

[54] **PARTITION FOR TUMBLING MILLS OR THE LIKE**

590,220 7/1932 Germany 241/72

[75] Inventor: **Arthur Selwyn Cornford**, Clarkson,
Ontario, Canada

Primary Examiner—Roy Lake
Assistant Examiner—E. F. Desmond

[73] Assignee: **Aerofall Mills Limited**, Ontario,
Canada

[22] Filed: **Feb. 19, 1974**

[57] **ABSTRACT**

[21] Appl. No.: **443,860**

[52] U.S. Cl. **241/71; 241/43; 241/72;**
241/172

[51] Int. Cl. **B02c 17/06**

[58] Field of Search 241/171, 176, 180, 183,
241/54, 57, 42, 71, 72, 43

A tumbling mill or like apparatus having a generally horizontally mounted rotary drum along which a charge is caused to flow from a first zone of the drum to a second zone includes an intermediate zone at which an additional material is introduced into the drum to be added to the charge. Deflector means in the intermediate zone ensure that the charge and additional material proceed to the second zone, the deflector means providing a trap to prevent material from passing back to the first zone. The additional material may be a gas or vapour, or a solid or liquid material or slurry.

[56] **References Cited**

UNITED STATES PATENTS

2,031,710 2/1936 Ihlefeldt 241/72 X
2,805,827 9/1957 Pierce 241/171

FOREIGN PATENTS OR APPLICATIONS

579,186 9/1931 Germany 241/71

4 Claims, 5 Drawing Figures

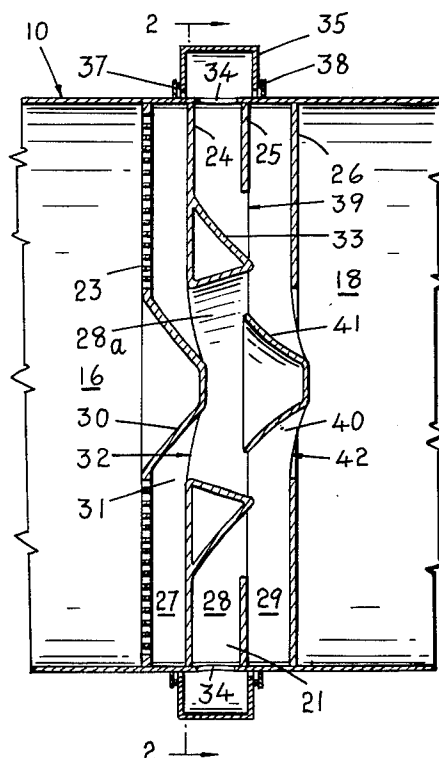


FIG. 1.

