May 23, 1933. A. B. ZAHN 1,910,873

ROTARY KILN

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Fig. 1.

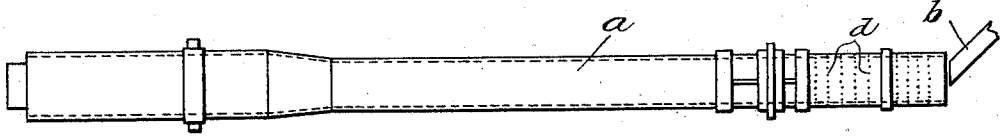


Fig. 2.

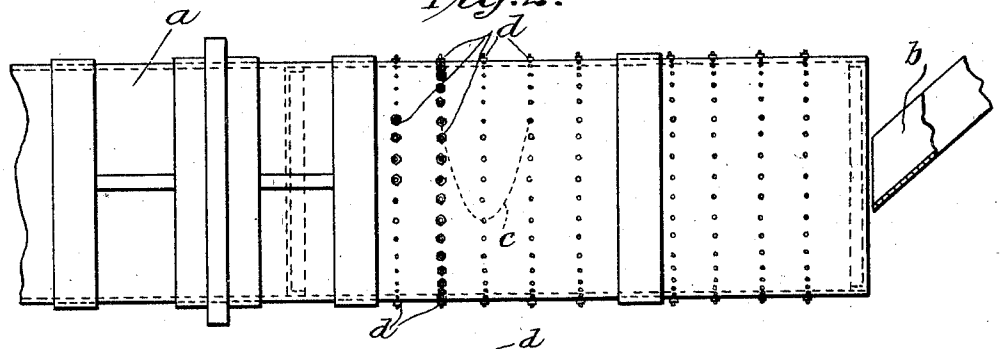
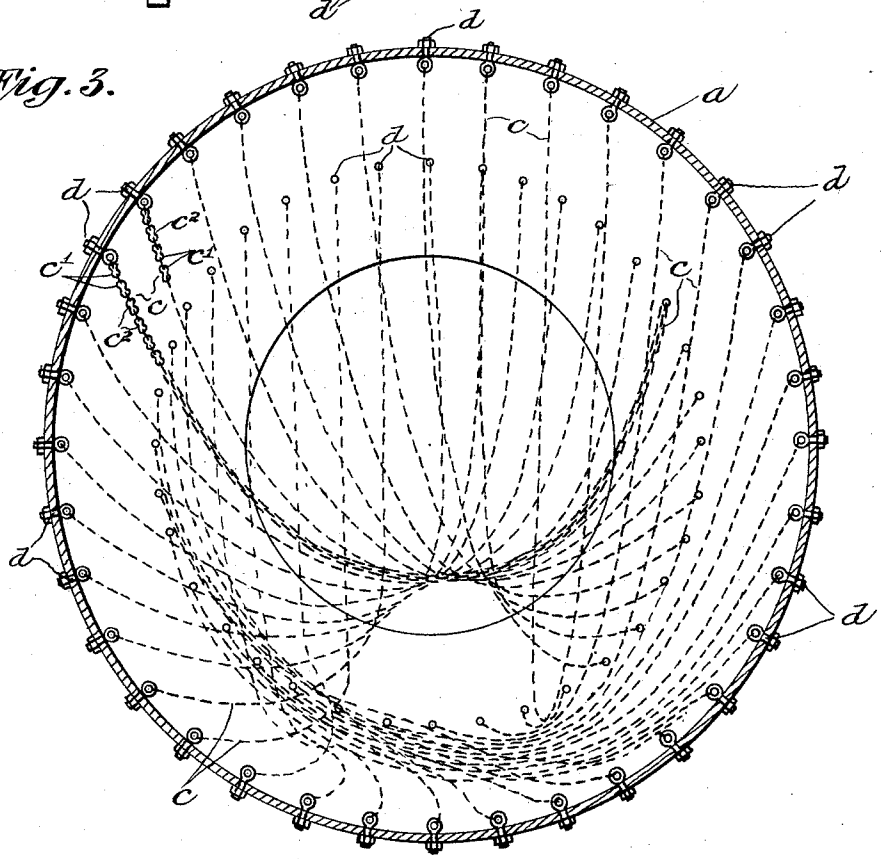


Fig. 3.



