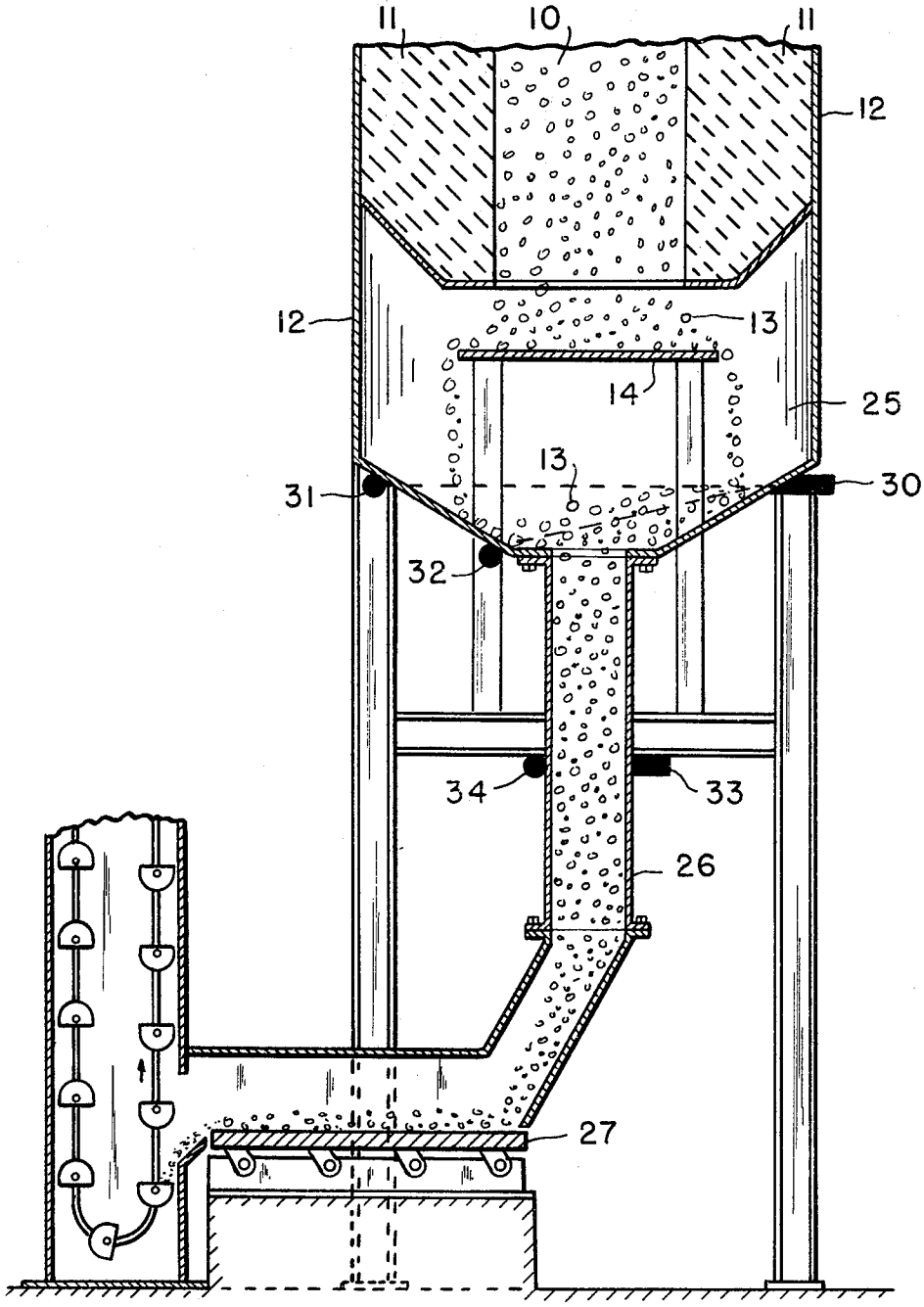
April 21, 1970 C. D. GABOR 3,507,480

SHAFT KILN DISCHARGE SYSTEM

Filed Sept. 25, 1968



INVENTOR.
CHARLES D. GABOR

Raymond F. Majeski

ATTORNEY

United States Patent Office 3,507,480
Patented Apr. 21, 1970

3,507,480

SHAFT KILN DISCHARGE SYSTEM

Charles D Gabor, Verona, Pa., assignor to Dresser Industries, Inc., Dallas, Tex., a corporation of Delaware