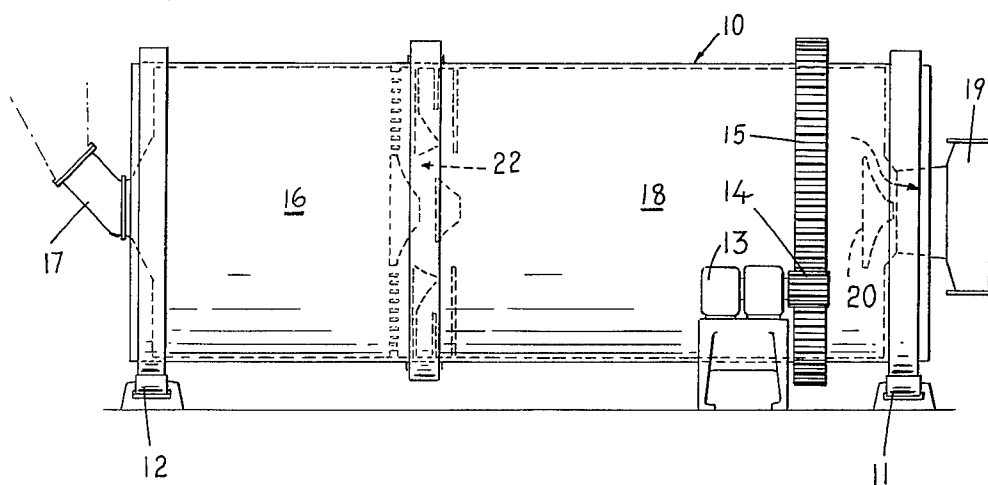
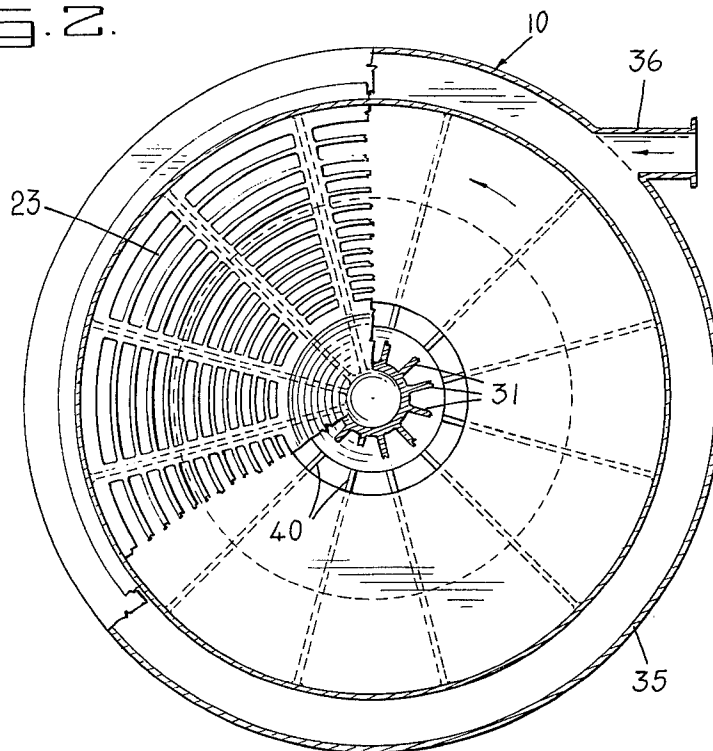


FIG. 2.



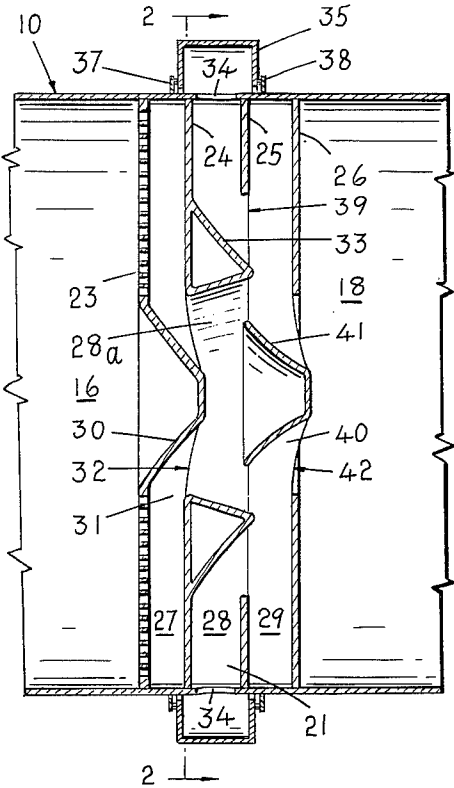


FIG. 3.

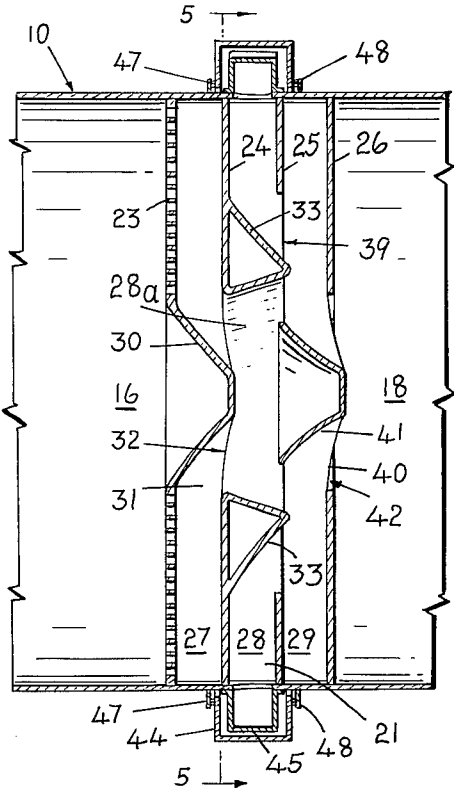


FIG. 4.

