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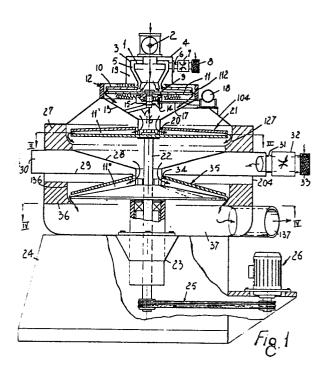
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## Micronizing apparatus.

57) The flow of the product with a suitable particle size, which is to be processed, and of a conveying fluid such as ambient air, sucked by a machine connected to the outlet of the apparatus according to the invention, are fed with the possibility of a selective adjustment (2-7) to the centre (9) of a distributing disk (10) with vertical axis, which while being rotated evenly distributes the flow on the rough surface of a ring (12) where a first comminution of the product takes place. From this stage, the flow of product and air is conveyed to the centre of a second distributing disk (21) with vertical axis and of a greater diameter, which is rotated at a higher speed than the former and evenly distributes the said flow on a comminution ring (27) made of a hard material, and having a smooth surface suitably tapering in downward direction, such that some of the product will temporarily stay on the said ring and will De broken owing to the dynamic impact thereon of the product particles being progressively delivered from the near distributing disk. The air and product If the form this second comminution stage is conveyed together with a fresh, rate-adjustable ambient air flow, to the centre of a third rotary distributing disk with vertical axis, similar to the preceding disk, but preferably having a downwardly diverging coni-Lacal shape. From this distributing disk, the air and product flow is evenly distributed on a near impact ring (36) just like the ring in the second stage, where

a further comminution of the product is acheived. The flow of air and micronized product issues from the apparatus through a volute (37) and reaches decantation means.



## "Micronizing apparatus"

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The invention relates to a micronizing apparatus for processing organic and inorganic products, the features and the advantages of which will appear evident from the following specification of one preferred embodiment of same, shown merely by way of a non-limiting example in the figures of the annexed sheet of drawings, in which:

Figure 1 diagrammatically shows the apparatus in a sectional view taken on an ideal vertical plane containing the axis of rotation of the distributing disks;

Figures 2 and 3 show some possible configurations of the channels in the distributing disks, in a sectional view taken on line II-II of figure 1;

Figure 4 shows the chamber from which flows the micronized product, in a sectional view taken on line IV-IV of figure 1.

In figure 1 there appears that the product to be processed is fed from the top of the apparatus into the funnel-shaped chamber 1, through a flow-or flow rate-regulating device, such as for example, a star-shaped rotary valve diagrammatically shown at 2, the whole in such a manner that only a predetermined and adjustable flow of product will flow into the said chamber 1. The chamber 1 is surrounded by a larger chamber 3 which is also fixed to the frame or to the casing 4 of the apparatus, the whole in such a manner that between the chambers 1 and 3 there will be left an interspace 5 which is open to the atmosphere through a duct 6 intercepted by a flow-regulating valve 7 and a filter

The chamber 1 and the interspace 5 co-axially discharge into the well 9 provided in a horizontal circular disk 10 which by suitable means to be disclosed hereinafter, is supported and is rotated at the required speed around its axis, always in one direction. The disk 10 is radially provided with a plurality of equispaced channels 11 of a suitable cross-section, and preferably having the configuration shown in plan view in figure 2, or the configuration of the alternative embodiment according to figure 3, which will be described later on.

The disk 10 consists of two superposed disks which are secured to each other by means of screws, and in one of them, for example in the lower disk, the channels 11 are formed, for example, by milling or by electroerosion, while the function of the other disk is to close the said channels at their top side.

Around the disk 10 and at the proper distance therefrom, a ring 12 is co-axially provided, with its generatrix being vertical and with its inner surface 112 being suitably roughened, for example, by knurling, by electroerosion, or by any other suitable

tecnique. The ring 12 is made of any suitable wear-resistant material, for example, of steel or cast iron.

