J. L. HARPER & W. J. LARKWORTHY.

ELECTRIC KILN.

APPLICATION FILED OCT. 7, 1907. RENEWED MAY 18, 1909.

925,902.

Patented June 22, 1909.

2 SHEETS—SHEET 1.

Fig. 1.

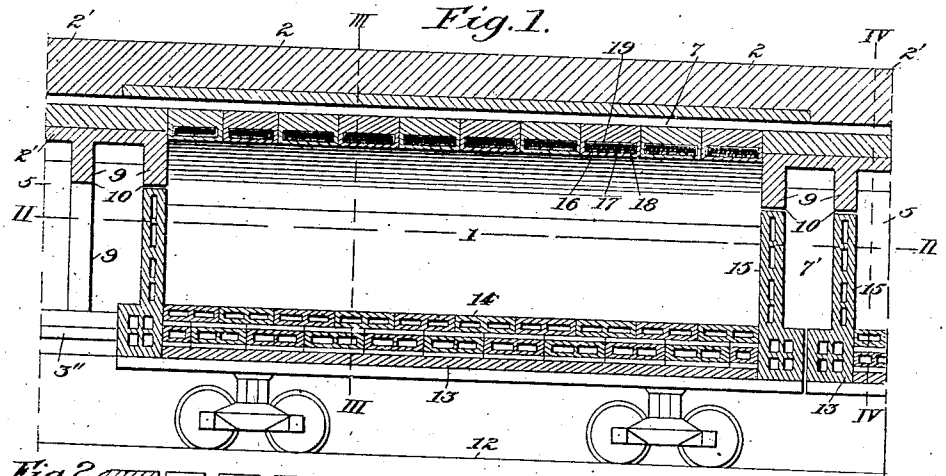

Fig. 2.

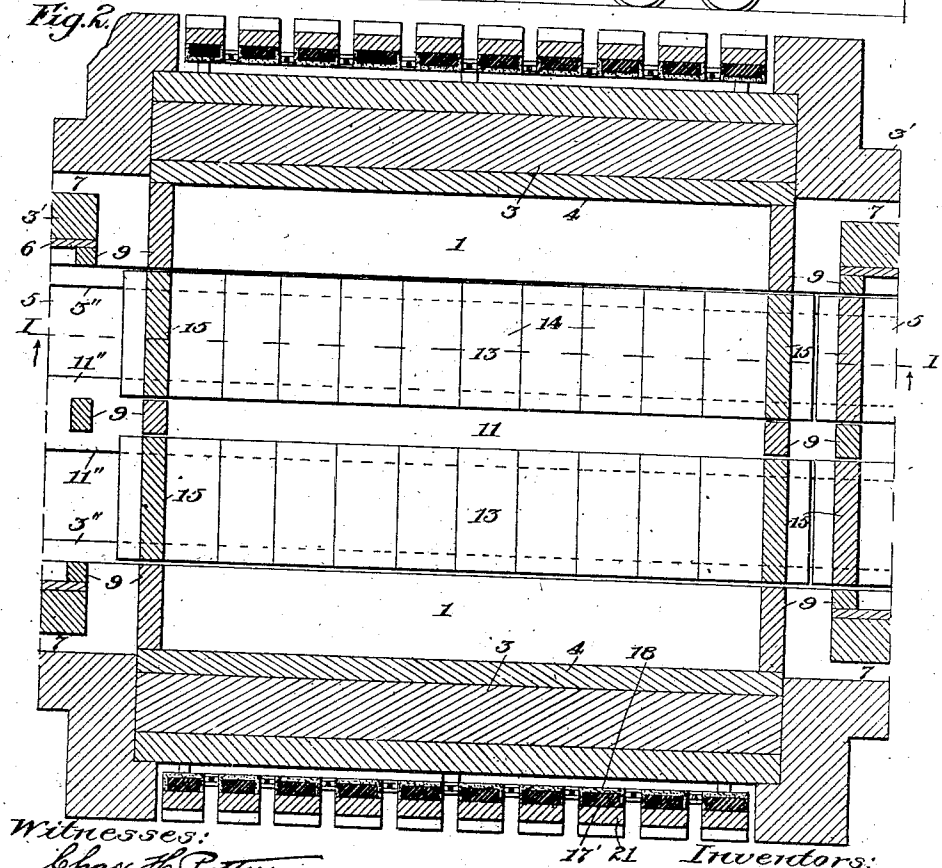

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Fig. 3.