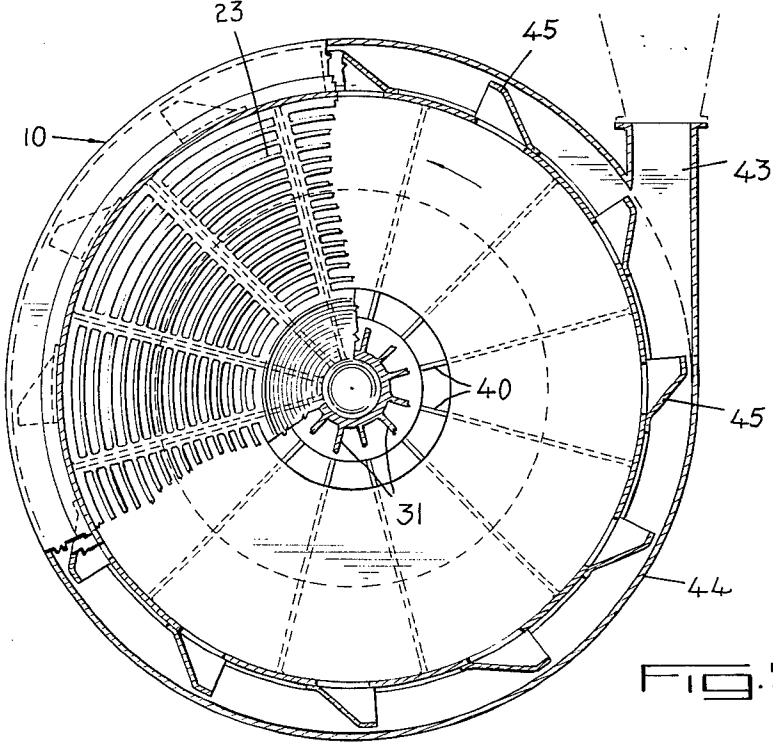


FIG. 5.

PARTITION FOR TUMBLING MILLS OR THE LIKE

This invention relates to tumbling or grinding mills, rotary kilns, dryers, and the like, and more generally to apparatus of the kind having a horizontally mounted or slightly inclined rotary drum along which a charge is caused to flow. The drum is usually of cylindrical or conical shape. Such apparatus is extensively used in the mineral and metallurgical process industries. In the majority of cases, the drums are fed and discharged continuously and openings are provided at the axial extremities of the drums for the ingress and egress of solids and/or fluids such as water, hot gas, and the like.

In some cases it may sometimes be desired to carry on two or more stages of the process in sequence within the same drum. One example of such a requirement is a two-stage grinding process in which coarse grinding is performed, using large grinding media, in the upstream end of a ball mill and fine grinding, using smaller grinding media, is performed in the downstream end of the mill. A diaphragm partition is usually used to keep the two sizes of media separate, the diaphragm partition being provided with slots through which the charge can pass.

Furthermore, it is usually advantageous to ensure that the charge will flow through the diaphragm in one direction only, i.e. downstream. This is usually accomplished by constructing a partition with two diaphragms spaced several inches apart, the upstream diaphragm being provided with slots for passage of the charge and the downstream diaphragm having a central opening of comparable size to the main feed and discharge openings of the drum. The space between the diaphragms is divided into a number of compartments by means of radial vanes or lifters, whose function is to elevate material as the drum rotates, the lifted material sliding down the lifter radially towards the centre of the mill shell. A conical deflector is provided at the axial centre of the diaphragm to deflect the material from the lifters to the outer, downstream side of the partition. In other cases it is sometimes advantageous to discharge process material or charge from a rotating drum through ports around the periphery of the drum rather than through an end discharge opening. In such a case, when grinding media have to be retained within the shell, it is usual to provide a single slotted grate diaphragm, without lifters, through which the material can flow and hence through the peripheral ports.

It is an object of the present invention to provide an apparatus with provision for introducing solids or fluids into the rotary drum, at an intermediate point between the ends of the drum, without accidental discharge of materials already inside the drum.