The ring 12 has its upper edge closed by the casing 4 of the apparatus, and has its lower edge connected to a funnel-shaped chamber 13.

The distributing disk 10 can be rotatably supported as shown in figure 1 by the vertical shaft of a bevel gear pair 14, with the box 15 containing same being supported by equispaced spokes 16 secured to chamber 13. The horizontal shaft of gears 14 is connected to a shaft 17 which is tightly passed through the sidewall of chamber 13, and which is to be connected to a geared motor 18 fixed to the portion 104 of the casing of the apparatus.

It is understood that differently from what has been described and shown, the disk 10 may be rotatably supported by the chamber 13 or by the casing 4, and that the driving of said disk may be effected with means located in the upper chamber 19, to avoid the presence in chamber 13 of the spokes 16 and the shaft 17 which inevitably cause a loss of head in the flow flowing through the apparatus.

The funnel-shaped chamber 13 discharges into the central well 20 provided in the distributing disk 21, which is similar to the previously considered disk 10, but that it has a greater diameter. Shown at 11' are the channels provided in disk 21, which are similar to the channels 11 shown in figures 2 or 3, but which differ from the former since they are longer, and their depth slightly decreases from the interior toward the exterior of said disk 21.

The disk 21 is keyed onto the upper end of a vertical shaft 22 which is rotatably supported by an intermediate support provided with bearings 23, and which in turn is fastened to a base frame 24. The lower end of shaft 22 is connected through the transmission drive 25 to a motor 26 mounted onto the base frame 24 and with adjustable speed. The direction of rotation of disk 21 preferably is concordant with that of the upper disk 10, this in order to avoid any loss of head in the flow flowing through the micronizer.

The distributing disk 21 is co-axially surrounded by a ring 27 made of a very hard material, such as steel suitably hardened at least at its inner surface 127, which is characterized by having a generatrix that is partly vertical and that at its lower end terminates in a curve oriented toward the centre of said ring, and having an angular amplitude between 15° and 90°. The ducts 11' in disk 21 discharge at any suitable intermediate point of the generatrix of surface 127.

The lower end of ring 27 is connected to a

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funnel-shaped chamber 28 surrounded by a chamber 29 forming a hollow space 30 which is open to the atmosphere through a duct 31 intercepted by a control valve 32 and a filter 33.

The chamber 28 and the hollow space 30 discharge co-axially into the central well 34 in a distributing disk 35 keyed onto the driving shaft 22, which is similar to, and has the same diameter as the disk 21, but which differs therefrom owing to its downwardly diverging truncated-cone configuration, and due to the fact that its channels 11", which therefore are longer than the channels 11", have a height dimension gradually decreasing from the interior toward the outer part of the disk 35 more markedly than it occurs for channels 11".

The disk 35 is surrounded by a ring 36 just like the upper ring 27, which at its top side is closed by means of the connection 204 with the chamber 29, and at its bottom side is connected to a chamber 37 fastened onto the base frame 24, and which is in form of the volute of a centrifugal fan, as shown in figure 4 of the drawings.

The tangential duct 137 of said chamber 37 is connected to one or to a plurality of cyclones (not shown) for separating the product from air, which in turn are connected to the suction of a fan or a lower (not shown) having suitable characteristics. The suction obtained in the bottom chamber 37 is such that from the outside a proper air stream is drawn through the circuit 5-6-7-8, so that the product gradually introduced into the chamber 1 by the means 2 will get into the well 9 in disk 10 and will be admixed with the said air stream flowing through the channels 11, and thanks to the rotation of said disk 10 the flow of air and product will be uniformly distributed on the inner surface of the rough ring 12, where a first comminution of the product is achieved. The disk 10 is rotated at a relatively moderate speed which in any case is much lower than that of the underlying disks 21 and 35 (see hereinafter).

