106-97 CROSS REFERENCE EXAMINER

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March 31, 1953 A. W. HEYMAN 2,633,347

ROTARY INTERNALLY-FIRED KILN

Filed May 1, 1951

Fig1.

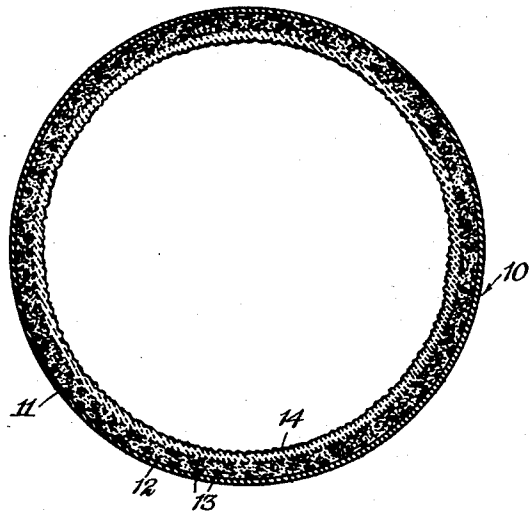


Fig2.

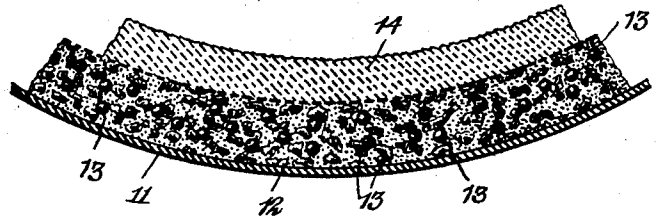
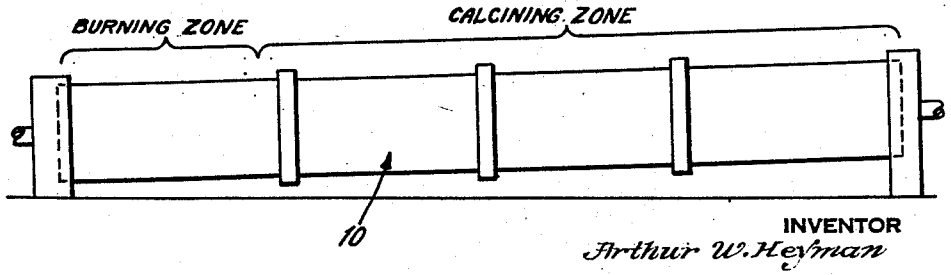


Fig3.



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ROTARY INTERNALLY-FIRED KILN

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7 Claims. (Cl. 263—33)

1

This invention relates to rotary internally-fired kilns and more particularly to the burning-zone lining of internally-fired kilns such as are used in the production of Portland cement, lime and similar materials.

This application is a continuation-in-part of my previous application Serial No. 759,609 filed July 8, 1947, and now abandoned.

In kilns of this general type, a steel cylinder is provided with a lining of firebrick. The firebrick prevents destruction of the steel cylinder and a coating of the material being processed protects the firebrick. Were it not for this coating of the material under process, the firebrick would be destroyed and the cylinder ruined. In the operation of kilns of the type described, it is exceedingly important therefore to maintain a relatively thick layer or coating of the material being processed on the firebrick and particularly on the firebrick which lines the lower end of the kiln at the point where the temperatures are highest.

The method by which this coating is applied to the firebrick may be described as follows:

Referring now to a firebrick lined kiln used for clinkering Portland cement, the kiln is heated gradually while the raw material moves downwardly through the kiln and becomes decarbonated. This occurs in the calcining zone of the kiln. When this decarbonated material approaches the point where the coating is desired, the temperature is increased until the surface of the firebrick begins to melt. The decarbonated material flows over the melted firebrick surfaces and unites therewith to form the initial coating. This phenomenon takes place in the burning zone of the kiln. By skillful handling, the coating may be built up to a thickness of several inches. The material at the junction between the firebrick and the coating has a much lower melting point than either the coating or the brick and, due to the fact that excessively high temperatures are occasionally built up in the kiln, such overheating may penetrate a coating which has not attained sufficient thickness, whereupon the junction material may soften and the coating fall off.

It is accordingly the principal object of this invention to provide a lined construction for kilns of the general type described which will insure a strong and permanent bond between the lining and the coating which protects the lining.

Another object of this invention is the provision of a lining construction for kilns of the

2

type herein referred to, in which provision is made for better heat dissipation whereby the accumulation of excessive heat in the bond between the lining and its coating is prevented.