According to the invention there is provided in an apparatus comprising a horizontally mounted rotary drum along which a charge is caused to flow from an upstream zone of the drum to a downstream zone which is axially spaced from the upstream zone, means defining an intermediate zone at which an additional material may be introduced into the charge, said means comprising a plurality of axially spaced transverse drum partitions defining first, second and third lifting chambers, with deflector means for deflecting the charge and additional material through the chambers towards the downstream zone, the deflector means providing a trap for preventing the passage of material back to the upstream zone. The additional material

may be a gas or vapor, or a solid or liquid material or slurry.

In order that the invention may be readily understood, two embodiments thereof will now be described, by way of example with reference to the accompanying drawings, in which:

FIG. 1 is a side elevation of a tumbling mill having means for introducing a gas or vapour at an intermediate zone of the mill;

FIG. 2 is a cross-sectional view of the mill, the section being taken through the intermediate zone, and certain parts being broken away to show details of said zone;

FIG. 3 is a longitudinal sectional view showing details of the intermediate zone;

FIG. 4 is a longitudinal sectional view corresponding to FIG. 3 of a modified apparatus having means for introducing solids or slurries at the intermediate zone, and

FIG. 5 is a cross-sectional view corresponding to FIG. 2 of said modified apparatus.

Referring to FIG. 1, the tumbling mill comprises a horizontally mounted rotary drum 10 of cylindrical shape, the drum being mounted on bearings 11, 12, and being rotated about its horizontal axis by a drive motor 13 through a pinion 14 and spur gear 15. The drum has an inlet opening and a discharge opening at its opposite ends. The charge, or material to be processed, is fed into an upstream zone 16 of the drum by way of a charging chute 17, and processed material is discharged from a downstream zone 18 of the drum by way of a discharge chute 19, a conical deflector 20 being positioned adjacent to the discharge opening and combined with grates and lifters for discharging material into the discharge chute in the known manner.

Positioned between the upstream and downstream zones 16, 18 is an intermediate zone 22 into which an additional material, in this case a gas, may be introduced to be added to the charge. The details of the intermediate zone are shown in FIGS. 2 and 3. Essentially, this zone is formed by a plurality of, in this case four, axially spaced, transverse drum partitions 23, 24, 25, 26, which define a plurality of chambers, in this case first, second and third lifting chambers 27, 28, 29. The first partition 23 is formed by a slotted grid which defines an inlet to the first chamber 27. Ground material of a suitable size, or slurry or the like, can pass from the upstream drum zone 16 through the grid into the first chamber 27. The central portion of the partition 23 is connected to, or formed integrally with, a conical deflector 30 which extends axially for substantially the full axial length of the first chamber 27. Radial lifters 31 extending from the conical deflector 30 serve, as the drum 10 rotates, to lift material in the chamber 27, which material descends by gravity onto the deflector to be deflected thereby through a central outlet 32 in the second partition 24. It will be appreciated that the lifters 31, and the lifters 21 and 40 referred to below, need not be straight as shown, but may be curved to suit the flow characteristics of the material in passage. The second partition 24 is formed with an annular deflector 33 which extends axially for substantially the entire axial length of the second chamber 28. This deflector has a frusto-conical outer surface and a frusto-conical inner surface, the latter defining a central region 28a of the second chamber 28, which central region is partitioned by the deflector from the outer annular region of the chamber. Process material dis-

charged into the central region 28a of the second chamber strikes the inner frusto-conical surface of the deflector 33 to be deflected thereby into the third chamber 29. Lifters 21 are provided in the second chamber. Their function is to scavenge materials which may be accidentally deflected from the third chamber and to prevent them from being discharged via inlet openings 34.

Gas or vapour to be added to the charge is introduced into the drum by way of the peripheral inlet openings 34 which communicate with the annular region of the second chamber 28. These openings communicate with a manifold formed by an annular casing 35 which encircles the drum. Gas or vapour is supplied to the manifold, at a pressure which is higher than that existing in the downstream zone 18 of the drum, by way of an inlet duct 36, and since the casing is stationary, annular seals 37, 38 mounted on the drum prevent leakage of the gas or vapour as the drum rotates. The flow of gas may be induced by means of an exhaust fan on the outlet side of the drum.

