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(71) Applicant: **F.L. Smidth & Co. A/S, 77 Vigerslev Allé, DK-2500 Valby Copenhagen (DK)**

(72) Inventor: **Svensson, Sven Ole, 77 Vigerslev Alle, DK-2500 Valby Copenhagen (DK)**

(74) Representative: **Skone James, Robert Edmund et al, GILL JENNINGS & EVERY 53/64 Chancery Lane, London, WC2A 1HN (GB)**

(54) Vertical roller mill.

(57) A vertical roller mill has a grinding table (1) with grinding rollers (3). Conveying air passes through nozzles (5) and entrains ground material which is carried into a separator (6) where fine material passes out through a top outlet (11). Coarse material falls through a bottom outlet (8) to the grinding table for further grinding. The adverse pressure difference across the outlet (8), impeding the flow of coarse material is counteracted by an ejector (12), which is fed from the source of conveying air and blows downwards through the outlet (8).

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F.L. SMIDTH & CO.A/S. GJE 5282/072

VERTICAL ROLLER MILL.

The invention relates to a method of providing unimpeded discharge of coarse material from a built-in stationary separator housed in a vertical roller mill.

A typical vertical roller mill comprises a grinding table rotating about a vertical axis and having a grinding path on which grinding rollers roll and, during the rotation of the table, grind the material supplied. The grinding rollers have stationary shafts and are urged against the grinding path by means of hydraulic cylinders or springs. The material to be ground is directed to the centre of the grinding table and is, by the rotation of the table, moved outwards to the grinding path. Ground material passes on beyond the periphery of the table and across a ring of nozzles encircling the table.

Conveying, and possibly also drying, air is introduced beneath the nozzle ring and flows up through the nozzle ring thereby entraining the ground material in suspension. This suspension is passed upwards through, and to the top of the mill housing and into the stationary separator in which the coarse material, i.e. insufficiently ground material, is separated from the suspension and falls towards the bottom of the separator, whereas the fine material, i.e. sufficiently ground material, leaves the mill housing

and the separator at the top together with the conveying air.

The bottom part of the separator is conical and ends in an outlet for coarse material oriented towards the grinding table. The insufficiently ground material is returned through this outlet to the grinding table for further grinding.

On its way through the mill housing the conveying air experiences two marked pressure drops, namely when passing through the nozzle ring from the bottom part of the mill housing to the grinding chamber and when passing from the chamber to the separator. The air passage into the separator preferably takes place through guide vanes imparting a cyclonic movement to the air in the separator, which movement encourages the separation of coarse material from the suspension.

Consequently, there is also a pressure difference over the coarse material outlet of the separator, and this pressure difference seeks to counteract the discharge of coarse material from the separator through the coarse material outlet.

This problem is known and has been solved by providing the coarse material outlet with a sluice mechanism which prevents the material from being blown back into the separator due to the pressure difference. Known sluices of this kind are provided with flaps or adjustable slits. Flaps or slits, however, require a certain material height above the sluice in order to be operational, and the movable or adjustable parts of such sluice means are vulnerable, especially in the dust and particle laden, and consequently also wear promoting, atmosphere inside a mill, which can result in interruptions of operation. Furthermore, it is also annoying, particularly in small separators, if the bottom part of the separation chamber is filled up with

coarse material owing to the desired necessary material height above the sluice. If the accumulation of coarse material above the sluice becomes too big, the coarse material can be entrained by the flow of conveying air and be discharged together with the fine material from the top of the separator, by which the separating capacity of the separator is impaired.

It is the object of the invention to avoid the above disadvantages, and according to the invention this is achieved by blowing air from an ejector directly down into the outlet of the separator, the ejector air being taken from the air fed to the mill for conveying the ground material, and the pressure difference between the air supplied, the air in a grinding chamber of the mill and the air in the interior of the separator being used as the sole means for blowing the ejector air through the ejector and hence through the separator outlet.

By means of the ejector during operation it is possible to relieve the otherwise existing pressure drop in the coarse material outlet of the separator, which pressure drop would counteract unimpeded and continuous discharge of the coarse material separated in the separator, without the necessity of establishing a material pressure column in the bottom part of the separation chamber. In this way it is further possible to avoid vulnerable, movable parts in a sluice mechanism, which are prone to jamming and which take up space under the outlet.

The invention also includes a vertical roller mill with a built-in stationary separator for carrying out the method according to the invention, the mill further comprising an air supply pipe for supplying conveying air to the grinding chamber of the mill; an ejector positioned inside the separator above, and

oriented towards, its coarse material outlet; and an air supply pipe for the ejector, which pipe is connected to the same air source as that to which the air supply pipe for the grinding chamber is connected.

