

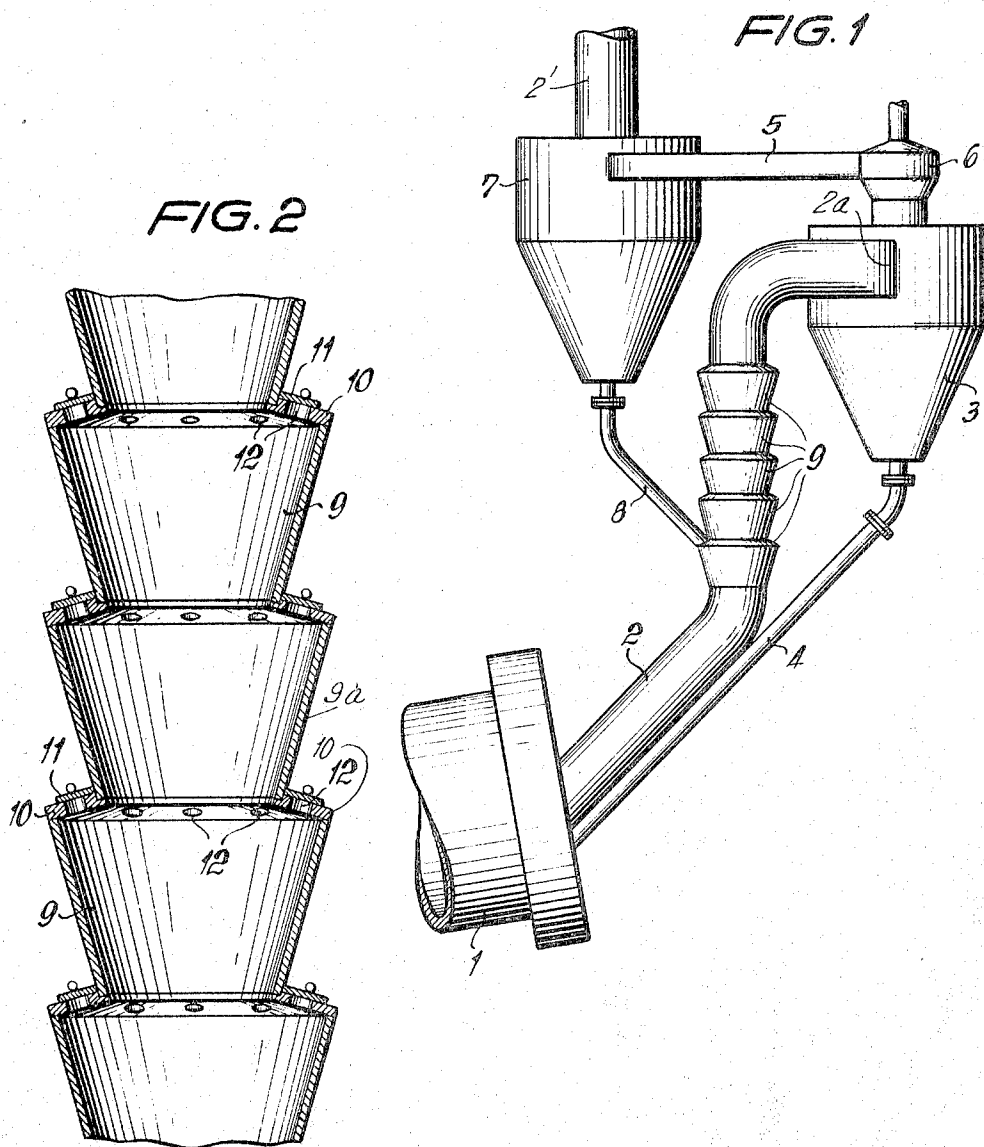
Jan. 17, 1967

R. KUS ETAL

3,298,110

APPARATUS FOR THE PREHEATING OF RAW CEMENT MATERIAL

Filed Dec. 17, 1963



INVENTORS
RUDOLF KUS
HEINZ JÄGER

Brislin & Holzfank
ATTORNEYS

1

3,298,110

APPARATUS FOR THE PREHEATING OF RAW CEMENT MATERIAL

Rudolf Kus and Heinz Jäger, Bochum, Germany, assignors to Wedag Westfalia Dinnendahl Groppel Aktiengesellschaft, Bochum, Germany, a corporation of Germany

Filed Dec. 17, 1963, Ser. No. 331,250

Claims priority, application Germany, Dec. 20, 1962, W 33,571

7 Claims. (Cl. 34-57)

This invention relates to apparatus for the preheating of pulverulent raw cement material, and more particularly to such apparatus having a number of cyclone separators mounted in tandem and which may be mounted in stages one above the other, the separators being traversed in sequence by the hot exhaust gases of a furnace, particularly of a rotary kiln, in countercurrent flow to the direction of travel of the charged raw material. Hot gas ducts having substantially vertical sections interconnect the cyclone separators.