The key to the present invention lies in the recognition of the fact that good heat dissipation through the kiln wall is necessary to prevent destruction of the bond between the kiln lining and the coating applied thereto. It has heretofore been believed that only firebrick or a substance equally as indestructible as firebrick in the presence of heat, is necessary to protect the steel cylinder which constitutes the outer wall of the kiln. Although the lining of the kiln protects the steel cylinder, such lining—even if composed of the most refractory firebrick—also needs protection from the heat and from the erosive and scorifying effects of the material being processed and this is furnished by the above mentioned coating. If this coating can be built up to such a thickness that the bond between coating and lining is not weakened by the occasional overheats which sometimes occur during operation, then it is unnecessary for the lining to be resistant to high temperatures.

Bearing these considerations in mind, the method by which the present invention is carried out consists in substituting a heat-conductive material for the less-conductive firebrick. In the preferred form of this invention, the steel cylinder is lined in whole or in part with a composition consisting of concrete which contains a preponderance of metal balls, metal filings, shavings, and the like. The metal is highly conductive and the more metal the concrete contains, the more conductive will be the lining.

A preferred form of this invention is shown on the accompanying drawing in which:

Figure 1 is a cross sectional view through a typical kiln of the character to which the lining forming the subject matter of this application is applied;

Figure 2 is an enlarged detailed fragmentary view of a portion of the kiln wall showing the nature of the new lining; and

Figure 3 is a view showing a rotary internally-fired kiln to which the lining is applied.

It will be seen that the kiln 10 has an outer wall or shell 11 which is made of steel plate. A lining 12 is applied to the inside surface of said wall, and it will be seen that said lining comprises a concrete mix containing pieces of metal 13. These pieces of metal may be scrap metal, metal balls, borings and filings, or the like. The type of metal which may be used is

not critical and the prime consideration is that it be highly conductive to heat. Therefore, scrap iron, for example, would be highly desirable to use for the purpose indicated. If the more expensive metals such as copper are also used, the purposes for which the present invention has been devised will be served equally as well. The more metal the concrete mix contains, the more conductive will the lining as a whole be.

As previously expressed, the ratio of metal pieces to the cementitious binder is such that a preponderance of metal is present. It is not the intent to limit this disclosure to a defined percentage. With the fact in mind that extensive conductivity is the aim, efficiency can be obtained by a selected degree of preponderance of metal as long as the cementitious material is sufficient in quantity to provide proper binder and adhesive surface for the formation of the coating of raw material in the kiln. The concrete itself may be laid directly upon the inside of the wall 11, being cast into the shape of a cylindrical shell surrounded by the metal wall or shell 11.

The conductive lining may consist basically of a binder of any type of cementitious material of the class known to the industry as hydraulic cements and this binder mixed with metal as described. An illustrative mix or composition, however, would consist of about one part by weight of a hydraulic cement such as calcium aluminate cement, about one part by weight of crushed firebrick, and about four to six parts by weight of scrap metal. Sufficient water is added to make a dense concrete and this is tamped or vibrated into place on the inside of the steel shell. As much metal as possible is used consistent with the attainment of low porosity in the final concrete product; also, the pieces of metal should be of various sizes (like sand and gravel in ordinary concrete) in order to attain greater density. Porosity increases the insulating quality of the concrete and this would negative to a certain extent the heat dissipating benefits which would be attained by incorporating metal into the concrete mix.

While calcium aluminate cement is a preferable binder for the lining, it should be kept in mind that Portland or any other type of hydraulic cement could be used and such use would not be a departure from the scope of this invention.

Although the concrete has hereinabove been described as being laid directly upon the inside of the steel wall of the kiln, it will be appreciated that the concrete may be preformed in the shape of blocks similar to the firebrick heretofore used, and these concrete blocks may of course be mounted on the inside of the kiln wall in substantially the same manner as has heretofore been done with the firebrick. It may be found desirable when the concrete mix is laid directly upon the kiln wall to affix metal bars or rods to the inside surface of said wall by means of welding or by similar means before the mix is laid thereon so that a better attachment or adherence of the concrete to the wall may thereby be attained.

It should be understood that the lining composition under discussion is applied to the kiln only in those areas where it is desirable to have a clinker coating 14 such as has above been described, i. e., in the burning zone. In all other parts of the kiln, conventional firebrick or other conventional material may be used for the lining.

The process by which the clinker coating may be deposited upon the concrete lining under discussion may now be described. Substantially the same process as has above been described in connection with conventionally lined kilns may be followed in connection with the concrete lining of the present invention. The newly-lined kiln is heated until the raw material which moves down the kiln becomes decarbonated. This of course is a continuous process, and when the decarbonated material approaches the concrete lining, the temperature is increased to such a degree that the exposed surface of the concrete lining is caused to melt. When the decarbonated material flows over the melted surface of the concrete lining, a bond is created between such material and said lining and the initial coating is thereby achieved. The process continues until the coating is built up to a desirable thickness.

