July 28, 1964 J. N. COATS 3,142,546

KILN DISINTEGRATOR

Filed Jan. 22, 1962

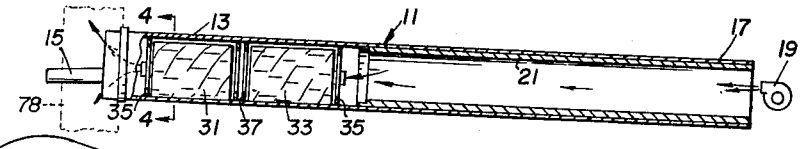


Fig. 1

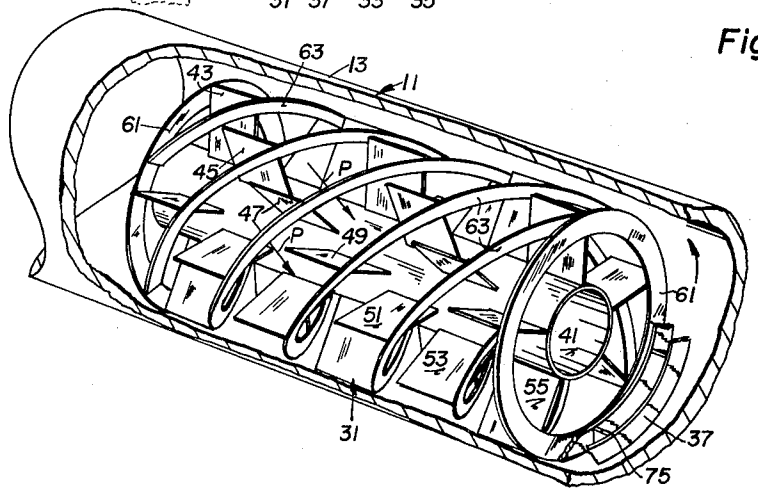
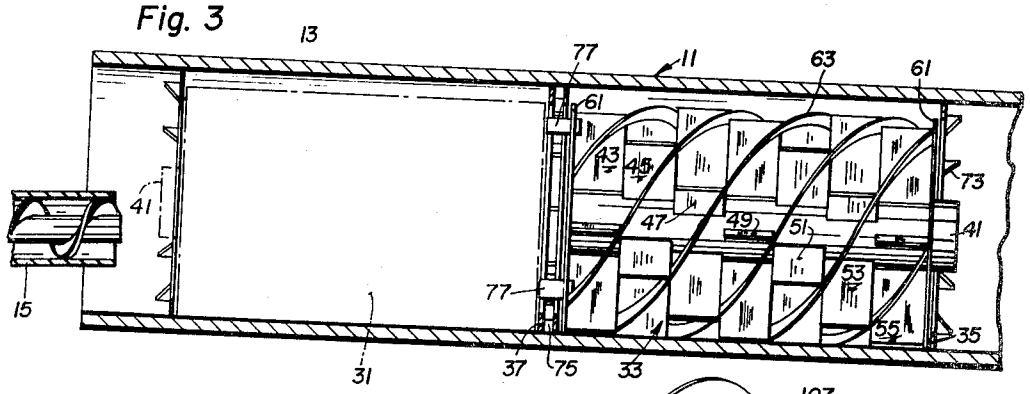


Fig. 2

Fig. 3



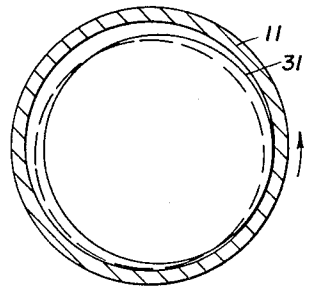


Fig. 4

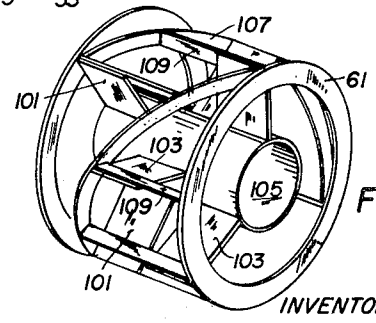


Fig. 5

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KILN DISINTEGRATOR

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This invention relates to rotary kilns, and particularly to devices for preventing accumulation of solidified work material, such as repossessed lime mud, within the kiln drum.