In the case of preheating devices which are intended for the utilization of the hot exhaust gases of a rotary furnace or kiln, it is desirable to achieve the most efficient heat transfer possible from the hot gases to the raw material. In this connection, there have been a number of methods adapted for the purpose of enhancing the heat-transfer efficiency of the plants. For example, the number of stages of superimposed cyclone separators has been increased, or a number of cyclone separators have been connected in tandem and arranged in a single plane. Tests have also been undertaken, through installation of baffle plates and the like, for the purpose of assuring a better distribution or dispersion of the powdery raw material through the current of hot gases. However, heretofore, endeavours aiming at improved heat transfer have proved more or less unsatisfactory, and among the disadvantages and adverse features which have been brought about in this manner are a higher initial cost outlay on the system, and increased maintenance cost of these extensive plants.

It is therefore an object of the present invention to overcome the above-mentioned disadvantages, and to provide an inexpensive and easily maintained apparatus for more efficiently preheating powdered raw cement material by means of hot waste kiln exhaust gases.

It is a further object of the invention to provide a heat-exchange apparatus for the preheating of powdered material, which securely prevents the formation of floating layers of the powdered material.

Still another object of the invention is to provide a plurality of easily cleanable eddy chambers which can be observed in operation.

It is a further object of the invention to provide an additional improved heat exchange between the generally downwardly flowing cement raw material and the generally upwardly flowing hot gases, into the hot gas pipes or portions thereof which are mounted more or less vertically, and which interconnect the heat exchanger cyclone separators with each other and which connect the lowermost cyclone with the rotary kiln.

To these ends, and according to the present invention, the hot gas duct means which interconnect the kiln with the lowermost or first cyclone separator are provided with eddy chambers, and at least some of the cyclones are interconnected by means of an upwardly extending hot gas duct means having eddy chambers. These chambers are provided in a vertical portion of the hot gas duct means and comprise a plurality of vertical superimposed downwardly tapered heat-exchange stages.

This is accomplished by having each of such hot gas

2

ducts comprise a plurality of superimposed stages, having downwardly and inwardly tapered sides and being of a frusto-conical shape or in the form of a truncated cone, tapering downwardly, thus forming a plurality of superimposed frusto-conical chambers. The lateral extending portion of each of the chambers is sealed off in an upward direction by means of an annular cover. The pulverulent material to be preheated is supplied in a conventional manner to the series of cyclones, and is then fed from the discharge of a cyclone separator to the lowermost of the superimposed stages. The stages thus form a superimposed series of heat-exchange eddy chambers which are traversed by the hot gases flowing upwardly from below so as to bring the gases into intimate and relatively long contact with the downwardly flowing raw material.

At the top, the annular covers of the eddy chambers are provided with peep-holes or apertures. For sealing the apertures, removable lids may be provided so that the apertures may be employed for cleaning of the inner walls of the eddy chambers.

Other objects, features and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing, wherein:

FIG. 1 is an elevation view showing the upper portion of a rotary cement kiln and the lower portion of a series of cyclone separators and other apparatus arranged according to the invention; and

FIG. 2 is a vertical cross section of a portion of FIG. 1 and illustrates a series of superimposed stages of the hot gas duct.

With continuing reference to the accompanying drawing wherein like reference numerals designate similar parts in the corresponding views, and as shown in FIG. 1, a rotary furnace or kiln 1 is fed by powdered raw cement material from a feed pipe 4 and from a feed pipe 8, the latter passing via duct 2. Hot exhaust gases issue from the rotary kiln 1 and flow generally upwardly through the duct 2. The hot gas duct 2 carrying the exhaust gases is connected at its outlet 2a tangentially into the cyclone separator 3, which is first in a series of separators along the flow path of the hot exhaust gas. The discharge pipe 4 connected to the bottom of this cyclone 3 conveys the raw material and the dust separated out in cyclone 3 down into the rotary kiln 1, while the exhaust duct 5 leading from the head 6 of cyclone separator 3 links up tangentially with cyclone separator 7, next ensuing in the series. The discharge pipe 8 of this cyclone 7 leads downwardly into the lowermost stage of a plurality of superimposed stages or contact chambers 9 which are lodged within a vertical portion of the hot gas duct 2 and which will be described presently.