Filed Sept. 25, 1968, Ser. No. 762,439
Int. Cl. F27b 1/20
U.S. Cl. 263—29 3 Claims

ABSTRACT OF THE DISCLOSURE

A discharge system for shaft kilns having a collection chamber, controllable unloading means and a conduit in communication with both the bottom of the chamber and the controllable unloading means. The lower portion of the chamber and the conduit are maintained full of charged material by a high-low level detector which cooperates with the controllable unloading means.

This invention relates to the construction and operation of high temperature shaft kilns. It relates to improved shaft kiln constructions suitable for dead burning magnesite and the like. The art of kiln construction is very old and the literature, particularly the patent literature, is replete with suggested constructions for shaft kilns. Shaft kilns have a long vertical hollow shaft or column in which charge material to be burned is passed downwardly through the open top of the kiln in countercurrent flow to an upwardly moving stream of hot gas. This type of kiln has been employed most frequently in the calcining of limestone. More recently, dead burned magnesite and dolomite have been manufactured in shaft kilns. By dead burned is meant fired at a very high temperature to produce a relatively non-reactive product. When one considers that a lime kiln in its hottest zone is usually not above 2550° F., it becomes readily apparent that an entirely new technology had to evolve to construct kilns for dead burning magnesite and dolomite at temperatures above about 3600° F.

The charge material entering the shaft kiln from the top is preheated by the escaping exhaust gases passing through them. The burnt charge passing downwardly through the lower portion of the shaft kiln transfers heat to combustion air which moves upwardly from the base of the kiln to the combustion zone. These two heat transferring steps make the operation of shaft kilns economical. As a rule, the longer the shaft kiln the more efficiently it will operate, i.e., the lower the temperature of the exhaust gases and the discharge product. In the case of higher hot zone temperatures even long shaft kiln discharge their products at temperatures in excess of 500° F. and in some cases even as high as 1000° F.

The long column of feed material (usually in briquette form) presents a considerable resistance to the combustion gas introduced at the base of the shaft kiln. In order that sufficient air for cooling briquettes in the lower portion of the kiln and for oxidizing the fuel introduced in the combustion zone, the lower end of the column must be maintained under substantial pressure. For this purpose, the lower end of the kiln is enclosed by a sealed collection chamber. It is necessary to remove the burned products through valves or air locks provided in the chamber. In the past, these valves have been double or triple door locks in which only one door is opened at a time. These valves work reasonably well but require a large amount of maintenance even though they are of heavy duty construction. The high temperature of the charge material complicates maintenance and lubrication of these valves. Furthermore, the rate at which charge can be moved through the valves is limited.

It is an object of this invention to provide a discharge system for high temperature shaft kilns which is relatively maintenance free, of simple construction and of substantially greater capacity than prior art discharge systems.

Briefly according to this invention, a shaft kiln discharge system is provided which comprises a sealed collection chamber in communication with the bottom of the shaft kiln column. A long, narrow tubular conduit is positioned below the collection chamber and its upper end is in communication therewith. The lower end of the conduit opens to a vibrating table, or any other positive and controllable unloading device. Positioned on or in the collection chamber is a high-low level detector device which cooperates with the unloading device to maintain the chamber and the conduits substantially full of discharge material while withdrawing discharge material from the chamber at about the rate it enters the chamber. In this manner, the lower portion of the collecting chamber and the conduit functions as an air lock.

The drawing is a vertical section through a shaft kiln discharging system according to this invention.