The air and product flow issuing from the first comminution stage is conveyed from the chamber 13 into the well 20 in disk 21 which, as already disclosed, is rotated at a relatively high speed, while its channels 11' are longer than the channels 11. Thanks also to the gradual narrowing of the cross-section area of channels 11', the flow of air and product is accelerated while it is flowing through the said channels, and as it flows out it violently hits against some of the product temporaneously staying on the inner surface 127 of ring 27, thanks to the downwardly flaring shape of said surface. As a result of the dynamic impact occurring between the product particles on the surface of ring 27, a further and important comminution of said product is achieved on said ring.

The air and product flow issuing from the sec-

ond comminution stage is conveyed from the chamber 28 into the well 34 in disk 35 together with the pressure air flow flowing into the said well from the circuit 30-31-32-33. This fresh flow of air and product, thus reinforced as to its speed and flow rate, flows through the channels 11" in disk 35 which further accelerate the said flow, thanks to the fact that they are longer than the channels 11' and to the more sensible gradual narrowing of their cross-section area. Thanks also to the high speed of rotation of the distributing disk 35, on the inner surface 136 of ring 36 a further and appreciable comminution of the product is achieved through the dynamic impact between the product particles, similarly to what occurs on the inner surface of ring 27.

In figures 2 and 3 it appears that in correspondence of their intermediate portion, the channels in the distributing disks have a portion 111 which is greater in cross-section, and which permits the forming of turbulences apt to guarantee an efficient mixing of differently fine particles of the product, with a consequent homogenization during the final processing of the product. In the modified embodiment according to figure 3, the sum of the cross-section areas of the terminal branches 211,211' of channels 11,11',11" is equal to, or is smaller than the cross-section area of said intermediate portion 111.

The air and product flow issuing from the third comminution stage flows into the chamber 37 and flows out through the duct 137, and gets to the decantation cyclone or cyclones, where the product is separated from air and is collected into silos or into bags, while air continues to flow toward the suction machine.

It is apparent that by adjusting the suction of air from the outside by means of the valves 7 and 32, and that by changing the speed of rotation of the driving units 18,26 and of the feeding device 2, it is possible to modify the final properties of the processed product.

Since the air flowing through the micronizer and conveying the product is sucked from the outside, and is not compressed air, the said air is at ambient temperature and does not modify the properties of the product to be processed. Cooling circuits may be associated, if required, to the rings 12,27 and 36 for cooling the said rings.

From experiments made by the applicant, it was possible to obtain very satisfactory results when processing even very abrasive products, such as clinker, by adopting the following parameters. The particles of the product fed to the apparatus had a diameter not greater than 5 mm. The diameter of the distributing disks 21 and 35 may vary between 600 and 800 mm. The height of the apparatus between the opening for feeding the

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product and the chamber 37 may vary between 700 and 900 mm. The outside diameter of the casing of the apparatus may vary between 800 and 1000 mm. The distance between the periphery of the distributing disks 10,21,35 and the relative impact rings 12,27,36 may vary between 4 and 15 mm. The speed of rotation of shaft 22 may be in the order of 3000 rmp. The rate of the air flow through the apparatus can be in the order of 60 cubic meters/hour.

It is however understood that these parameters may widely vary as a function of the properties of the product to be treated.

In order to limit any loss of head in the apparatus, it is provided for the ends of channels 11,11',11" which open into the central well in the respective distributing disk, to be suitably flared and correctly oriented as a function of the direction of rotation of the distributing disks, as shown, for example, at 311 in figures 2 and 3. Still for this purpose, the shaft 22 may be eliminated. In fact, the disks 21 and 35 may be rotatably supported by the overlying chambers 13 and 29 and may be driven by means located at a higher level, similarly to what has been disclosed in connection with the disk 10. The rotation of the distributing disks may be otherwise obtained by reaction, by suitably orienting the channels 11,11',11" in the direction of the impact rings 12,27 and 36.

