Feb. 26, 1924. 1,485,109

H. W. H. BETH ET AL

TUNNEL KILN

Original Filed Nov. 27, 1920

Fig. 2

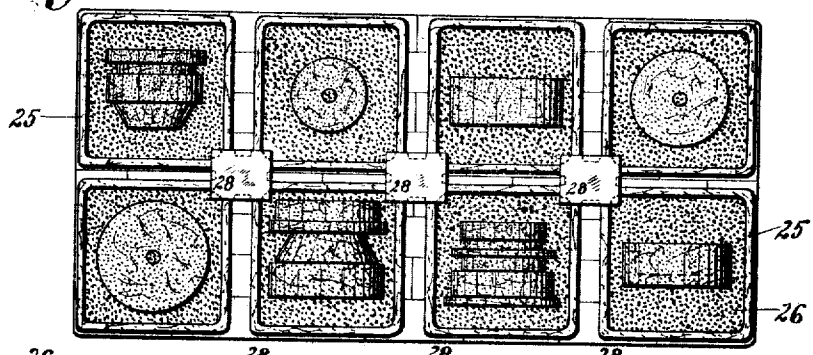


Fig. 1

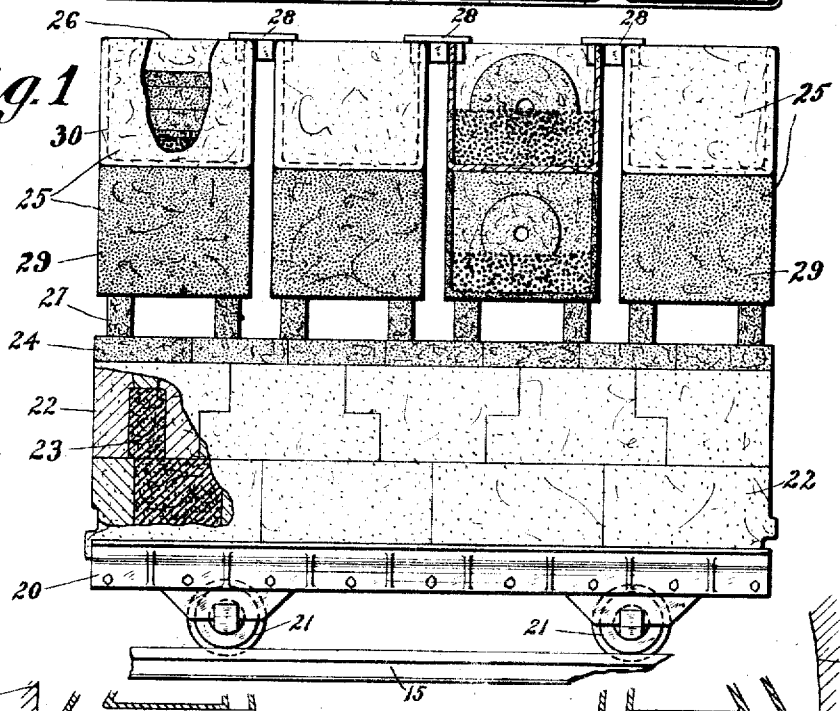
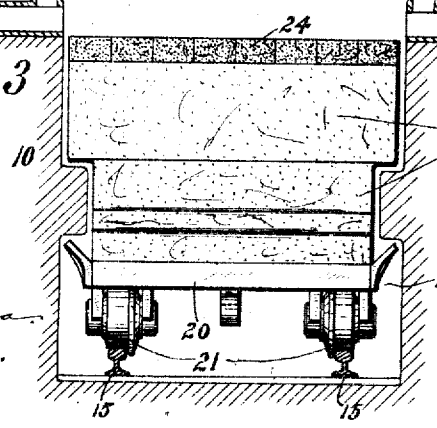


Fig. 3



WITNESSES

John H. Keenan

Harold R. Savage.

INVENTORS

Hugo W.H. Beth.

Milton F. Beecher.

BY

Clayton C. Jenkins

ATTORNEY

Patented Feb. 26, 1924. 1,485,109

UNITED STATES PATENT OFFICE.

HUGO W. H. BETH AND MILTON F. BEECHER, OF WORCESTER, MASSACHUSETTS, ASSIGNORS TO NORTON COMPANY, OF WORCESTER, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

TUNNEL KILN.

Application filed November 27, 1920, Serial No. 426,712. Renewed January 7, 1924.