Heretofore, it has been common practice to provide within the drum, a number of lengths of chain anchored at one set of ends to the interior of the cold end of the kiln drum to function as flails to prevent the accumulation and hardening of flowable work material. In time, however, a build up of work material on the chains themselves, occurs, usually with the flowable work material hardening in the form of balls on the chains. In order to remove these balls, the operation of the kiln is discontinued, the kiln allowed to cool slowly, to avoid damage to the kiln lining, and the kiln entered and the balls forcibly shattered and removed, such as being shot by a charge of pellets from a shotgun. Then the kiln is slowly heated up, and operation recommenced. The above-described removal operations are time-consuming and expensive.

It is a main object of the present invention to provide a kiln having a work material disintegrating device overcoming the above disadvantages.

A more specific object is to provide in a kiln, a disintegrator in the form of a cylindrical member freely resting in the cold end of the kiln drum and having a diameter smaller than that of the drum interior to have a scraping action with respect thereto during rotation of the drum so as to prevent build up of work material on the interior of the cold end of the drum.

Various other objectives of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

FIG. 1 is a diagrammatic longitudinal midsectional view of a kiln having a disintegrating assembly of the present invention installed therein;

FIG. 2 is a perspective view on an enlarged scale of part of the kiln drum broken away to show a disintegrator;

FIG. 3 is a vertical longitudinal section on an enlarged scole through the cold end of the kiln;

FIG. 4 is a vertical transverse section taken along line 4—4 of FIG. 1 on an enlarged scale; and

FIG. 5 is a perspective view of a modified form of the invention.

Referring to FIG. 1, the kiln includes a kiln drum **11** rotated by a conventional mechanism not shown. The drum has a cold end **13** equipped with a conveyer **15** to feed work material, such as repossessed lime mud, into the drum. The drum is inclined downwardly from left to right so that the work material progresses toward the hot end **17**. A burner **19** at the hot end directs a gas flame toward the cold end. The drum is lined with fire bricks **21** or equivalent material throughout its length, except at the cold end. The construction so far described, is conventional.

A disintegrator assembly is provided in the cold end of the kiln drum to prevent accumulation and solidifying of mud on the interior walls of the cold end. The assembly includes a pair of cylindrical disintegrator members cages **31** and **33** of almost identical construction which are limited against any substantial endwise movement by a pair of end stop members **35** and an intermediate stop member **37**. These disintegrators have a diameter less than that of the interior of the drum **11**,

as shown in FIG. 4, for a purpose to be presently described.

The construction of a disintegrator member or cage is best shown in FIGS. 2 and 3 where it is apparent that a cage comprises a central tubular duct element **41** to which are secured a plurality of sets of flat rectangular, radially disposed plates **43**, **45**, **47**, **49**, **51**, **53**, and **55** of identical form, but having different reference numerals to distinguish the plates of one set from the plates of another set. The plates are secured in place so that the plane of each plate contains the axis of the tubular duct element. The plates of each set are spaced equidistantly around the duct element. The plates of the various sets are staggered in circumferential echelon relation with respect to one another. This provides spiral longitudinally extending passages P for the disintegrator. The spirals extend from the left to the right around the disintegrator member in the same direction as the drum is rotated. Thus the spiral passages may be considered as advancing in a clockwise direction when viewed from the cold end of the kiln drum.