Differently from what has been illustrated the distributing disks 27 and 35 may be rotated at a different speed, preferably at a peripheral speed of the lower disk which is higher than that of the upper disk.

It is finally understood that depending on the requirements of the product to be treated, the product-conveying medium may consist of a fluid different from air or combined with air, for example, steam.

The distributing disks 21 and 35 may be of a different diameter and, in this case, the disk 35 may not be conical and may have the configuration of disk 21.

Instead of being carried out in three stages, as disclosed, the processing of the product may be effected in two or in four or more stages.

## Claims

A micronizing apparatus for processing organic and inorganic products, characterized by the fact of comprising means (2,7) for feeding the product, together with at least one product-conveying fluid such as ambient air, to the centre of a first distributing disk (10) with vertical axis, which by rotating distributes the composite flow on the rough surface of a first ring (12) where a first comminution of the

product takes place, the air-and-product flow being then conveyed to the centre of a second distributing disk (21) with vertical axis and of a greater diameter, which is rotated at a higher speed than the first disk, and which accelerates and uniformly distributes the said flow on a second comminution ring (27) of a very hard material and tapered downwardly, whereby some of the product will temporarily stay on the said ring, and will be broken owing to the dynamic impact thereon of the product particles progressively delivered from the said second distributing disk (21), and a further characterized by the fact that the air-and-product flow from this second comminution stage is mixed with a fresh ambient air flow, and reaches a third comminution stage comprising a disk and a ring (35, 36) which are similar to the second disk and ring, and from which the said flow is finally discharged for further processing.

- 2. The apparatus according to claim 1, in which the first impact ring (12) is made from fast iron and is internally roughened by knurling, or by electroerosion, or by any other suitable technique.
- 3. The apparatus according to claim 1, in which the impact rings (27,36) of the second and the third comminution stage are made of steel and have their inner surface, on which the comminution takes place, hardened by means of any suitable treatment.
- 4. The apparatus according to claim 3, in which the inner surface of the impact rings (27,36) of the second and the third comminution stage has a generatrix partly formed by a straight line and terminating at its lower end in a curve which is oriented towards the centre and has an angular amplitude between 15° and 90°.
- 5. The apparatus according to claim 1, in which suitable means may be provided for cooling the different impact rings (12,27,36).
- 6. The apparatus according to claim 1, in which the distributing disks (21,35) of the second and the third comminution stage have substantially the same diameter, so that it is possible to use impact rings (27,36) with like features, the last distributing disk (35) being shaped with a downwardly diverging conical configuration.
- 7. The apparatus according to claim 1, in which the third disk has a greater diameter than the second disk.
- 8. The apparatus according to claim 1, in which suitable means may be provided for adjusting the speed of rotation of the distributing disks (10,21,35).
- 9. The apparatus according to claim 1, characterized by the fact that the distributing disks (10, 21, 35) are provided with radially directed distributing channels (11, 11', 11").

- 10. The apparatus according to claim 9, in which the rotation of the distributing disks (10,21,35) is obtained by means of the reaction of the flow against the respective impact ring, the channels (11,11",11") in the distributing disks being accordingly suitably oriented.
- 11. The apparatus according to claim 9, in which the channels (11,11',11") in the distributing disks are characterized by having an intermediate portion (111) which is greater in cross-section.
- 12. The apparatus according to claim 9, in which the inlet ends (311) of the channels (11,11',11") in the distributing disks are suitably flared and oriented.
- 13. The apparatus according to claim 9, in which the distributing disks consists each of two superposed disks secured to each other by means of screws, so that the channels formed in at least one of the said two disks, for example, by milling, by electroerosion, or by any other suitable technique, will have their surface closed by the other disk.
- 14. The apparatus according to claim 9, in which the channels (11',11") in the second (21) and in the third distributing disk (35) are characterized by having a cross-section area which gradually decreases towards the periphery of the respective disks.