It is recognized by men skilled in the art that the readiness with which a thick coating may be formed depends largely on the heat-dissipating quality of the lining on which the coating is to be deposited. If such lining is highly non-conductive, it is very difficult to build a coating of the desired thickness. By the use of a conductive lining, heat is more readily dissipated, whereby a coating is formed which is sufficiently thick to prevent the penetration of an overheat to the vulnerable junction point.

Thus, in my invention I have departed from the old established theory in the industry that a highly protective lining such as firebrick is absolutely essential. By turning to the theory of conductivity I have proved that a lining which will readily conduct heat will so permit the buildup of clinker coating that the protective characteristics of the lining composition is not critical.

It will be seen that my conductive lining is doubly effective in protecting the junction point; first, it allows the deposition of a thicker coating; second, it dissipates to the outside shell any heat which may penetrate the coating and thus prevents the melting or softening of the junction material.

It will be understood from the foregoing that, although the concrete lining is not as resistant as ordinary firebrick to the destructive effect of high temperatures it will nevertheless have a much longer life because of the greater protection afforded by the thicker coating.

The invention above described is susceptible of modifications in accordance with the practices and skills of the art and these modifications are contemplated herein. For example, the kiln under discussion may be a conventional air-cooled kiln. On the other hand, it may also be a water-cooled kiln. It will be appreciated that if water is poured or spread upon the kiln shown in the accompanying drawing, even greater heat-dissipating qualities will be provided than would be possible in the absence of such water-cooling process.

I claim:

1. A rotary internally-fired kiln used in the production of Portland cement, lime and similar materials having a conductive lining in its burning zone, said lining consisting essentially of a binder of hydraulic cement having a preponderance by weight of iron pieces of varying size distributed throughout it, together with sufficient water to make it a dense concrete, said lining adapted to have built up thereon a coating of material being processed to a thickness such that the junction of coating and lining does not

soften due to occasional overheats of the kiln.

2. A rotary internally-fired kiln used in the production of Portland cement, lime and similar materials having a conductive lining in its burning zone, said lining consisting essentially of a binder of calcium aluminate cement having a preponderance by weight of highly conductive iron pieces distributed throughout it, together with sufficient water to make it a dense concrete, said lining adapted to have built up thereon a coating of material being processed to a thickness such that the junction of coating and lining does not soften due to occasional overheats of the kiln.

3. A rotary internally-fired kiln used in the production of Portland cement, lime and similar materials having a conductive lining in its burning zone, said lining consisting essentially of a binder of hydraulic cement with crushed fire-brick and having a preponderance by weight of iron pieces of varying size distributed throughout it, together with sufficient water to make it a dense concrete, said lining adapted to have built up thereon a coating of material being processed to a thickness such that the junction of coating and lining does not soften due to occasional overheats of the kiln.

4. A rotary internally-fired kiln used in the production of Portland cement, lime and similar materials having a conductive lining in its burning zone, said lining consisting essentially of a binder of calcium aluminate cement with crushed fire-brick and having a preponderance by weight of highly conductive iron pieces distributed throughout it, together with sufficient water to make it a dense concrete, said lining adapted to have built up thereon a coating of material being processed to a thickness such that the junction of coating and lining does not soften due to occasional overheats of the kiln.

5. A rotary internally-fired kiln used in the production of Portland cement, lime and similar materials having a conductive lining in its burning zone, said lining consisting essentially of a binder of hydraulic cement having from four to six parts by weight of iron pieces of varying size distributed throughout it, together with sufficient water to make it a dense concrete, said

lining adapted to have built up thereon a coating of material being processed to a thickness such that the junction of coating and lining does not soften due to occasional overheats of the kiln.

6. A rotary internally-fired kiln used in the production of Portland cement, lime and similar materials having a conductive lining in its burning zone, said lining consisting essentially of a binder of calcium aluminate cement having from four to six parts by weight of highly conductive iron pieces distributed throughout it, together with sufficient water to make it a dense concrete, said lining adapted to have built up thereon a coating of material being processed to a thickness such that the junction of coating and lining does not soften due to occasional overheats of the kiln.

7. A rotary internally-fired kiln used in the production of Portland cement, lime and similar materials having a conductive lining in its burning zone, said lining consisting essentially of a binder of hydraulic cement with crushed fire brick and having from four to six parts by weight of highly conductive iron particles distributed through it, together with sufficient water to make it a dense concrete, said lining adapted to have built up thereon a coating of material being processed to a thickness such that the junction of coating and lining does not soften due to occasional overheats of the kiln.

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