In case of sub-pressure mills, i.e. mills to which no drying air is supplied from a separate air source, both the air supply pipe of the ejector and the air supply pipe of the mill can supply atmospheric air direct as drying air.

In case of over-pressure mills, to which air is supplied by over-pressure, e.g. in the form of heated drying and conveying air from a separate air source, it is advantageous if the air supply pipe of the ejector is directly connected to the air supply pipe of the mill.

Use of such an ejector calls for no separate compressed-air system like in previously known compressed-air nozzles in cyclone outlets, as the ejector is fed from an already existing air source, e.g. the air supply pipe of the mill. The additional air consumption required for the ejector only amounts to 0.8 - 1.3 % of the total air supply to the mill.

An example of a mill constructed in accordance with the invention is illustrated in the accompanying drawings, which is a diagrammatic vertical axial section through the mill showing, however, only such parts that are necessary for understanding the invention.

As illustrated, a grinding table 1 rotates about its vertical axis, driven via a gear 2.

Grinding rollers 3 roll on and against the grinding table, the rollers being mounted on a common carrying frame 4 and urged against the grinding table by means of known push or pull means.

A ring of nozzles 5 encircles the table, and above the table and carrying frame is fitted a

stationary separator 6 having, at its top, an inlet for suspended material in the form of a ring of adjustable vanes 7, and, at its bottom, an outlet 8 for coarse material separated in the separator.

All the abovementioned mill parts are encased by a mill housing 9.

Conveying air and possible drying air to the mill are introduced at the bottom of the housing 9 through an air supply pipe 10 into a chamber below the grinding table 1 and the nozzle ring 5. Spent mill air with fine material, i.e. material sufficiently ground in the mill, is discharged from the mill through an air outlet 11 above the separator 6.

Material to be ground is supplied from outside and passed through a duct not shown down towards the centre of the grinding table 1 and moves due to the rotation of the grinding table outwards and under the grinding rollers 3 where it is ground, and hence beyond the nozzle ring 5.

Conveying and drying air from the bottom part of the mill flow up through the nozzle ring 5, entrain the ground material and convey it up through the mill, as indicated by arrows, and into the separator 6 through the vanes 7.

The coarse material is separated in the separator 6 and falls down through the hopper-shaped part of the separator towards the separator outlet 8 and hence onto the grinding table for renewed treatment together with freshly supplied, not ground material.

The pressure exerted by the conveying and drying air in the supply pipe 10 and consequently in the chamber below the grinding table 1 and the nozzle ring 5 is designated P_1. This pressure can in case of sub-pressure mills be the atmospheric air pressure.

When the air flows up through the nozzle ring 5 a

pressure drop to the pressure P_2 occurs in the grinding chamber, i.e. in the chamber delimited by the grinding table 1, the nozzle ring 5 and the separator 6.

When the air flows into the separator 6 through the vanes 7 an additional pressure drop to the pressure P_3 occurs in the separator.

Thus there is above the coarse material outlet 8 a sub-pressure tending to counteract the outflow of coarse material from the separator 6.

Accordingly, an ejector 12 is positioned immediately above the separator outlet 8 and downwardly oriented towards same. The air to the ejector 12 is supplied via a pipe 13 connected to the supply pipe 10 for conveying and drying air for the mill. The air is forced through the pipe 13 and the ejector 12 by means of the pressure difference P_1-P_2, prevailing over the nozzle ring 5.

If the ejector pressure is designated E_p, the requirement for obtaining the desired effect of the ejector is that $P_3+E_p \geqq P_2$, where $E_p = P_1-P_2$; consequently, the above pressures P_1, P_2, and P_3 should fulfill the equation

