN.

1,275,352. Specification of Letters Patent. Patented Aug. 13, 1918.

Application filed June 8, 1918. Serial No. 239,066.

To all whom it may concern:

Be it known that I, CARL H. ZWERMANN, a citizen of the United States, residing at the city and county of Kalamazoo, State of Michigan, have invented certain new and useful Improvements in Kilns, of which the following is a specification.

This invention relates to improvements in kilns.

The main objects of this invention are:

First, to provide an improved kiln of large capacity.

Second, to provide an improved kiln in which the preheating and cooling is effectively accomplished so that the stock is not likely to be injured in the process.

Third, to provide an improved kiln in which the heat from the cooling stock is utilized for the initial heating of the new stock.

Fourth, to provide an improved kiln in which the products of combustion are confined to restricted zones and at the same time the heat units are effectively utilized.

Further objects, and objects relating to structural details, will definitely appear from the detailed description to follow.

I accomplish the objects of my invention by the devices and means described in the following specification. The invention is clearly defined and pointed out in the claims.

A structure which is a preferred embodiment of my invention is clearly illustrated in the accompanying drawing, forming a part of this specification, in which:

Figure I and Fig. I^A are complementary detail vertical longitudinal sections through one of the kiln tunnels on a line corresponding to line 1—1 of Figs. II and II^A.

Fig. II and Fig. II^A are complementary detail horizontal sections through my improved kiln on a line corresponding to line 2—2 of Figs. III and IV.

Fig. III is a transverse section on a line corresponding to line 3—3 of Fig. I.

Fig. IV is a transverse section on a line corresponding to line 4—4 of Fig. I.

Fig. V is a vertical transverse section on a line corresponding to line 5—5 of Fig. II.

Fig. VI is a detail longitudinal section on a line corresponding to line 6—6 of Fig. V.

Fig. VII is an enlarged detail section through one of the heating flues on a line corresponding to line 7—7 of Fig. II.

Fig. VIII is a detail longitudinal section on a line corresponding to line 8—8 of Fig. II.

Fig. IX is a detail vertical section corresponding to that of Fig. V showing a modified form of fire-pot.

Fig. X is a similar detail view showing a gas heating means.

In the drawing similar reference characters refer to similar parts throughout the several views, and the sectional views are taken looking in the direction of the little arrows at the ends of the section lines.

Referring to the drawing, I provide a pair of tunnels, designated generally by the numerals 1 and 2, the tunnels being substantial duplicates and arranged side by side but in a reverse relation, the discharging end of one tunnel being at the charging end of the other. The inner wall 3 of the tunnels is common to both. A transfer track 4 is arranged at each end of the tunnels. Adjacent each end of the tunnels the inner wall 3 is provided with relatively thin radiating portions, the outer portions 5 of the radiating portion being preferably of metal, the remaining portion 6 being thin but preferably of brick or the like.

Each tunnel is provided with tracks 7 for the trucks 8 on which the ware or stock to be treated is arranged. As the details of the track and trucks form no part of my present invention they are not further described herein. It will be understood that in practice it is my purpose to provide a series of trucks which are gradually advanced from the charging end of the kiln, the timing being regulated according to the nature of the stock, the results desired and other conditions which will be understood by those skilled in the art to which this invention relates.

The heating means illustrated in the preferred embodiment consist of a series of furnaces 9, designed for the use of fuel, such as coal, and are located centrally of the tunnels at their outer sides and below the truck levels thereof. The hot gases are discharged into the tunnels through the baffle walls 10 which have a series of holes therethrough, the tops of the walls being spaced from the tops of the tunnels, the purpose being to distribute the heat effectively throughout a central hot zone.

In the inner wall 3 opposite the heating means I provide an outlet flue 11, the same

being disposed horizontally and provided with a series of inlet openings 12 at the bottoms at the truck bed levels of the tunnel chambers. Both tunnels open into this flue, a baffle plate 13 being provided to prevent currents setting up from one tunnel into the other through this outlet flue. The outlet flue delivers at each end to the heating flues 14 extending from the bottom of the inner wall over the tops of the tunnel chambers at 15 and downwardly in the outer walls thereof at 16,—see Fig. IV. These heating flues are of substantial width and are disposed oppositely over the tunnels, that is, they are disposed in advance of the heating means so that a preheating zone is provided in front of the heating means. The outer down draft portions 16 of these heating flues are provided with vertical baffles or distributing plates 17 dividing the portion 16 of the flue into compartments or chambers, such compartments or chambers being provided with baffles 18 terminating above the bottom of the flue so that the hot gases are distributed quite uniformly through the flue.