The hot gas duct 2' leading from the top of cyclone separator 7 may also be provided with a series of vertically superimposed eddy chambers 9 similar to those illustrated in FIG. 2 and described herein relative to exhaust duct 2. The exhaust gases from duct 2' after leaving such eddy chambers can be directed by means of an outlet pipe connected into a further dust separator (not illustrated) similar to the connection at 2a.

FIG. 2 illustrates, in enlarged cross section, the superimposed stages or eddy chambers 9 of the hot gas duct 2. As shown in FIG. 2, the side walls 9a of the chambers are downwardly tapered, so that the diameter of each chamber widens in the upward direction. The walls 9a of the chambers 9 are arranged and shaped so that the chambers are of frusto-conical form, or in the form of a truncated cone whose side walls 9a taper downwardly. Annular covers 10 are provided for each of the chambers 9, and join the upper portion of the walls 9a of a par-

3

ticular chamber 9 to the base of the walls of the next upper chamber, or to the exhaust pipe outlet leading from the uppermost chamber 9. The annular covers 10 serve to seal off the laterally projecting portions of the tops of the respective chambers 9, and are each provided with a number of access openings or apertures 12 which serve as peep-holes and provide access for cleaning the inner walls of the chambers 9. The covers 10 are preferably made to slope outwardly and downwardly as illustrated in FIG. 2 in order to provide easier access for cleaning and better vision for observing the action within the chambers 9. The direction of slope of the cover 10 also directs the flow of gases which impinge upwardly on the bottom of cover 10 in a generally upward direction into the next upper chamber or outlet duct. Removable lids 11 are provided for sealing off the apertures 12.

Operation of the apparatus is as follows:

The hot exhaust gases from the rotary kiln 1 flow upwardly through the exhaust duct 2, through the heat-exchange eddy chambers 9, through the outlet 2a of pipe 2 into cyclone separators 3, through head 6 of cyclone 3 into pipe 5 and thence into cyclone separator 7, from which it issues through outlet pipe 2' and continues similarly through exhaust ducts and dust separators until it finally reaches the atmosphere. In passing from the rotary kiln 1 through the preheater apparatus, the hot exhaust gases come into intimate contact with the raw cement pulverulent material flowing downwardly in countercurrent flow to the upwardly flowing gases. The pulverulent material to be heated enters from pipe 8 into the lowermost stage 9 of duct 2, where it comes in contact with the upwardly flowing hot gases. The stages 9 form a superimposed series of eddy chambers which are traversed by the hot gases flowing upwardly from below. An intensive upward flow develops in the constricted areas of the eddy chambers and prevents the material from dropping back into the hot gas pipe 2, or from sinking down to a lower eddy chamber. The larger volume in the upper portion of each of the chambers 9 permits the vertical flow in those chamber portions to be less intensive and provides a space for mixing and for eddy currents to take place, to promote the desired longer duration of contact between the downwardly flowing powder and the upwardly flowing hot gas. Moreover, the fact that the lower portions of the eddy chambers are constricted serves to produce an intensive flow which securely prevents the formation of floating layers of powder or of dead spaces in the chambers where little or no flow takes place.

It will be obvious to those skilled in the art, upon studying this disclosure, that devices according to our invention can be modified in various respects and hence may be embodied in apparatus other than as particularly illustrated and described herein, without departing from the essential features of our invention and within the scope of the claims annexed hereto.

We claim:

1. A preheating apparatus comprising upwardly extending hot gas duct means, a plurality of sequentially arranged interconnected cyclone separators, said duct means being connected to a first one of said separators, said duct means including a plurality of superimposed downwardly tapered eddy chambers, and discharge means connected to another of said separators and to said duct means for feeding material to be preheated into the lowermost of said eddy chambers.