To all whom it may concern:

Be it known that we, HUGO W. H. BETH and MILTON F. BEECHER, citizens of the United States of America, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented certain new and useful Improvements in Tunnel Kilns, of which the following is a full, clear, and exact specification.

This invention relates to tunnel kilns of the type exemplified by the patent to Dressler No. 1,023,628 of April 16, 1912, and more particularly to kiln cars and associated equipment for supporting and conveying ceramic ware through the tunnel kiln.

Tunnel kilns of this type involve a longitudinal heating chamber having benches for supporting heating muffles thereon and a longitudinal passage for the kiln cars between the benches so arranged that the car wheels and frame will be below the heating zone and shielded from the intense heat by a body of refractory material on the car frame. The muffles in this kiln have transverse air circulating passages adapted to cooperate with a similar transverse passage in the car body to circulate the heated air beneath the ware and around the heating muffles. In the cars heretofore utilized in this kiln, the car top made of the usual refractory poor conducting fire clays has been mounted upon separated transverse beams and provided with spaced openings communicating with the transverse passages. Since such cars are periodically removed from the kiln and so subjected to repeated heating and cooling treatment, these car tops tend to warp and otherwise become defective and so render it difficult to properly set the cylindrical batts and saggers heretofore employed to support the ceramic ware during firing and require the careful levelling of each stand of saggers. Furthermore, an uneven heat distribution results from the facts that some of the car top openings are partly covered and free circulation of the air partially restricted by the saggers, while others are wholly exposed, and that the massive car top and its supports being of ordinary fire clay and therefore poor heat conductors, retard somewhat the conduction of heat to the center of the car, and this is a contributing cause for the ware being cooler at the bottom than at the top of the car.

It is accordingly an object of this invention to obviate the difficulties heretofore experienced in setting and conveying ceramic ware through the heating zone of the kiln and to provide a kiln car construction and arrangement of parts which is well adapted for setting and firing ceramic articles, which will be economical of space and permit the setting of the maximum number of articles on each car, which will insure more uniform heating of the ware during firing, and which otherwise will increase the general efficiency and practicability of kilns of this type.

With this and other objects in view, as will be apparent from the following disclosure, our invention resides in the combination of parts as described herein and covered by the claims appended hereto.

In the drawings:

Figure 1 is a side elevation of a tunnel kiln car embodying this invention;

Fig. 2 is a top plan view of the car; and

Fig. 3 is an end view of the car showing the relation of the car to the tunnel kiln walls and heating muffles.

In the drawings, which illustrate one embodiment of this invention, we have therein diagrammatically shown a tunnel kiln (see Fig. 3) which involves the masonry work 10 made of suitable refractory material having an arched roof indicated in part at 11 and flat benches 12 for supporting the muffles 13 thereon. The benches 12 are spaced by a longitudinal passage 14 within which the kiln cars traverse, these cars being adapted to run upon suitable rails 15 supported on the floor of the kiln. In the form illustrated, this kiln car comprises a metal frame work 20 suitably mounted upon wheels 21 in accordance with any suitable construction as is well known in this art. The refractory superstructure mounted upon the car frame 20 comprises hollow refractory blocks 22 which may be filled with suitable powdered refractory heat insulating material 23 such as infusorial earth. These blocks 22 are of jointed shape adapted

to interlock and interfit with each other to provide a solid and substantial foundation for the ceramic ware.

Since it is necessary that the ceramic ware be uniformly heated and to prevent the kiln car cooling the ware adjacent it because of the car body being massive and absorbing heat but slowly due to its location in the unheated passage below the muffle benches, we provide a car top 24 of refractory material which has a high heat conductivity. As a specific example of one type of block which is adapted for this purpose, we may utilize crystalline alumina or silicon carbide granules which have been bonded by suitable ceramic bonds well known in the refractory art, such as a mixture of suitable ball clays so proportioned as to bond the granules into a compact, dense structure capable of resisting heavy loads, as well as high temperature conditions in the kiln. As illustrated in Fig. 3, this car top is made up of solid bricks closely positioned and joined by a refractory cement, which may be similar in composition to the bricks, to form a plain and imperforated surface. This top is substantially on a level with the top of the muffle bench so that heat from the muffles may be directed across the car beneath the saggers.