Gas from the annular region of the chamber 28 is discharged through an outlet 39 in the partition 25 into the third chamber 29. Process material deposited into the third chamber is lifted by radial lifters 40 extending from a central conical deflector 41, the deflector 41 extending substantially for the full axial length of the third chamber and cooperating with a central opening 42 in the fourth partition 26. The process material, having been lifted is deposited onto the upper surface of the deflector 41, and is deflected thereby into the downstream zone 18 of the drum. In this way, gas or vapour is introduced to the drum to be added to the charge, the intermediate zone being so arranged as to prevent the charge from returning from the intermediate zone to the upstream zone of the drum.

The modification illustrated in FIGS. 4 and 5 differs from the preceding embodiment in that means are provided for adding a heavier-than-air material, such as a granular solid or a slurry, to the charge at the intermediate zone. In these Figures, parts which have exact counterparts in FIGS. 2 and 3 are denoted by the same reference numerals. In this case, however, instead of there being gas or vapour admitted to the drum, a granular solid or a liquid is fed by a chute 43 into an annular chute 44. The annular chute is formed by an annular casing which encircles the intermediate zone of the drum 10. The heavier-than-air material descending into the chute 44 is scooped up by scoops or buckets 45, lifted, and deposited into the second chamber 28 of the intermediate zone via peripheral openings 46. The casing 44, which is stationary, cooperates with rotary seals 47, 48 to prevent leakage of the additional material as the drum rotates.

As will be appreciated by those skilled in the art, in certain applications the axis of the drum may not be truly horizontal, but may be slightly inclined to the horizontal to assist the flow of material. Such cases are considered to be within the scope of the invention. Accordingly, the expression "generally horizontally mounted rotary drum" as used in the specification and claims is intended to mean a rotary drum which is mounted so that its axis of rotation is horizontal or slightly inclined to the horizontal.

Furthermore, it is to be understood that the terms "conical" and "frusto-conical", as applied to the deflector surfaces of the "conical deflectors" and the

"annular deflector" are not restricted to shapes which are conical and frusto-conical in the strict mathematical sense. In the illustrated embodiments the surfaces described by these terms are essentially flared surfaces of revolution which are approximately conical and frusto-conical, and the said terms as used in the specification and claims are deemed to described such shapes.

What I claim as my invention is:

1. In an apparatus comprising a horizontally mounted rotary drum along which a charge is caused to flow from an upstream zone of the drum to a downstream zone which is axially spaced from the upstream zone, means defining an intermediate zone at which an additional material may be introduced into the charge, said means comprising

a plurality of axially spaced transverse drum partitions defining first, second and third lifting chambers,

the first chamber including inlet means communicating with said upstream zone for admitting charge from the upstream zone to the first chamber, outlet means communicating with a central region of the second chamber, and conical deflector means extending axially across the first chamber for substantially the entire axial length thereof, said conical deflector means cooperating with said outlet means for deflecting charge from the first chamber to a central region of the second chamber,

the second chamber including outlet means communicating with the third chamber, and annular deflector means extending axially across the second chamber for substantially the entire axial length thereof, said annular deflector means defining an annular region of the second chamber partitioned from the central region,

the second chamber further including peripheral inlet means communicating with said annular region for the admission of additional material thereto,

the annular deflector means providing a pair of inner and outer frusto-conical deflector surfaces cooperating with the outlet means of the second chamber for deflecting charge from said central region, and material from said annular region, into the third chamber,

the third chamber including outlet means communicating with said downstream zone and conical deflector means extending axially across the third chamber for substantially the entire axial length thereof, said conical deflector means cooperating with the outlet means of the third chamber for deflecting the charge and said additional material therethrough.

2. Apparatus according to claim 1, wherein the chambers are defined by first, second, third and fourth drum partitions, the first drum partition including an annular grid defining said inlet means, and said outlet means being defined by respective openings in the second, third and fourth partitions, said grid, said openings, and said deflector means being coaxial with one another and with the drum.

3. Apparatus according to claim 1, including an annular casing encircling the external surface of the drum at said intermediate zone and defining therewith a manifold communicating with said peripheral inlet means, and means for supplying a gas to the manifold.

5

4. Apparatus according to claim 1, including an annular casing encircling the external surface of the drum at said intermediate zone and defining therewith an annular chute communicating with said peripheral inlet means, means for supplying heavier than air material to

6

the chute, and scoop means connected to the drum and rotatable therewith for conveying said material to the peripheral inlet means.

* * * * *

10

15

20

25

30

35

40

45

50

55

60

65