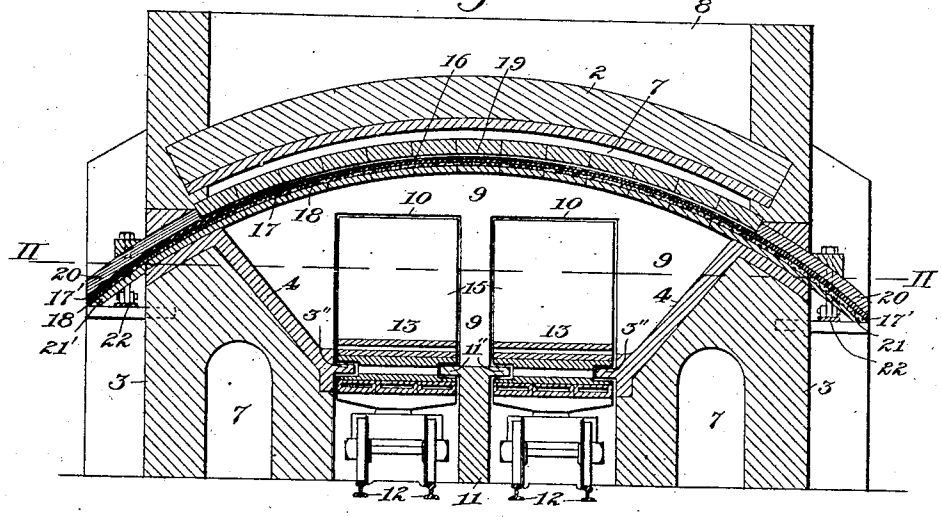


Fig. 4.

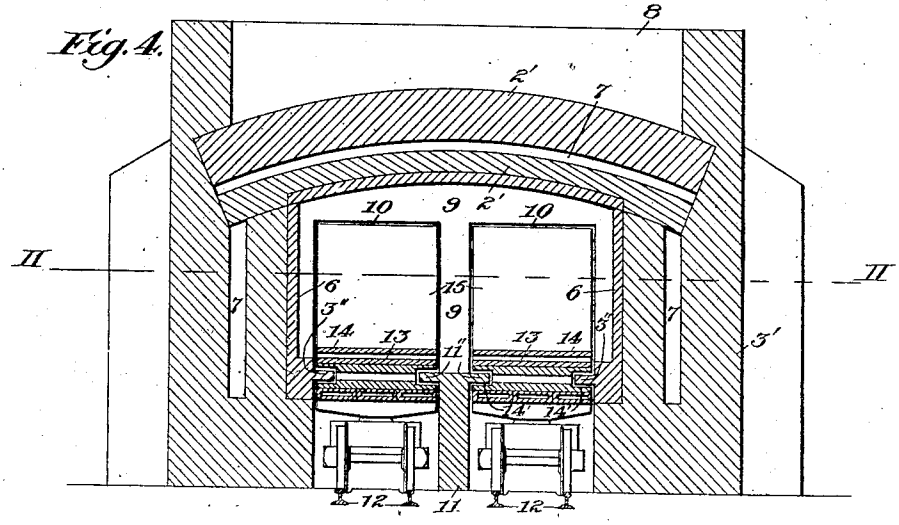
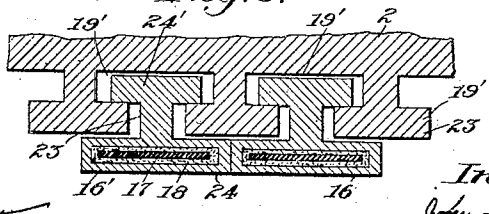


Fig. 5.



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UNITED STATES PATENT OFFICE.

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ELECTRIC KILN.

No. 925,902. Specification of Letters Patent. Patented June 22, 1909.

Application filed October 7, 1907, Serial No. 396,236. Renewed May 18, 1909. Serial No. 496,718.

To all whom it may concern:

Be it known that we, JOHN L. HARPER and WILLIAM J. LARKWORTHY, citizens respectively of the United States and Canada, residing at Niagara Falls, in the county of Niagara and State of New York, have invented certain new and useful Improvements in Electric Kilns, of which the following is a specification.