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Fig. 4.

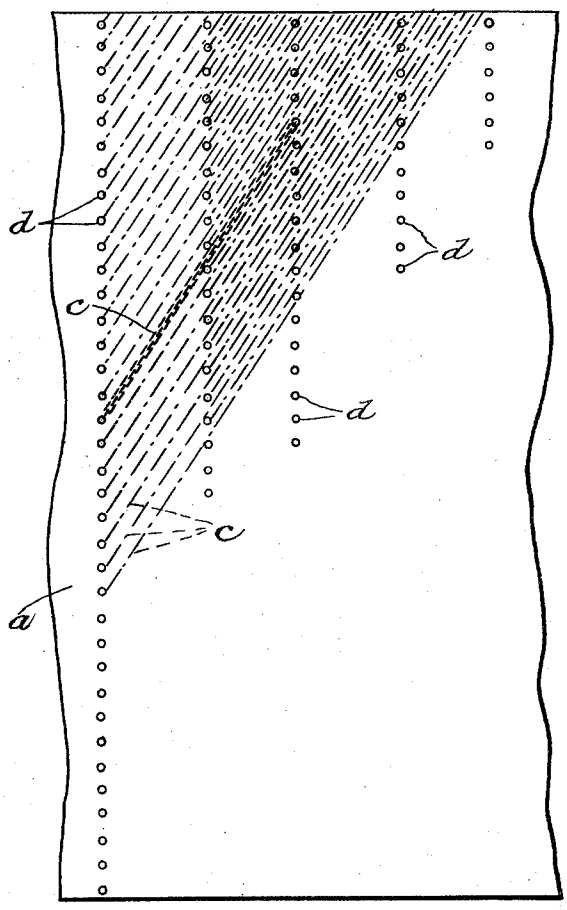


Fig. 5.

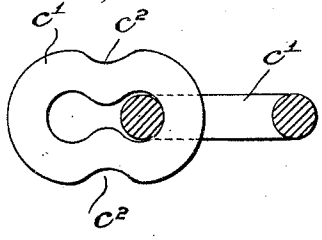


Fig. 6.

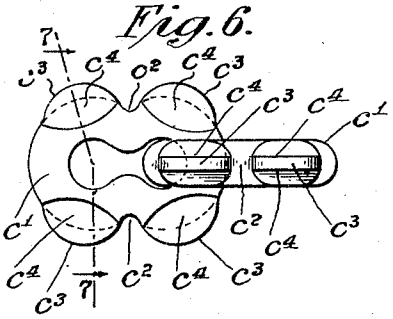


Fig. 7.

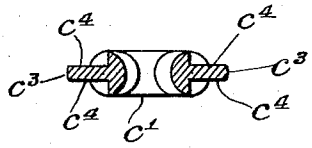
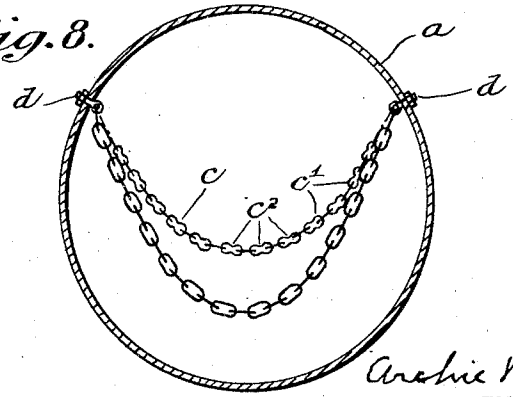


Fig. 8.