Valves 19 control the ports 20 connecting the flues 16 with the discharge flues 21 leading to the chimneys 22. To cause an effective circulation of air in this preheating zone I provide a series of vertical circulating flues 23, the inner walls 24 of the heating flues constituting walls for these circulating flues so that the heat is effectively transmitted through the circulating flues and an effective circulation set up as indicated by the arrows in Fig. IV.

A series of circulating flues 25 are disposed on opposite sides of the radiating walls 5 and 6, the walls forming the inner walls of these flues. These flues are open at the top and bottom as indicated in Fig. III so that the air is caused to circulate through the flues and through the tunnel chambers as indicated by dotted lines in Fig. III, that in the cooling or discharge end of the tunnel circulating downwardly through the flues and that in the charging end circulating upwardly through the flues, that is, in the charging end the air is heated in the flues so that it circulates down through the fresh stock, thereby providing heat for the "water smoking" step and the air in the cooling or discharging end of the adjacent tunnel is cooled by contact with the radiating wall so that it circulates upwardly through the ware, thus utilizing the heat from the cooling zone of one tunnel to initially heat the ware in the "water smoking" zone of the other tunnel.

The "water smoking" zone in the tunnel is provided with vents 26.

By this arrangement the stock is gradually heated and this without bringing the products of combustion into contact with the ware until the baking or hot zone is reached and at the same time an effective circulation is maintained in the tunnels without employment of circulating means such as fans or the like.

To provide preheated air for the furnaces and in a measure cool the trucks in the heating zone I arrange a cold air flue 27 longitudinally between the track rails with connections 28 to each fire-pot, the ends of the flue being connected at 29 to the outer air.

In the modified construction shown in Fig. IX an air inlet 30 is provided above the fire, the means for preheating being omitted.

In the modification shown in Fig. X the hot gases are introduced into a chamber 31, the burners not being illustrated.

My improved kiln is of large capacity and economical in use. A relatively large proportion of the heat units are utilized while the stock is gradually heated and gradually cooled so that loss through cracking or injury which sometimes results from undue, uneven or too rapid heating or cooling is prevented.

The circulation is effectively maintained throughout various zones of the tunnels so that the stock on different parts of the trucks is evenly heated.

I have illustrated and described my improvements in an embodiment which I consider to be highly desirable. I have not attempted to illustrate or describe certain other modifications or adaptations which I contemplate, as I believe the disclosure made will enable those skilled in the art to which my invention relates to embody or adapt the same as particular installations or uses may render desirable.

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

1. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharge end of the other and having a common inner wall with relatively thin radiating portions toward each end, heating means, upright foraminated baffle walls through which the heating means deliver disposed centrally at the outer sides of the tunnels, the tops of the baffle walls being spaced from the tops of the tunnels, a central longitudinal outlet flue in said inner wall opposite said baffle walls and communicating with both tunnel chambers through a series of outlet openings at the bottoms thereof, heating flues leading from the ends of said central outlet flue over the tops of said tunnel chambers and downwardly at the outer sides thereof, said heating flues being disposed oppositely toward the charging ends of the tunnels and being of substantial width and constituting a heating means for a preheating zone in each

tunnel chamber in advance of its said heating means, discharge flues to which said heating flues deliver, vertical circulating flues for such preheating zones open at their tops and bottoms, and disposed at the outer sides of the tunnels, the walls of said heating flues constituting walls for said circulating flues, and vertical circulating flues open at their tops and bottoms disposed on opposite sides of said radiating walls, said radiating walls constituting the inner walls of such flues whereby circulation is created in the charging and discharging ends of both tunnels.

2. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharge end of the other and having a common inner wall with relatively thin radiating portions toward each end, heating means, upright foraminated baffle walls through which the heating means deliver disposed centrally at the outer sides of the tunnels, the tops of the baffle walls being spaced from the tops of the tunnels, a central longitudinal outlet flue in said inner wall opposite said baffle walls and communicating with both tunnel chambers through a series of outlet openings at the bottoms thereof, heating flues leading from the ends of said central outlet flue over the tops of said tunnel chambers and downwardly at the outer sides thereof, said heating flues being disposed oppositely toward the charging ends of the tunnels and being of substantial width and constituting a heating means for a preheating zone in each tunnel chamber in advance of its said heating means, discharge flues to which said heating flues deliver, vertical circulating flues for such preheating zones open at their tops and bottoms and disposed at the outer sides of the tunnels, the walls of said heating flues constituting walls for said circulating flues, vertical circulating flues open at their tops and bottoms disposed on opposite sides of said radiating walls, said radiating walls constituting the inner walls of such flues whereby circulation is created in the charging and discharging ends of both tunnels, and longitudinal cold air flues in the bottoms of the tunnels in the zones of said heating means having discharge connections with said heating means and inlet connections with the outer air.

3. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharge end of the other and having a common inner wall with relatively thin radiating portions toward each end, heating means, upright foraminated baffle walls through which the heating means deliver disposed centrally at the outer sides of the tunnels, the tops of the baffle walls being spaced from the tops of the tunnels, a central longitudinal outlet flue in said inner wall opposite said baffle walls and communicating with both tunnel chambers through a series of outlet openings at the bottoms thereof, heating flues leading from the ends of said central outlet flue over the tops of said tunnel chambers and downwardly at the outer sides thereof, said heating flues being disposed oppositely toward the charging ends of the tunnels and being of substantial width and constituting a heating means for a preheating zone in each tunnel chamber in advance of its said heating means, discharge flues to which said heating flues deliver, vertical circulating flues for such preheating zones open at their tops and bottoms and disposed at the outer sides of the tunnels, the walls of said heating flues constituting walls for said circulating tops and bottoms disposed on opposite sides of said radiating walls, said radiating walls constituting the inner walls of such flues whereby circulation is created in the charging and discharging end of both tunnels, discharge vents for the charging ends of said tunnels, and longitudinal cold air flues in the bottoms of the tunnels in the zones of said heating means having discharge connections with said heating means and inlet connections with the outer air.

4. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharging end of the other and having a common inner wall, heating means, upright foraminated baffle walls through which the heating means deliver disposed centrally at the outer sides of the tunnels, the tops of the baffle walls being spaced from the tops of the tunnels, a central longitudinal outlet flue in said inner wall opposite said baffle walls and communicating with both tunnel chambers through a series of outlet openings at the bottoms thereof, heating flues leading from the ends of said central outlet flue over the tops of said tunnel chambers and downwardly at the outer sides thereof, said heating flues being disposed oppositely toward the charging ends of the tunnels and being of substantial width and constituting a heating means for a preheating zone in each tunnel chamber in advance of its said heating means, said heating flues having a series of distributing baffles therein, discharge flues to which said heating flues deliver, and vertical circulating flues for such preheating zones open at their tops and bottoms and disposed at the outer sides of the tunnels, the walls of said heating flues constituting walls for said circulating flues.

5. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharging end of the other and having a common inner wall, heating means, upright foraminated baffle walls through which the heating means

deliver disposed centrally at the outer sides of the tunnels, the tops of the baffle walls being spaced from the tops of the tunnels, a central longitudinal outlet flue in said inner wall opposite said baffle walls and communicating with both tunnel chambers through a series of outlet openings at the bottoms thereof, heating flues leading from the ends of said central outlet flue over the tops of said tunnel chambers and downwardly at the outer sides thereof, said heating flues being disposed oppositely toward the charging ends of the tunnels and being of substantial width and constituting a heating means for a preheating zone in each tunnel chamber in advance of its said heating means, and discharge flues to which said heating flues deliver.

6. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharging end of the other and having a common inner wall with relatively thin radiating portions toward each end, heating means delivering centrally at the outer sides of the tunnels, a central outlet flue for said tunnel chambers communicating therewith through a series of outlet openings at the bottoms thereof, heating flues leading from said central outlet flue over the tops of said tunnel chambers and downwardly at the outer sides thereof, said heating flues being disposed oppositely toward the charging ends of the tunnels and constituting a heating means for a preheating zone in each tunnel chamber in advance of its said heating means, vertical circulating flues for such preheating zones open at their tops and bottoms and disposed at the outer sides of the tunnels, the walls of said heating flues constituting walls for said circulating flues, vertical circulating flues open at their tops and bottoms disposed on opposite sides of said radiating walls, said radiating walls constituting the inner walls of such flues whereby circulation is created in the charging and discharging ends of both tunnels, and discharge vents for the charging ends of said tunnels.

7. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharging end of the other and having a common inner wall with relatively thin radiating portions toward each end, heating means delivering centrally at the outer sides of the tunnels, a central outlet flue for said tunnel chambers communicating therewith through a series of outlet openings at the bottoms thereof, heating flues leading from said central outlet flue over the tops of said tunnel chambers and downwardly at the outer sides thereof, said heating flues being disposed oppositely toward the charging ends of the tunnels and constituting a heating means for a preheating zone in each tunnel chamber in advance of its said heating means, vertical circulating flues open at their tops and bottoms disposed on opposite sides of said radiating walls, said radiating walls constituting the inner walls of such flues whereby circulation is created in the charging and discharging ends of both tunnels, and discharge vents for the charging ends of said tunnels.

8. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharge end of the other with relatively thin radiating portions toward each end, heating means delivering centrally to the outer sides of the tunnels, heating flues constituting conduits for the products of combustion leading from the inner sides of the tunnels opposite the heating means over the tops of the tunnel chambers and downwardly at the outer sides thereof, said heating flues being disposed oppositely toward the charging ends of the tunnels and constituting a heating means for a preheating zone in each tunnel chamber in advance of its said heating means, vertical circulating flues disposed at the outer sides of the tunnels, the walls of said heating flues constituting the walls for said circulating flues, vertical circulating flues open at their tops and bottoms disposed so that said radiating walls are common thereto whereby circulation is created in the charging and discharging ends of both tunnels, and discharge vents for the charging ends of the tunnels.

9. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharge end of the other with relatively thin radiating portions toward each end, heating means delivering centrally to the outer sides of the tunnels, heating flues constituting conduits for the products of combustion leading from the inner sides of the tunnels opposite the heating means over the tops of the tunnel chambers and downwardly at the outer sides thereof, said heating flues being disposed oppositely toward the charging ends of the tunnels and constituting a heating means for a preheating zone in each tunnel chamber in advance of its said heating means, vertical circulating flues open at their tops and bottoms disposed so that said radiating walls are common thereto whereby circulation is created in the charging and discharging ends of both tunnels, and discharge vents for the charging ends of the tunnels.

10. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharging end of the other, heating means delivering centrally at the outer sides of the tunnels, a central outlet flue for said tunnel chambers communicating therewith through a series of outlet openings at the bottoms thereof,

heating flues leading from said central outlet flue over the tops of said tunnel chambers and downwardly at the outer sides thereof, said heating flues being disposed oppositely toward the charging ends of the tunnels and constituting a heating means for a preheating zone in each tunnel chamber in advance of its said heating means, and vertical circulating flues for such preheating zones open at their tops and bottoms and disposed at the outer sides of the tunnels, the walls of said heating flues constituting walls for said circulating flues.

11. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharging end of the other, heating means delivering centrally at the outer sides of the tunnels, a central outlet flue for said tunnel chambers communicating therewith through a series of outlet openings at the bottoms thereof, heating flues leading from said central outlet flue over the tops of said tunnel chambers and downwardly at the outer sides thereof, said heating flues being disposed oppositely toward the charging ends of the tunnels and constituting a heating means for a preheating zone in each tunnel chamber in advance of its said heating means.

12. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharge end of the other, heating means delivering centrally to the outer sides of the tunnels, heating flues constituting conduits for the products of combustion leading from the inner sides of the tunnels opposite the heating means over the tops of the tunnel chambers and downwardly at the outer sides thereof, said heating flues being disposed oppositely toward the charging ends of the tunnels and constituting a heating means for a preheating zone in each tunnel chamber in advance of its said heating means, and vertical circulating flues disposed at the outer sides of the tunnels, the walls of said heating flues constituting the walls for said circulating flues.

13. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharge end of the other, heating means delivering centrally to the outer sides of the tunnels, and heating flues constituting conduits for the products of combustion leading from the inner sides of the tunnels opposite the heating means over the tops of the tunnel chambers and downwardly at the outer sides thereof, said heating flues being disposed oppositely toward the charging ends of the tunnels and constituting a heating means for a preheating zone in each tunnel chamber in advance of its said heating means.

14. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharging end of the other and having a common inner wall with relatively thin radiating portions toward each end, the outer portions of such radiating portions being of metal, heating means delivering centrally to said tunnels, and vertical circulating flues open at their tops and bottoms disposed on opposite sides of said walls, said radiating walls constituting the inner walls of such flues whereby a cooling circulation is created in the discharge end of the tunnel and a heating circulation in the charging end thereof.

15. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharging end of the other and having a common inner wall with relatively thin radiating portions toward each end, heating means delivering centrally to said tunnels, and vertical circulating flues open at their tops and bottoms disposed on opposite sides of said walls, said radiating walls constituting the inner walls of such flues whereby a cooling circulation is created in the discharge end of the tunnel and a heating circulation in the charging end thereof.

16. The combination of a pair of tunnel kilns disposed in reverse relation with the charging end of one at the discharging end of the other and having a common inner wall, heating means delivering centrally to said tunnels, and vertical circulating flues open at their tops and bottoms disposed on opposite sides of said common wall whereby a cooling circulation is created in the discharge end of the tunnel and a heating circulation in the charging end thereof.

In witness whereof I have hereunto set my hand and seal in the presence of two witnesses.

CARL H. ZWERMANN. [L. S.]

Witnesses:

LUELLA G. GREENFIELD,

GRACE B. THOMPSON.