This invention is an electrically-heated kiln for baking brick, firing pottery, annealing glass, and similar purposes. The kiln is constructed to conserve electrical energy by transferring heat from the outgoing finished product to the incoming raw material. In its preferred construction, the kiln comprises a longitudinal series of chambers, having parallel tracks on which trains of trucks carrying the articles to be heated are moved in opposite directions. The source of heat is located in the middle chamber and the temperatures of the other chambers progressively decrease toward both ends of the kiln. The several chambers and the trucks are preferably of equal length, and when the kiln is in operation each chamber is occupied by two adjacent trucks of the oppositely-moving trains. The trains are moved simultaneously at intervals, so that the trucks of each are successively shifted, first from chamber to chamber of increasing temperature, up to the heating chamber, and then through chambers of decreasing temperature, until they leave the kiln. The periods between the shifting of the trucks are sufficient to permit the transfer of heat from the articles on each truck leaving the source of heat to those on the other truck in the same chamber, until the temperature of the two becomes substantially equal, so that when the finished articles leave the kiln their temperature is but little above that of the atmosphere. The trucks have end walls which close the openings in the partitions between the adjacent chambers, retarding the longitudinal flow of heat through the chambers, and the kiln-walls and the floors and end walls of the trucks have dead-air spaces to retard the flow of heat therethrough. The preferred heating means is a series of carbon resisters, extending transversely across the top of the middle chamber.

Referring to the accompanying drawings: Figure 1 is a vertical longitudinal section of the heating chamber and portions of two heat-equalizing chambers of a kiln, on the line I—I of Figs. 2, 3, 4; Fig. 2 is a horizontal longitudinal section of the same chambers, on the line II—II of Fig. 1; Fig. 3 is a vertical transverse section of the heating chamber, on the line III—III of Fig. 1; Fig. 4 is a vertical transverse section of a heat-equalizing chamber, on the line IV—IV of Fig. 1; and Fig. 5 is a vertical longitudinal section of a portion of the roof of a heating chamber having modified resistors.

In the specific construction illustrated, the heating chamber 1 has an arched roof 2 and side-walls 3 the inner faces 4 of which are inclined to assist in reflecting heat onto articles on the trucks. Each of the heat equalizing chambers 5 has an arched roof 2′, in line with the roof 2 of the heating chamber, and vertical side-walls 3′, set inward from the side walls 3 of the heating chamber. The inner faces 6 of the walls 3′ are vertical. The roofs 2, 2′ and side walls 3, 3′ may be built of common brick lined with fire-brick, and contain dead-air spaces 7 for heat insulation. The space 8 above the roofs may be filled with sand or other poor conductor of heat. The adjacent chambers of the kiln are partially separated by two spaced transverse walls 9, each containing two rectangular openings 10 to receive the end walls of the trucks. The lower portion of each chamber is divided by a longitudinal wall 11, to separate the trucks of the two trains.

Through the chambers 1, 5 run two parallel lines of tracks 12, each carrying a train of trucks 13. Each truck has a floor 14 and end walls 15 of refractory tile containing dead-air spaces. The trucks are of the same length as the chambers 1, 5, and their rectangular end walls 15 are of such size as to substantially fill but not touch the edges of the openings 10 in the transverse partitions 9. The spaces 7′ between the end walls contain non-circulating air and communicate with the dead-air spaces 7. Horizontal ribs 3″, 11″, projecting from the side walls 3, 3′ and the intermediate wall 11 of the kiln, extend loosely into horizontal grooves 14′ in each side of the truck-floors 14, and retard the escape of the heated air.

The heating means illustrated comprises a longitudinal series of transverse continuous resistors 16, each preferably consisting of a wide thin bar or granular element 17 of car-

bon or graphite, surrounded by a refractory non-conducting sheath 18, for example of siloxicon and a binder. These resisters are curved longitudinally in the arc of a circle and are loosely mounted in separate openings 19 in the refractory lining-arch of the roof 2. The terminal ends 17′ of the resister-bars are relatively thick and extend out of the sides of the heating chamber between clamping-plates 20, 21, which are connected to the electric mains 22. The upper sides of the graphite terminals are bare and the upper clamping plates 20, preferably of graphite, fit closely upon them, providing a joint of low resistance. By unclamping the plates 20, 21, any resister may be slid longitudinally out of its opening into a pit at the side for repair or renewal.