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UNITED STATES PATENT OFFICE

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ROTARY KILN

Application filed April 19, 1932. Serial No. 606,130.

This invention relates to the burning of slurry in rotary kilns and more particularly to use in such kilns of cross chains by which the transmission of heat from the hot products of combustion to the slurry is promoted. The arrangement of such cross chains in rotary kilns and the manner in which they function are fully described in Letters Patent of the United States No. 1,313,281 dated August 19, 1919 and granted to F. L. Smidth & Co., the assignee in the present case, upon the application of J. S. Fasting. The installation of such chains in rotary kilns employed in the wet process of cement manufacture has been of great value to the cement industry of the United States, the annual saving in fuel cost to the cement manufacturers, effected thereby, being estimated conservatively at one and one-half million dollars. In the long continued and widespread use of such cross chains under the observation of the engineers of the assignee herein efforts have been made to increase the efficiency of such heat transmission devices. It has been realized, of course, that the transmission of heat might be increased by an increase in the number of chains installed in a kiln, or by increasing the length of the chains employed, but it has been realized also that thereby the dead load carried by the kiln in its rotation would be increased also and that, particularly if it should be sought to increase the length of the chains used, the wear on the kiln lining and on the chains themselves would be increased. In the continued study of the problem presented it has been found, in the development of the present invention, that the increase of efficiency in the transmission of heat, without increase of wear of the chains and of the kiln lining, can be secured by such deformation of the chains as will increase the heat absorbing surface of the chains without increasing their length. In accordance with the invention, therefore, the chains employed for the purpose in rotary kilns are deformed, primarily, by bending in the sides of each link, between its ends, toward the longitudinal axis of the link and also, it may be, by pinching or stamping the metal of the link so as to form flattened projections. In these ways it has been found possible to increase materially the surface per unit of length and thereby to promote more rapid absorption and conduction of the heat, not only without increasing the number of chains or the length of the chains, but also with chains somewhat shorter than those commonly employed, whereby wear of the chains and lining of the kiln is considerably diminished.

The invention will be more fully explained hereinafter with reference to the accompanying drawings in which it is illustrated, and in which:

Figure 1 is a view in elevation of a rotary kiln to which the present improvements may be applied.

Figure 2 is a view in elevation, on a somewhat larger scale, of the feeding end of the kiln.

Figure 3 is a cross-sectional perspective view, partly diagrammatic, showing one chain in the position which it occupies at one point in the rotation of the kiln, the positions of the other chains of the same series being indicated by broken lines.

Figure 4 is a diagrammatic view of a development of the inner wall of the kiln indicating the disposition of the cross chains.

Figure 5 is a detail view showing one of the improved links as having its sides bent inward toward the longitudinal axis, the adjacent link being shown in section.

Figure 6 is a detail view showing two interconnected links with their sides bent in toward the longitudinal axis and pressed or stamped to form flattened projections.

Figure 7 is a detail view in section on the plane indicated by the broken line 7—7 of Figure 6.

Figure 8 is a conventional view illustrating the advantage gained by the invention.