The plates at each end of a disintegrator or cage are additionally supported by a ring **61** having a diameter equal to that of the peripheries of the sets of plates. Also rendering additional support are spiral strips **63** which are parallel to one another and are secured at their ends to the rings **61**. It is apparent that the spiral strips are curved and dimensioned to pass next to the outer righthand side edge portions of echelon related plates, as the parts are shown in FIGS. 2 and 3. The strips are secured, such as by welding to such side edge portions. While the spiral passages P advance away from the cold end of the drum in a clockwise direction when viewed from the cold end of the kiln drum, the spiral strips advance in a counterclockwise direction when viewed from such end.

The end stop members **35** each comprises a ring (FIG. 3) which for convenience is identified by the same reference numeral as its stop member and is held in place by gussets **73** welded to the interior of the drum. The central stop member **37** (FIG. 3) is comprised of a pair of rings **37** connected by spacer plates **75**. The central stop member is also secured such as by welding to the interior wall of the drum.

In order to prevent accumulation and solidification of mud on the interior of the central stop member **37**, a plurality of scrapers **77** in the form of small plates are secured to the end ring of one disintegrator, the righthand one being chosen in the form of the invention shown, in positions to project into the central stop member **37** next to its inner periphery.

As is well known, access to the cold end of the kiln drum is by way of a conventional dust collector **78**. Since a disintegrator of the present invention is almost as large as the interior of the drum, it cannot be assembled outside of the drum and inserted in place. In fact, the rings and spiral strips are of sectional form to enable them to be passed through the door. The door is large enough to pass the plates **43–55** and the tubular duct **41** without their being sectionalized. Preferably, the parts of a disintegrator are spot or tack welded together for transportation to the kiln and to assume proper assembly. The disintegrator is then disassembled, the parts passed through the access door, and reassembled and welded together inside of the drum.

In operation, as the drum rotates, the force of friction between the disintegrators or cages and the drum tends to cause the disintegrators to rotate with the drum and climb up the rising wall of the drum as is shown in FIG. 4. However, the force of friction decreases as the disintegrators climb up such wall and soon the disintegrators slip and slide back to the bottom of the drum.

This repetitive slipping and sliding action scrapes the interior walls of the drum clean, with the ends of the plates **43–55** and the spiral strips **63** performing the scraping operation.

The disintegrators or cages have a slow relative counter-rotating action with respect to the drum because of such repetitive slipping, and the direction of advance of the spiral strips **63** is such that the strips tend to shove mud upstream. This action, however, exerts only a minor retarding action on the mud which apparently more readily advances along the passages P by falling from plate to plate in an axial direction. In any event, the mud does advance and is partially or wholly dried by its contact with the extensive surface area of the plates and associated parts.

Rather strangely, there is no tendency for accumulation of solidified mud on the plates and associated parts. This may be due to the flexing of the plates or vibration caused by the repetitive sliding action of the disintegrators relative to the drum.

The hot gases directed down the length of the drum **11** by the burner **19** can readily pass through the duct elements **41** and can also pass between the plates **43–15** to heat them and the mud thereon.

The lefthand end of the duct element **41** of the disintegrator **31** projects beyond the associated stop ring **35** so that mud deposited into the cold end of the drum **11** does not enter the tubular element **41**.

While two disintegrators or cages **31** and **33** are shown for the drum **11** in FIG. 1, a single disintegrator might suffice for a particular installation, or a particular installation might require three or more disintegrators.

While the disintegrator or cage shown has five plates in a set, more or less plates could be employed, although for reasons not presently understood, sets having an odd number of plates have proved to operate more satisfactorily than sets having an even number of plates.

FIG. 5 shows a modified form of the invention in which the disintegrator or cage plates **101** and **103** are in sets of three. Two sets are shown, with the plates of each set being equally spaced around the duct element **105**, and the plates of one set are medially spaced relative to the spaces between the plates of the other set. There are spiral strips **107** as in FIGS. 2 and 3, and also auxiliary axially extending straight supporting strips **109** securing the free side edge of each plate to the remote strip. This additional support has been found desirable when there are only three plates in a set.