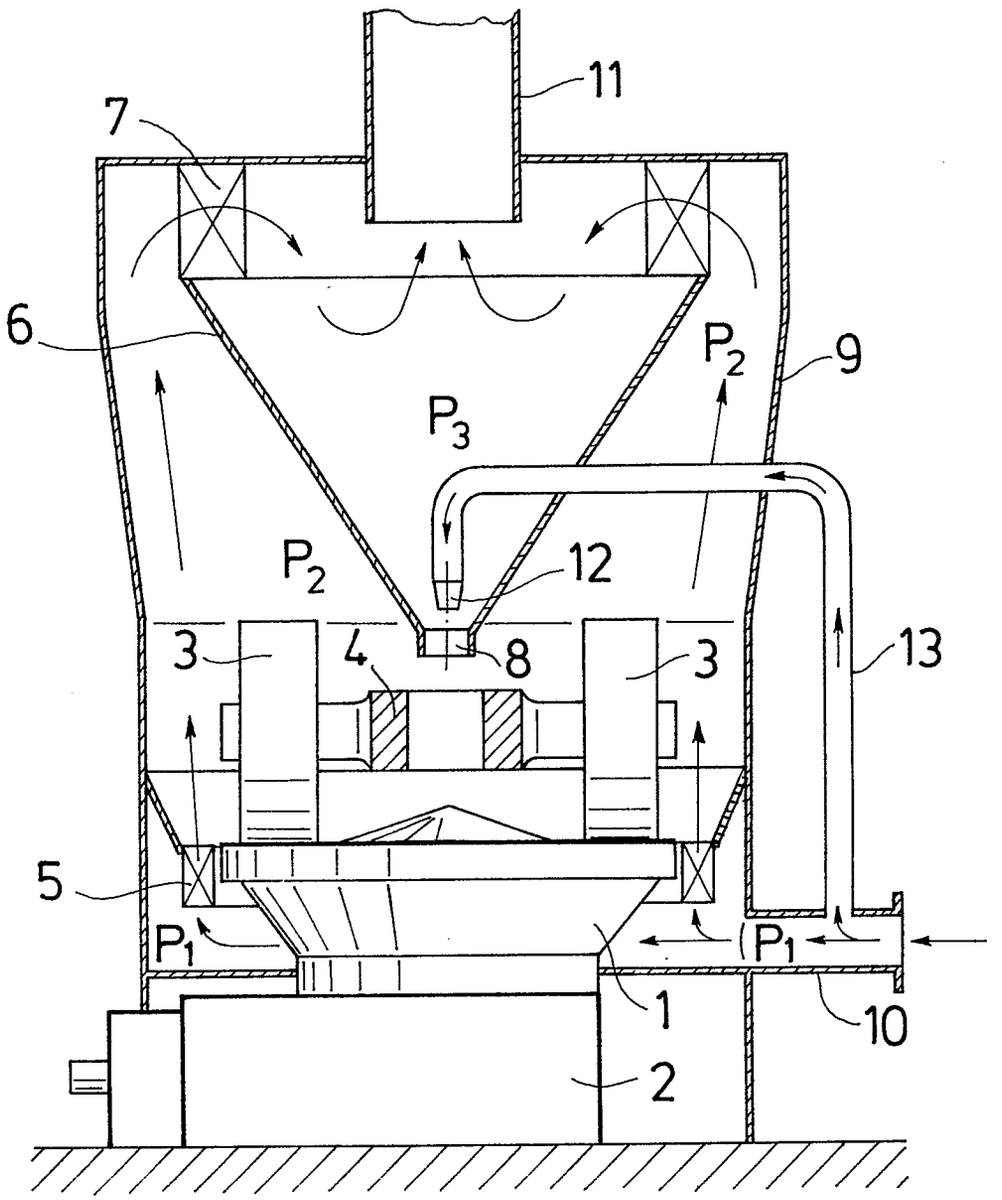
$$(P_1-P_2) \geqq (P_2-P_3)$$

When the air leaves the ejector 12, the air jet is spread so that the entire opening of the coarse material outlet 8 is covered by the air jet. At the same time the dynamic pressure of the air jet is converted into a static pressure of the same size as the pressure P_2 in the grinding chamber. A certain amount of air will be entrained from the interior of the separator, and consequently the ejector should be so dimensioned that the resulting sub-pressure in the separator corresponds to the pressure drop P_2-P_3 whereby the outflow of coarse material through the outlet 8 can take place unimpededly.

CLAIMS

1. A method of providing unimpeded discharge of coarse material from an outlet (8) at the bottom of a built-in stationary separator (6) housed in a vertical roller mill, characterized in that air from an ejector (12) is blown directly down into the outlet (8) of the separator (6), the ejector air being taken from air fed to the mill for conveying the ground material, and the pressure differences between the air supplied, the air in a grinding chamber of the mill and the air in the interior of the separator (6) being used as the sole means for blowing the ejector air through the ejector (12) and hence out through the separator outlet (8).

2. A vertical roller mill with a built-in stationary separator (6) for carrying out the method according to claim 1, the mill further comprising an air supply pipe (10) for supplying conveying air to the grinding chamber of the mill to convey ground material to the separator (6) and fine material out of the separator; characterized by an ejector (12) positioned inside the separator (6) above, and oriented towards, its coarse material outlet (8); and an air supply pipe (13) for the ejector (12), which pipe (13) is connected to the same air source as that to which the air supply pipe (10) for the grinding chamber is connected.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