As represented in Fig. 1, the kiln *a* may be of ordinary construction, being provided at its feeding end with a suitable supply chute *b* through which the slurry is fed to the kiln and at its other end with a suitable combustion chamber. As is well understood more or less of the slurry, in the rotation of such a kiln, adheres to the inner wall of the kiln, is carried upward with the wall of the kiln, in the direction of rotation, and is continuously falling or slipping back toward the lowest part of the kiln. The chains *c*, which are secured at their ends to the inner wall of the kiln by suitable bolts, as indicated at *d*, and are preferably arranged helically in the kiln, as indicated particularly in Fig. 4, dip into the wet slurry in the rotation of the kiln and carry the adhering slurry upward and across the flowing stream of the hot products of combustion. Preferably the chains are somewhat slack, so that the bight of each chain shall lie in the slurry in the lower part of the kiln. The chains themselves, as they pass through the hot products of combustion in the kiln, absorb heat from such products of combustion and give up the heat to the slurry with which they are coated, the slurry which passes through the current of hot gases itself absorbing heat from the hot gases. As indicated in the drawings many chains are provided and they are preferably arranged helically, that is, with the leading end of each chain out of the plane of the following end so that the movement of the slurry through the kiln is promoted. As will be understood the slurry which dries on the chains is broken away from the chains by the flexing of the slack chains and falls into the slurry below and further when the chains are sufficiently slack to rest upon the inner wall of the kiln, as indicated in the drawings, the incrustation of slurry on the wall of the kiln will be prevented thereby. Preferably the two ends of each chain are connected to the wall of the kiln about 120° apart, but it will be understood that the specific arrangement of the chains, both as regards their connection to the wall of the kiln and as regards the degree of slackness and the degree of obliquity of the chains will be determined by the conditions of operation.

As thus far described the arrangement and operation of the chains are substantially the same as described in said Patent No. 1,313,281. For the purpose of increasing the heat absorbing and heat transmitting surface of the chains without increasing their length or number, each link c^1 of each chain is deformed as by having its sides pressed in, as indicated at c^2, toward its longitudinal axis whereby the total length of the chain is materially decreased, but without impairing the flexibility of the chain or increasing its weight. For the purpose of further increasing the area of the absorption surface each link is further deformed, as by stamping or pressing, to form projecting portions c^3 with flat surfaces, as at c^4, the increase of surface area of each link being thereby increased without affecting the flexibility of the chain or increasing its weight.

The chains ordinarily used for the purpose described are formed in electric welding machines from rods 5/8″ diameter. The standard chain, such as has been used hertofore, made without deformation of the links, has a total surface area of 93 square inches for each foot in length of the chain, with a weight of 4.1 pounds per foot. A chain formed in the same manner and of rods of the same diameter, but deformed as described, has a surface area of 109.5 square inches for each foot in length of the chain with a weight of 4.796 pounds for each foot in length. The improved chain has therefore a surface area approximately 17% greater than a chain of the same length without deformation of the links and a weight about 17% greater.

For purposes of comparison it may be pointed out that a standard chain made of 3/4″ rod has a surface area of 110 square inches per foot and a weight of 5.8 pounds per foot, that is to say, for approximately the same surface area such a standard chain has a weight about 12% greater than a special chain of the same length. The relative lengths of a special chain having links deformed in accordance with the invention, and of a standard chain of the same length before deformation, are indicated, with but slight exaggeration, in Fig. 8 of the drawings.

I claim as my invention:

1. The combination with a rotary kiln for burning slurry of cross chains secured to the interior of the kiln near the feeding end of the kiln and adapted, in the rotation of the kiln, to be dipped into the wet slurry, to become coated thereby, and to lift the slurry into the path of the hot products of combustion, each link of each chain being deformed to shorten its length for the purpose of giving a greater surface area in proportion to its length.

2. The combination with a rotary kiln for burning slurry of cross chains secured to the interior of the kiln near the feeding end of the kiln and adapted, in the rotation of the kiln, to be dipped into the wet slurry, to become coated thereby, and to lift the slurry into the path of the hot products of combustion, each link of each chain being deformed to shorten its length and having projections with flattened sides all for the purpose of giving a greater surface area in proportion to its length.

3. The combination with a rotary kiln for burning slurry of cross chains secured to the interior of the kiln near the feeding end of

the kiln and adapted in the rotation of the kiln, to be dipped into the wet slurry, to become coated thereby, and to lift the slurry into the path of the hot products of combustion, each link of each chain having its sides bent inward toward its longitudinal axis to shorten its length for the purpose of giving a greater surface area in proportion to its length.

This specification signed this 5th day of April A. D. 1932.

ARCHIE B. ZAHN.