Having described the invention in what is considered to be the preferred embodiment thereof, it is desired that it be understood that the invention is not to be limited other than by the provisions of the following claims.

I claim:

1. An apparatus for the treatment of pulverant materials to be dried, comprising:

a drum rotatable in a predetermined direction and adapted to have hot air passed therethrough,

a cylindrical cage freely resting within said drum and having a diameter less than the interior of said drum, so that during rotation of said drum, the cage rotates, relative to the drum, in a direction opposite to that of the drum,

said cage including a central elongated mounting member,

a plurality of sets of scraping and drying plates secured to and projecting at least generally radially from said mounting member,

each set being located at a place which is axially displaced from the location of the other sets,

the plates of each set being arranged in equally spaced paddle wheel fashion about said mounting member,

the plates of adjacent sets being staggered relative to one another in a circumferential direction in progressive fashion from one end to the other of said cage so that the plates are disposed in spiral fashion about the mounting member,

said plates being of rectangular form and having inner edges secured to said mounting member and having outer edges which are exposed for progressive contact with the interior of the drum as the drum rotates so that during the movement of the cage relative to the drum, said plates scrape material to be dried from the interior of the drum and carry at least some of such material upwardly and over the mounting member to expose such material to the hot air flowing through said drum, so that such material can be dried and disloged from said plates and progress down said drum.

2. An apparatus for the treatment of pulverant materials to be dried, comprising:

a drum rotatable in a predetermined direction and adapted to have hot air passed therethrough,

a cylindrical cage freely resting within said drum and having a diameter less than the interior of said drum, so that during rotation of said drum, the cage rotates, relative to the drum, in a direction opposite to that of the drum.

said cage including a central elongated mounting member,

a plurality of sets of scraping and drying plates secured to and projecting at least generally radially from said mounting member,

each set being located at a place which is axially displaced from the location of the other sets,

the plates of each set being arranged in equally spaced paddle wheel fashion about said mounting member,

the plates of adjacent sets being staggered relative to one another in a circumferential direction in progressive fashion from one end to the other of said cage so that the plates are disposed in spiral fashion about the mounting member,

the end edges of said plates being of rectangular form and having inner edges secured to said mounting member and having outer edges which are exposed for progressive contact with the interior of the drum as the drum rotates so that during the movement of the cage relative to the drum, said plates scrape material to be dried from the interior of the drum and carry at least some of such material upwardly and over the mounting member to expose such material to the hot air flowing through said drum, so that such material can be dried and dislodged from said plates and progress down said drum,

said cage including at least one spiral strip extending around the periphery thereof,

the spiral of said strip matching the spiraling of said plates,

said strip being located so as to pass next to one of the radially extending edges of each of certain of said plates and being secured to the just-mentioned edges to be supported thereby and lend support to the outer portions of said plates.

3. An apparatus for the treatment of pulverant materials to be dried, comprising:

a drum rotatable in a predetermined direction and adapted to have hot air passed therethrough,

a cylindrical cage freely resting within said drum and having a diameter less than the interior of said drum, so that during rotation of said drum, the cage rotates, relative to the drum, in a direction opposite to that of the drum,

said cage including a central elongated mounting member,

a plurality of sets of scraping and drying plates secured to and projecting at least generally radially from said mounting member,

each set being located at a place which is axially displaced from the location of the other sets,

the plates of each set being arranged in equally spaced paddle wheel fashion about said mounting member,

the plates of adjacent sets being staggered relative to one another in a circumferential direction in progressive fashion from one end to the other of said cage so that the plates are disposed in spiral fashion about the mounting member,

said plates being of rectangular form and having inner edges secured to said mounting member and having outer edges which are exposed for progressive contact with the interior of the drum as the drum rotates so that during the movement of the cage relative to the drum, said plates scrape material to be dried from the interior of the drum and carry at least some of such material upwardly and over the mounting member to expose such material to the hot air flowing through said drum, so that such material can be dried and dislodged from said plates and progress down said drum,

said cage including at least one spiral strip extending around the periphery thereof in a direction opposite the direction of rotation of said drum,

the spiral of said strip matching the spiraling of said plates,

said strip being located so as to pass next to one of the radially extending edges of each of certain of said plates and being secured to the just-mentioned edges to be supported thereby and lend support to the outer portions of said plates.