In the modification illustrated in Fig. 5, the roof of the heating chamber has transverse recesses 19′ with lower slots 23. Each resister 16′ comprises a carbon or graphite bar 17 and refractory sheath 18, mounted in a refractory non-conducting support 24. This support has an upper flanged rib 24′ of such shape and size as to loosely enter one of the recesses 19′ and slots 23 in the roof, being removable with its contained resister. This kiln enables articles to be uniformly heated to a high temperature with the minimum consumption of energy, little of the heat being lost through the walls, which may be effectively insulated, or being carried away by the outgoing product. While the kiln is especially designed to employ electricity as a source of heat-energy, the center chamber may be provided with grates for coal or burners for liquid or gaseous fuel, in lieu of the resisters, if a high temperature is not required. The kiln may conveniently have thirteen chambers and by the use of resisters as a heating means the heating chamber may be maintained at a temperature of 3,000°F., the first set of heat-equalizing chambers at each end of the heating chamber, at 2,400°, the second set at 1,800°, the third set at 1,200°, the fourth set at 750°, the fifth set at 500°, and the sixth set or end chambers at 250°. The electric kiln is especially advantageous for the firing of ceramic wares, on account of the absence of smoke and soot, saggers for the protection of the ware being unnecessary. Where economy of space is important the chambers of the kiln may be arranged in a circle or arc instead of a straight line.

I claim:

1. A kiln, consisting of a tunnel divided into a longitudinal series of chambers, means for heating an intermediate chamber, and two trains of trucks movable in opposite directions through the tunnel, each chamber receiving two trucks and permitting the unrestricted flow of heat between the contents of said trucks.

2. A kiln, consisting of a tunnel divided into a longitudinal series of chambers, means for heating an intermediate chamber, and two trains of trucks movable in opposite directions through the tunnel, the several chambers and trucks being of substantially the same length.

3. A kiln, comprising a longitudinal series of chambers, transverse apertured partitions between said chambers, means for heating an intermediate chamber, and two trains of trucks movable in opposite directions through the kiln, the several chambers and trucks being of substantially the same length and the trucks being constructed to substantially close the openings in said partitions.

4. A kiln, comprising a longitudinal series of chambers, transverse apertured partitions between the chambers, means for heating an intermediate chamber, and two trains of trucks movable in opposite directions through the kiln, the several chambers and trucks being of substantially the same length, and the trucks having heat-insulating floors and end-walls, said end-walls substantially closing the openings in said partitions.

5. A kiln, consisting of a tunnel divided into a longitudinal series of chambers, means for electrically heating an intermediate chamber, and two trains of trucks movable in opposite directions through the tunnel, each chamber receiving two trucks and permitting the unrestricted flow of heat between the contents of said trucks.

6. A kiln, consisting of a tunnel divided into a longitudinal series of chambers, electric resisters in position to heat an intermediate chamber, and two trains of trucks movable in opposite directions through the tunnel, each chamber receiving two trucks and permitting the unrestricted flow of heat between the contents of said trucks.

7. A kiln, consisting of a tunnel divided into a longitudinal series of chambers, electric resisters carried by the roof of an intermediate chamber, and two trains of trucks movable in opposite directions through the tunnel, each chamber receiving two trucks and permitting the unrestricted flow of heat between the contents of said trucks.

8. A kiln, comprising a longitudinal series of chambers, transverse apertured partitions between said chambers, electric resisters carried by the roof of an intermediate chamber, and two trains of trucks movable in opposite directions through the kiln, the several chambers and trucks being of substantially the same length and the trucks being constructed to substantially close the openings in said partitions.

9. A kiln, comprising a longitudinal series of chambers, transverse apertured partitions between said chambers, longitudinally-

removable electric resistors carried by the roof of an intermediate chamber, and two trains of trucks movable in opposite directions through the kiln, the several chambers and trucks being of substantially the same length and the trucks being constructed to substantially close the openings in said partitions.

In testimony whereof, we affix our signatures in presence of two witnesses.

JOHN LYELL HARPER.
WILLIAM JOHN LARKWORTHY.

Witnesses:
FRANK E. REID,
BENJ. F. LEE.