Before describing the drawing in detail it should be understood that it is but exemplary of construction embodying the concepts of this invention, and is given by way of explanation and not by way of limitation. In the drawing is shown the bottom portion a typical vertical kiln which is capable of dead burning refractory materials above about 3600° F. The kiln is defined by a relatively thin tubular outer shell **12** and an internal refractory lining **11**. The dead burning of feed material **13** takes place in the column **10**. The top end of the column is the feed end and the bottom end of the column is the discharge end. The refractory lining **11** is of substantial thickness and may be on the order of 2 to 3 feet as compared to about ½ inch thickness for the shell **12**.

A metal wall arranged to form an inwardly converging skirt which defines the collection chamber **25**, of such dimensions as to abut the outer surface of the bottom portion of the refractory lining **11**. The collection chamber is air tight so that a positive pressure can be maintained in the lower end of the column **10**. Means for removing charged material from the column and the depositing it within the collection chamber is contained entirely within the chamber. For example, a table **14** having a flat surface larger than the opening at the base of the shaft kiln column may be orientated perpendicular to the column parallel to the base. A drag bar (not shown in the drawings) is attached at each end to push rods (not shown) which urge it back and forth across the table removing charge material from the top of the table. A conduit **26** is positioned beneath the collection chamber and at its upper end is in communication with the collection chamber. At its lower end, the conduit is in communication with a positive acting controllable unloading device which is shown in the drawing as a vibrating table **27**. Positioned on or in the collecting chamber is a high-low level detecting device which may comprise a nuclear radiation source **30** and two radiation detecting devices **31** and **32**. Gamma rays from the source pass through the walls of the collection chamber and the feed material and are detected by a sensory device that converts gamma rays to electrical signals for control purposes (gamma rays do not affect the feed material in any way). The nuclear source high-low level detector is especially satisfactory as it can be positioned externally of the collection chamber away from dust, heat and abrasion. As a safety measure, an additional nuclear radiation source **33** and detecting device **34** may be positioned on the conduit **26**. The conduit **26** full of discharged material acts as an air lock enabling the maintenance of a positive pressure in the collection chamber **25**.

The conduit **26** must be long enough to overcome the operating pressure at the bottom of the shaft kiln and large enough in diameter to handle the load to prevent clogging of material and prevent any air from escaping through the conduit. The dimensions of the conduit can be varied to obtain satisfactory results.

Electrical signals from the high-low level detector start and stop the motor on the unloading means at the end of the conduit. When the lower portion of the collection chamber is full the high level detector produces electrical signals that start the unloader. Discharge material moves through the conduit until the low level detector signals the unloading means to stop. The additional device **33** and **34** on the conduit monitors a full pipe. If the feed material level falls below this point, an alarm is arranged to sound and the gas valve of the shaft kiln burners immediately shuts off.

Having thus described the invention in detail with the particularity required by the patent laws what is required to have protected by Letters Patent is as follows:

1. In a shaft kiln having a long hollow column through which charge material passes downwardly and air and combustion products pass upwardly, said kiln having a discharge system at the lower end thereof comprising; means enclosing the lower end of the column to form a sealed collection chamber into which combustion and cooling air may be introduced; means for removing charge material from the column and placing it in the lower portion of the collection chamber; conduit means in communication with the lower portion of the collection chamber positioned so that the charge materials in the chamber will flow into the conduit means; controllable unloading means positioned at the end of the conduit means opposite the chamber for removing charge material from the conduit means; means for detecting high and low levels of charge materials within said chamber, said detecting means and controllable means in cooperation to maintain the lower portion of the chamber and the conduit means full of charge material whereby substantially all air introduced into said collection chamber passes up the column.

2. A discharging system according to claim **1** in which the detecting means is positioned outside the collecting chamber and has a nuclear radiation source.

3. The discharging system according to claim **2** in which a detecting means is positioned on the conduit means for monitoring the level of the charge material therein.

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DONLEY J. STOCKING, Primary Examiner

R. A. DUA, Assistant Examiner

U.S. Cl. X.R.

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