4. An apparatus for the treatment of pulverant materials to be dried, comprising:

a drum rotatable in a predetermined direction and adapted to have hot air passed therethrough,

a cylindrical cage freely resting within said drum and having a diameter less than the interior of said drum, so that during rotation of said drum, the cage rotates, relative to the drum, in a direction opposite to that of the drum,

said cage including a central elongated mounting member,

a plurality of sets of scraping and drying plates secured to and projecting at least generally radially from said mounting member,

each set being located at a place which is axially displaced from the location of the other sets,

the plates of each set being arranged in equally spaced paddle wheel fashion about said mounting member,

the plates of adjacent sets being staggered relative to one another in a circumferential direction in progressive fashion from one end to the other of said cage so that the plates are disposed in spiral fashion about the mounting member

said plates being of rectangular form and having inner edges secured to said mounting member and having outer edges which are exposed for progressive contact with the interior of the drum as the drum rotates so that during the movement of the cage relative to the drum, said plates scrape material to be dried from the interior of the drum and carry at least some of such material upwardly and over the mounting member to expose such material to the hot air flowing through said drum, so that such material can be dried and dislodged from said plates and progress down said drum,

said cage including one spiral strip for each of the plates of a set of plates,

the spiral of each such strip matching the spiraling of said plates,

each strip being located so as to pass next to at least one radially extending edge of one plate only of each set said plates and being secured to the just-mentioned edges to be supported thereby and lend support to the outer portions of such plates.

5. An apparatus for the treatment of pulverant materials to be dried, comprising:

a drum rotatable in a predetermined direction and adapted to have hot air passed therethrough,

a cylindrical cage freely resting within said drum and having a diameter less than the interior of said drum, so that during rotation of said drum, the cage rotates, relative to the drum, in a direction opposite to that of the drum,

said cage including a central elongated mounting member,

a plurality of sets of scraping and drying plates secured to and projecting at least generally radially from said mounting member,

each set being located at a place which is axially displaced from the location of the other sets,

the plates of each set being arranged in equally spaced paddle wheel fashion about said mounting member,

the plates of adjacent sets being staggered relative to one another in a circumferential direction in progressive fashion from one end to the other of said cage so that the plates are disposed in spiral fashion about the mounting member,

said plates being of rectangular form and having inner edges secured to said mounting member and having outer edges which are exposed for progressive contact with the interior of the drum as the drum rotates so that during the movement of the cage relative to the drum, said plates scrape material to be dried from the interior of the drum and carry at least some of such material upwardly and over the mounting member to expose such material to the hot air flowing through said drum, so that such material can be dried and dislodged from said plates and progress down said drum,

said cage including one spiral strip for each of the plates of a set of plates,

the spiral of each such strip matching the spiraling of said plates,

each strip being located so as to pass next to at least one radially extending edge of one plate only of each set said plates and being secured to the just-mentioned edges to be supported thereby and lend support to the outer portions of such plates,

and a ring at each end of the cage secured to the adjacent ends of the spiral strips and to the adjacent edges of the adjacent plates.