In order that the ware, such as grinding wheels, may be subjected to even temperature conditions, we support them in suitable saggers 25 of rectangular cross section, as illustrated in Figs. 1 and 2. Each sagger has an open top 26 and is so shaped and constructed that it may be set upon the open top of another sagger and firmly supported thereon to form stacks of a suitable height depending upon the space in the kiln. In order to provide for transverse circulation of the heated air from the muffles across the car top, we utilize refractory bricks 27, which are also of high heat conductivity and may be made of the ceramic bonded crystalline alumina granules. These bricks, which are of proper dimensions, are spaced apart on the car top for suitably supporting the stacks of the saggers and to permit the circulation of gas therebetween. The saggers are mounted on the bricks 27 with their sides parallel to the car side and spaced apart both longitudinally and transversely so that heated air may circulate freely around each stack. This spacing may be maintained by suitable means such as the refractory blocks 28 which engage the upper saggers, as illustrated, and steady the whole pile. Since the upper portion of the kiln chamber tends to be hotter than the part adjacent the car top, we may make the saggers 29 adjacent the car of a refractory material of high heat conductivity, such as ceramic bonded crystalline alumina or silicon carbide, and use the ordinary fire clay saggers 30 for the top members of the stacks. By this arrangement and selection of kiln furniture of proper conductivities, we insure furnishing more heat to the ware which is located in relatively cool positions and somewhat protect the ware in hotter portions of the kiln from the effects of direct radiation of heat.

In accordance with this invention, we provide a tunnel kiln car and its associated equipment which largely increases the efficiency of the kiln. Due to lowering the car platform to the level of the muffle bench, one may pile higher stacks or saggers on the car than heretofore possible. A large economy furthermore results from the employment of open top saggers of rectangular cross section arranged in vertical spaced stacks, it having been found that the primary loss in setting space has been due to the use of round saggers as are ordinarily employed in the grinding wheel industry for supporting wheels on their flat faces. The heat distribution is maintained more uniform than heretofore possible by separating the stacks of saggers from one another and from the car top so that the heated air may traverse the kiln above the car top and directly in contact with the bottoms of the saggers and circulate around each stack. The heat distribution is furthermore aided by the employment of bricks of high heat conductivity for the car top and the supporting blocks, these blocks being made of such material that they retain their shape under the high heat conditions in the kiln and do not deteriorate under normal usage.

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

1. In a tunnel kiln having longitudinal muffle benches in the heating chamber and a car traversing passage therebetween, the combination therewith of a car comprising a wheeled support, an imperforate refractory body portion thereon having a plane top disposed substantially on a level with said benches, small refractory blocks of high heat conductivity spaced on said car top so as not to obstruct the transverse flow of gases and stacks of refractory containers disposed on said blocks in spaced relation transversely and longitudinally of the car.

2. A tunnel kiln car comprising a wheeled support, a refractory body thereon having a plane imperforate top of ceramic bonded granules of high heat conductivity, refractory blocks of high heat conductivity spaced on said top and open topped saggers of rectangular cross section mounted on said blocks and spaced apart longitudinally and transversely of the car.

3. An apparatus for firing ceramic ware in a tunnel kiln comprising a wheeled support, a refractory body thereon having an

imperforate flat car top, rows of stacks of refractory containers spaced each way from one another and small refractory blocks supporting said stacks on the flat car top and permitting a substantially free circulation of heated gas thereunder and between the stacks.

4. An apparatus for firing ceramic ware in a tunnel kiln comprising a wheeled support, a refractory body of low conductivity thereon, an imperforate flat top layer on said body of super-refractory material of high heat conductivity and rows of stacks of refractory containers supported on said top layer in spaced relation from each other and said top layer to permit free circulation of heated kiln gas thereabout.

5. In combination with a tunnel kiln having a car passage, a muffle bench and a muffle thereon which has transverse air circulating passages, a car comprising a wheeled support, a refractory body thereon having a plane imperforate top disposed just below said passages, stacks of open topped refractory receptacles of rectangular cross-section mounted on said car tops in spaced relation and means to hold the stacks spaced from each other and the car top for the circulation of heating gases around the stacks.

Signed at Worcester, Massachusetts, this 26th day of Nov., 1920.

HUGO W. H. BETH.
MILTON F. BEECHER.

Certificate of Corre[illegible]

It is hereby certified that in Letters Patent No. 1,485,109, granted February 26, 1924, upon the application of Hugo W. H. Beth and Milton F. Beecher, of Worcester, Massachusetts, for an improvement in "Tunnel Kilns," errors appear in the printed specification requiring correction as follows: Page 2, line 110, claim 1, strike out the words "an imperforate" and insert instead the article *a*, and line 111, strike out the article "a" and insert the words *an imperforate;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of April, A. D. 1924.

[SEAL.]

KARL FENNING,
Acting Commissioner of Patents.