2. An apparatus for preheating pulverulent raw cementitious material comprising upwardly extending hot gas duct means, a plurality of sequentially arranged serially interconnected cyclone separators each having a hot gas outlet and defining together a flow path for hot gas, said duct means being connected to one of said separators, said duct means including a plurality of vertically superimposed downwardly tapered frusto-conical eddy chambers, another one of said separators having conduit means connected tangentially thereto and joined to said hot gas

4

outlet of said one separator, and discharge means connected from the bottom of said other one of said separators to said duct means for feeding the cementitious material to be preheated into the lowermost of said eddy chambers.

3. An apparatus for preheating pulverulent raw cementitious material comprising upwardly extending hot gas duct means, a plurality of sequentially arranged serially interconnected cyclone separators each having a hot gas outlet and defining together a flow path for hot gas, said duct means being connected to one of said separators, said duct means including a plurality of vertically superimposed downwardly tapered frusto-conical eddy chambers, a subsequent one of said separators having conduit means connected tangentially thereto and joined to said hot gas outlet of said one separator, and discharge means connected from the bottom of said subsequent one of said separators to said duct means for feeding the cementitious material to be preheated into the lowermost of said eddy chambers, the top portions of said chambers having access openings therein, and removable lids on said chambers for closing said openings.

4. An apparatus for preheating pulverulent raw cement material comprising an upwardly extending hot gas duct, a plurality of tandem arranged serially interconnected cyclone separators each having a hot gas outlet and defining together a flow path for hot gas, said duct being connected to one of said separators, said duct including a plurality of superimposed downwardly tapered truncated conically shaped eddy chambers, a subsequent one of said separators having conduit means connected tangentially thereto and joined to said hot gas outlet of said lowermost separator, a discharge pipe connected from the bottom of said subsequent one of said separators to the lowermost of said eddy chambers for feeding material to be preheated from said subsequent one of said separators into the lowermost of said eddy chambers, said eddy chambers being provided with annular covers, said eddy chambers having upper laterally projecting portions, said covers sealing said projecting portions.

5. An apparatus for preheating pulverulent raw cement material comprising an upwardly extending hot gas duct, a plurality of tandem arranged serially interconnected cyclone separators each having a hot gas outlet and defining together a flow path for hot gas, said duct being connected to one of said separators, said duct including a plurality of superimposed downwardly tapered truncated conically shaped eddy chambers, a subsequent one of said separators having conduit means connected tangentially thereto and joined to said hot gas outlet of said lowermost separator, a discharge pipe connected from the bottom of said subsequent one of said separators to the lowermost of said eddy chambers for feeding material to be preheated from said subsequent one of said separators into the lowermost of said eddy chambers, said eddy chambers having provided with annular covers, said eddy chambers having upper laterally projecting portions, said covers sealing said projecting portions, said covers having access openings therein, and removable lids disposed on said covers for closing said openings.

6. A preheating apparatus for treating cementitious material, comprising upwardly extending hot gas duct means, a plurality of serially interconnected sequentially arranged cyclone separators each having a hot gas outlet and defining together a flow path for hot gas, said duct means being connected to one of said separators, said duct means including a plurality of vertically superimposed downwardly tapered eddy chambers, a subsequent one of said separators having conduit means connected tangentially thereto and joined to said hot gas outlet of said lowermost separator, a discharge pipe connected from the bottom of said subsequent one of said separators to the lowermost of said eddy chambers for feeding material to be preheated from said subsequent one of said separators into the lowermost of said eddy chambers.

5

7. An apparatus for preheating pulverulent raw cement material, comprising an upwardly extending hot gas duct, means connected to said duct for directing hot gas through said duct, a plurality of serially interconnected cyclone separators each having a hot gas outlet and defining together a flow path for hot gas, said separators being sequentially arranged in tandem relationship, said duct being connected to the lowermost one of said separators, said duct including a plurality of substantially vertically superimposed downwardly tapered frusto-conical eddy chambers, a subsequent one of said separators having conduit means connected tangentially thereinto and joined to said hot gas outlet of said lowermost separator, a discharge pipe connected from the bottom of said subsequent one of said separators to the lowermost of said eddy 15

6

chambers for feeding material to be preheated into the lowermost of said eddy chambers, said eddy chambers having annular covers, said covers having peep-holes therein, and removable lids on said covers for closing said peep-holes.

References Cited by the Examiner

UNITED STATES PATENTS

2,538,833	1/1951	De Rycke	-----	34—57
2,797,077	6/1957	Muller	-----	263—32

FREDERICK L. MATTESON, JR., *Primary Examiner.*

JOHN J. CAMBY, *Examiner.*