6. An apparatus for the treatment of pulverant materials to be dried, comprising:

a drum rotatable in a predetermined direction and adapted to have hot air passed therethrough,

a cylindrical cage freely resting within said drum and having a diameter less than the interior of said drum, so that during rotation of said drum, the cage rotates, relative to the drum, in a direction opposite to that of the drum,

said cage including a central elongated mounting member,

a plurality of sets of scraping and drying plates secured to and projecting at least generally radially from said mounting member,

each set being located at a place which is axially displaced from the location of the other sets,

the plates each set being arranged in equally spaced paddle wheel fashion about said mounting member,

there being an equal number of plates for each set of plates,

the plates of adjacent sets being staggered relative to one another in a circumferential direction in progressive fashion from one end to the other of said cage so that the plates are disposed in spiral fashion about the mounting member,

said plates being of rectangular form and having inner edges secured to said mounting member and having outer edges which are exposed for progressive con-

tact with the interior of the drum as the drum rotates so that during the movement of the cage relative to the drum, said plates scrape material to be dried from the interior of the drum and carry at least some of such material upwardly and over the mounting member to expose such material to the hot air flowing through said drum, so that such material can be dried and dislodged from said plates and progress down said drum,

said cage including a plurality of spiral strips equal in number to the number of plates in a set of plates,

the spiral of said strip matching the spiraling of said plates,

each strip being located so as to pass next to certain edges of said plates and being secured to the just-mentioned plates to be supported thereby and lend support to the end portions of said plates,

the axial distance between adjacent strips being greater than the axial dimension of the plates so that each plate is secured to only one strip.

7. An apparatus for the treatment of pulverant materials to be dried, comprising:

a drum rotatable in a predetermined direction and adapted to have hot air passed therethrough,

a cylindrical cage freely resting within said drum and having a diameter less than the interior of said drum, so that during rotation of said drum, the cage rotates, relative to the drum, in a direction opposite to that of the drum,

said cage including a central elongated mounting member,

a plurality of sets of scraping and drying plates secured to and projecting at least generally radially from said mounting member,

each set being located at a place which is axially displaced from the location of the other sets,

the plates of each set being arranged in equally spaced paddle wheel fashion about said mounting member,

the plates of adjacent sets being staggered relative to one another in a circumferential direction in progressive fashion from one end to the other of said cage so that the plates are disposed in spiral fashion about the mounting member,

said plates having inner edges secured to said mounting member and having outer edges which are exposed for progressive contact with the interior of the drum as the drum rotates so that during the movement of the cage relative to the drum, said plates scrape material to be dried from the interior of the drum and carry at least some of such material upwardly and over the mounting member to expose such material to the hot air flowing through said drum, so that such material can be dried and dislodged from said plates and progress down said drum,

said cage including at least one spiral strip extending around the periphery thereof,

the spiral of said strip matching the spiraling of said plates,

said strip being axially related to said plates so as to pass next to one side edge of one plate of each set,

said strip being secured to such edges.

8. An apparatus for the treatment of pulverant materials to be dried, comprising:

a drum rotatable in a predetermined direction and adapted to have hot air passed therethrough,

a cylindrical cage freely resting within said drum and having a diameter less than the interior of said drum, so that during rotaiton of said drum, the cage rotates, relative to the drum, in a direction opposite to that of the drum,

said cage including a central elongated mounting member,

a plurality of sets of scraping and drying plates secured to and projecting at least generally radially from said mounting member,

each set being located at a place which is axially displaced from the location of the other sets,

the plates of each set being arranged in equally spaced paddle wheel fashion about said mounting member,

the plates of adjacent sets being staggered relative to one another in a circumferential direction in progressive fashion from one end to the other of said cage so that the plates are disposed in spiral fashion about the mounting member,

said plates being of rectangular form and having inner edges secured to said mounting member and having outer edges which are exposed for progressive contact with the interior of the drum as the drum rotates so that during the movement of the cage relative to the drum, said plates scrape material to be dried from the interior of the drum and carry at least some of such material upwardly and over the mounting member to expose such material to the hot air flowing through said drum, so that such material can be dried and dislodged from said plates and progress down said drum,

a second cage within said drum next to said first cage and being of similar construction,

an annular stop member on said drum between said cages,

and scrapers on at least one of the adjacent ends of said cages disposed in scraping relationship to said annular stop member to prevent build up of material thereon.

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